Use Case 1: Network Extension

1 Summary:

Brief description of this use case.

Add a new line and transformer. Consider then:

- how to reuse the data from the old system, e.g. tag-names, parameters, connectivity.
- the addition of new measurements, control functions, protection etc.
- implications of emergency replacement

The perspective is that of two companies:

1. Company 1 which needs to build a new substation with substation automation
2. Company 2 which needs to add new bay and transformer and replace the old protection system with substation automation based on 61850 standards

2 Actor(s):

Describe the primary and secondary actors involved in the use case. This might include all the people (their job), systems, databases, organizations, and devices involved in or affected by the role performed (e.g. operators, system administrators, customer, end users, service personnel, executives, meter, real-time database, ISO, power system). Actors listed for this use case should be copied from the global actors list to ensure consistency across all use cases**.**

Actor Name	Actor Type (person, system, device, etc.)	Role description for this use case
Network Planner, company 1 (builds a new substation)	Person	Make studies of the line parameters to properly design the line. Works within the planning department at the ISC (ISO).
Network Planner, company 2 (builds a new bay)	Person	Make studies of the line parameters to properly design the line. Works within the planning department at the ISC (ISO).
Line Engineer company 1	Person	Engineer the line on company 1 territory. System operator engineering department.
Line Engineer company 2	Person	Engineer the line on company 2 territory. System operator engineering department.
Substation Engineer company 1	Person	Engineer the new substation primary and secondary equipment. System operator engineering department. This includes substation layout, protection, control, and metering.
Substation Engineer company 2	Person	Engineer the new bay primary and secondary equipment. System operator engineering department. This includes bay layout, protection, control, and metering. A large number of people from various departments are cooperating in this.
Vendors	Organization	Build and/or install equipment.
System Operator company 1	Person	Upgrades the Control Center (CC) with new data reflecting the new line and data exchange. Prepares the data exchange with other Control Centers. Company specific rules are used to decide what data is exchanged and how (ICCP, 101/104 etc.)
System Operator company 2	Person	Upgrades the Control Center (CC) with new data reflecting the new line and data exchange. Prepares the data exchange with other Control Centers.
Power System Network planning tool	System	Make studies of the line parameters to properly design the line. Works within the planning department at the ISC (ISO). Examples include: • Siemens PTI PSS/E • EDF tool: PRAO
Line engineering tool	System	Engineer the line on company 1 territory. System operator engineering department. Examples include: • TVA: TL Characteristics (in-house program)
Substation engineering tool	System	Engineer the line on company 2 territory. System operator engineering department. Examples include: • TVA: AutoCAD (but no program to export file)
Metering Design Tool	System	Engineer the meters for the new and updated substations. Examples include: •
Metering system Function Data Engineering	Organization	Upgrades the Control Center (CC) with new data reflecting the new line and data exchange. Prepares the data exchange with other Control Centers. Company specific rules are used to decide what data is exchanged and how (ICCP, 101/104 etc.)
Control Center Data Engineering	Organization	Upgrades the Control Center (CC) with new data reflecting the new line and data exchange. Prepares the data exchange with other Control Centers.

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Deleted: Protection design to ... [3]

Deleted: Substation automation configuration tool (System configurator in 61850-6) ... [4]

Control Center	Organization	Make studies of the line parameters to properly design the line. Works within the planning department at the ISC (ISO).

3 Assumptions / Design Considerations:

State any known assumptions, limitations, constraints, or variations that may affect this use case. Consider:

- ***Timing requirements***
- ***Frequency of use***
- ***Sizing characteristics, etc.***

4 Pre-conditions:

Describe conditions that must exist prior to use case triggering event that starts this use case.

Capacity planning has identified the need for additonal line capacity.

Substation automation is not in use at existing substation.

