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EU-F-Gas-regulation and its impact on manufacturers and users of SF_6-electric power equipment

EPA‘s 2009 Workshop on SF_6 Emission Reduction Strategies
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Content

- Introduction
- EU-F-Gas-regulation 842/2006
- Commission regulation amendments 1493,1494/2007 and 305/2008
- Impact on manufacturers
- Impact on users
- Conclusion

Characteristics of SF_6

SF_6 is colorlessly, odorless and a chemical neutral (inerted) gas

SF_6 it is 5x heavier than air, is not toxic and has no dangerous components inside

SF_6 is no hazardous material

SF_6 has no eco-toxic potential

SF_6 has no impact for the ozonosphere

SF_6 is a potent greenhouse gas

SF_6 has excellent electrical characteristics

Situation of GHG in Europe before the regulation

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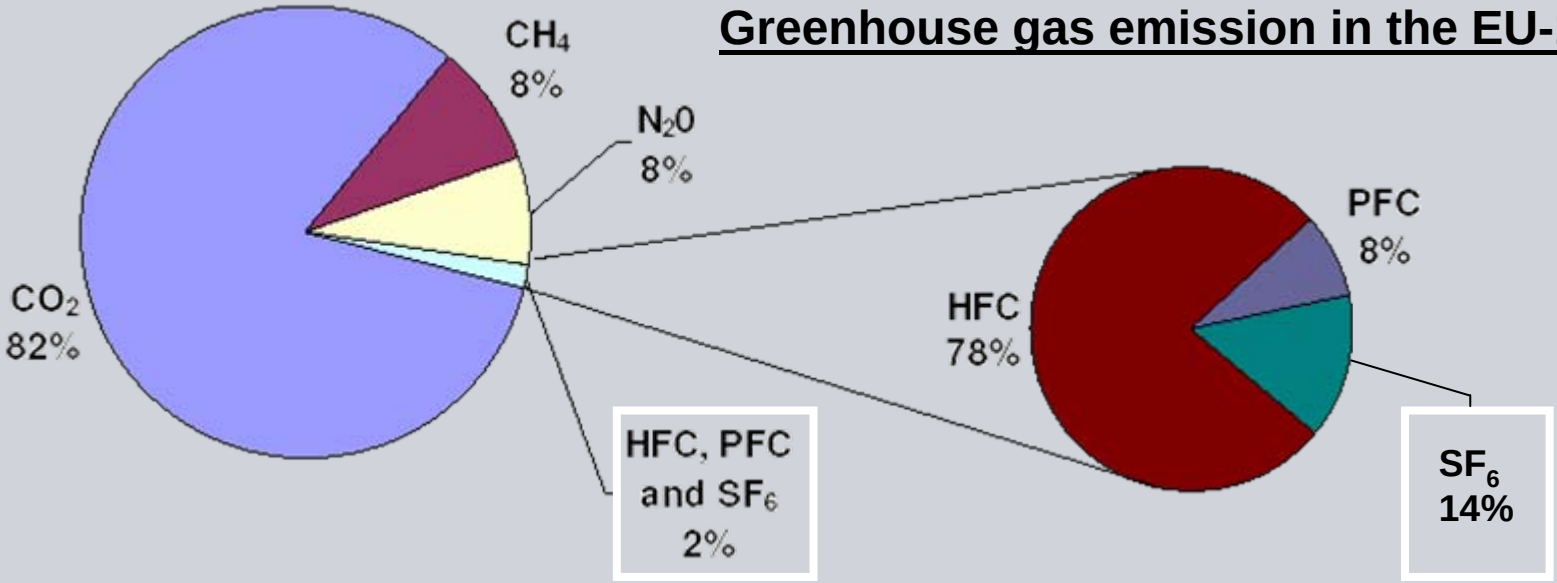
Greenhouse gas emission in the EU-15, 2002



Total SF_6-emission contribution only 0,28 %
SF_6-emission from electric power equipment: 0,05 %
(„closed and sealed pressure systems“); in Germany: 0,03 % !

