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Fourth UHVnet Colloquium

January 18th – 19th 2011

Winchester, UK

This colloquium is supported by:

IEEE DEIS

IOP Institute of Physics
Dielectrics Group

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Electrostatics Group

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Welcome to the fourth UHVnet colloquium hosted by the University of Southampton on the 18th and 19th January 2011. Previous UHVnet events have been held at Cardiff University, Glasgow Caledonian University and the University of Manchester. This meeting will take place at Winchester Guildhall and consist of a registration and poster session on the Tuesday evening to encourage a relaxed discussion of current work between early career researchers. The second day of the event will consist of oral presentations covering the following four topic areas; High Voltage Plant, Condition Monitoring, Materials and Theories, Methods and Models. Each topic will have an opening presentation by a leading researcher in the field followed by 5 oral presentations by early career researchers and postgraduates.

UHVnet is an informal grouping of universities and was set up in 2005 to further interests of high voltage research within the United Kingdom. The university members are Cardiff University, Glasgow Caledonian University, University of Liverpool, University of Leicester, University of Manchester, University of Southampton, University of Strathclyde and the University of Surrey. These universities are supported by a steering group which includes industrial representation from the Areva T&D Technology Centre, PPA Energy, National Grid and Narec.

Specific objectives of the group include raising awareness of the researcher capabilities of group members to UK high-voltage related industry, particularly manufacturers and electricity supply companies and lobbying research funding organisations for ear-marked high-voltage related programs.

We would be delighted to receive any feedback about this event as we are keen to further improve our communication with both UK and overseas stakeholders. Future events will be listed on our website and we hope to see you again.

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Timetable

Tuesday 18th January 2011

1700 – 2000 Registration, Reception and Poster Session

Wednesday 19th January 2011

0800 – 0830 Registration

0830 – 0845 Welcome by Meeting Chair

0845 – 1015 Session 1: High Voltage Plant

1015 – 1045 Coffee break

1045 – 1215 Session 2: Condition Monitoring

1215 – 1330 Lunch and Poster Session

1330 – 1500 Session 3: Materials

1500 – 1515 Coffee break

1515 – 1645 Session 4: Theory, Methods and Models

1645 – 1700 Closing Remarks

A Survey on the Potential of CF_3I Gas as an Alternative for SF_6

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Sulphur hexafluoride (SF_6) has been widely used as an insulator in gas-insulated switchgear (GIS) applications. But due to the fact that it is a greenhouse gas, many researchers have been trying to find alternative solutions for it. Furthermore, SF_6 produces highly toxic and corrosive substances when it is subjected to electrical discharges. Trifluoroiodomethane (CF_3I) has recently been regarded as a candidate for replacing SF_6. CF_3I has been used as a fire suppressor and now many investigations have been carried out throughout the world to assess its capability in high voltage applications. This paper surveys this previous work and identifies some of the properties which are relevant to high voltage applications.

With a global warming potential 23,900 times greater than carbon dioxide (CO_2), and atmospheric lifetime 3,200 years, SF_6 is the most potent greenhouse gas in existence. Its production is now restricted under Kyoto Protocol. Table 1 shows the general properties comparison between CF_3I with SF_6.

Table 1: General properties of CF_3I and SF_6

Material	**CF_3I**	**SF_6**
Molecular mass	195.91	146.05
Characteristic	Colourless Non-flammable	Colourless Non-flammable
Global Warming Potential (GWP)	Less than 5	23,900
Ozone Depleting Potential (ODP)	0.0001	0
Lifetime in atmosphere (year)	0.005	3,200
Boiling point (0.1 MPa)	– 22.5°C	– 63.9°C

At 0.5 MPa, the boiling point of CF_3I is around 25°C, compared to –30°C for SF_6 [1]. For this reason, it can be difficult to compress CF_3I in HV switchgear at temperature common in winter. The adoption of other gases such as nitrogen (N_2) or CO_2 helps in reducing the boiling point, and it is required for outdoor application. Using Dalton's law, the partial pressure in a CF_3I- N_2 gas mixture can be expressed as

$$P_{gas\ mixture} = P_{CF3I} + P_{N2} \quad (1)$$

where

$P_{gas\ mixture}$ total pressure of the gas mixture
P_{CF3I} partial pressure of CF_3I gas
P_{N2} partial pressure of N_2

A study by Toyota et. al in 2006 [2] revealed that for a same gap length of electrodes, CF_3I gas has a higher dielectric strength of SF_6, which is about 1.2 times higher. Another study by the same researchers revealed that a mixture of 60% CF_3I with 40% N_2 has a dielectric strength as equal to that of SF_6.

With a dielectric strength of 1.2 times better than SF_6, CF_3I has been identified as a very good candidate to replace SF_6 as a gas insulator. More research works should be carried out on the capabilities of CF_3I, particularly with regards of its mixtures, its performance under uniform and non-uniform field and also to control the by-products produced after a successful discharge. Work is in progress to develop a test facility to explore the properties of CF_3I and its mixtures for insulation and switchgear applications.

[1] M. Taki, D. Maekawa, H. Odaka, H. Mizoguchi and S. Yanabu, "Interruption Capability of CF_3I Gas as a Substitution Candidate for SF_6 Gas", *IEEE Transactions on Dielectrics and Electrical Insulation*, vol. 14, no. 2, 2007.

[2] H. Toyota, S. Matsuoka and K. Hidaka, "Measurement of Sparkover Voltage and Time Lag Characteristics in CF_3I-N_2 and CF_3I-Air Gas Mixtures by using Steep-Front Square Voltage", *Electrical Engineering in Japan*, vol. 157, no. 2, 2006.