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# Study on the ISO 15926 based data modeling methodology for nuclear power industry

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## Agenda

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- Introduction
- Technology Intro
- NPP Class Extension
- Conclusion
- Reference



## Introduction

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- ISO15926 is an international standard for the representation of process plant life-cycle information. The scope is data integration and data to support the whole life of a plant. This representation is specified by a generic, conceptual Data Model (DM) that is independent of any particular application, but that is able to record data from the applications used in plant design, fabrication and operation. The data model is designed to be used in conjunction with Reference Data (RD): standard instances of the DM that represent information common to a number of users, plants, or both.
- This paper introduces a high level description of the structure of ISO 15926 and how this can be adapted to the nuclear power plant industry in particular.
- ✓ ISO15926: Integration of life-cycle data for process plants including oil and gas production facilities

# Product Complexity

Product Design Complexity	High	<b>Missiles</b> <b>Satellites</b> Ordnance	Business Aircraft Special Ind. Equipment Telecom Switchgear Aircraft Engine Avionics	Military ship Commercial Ship Military Aircraft Commercial Aircraft Submarine <b>Power Plant</b> Oil production Rigs
	Medium	Computers Leisure Vehicles Radio/Rader	Automobiles Transmissions Special M/c Tools Agricultural Machinery Engines	<b>Power turbine</b> Mining Equipment Trucks Landing Gear Elevators Process Plant Army Vehicles
	Low	Domestic Appliances Consumer Electronics Bicycles Exhaust Systems	Boats Lawn Equipment Rail Cars Transformers	<b>Pumps</b> <b>Valves</b> <b>Filters</b> Brakes
		Low	Medium	High
		<b>Product Support Complexity</b>		

# Information complexity level

# Information Complexity

**4D data** (product and process data integration) **15926-7, PLCS**  
3D data (geometry) *AP214*  
2D data (product data) *IFC, PLIB*  
1D data Dictionary's (terms and definitions) *15926-4*

Engineering and construction support  
Supply chain and logistics support  
Operation and maintenance support  
Knowledge management  
Quality management

Bicycles   Boats   Army Vehicles   Automotive   **POWER PLANT**

# Product Complexity

**Long term archiving**

# Application area

# Historian



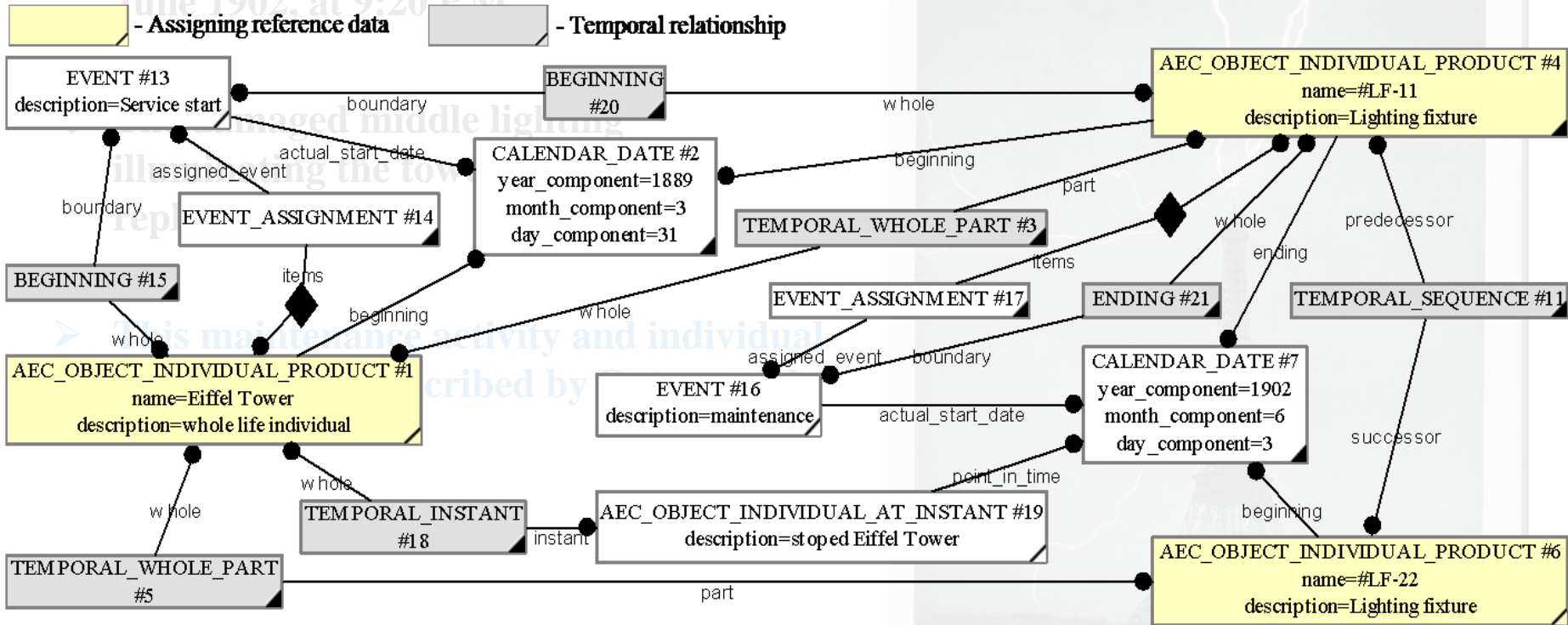
# Product Data Model

- ◆ Eiffel Tower was struck by lightning on 3 June 1902, at 9:20 P.M.
- ◆ The damaged middle lighting illuminating the tower had to be replaced.
- This maintenance activity and individual objects can be described by Data model



# Product Data Model

◆ Eiffel Tower was struck by lightning on 3 June 1902, at 9:20 P.M.

