SIEMENS Gamesa RENEWABLE ENERGY	**GENERAL CHARACTERISTICS MANUAL**	*Code:* **GD336798-en** *Rev:* **2**
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Documentation Type: **PDTD - Product**	*Title:* **SGRE REQUIREMENTS FOR THE EXTERNAL COMMUNICATIONS**	*Approval process:* **Electronic: PDM Flow + Translation**
		Prepared: **JEZCURRAMENDIA**
Deliverable: **S12**		*Verified:* **LEF/RUARTIEDA**
		Approved: **IIRIBARREN**

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1 AIM

The aim of this document is to detail the minimum requirements of the communication lines to be installed in the wind farms in order to perform full maintenance and support during the warranty and/or maintenance periods of SGRE.

SGRE is currently constructing wind farms and providing warranty and/or maintenance service in more than 50 countries over the world (more than 50GW under O&M including warranty). The communications requirements for the external access to the wind farms included in the present document are defined based on the experience in all these wind farms considering all the data acquisition needs from the central systems for the appropriate monitoring of the wind farm and the needs of the maintenance technicians of the wind farms for the correct accomplishment of the maintenance tasks.

This document does not apply to the customer's access to the SGRE SCADA system from a remote site. For that purpose, the customer must supply its own infrastructure. Customer will connect to the specific designated interface in the SGRE SCADA system in order to have access to the SGRE SCADA server.

2 GENERAL DESCRIPTION

In order to provide warranty, operation and maintenance services, during the warranty and/or maintenance periods, wind farms with SGRE wind turbines must be integrated in the SGRE Central data acquisition systems, under Service's Operation Center. The established communication lines are used by SGRE to extend its corporate network to each wind farm in order to cover the operational needs of the personnel of maintenance making maintenance tasks effective.

Therefore, the communications solution designed by SGRE consists of two communication lines of different technology that work redundantly, so that the backup line comes into service automatically when the drop of the main line is detected. All the necessary hardware devices for automatic switch of the lines are provided by SGRE.

See details about SGRE's connectivity solution in document GD174017.

3 NETWORK TOPOLOGIES

SGRE has validated the following network topologies, and therefore all types of services offered by SGRE can be performed at full capacity. The topologies introduced below create different connection scenarios depending who is providing the communication lines.

None of topologies introduced affects by any mean the remote or local capacities or functionalities of any of SGRE products or services offered to the customer.

3.1 SCENARIO 1: BOTH COMMUNICATION LINES PROVIDED BY SGRE

A In this scenario both communication lines and the necessary equipment for automatic communication redundancy are provided by SGRE (See Figure 1). SGRE depending on the wind farm's location is using private networks to communicate with the wind farms so that all the data collected is securely delivered to the central systems.

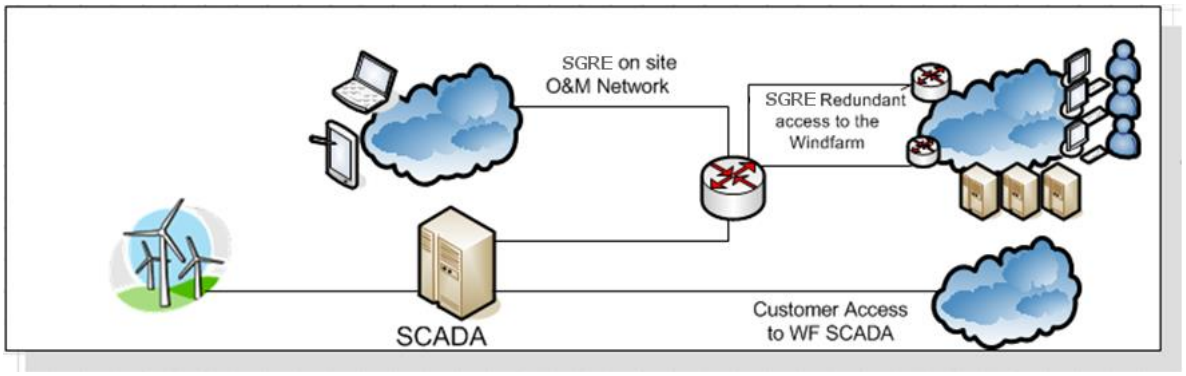

Figure 1. External communication lines provided by SGRE.

3.2 SCENARIO 2: ONE LINE PROVIDED BY THE CUSTOMER AND THE OTHER ONE BY SGRE

SGRE's and customer's networks are securely communicated using site to site VPNs (IPSEC tunnel). If the customer provides wind farm access by means of only one communication link, SGRE provides a second communication line to the wind farm (See Figure 2).

Both links, the one provided by the customer and the one provided by SGRE, are connected and integrated in the communication devices installed in the wind farm. These devices consists of all the necessary equipment to provide the redundant access to the SCADA from SGRE Control Center and SCADA support areas and provide access to corporate tools to the SGRE's technicians in the wind farm.

