

Workshop: HVDC GIS PROMOTioN work package 15

HVDC GIS technology demonstrator

Thursday | 20 September 2018 | 09:00–16:00 , DNV GL office, Utrechtsweg 310-B50, 6812 AR Arnhem, The Netherlands

Uwe Riechert



AGENDA



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This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No 691714.

AGENDA 1/2

Time	TOPIC	Presenter
09:00–09:10	Introduction PROMOTioN	C. Plet (DNV-GL)
09:10–09:30	PROMOTioN WP15 "HVDC GIS technology demonstrator"	U. Riechert (ABB)
09:30–09:45	Recommendations for specifying gas insulated HVDC systems	Y. Audichya (SHE Transmission)
09:45–10:00	Test requirements, procedures and methods for gas insulated DC systems & HVDC GIS prototype installation test	H. He (DNV-GL) K. Dimitropoulos (DNV-GL) M. Gatzsche (ABB)
10:00–10:15	Development of PD monitoring and diagnostic methods for gas insulated HVDC systems	A. R. Mor (TU Delft)
10:15–10:30	Applicability of SF ₆ alternatives	C.-T. Vu (SuperGrid Institute)
10:30–12:00	Witnessing of ABB HVDC GIS pole in KEMA HVDC lab in Kleefsewaard	H. He (DNV-GL) K. Dimitropoulos (DNV-GL)

AGENDA 1/2

Time	TOPIC	Presenter
13:00–13:20	The Kii HVDC link in Japan	H. Ito (Mitsubishi)
13:20–13:40	State of development of gas-insulated DC systems at Siemens	M. Hering (Siemens)
13:40–14:00	RC divider for HVDC applications	E. Sperling (Pfiffner)
14:00–14:20	Report from CIGRE WG D1/B3.57 "Dielectric testing of gas-insulated HVDC Systems"	C. Neumann (CIGRE)
14:20–14:30	Status IEC standardization related to gas insulated HVDC systems	U. Riechert (IEC)
14:30–15:50	Discussion	K. Dimitropoulos (DNV-GL)
15:50–16:00	Summary	K. Dimitropoulos (DNV-GL) U. Riechert (ABB)





HVDC GIS



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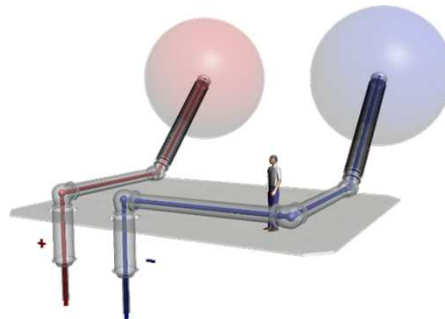
HVAC / HVDC GIS Advantages

HVDC GIS

A DC-GIS installation can be built with a much **higher degree of compactness** and significantly **lower sensitivity to ambient factors** than with air-insulated switchgear (AIS).

The most obvious cost-saving potential can be found on **off-shore converter platforms** where the required air-clearance for AIS leads to much larger and heavier off-shore structures.

By using DC-GIS, the **volumetric space** of the switchgear installation can be **drastically reduced** e.g. by 70%- 90%.



HVDC GIS History



**First long-term test
BPA (USA)-ABB**



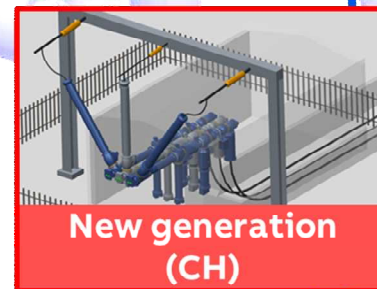
**First 250 (500) kV GIS
KII – link (Japan)**