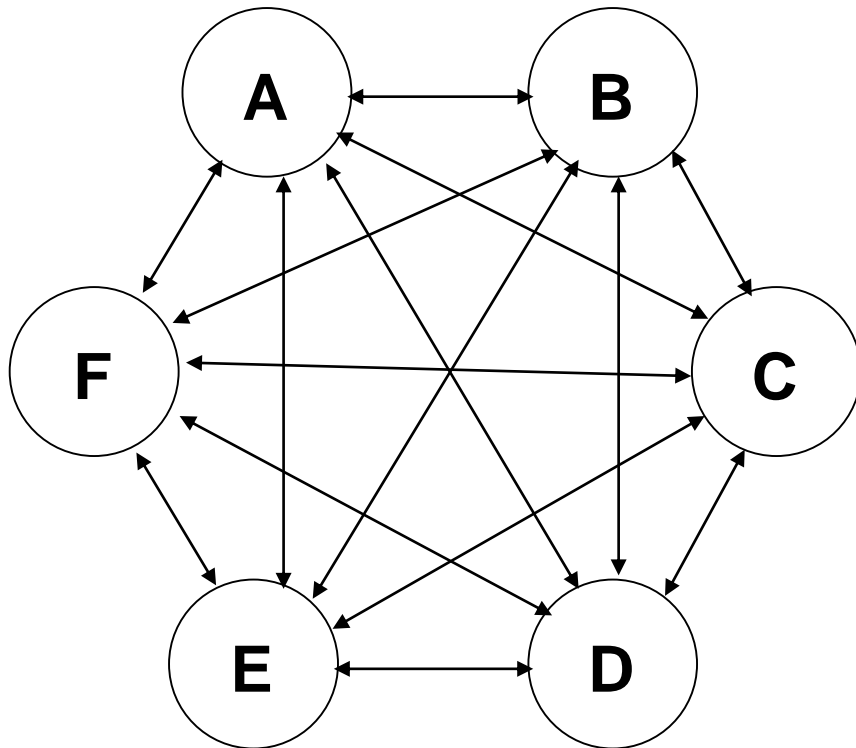


THE EIFFEL TOWER AS A GLOBAL LIGHTNING CONDUCTOR.  
Photograph taken June 3, 1902, at 9:20 p.m., by M. G. Lippé. Published in the Bulletin de la Société Française de Physique (May, 1903), p. 175-84.

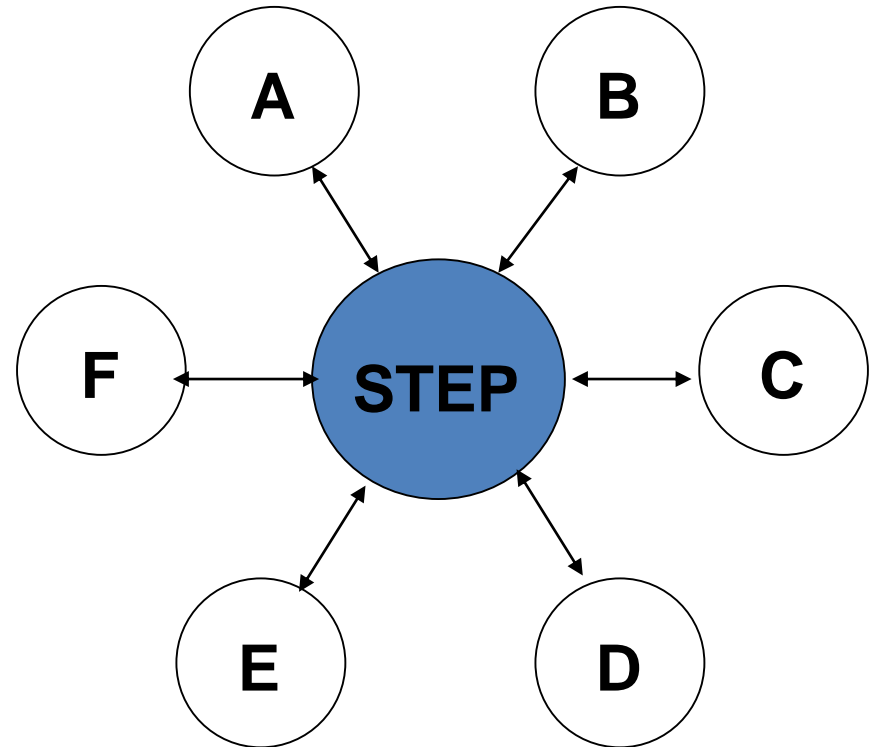


# ISO/STEP

**S**Tandard for the **E**xchange of **P**roduct model data



Direct translation:  
30 translators for 6 systems  
(what do we archive?)



Neutral file method:  
12 translators for 6 systems  
(STEP suitable for archiving)

# Data exchange issue During the Life Cycle

between  
partners &  
suppliers

- ❖ Data exchange between consortium partners, architect engineers, key engineering contractors
- ❖ Data exchange between equipment suppliers (component data, operation & maintenance)

between  
projects

- ❖ Modularization of plant and Engineering „re-use“
- ❖ Information/ Configuration Management across plants

between  
EPC & O/O

- ❖ Handover of „virtual plant“ into Owners system
- ❖ Consider Owner/ Operators need for operation and maintenance
- ❖ Consider plant life time (80 years) data maintainability

