Process a MV network reconfiguration request

Based on IEC 62559-2 edition 1
Generated from UML Use Case Repository with Modsarus® (EDF R&D Tool)

1. Description of the use case

1.1. Name of use case

Use case identification		
ID	***Area(s)/Domain(s)/Zone(s)***	***Name of use case***
	Transmission System, Distribution System, Operational planning, Long-term planning, Distribution Management, Energy Markets, Users, Real-Time Operation, Energy systems	Process a MV network reconfiguration request

1.2. Version management

Version management				
Version No.	***Date***	***Name of author(s)***	***Changes***	***Approval status***
1	2018-07-30	Belen Goncer & Jérôme Cantenot & Hugo Morais		Approved Version

1.3. Scope and objectives of use case

Scope and objectives of use case	
Scope	Validate the MV network reconfiguration considering the estimated power flows in distribution network during the short period when the network is operated in loop. To do this estimation, the DSO needs some observability (in operational or real time) of the TSO network.
Objective(s)	Validate the Network Reconfiguration Process. Evaluate the computational performance of the reconfiguration network process.
Related business case(s)	

1.4. Narrative of Use Case

Narrative of use case
Short description
The presented SUC describes the process to validate if the MV network reconfiguration is possible. The reconfiguration should be done in service (without power curtailment), meaning that the network will be exploited in a loop during some few seconds. The process should assure that the power flow during this time will not affect the normal operation of the network.
Complete description
DSO can proceed to a network configuration in different situations, as the followings: a) DSO proceed to a network configuration for its work planning needs. As for the TSO work planning needs, the DSO may need a network configuration which can involve operation in loop for a short period. The DSO can evaluate the work planning in operational and real time. b) DSO proceed to a network configuration to response to a TSO request to guarantee system security or to solve a congestion in TSO network. For all these situations and to validate the MV network reconfiguration, the DSO needs to have some observability of the TSO network (both at operational or real time).

The process to validate the network MV reconfiguration is presented below: 1. Collection of input data. The DSO needs some input data (at operational or real time) of both the TSO and the DSO network to launch an algorithm to obtain the estimated power flows; 2. Launch of the algorithm to obtain an estimation of the current transit. If all the input data is available, the DSO can perform the calculation of the current transit; 3. Make a decision. If the estimated current transit does not lead to constraints in distribution network, the load transfer can be made. Otherwise, the DSO should postpone the load transfer or look for another solution.

1.5. Key performance indicators (KPI)

Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
1	Rate between the maximum current calculated and measured		Validate the Network Reconfiguration Process.
2	Number of reconfigurations validated.		Validate the Network Reconfiguration Process.
3	Time to provide an answer (in minutes).		Evaluate the computational performance of the reconfiguration network process.