5 Normal Sequence:

Use Case Step	Event/ Input to this step	Actor activity and tools used	Description Of Processing	Information Producer	Information Receiver	Output Information to be Exchanged	Notes or Comments
#	*Event that triggers this step and/or inputs*	*Name of actor(s), activity description, and tools/ applications used*	*Describe the processing that takes place in this step.*	*Actors/tools responsible for producing information.*	*Actors responsible for receiving information*	*Description of information produced in this step to be exchanged with Information Receiver*	
1	Order from manager at the company. Requested line capacity.	Network planner plans transmission line. Network planning tool TVA: Siemens PTI PSS/E EDF tool: PRAO	High level planning for new line and transformer	PSS/E EDF tool: PRAO	Line Eng. Tool	Planned line parameters (in the CIM model), e.g. tentative impedance values, approx length, substations at endpoints. Format: Plan as Incremental CIM/XML model export or less formally.	***Need to define parameters involved***
2A	Planned line parameter s from step 1.	Line engineer designs the line. Line engineering tool TVA: Line impedances designed by in-house program, TL Characteristics program	Select towers, patterns of lines, catalog lookup, calculate exact line length, - , tower placement, mutual coupling, etc.	Line Eng. Tool TVA: TL Characteristi cs	Substation Engineer	Actual line parameters updated (in the CIM model), e.g. impedance values, length, cable characteristics, geometries, line right of way, geometry, ratings Format: CIM/XML Additional data not currently in CIM for planning	***Need to define parameters involved***
2B	Planned transforme r parameter s from step 1	Comp 1&2 Substation engineer designs transformer Transformer Design Tool	Select power transformer, catalog lookup, calculate winding and tap characteristics for proper voltage levels.	Transformer Design tool ***Examples?***	Substation engineer	Actual transformer electrical characteristics updated (in the CIM model)	***Need to define parameters involved***

3	Actual line and transformer parameters from step 2. Availability and capacity requirements.	Substation engineer Comp 1 designs the substation layout and specifies primary equipment (includes both planning and design). Substation Engineer Comp 2 designs the new bay layout and primary equipment. Substation engineering tool – will need interfaces, TVA: AutoCAD – wiring drawing, one lines, AC/DC schematics No tools to serve this function.	Instantiate existing model with new breakers, switches, bus extension, to existing CIM model. Name all new equipment (line, transformer, other) Generate specs for all new equipment in with CIM-based tools. Map to required output formats: 1. CIM-based XML messages 2. CIM-based SVG graphics files	System specification tool ***Examples?***	TVA: no receiving system	Primary equipment specifications, names (on drawings) and Power System connectivity (topology). Partial CIM-based bus breaker network model updates with topology, instance data, and names. One line diagrams.	***Need to define parameters involved*** ***Need list of vendors and tools used in this step to identify applications involved in information exchange and specific parameters.***
4	Substation diagrams and topology from step 3	System Operator configures control center including Power System model and SCADA data points (measurements) Control Center Data Engineering tool	Associate SCADA control and measurement points with network model in control center	Substation tools or database	EMS Network Modeling tools	New CC configuration and model ready for operation	

Deleted: Produce partial SSD (output of system spec tool file (topology) –single line diagrams with SA functionality (i.e., LNodes could be specified here)¶

Deleted: 61850 System configurator for SSD file¶
For CIM format, see Ken (???)¶

Deleted: <#>SCL XML for partial SSD file¶

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See 61850 part 6 for flow diagram. ¶
Action – **Christoph and Terry** - Put 61850 and CIM FDIS in SS-CC folder in WG19 eroom so we can have access for this project. Also put on CIMug when permission granted from TC57¶
Visual SCL, ASE

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Communication Network topology and Functional Model from steps 9 and 10.

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6 Exceptions / Alternate Sequences:

Describe any alternative actions that may be required that deviate from the normal course of activities. Should the alternate sequence require detailed descriptions, consider creating a new Use Case.

Since updates are supplied in advance of commissioning, several may be outstanding at one time. Furthermore, updates could be issued in one order and notified in another, i.e., for two updates X and Y, the steps could be: issue X; issue Y; notify Y in service; notify X in service.

There are additional steps following Step 3 for CIM-based exchanges to other systems involved in engineering, such as asset management, that comprise separate use cases. 61968 Network Extension use case is another source for these alternate sequences.

7 Post Conditions

Describe conditions that must exist at the conclusion of the use case.

Complete and error-free transfer. A model merge is required before model should be used. Any unnecessary (e.g., duplicate data or data outside scope of merged model) model data received will be discarded.

8 Activity Diagrams

Typically an activity diagram with swim lanes for each participating system or actor to graphically describe the step-by-step interactions between actors/systems and the messages exchanged between them. Additionally, sequence diagrams may be developed to help describe complex event flows.

Activity Diagram is attached (Attachment A).

9 References:

Use Cases referenced by this use case, or other documentation that clarifies the requirements or activities described. Also any prior work (intellectual property of companies or individuals) used in the preparation of this use case.

- Incremental Model Update Use Case
- Network Snapshot Use Case

10 Issues:

List of outstanding issues that must be addressed to complete the use case.

