Roadmap of Transition toward SF_6 Alternative Technologies

- Initiatives by Switchgear Manufacturers in Japan -

June 24, 2025 (Rev.2)

Task force on SF_6 Alternative Technologies, SF_6 Gas WG
The Japan Electrical Manufacturers' Association

Back Ground and Motivation

- Worldwide efforts towards “Carbon Neutrality by 2050”
- Introduction of environmental regulations in EU and the US on SF_6 gas usage of T&D equipment
- Acceleration in development of SF_6 alternative technologies

- Japanese manufacturers have to steadily proceed development of SF_6 free equipment to completely meet with the “7 requirements*” under a feasible roadmap in the view point of both contribution of reducing environmental load and enhancement of global business

(*“seven(7) requirements”: Application guidelines for SF_6 gas alternative technologies, proposed by “The SF_6 Alternative Gas Study Group” participated by Japanese academic organizations, electric power companies and switchgear manufacturers)

- Industry-level broad discussions are necessary on evaluation system to activities for environment and society issues
- Clarification of effective timing and process is necessary to advance “Carbon Neutrality of T&D systems”

The Japanese Seven switchgear manufacturers have jointly developed a roadmap toward SF_6 alternative technologies

The Seven Requirements from T&D Market in Japan

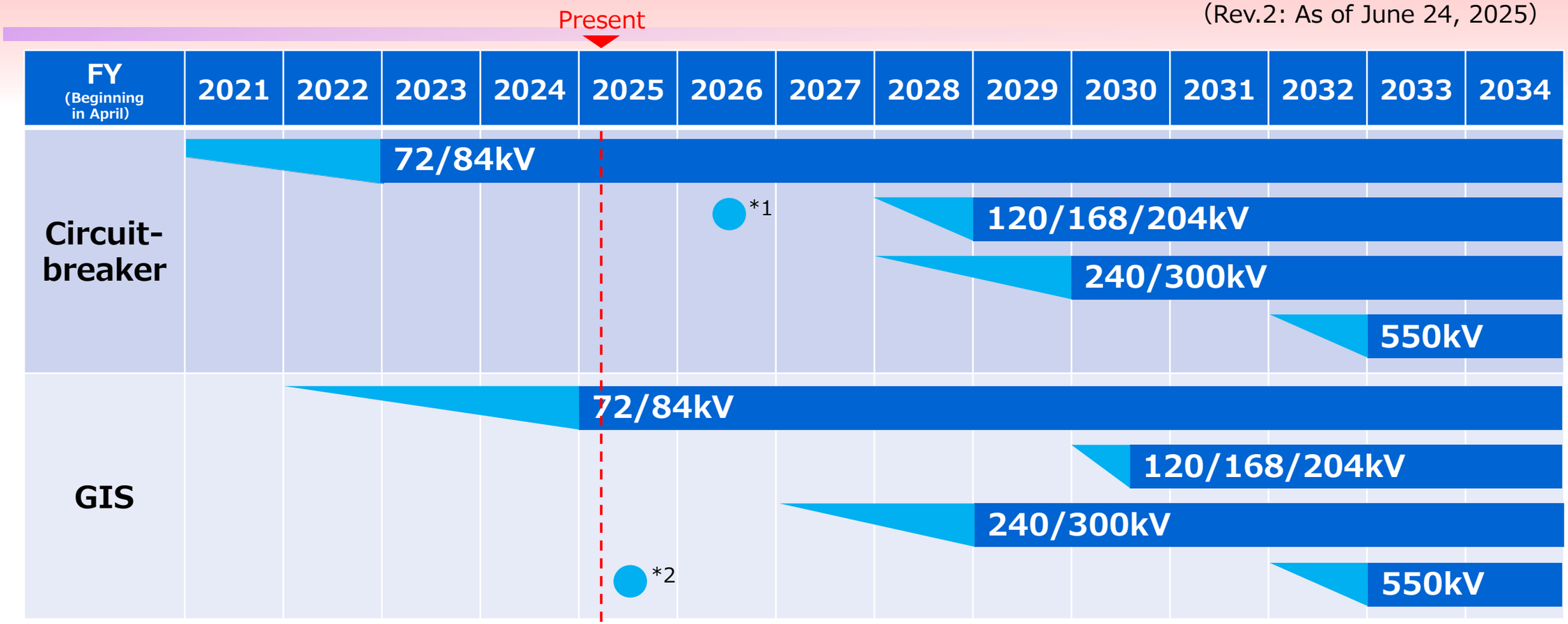
Development has to meet the “7 requirements” proposed by The SF_6 Alternative Gas Study Group*

(*The SF_6 Alternative Gas Study Group was established in April 2016 to grasp various issues such as the impact of the introduction of SF_6 alternative gases in Japan collect and share experiences in the past development of SF_6 gas equipment, the latest international technical trends, and verification issues. Japanese 11 electric companies, 7 academic organizations and 7 switchgear manufacturers participate in the group.)

No.	Category	Requirement
1	**EHS**	Especially, toxicity of decomposition gas and decomposition
2	**Service Condition**	Normal use conditions specified in the standard
3	**Stable Supply**	Stable supply of alternative gases is possible in the future. It is desirable that gas can be supplied by multiple suppliers.
4	**Gas Handling**	Simple handling of SF_6 alternative gas
5	**Life Cycle Cost**	Life cycle cost is equivalent or reasonable to SF_6 gas equipment.
6	**Footprint**	Replacement in locations where installation space is limited
7	**Voltage Coverage**	Support up to the maximum operating voltage of 500kV–63kA

JEMA Roadmap of non-SF_6 Switchgear Development

(Rev.2: As of June 24, 2025)



*1: Up to 120 kV. *2: Gas-insulated bus bars and Surge Arresters only.

Notes

- The present roadmap was compiled based on the results of an anonymous survey conducted by seven manufacturers in “Task Force on SF_6 Alternative Technologies” of JEMA.
- Making compliance with “the Seven Requirements” and the relevant JEC standards the fundamental basis, product release schedules for circuit breakers and GISs were compiled based on each manufacturers’ latest development record and plan. The term “product release” here was defined as the date on which type testing is completed and sales begin (excluding manufacturing lead time).
- Rated voltages were categorized based on JEC-2300:2020.
- The light blue triangles ◥ indicate the period between the release of the first product and the release of the second manufacturer's product. The blue bars ▬ indicate periods during which at least two manufacturers have released products in each category.
- The information provided here reflects each manufacturer’s latest development plans and does not guarantee the product release date in the future. This roadmap will be revised on regular basis, approximately once a year. A revision history is provided at the end of this document.

Revision history of the contents

First Edition: May 31, 2022
Revision 1: September 11, 2023
Revision 2: June 24, 2025