

Hydro-Québec

Use Case

IEC 61850 - A Utility Perspective

Grid Modernization and Automation Evolution Program (CREA)

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Agenda

Context

- Use case diagram: IEC 61850 Standard to System Specification
- Model-Driven IEC 62850 Engineering Process – Data domain
- NSD – SCL Harmonization (XSD Schemas)

Data Modeling

- Creation of Utility Data Profile derived from the IEC 61850 Model

System Specification Tool

- Engineering workflow
- SLD to produce the Substation section (using a System Configurator Tool)
- Automatic generation:
 - .ISD files using Virtual IEDs from Data profile
 - .SSD (including Substation, Communication, IED and DataType templates sections)
 - Documentation (.docx, .pdf, .html, .xlsx)

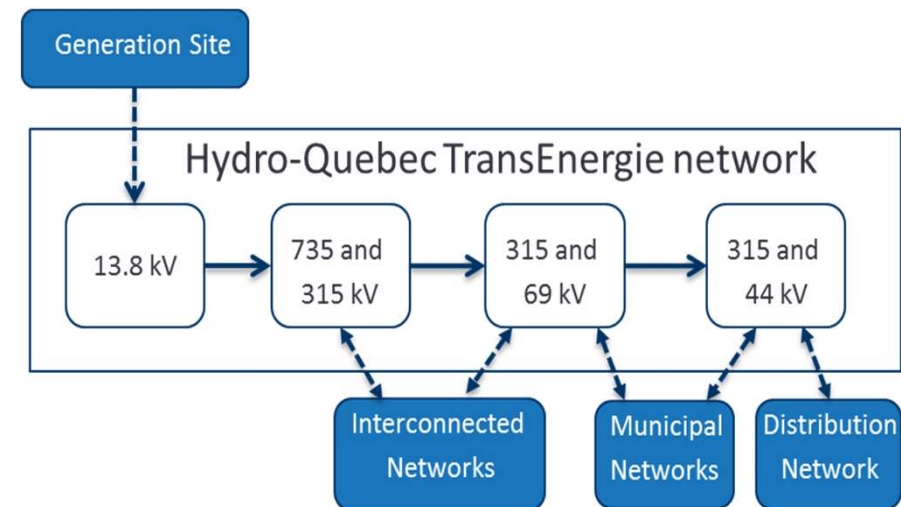
SCL Validation Tools

- HQ SCL File Compare tool
- EDF-HQ RiseClispe SCL Validation tool (IEC 61850 configuration files, in SCL (XSD 2007B4, 61850-6 ed2.1))

