For some time now, SF_6 technology has been used in high voltage switchgears (above 1000 V, as well as in medium voltage switchgears and circuit breakers) in power generation, transmission and distribution plants around the world. The insulating – and extinguishing – gas sulphur hexafluoride (SF_6) is a non-toxic, non-ozone depleting, non-combustible gas with outstanding electrical properties. However, it belongs to the greenhouse gases covered by the Kyoto Protocol.

SF_6 technology in energy transmission and distribution

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The specific Global Warming Potential (GWP) of SF_6 is approximately 23,000 times that of CO_2. However, thanks to a sealed design combined with sound production, service and end of life management, electrical equipment containing SF_6 gas allow for solutions that have a minimal impact on the environment.

As proof of this, the proportion of SF_6 emissions from high and medium voltage switchgear in the European Union (EU) was less than 0.05 percent of the total greenhouse effect in 2002.

Ecological balance sheets (so called Life Cycle Assessment studies) have demonstrated that power losses are reduced by the use of compact SF_6 – insulated switchgear (GIS) in electrical networks. This results in CO_2 emission savings from power plants, and it has a favorable effect on the greenhouse gas balance sheet.

A GIS is smaller than conventional designs (open type and metal-enclosed air-insulated switchgear) thus saving on material used. On the other hand, smaller switchgear requires smaller bus bars and active parts, and so "smaller" energy losses are benefits for GIS because of the Joule effect. At the same time, the possibility of installing the compact equipment closer to the load demand makes the network itself more efficient reducing the losses. This is an indirect reduction of energy use by the application of SF_6 insulated switchgear in the network.

CAPIEL[1], the Coordinating Committee for the Associations of Manufacturers of Industrial Electrical Switchgear and Control gear in the European Union together with the Union of the Electricity Industry, EURELECTRIC, requested an analysis of SF_6 reduction from high and medium voltage electrical equipment. The analysis was carried out by Ecofys – an energy consultancy firm specializing in energy saving and renewable energy solutions – and the results were published in June 2005. The following paragraphs briefly discuss these results.

Total greenhouse gas emissions in the EU-15 in 2002 amounted to 4,852 mil-

lion tons of CO_2-equivalent (EEA 2004). According to the most recent survey, the manufacturing, use and decommissioning of SF_6 electrical equipment contributed 2.4 million tons of CO_2-equivalent.

Although the electricity industry is a major user of SF_6, it is only a minor source of SF_6 emissions. Most of the potential for emission reductions has already been realized. However there remains some scope for further reductions. Accepting possible climate change as a future challenge, the electricity industry – manufacturers and users of electrical equipment containing SF_6 – started in 1995 to implement various measures to reduce SF_6 emissions. These measures include designs that significantly reduce SF_6 leakage rates, gas recovery and re-use as well as training personnel in the correct handling of SF_6.

Life Cycle Assessments (LCAs) show that the use of SF_6 in electrical equipment can reduce the overall CO_2 emissions from electricity systems because of reduced network losses. High voltage networks can be located closer to consumers of electrical energy, which in turn leads to lower transmission losses. Less energy lost means less CO_2 emissions from power generation plants burning fossil fuels. In 2003 this effect is estimated to have avoided about 1.7 million tons of CO_2 emissions across the EU-25. These savings have therefore helped diminishing the net-climate contribution of SF_6-technology in any power generation system.

The Ecofys study shows that the voluntary actions taken by the electricity industry – including both manufacturers and users of electrical equipment containing SF_6 – since the mid-nineties have resulted in significant emission reductions. Voluntary actions taken and commitments entered into by the manufacturers and operators have already led to a reduction in emissions of over 40 percent in Europe since 1995. The study also proposes how the remaining reduction potential can be accessed through further voluntary action. In Europe, ABB and the electrical branch were very active in helping to bring into existence voluntary emission reduction agreements signed by the authorities. Signed voluntary agreements are now implemented in Denmark, Norway and Switzerland.

Also in answer to these proposals, the German associations of electrical equipment manufacturers and operators, and Solvay Fluor GmbH, the manufacturer of sulphur hexafluoride (SF_6), reached an agreement with the Federal Ministry for the Environment, Conservation and Reactor Safety (BMU) in June of this year on how to further develop their voluntary commitment. The aim is to limit emissions of SF_6. The BMU has now agreed to waive the September 2002 proposed ban on SF_6 gas in electrical equipment (greater than 1 KV).

The German voluntary commitment involves a package of actions that limit emissions when SF_6 is used in electrical power supply equipment such as circuit breakers, switchgear, instrument transformers and capacitors. The measures taken cover the entire product life cycle, from manufacture to recycling and/or disposal of the gas.

It aims, on the one hand, to apply the successful actions taken with switchgear to all SF_6 power supply applications and expanding the group of operators involved. On the other hand, it aims at specifying the future actions and objectives required for the recovery, recycling and disposal of SF_6 gas when equipment has reached the end of its service life.

A CIGRE Guide entitled “Practical SF_6 Handling Instructions” has been recently published which explains all significant aspects with regard to the handling of SF_6 gas in electric power equipment.

Maintenance work should only be performed by properly qualified staff. At the end of a product’s life, SF_6 gas is either directly reused, or purified on the spot and reused in a closed circle. SF_6 which cannot be reused is disposed of by environmentally compatible procedures. Staff dealing with SF_6 receives regular information and training.

Statistics of the quantities produced and supplied are kept by the producers of SF_6 gas, while the manufacturers and users of switchgear and substations keep a record of consumption figures and inventories.

For the EU and European Industry, this ruling from Germany is a very positive signal. It means that the indispensable SF_6 technology, as well as a reliable energy supply and of course jobs within the EU, will be secure in the long term.

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Footnotes
[1] www.capiel-electric.com