Definition of annual optimal scheduling of works with impact in observability area

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, Energy Markets, Users	Definition of annual optimal scheduling of works with impact in observability area

1.2. Version management

Version management				
Version No.	***Date***	***Name of author(s)***	***Changes***	***Approval status***
1	2018-08-30	Hugo Morais & Belen Goncer & Jérôme Cantenot		Approved Version

1.3. Scope and objectives of use case

Scope and objectives of use case	
Scope	Works impacting the distribution network operation, namely: - In transmission network - In SGU - In primary substations (Border between TSO/DSO) - In distribution network
Objective(s)	Maximise renewable energies production Program as many works as possible in coordination with other parties Validate the Works proposed by the TSO, DSO and SGU Anticipate transmission and distribution grids constraints because of scheduled maintenance actions.
Related business case(s)	

1.4. Narrative of Use Case

Narrative of use case
Short description
This SUC describe the process to define the works scheduling with impact in the observability area on a yearly basis. The works can be requested by the TSO, by the DSO and by the SGU.
Complete description
The works planning in transmission and distribution network assets inside the observability area should be articulated between the TSO and DSO. The works planned in the SGU connected both in transmission and distribution networks should also be planned by the relevant SO, taking into account the periods with less generation forecast and/or the periods with less consumption. The information of the scheduled works of SGU should be exchanged between the TSO and DSO when the SGU is within the observability area. The works programmes should include the maintenance works but also

the network evolution network. In the presented use case, it is considered that the list of the works to be executed is already defined taking only into account the long term planning activities and the preventive maintenance plans. The first exchanges in works programmes should be done in a yearly basis. In the presented SUC a year-ahead is considered. The goal is to define the interactions between TSO, DSO and SGUs to determine the works to be realized during the following year. In the end of this scenario, the works should be schedule at a week level. A technical and market constraint minimization process will be proposed to schedule the works in the optimal time slot. The SGU should provide the works plans and, for the Distributed Renewable Energy Sources (DRES) to the relevant network operator the periods with less forecasted generation. In this time-horizon, TSOs' and DSO's can agree on the best plan for critical asset planned outage management.

1.5. Key performance indicators (KPI)

Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
1	Increase DER production		Maximise renewable energies production Program as many works as possible in coordination with other parties Validate the Works proposed by the TSO, DSO and SGU
2	Reduction of TSO and DSO constraints		Validate the Works proposed by the TSO, DSO and SGU Anticipate transmission and distribution grids constraints because of scheduled maintenance actions.
3	Reduction of the unavailability of the network		Validate the Works proposed by the TSO, DSO and SGU