Hydro-Québec at a glance

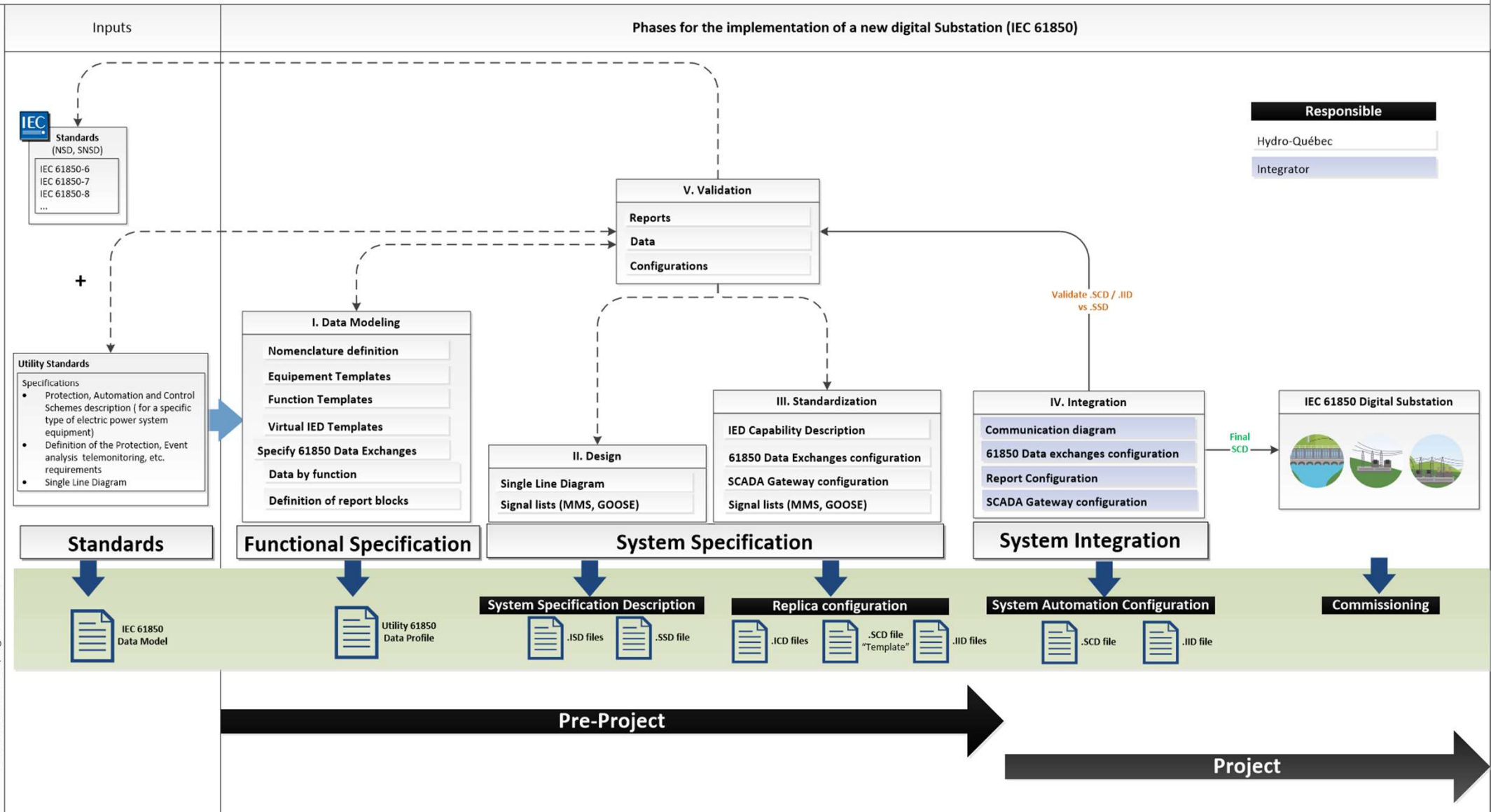


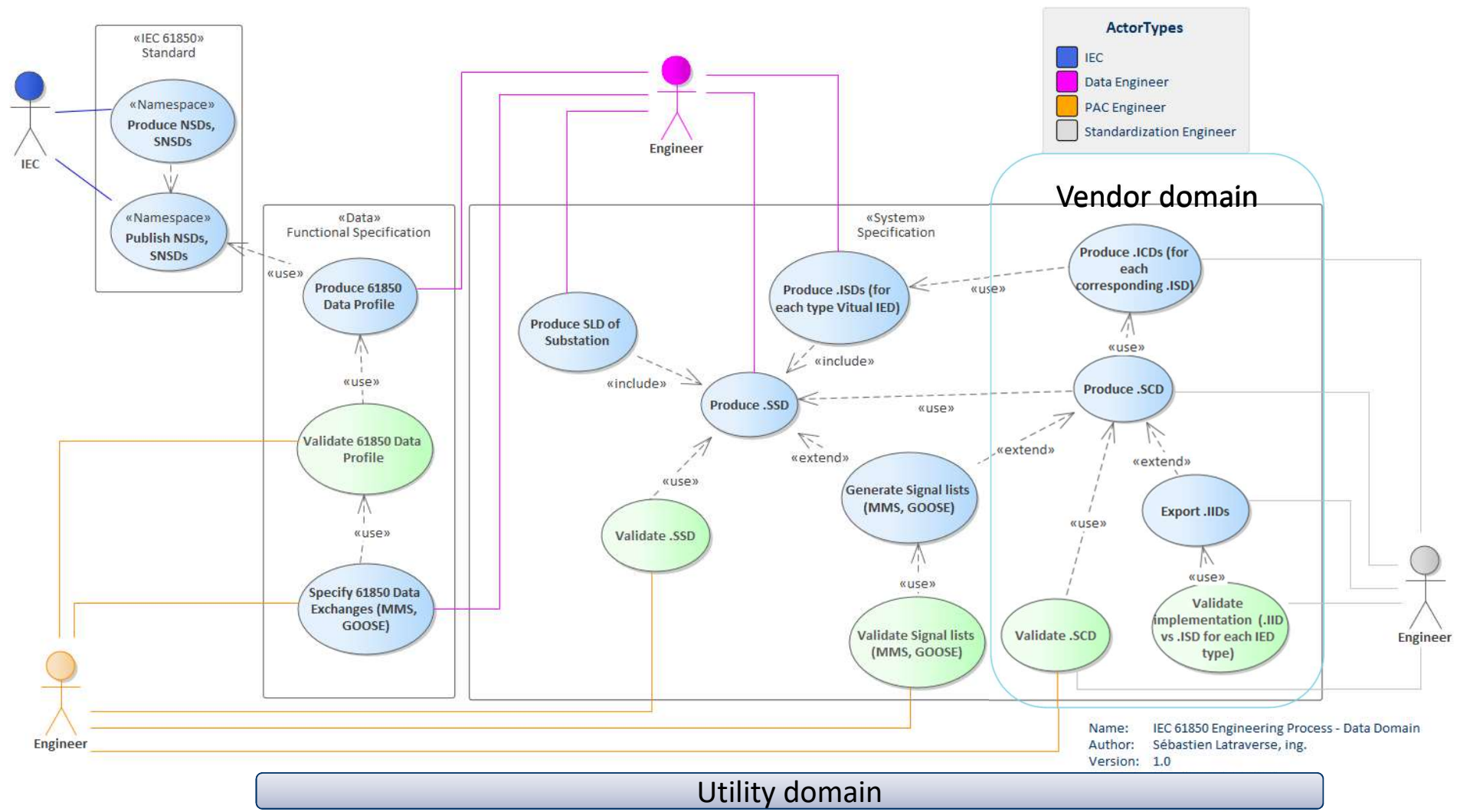
- 37 310 MW peak power**
- 209 TWh annual electricity sales**
- 99 % renewable generation**
- 63 power plants**
- 34 361 km of transport lines**
- 118 130 km of distribution lines**
- More than 4 M of customers**