**New generation
(DE)**



**First long-term test
(Japan)**



**New generation
(CH)**



**First 150 kV GIS
Gotland 2**



**150 kV GIS
Gotland 3**



First research

1980

1983

1987

1995

2000

2013 2014

HVDC GIS Components

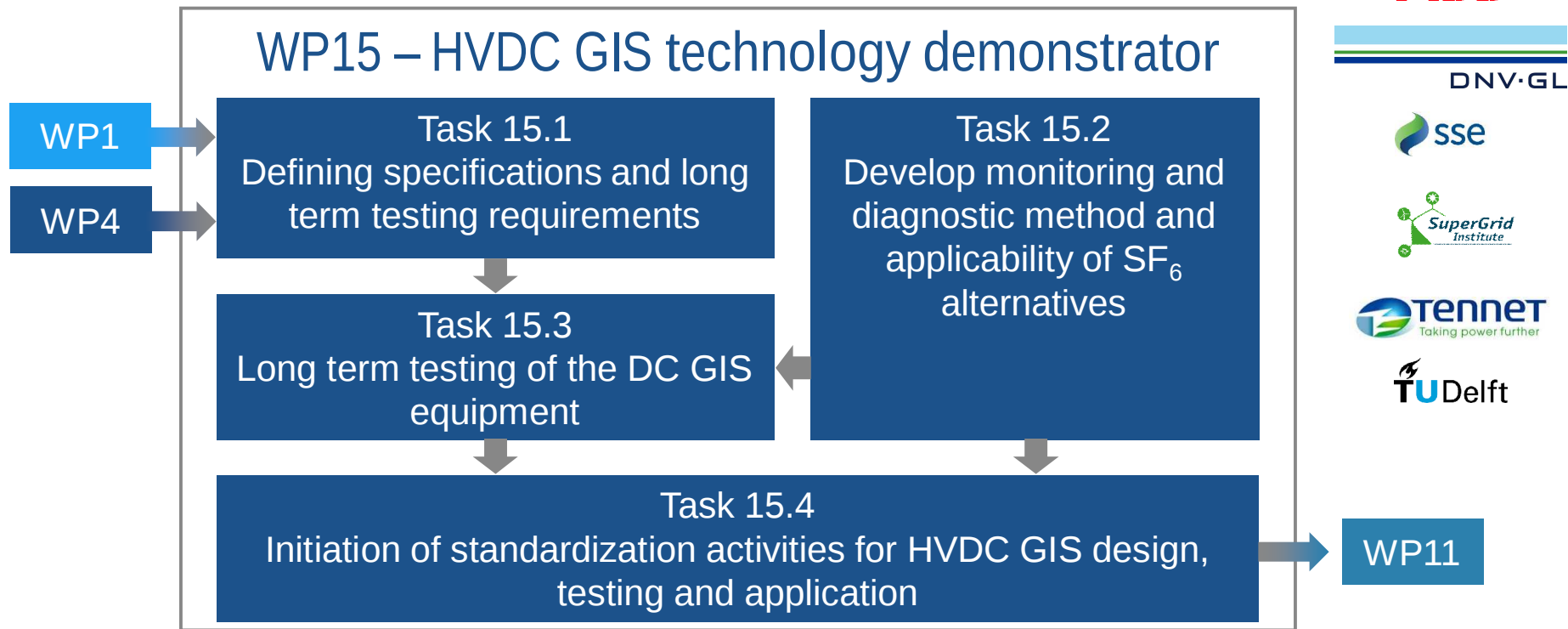
HVDC GIS

The HVDC-GIS technology spans a number of switchgear components, e.g.:

