

Dynamic Line Rating solution implementation and support
Technical specification. Annex I - Technical requirements

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1. Introduction

Purchaser is procuring DLR solution, which calculates load capacities for power lines based on weather provider and installed sensors data, and DLR solution support.

2. DLR solution

Requirements for the implementation of the DLR solution are defined in Table 1.

Table 1. Requirements for DLR solution implementation

No.	Requirement
DS.01	DLR solution adheres to IEEE-738 standard or CIGRE technical brochure 601 or 207 or equivalent.
DS.02	Produces real time DLR ampacity data.
DS.03	Produces 15 minutes forecast DLR ampacity data for at least 72 hours in the future for planning process.
DS.04	Data system output includes information about the transmission line, time horizon, and the ampacity in amperes.
DS.05	Expansion of the application for further power lines should be possible as much as possible with configuration changes instead of requiring code changes and version updates.

3. Functional requirements

3.1. General functional requirements

Provisions for the implementation of the functional requirements are defined in Table 2.

Table 2. General functional requirements

No.	Requirement
GF.01	Real time ratings shall be provided at least every 5 minutes in Amps.
GF.02	Solar radiance, ambient temperature, wind speed and direction shall be obtained and utilized from a reliable weather data provider.
GF.03	Forecasted line ratings shall be updated at least every 1 hour and be provided at 15 minutes time scale in Amps.
GF.04	The system shall provide Short Term Emergency Line ratings (5min-30min) to allow the conductors to be pushed to higher temperatures during emergency conditions.
GF.05	The system must be capable to store and display at least 5 years DLR related data. All data shall be stored at least in 15 minutes timestamps.
GF.06	The system must have API interface to export forecasted DLR values including timestamp and OHL identifier to other operational planning tools.

3.2. User interface requirements

Provisions for the implementation of the interface requirements are defined in Table 2 3.

Table 3. User interface requirements

No.	Requirement
UI.01	Software shall be able to export all line related data (at least .csv format).
UI.02	Software shall be able to visualise line related data (line parameter graphs, duration curve, sag, ambient temperature, etc.) in different specified timeframes.
UI.03	Software shall be able to filter line related data by date, time and type in different specified timeframes.
UI.04	The software shall be able to show all related line data in various time zones (for example UTC, CET or EET). This feature must be controlled from the user interface.
UI.05	The software must be able to generate a report in the intended format, consisting of timestamp, the OHL identifier and expected DLR value. The report file structure and format will be coordinated during the installation depending on system capabilities.
UI.06	The software must have functionality to generate report (described in UI.05) for specified time frame.
UI.07	The software shall be capable to export data collected for specified time frame which includes timestamp, OHL identifier and DLR value by API interface.
UI.08	The software shall be able to calculate line parameters (line temperature, dynamic line rating, sag) for every span of the line.
UI.09	Optional requirement: the software shall be able to set limits for line minimum and maximum DLR values taking into account the limiting factors by other line equipment.

4. Non-functional requirements

4.1. Cyber security requirements

Provisions for the implementation of the cyber security requirements are defined in Table 4.

Table 4. Cyber security requirements

No.	Requirement
CS.01	System must integrate with Purchaser's Active Directory service.
CS.02	System must have role based-access control (RBAC). Must be able to restrict user access based on roles to minimize privilege escalation.
CS.03	System (including applications) must send audit and security logs to Purchaser SIEM.
CS.04	System must have data integrity validation mechanism implemented.
CS.05	System physical sensors must have protection from unauthorised connections (whitelisted IP addresses, etc).
CS.06	System, including third-party software, must be patched after identified security vulnerabilities. Critical vulnerabilities must be addressed as a priority.
CS.07	Data traffic outside Purchaser infrastructure must be encrypted using strong and secure encryption protocols (including but not limited to DLR sensor transmitted data).

CS.08	Secure and encrypted protocols must be used for both System administration and client connections.
CS.09	Contractor must comply with the requirements in Annex II (Minimum information security requirements for the provision of services) at all stages of the project, including the warranty period.
CS.10	Ensure that services or provided equipment are not provided from countries that pose a threat to the national security of the Republic of Lithuania and the assurance of national security interests according to the National Security Strategy.
CS.11	The Contractor must identify all third-party components, libraries, and schemas used in the System, whether commercial, free, open source, or closed source software.

4.2. IT/OT requirements

Provisions for the implementation of the IT/OT requirements are defined in Table 5.