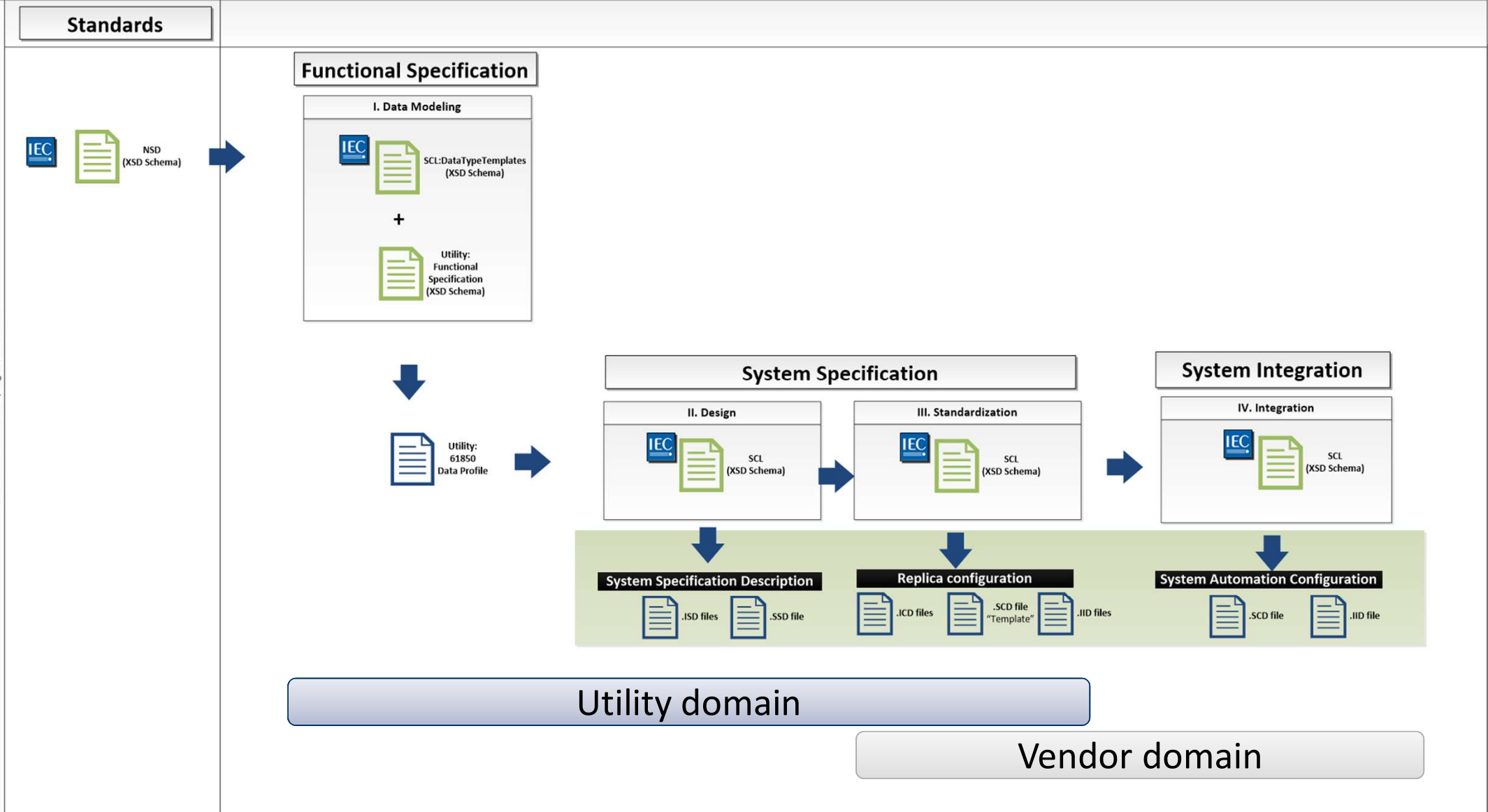
Context

IEC 61850 Engineering Process – Data domain





NSD – SCL Harmonization (XSD schemas)