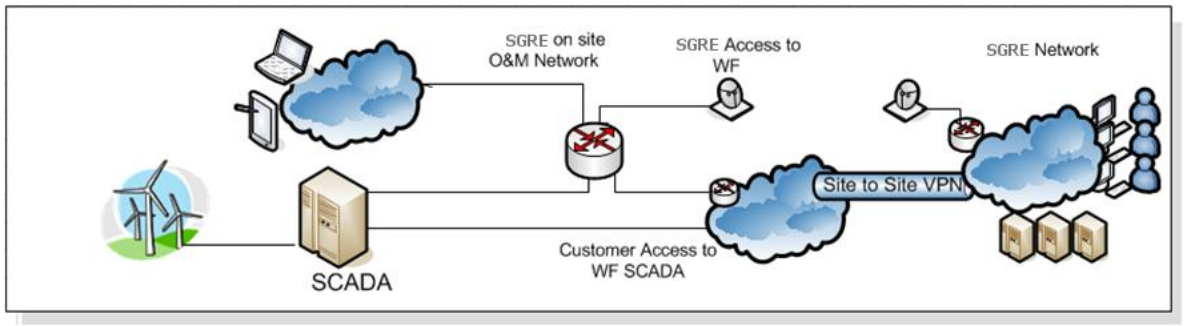

Figure 2. One line is provided by the customer, while SGRE provides the other line.

3.3 SCENARIO 3: ALL EXTERNAL LINKS PROVIDED BY THE CUSTOMER

Both communication lines are provided by the customer. SGRE's and Customer's networks are securely interconnected and communication to the wind farm from SGRE network is routed through customer network. Usually a specific designee is agreed between SGRE and the customer.

Figure 3 shows an example of interconnection although as commented specific solutions might be designed in agreement with the customer.

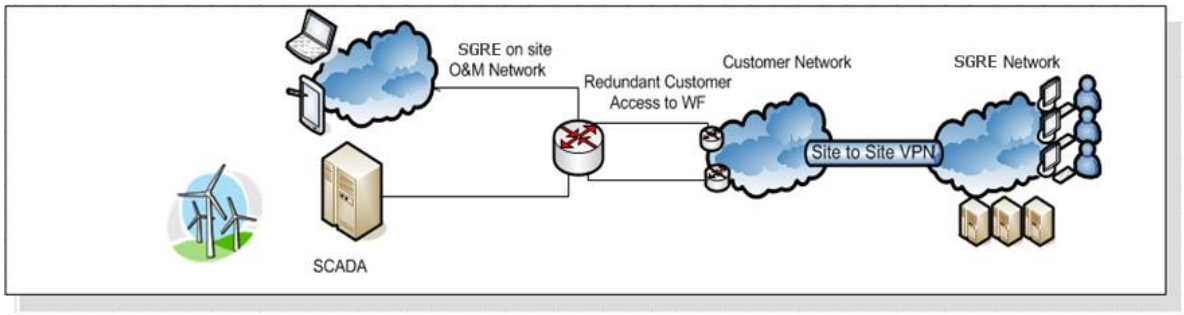

Figure 3. External communication lines provided by the customer.

4 REQUIREMENTS OF THE COMMUNICATION LINES

The requirements detailed below are considered as minimum; obviously SGRE accepts lines with higher performance characteristics. These requirements apply specifically to the communications line(s) provided by the customer, both in Scenario 2 and Scenario 3.

- Communication lines should be terminated at the SCADA rack, usually installed at the wind farm substation.
- As described above, redundant communication solution is required. In order to increase the availability of communications to the wind farms two communication lines using different technologies should be provided.
- Terrestrial (Radiolink, Wimax-LDMS, fiber links) communication solutions are preferred, although solutions based on cellular networks (3G, 3G, 3,5G, 4G, LTE) can eventually be accepted after a detailed performance analysis. In any case return trip delay (RTT) of the lines should not be higher than 300 ms end to end. Regarding satellite solutions, due to the associated delay, should be considered as a last option solutions, as some products or services will not be possible to be provided.
- The automatic switching and VPN configuration are implemented in SGRE's routing devices and should not be included as part of the supply.
- Neutral interconnections points for delivering traffic are preferred, however direct Internet connections with public and fixed IPs will also be acceptable.
- Communication lines should be delivered to SGRE in Ethernet interface.
- Communication links to the wind farm must allow to extend SGRE's corporate network in order to cover all the SGRE's maintenance personnel needs. Data traffic for all these SGRE's activities must be guaranteed.
- The following table is relating the Wind farm size with the minimum required bandwidth. If one or both lines are provided by customer, the below bandwidths should be guaranteed exclusively for SGRE.

Wind farm size		Bandwidth (kbps)	
		Main line	Backup line
Type 0	1 – 5 WTG	100*	
Type I	6 – 22 WTG	256	128
Type II	23 – 47 WTG	512	256
Type III	48 – 97 WTG	1024	512
Type IV	98 – 150 WTG	1536	768
Type V	> 150 WTG	2048	1024

* In wind farms with 5 or less wind turbines, after a performance and availability analysis, specific requirements could be accepted.

Table 1. Bandwidth requirements (Main/backup lines).

- Lines with symmetric bandwidth are preferred (uplink/downlink). The minimum bandwidths detailed above should be specially guaranteed on the uplink direction (from the wind farm side to headquarters). Asymmetric line configurations are also acceptable, although the above bandwidth should be provided in the uplink channel.

- Average monthly site communication availability should be guaranteed to at least 99.5%, considering both lines. Also main line monthly average should be at least 99%.

- All the supply and installation activities will be performed in an industrial environment, thus the provider should supply all the necessary health and safety documents required by SGRE or/and its customers.

5 MAJOR CHANGES COMPARED TO LAST VERSION

Rev.	Date	Author	Description
0	06/06/2017	MRODRIGUEZ	Initial version considering the content of ECM027 v5.
1	01/06/2018	JEZCURRAMENDIA	Section 4 of the document is updated.
2	26/10/2018	JEZCURRAMENDIA	Document updated to SGRE template.