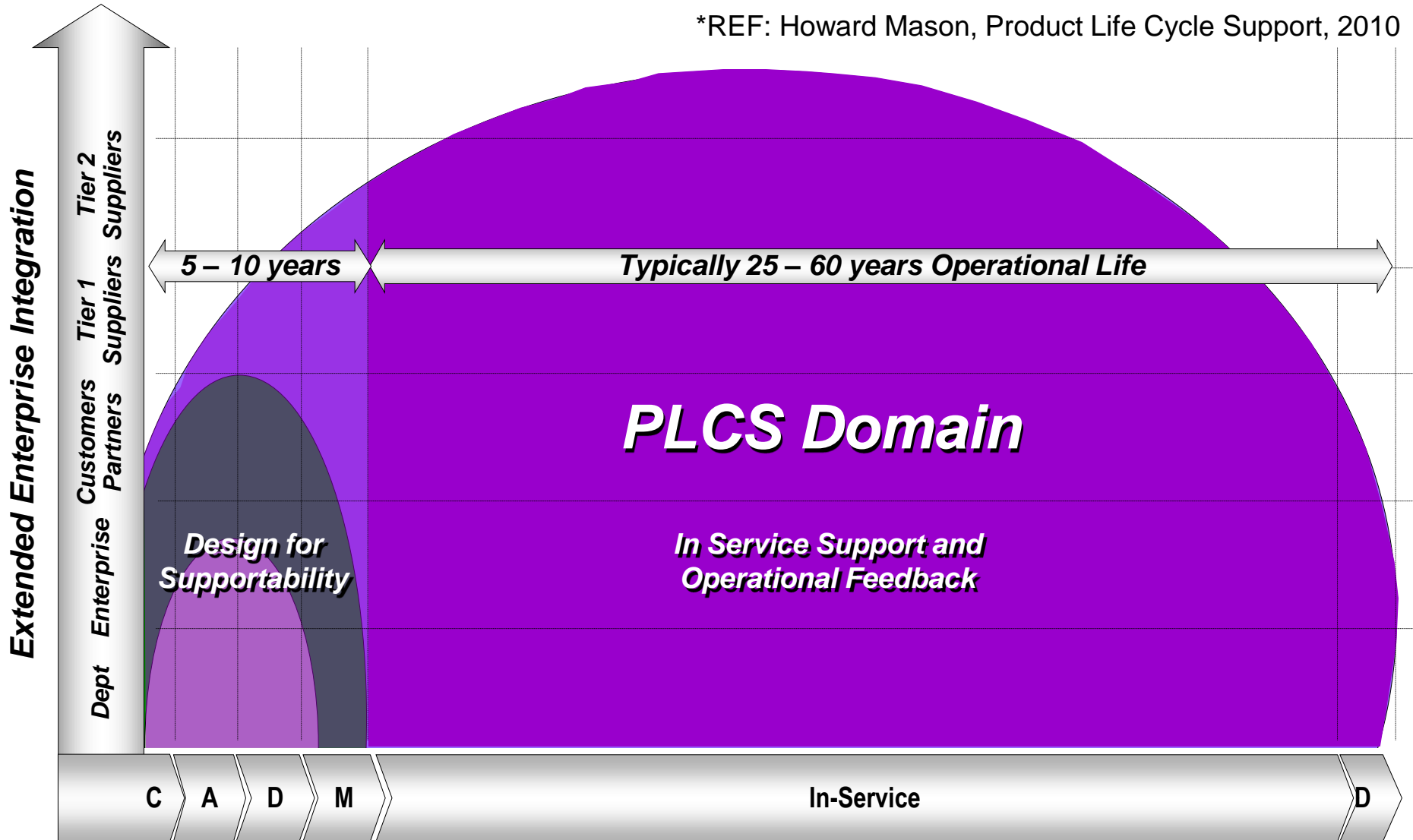
between  
tools

- ❖ Data management & configuration management between the modules of the IMS
- ❖ Interfacing ERP, EDM, PMS, and design tools of specific disciplines

# ISO 10303-239 PLCS

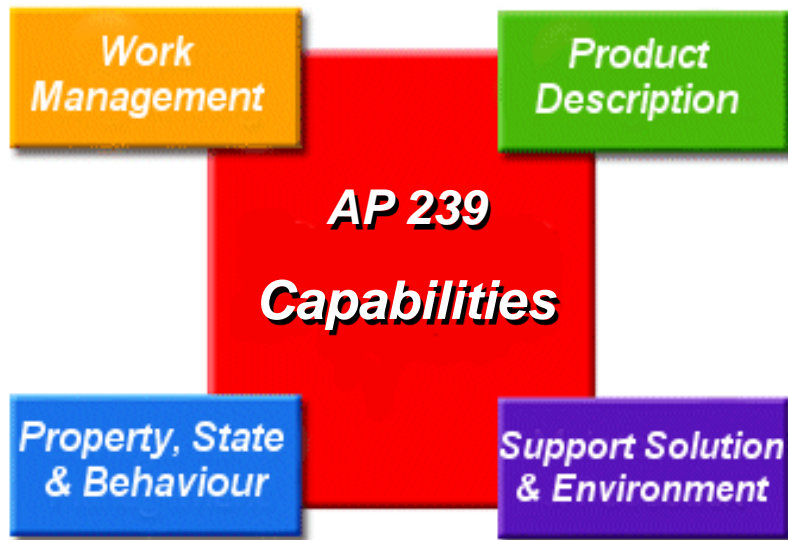
## Product Life Cycle Support

\*REF: Howard Mason, Product Life Cycle Support, 2010



# ISO 10303-239 PLCS

## Product Life Cycle Support



### ***Product Description***

*Capability to define product requirements and configuration, including relationships between parts and assemblies in multiple product structures (as-designed, as-built, as-maintained)*

### ***Work Management***

*Capability to request, define, justify, approve, schedule and capture feedback on work (activities) and related resources.*

### ***Property, State and Behaviour***

*Capability that describes and captures feedback on product properties, operating states, behaviour and usage*

### ***Support Solution and Environment***

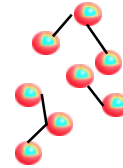
*Capability to define the necessary support for a given set of products in a specified environment and to define support opportunity, facilities, personnel and organizations*

# ISO 15926

Integration of life-cycle data for process plants including oil and gas production facilities

ISO 15926-2  
Data model

Core Model



Object,  
Activity...

Data Model

ISO 15926-4  
RDL

Class Library

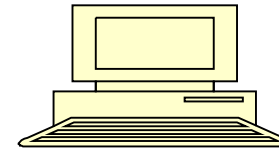
IRDL



Common Taxonomy

Standard Class

SRDL



Computer Prototype

Standardized Taxonomy

Manufactured Product Class

MRDL



LG-X20

Proprietary Product Class

# The Best Breed

ISO15926 for Engineering  
Data

Reference data library  
Engineering data format  
P&ID/3D data exchange(draft)