Table 5. IT/OT requirements

No.	Requirement
IT.01	The software license includes the licenses of the software used by the System.
IT.02	The System must be accessible and manageable without an Internet connection. Purchaser understands that in the case of internet outage, the weather data will not update. In this case, the System should not crash but instead use the latest available data.
IT.03	No hardware other than server provided by Purchaser is needed to use the application.
IT.04	System or dedicated DLR component must support IEC60870-5-104 edition 2 protocol. DLR IEC60870-5-104 Slave must support redundant masters (up to four redundant masters will communicate with Slave by the same 2404 port and same ASDU).
IT.05	DLR IEC60870-5-104 Slave must support flexible configuration by configured Δ measurement parameters to avoid signals flood without any deadbands.
IT.06	DLR IEC60870-5-104 Slave measurements must be configured without time stamp, Status changes (if will be used) must be time tagged only with report by exception. GI response must be without time tag.
IT.07	Only agreed signal list signals must be configured to SCADA/EMS. Any other signals not related to SCADA/EMS must be prohibited.
IT.08	It must have the capability to access sensor data using an API, utilizing REST or SOAP web services, while ensuring appropriate security mechanisms (e.g., WS-Security).
IT.9	System must be built in client - server architecture.
IT.10	System must provide web-based access for end users.
IT.11	System must support (at least) internet browsers used by Purchaser: <ol style="list-style-type: none"> 1. Chrome 130 (and higher versions), 2. Edge 130 (and higher versions).
IT.12	Contractor must prepare System to work on at least 3 environments: <ol style="list-style-type: none"> 1. Production (including backup production environment in second data centre), 2. Training / Test environment, 3. Development environment (The DEV environment must be located in the Contractor's infrastructure).
IT.13	System must be monitored by Zabbix v7 monitoring and notification system used by Purchaser. Purchaser is responsible for preparing System connect to monitoring system, but Contractor is obliged to provide any necessary assistance to Purchaser in that

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	<p>process. That would include the monitoring of infrastructure components (service stations, operating systems, databases, network connections, etc.) (or responsibility for process preparation and suitability, when changes are required in the Purchaser's infrastructure related to the System) automatically generating service failure messages to the Purchaser:</p> <ol style="list-style-type: none"> 1. Changes in operating/non-operating status; 2. Reaching/exceeding threshold (critical) values in operating system processes; 3. Unusual change in values for normal operation (change in units of measurement, expressed as a percentage); 4. Other values or their change, indicating a possible or occurring System malfunction.
IT.14	<p>System must allow to perform backup of the System using standard VMware API used by Purchaser. Purchaser is responsible for connecting System to backup system, but Contractor is obliged to provide any necessary assistance to Purchaser in that process.</p> <p>Backup policy will be determined during Technical Dialog or Analysis project phase but at DRL System must allow to create both full and incremental backup. Which would include backup copies of the System data. Ensure of backup correctness, or responsibility for process preparation and suitability, when changes are required in the Purchaser's infrastructure related to the System.</p>
IT.15	<p>System must support role-based access management system and must relate to Purchaser's Active Directory service. Purchaser is responsible for connecting System to AD system, but Contractor is obliged to provide any necessary assistance to Purchaser in that process. System must support SSO mechanisms.</p>
IT.16	<p>System must be prepared to use DNS infrastructure service provided by Purchaser. Furthermore, System could use Load Balancing services provided by Purchaser.</p>
IT.17	<p>System must work in 8x5 mode and provide high availability.</p>
IT.18	<p>Contractor is obliged to help Purchaser design and implement Disaster Recovery mechanisms for System based on Purchaser virtualization platform - VMware Site Recovery Manager.</p>
IT.19	<p>System must be ready to meet DR parameters:</p> <ul style="list-style-type: none"> - RTO = 22 hours, - RPO = 8 hours.
IT.20	<p>The System must operate and be installed on infrastructure provided by Purchaser.</p>
IT.21	<p>The System must work in virtual environment using Purchaser's VMware v7 platform.</p>
IT.22	<p>Contractor must specify requirements for System's infrastructure using standard components specified by Purchaser. The System must work on the operating platforms currently used by Purchaser, the replacement of which is not planned; therefore, appropriate compatibility must be ensured due to the fact that the System being installed will have to work in the single integrated infrastructure of the Purchaser:</p> <ol style="list-style-type: none"> 1. MS Windows Server 2022 and a newer version (licenses will be provided by Purchaser); 2. Oracle Enterprise Linux 9 and a newer version (licenses will be provided by Purchaser); 3. Containerized platform solutions.
IT.23	<p>The System must work on one of the below-mentioned database platforms currently used by Purchaser, the replacement of which is not planned, therefore, appropriate compatibility must be ensured due to the fact that the system being installed will have to work in the single integrated infrastructure of the Purchaser:</p> <ol style="list-style-type: none"> 1. MS SQL Server manufacturer supported version not older than 2019; 2. Oracle Database Server 19c SE and newer;

	3. Open source databases, but Open source databases has to be developed and supported not less than 5 years after and fully supported by Supplier.
IT.24	System must be prepared to work in logically separated domain.
IT.25	System must work with antivirus solution that will be provided by Purchaser.
IT.26	Seller must provide all necessary software licenses (and subscriptions) to access, use and configure all System functions including licences for 3rd party software (if there will be any necessary).
IT.27	Use of the System will not require the Purchaser to purchase any additional licenses or pay any additional fees for using systems functions.