Other SF_6-emission sources were: magnesium and aluminium industry, footwear, tyres, window noise insulation, military applications, semiconductor industry, medical devices (mainly „open applications“)

Ecofys-Study, 2005 for Capiel[1)] & Eurelectric[2)]

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"Reductions of SF_6 emissions from electrical high and medium voltage equipment in Europe"

- In 2002 in the EU-15 the SF_6-emission of electrical power equipment was 0,05 % of all greenhouse gases → Slide 4
- Volunteer actions of manufacturers and users of electrical high and medium voltage equipment in Europe realized a reduction of 40% SF_6-emission in the last 10 years
- Additional reduction of SF_6-emisson possible – improve tightness, gas-recycling; complete & Europe-wide realization of this activities in the future
- Environmental life cycle assessments show a relief of the CO_2- balance by using SF_6-technology

1) **Coordinating Committee for the Associations of Manufacturers of Industrial Electrical Switchgear and Control gear in the European Union (now renamed/reorganized to "T&D Europe")**

2) **European Union of the Electricity Industry (utilities/users)**

Ecofys-Study: https://www.zvei.org/fileadmin/user_upload/Fachverbaende/Energietechnik/Brancheninformationen/SF6_in_Schaltanlagen/Ecofys_SF6_Study_Final_Report_22Nov.pdf

Possible SF_6 emissions in the lifecycle process of switchgear

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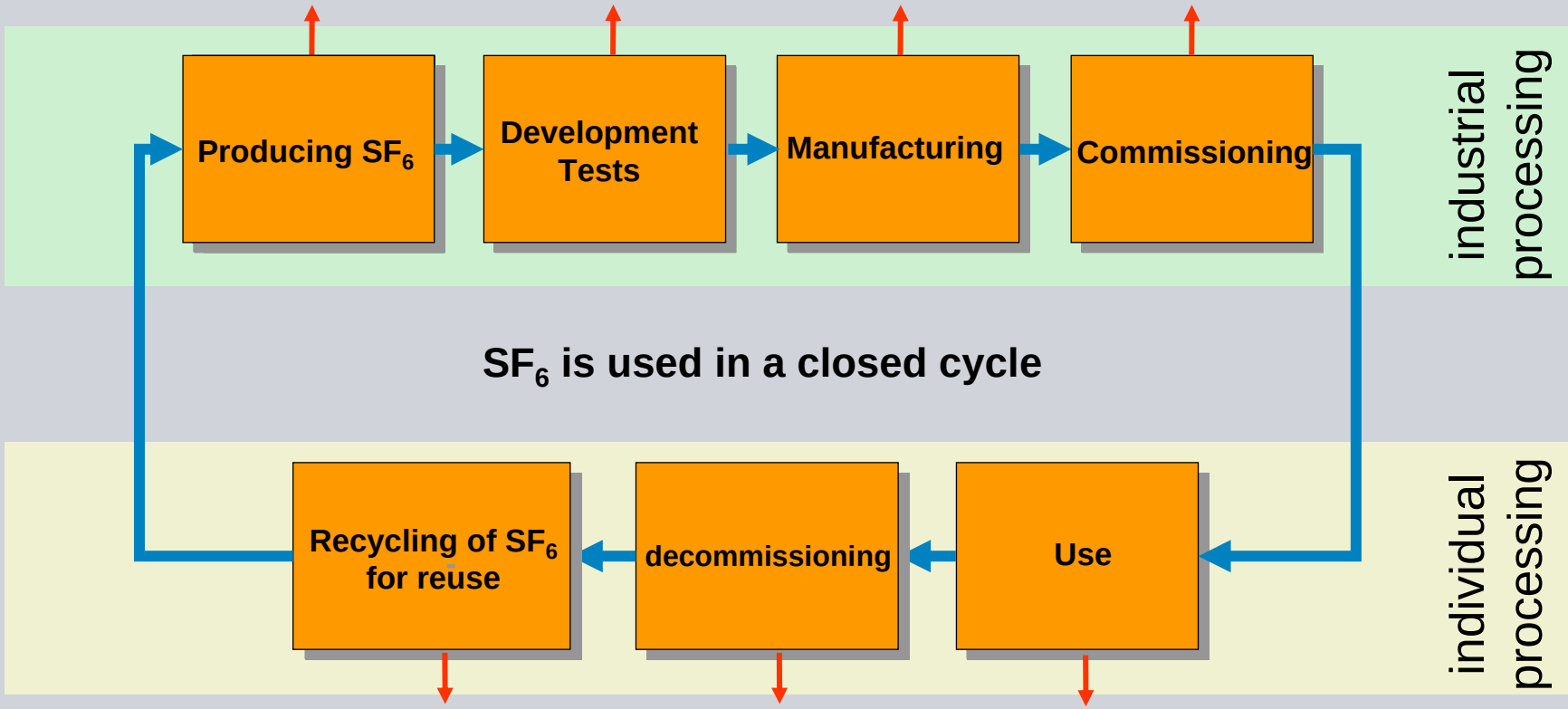

