I. Title of the challenge

Design of singular pylons for the Spanish power transmission grid.

II. Need

RED ELÉCTRICA de España (hereinafter REE) develops the power transmission grid based on the actions contained in the "Energy Planning. Plan for the Development of the Electricity Transmission Grid", building new transmission grid infrastructures, mainly for 400 and 220 kV voltage levels in the Spanish mainland power system, and 220, 132 and 66 kV in the island power systems.

For the aforementioned development of transmission grid, power line designs have traditionally based on the use of self-supporting steel lattice towers, where the electrical conductors are attached, made up of laminated steel angles and assembled by bolts and nuts. An example of these supports is shown in the figure below:

Figure 1. Steel lattice tower

This technology is currently one of the most efficient solution for the development of the transmission and, furthermore, makes it possible to recycle the metal supports once the

useful life of the installation is over, which generates a positive impact on the circular economy of the installations.

REE is currently conducting R&D&I programmes in search of innovative designs and technologies to traditional steel lattice supports for the development of the transmission grid. The main objective is the exploration of new proposals that promotes the evolution, modernization and sustainability of these infrastructures as they play an essential role in the power supply of the society. This challenge represents a step forward in the Red Electrica Group commitment towards the development of power infrastructures that generate a positive impact in the territory.

III. Description of the challenge

The objective of this challenge is to present new pylons designs for the development of the power transmission grid operating at voltages of voltages of 400, 220, 132 and 66 kV and that represents an alternative to the currently used option based on self-supporting metallic lattice pylons. Designs that are applicable to all or some of the indicated voltages may be submitted.

The challenge seeks solutions that, among others, improve the landscape integration of overhead transmission lines, reduce the dimensions of the pylons (and consequently less footprint and ROW under the lines), the cost of manufacturing and installing them and the carbon footprint associated with the manufacturing process, their installation, maintenance and disassembling at the end of the life span of the installation, as well as the recyclability of the materials to be used for the design of the pylons. In addition, safety preservation of professionals involved in the construction and maintenance shall be also considered in the proposals.

The proposed design must meet the mechanical and electrical requirements necessary to fulfil its main function of supporting the loadsof the line, complying with the requirements established in Royal Decree 223/2008, of 15 February, which approves the regulation on technical conditions and safety guarantees for high voltage power lines and its complementary technical instructions ICT-LAT-01 to 09[1], as well as being able to transport the required electrical energy at the specified voltage levels, all in a reliable and safe manner. The mechanical design loads are indicated in Annex I "Design loads of singular supports", according to the voltage level of the power lines (400, 220, 132 and 66 kV).

In addition, RED ELÉCTRICA is looking for proper designs for application to different territorial areas and geographies. On the one hand, designs of general application to the entire Spanish territory where the RED ELÉCTRICA Group provides its services. On the other hand, designs adapted to specific geographical areas, for example, autonomous communities or regions with specific landscape and orographic characteristics.

[1] https://www.boe.es/diario_boe/txt.php?id=BOE-A-2008-5269

IV. Impact

The presented proposals for this challenge are expected to provide technological innovations to continue the evolution, modernization and sustainability of transmission power lines, infrastructures that are a key element to make possible the energy transition in our country.

V. Evaluation criteria

The submitted proposals will be assessed on the basis of the following criteria.

Design of the proposed pylon:

- Landscape integration.
- Originality of the design
- Technical feasibility for its manufacture and actual implementation on power lines.
- Applicability for the whole range of voltages (400, 220, 132 and 66 kV) or only for a specific voltage.
- Simplicity of the design.
- Improvement in occupational safety, arising from the simplicity of transport, handling and assembly.

Sustainability of the solution:

- Type of materials used, their availability and environmental impact.
- Recyclability of materials at the end of the life span of the line.
- Carbon footprint associated to the manufacturing, installation and maintenance.

Cost of the proposed solution during all its life lifetime:

- Cost of manufacture, installation and maintenance.
- Expected lifetime (corrosion resistance, abrasion, fire, etc,)
- Pylon size decrease, especially the ground below the line
- Reduction of the pylon foundations

Time-to-market

- Resources required for the real implementation of the pylon in power lines

Innovative nature of the proposed solution

Experience of the work team

Documentation submitted to justify the proposal

VI. Proposal content

The proposal should include at lest the following sections:

1. Technical description of the proposed design (including all the details for an appropriate evaluation)
2. Technical viability of the proposed design
3. Benefits and added value provided by the proposed design
4. Cost of the solution
5. Tasks required for the new design implementation
6. Previous experiences of the team

Those additional sections that would be considered as necessary for the correct evaluation of the design can be included in the proposal.