1.6. Use case conditions

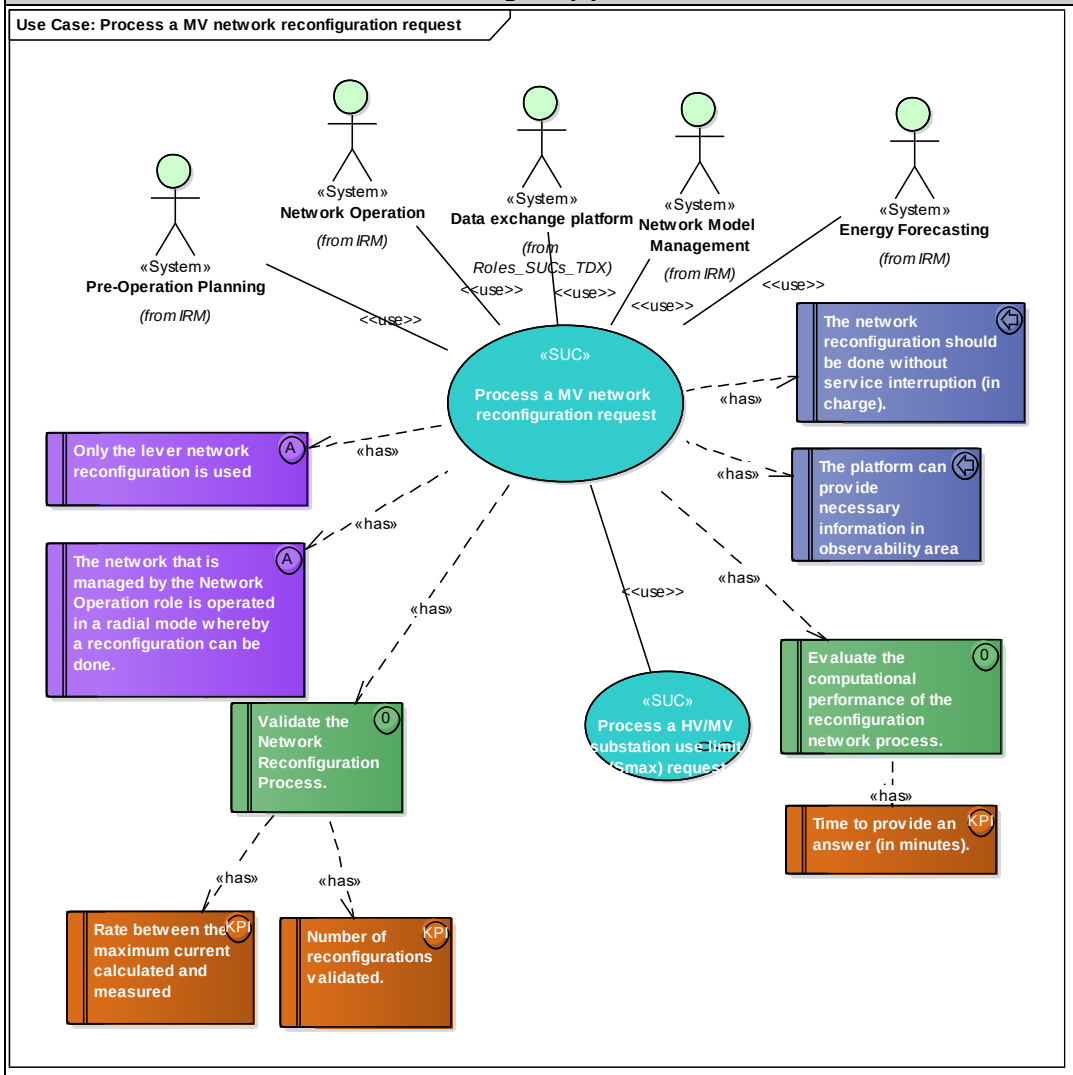
Use case conditions	
Assumptions	
1	Only the lever network reconfiguration is used
2	The network that is managed by the Network Operation role is operated in a radial mode whereby a reconfiguration can be done.
Prerequisites	
1	The platform can provide necessary information in observability area
2	The network reconfiguration should be done without service interruption (in charge).

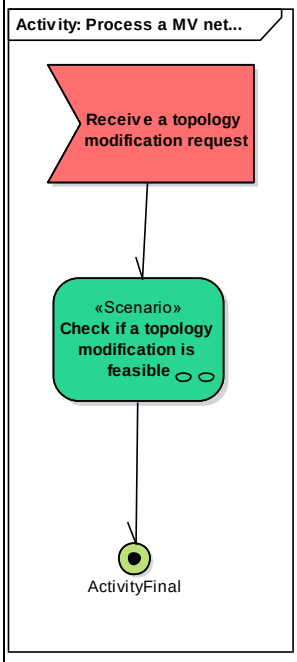
1.7. Further information to the use case for classification/mapping

Classification information
Relation to other use cases
<<SUC>> Process a HV/MV substation use limit (Smax) request <<SUC>> Information exchange using a collaborative platform <<SUC>> Disaggregated consumption and generation forecast for operational planning purposes
Level of depth
Medium
Prioritisation
High
Generic, regional or national relation
Generic
Nature of the use case
SUC
Further keywords for classification
Network reconfiguration