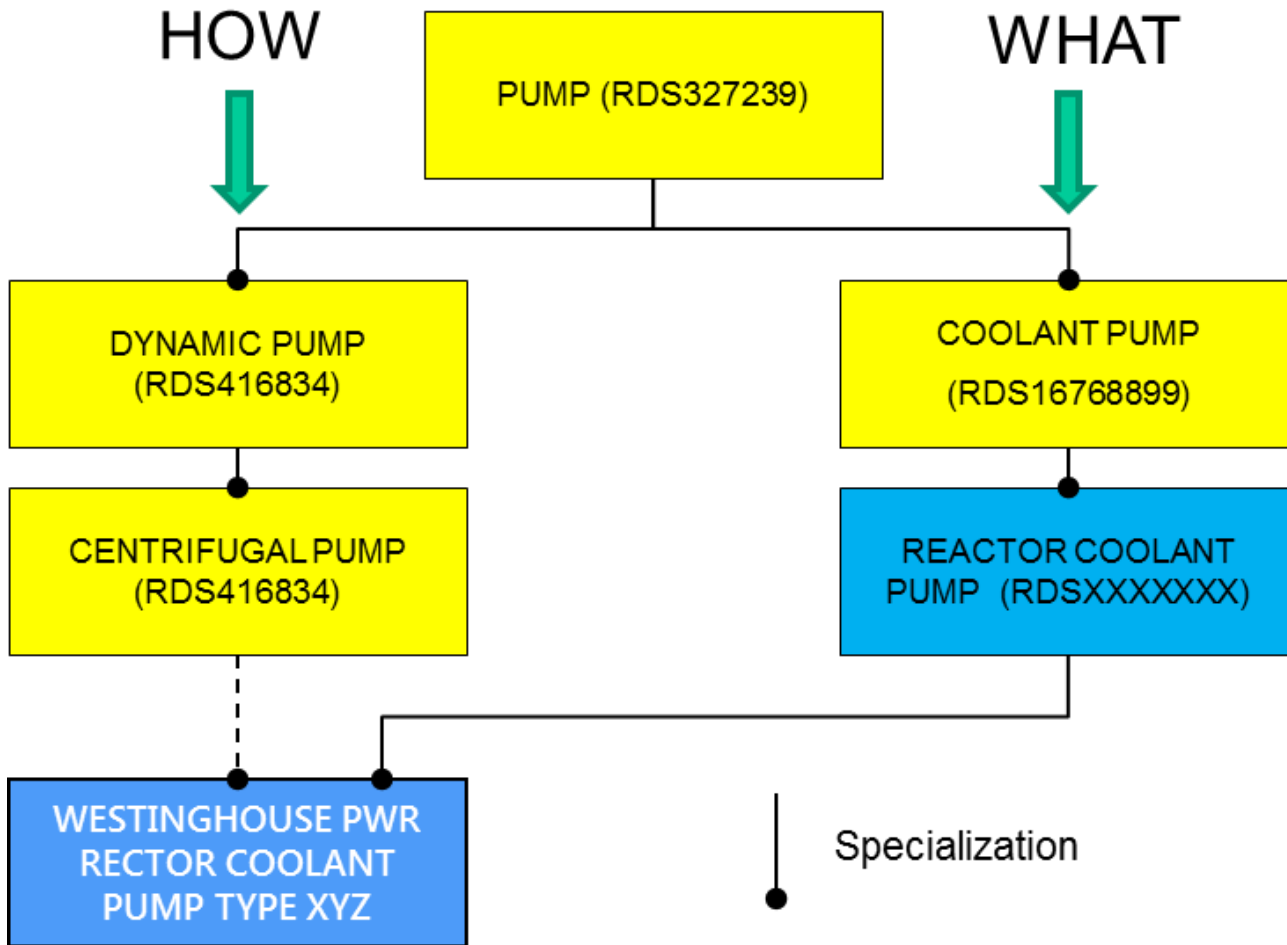
**Superior integrated support for the  
Full Life Cycle of Nuclear Power Plant**

Requirement Management  
Configuration Management  
Product as realized  
O&M  
D&D  
Information Consolidation

**PLCS: from Client Requirements to Decommission  
= Full Life Cycle Support (Systems Engineering)**

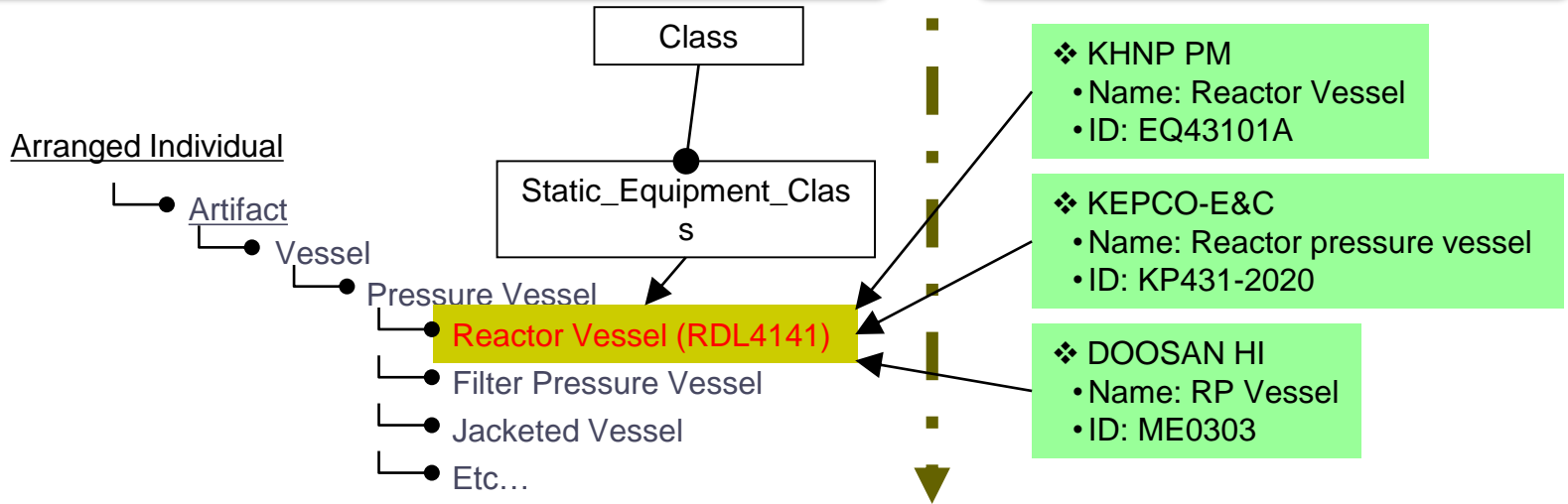
# Extension of ISO 15926 RDL

## Reactor Coolant Pump Example



# Extension of ISO 15926 RDL

	KHNP RDL	KHNP PM	KEPCO-E&C	DOOSAN HI
Name	Reactor Vessel	Reactor Vessel	Reactor pressure vessel	RP Vessel
ID	RDL4141	EQ43101A	KP431-2020	ME0303
Usage	Mapping standard	O&M data linking	Design data linking	Equipment vendor data linking