The EU-F-Gas regulation concentrates on the individual processing

(↓=possible emission)

EU-F-Gas regulation 842/2006

„Regulation (EC) No 842/2006 of the European Parliament and of the Council on fluorinated greenhouse gases“

SF_6 is considered in some articles only

The use of SF_6 in electric power equipment is permitted

Certain measures to be carried out by manufacturers and users have been implemented

Amendments have been released to describe measures more in detail

European F-Gas-regulation 842/2006 relevant articles for SF_6 electric power equipment

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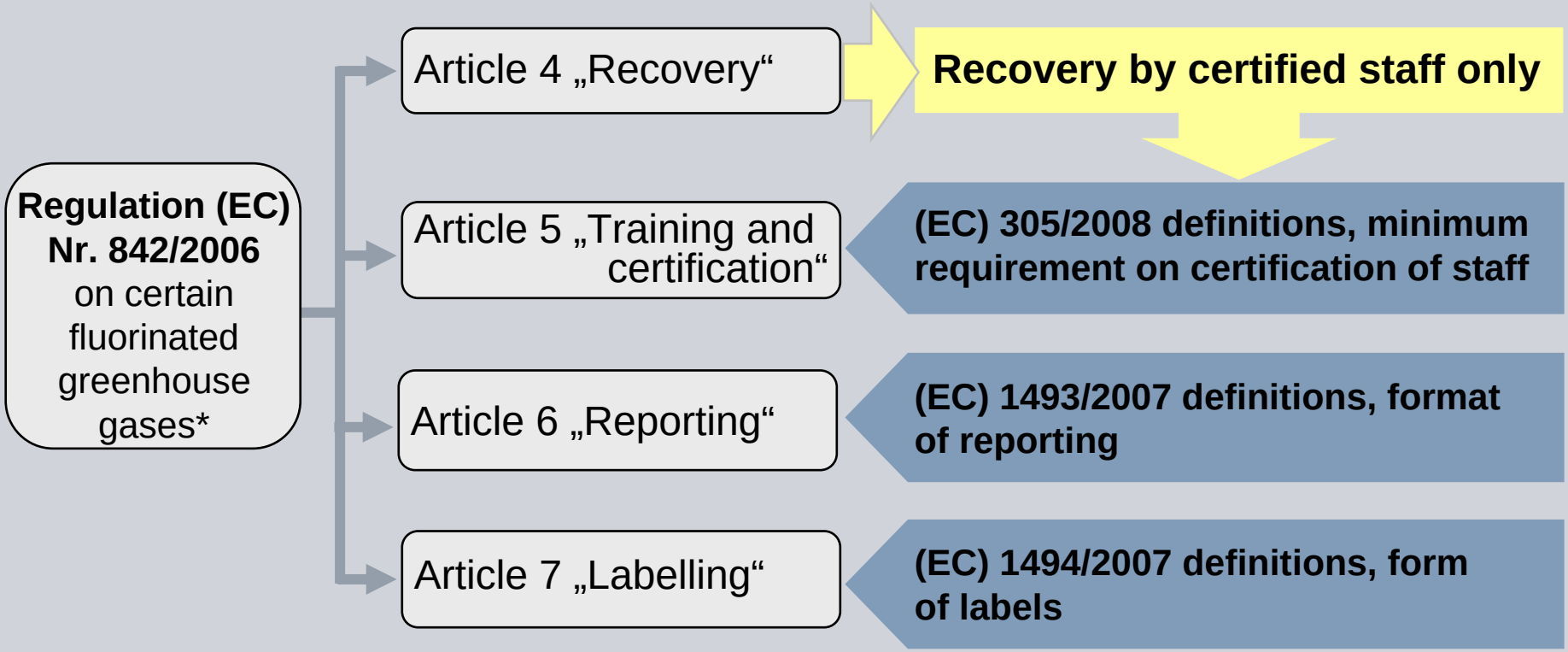