2. Diagrams of use case

Diagram(s) of use case





3. Technical details

3.1. Actors

Actors			
Grouping (e.g. domains, zones)		***Group description***	
Actor name	***Actor type***	***Actor description***	***Further information specific to this use case***
Energy Forecasting	System	The Energy Forecasting business (EF) function involves the forecasting of one or more of the items consumption (load), production (primarily intermittent or price inelastic production), direct current and area inter-exchange. This also include energy forecast for intermittent or price inelastic production that is part of Distributed Energy Resources (DER).	
Data exchange platform	System	Platform used by several entities to exchange information for different proposes. The 3 type of data (Real-time; scheduled and structural data) can be exchanged in this platform. The operational/control data are not included in real-time type. The exchange of information related with the markets are included in the scheduled data. Data-agnostic ICT infrastructure that enables secured and reliable information exchange for different purposes and within different time scales.	
Network Operation	System	The Network Operation function includes business activity directly involved with monitoring and operating the power grid as a whole system. • The phrase ‘directly involved’ indicates that the covered activities are limited to a hands-on focus on keeping the power grid running successfully, and more indirect influences on grid operation, such as energy markets, will be covered by other business functions. • The phrase ‘as a whole system’ indicates that local activity, such as operating a generating plant or substation, is excluded, and here the concern is a system perspective, such as is typical in transmission or distribution control centres.	
Network Model Management	System	The Network Model Management (NMM) manages information for establishing and maintenance of the functional description of the network grid that is provided by current installed asset (as-built model), planned installed asset (future model) or potential installation (what-if/ hypothetical model). The focus is to provide a mathematical model of the network grid that can be used in different analysis of the grid, including but not limited to steady state power flow, state estimation, contingency analysis as part of security assessment and stability analysis. It maintains master representations of the power system for network analysis functions, so that all analysis shares the same source information. Network Model Management (NMM) handles both internal	

		enterprise element and cross entity both in the horizontal and vertical domain, e.g. TSOs-TSOs and TSOs-DSOs coordination.	
Pre-Operation Planning	System	The Predictive Operation Planning (POP) business function involved in forecasting future operation situation with an acceptable level of reliability, the inclusion of what-if scenarios and risk assessment. This include the management of adequate that requires system operators and planners to take into account scheduled and reasonably expected unscheduled availability of equipment, while maintaining a constant balance between supply and demand.	