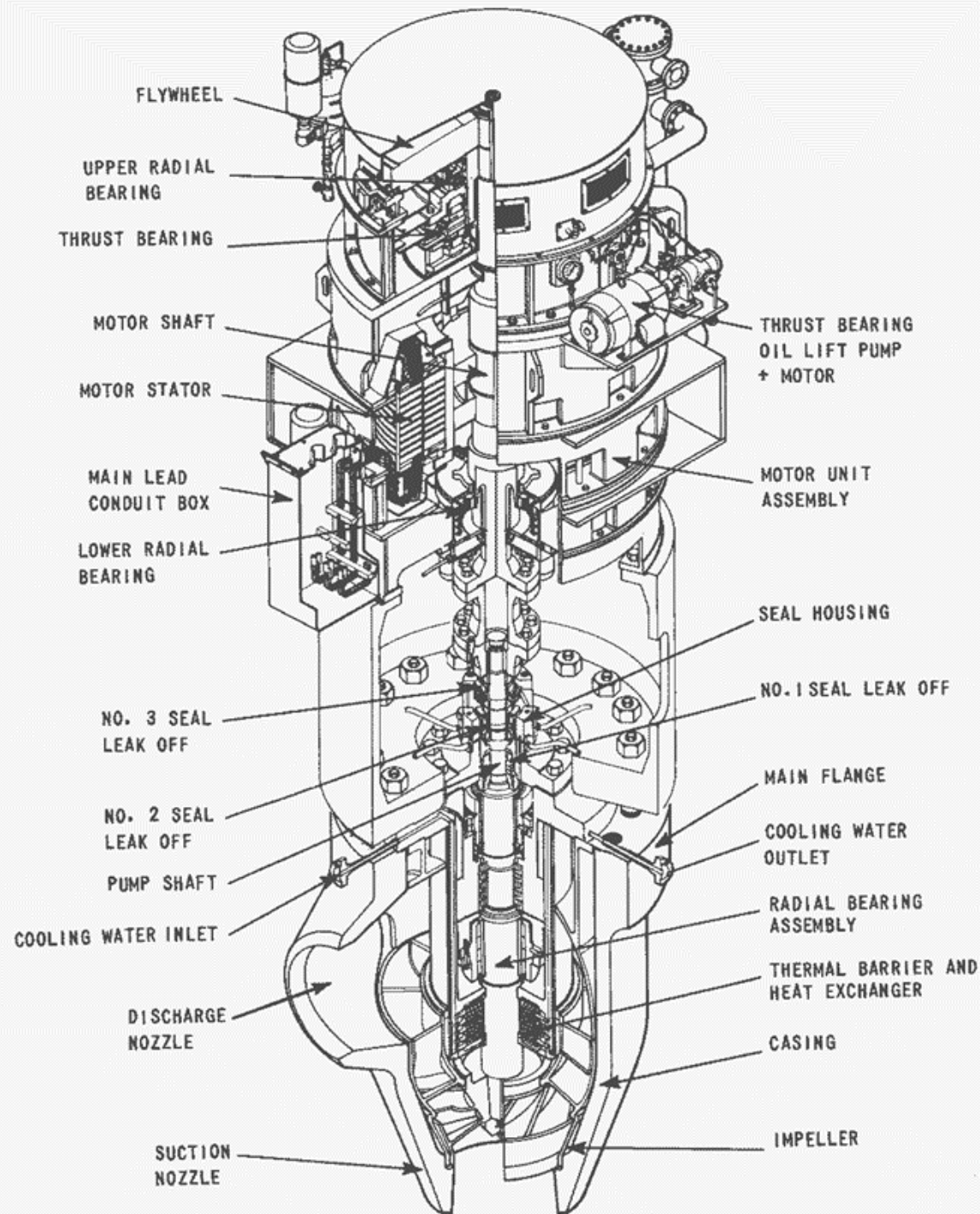
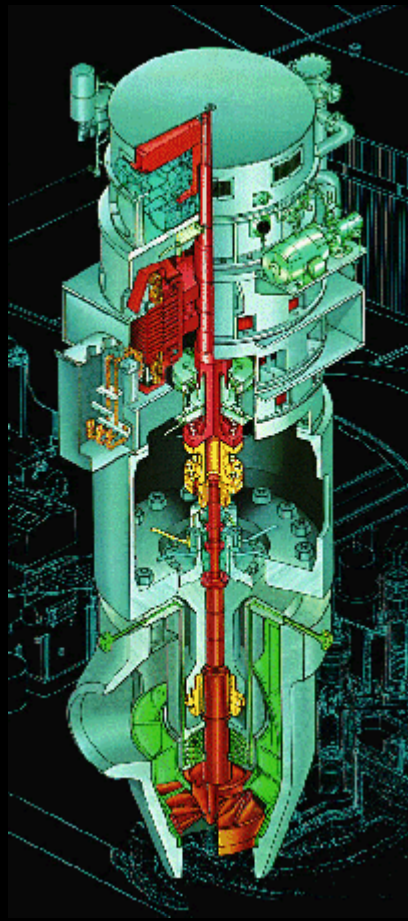


- EQ43101A in KHNP PM is a Reactor Vessel.
- KP431-2020 in KEPCO-E&C is a Reactor Vessel.
- ME0303 in DOOSAN HI is a Reactor Vessel.

→ All data related with Reactor Vessel(RDL4141) can be integrated using ISO 15926 based information system