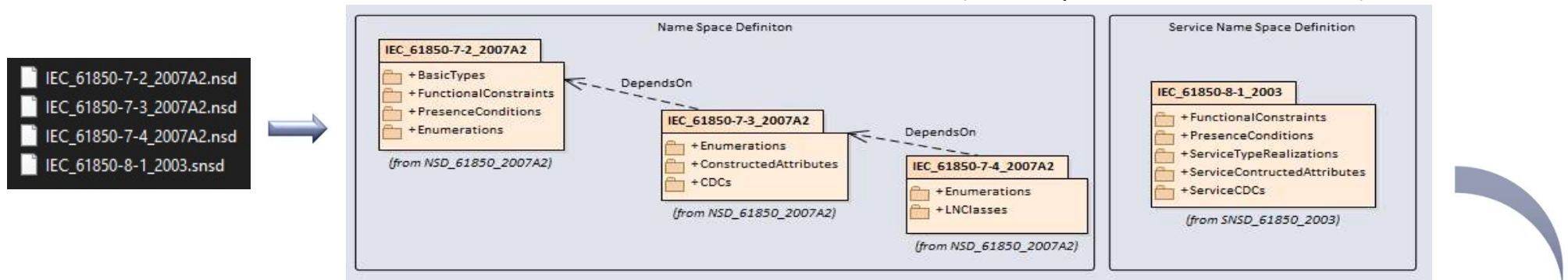


Data Modeling

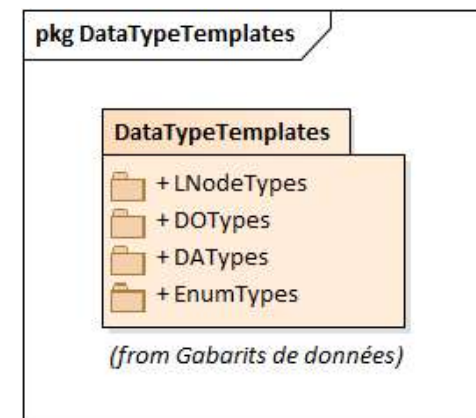
NSDs to DataTypeTemplates

Hydro-Québec Data Profile is derived from the IEC 61850 Data Model

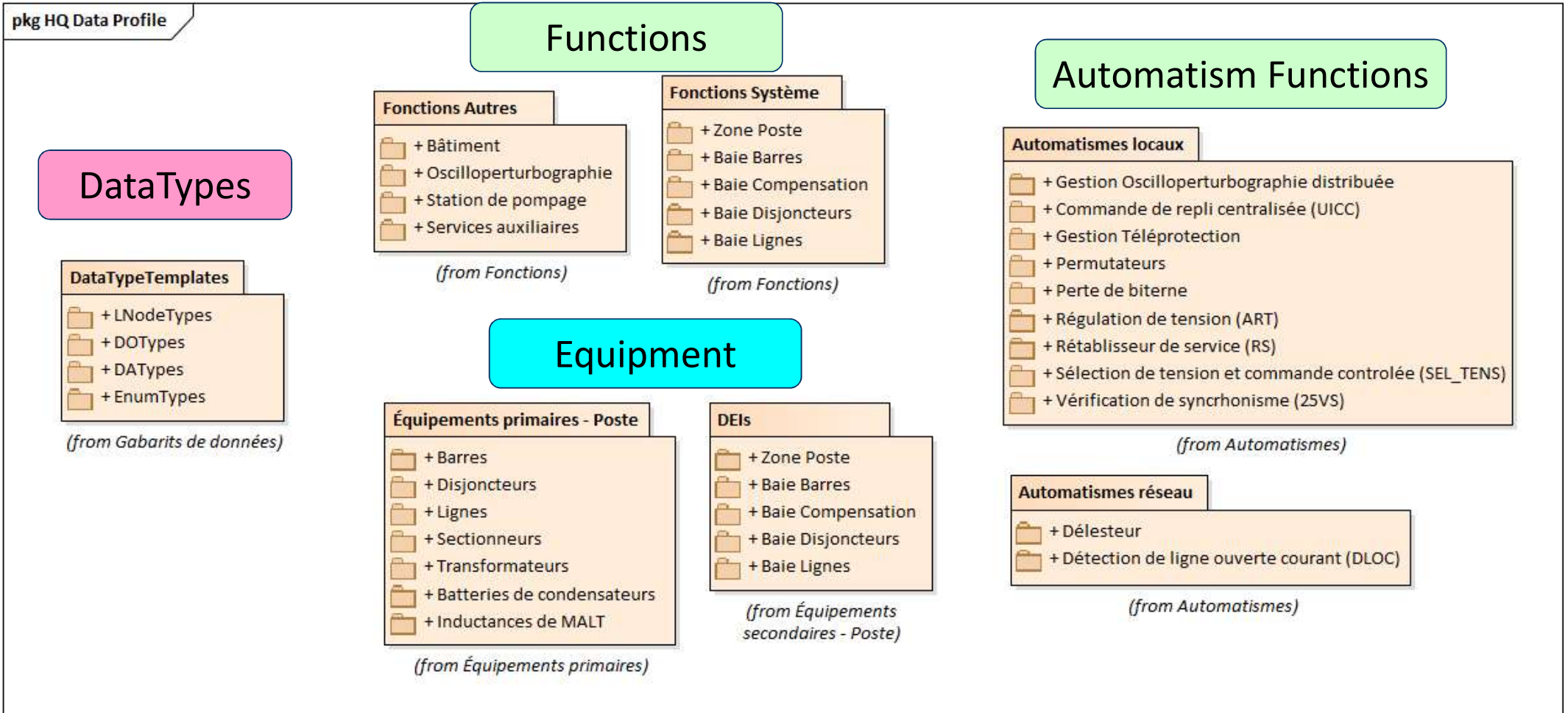
1. Transformation of NSDs and SNSDs files into UML and XML format (Namespace Definition Model)