5. Requirements for testing

Provisions for the implementation of the testing requirements are defined in Table 6.

Table 6. Requirements for testing

No.	Requirement
TS.01	Testing Plan must be submitted by Contractor for Purchaser approval.
TS.02	For each of test cycle, Contractor must provide Purchaser with a current set of user documentation and technical documentation of the solution adequate to the scope of current test cycle.
TS.03	Every test cycle must be organized with steps: <ol style="list-style-type: none"> 1. Preparing documentation, test scenarios, 2. Conducting tests, 3. Registering and repairing defects, 4. Defects re-testing, 5. Preparing test report.
TS.04	Contractor must perform integration tests: <ol style="list-style-type: none"> 1. Real time data exchange with SCADA/EMS complex test; 2. High availability redundant masters support test with SCADA/EMS; 3. Data exchange using API interfaces test.
TS.05	Contractor must perform Site acceptance test (SAT) to verify that the System delivered meets all functional and non-functional requirements specified.
TS.06	DLR system trial operation period - at least 1 (one) month. DLR system trial operation must be performed with all integrations, on live SCADA system. Contactor has to provide a trial operation report to the Purchaser. If defects occur during trial operation, Contactor has to resolve all identified defects, then trial operation starts over from the beginning for the next 1 (one) month.
TS.07	During DLR system trial operation Contractor must perform availability test.
TS.08	The availability test must last 168 hours (one week), within which period the performance test and all unplanned tests must be carried out with the consent of the Purchaser.
TS.09	The purpose of the availability test: <ul style="list-style-type: none"> • shows the availability of all critical functions, • to demonstrate that the system functions satisfactorily during different operating scenarios, as well as under different conditions resulting from unplanned tests,

	<ul style="list-style-type: none"> to demonstrate that the system can withstand and return to an operable state after the failure of a single piece of hardware.
TS.10	For the system availability test to be successfully conducted, at least the following criteria must be met: <ul style="list-style-type: none"> no changes may be made to the software, there must be no loss of data from the weather data provider, there must be no unwanted results from the DLR calculation, there must be no malfunctions in the operation of the software.
TS.11	The entire DLR system will be ready for takeover when the Purchaser approves the Report on the results of the availability test and the report on the successful completion of the trial operation of the entire DLR system.

6. Requirements for the sensors

The requirements set for sensors are defined in Table 7.

Table 7. Requirements for sensors

No.	Requirement
FS.01	Sensor weight: under 11 kg.
FS.02	Sensor should be maintenance free.
FS.03	Sensor housing material: aluminium.
FS.04	Conductor diameter range: at least from 6,5 mm to 33 mm.
FS.05	Waterproofing, corrosion & ingress: at least IP66.
FS.06	Minimum operating line current: at least 50 A.
FS.07	Current Survivability spike: at least 125 kA peak, 50 kA rms.
FS.08	Sensor operating voltage: at least 260 kV (line to line voltage up to 450 kV).
FS.09	Sensor operating line frequency: at least from 49,2 to 50,8 Hz.
FS.10	Sensor operating ambient temperature: at least -40 to +60 °C.
FS.11	Power supply: self-supplied by induction.
FS.12	Communications: cellular data 4G/5G LTE. SIM cards will be provided by Purchaser.
FS.13	Sensor line current measurement range: from 0 to at least 1500 A (AC).
FS.14	Sensor line current measurement accuracy: at least ± 1 A.
FS.15	Sensor line temperature measurement range: at least from -40 to +100 °C.
FS.16	Sensor line temperature measurement accuracy: at least ± 1 °C.
FS.17	Sensor should measure conductor tension.
FS.18	Sensor should measure conductor vibration (frequency and amplitude).
FS.19	Sensor should be able to detect icing with ice accretion weight reported at least every 10 minutes in kg/m of conductor.
FS.20	Sensor should be able detect galloping and large vibration events.
FS.21	Sensor should measure conductor sag. The accuracy of conductor sag and clearance measurements shall not be impacted by conductor distance from ground.
FS.22	The equipment measurement unit must not require calibration or subsequent recalibration.

