

POSITION PAPER

# Transition Times from SF<sub>6</sub> to alternative technologies for HV and EHV applications

ENTSO-E and T&D Europe, October 2021



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ENTSO-E, the European Network of Transmission System Operators for Electricity, is the association for the cooperation of the European transmission system operators (TSOs). The 42 member TSOs representing 35 countries are responsible for the secure and coordinated operation of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E brings together the unique expertise of TSOs for the benefit of European citizens by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.



T&D Europe is the European Association of the Electricity Transmission & Distribution Equipment and Services Industry, which members are the European National Associations representing the interest of the electricity transmission and distribution equipment manufacturing and derived solutions. The companies represented by T&D Europe account for a production worth over € 25 billion and employ over 200,000 people in Europe.



Transmission System Operators (ENTSO-E) use sulphur hexafluoride (SF<sub>6</sub>) gas in numerous high-voltage (HV) and extra-high-voltage (EHV) alternating current (AC) applications, in particular in their Gas Insulated Substations (GIS), compact switchgear assemblies and in circuit breakers, and instruments transformers in their Air Insulated Substations (AIS).

ENTSO-E and T&D Europe are aware of the impact of SF<sub>6</sub> gas emissions on global warming. Accordingly, both associations expressed their commitment to reduce these emissions, as declared in previous position papers on SF<sub>6</sub> and SF<sub>6</sub> alternative technologies (see references [1] to [5]) that are in line with the EU carbon neutrality target for 2050.

In continuation with these previous positions, and given the progress made to date in the search for alternatives, ENTSO-E and T&D Europe propose the following transition times to shift from SF<sub>6</sub> to alternative technologies, covering the wider European HV and EHV energy transmission community:

### Transition times needed before the POM<sup>1</sup> prohibition for SF<sub>6</sub> equipment

From the entry into force of the F-Gas Regulation (presumably from 01.01.2023)

Voltage class	52 < U <sub>m</sub> ≤ 72.5 kV	72.5 < U <sub>m</sub> ≤ 145 kV	145 kV < U <sub>m</sub> ≤ 420 kV
Standard applications	<b>5 years</b>	<b>6 years</b>	<b>9 years</b>
Special and limit value applications	In the F-Gas Regulation, no restrictive measures should be provided for this segment. Limit applications should be considered in a later renewed review of the F-Gas Regulation.		
Extension and repair of existing installations	SF <sub>6</sub> will also be needed beyond 2050 for the maintenance, repair, and extension of existing installations. <sup>2</sup>		

<sup>1</sup> Placing On the Market (POM)

<sup>2</sup> Scenario for reducing SF<sub>6</sub> operating emissions from electrical equipment through the use of alternative insulating gases, ZVEI July 2020

The transition times refer to the start from the date of applying a revised EU F-Gas Regulation<sup>3</sup> (presumably from January 2023) until the entry into force of restrictive measures. The transition times include the steps required by manufacturers and users for the development and introduction of new alternative gas-insulated technologies on the grid. Therefore, the evidence for the POM prohibition for SF<sub>6</sub> equipment is provided when alternative technologies have successfully passed all necessary steps at the manufacturer and user level (See Appendix I).

Standard SF<sub>6</sub> applications for GIS and AIS – 145 kV (40 kA), 170 kV (50 kA), 245 kV (50 kA) and 420 kV (63 kA) – are estimated to cover about 80% of the HV and EHV European market.

On the other hand, the 20% of the HV and EHV European market consists of special and limit value applications (i.e., niche market), which are also indispensable to the grid and usually associated with very high-performance requirements (e.g., switching of reactive power compensation), special requirements for temperature ranges, maximum size/weight limitations (e.g., inner-city areas), highly reliable applications (e.g., offshore) and direct current HV applications. In the F-Gas Regulation, no restrictive measures should be provided for this segment until SF<sub>6</sub>-free alternative solutions are available.