The maximum length of the proposal is 10 pages (arial font, 11 size). In addition to this extension, specific annexes can be included in the proposal to incorporate the information that facilitates the understanding and evaluation process.

VII. Proposal submission

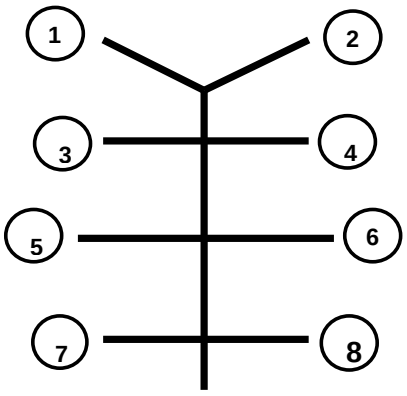
To send your proposal you have to complete the form available in the challenge description and follow the instructions in that form to send the documentation.

VIII. Award

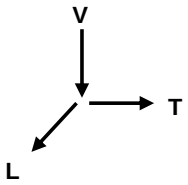
The selected finalists will be announced via Elewit's website and company profiles in social media, providing recognition and visibility to the team and proposal. The finalist will have the opportunity to present the proposal to Red Electrica Groups experts and a dedicated event might be organised for this purpose. The winner will receive an award valued on €10,000. In addition, the winner will have the possibility to implement an innovation project to progress in the proposed design, option conditioned to the value of the proposed solution. The organization preserves the possibility to declare the challenge null and void in case none of the proposal does not fulfil the minimal desired requirements.

Annex I. Design loads of single supports

A. Design loads (daN) for voltage levels of 400 kV:



Hipótesis	
1	Viento (140 km/h)
2	Hielo
3	Desequilibrio
4a	Rotura Cable de tierra
4b	Rotura Conductor Superior
4c	Rotura Conductor Medio
4d	Rotura Conductor Inferior
5	Viento (60 km/h) y hielo



		HIPÓTESIS Nº							
FASE		1	2	3	4a	4b	4c	4d	5
1	V	644	1713	1713	1713	1713	1713	1713	1713
	T	612	0	0	0	0	0	0	338
	L	0	0	675	4502	0	0	0	0
2	V	644	1713	1713	1713	1713	1713	1713	1713
	T	612	0	0	0	0	0	0	338
	L	0	0	675	0	0	0	0	0
3	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	4073	0	0	0
4	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	0	0	0	0
5	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	0	4073	0	0
6	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	0	0	0	0
7	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	0	0	4073	0
8	V	3060	7040	7040	7040	7040	7040	7040	7040
	T	2827	0	0	0	0	0	0	1184
	L	0	0	2444	0	0	0	0	0
c.s.		1.5	1.5	1.2	1.2	1.2	1.2	1.2	1.5
Viento		140 km/h	NO	NO	NO	NO	NO	NO	60 km/h

To the loads indicated in the table, a safety coefficient must be added in each hypothesis of:

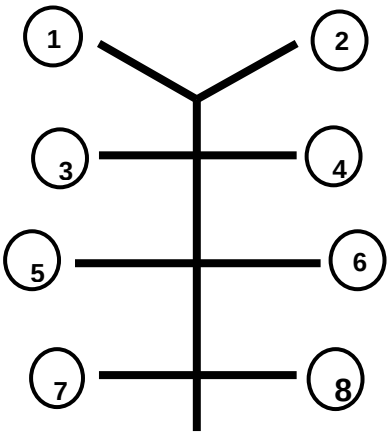
- 1.5 for cases no. 1, 2, and 5;
- 2 for no. 3, 4a, 4b, 4c, 4d.

In cases 1 and 5, the wind pressure on the supports generated by a wind speed of:

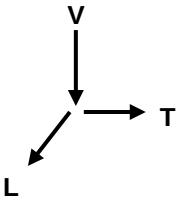
- Case no. 1: 140 km/h
- Case no. 5: 60 km/h

The values of wind pressures on the supports are established in Royal Decree 223/2008, of 15 February, which approves the regulation on technical conditions and safety guarantees on high voltage power lines and its complementary technical instructions ITC-LAT-01 a 09 (https://www.boe.es/diario_boe/txt.php?id=BOE-A-2008-5269).