*) “certain fluorinated greenhouse gases” means hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)

European F-Gas-regulation 842/2006, article 2 „Definitions“

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Definitions for SF_6-handling

- **Recovery**

  Collection and storage of SF_6 from electric power equipment or containers
  → ***in practice: taking out SF_6 from equipment and putting it into a container***

- **Recycling**

  Reuse of recovered SF_6 following a basic cleaning process
  → ***in practice: recycling of SF_6 on site***

- **Reclamation**

  Reprocessing of recovered SF_6 in order to meet a specific standard* of performance
  → ***in practice: used SF_6 is reprocessed (e.g. SF_6-production plant)***

- **Destruction**

  Transformation or destruction into one or more stable substances which are not fluorinated GHG
  → ***in practice: burning of SF_6***

***) - IEC 60376 “Specification of technical grade sulfur hexafluoride (SF_6) for use in electrical equipment”**
- IEC 60480 “Guidelines for the checking and treatment of sulfur hexafluoride (SF_6) taken from electrical equipment and specification for its re-use”

European F-Gas-regulation 842/2006, article 4 „Recovery“

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Manufacturers

Individual activities

Certificate necessary?

YES ✓

Processed handling

Certificate necessary?

NO ✗

SF_6-handling processes are described – based on IEC 62271-303 (2008)
(and CIGRÉ No 276/2005 SF_6-handling, IEEE P1712/D1 guide for SF_6-handling)

European F-Gas-regulation 842/2006, article 4 „Recovery“

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Users

	Certificate necessary?
▪ SF_6- handling at high voltage switchgear → ***in practice:*** maintenance, service, end-of-life of equipment	**YES** ✓
▪ SF_6- recycling, processing → ***in practice:*** improvement of SF_6-quality	**YES** ✓
▪ SF_6- filling / refilling → ***in practice:*** topping-up of transport filling pressure to nominal pressure	**NO** ✗

Which measures have to be considered therefore?

- **certify own staff**
- **contract OEM or service companies with certified personal only**

European F-Gas-regulation 842/2006, article 5 „Training and certification“ together with regulation 305/2008*