# Westinghouse RCP MB3596



# Classes that represent main parts of a RCP

Item	Description	Class	URI
1	Impeller	PUMP IMPELLER	<a href="http://data.posccaesar.org/rdl/RDS816299">http://data.posccaesar.org/rdl/RDS816299</a>
2	Suction nozzle	INLET NOZZLE	<a href="http://data.posccaesar.org/rdl/RDS43167562153">http://data.posccaesar.org/rdl/RDS43167562153</a>
3	Discharge nozzle	DISCHARGE NOZZLE	<a href="http://data.posccaesar.org/rdl/RDS402642231">http://data.posccaesar.org/rdl/RDS402642231</a>
4	Casing	SINGLE TYPE CASING	<a href="http://data.posccaesar.org/rdl/RDS881459">http://data.posccaesar.org/rdl/RDS881459</a>
5	Thermal barrier	No	
6	Heat exchanger	HEAT EXCHANGER	<a href="http://data.posccaesar.org/rdl/RDS304199">http://data.posccaesar.org/rdl/RDS304199</a>
7	Radial bearing assembly	RADIAL BEARING BEARING ASSEMBLY	<a href="http://data.posccaesar.org/rdl/RDS6810280">http://data.posccaesar.org/rdl/RDS6810280</a> <a href="http://data.posccaesar.org/rdl/RDS12956450">http://data.posccaesar.org/rdl/RDS12956450</a>
8	Cooling water inlet		
9	Cooling water outlet		
10	Pump shaft	PUMP SHAFT	<a href="http://data.posccaesar.org/rdl/RDS869714">http://data.posccaesar.org/rdl/RDS869714</a>
11	Main flange		
12	No. 1 seal leak off		
13	No. 2 seal leak off		
14	No. 3 seal leak off		
15	Seal housing		
16	Lower radial bearing		
17	Main lead conduit box		
18	Motor unit assembly		
19	Motor stator	ELECTRICAL STATOR	<a href="http://data.posccaesar.org/rdl/RDS891449">http://data.posccaesar.org/rdl/RDS891449</a>
20	Motor shaft		
21	Thrust bearing	THRUST BEARING	<a href="http://data.posccaesar.org/rdl/RDS6810235">http://data.posccaesar.org/rdl/RDS6810235</a>
22	Thrust bearing oil lift pu mp and motor		
23	Upper radial bearing		
24	Flywheel	FLYWHEEL	<a href="http://data.posccaesar.org/rdl/RDS13662164">http://data.posccaesar.org/rdl/RDS13662164</a>

# Definition of Pump Impeller

## PUMP IMPELLER

<b>rdl:defaultRdsId</b>	"R15904148988"
<b>rdl:hasCreationDate</b>	"1999.10.26"
<b>rdl:hasCreator</b>	"u20683"
<b>rdl:hasDefinition</b>	"An impeller that forms part of a rotating assembly of a pump imparting kinetic energy to the liquid being pumped."
<b>rdl:hasDesignation</b>	"PUMP IMPELLER"
<b>rdl:hasIdPCA</b>	"RDS816299"
<b>rdl:hasStatus</b>	"Incomplete"
<b>rdf:type</b>	p2:ClassOfInanimatePhysicalObject
<b>rdfs:label</b>	"PUMP IMPELLER"
<b>owl:sameAs</b>	<a href="http://posccaesar.org/rdl/RDS816299">http://posccaesar.org/rdl/RDS816299</a>

### Classification

- Classifier** • [NORSOK Z-CR-002 EQUIPMENT CLASS](#)
- [PUMP COMPONENT CLASS](#)

### ClassOfIndirectProperty

- Property Space** • [LOWER LIMIT IMPELLER DIAMETER](#)
- [RATED IMPELLER DIAMETER](#)
  - [UPPER LIMIT IMPELLER DIAMETER](#)
  - [UPPER LIMIT IMPELLER HEAD AT RATED SPEED](#)

### ClassOfIdentification

- Pattern** • [rdl:RDS6192912](#)
- [rdl:RDS6713607](#)
  - [rdl:RDS6714627](#)
  - [rdl:RDS999707260](#)

### ClassOfAssemblyOfIndividual

- ClassOfWhole** • [CENTRIFUGAL PUMP](#)

- Subclass** • [AXIAL FLOW PUMP IMPELLER](#)
- [CLOSED PUMP IMPELLER](#)
  - [DOUBLE SUCTION PUMP IMPELLER](#)
  - [INDIVIDUALLY SECURED PUMP IMPELLER](#)
  - [MIXED FLOW PUMP IMPELLER](#)
  - [OPEN PUMP IMPELLER](#)
  - [RADIAL FLOW PUMP IMPELLER](#)
  - [SEMI-OPEN PUMP IMPELLER](#)
  - [SINGLE SUCTION PUMP IMPELLER](#)

<http://data.posccaesar.org/rdl/RDS816299>

# Definition of Operating Weight

## OPERATING WEIGHT

<code>rdl:defaultRdsId</code>	"RDS1661800301"
<code>rdl:hasDesignation</code>	"OPERATING WEIGHT"
<code>rdl:hasIdPCA</code>	"RDS1661800301"
<code>p2:hasClassOfPosse...</code>	ARTEFACT
<code>p2:hasPropertySpace</code>	WEIGHT RANGE
<code>rdf:type</code>	p2:ClassOfIndirectProperty
<code>rdfs:label</code>	"OPERATING WEIGHT"
<code>owl:sameAs</code>	<a href="http://posccaesar.org/rdl/RDS1661800301">http://posccaesar.org/rdl/RDS1661800301</a>