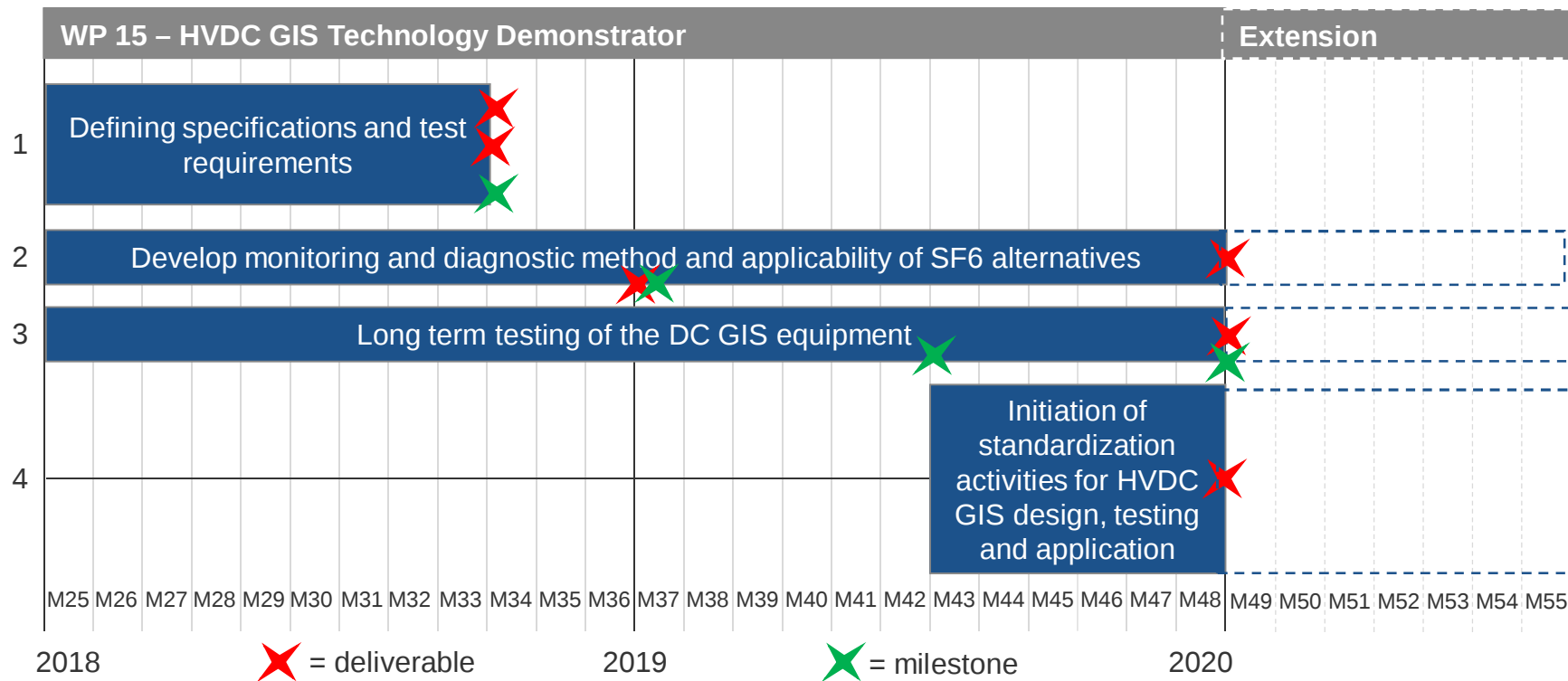
- Bus-ducts and high voltage DC conductors
- Disconnect- and earthing switches
- Bushings and cable terminations
- Current- and voltage measurement sensors
- Surge arresters