2. Build datatype templates using Namespace Definition Model



Data Profile



System Specification Tool

Engineering Workflow

IEC 61850-90-2

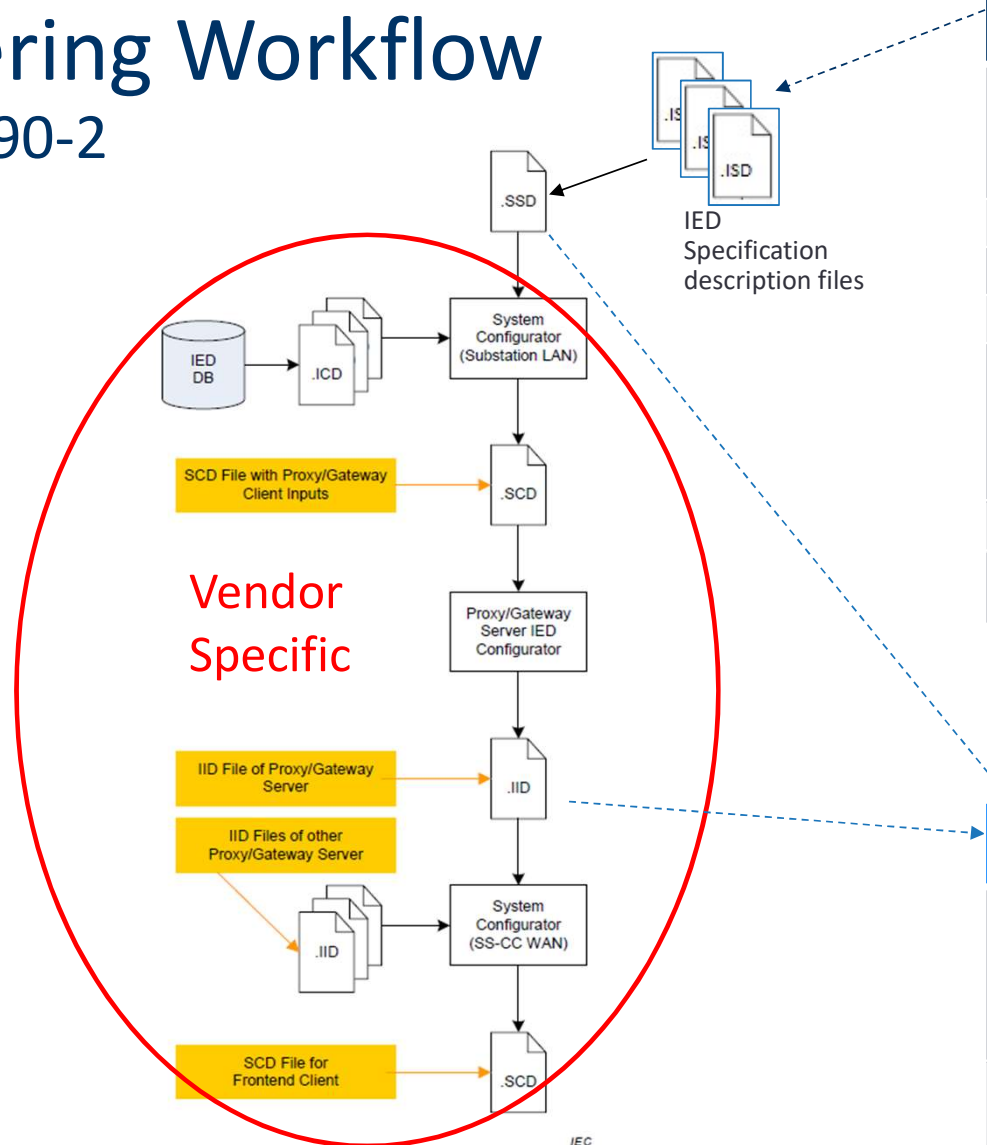


Figure 14 – Engineering workflow

61850 Specification Tool

Automates the generation of IED Specification Description files and .SSD specification file from a 61850 Utility Data Profile.

Section	Description
Substation	Complete
Communication	Partial
IED	Specification of virtual IEDs <ul style="list-style-type: none"> • Services • LDevice • LN (DataSet, FCDA, ReportControl, GSEControl)
DataTypeTemplates	Complete