*<http://data.posccaesar.org/rdl/RDS1661800301>*

### Specialization

**Superclass** • ISO 15926-4 INDIRECT PROPERTY

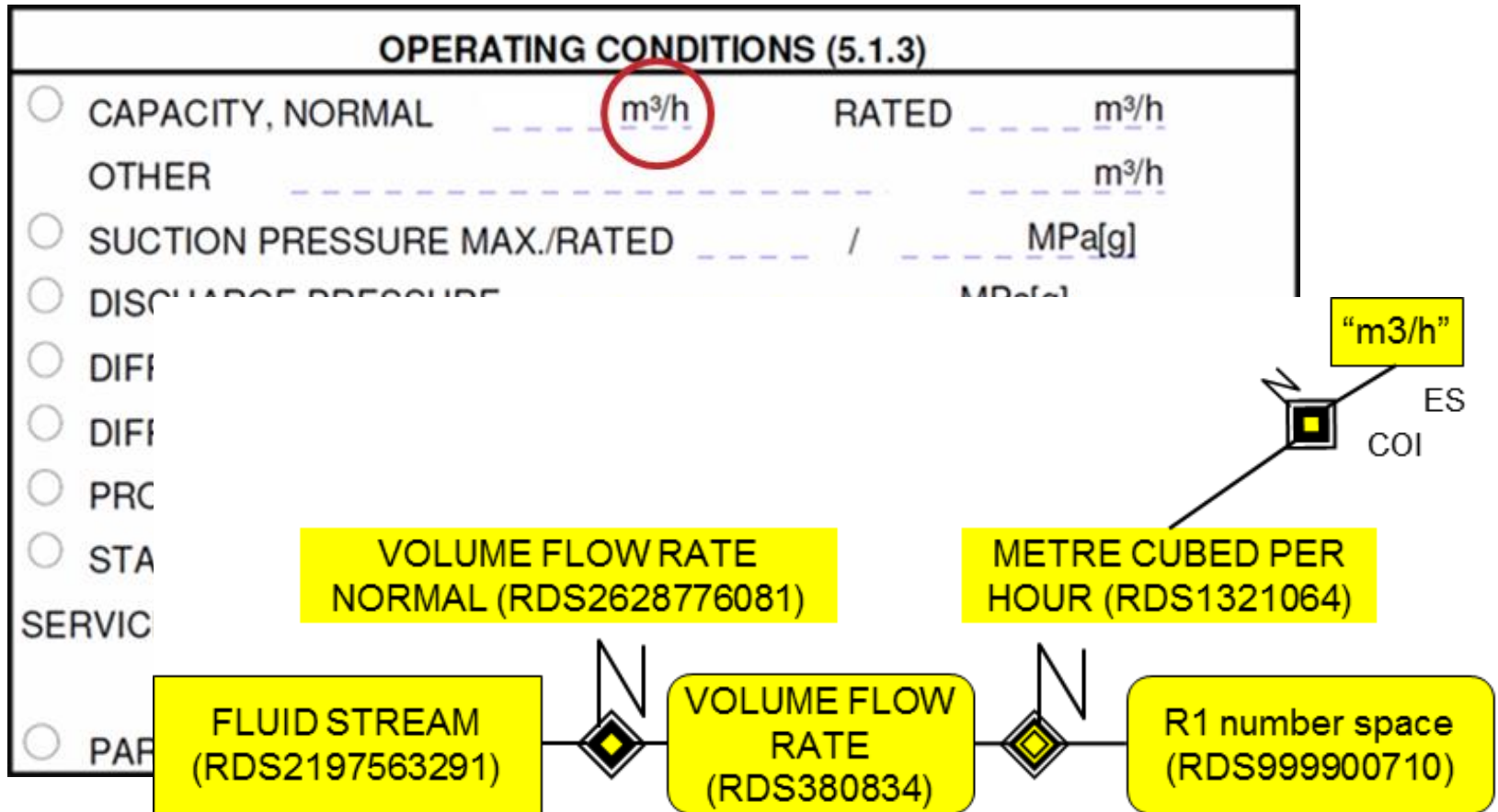
### Classification

**Classifier** • ISO TS 15926-4 (2007) PROPERTY CLASS

- Subclass** •
- CALCULATED OPERATING WEIGHT
  - CATALOGUE DATA OPERATING WEIGHT
  - ESTIMATED OPERATING WEIGHT
  - WEIGHED OPERATING WEIGHT

# Usage of ISO 15926 RDL

API 610 data sheet for Centrifugal Pumps has a section called “OPERATING CONDITIONS”



# Class library extension

Legacy library data

Standardized class library

Library data instance

The image displays a complex software interface with multiple overlapping windows. The background is a Microsoft Excel spreadsheet titled '2-ComponentData\_090807\_2.xls' in '호환 모드' (Compatibility Mode). The spreadsheet has columns labeled 'A' and 'D9', and rows containing various alphanumeric codes such as 'PPSAFTTP2-25', 'PE1AB1EC2-25', and 'ROTAMETER FIT8275G #150 RF 1/2'. A blue callout box labeled 'Legacy library data' points to the top-left area of the spreadsheet. Another blue callout box labeled 'Standardized class library' points to a central area. A third blue callout box labeled 'Library data instance' points to a specific row in the spreadsheet. In the foreground, there is a window titled 'iso15926facade' which shows a tree view of a database schema with folders for 'information\_schema', 'iso15926facade', 'Tables', 'Views', 'Stored Procs', 'Functions', 'Triggers', 'Events', and 'mysql'. Below the tree view is a 'Query' window with a table of data. The table has columns 'Subj', 'Prop', and 'Obj'. The 'Subj' column contains URIs like 'Uv::http://oim...'. The 'Prop' column contains URIs like 'Uv::http://www.w3.org/2000/01/rdf-schema#subClassOf'. The 'Obj' column contains URIs like 'Uv::http://tpl.rdlfacade.org/data#ST-3401'. The bottom-left corner of the image features the logo for 'PartDB Co., Ltd. (주) 부품디비'.

# System implementation case

Movie

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User: ycgwon@partdb.co.kr

**Categories**

Filter

Product Directory

- Measuring and Observing and Testing
- Electrical Equipment & Material
- Piping Equipments & Material
  - Pipe & Tube & Hose
  - Gasket and Seal
  - Fluid and Gas Distribution
    - Regulator & Controller
    - Flange
    - Trap and Strainer
    - Duct
    - Valve
- Piping Module
- Equipment
  - Noise/Vibration Protection
  - Blowers & Fan
  - Waters treatment equipments
    - Sludge Cake disposal Equipments
    - Water filtration facility
    - Other waterworks facility & Equipmen
    - Sewage & wastewater primary treatm
    - Ozone treatment/Ozonizer facility
    - ogical Sewage & Wastewater (Sec
    - ering Equipments
  - Water treatment consumables
  - Chlorines treatment Equipments
  - Desalination Equipments
- Transporting Equipments
- Refrigeration Equipments
- Mining machinery and accessories
- Instrument

**Parts List**

PartId	Name	Model	Company Name	Description
cd092355	Flanges	꺽연플랜지 10K 4inch	월드조인트(주)	플랜지, 월드조인트, ...
cd057686	Check valve	WHL-10	(주)원일산업	원일산업, 해머리스, ...
cd064667	Separators	VARIOMAT2-2/95	한국에이취알산업(주)	한국에이취알, 팽창기
cd079898	Inverter	SV110iPSA-2(50Hz)	엘에스상전(주)	인버터, LS상전, SV11
cd031414	Corrugated steel pipe	PL301	(주)픽	
cd118190	Sluice gate valve, pow	M03AB09	(주)우	
cd122890	Single suction volute	HES150-250	효성에	
cd093463	Panelboards	DS-750-HA-M	(주)아	DS
cd105998	Water tanks	30톤	영성산업	물탱크, 용량: 30톤, 지
cd014668	Heating cables	30AHH1-5B	케이티알	LG전선, 30AHH1-5B, ...
cd014644	Heating cables			LG전선, 30AHL1-5B, ...
cd014645	Heating cables			LG전선, 10AHL2-5B, ...
cd014659	Heating cables			LG전선, 24AHH1, 정은
cd014664	Heating cables			LG전선, 30AHH2, 정은
cd014667	Heating cables			
cd174691	Polyethylene pipes fo			
cd014680	Heating cables			
cd014641	Heating cables			
cd014688	Heating cables			
cd016002	Polyethylene pipe for			PE 이중벽하수관 (분류
cd016012	Polyethylene pipe for			PE 이중벽하수관 (분류
cd016013	Polyethylene pipe for			PE 이중벽하수관 (분류
cd016023	Polyethylene pipe for			PE 이중벽하수관 (분류
cd026408	Oil filled cables			66KV OF 3x100m³ 동
cd026430	Gas pressure cables			22000V입축원형, GFZ
cd026431	Gas pressure cables			22
cd026449	Gas pressure cables			22
cd026479	Gas pressure cables			33
cd026484	Gas pressure cables			33