Work package organization



Planning



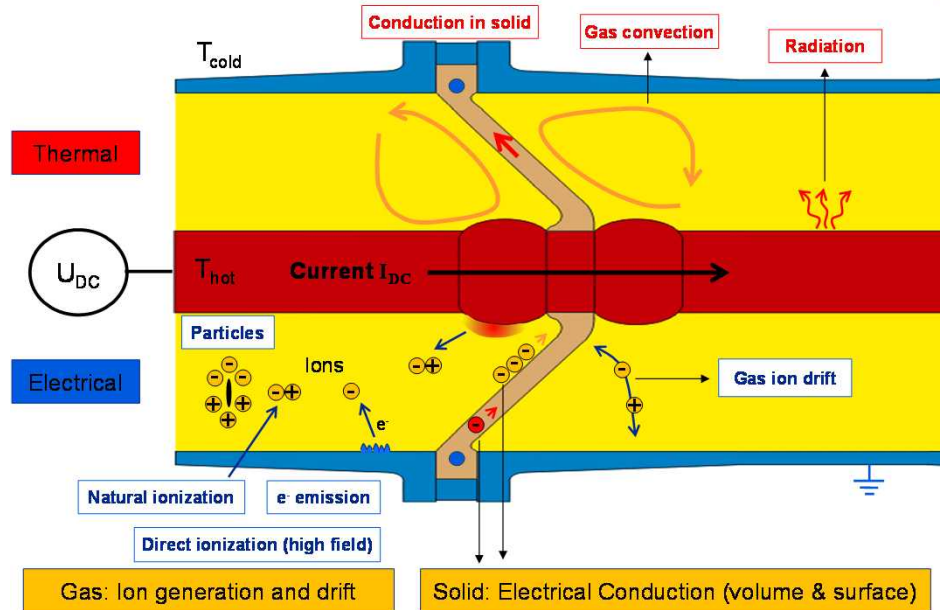
Deliverables

- D15.1 : Document on recommendations for specifying DC GIS systems (SHE Trans, M33)
- D15.2 : Document on test requirements, procedures and methods (DNV GL, M33)
- D15.3 : Report on DC GIS diagnostic and monitoring tools and methods (TU Delft, M36)
- D15.4 : Anonymized test reports on tests carried out (DNV GL, M48) - Classified
- D15.5 : Report of diagnostic analysis and condition assessment (TU Delft, M48)
- D15.6 : White- and position papers on pre-standardization of DC GIS testing (DNV GL, M48)
- D15.7 : Report on characteristics of PD Alternative gas: comparison with SF6 (SGI, M36)
- D15.8 : Report on long term monitoring of DC GIS with defects (SGI, M48)



HVDC gas insulated system technology demonstrator

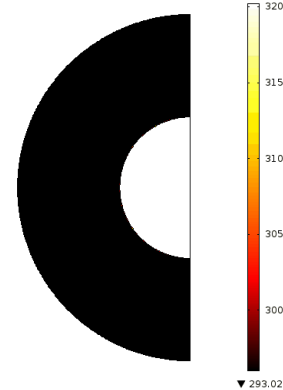
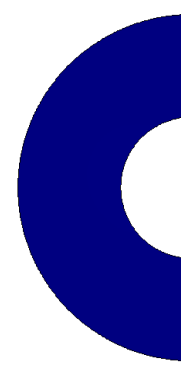
Modelling



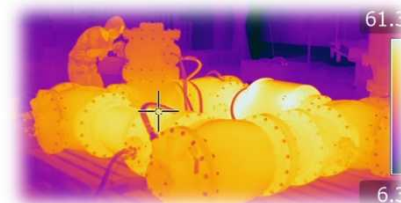
Velocity distribution

V [m/s]

Temperature T [K]

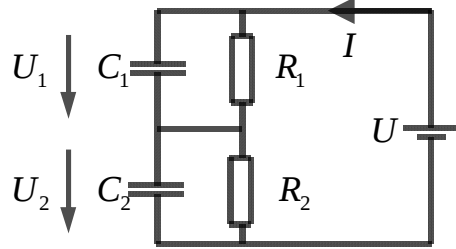


Validation with temperature measurements in real scale GIS



HVDC gas insulated system (GIS)

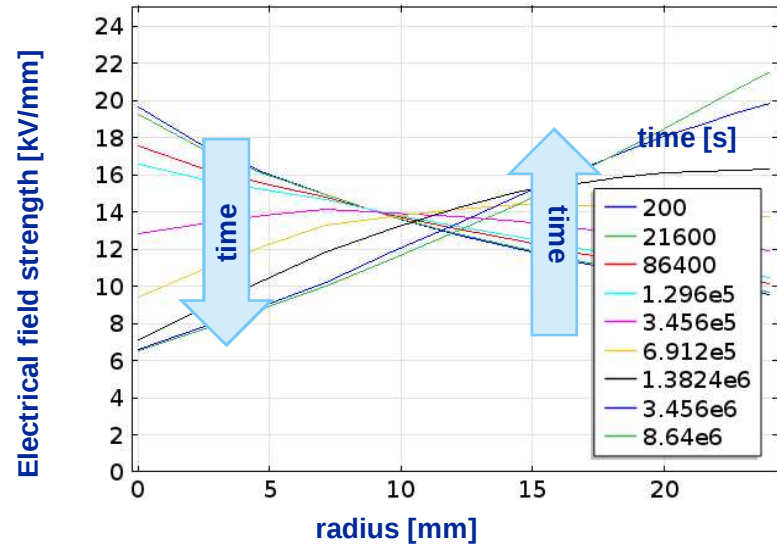
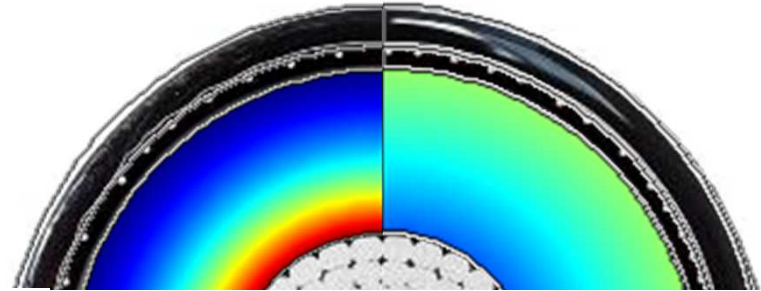
Basics - Cable