3.2. References

4. Step by step analysis of use case

4.1. Overview of scenarios

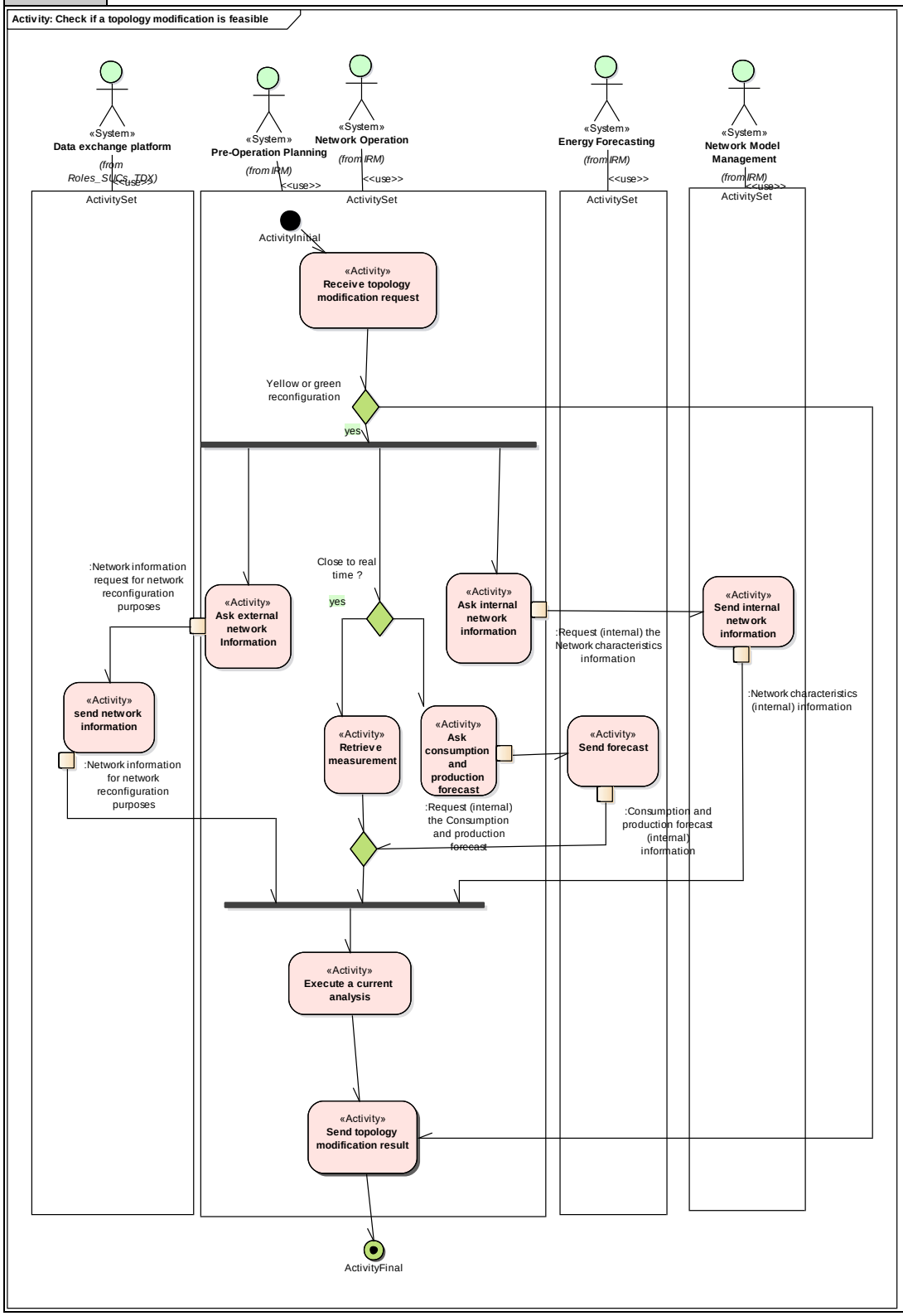
Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Check if a topology modification is feasible			Receive a topology modification request: From himself or another system operator through the data exchange platform.		

4.2. Steps - Scenarios

4.2.1. Check if a topology modification is feasible

Scenario step by step analysis

Scenario	
Scenario name	Check if a topology modification is feasible



Step No	Event	Name of process/activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged (IDs)	Requirement, R-IDs
1.1		Receive topology modification request	In this request should be identified the reconfiguration conditions (open and close switches)		Network Operation, Pre-Operation Planning			
1.2		Ask external network Information	DSO need to have the information of the transmission system operation conditions (real or forecasted) to compute the analysis). Depending of the level of coordination, the DSO request the Ssc and the voltage angle or this information can be exchanged periodically as proposed in the SUC "Exchange short circuit levels at bay level for the next 24 hours". If the DSO can represent a simplified model of transmission network and the information concerning this simplified model was exchanged, the Ssc and the voltage angle are not required. In the presented SUC it is considered that the DSO request the Ssc and the voltage angle.		Network Operation, Pre-Operation Planning	Data exchange platform	Info1-Network information request for network reconfiguration purposes	
1.3		Ask consumption and production forecast	When the request is done in operational planning, the system needs the		Network Operation, Pre-Operation Planning	Energy Forecasting	Info2-Request (internal) the Consumption and	