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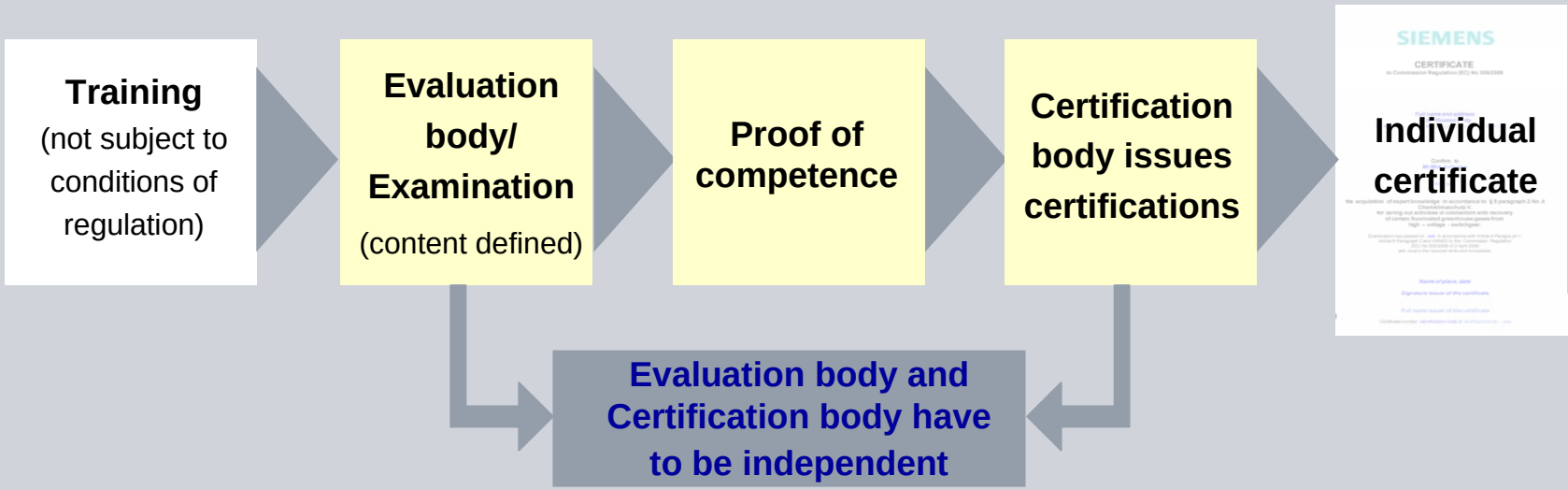
„Commission regulation No. 305/2008 establishing minimum requirements and the conditions for mutual recognition for the certification of personnel recovering certain fluorinated GHG from HV switchgear“

Process and responsibilities



*) regulation refers to HV switchgear only

European F-Gas-regulation 842/2006, article 5 „Training and certification“ together with regulation 305/2008

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Minimum requirements

- to be known by technicians
- to be tested by evaluation body

(a) **theoretical test** with one or more questions testing that skill or knowledge, as indicated in the column ‘Test type’ by **T**

(b) **practical test** where the applicant shall perform the corresponding task with the relevant material, tools and equipment, as indicated in the column ‘Test type’ by **P**

No	Minimum knowledge and skills	Test type
1	Basic knowledge of relevant environmental issues (climate change, Kyoto Protocol, Global Warming Potential), the relevant provisions of Regulation (EC) No 842/2006 and of the relevant Regulations implementing provisions of Regulation (EC) No 842/2006	T
2	Physical, chemical and environmental characteristics of SF_6	T
3	Use of SF_6 in electric power equipment (insulation, arc quenching)	T
4	SF_6 quality, according to the relevant industrial standards (1)	T
5	Understanding of the design of electric power equipment	T
6	Checking the SF_6 quality	P
7	Recovery of SF_6 and SF_6 mixtures and purification of SF_6	P
8	Storage and transportation of SF_6	T
9	Operation of SF_6 recovery equipment	P
10	Operation of tight drilling systems, if necessary	P
11	Re-use of SF_6 and different re-use categories	T
12	Working on open SF_6 compartments	P
13	Neutralising SF_6 by-products	T
14	Monitoring of SF_6 and appropriate data recording obligations under national or Community legislation, or international agreements	T

(1) For instance IEC 60376 and IEC 60480.