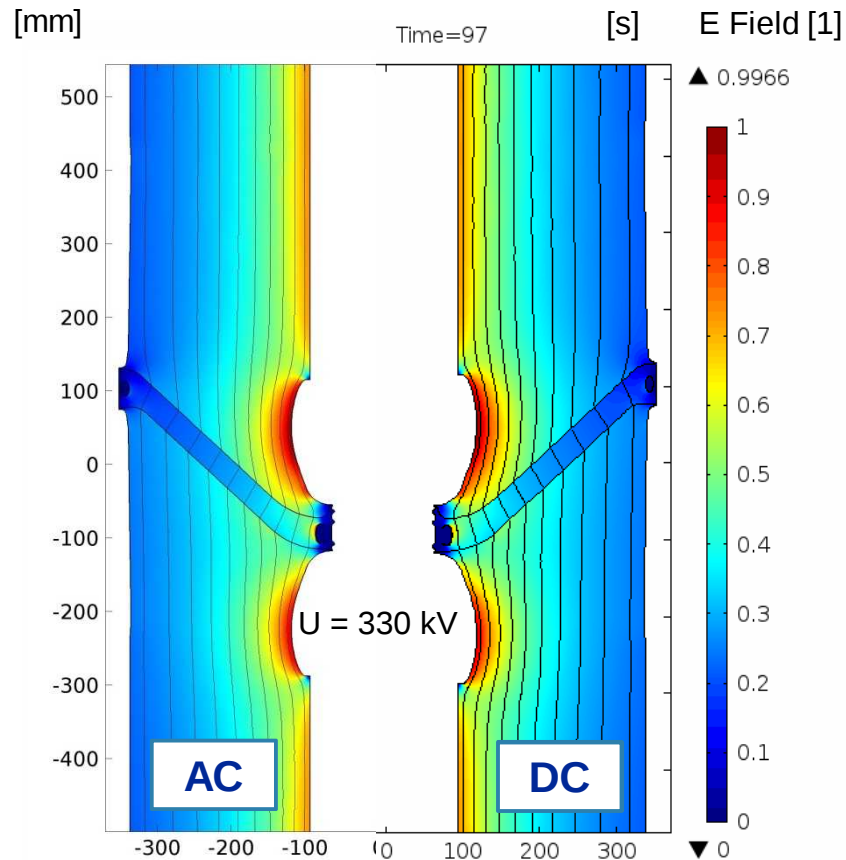
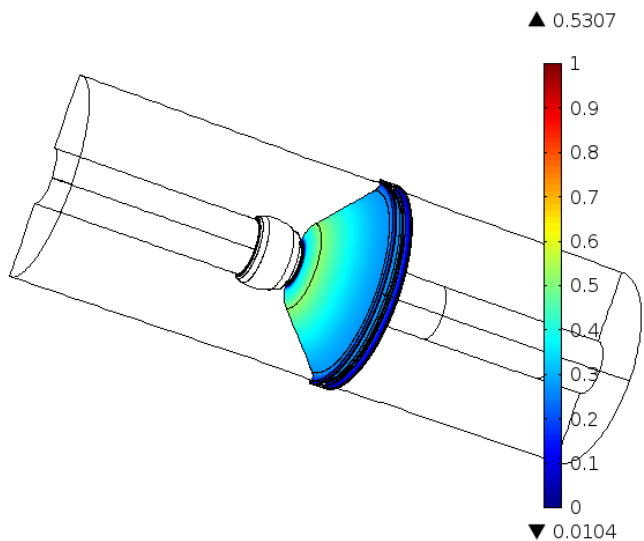
$$I = \frac{U}{R} + C \frac{d(U)}{dt}$$