			values of the forecasted generation and consumption. The forecasted values should be aggregated by feeder.				production forecast	
1.4		Ask internal network information	To run the algorithm it is necessary the information concerning the network characteristics (structural information). This information is required by substation, transformer and feeder.		Network Operation, Pre-Operation Planning	Network Model Management	Info3-Request (internal) the Network characteristics information	
1.5		Execute a current analysis	The current analysis is performed using a load flow based algorithm. The process will determine if the load flow during the loop periods not exceed the lines thermal limits and if the protections will not be activated. The algorithm returns the reconfiguration validation (possible or not possible) and the apparent power variation in the feeders, transformers and substations.		Network Operation, Pre-Operation Planning			
1.6		Send topology modification result	Send topology modification validation (possible or not possible) result and the apparent power modification by substation, transformer and feeder		Network Operation, Pre-Operation Planning			

1.7		Send forecast	Depending of the systems, the forecast values are normally done by substation or by consumer/producer. In both cases, a treatment should be done to provide the values by feeder. The process to compute the forecast is not the focus of this SUC. It is assumed that the forecast values are available.		Energy Forecasting	Network Operation, Pre-Operation Planning, Network Operation, Pre-Operation Planning	Info4-Consumption and production forecast (internal) information	
1.8		Send internal network information			Network Model Management	Network Operation, Pre-Operation Planning	Info5-Network characteristics (internal) information	
1.9		Retrieve measurement			Network Operation, Pre-Operation Planning			
1.10		send network information	Depending of the type of information exchanged, the data exchange platform can have this information or a request can be necessary. In the presented case, is considered that the information is available.		Data exchange platform	Network Operation, Pre-Operation Planning	Info6-Network information for network reconfiguration purposes	

5. Information exchanged

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Network information request for network reconfiguration purposes	Information concerning the Ssc and Teta in specific bus: Request ID Type of request (Ssc and Teta) Time (day; hour; minute) Bus	

		Start Time (day; hour; minute) End Time (day; hour; minute) In the request the DSO should ask at least the information for two bus. This information can be requested in real-time (real-time data) or in operational planning (scheduled data). The time should be done in intervals of 15 minutes	
Info2	Request (internal) the Consumption and production forecast	The consumption and generation forecast (scheduled information) are needed by several SUCs. This BO request intends to be general for all the SUCs Int. Request ID Type of Request Substation Transformer Feeder Start Time (day; hour; minute) End Time (day; hour; minute) The time should be done in intervals of 15 minutes.	
Info3	Request (internal) the Network characteristics information	The structural information of the network (lines) characteristics are required to the computation process. This information is exchanged between the DSO owned systems Structural network information request: Int. Request ID Type of request Substation (All the information in downstream of substation) Transformer (All the information in downstream of transformer) Feeder (All the information in downstream of feeder)	
Info4	Consumption and production forecast (internal) information	The consumption and generation forecast (scheduled information) should be provided by several SUCs. Int. Request ID Type of Request Substation Quantile Pconso_Substation Pprod_Substation Qconso_Substation Qprod_Substation Transformer Quantile Pconso_Transformer Pprod_Transformer Qconso_Transformer	

		Qprod_Transformer Feeder Quantile Pconso_Feeder Pprod_Feeder Qconso_Feeder Qprod_Feeder Start Time (day; hour; minute) End Time (day; hour; minute) The time should be done in intervals of 15 minutes. If necessary, several quantiles can be included in the forecast. With this information, more advanced algorithms leading with uncertainties can be adopted.	
Info5	Network characteristics (internal) information	The structural information of the network (lines) characteristics are required to the computation process. This information is exchanged between the DSO owned systems Structural network information request: Int. Request ID Substation Power Transformer R L Feeder Line R L C Each feeder is composed by several lines.	
Info6	Network information for network reconfiguration purposes	Information concerning the Ssc and Teta in specific bus: Request ID Request Status Bus Start Time (day; hour; minute) End Time (day; hour; minute) Ssc Teta The Time should be done in intervals of 15 minutes This business information is related with the BO "Network information request for network reconfiguration purposes"	