1.6. Use case conditions

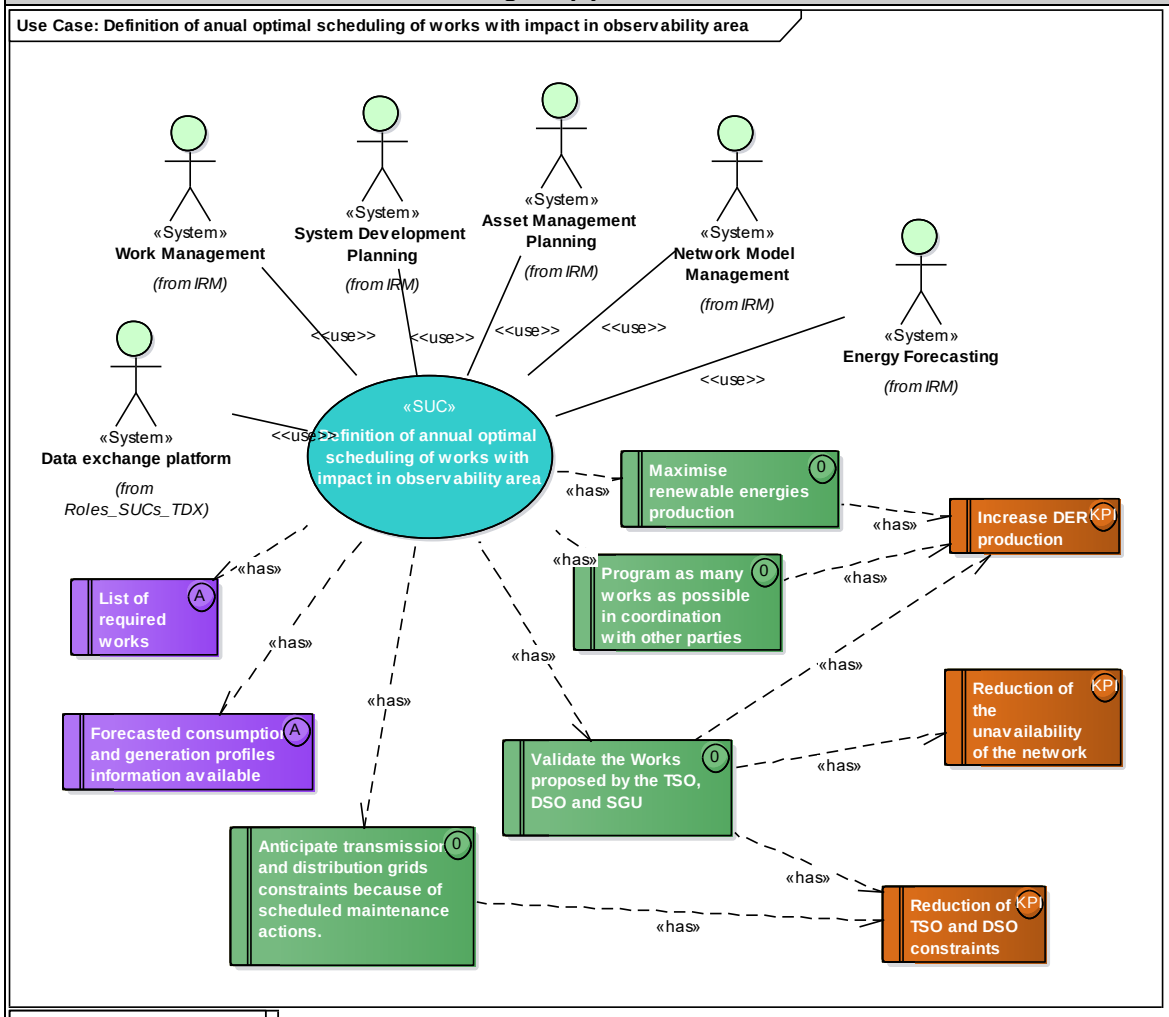
Use case conditions	
Assumptions	
1	List of required works: A list of the works to be done should be provided by each player based in the maintenance planning and in the network evolution planning.
2	Forecasted consumption and generation profiles information available: All the actors should have their own forecast information for consumption and generation. Other possibility is that the forecasts can be shared between the actors
Prerequisites	

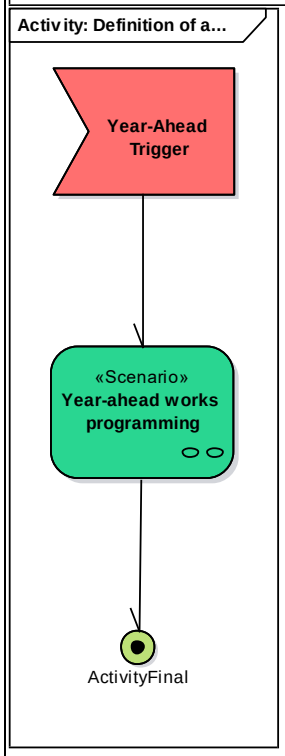
1.7. Further information to the use case for classification/mapping