Optimized gas recovery needs „State of the Art“ equipment

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1mbar SF_6-maintenance unit

SF_6– measurement device
%- SF_6,
dew-point temperature,
SF_6-byproducts

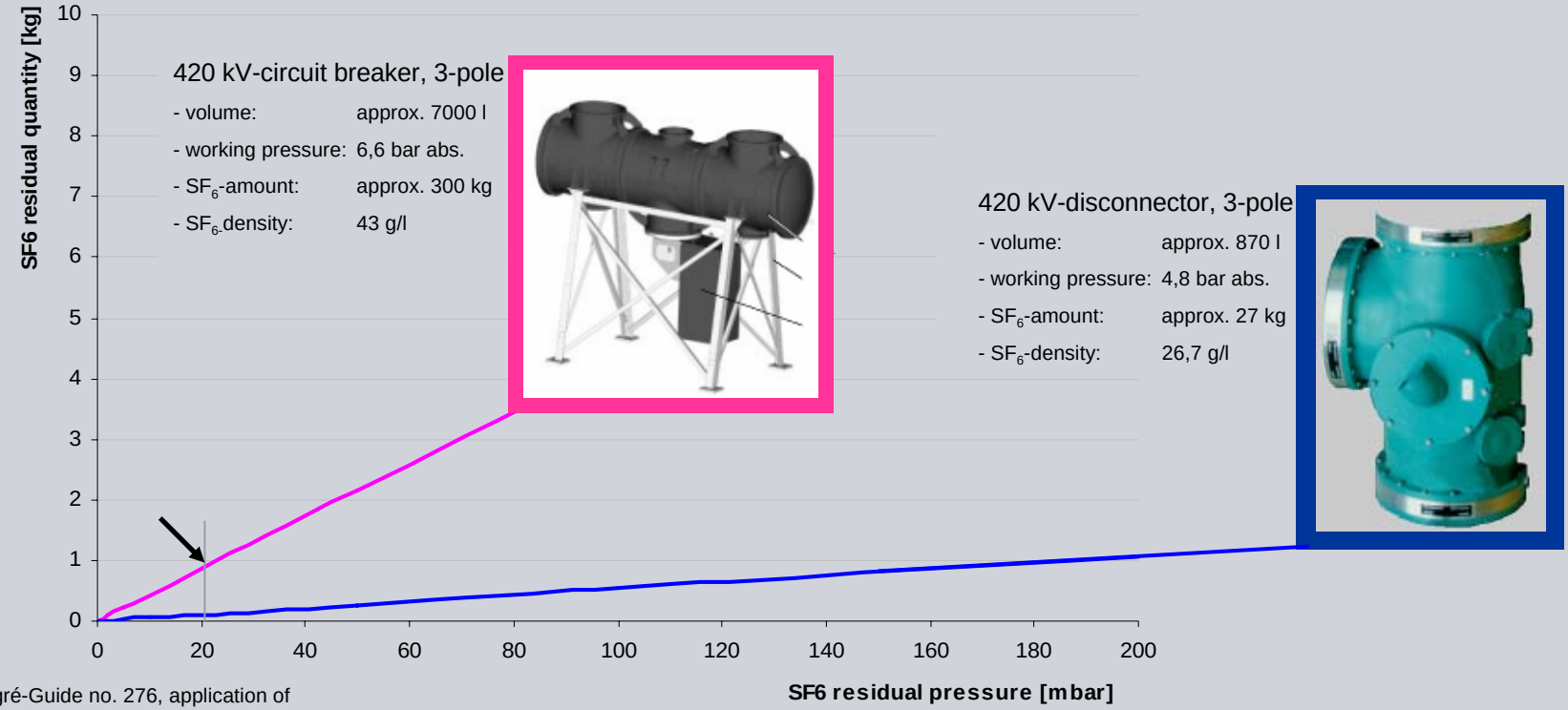
SF_6– collecting device
for measurement of gas

Source: DILO

Optimized SF_6 handling

With State-of-the-art-handling equipment SF_6 recovery of each gas compartment till very low pressure (1 - 20 mbar) is possible, thus securing losses of at least less than 2% during maintenance and end of life.

SF_6-residual quantity (emission) dependence on the SF_6 rated filling pressure / compartment size / SF_6 residual pressure



source: Cigré-Guide no. 276, application of table 25; Example: GIS Siemens

European F-Gas-regulation 842/2006, article 6 „Reporting“ together with regulation 1493/2007

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„Commission regulation No 1493/2007 establishing the format for the report to be submitted by producers, importers and exporters of certain fluorinated GHG“

- **Reporting of producers, importers and exporters in the EU**
- **Submission of the report by 31 March of the year following the year for which the report applies**
- **Report shall be submitted to the EU commission and the competent authority of the member state**
- **For utilities usually not relevant**

European F-Gas-regulation 842/2006, article 6 „Reporting“ together with regulation 1493/2007