$$t = RC = \frac{\epsilon_0 \epsilon_r}{s}$$

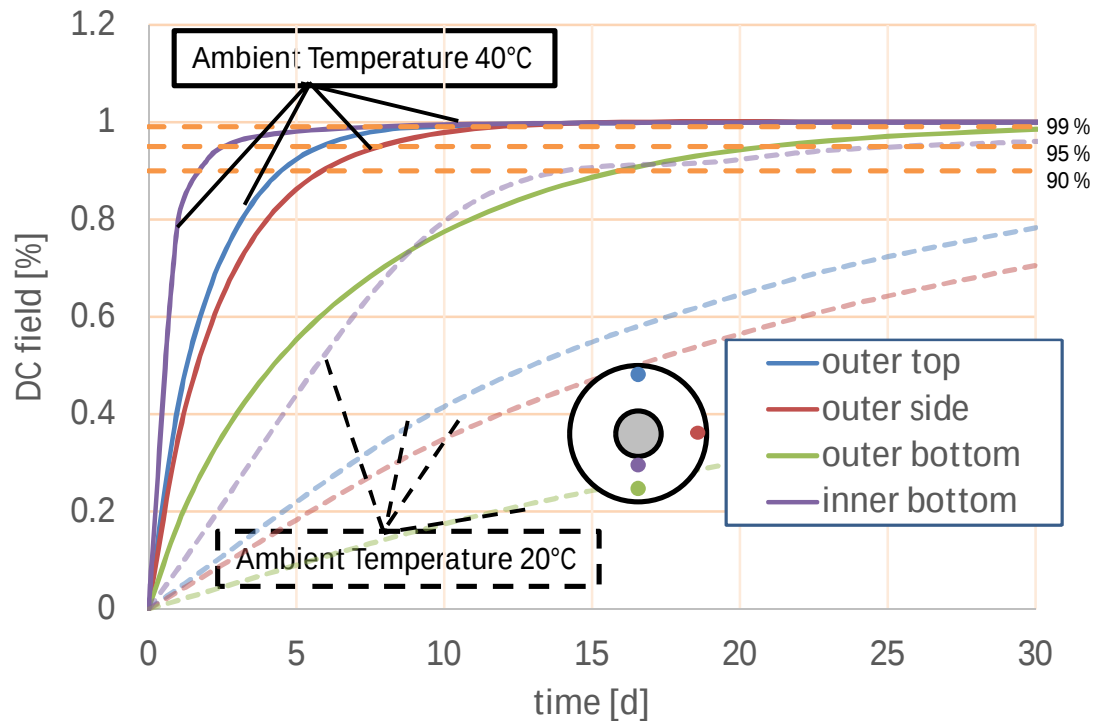
$t = 0$ ("AC") $t \rightarrow \infty$ ("DC")



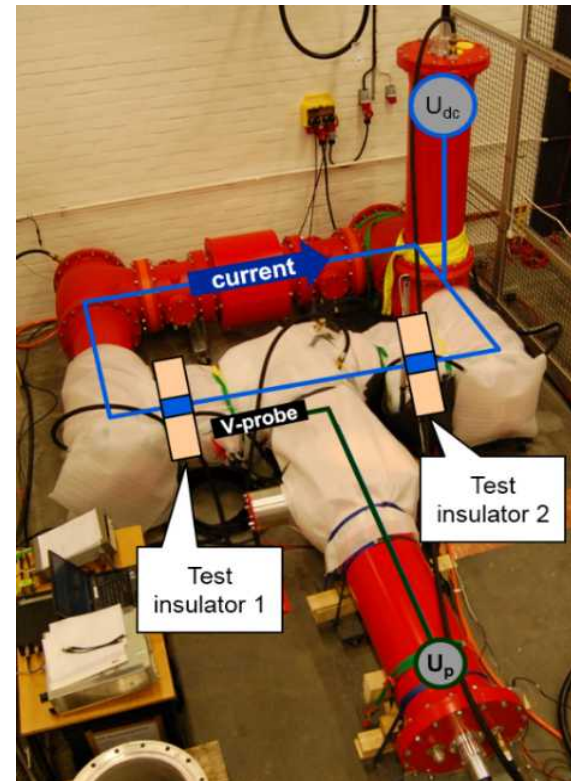
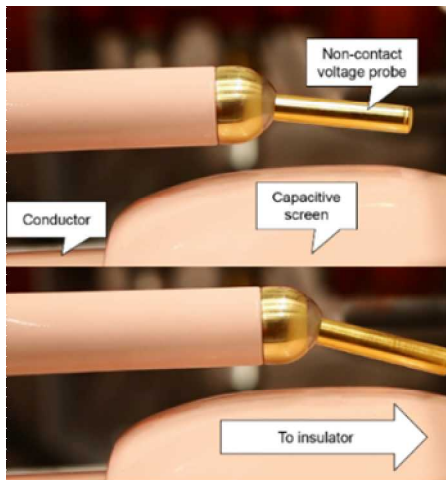
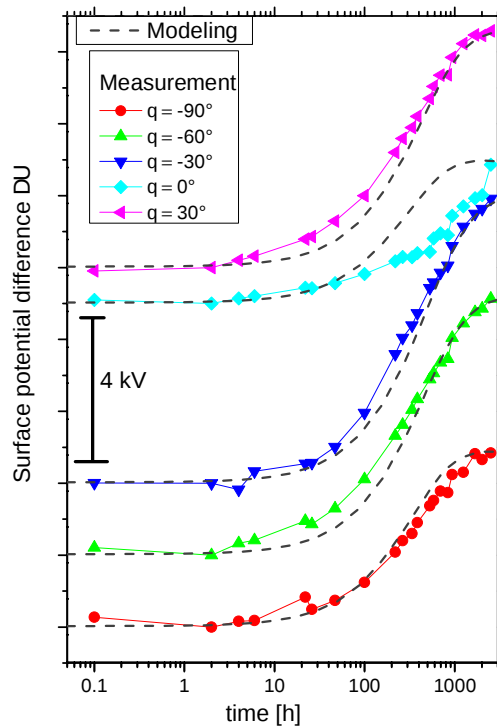
HVDC gas insulated system technology demonstrator