Technologies used : UML, XML, XLST

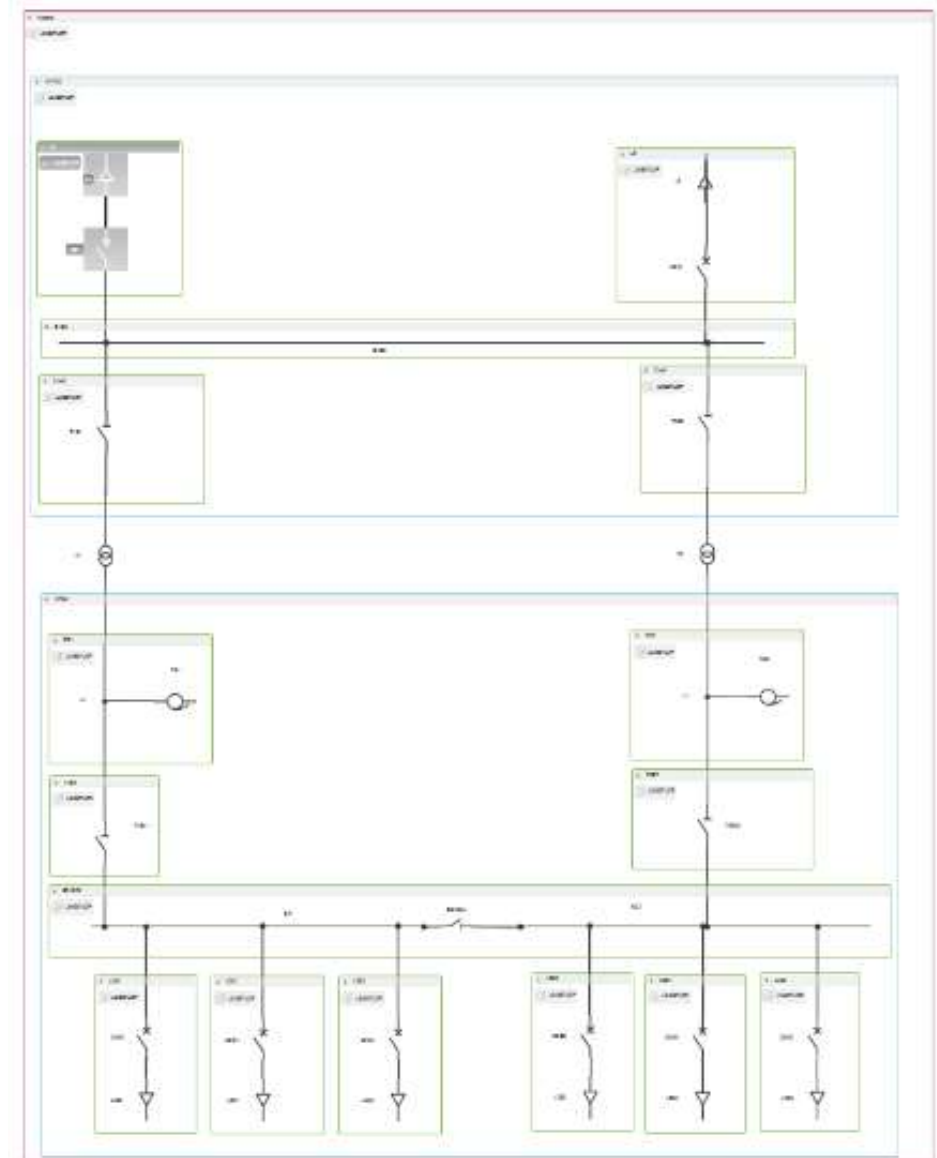
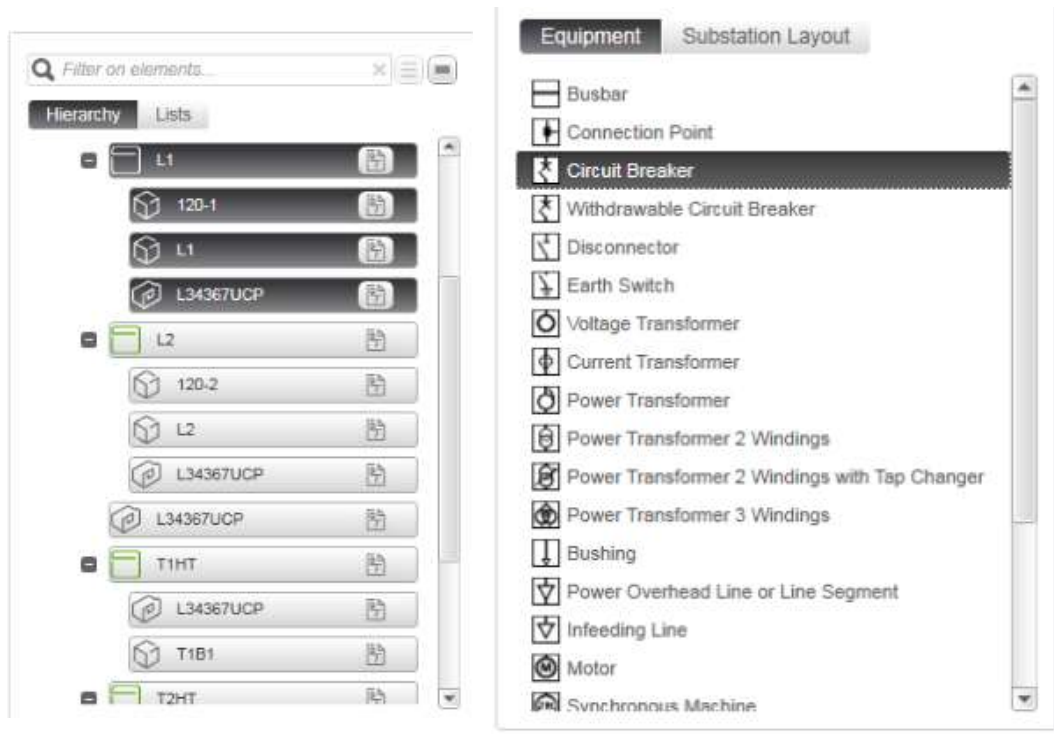
HQ SCL File Compare Tool

Web application validating SCL Files :

- .ISD vs .IID
- .SSD vs .IID
- .SSD vs .SCD

Technologies used : HTML, XSLT, XQuery, JavaScript

Single Line Diagram (SLD) System Configurator Tool



Automated Documentation (.docx, .pdf, .html, .xlsx)

1.6.3 Name: HQ_MMXU_LMT_base_V1.0

This logical node is used for calculation of currents, voltages, powers and impedances in a three-phase system. The main use is for operative applications.

HQ_MMXU_LMT_base_V1.0 class			
Data object name	Common data class	Explanation	T
Beh	HQ_ENS_Beh_V1.0	Read-only value, describing the behaviour of a domain logical node. It depends on the current operating mode of the logical node ('DomainLN.Mod'), and the current operating mode of the logical device that contains it ('LLN0.Mod'). Processing of the quality status ('q') of the received data is the prerequisite for correct interpretation of 'DomainLN.Beh'.	
ClcMth	HQ_ENG_SP_ClcMth_status_only_V1.0	Calculation method of statistical data objects.	
TotW	HQ_MV_base_V1.0	Total real power in a three-phase circuit [W].	
TotVAr	HQ_MV_base_V1.0	Total reactive power in a three-phase circuit [VAr].	
...

6.1.4.1.4 Name: HQ_Unit_V1.0

This type shall be used to represent unit and multiplier information.

HQ_Unit_V1.0 type definition			
Attribute name	Attribute type	Value/Value range	Explanation
SIUnit	HQ_SIUnitKind_V1.0	According to Tables A.1 to A.4 in Annex A (7-3)	SI unit of measure. sci:IBDA[(@name=SIUnit) and (@bType=Enum)]
multiplier	HQ_MultiplierKind_V1.0	According to Table A.5 in	Unit multiplier.

7.4.3.4 Name: HQ_SIUnitKind_V1.0

HQ_SIUnitKind_V1.0 enumeration definition		
SI units, with sub-categories as follows:	Value	Explanation
<ul style="list-style-type: none"> 1-8: base SI units 9-39: derived SI units 41-60: extended SI units 61-85: industry-specific SI units. 		
none	1	dimensionless
m	2	meter: Length
kg	3	kilogram: Mass
s	4	second: Time
A	5	ampere: Current
K	6	kelvin: Temperature
mol	7	mole: Amount of substance

5.5.1.1.6 Name: HQ_MV_base_V1.0

This common data class shall be used to represent measured values.