FS.23	Sensors' delivery term is 6 months from the contract signature.
FS.24	Sensor must comply with the IEC 60068 standard.
FS.25	Sensor must comply with the IEC 61000 standard.
FS.26	Sensors must be covered by not less than 60 months warranty starting from the date of their delivery to the Purchaser.
FS.27	Optional requirement: sensor should measure wind speed and wind angle.

7. Training requirements

Provisions for the implementation of training requirements are defined in Table 28.

Table 8. Requirements for training

No.	Requirement
TR.01	Contractor must provide 1-day training session on the installation of the sensors for a group of up to 20 Purchaser's and sub-contractors' employees. Training to be provided on-site in the field of installation works.
TR.02	Contractor must provide 1-day end user training. Trainings should include basics of system usage with practical work on real data - how to connect to the system, how to select data/view, how to export/save data and etc. Training to be carried out remotely using MS Teams to a group of up to 45 Purchaser's employees.
TR.03	Contractor must provide 1-day training for power users and administrators. Training should include advanced system setting features, application installation, data exchange with other systems configuration, user access management, DB configuration, data flow configuration and etc. Training to be carried out remotely using MS Teams to a group of up to 5 Purchaser's employees.
TR.04	Training material (electronically) should be provided by Contractor and agreed by Purchaser.
TR.05	Training language should be in English.
TR.06	Exact dates, training schedule and content shall be agreed between Purchaser and Contractor, however no later than 2 months before the beginning of the training.

8. Requirements for DLR maintenance and support

Provisions for the DLR maintenance and support requirements are defined in Table 9.

Table 9. Requirements for the maintenance and support

No.	Requirement
MS.01	During the warranty period, malfunction sensor must be replaced by a new one. All costs related to the sensor replacement (new sensor, delivery, uninstallation/installation, software adjustments, etc.) must be covered by the Contractor. New sensor for the replacement must be provided as soon as possible but not later than in 6 weeks from the Purchaser request.

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MS.02	Contractor has System support and maintenance services available.				
MS.03	Contractor has to provide realise notes, newest updates and fixes, vulnerability patches.				
MS.04	Support and maintenance services are provided based on the requests of the Purchaser.				
MS.05	The Contractor must ensure the functionality of the means used for communication with the Purchaser.				
MS.06	Sending a notification to the Contractor's email address is equivalent to submitting a request, and from that moment, the response and resolution times for the request are counted.				
MS.07	All notifications to the Contractor are recorded in the IT service management system (of the Purchaser and/or the Contractor), where request tracking and response/resolution times are registered. The Contractor may also manage their provided services in their service management system.				
MS.08	The Contractor must provide the Purchaser or its authorized representatives with current information on the status of requests upon request, and in the case of incident resolution or order fulfillment, without delay.				
MS.09	The time of incident resolution or order fulfillment is considered the moment the Contractor provides information about the fulfillment to the Purchaser or its authorized representatives.				
MS.10	By separate agreement with the Contractor, the information about request fulfillment can be transferred to the Purchaser in an automated manner or by submitting a notification directly to the Purchaser's service management system.				
MS.11	Maintenance of servers, server infrastructure, and their operating systems is not included in the scope of the purchased maintenance and support services.				
MS.12	Maintenance services must be provided in accordance with the best ITIL practices and the service delivery process agreed upon with the Purchaser after the contract is concluded.				
MS.13	Requests from the Purchaser notifying about System disruptions are considered incidents and are handled by the Contractor according to the incident resolution process agreed upon with the Purchaser after the contract is concluded.				
MS.14	Depending on the scale of the System disruptions, incidents will be categorized as high, medium, or low. The scale of the incident is determined by the Purchaser or its authorized representatives and indicated in the request information sent to the Contractor.				
MS.15	Criteria for determining the scale of an incident:				
	Criteria for determining the scale of an incident			Scale	
	The System/service is completely non-functional, critical functions/modules are not working.			High	
	The System/service is partially non-functional, some (non-critical) functions/modules are not working.			Medium	
	All other minor disruptions that do not fall under "High" and "Medium" categories.			Low	
MS.16	Indicators for resolving System disruptions (incidents):				
	DLR system maintenance indicators		High	Medium	Low
	Maximum disruption resolution times during service hours, hours*		12	24	40
	Availability (minimum percentage)		96.0%		
	* The indicated maximum resolution time includes response time (the Contractor's obligation to promptly start resolving the incident).				
MS.17	Availability is calculated for the reporting period (month) during service hours.				

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MS.18	Incident resolution time is calculated individually for each registered incident during service hours.
MS.19	The System is considered unavailable during the resolution of high-scale incidents (from the time the disruption is reported to the Contractor until the Contractor notifies about the resolution of the disruption).
MS.20	System maintenance includes updates of software components.
MS.21	Contractor ensures reliable weather data provision. Weather data provider costs must be covered by the Contractor.