ID	Description	Status
1	Need details for data parameters produced at several of the steps	Open
2	Final steps involving exchange of detailed SCADA configuration data to control center have not been defined	Open

11 Revision History:

No	Date	Author	Description
0	11/07/06	T. Saxton	Initial version

12 Use Case Diagram

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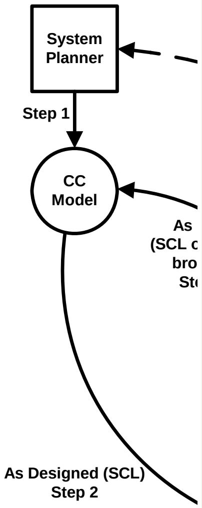

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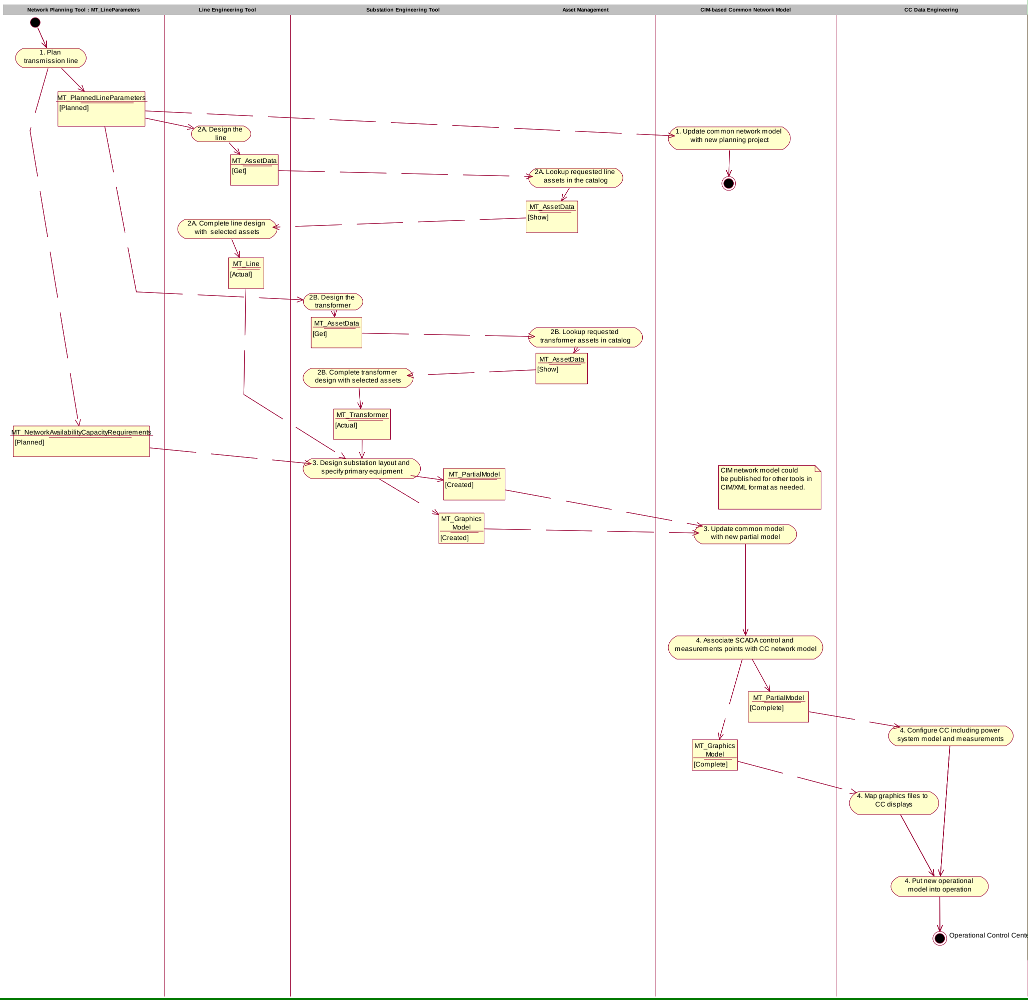
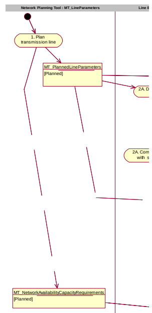
Attachment A – Network Extension Activity Diagram





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Communication Network Engineer company 1	Person	Engineer the Communication Network in company 1 f communications, or IT department.
Communication Network Engineer company 2	Person	Engineer the Communication Network in company 2 f communications, or IT department.

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Communication Network planning	System	Make studies of the line parameters to properly design the li at the ISC (ISO). Examples include:

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Protection design tool	System	Engineer the new substation primary and secondary ec department. This includes substation layout, protection, contr Aspen CAPR EDF: ARENE (simulation)

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Substation automation configuration tool (System configurator in 61850-6)	System	Engineer the new bay primary and secondary equipment. S This includes bay layout, protection, control, and metering, departments are cooperating in this. Examples include: TVA: Siemens DIGSI (IEC configurator expanded to also Bradley project) Visual SCL – bring in all vendor files and layout one lines EDF digital substation: Configuration System
IED configuration tool (IED configurator in 61850-6)	System	Engineer the Communication Network in company 1 f communications, or IT department. Examples include:
Substation control system (IED hardware)	Device	Engineer the Communication Network in company 2 f communications, or IT department.
Communication Network Data communication concentrator configuration/configurator	System	Engineer the communications data concentrator in the substa
Communication Network Data Concentrator	Device	Provides management of all measurements and controls in s data and provides control signals on buses.

