



# **Eco-Friendly 170kV 50kA GIS**

## **Research and Development**

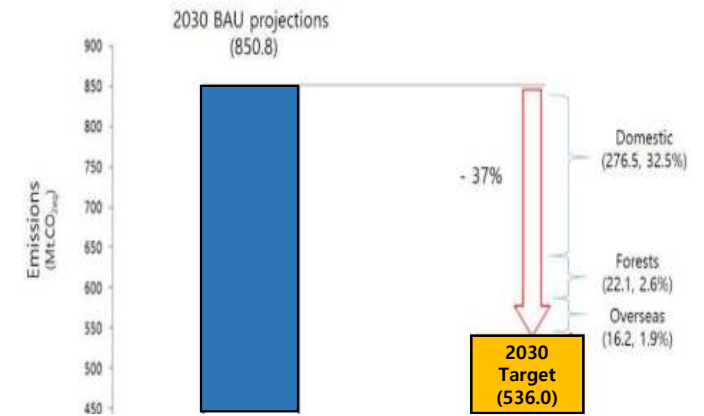
**HV Switchgear R&D Team**

## 1. Korea Market trend of Eco-friendly GIS

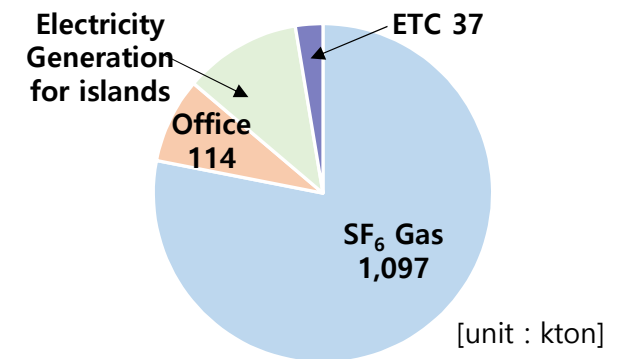
- South Korea agreed to reduce greenhouse gas emissions by 37% compared to 2015 by 2030. (At Climate Change Conference 2015)

- SF<sub>6</sub> accounts for 78% of KEPCO's greenhouse gas emissions.

- KEPCO needs operation/diagnosis technology and development for SF<sub>6</sub> Free Eco GIS.



[Reduction of Greenhous Gas Emissions of Korea ]



[CO2 emission of KEPCO]

## 2. Development status of domestic manufacturers for ECO 170kV 50kA GIS

▣ KEPCO's Spec. only require GWP 500 or less for dielectric medium.

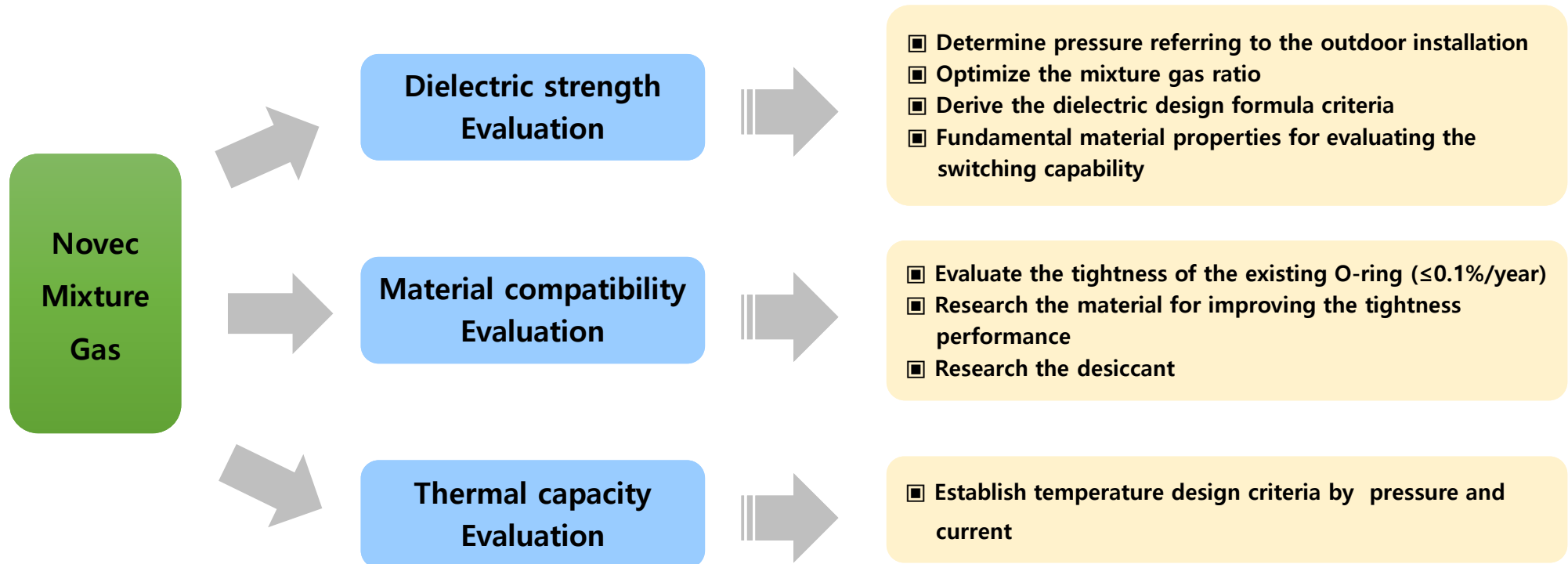
(there is no regulation for dielectric medium/interrupting medium)