The equipment with voltage levels of 170 kV and 245 kV are considered as standard applications with the indicated transition time of 9 years.

## PREREQUISITE FOR TRANSITION TIMES

A mandatory prerequisite from a TSO point of view for applying such transition times is the availability of at least two products from different manufacturers, which completed the required manufacturer and user steps, including service providers for each application area. Collaboration between the user and manufacturer for the development and qualification of the alternative solution already generates a reduction of transition times of approximately 2 years. However, any delay in the development times proposed by the manufacturer or in the user times will impact the ending of the transition times (See Appendix I).

In addition, TSOs require sufficient and stable supply capacities of products from at least two manufacturers to be available on the market, in order not to delay grid expansion and the integration of renewables, or not to jeopardise the reliability of energy supply. Otherwise, the use of conventional SF<sub>6</sub> equipment must remain possible for transitional purposes. In this regard, it must also

be ensured that projects and contracts already awarded using SF<sub>6</sub> equipment can still be carried out, even after POM<sup>4</sup> prohibition for SF<sub>6</sub> equipment.

As for the maintenance and repair of existing installations and equipment, the use of SF<sub>6</sub> technology and the availability of SF<sub>6</sub> gas will remain necessary beyond 2050. Similar need may also occur for the extension of existing SF<sub>6</sub> installations.

**Considering all this, ENTSO-E and T&D Europe recommend the European Commission not to consider POM prohibition for SF<sub>6</sub>-insulated HV and EHV equipment before the end of the above-mentioned transition times.** TSOs commit to order alternative solutions as soon as evidence of availability is provided, which may be sooner than the current transition periods mentioned in this common position, in order to meet the EU CO<sub>2</sub> emissions targets as soon as possible.

## REFERENCES

- [1] ENTSO-E position paper on the reduction of SF<sub>6</sub> emissions and introduction of alternative technologies [↪](#)
- [2] T&D Europe position paper on SF<sub>6</sub> and SF<sub>6</sub> alternative technologies [↪](#)
- [3] FNN Transition times necessary for alternative gas insulated electrical equipment [↪](#)
- [4] Scenario for reducing SF<sub>6</sub> operating emissions from electrical equipment through the use of alternative insulating gases [↪](#)
- [5] Position of the Spanish electricity sector on SF<sub>6</sub> and alternatives to SF<sub>6</sub> [↪](#)

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<sup>3</sup> Current regulation (EU) No 517/2014  
<sup>4</sup> Placing On the Market (POM)

# Appendix I

## Transition times needed before the POM<sup>5</sup> prohibition for SF<sub>6</sub> equipment

From the entry into force of the F-Gas Regulation (presumably from 01.01.2023)

Voltage and application classes	Manufacturer time	User time	Transition time (synergy potential taken into account, if applicable)
<b>Standard applications</b> 52 < U <sub>m</sub> ≤ 72.5 kV	Available from various manufacturers, international operating experience available	<b>5 years</b>	<b>5 years</b>
<b>Standard applications</b> 72.5 < U <sub>m</sub> ≤ 145 kV		<b>6 years</b>	<b>6 years</b>
<b>Standard applications</b> 145 < U <sub>m</sub> ≤ 420 kV*	Especially devices with circuit breaker function require longer development times	<b>3 years</b>  <b>8 years</b> Synergy potential of 2 years**	<b>9 years</b>
<b>Special and limit value applications</b> 52 < U <sub>m</sub> ≤ 420 kV	Especially devices with circuit breaker function require longer development times	Open	Limit applications should be considered in a later, renewed review of the F-Gas Regulation