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4	Substation diagrams and primary equipment specifications from step 3.	Substation Engineer plans protection. Protection design tool such as Aspen or CAPE EDF tool ARENE (simulation)	Provide all new SS protection equipment, IEDs, etc. to bring in 61850 automation. Allocate logical nodes (LNodes) to parts and equipment in the single line diagram to indicate needed SA functionality	Protection Design Tool ***Examples?***	Substation Automation Configuration tool	Pr pa LN EI
5	Substation diagrams and primary equipment specifications from step 3.	Plan metering. Metering design tool		***Examples?***		M pa M
6	Protection and metering functions and parameters from steps 4 and 5. Substation diagrams and primary equipment specifications from step 3. IED capability description file (SCL ICD file) from IED database	Substation engineer designs substation functions. Substation automation configuration tool TVA: Siemens DIGSI (IEC configurator expanded to also handle substation configuration based on Bradley project) Visual SCL – bring in all vendor files and layout one lines and configure substation 61850 System Configurator EDF digital substation: Configuration System	Engineer the new substation (Comp 1) and/or bay (Comp 2) primary and secondary equipment, including protection, control, and metering. Assign LNodes to the LNode types provided by selected IEDs Design substations communications logical communications configuration in terms of the access point connections for each IED and subnetwork paths. Produce complete system configuration specifying how IEDs are bound to process functions and primary equipment using the IED and Substation parts of the SCL model	System Configura-tor Siemens DIGSI Visual SCL EDF digital substation: Configuration System	IED Configura-tor EDF: IED tool	Co lo m SC
7	Control, protection, and metering functions from step 6.	Substation Engineer allocates functions (includes protection and metering) to IEDs. IED Configurator EDF: Substation designers in planning phase, then operator	Define configuration for each individual IED	IED Configura-tor ***Examples?*** EDF digital substation: Configuration System	Individual IEDs	De co si
8	Defined IEDs from	Substation Engineer deploys	Load IEDs with	IED	IED	Co

	step 7	functions to IEDs. IED Configurator	configuration data	Configurator ***Examples?***		de
9	Complete configured IED configurations from steps 3 thru 8.	Communication Network Engineer designs physical communication network topology. Communications Network Configurator	Assign logical subnetwork design to physical network and define communication protocol profiles Produce cabling file	EDF: Control Center configurator	EDF: SCL=Substation configuration system	Co as re in Th co in (e RT EI Th Ca

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10	Complete configured IED deployed to hardware from step 8. Old point definitions, any new points available.	Communication Network Engineers configures Substation Communication Information Exchange Model (communication front end). Data communication concentrator or configurator.	Produce all control and metering points with measurements defined. Import cabling files into substation supervision system Map relevant data to CIM-based message/file for communications from SS to CC	Comm Network Configurator	CIM Network Model Data Communications Concentrator Substation Supervision System	Fu th de gr CI or
114	Substation diagrams and topology from step 3.3. Communication Network topology and Functional Model from steps 9 and 10.	System Operator configures control center including Power System model and SCADA data points (measurements) Control Center Data Engineering tool	Associate SCADA control and measurement points with network model in control center	Substation tools or database	EMS Network Modeling tools	Ne m

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12	Communication Network topology and Functional Model from steps 9 and 10.	Configure metering system function. Metering system Data Engineering	Upgrade the Control Center (CC) with new data reflecting the new line and data exchange. Prepare the data exchange with other Control Centers. Company specific rules are used to decide what data is exchanged and how (ICCP, 101/104 etc.)	Metering System Data Engineering	Metering System	Op
13	Operational systems from steps 10, 11, and 12.	Take data into operation Control Center and/or metering system	Test new model, communications, and metering and put into operation	Test Engineering	Operational CC	Te ve

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Terminology update

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2	8/5/2003	AHWG07	Reviewed in meeting
3	7/12/2006	T. Saxton	Expanded to discover data required at each step
4	8/16/2006	T. Saxton	Expanded to include TVA specific data and generic additions based on Bradley SS
5	9/15/2006	T. Saxton	New template used and several steps were augmented with additional information
6	10/09/06	T. Saxton	Incorporated EDF comments

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Incorporated EDF comments

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Added activity diagram