ITEMS	HYOSUNG	A	B	C	D
Dielectric medium	Novec + CO <sub>2</sub>	Novec + CO <sub>2</sub> + O <sub>2</sub>	Novec + CO <sub>2</sub>	Dry Air (N <sub>2</sub> +O <sub>2</sub> )	Novec + CO <sub>2</sub>
Interrupting medium	Novec + CO <sub>2</sub>	Novec + CO <sub>2</sub> + O <sub>2</sub>	Novec + CO <sub>2</sub>	VI	VI
GWP	396	350	396	0	396
BC or BTB performance	◎	◎	◎	△	△
Development Status	Completed	Completed	Completed	In progress	In progress

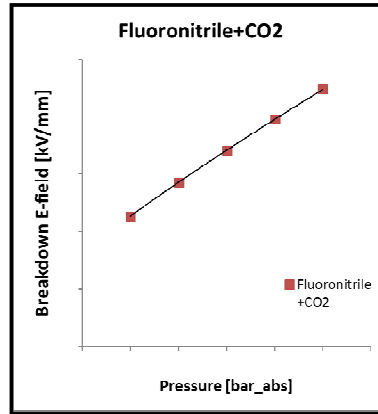
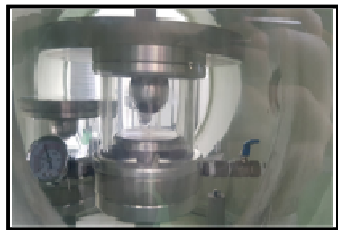
※ Novec4710 is called Novec.

## 1. Fundamental research of Novec mixture gas for developing ECO GIS (Sep 2016~Apr 2017)

- Fundamental research on the basic gas properties to secure data for GIS design
- Prior to developing the GIS, Hyosung developed a 362kV GIB with Novec mixture gas and has been running commercial operation since '19.



[Dielectric test of Novec mixture gas pressure, mix ratio and shape of poles]



[Temperature-rise test]



[Leakage test for sealing material]



[Development and installation of the pilot project of 362kV 63kA 6300A GIB, Jun 2019~]



# 1. Development of the ECO 170kV 50kA GIS

## 1) Development of eco-friendly Circuit Breaker

### ■ The most technically difficult aspect of circuit breaker development;

- Securing SLF(Short Line Fault) performance
- Preventing ground faults in Terminal fault test duty (at 100% current)

### Novac Mixture Gas's Characteristic

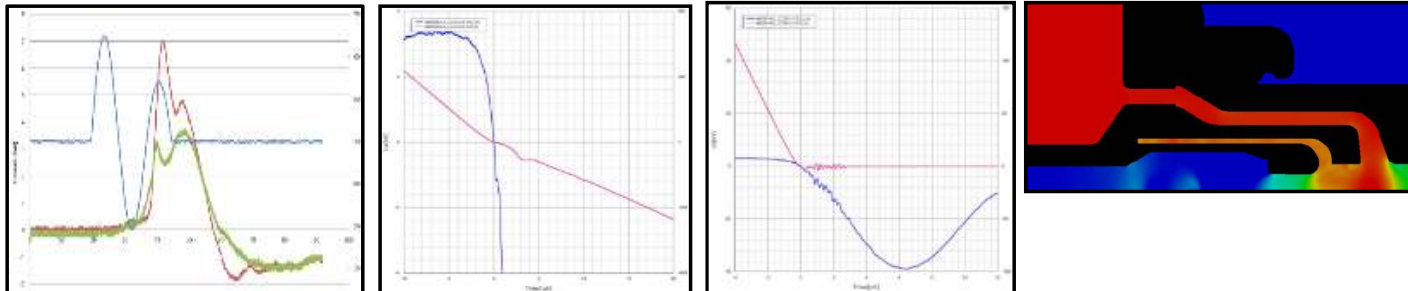
Longer Arc time constant

Lower molecular weight

### Risk factor

Lower thermal dielectric recovery

Increase of ground fault risk



[Measurement of the pressure, arc Voltage and post arc current]