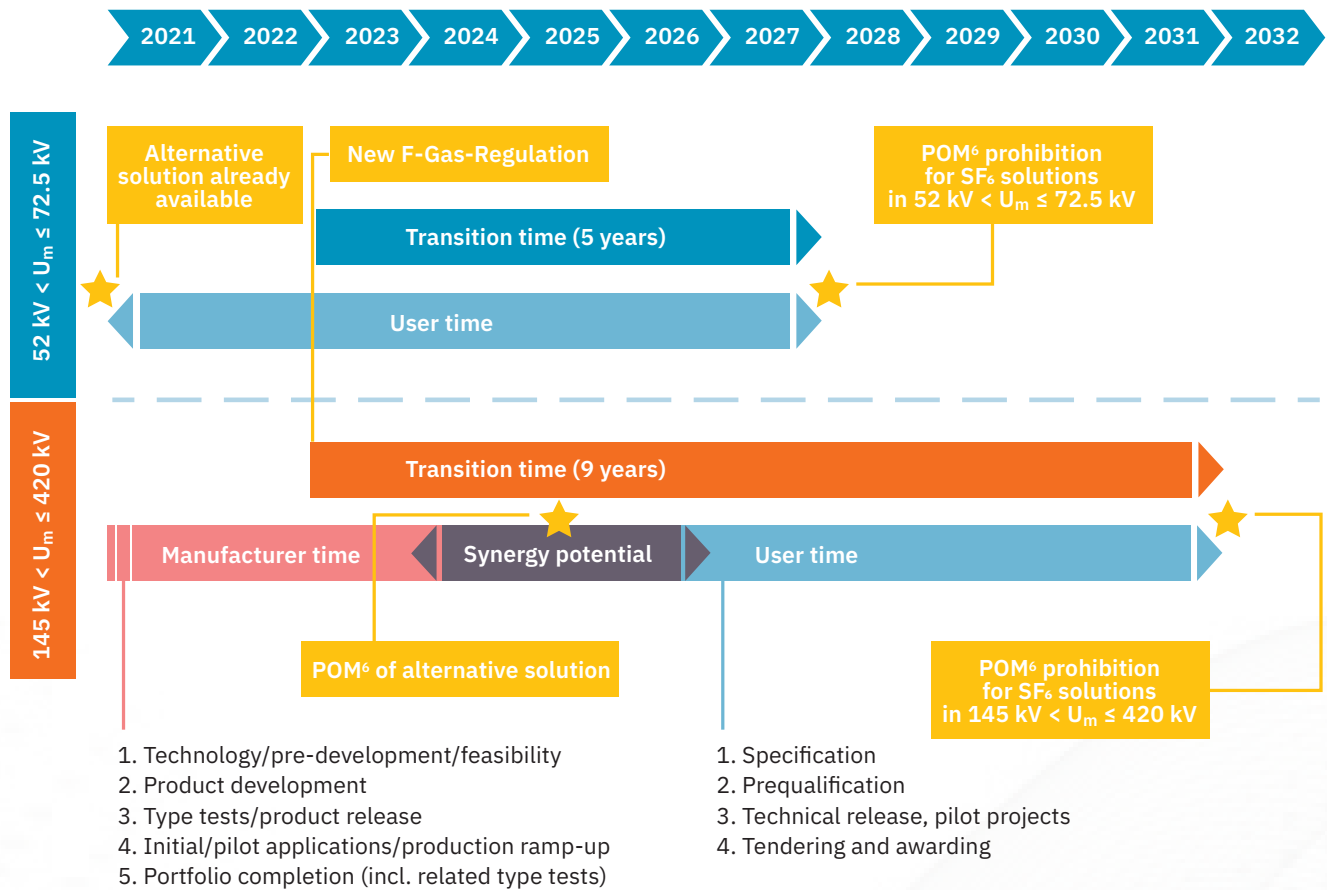
SF<sub>6</sub> will also be needed beyond 2050 for **the maintenance, repair, and extension of existing equipment.**

\* The equipment with voltage levels of 170 kV and 245 kV are considered as standard applications as well.

\*\* The synergy potential takes into account that certain steps 1 to 5 by manufacturers and steps 1 to 4 by users can be conducted in parallel (see example below)

# Appendix II

## EXAMPLE OF A TIMELINE FOR STANDARD APPLICATIONS



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