B. Design loads (daN) for voltage levels of 220 kV:



Hipótesis	
1	Viento (140 km/h)
2a	Hielo
2b	Viento (60 km/h) y hielo
3	Desequilibrio
4a	Rotura Cable de tierra
4b	Rotura Conductor Superior
4c	Rotura Conductor Medio
4d	Rotura Conductor Inferior



		HIPÓTESIS Nº							
FASE		1	2a	2b	3	4a	4b	4c	4d
1	V	819	2194	2194	2194	2194	2194	2194	2194
	T	734	0	405	0	0	0	0	0
	L	0	0	0	622	4148	0	0	0
2	V	819	2194	2194	2194	2194	2194	2194	2194
	T	734	0	405	0	0	0	0	0
	L	0	0	0	622	0	0	0	0
3	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	2662	0	0
4	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	0	0	0
5	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	0	2662	0
6	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	0	0	0
7	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	0	0	2662
8	V	2623	6034	6034	6034	6034	6034	6034	6034
	T	2262	0	947	0	0	0	0	0
	L	0	0	0	1597	0	0	0	0

To the loads indicated in the table, a safety coefficient must be added in each hypothesis of:

- 1.5 for cases nº 1, 2a, 2b,

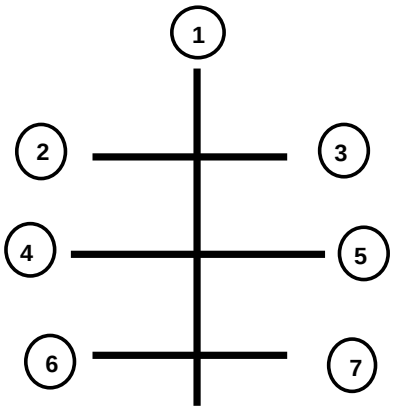
- 2 for No. 3, 4a, 4b, 4c, 4d.

In cases 1 and 2b, the wind pressure on the supports generated by a wind speed of:

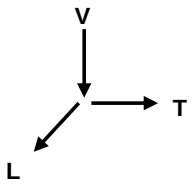
- Case no. 1: 140 km/h
- Case no. 2b: 60 km/h

The values of wind pressures on the supports are established in Royal Decree 223/2008, of 15 February, which approves the regulation on technical conditions and safety guarantees on high voltage power lines and its complementary technical instructions ITC-LAT-01 a 09 (https://www.boe.es/diario_boe/txt.php?id=BOE-A-2008-5269).

C. Design loads (daN) for voltage levels of 132 and 66 kV:



Hipótesis	
1	Viento (140 km/h)
2a	Hielo
2b	Hielo y Viento (60 km/h)
3	Desequilibrio
4a	Rotura Cable de tierra
4b	Rotura Conductor Superior
4c	Rotura Conductor Medio
4d	Rotura Conductor Inferior



		HIPÓTESIS Nº							
FASE		1	2a	2b	3	4a	4b	4c	4d
1	V	333	678	678	678	678	678	678	678
	T	438	0	198	0	0	0	0	0
	L	0	0	0	376	2506	0	0	0
2	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	2987	0	0
3	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	0	0	0
4	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	0	2987	0
5	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	0	0	0
6	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	0	0	2987
7	V	377	788	788	788	788	788	788	788
	T	516	0	190	0	0	0	0	0
	L	0	0	0	448	0	0	0	0

To the loads indicated in the table, a safety coefficient must be added in each hypothesis of:

- 1.5 for cases nº 1, 2a, 2b,
- 2 for No. 3, 4a, 4b, 4c, 4d.

In cases 1 and 2b, the wind pressure on the supports generated by a wind speed of:

- Case no. 1: 140 km/h
- Case no. 2b: 60 km/h

The values of wind pressures on the supports are established in Royal Decree 223/2008, of 15 February, which approves the regulation on technical conditions and safety guarantees on high voltage power lines and its complementary technical instructions ITC-LAT-01 a 09 (https://www.boe.es/diario_boe/txt.php?id=BOE-A-2008-5269).