Classification information
Relation to other use cases
<<BUC>> Optimise work programmes (TSO, Producers, and DSO works) <<SUC>> Monthly Validation of works programmes <<SUC>> Information exchange using a collaborative platform
Level of depth
Prioritisation
High
Generic, regional or national relation
Generic
Nature of the use case
SUC
Further keywords for classification
Works Programmes, Operational Planning

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***
Work Management	System	The Work Management (WM) business function involves the tracking of field service orders through request, schedule, dispatch, execution and completion. The focus is on efficient use of available resources to meet work requirement in regard to time and quality.	
Engineering Design Management	System	The Engineering Design Management (ED) business function involved creating and maintaining detailed design (e.g. blueprints) of all the structures that constitute the relevant grid elements.	
System Development Planning	System	The System Development Planning (SDP) business function involves network development and long term planning. The business function support cooperation and coordination to develop of a secure, environmentally sustainable and economic network system aimed at an adequate grid for the purpose of a well-functioning network operation and market operation. This is done through good planning with focus on future infrastructure characteristics, efficient asset management, critical infrastructure protection and system operability perspective.	
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.	
Significant Grid User (SGU)	Business	Significant Grid User - Generating and demand facilities which are significant because of their impact in electricity networks in terms of security of supply including provision of ancillary services [Survey of D1.1]	
Transmission System Operator	Business	According to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area. Source : EU Commission Task Force for Smart Grids, EG3	
Distribution System Operator	Business	A natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for	

		ensuring the long term ability of the system to meet reasonable demands for the distribution of electricity or gas. That definition is provided for by art. 2 n. 6 Dir 2007/72/EC with regards to electricity and by art. 2 (6) Dir 2007/73/EC with regards to gas. In the electricity sector distribution means the transport of electricity on high-voltage, medium-voltage and low-voltage distribution systems with a view to its delivery to customers, but does not include supply according to art. 2 (5) Dir, 2007/72/EC. Accordingly, distribution in the gas sector means the transport of natural gas through regional pipeline networks with a view to its delivery to customers, but not including supply. DSOs have to act according to art. 25, 26, 27 Dir. 2007/72/EC (with regards to electricity) and to art. 25, 26, 27 Dir. 2007/73/EC (with regards to gas). The aforementioned provisions provide the tasks and duties of DSOs. One of the main characteristics of the DSO is that it shall be independent at least in terms of its legal form, organisation and decision making from other activities not relating to distribution within a vertically integrated undertaking. Unlike the transmission system operator, the DSO is not affected by ownership unbundling.	
Asset Management Planning	System	The Asset Management Planning (AMP) business function involves the specification of the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organization's asset management objectives. Reliability trends and the evaluation of corrective actions needs to be performed. The grouping of assets may be by asset type, asset class, asset system or asset portfolio. An asset management plan is derived from the strategic asset management plan.	
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.	
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).	