HQ_MV_base_V1.0 class				
Data attribute name	Type	FC	TrgOp	Explanation
mag	HQ_AnalogueValue_f_V1.0	MX	dchg, dupd	Value of the magnitude based on a deadband calculation from the instantaneous value 'instMag'. The value of 'mag' shall be updated to the current instantaneous value 'instMag' when the value has changed according to the configuration parameter 'db'. If 'db'=0, 'mag'=instMag'. NOTE 1 This value is typically used to create reports for analogue values. Such a report sent "by exception" is not comparable to the transfer of sampled measured values as supported by the CDC SAV. NOTE 2 This 'mag' is not the same as 'mag' of the constructed attribute class 'Vector'.
q	Quality	MX	qchg	Quality of the values in 'instMag', 'mag', 'range'.
t	TimeStamp	MX		Timestamp of the last refresh of the value in 'mag' or of the last change of the value in any of 'range' or 'q'.
units	HQ_Unit_V1.0	CF	dchg	Unit for: 'instMag', 'mag', 'subMag', 'rangeC'.
db	INT32U	CF	dchg	Deadband is a configuration parameter used to calculate deadbanded value 'mag'. The value of 'db' shall represent the percentage of difference ('rangeC.max' - 'rangeC.min') in units of 0.001%. Therefore, 'db'=[0, 100'000], corresponding to [0%, 100%], respectively. If an integral calculation is used to determine the deadbanded value, the value of 'db' shall be represented as 0,001% s. Value 0 shall suppress reporting events on the analog value, so that only changes of the 'range' value will lead to events.

HQ SCL File Compare Tool

Outil de validation de fichiers SCL- Version 1.0

Compatible avec les fichiers [SCL CEI 61850-6 Édition 2.0 \(2009-12\)](#)

[Spécifications HQT] ▾ [Configuration système] ▾ [Comparaison passerelles] ▾ Documentation ▾



Section IED - Logical Devices

Rechercher :

Passerelle H-Q

[IED] name=L35134IPC647D

Comparaison

Passerelle Fournisseur

[IED] name=L35134IPC647D

[LDevice] inst=L35134ALIMCA_ARCM ldName=L35134ALIMCA_ARCM

[LDevice] inst=L35134ALIMCA_ARCM ldName=L35134ALIMCA_ARCM

[LN0] (LN0) lnType=HQ_LLNO_base_V1.0 lnClass=LLNO

[LN0] (LN0) lnType=HQ_LLNO_base_V1.0 lnClass=LLNO

L35134ALIMCA_ARCM.Beh(ENS).q(Quality)

*** Élément manquant** -

*** Élément supplémentaire**

L35134ALIMCA_ARCM.Beh(ENS).q(Quality)TEST

*** Élément supplémentaire**

L35134ALIMCA_ARCM.NamPlt(LPL).attTest(VisString255)

[LN] (LN) lnType=HQ_ISAF_ArmoireCommandeExt_V1.0 lnClass=ISAF
inst=1

[LN] (LN) lnType=HQ_ISAF_ArmoireCommandeExt_V1.0 lnClass=ISAF
inst=1

L35134ALIMCA_ARCM.Beh(ENS).t(Timestamp)