Column No.  Search Value  Apply

Column No.  Greater Than  Apply

1 2 3 4 5 6 7 8 9 10 → — Records from 1 to 29 of 2074

**Part Details**

Information   Property & Document

**Property**

Id	Name	Value	Unit
pcd_Companycode	Company code	cmpy004772	
pcd_Companyname	Company name	한국에이취알산업(주)	
pcd_Companyreg.co	Company reg. code	1138122385	
pcd_Englishname	English name	Separators	
pcd_Koreanname	Korean name	기수분리기	
pcd_Model	Model	VARIOMAT2-2/95	
pcd_사용관경	사용관경	32x32x15mm	
pcd_용선/기타	용선/기타	9.0kg/㎥, 2.2kw(1P/	
pcd_종류	종류	팽창기수분리기	
pcd_크기	크기	1000x2060x1780mm	

**Document**

Name	Description	File
2D Data sheet		user057686.pdf
3D CAD Model	3D 모델 다운로드용	user057686.stp
3dviewmodel		user057686.wrl

Item properties

Item /DWG/DOC

Catalogue item

3D Model

Library classification structure

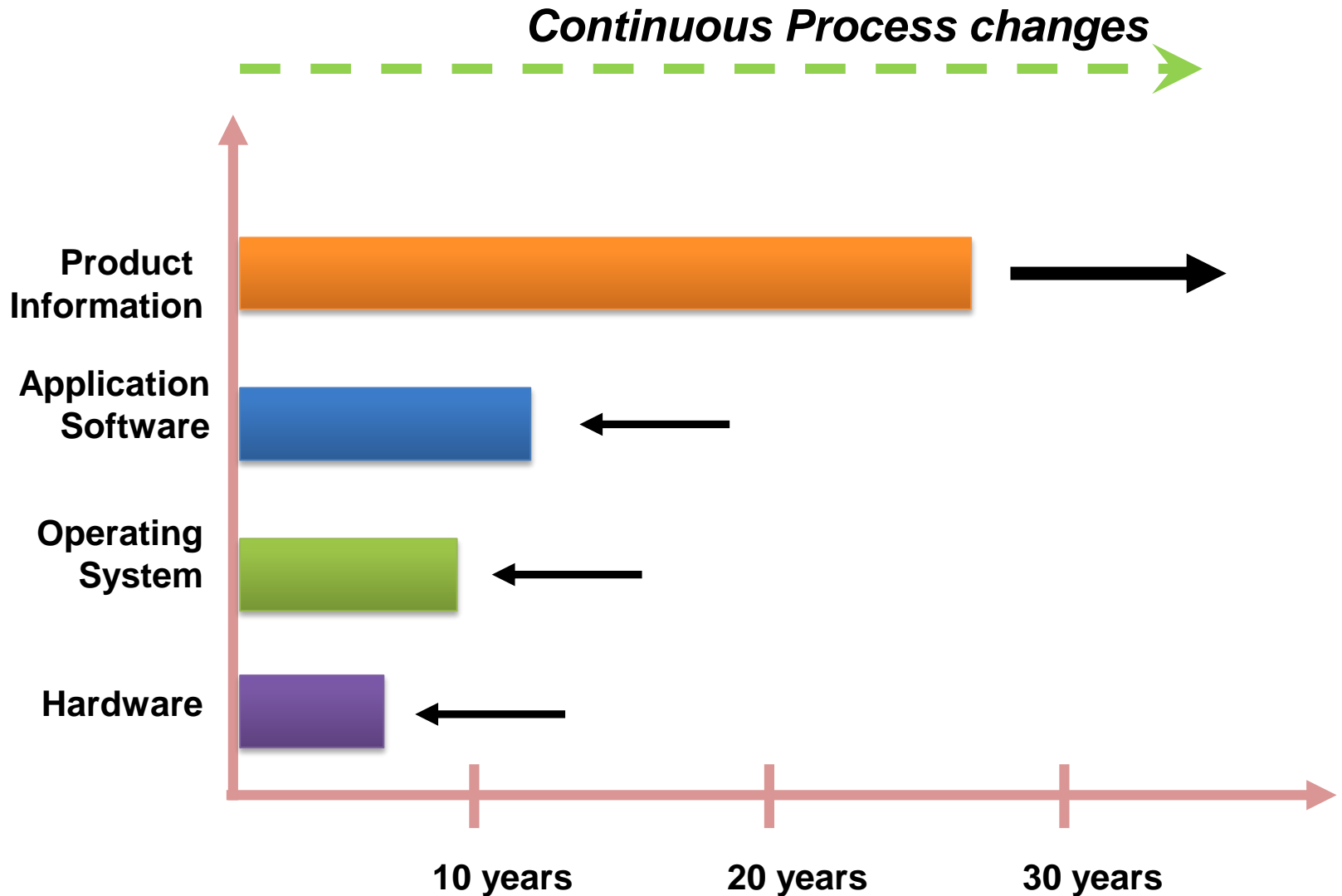
## Conclusions

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- This paper introduces ISO 15926 methodology and how to extend the existing RDL for nuclear power industry.
- As the ISO 15926 representation is independent of applications, interfaces to existing or future applications have to be developed. Such interfaces are provided by Templates that takes input from external sources and “lifts” it into an ISO 15926 repository, and/or “lowers” the data into other applications.
- This is a similar process to the process defined by W3C. Data exchange can be done using e.g. XML messages, but the modelling is independent of technology used for the exchange.
- ISO 15926 based RDL is useful for NPP class standardization and lifecycle data integration.



# Importance of Product Information



# Q&A

<http://www.partdb.com>

Kyungik.an@partdb.com