3.2. References

4. Step by step analysis of use case

4.1. Overview of scenarios

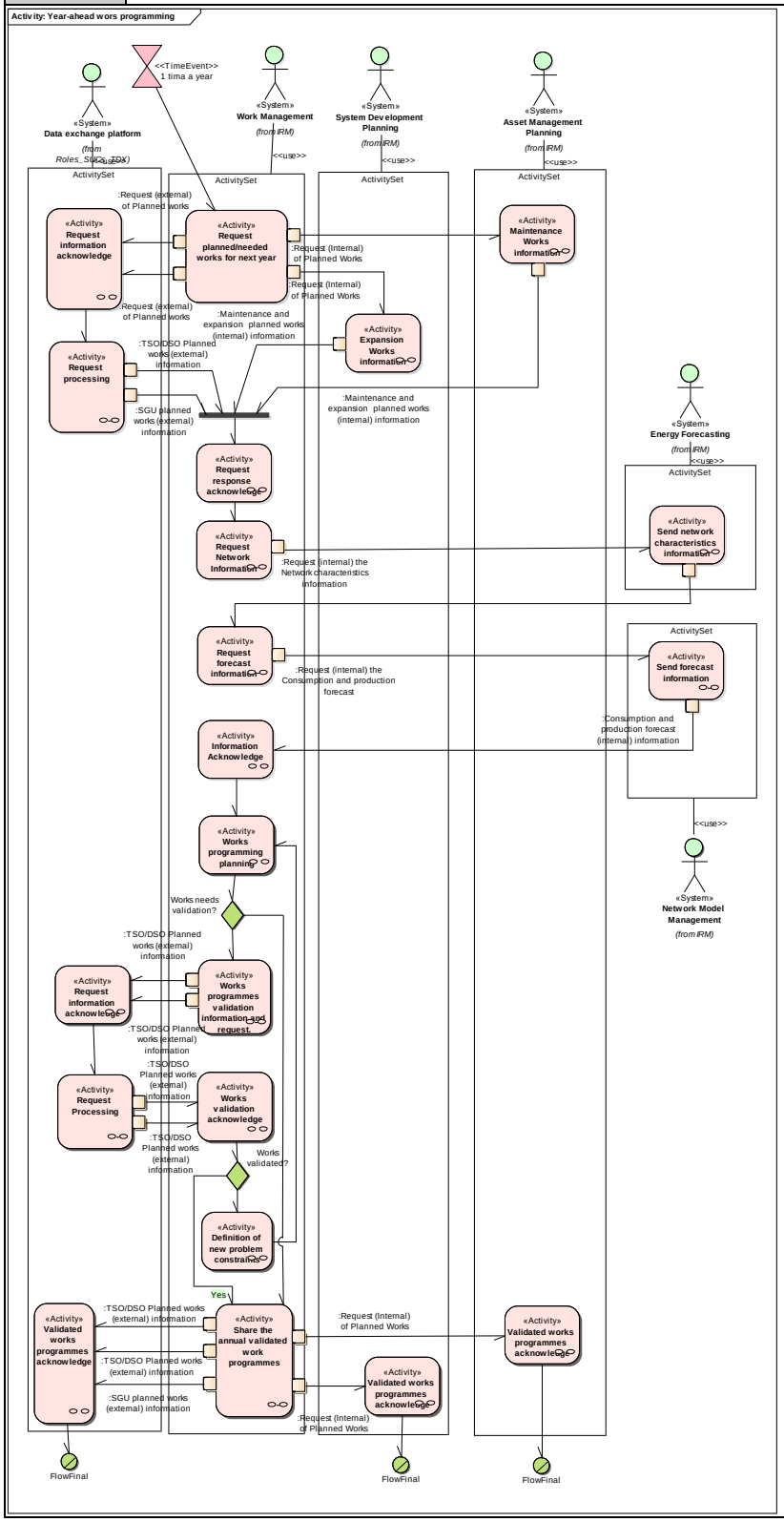
Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Year-ahead works programming	Interactions between TSO, DSO and SGUs to determine the schedule of the works to be realized during the follow year. In the end of this scenario, the works should be schedule at a week level. In the presented scenario are also considered the schedule of the works of expansion and maintenance of the owned network.		Year-Ahead Trigger		

4.2. Steps - Scenarios

4.2.1. Year-ahead works programming

Scenario step by step analysis

Scenario	
Scenario name	Year-ahead works programming



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		Request planned/needed works for next year	One time a year, the DSO should request the expected works to TSO and to SGU connected to distribution system. Additionally, the Work Order Management System should also consider the internal work's needs. The TSO only needs to communicate the works with impact in DSO and in the observability area. The SGU should communicate the planned works and 6 periods in the year with less generation forecast. The System Development Planning should transmit the works concerning the network expansion and the times with impact in the existing network The System Maintenance Planning should transmit the maintenance works planned to the next year		Work Management	Data exchange platform	Info1-Request (external) of Planned works, Info1-Request (external) of Planned works	