[SLF test using simplified synthetic test in Hyosung]



[Short-Circuit test in KERI]

## 2) Development of the ECO GIS components

Test Items	Test place	Issue
Dielectric test	Hyosung	-
Temperature rising test	Hyosung	-
Internal Arc test	KERI	-
Bus charging current switching test	KERI	-
Short-circuit making performance for ES	KERI	-
Induced current switching test for ES	KERI	◎



[Dielectric test]



[Temperature rising test]



[Internal arc test]



[Bus charging current test]



[Making performance for ES]



[Induced current test for ES]

## 3) Type test : Performed at KERI ('21.07)



[CB Short circuit test]



[GIS Dielectric test]



[GIS Temperature-rise test]



[GIS Tightness test]

KERI	
217C180213	
<b>시험성적서</b>	
제품명	170 kV 선형권 가스절연개폐장치
품목명	HGG-170C
수량	3대 (170 kV 1150 kVA 50/5A 40 Hz)
시험처	호성중공업(주) 양천사업장 경상남도 창원시 양산구 안곡로 171 (8동)
제작처	호성중공업(주) 양천사업장 경상남도 창원시 양산구 안곡로 171 (8동)
시험일자	2021-04-05 ~ 2021-04-10
발행번호	217C180213
<p>* 시험성적서는 시험결과 요건과 기술 명세를 포함하며, 이에 근거로 시험결과에 따라 합격/불합격/수정필요함</p> <p>GS 5025-0151: 2019-04-02 5.1.2, 6.3.1, 6.3.2, 6.3.4-6.3.6, 6.3.10-6.3.12, 6.3.14-6.3.18, 6.3.20, 6.3.24, 6.3.26, 6.3.30-6.3.32</p> <p>시험결과에 관한 구체적인 요구사항을 만족하고, T-12 제외 200 정격시공은 적합함          * 시험성적서는 시험물체의 최종 상태, 동일한 형식의 제품 품질상 제삼자에게 제공          * 시험성적서는 총 1000 페이지로 구성됨</p> <p>KERI 시험장 안전관리 시험장에서의 안전을 위하여 시험물체 100kg 이상인 경우 시험물체 이동 시 안전사고 예방을 위하여 그중에서 100kg</p>	
작성	
검수	
승인	이승훈
발행일	2021-10-20
<p>한국전기연구원</p>	
<small>25, Yongin-gi, Gyeonggi-do, Chungnam-A, Gyeongju-si, 305390, TEL: 200-2411</small>	

[KERI TYPE TEST REPORT]



# 1. Pilot Project with KEPCO

## 1) Introduction

- Secure the facility soundness through injection with voltage test and current test same time
- Establishment of long-term reliability verification-based construction/operational management standards  
(moisture management, gas aging management, gas composition ratio)

## 2) Pilot project outline (Gochang power test center)

Items	Outline	
Location	Gochang-gun, Jeollabuk-do	
Size	1 <sup>st</sup> basement floor and 3 <sup>rd</sup> floor, outdoor test center	
Outdoor test center	Supply voltage	154kV~242kV
	Supply current	Up to 4000A (Variable current source)
	Capacity	170kV GIS 1CCT, connected to bushing



[Gochang power test center]



[Installation of ECO 170kV GIS]

### 3) Pilot project operation plan

Items		Operation plan	Remark
Voltage Test	Test Voltage	170kV (Rated voltage)	<ul style="list-style-type: none"> <li>Applying rated voltage to GIS using 154~242kV variable transformer</li> </ul>
Current Test	Test Current	Continuous current (Up to 3150A)	<ul style="list-style-type: none"> <li>Connecting 4000A variable current source for rated load current switching               <ul style="list-style-type: none"> <li>CB, DS operation(7 times a week, more than 110 times in total)</li> <li>※ Based on the average number of interruptions(104 nos) during the life of the circuit breaker (KEPCO analysis data)</li> <li>Data analysis of Carbon monoxide in the circuit breaker, and management manual of other components are established.</li> </ul> </li> </ul>
	Switching Current	Switch the actual load (over 110)	
Test Environment		Outdoor installation in salt sea area (connected to Bushing)	<ul style="list-style-type: none"> <li>Checking the soundness of GIS according to the external environment</li> </ul>
Project period		17weeks ('22.03 ~ '22.06)	<ul style="list-style-type: none"> <li>Inspection contents during the pilot period (KEPCO &amp; HYOSUNG)</li> </ul>