HVDC GIS - Verification Test for Insulators



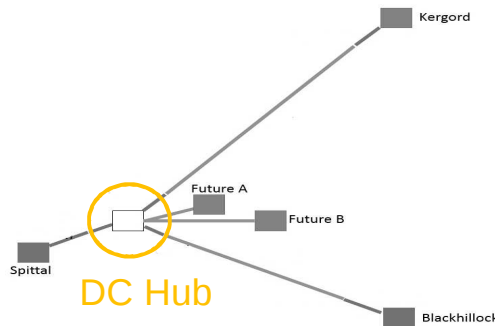
HVDC GIS - Verification Test for Insulators



Specifications and test procedures

Specifications

Offshore DC HUB studies (SSE)



Recommendations for specifying DC GIS systems PROMOTioN

Test Procedures

Dielectric Testing of gas-insulated HVDC Systems
CIGRE D1/B3.57
(under Progress)

Start of IEC AHG37

Test methods PROMOTioN

Pre Standardization PROMOTioN



HVDC GIS prototype installation test

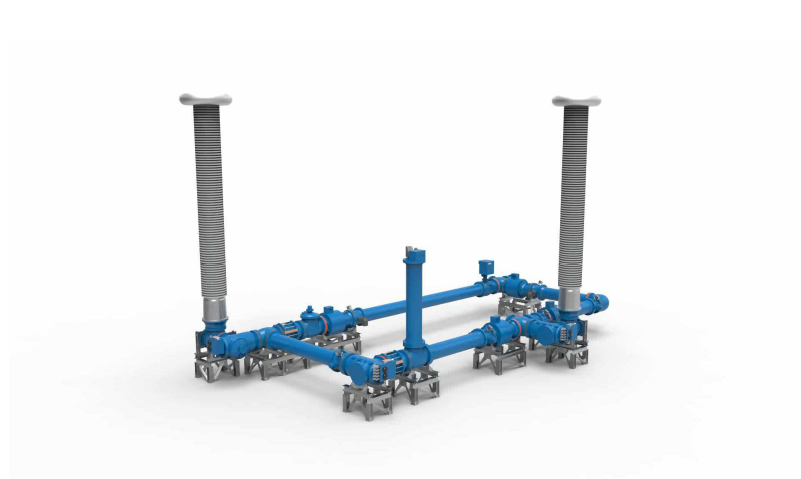


- Pre test insulator: Quality (Voids)
AC & PD (PXIPD)
- FAT: Assembly (protrusions, particles)
AC & PD
- On-site: Assembly / transport (particles)
AC & PD



PROMOTiON – HVDC GIS

Team – WP15





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