1.2		Request planned/needed works for next year	One time a year, the DSO should request the expected works to TSO and to SGU connected to distribution system. Additionally, the Work Order Management System should also consider the internal work's needs. The TSO only needs to communicate the works with impact in DSO and in the observability area. The SGU should communicate the planned works and 6 periods in the year with less generation forecast. The System Development Planning should transmit the works concerning the network expansion and the times with impact in the existing network The System Maintenance Planning should transmit the maintenance works planned to the next year		Work Management	Asset Management Planning	Info2-Request (Internal) of Planned Works	
1.3		Request planned/neede	One time a year, the DSO should request		Work Management	System Development Planning	Info2-Request (Internal) of	

		d works for next year	the expected works to TSO and to SGU connected to distribution system. Additionally, the Work Order Management System should also consider the internal work's needs. The TSO only needs to communicate the works with impact in DSO and in the observability area. The SGU should communicate the planned works and 6 periods in the year with less generation forecast. The System Development Planning should transmit the works concerning the network expansion and the times with impact in the existing network The System Maintenance Planning should transmit the maintenance works planned to the next year				Planned Works	
1.4		Request information acknowledge			Data exchange platform			
1.5		Request processing	The data information exchange		Data exchange platform	Work Management	Info3-TSO/DSO Planned	

			platform should send the request to the concerned actors (SOs and SGUs). When the information from the SOs and from the SGUs was available, the data exchange platform should send it to the DSO. The process is described in the SUC 'Information exchange using a collaborative platform' in the scenario 'Works Programmes information exchange'.				works (external) information, Info4-SGU planned works (external) information	
1.6		Maintenance Works information	Send the information concerning the planned maintenance works in the existing network. Works ID Time Duration Priority Unavailable Asset ID		Asset Management Planning	Work Management	Info5-Maintenance and expansion planned works (internal) information	
1.7		Expansion Works information	Send the information concerning the planned expansion works in the existing network. Works ID Time Duration Priority Unavailable Asset ID		System Development Planning	Work Management	Info5-Maintenance and expansion planned works (internal) information	

			Unavailability time in relation of time duration					
1.8		Request response acknowledge			Work Management			
1.9		Request Network Information	Request the network characteristics		Work Management	Energy Forecasting	Info6-Request (internal) the Network characteristics information	
1.10		Send network characteristics information			Energy Forecasting	Work Management		
1.11		Request forecast information	The yearly production and consumption forecast is needed to execute the method. Some quantiles can be provided if stochastic methods are used.		Work Management	Network Model Management	Info7-Request (internal) the Consumption and production forecast	
1.12		Send forecast information			Network Model Management	Work Management	Info8-Consumption and production forecast (internal) information	
1.13		Information Acknowledge			Work Management			
1.14		Works programming planning	The DSO should validate the works planned by the TSO (selecting the best option if several options are available). Based in the TSO works and in the SGU work's needs, the DSO should define the periods for the SGU works.		Work Management			

			The DSO should include in the planning the distribution network expansion work's needs. Finally, the DSO should also integrate in the planning the works concerning the maintenance of the existing distribution network. If the internal works have impact in the TSO network, the DSO should request the validation of these works.					
1.15		Works programmes validation information and request.	The DSO should inform the TSO concerning the validation of the TSO networks. If some works are not validated, the DSO should change the 'status' for 'not validated' and add some time constraints to avoid the works during these periods. Additionally, the DSO should send a second request, related with the first one, requesting the validation of the works in the distribution network with		Work Management	Data exchange platform	Info3-TSO/DSO Planned works (external) information, Info3-TSO/DSO Planned works (external) information	

			impact in the transmission system.					
1.16		Request information acknowledge			Data exchange platform			
1.17		Request Processing	The data information exchange platform should send the request to the concerned actors (SOs and SGUs). When the information from the SOs and from the SGUs is available, the data exchange platform should send it to the DSO. The process is described in the SUC 'Information exchange using a collaborative platform' in the scenario 'Works Programmes information exchange'.		Data exchange platform	Work Management	Info3-TSO/DSO Planned works (external) information, Info3-TSO/DSO Planned works (external) information	
1.18		Works validation acknowledge			Work Management			
1.19		Definition of new problem constraints	Based in the information provided by the TSO concerning of the works not validated, the system should define new constraints to be considered in the works programmes planning. The constraints should be of type period not		Work Management			