[Moisture and Composition ratio measurement]

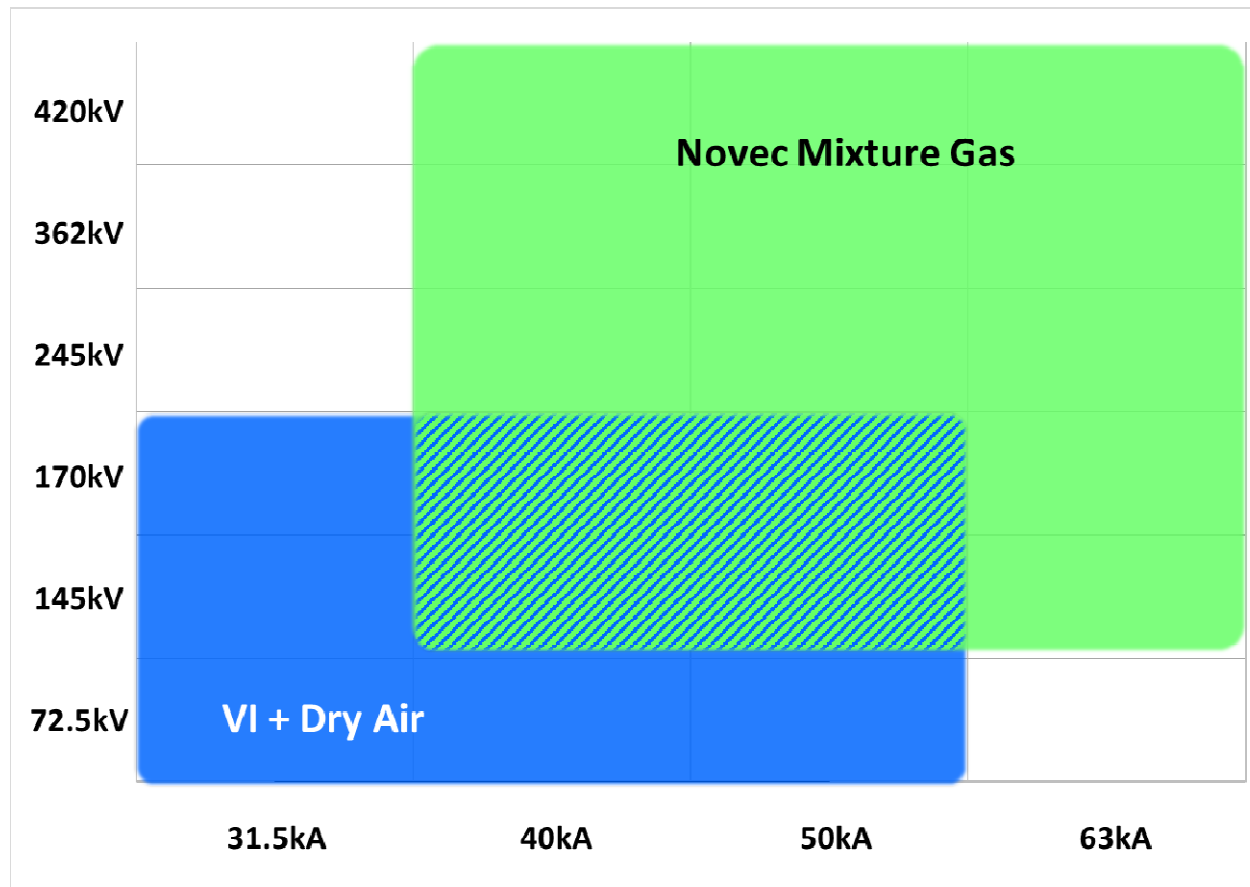


[Collecting for decomposition Gas]



[Operating test]

## 1. Future development direction for eco-friendly GIS



■ VCB + Dry Air

: From 72.5kV to 170kV 50kA

■ Novec Mixture Gas

: From 145kV to 420kV 63kA

■ Mixed Product

: From 145kV 40kA to 170kV 50kA

Thank you

Q&A