*** Élément manquant** -

[LDevice] inst=L35134ALIMCC MS ldName=L35134ALIMCC MS

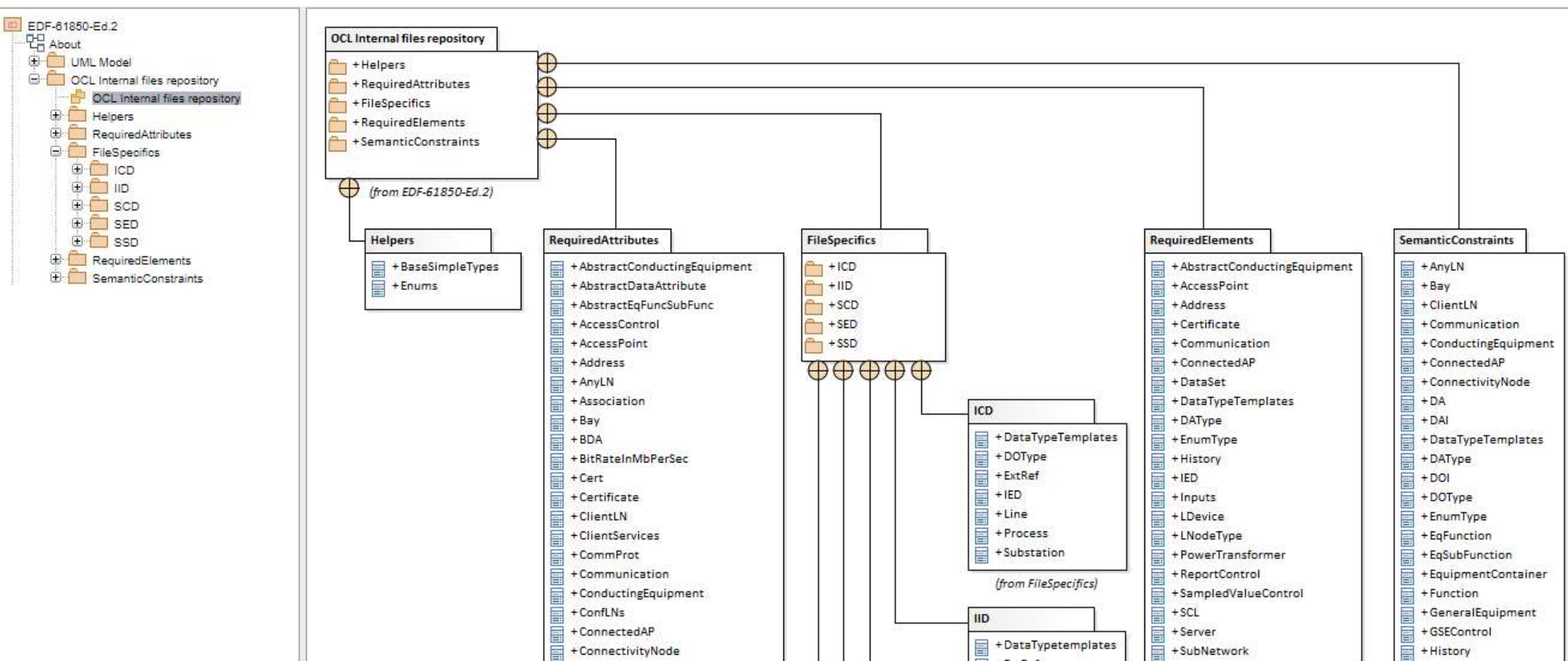
*** ldName différent**

[LDevice] inst=L35134ALIMCC MS ldName=L35134ALIMCC MS test

EDF-HQ RiseClipse SCL Validation tool

OCL Constraints Files UML Model

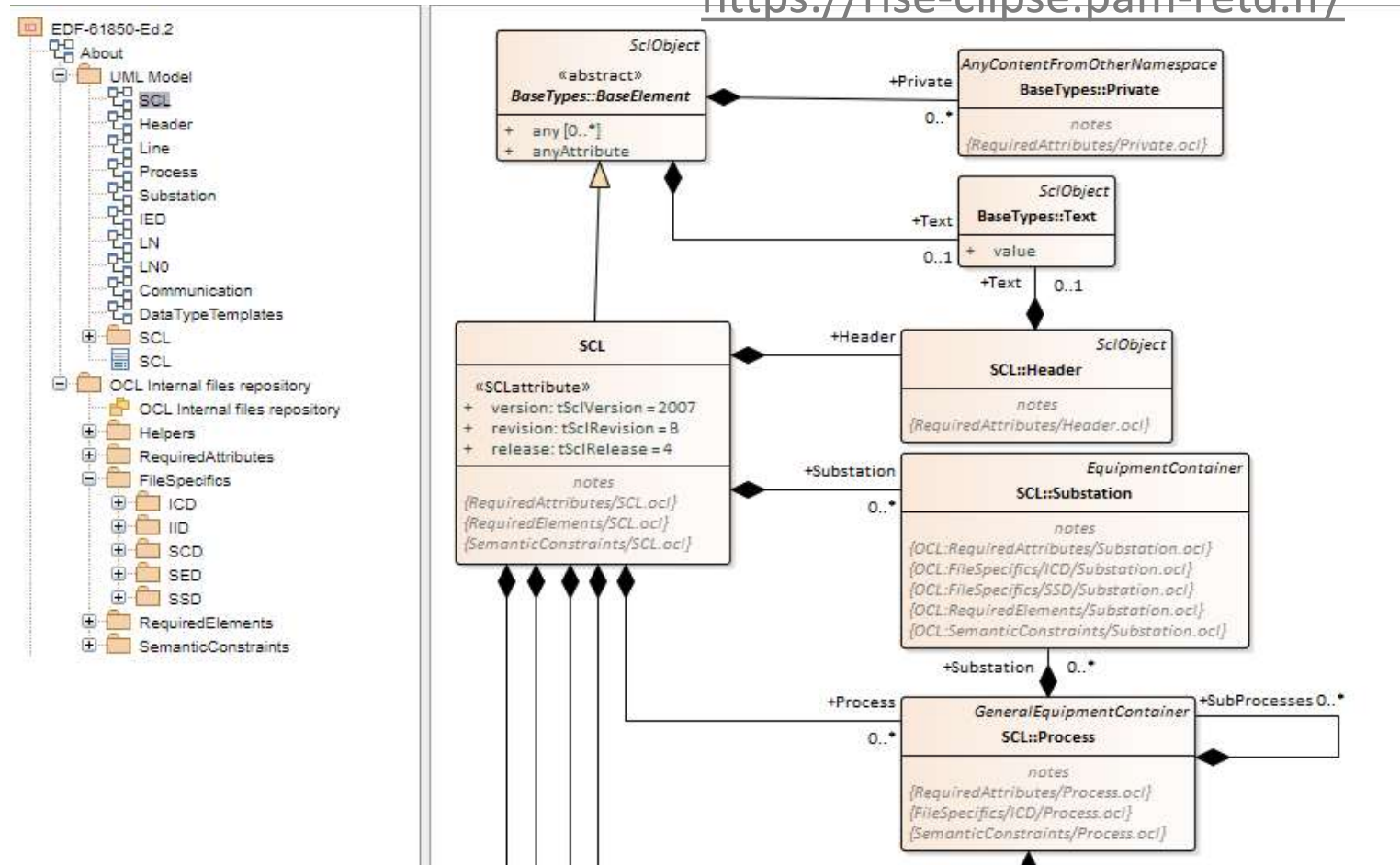
<https://rise-clipse.pam-retd.fr/>



EDF-HQ RiseClipse SCL Validation tool

SCL UML Model with OCL references

<https://rise-clipse.pam-retd.fr/>



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