			allowed to plan the works.					
1.20		Share the annual validated work programmes	Send validated works programmes to TSO, SGU and internal systems. If the internal works have impact in the TSO network or in the SGU* activity, the DSO should also share this information. * In some systems, the information exchange with the SGU is intended as commercial communication and manage in a different way.		Work Management	Data exchange platform	Info3-TSO/DSO Planned works (external) information, Info3-TSO/DSO Planned works (external) information, Info4-SGU planned works (external) information	
1.21		Share the annual validated work programmes	Send validated works programmes to TSO, SGU and internal systems. If the internal works have impact in the TSO network or in the SGU* activity, the DSO should also share this information. * In some systems, the information exchange with the SGU is intended as commercial communication and manage in a different way.		Work Management	Asset Management Planning	Info2-Request (Internal) of Planned Works	
1.22		Share the annual validated work programmes	Send validated works programmes to TSO, SGU and internal systems. If the		Work Management	System Development Planning	Info2-Request (Internal) of Planned Works	

			internal works have impact in the TSO network or in the SGU* activity, the DSO should also share this information. * In some systems, the information exchange with the SGU is intended as commercial communication and manage in a different way.					
1.23		Validated works programmes acknowledge			Asset Management Planning			
1.24		Validated works programmes acknowledge			System Development Planning			
1.25		Validated works programmes acknowledge			Data exchange platform			

5. Information exchanged

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Request (external) of Planned works	Request of planned works with impact in the distribution system. The request can be done in a specific observability area (for other SOs) or in a specific node (for SGU). Request ID Observability area ID Bus ID Year	
Info2	Request (Internal) of Planned Works	Request of planned works in the distribution system. Request ID Year	
Info3	TSO/DSO Planned works (external) information	For each work planned by the TSO or by the DSO: - Request ID - Iteration / Related Request	

		- Status [in Validation / Not validated / Validated] - Observability area - Work ID - Work Type* - Work description - Priority - Start week (Option 1)*** - Start week (Option 2)*** - Duration For an unavailability in the observability area: - Asset ID For a limitation: - Region ID** - Bus ID - Apparent Power limit (TSO->DSO) - Apparent Power limit (DSO->TSO) - Reactive Power setpoint Works constraints: - Periods not allowed**** - Justification Work Type* - The identification of the type of works should be the same for the TSO and DSO. Region ID**-Some works can impose some limits in a region (group of substations). Start week*** - In same cases only one option can be provided depending of TSO/DSO agreements. Periods not allowed**** - If a SO does not validate the work, a time constraint should be included in the information exchange. It is recommended to include a small justification.	
Info4	SGU planned works (external) information	For each work planned by the SGU: - Request ID - Status [in Validation / Validated] - SGU ID - Bus ID - Work ID - Work Type* - Work description - Priority - Duration - Active power available - Reactive power available (inductive) - Reactive power available (capacitive) For each period (Minimum 6) - Period_x ID - Start week - Forecasted Production during the duration of	

		the work Work Type* - The identification of the type of works should be the same for the SGU and DSO.	
Info5	Maintenance and expansion planned works (internal) information	For each work planned for maintenance system: - Request ID - Work ID - Work Type* - Work description - Priority - Work Duration For each asset - Asset ID - Intervention start* - Intervention duration - Work under voltage [Possible / Not Possible] Information after validation** - Work start For each asset - Asset ID - Intervention start* - Work under voltage [Yes / No] The unavailability start* is in relation to the work duration. After the validation process, the works	
Info6	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)	
Info7	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.	
Info8	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.	

6. Requirements (optional)

7. Common terms and definitions

8. Custom information (optional)