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The reporting is a must to do in case of…

country A outside EU

Import
SF_6 > 1 t
in container or bottles

Export
SF_6 > 1 t
in container or bottles

country B outside EU

The reporting is not necessary for…

In some countries additional voluntary commitments regarding reporting exist

European F-Gas-regulation 842/2006, article 7
„Labelling“ together with regulation 1494/2007

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„Commission regulation establishing the form of labels and additional labelling requirements as regards products and equipment containing certain fluorinated GHG“

- **It applied from 1. April 2008**
- **SF_6 labelling on the product itself**
- **Information in the instruction manual**

European F-Gas-regulation 842/2006, article 7 „Labelling“ together with regulation 1494/2007

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Standards required SF_6-weight already in the past:
declaration of *„weight of gas”* according to
IEEE C37.122 or IEC 62271-203

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Year of manufacture / No.		2006 / K 31251030
Type		8DN8-2
Rated voltage		145 kV
Rated impulse withstand voltage		650 kV
Rated power–frequency withstand voltage		275 kV
Rated frequency		50 Hz
Rated normal current	Busbar	2500 A
	Bus Coupler	2500 A
Rated short-time withstand current		40 kA
Rated duration of short-circuit		3 s
Circuit-breaker	Rated short-circuit breaking current	40 kA
	First – pole – to – clear factor	1,5
	Rated operating duty	O-0,3s-CO-3min-CO
	Rated out of phase breaking current	10 kA
SF_6 – pressures see inside		
Weight of SF_6 – filling		99 kg
Weight with SF_6 – filling		3,1 t
Ambient air temperature		-5…+50 °C
Standards: IEC-Publ.62271-100, 62271-102, 62271-203		
MADE IN GERMANY		

NEW additional label*

The label shall be placed clearly, indelibly and adjacent to the service point of the equipment

*) Content defined in the regulation but the form can vary between the different manufactures

European F-Gas-regulation 842/2006, article 7 „Labelling“ together with regulation 1494/2007

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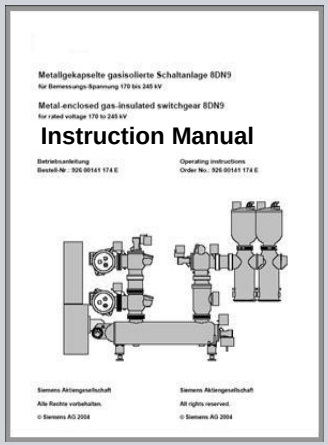
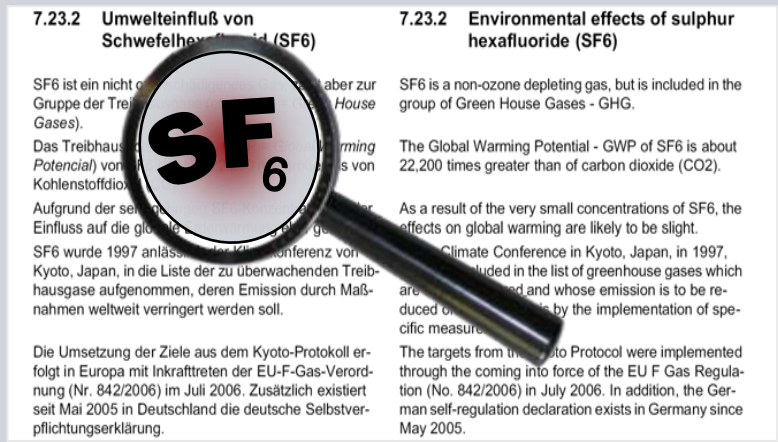
Labelling of products

The instruction manual must contain a note in the sense of…

“This equipment contains the fluorinated greenhouse gas SF_6 covered by the Kyoto Protocol and with a global warming potential (GWP) 22 200. SF_6 shall be recovered and not released into the atmosphere. For further information on use and handling of SF_6 please refer to IEC 62271-303: High-voltage switchgear and control gear – Part 303 Use and handling of sulphur hexafluoride (SF_6)”

Source: T&D Europe, Guide for Manufacturers of HV Switchgear containing SF_6…





What can users of SF_6-electric power equipment expect from the manufactures?

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- Low leakage rates during lifetime of equipment
- Comply with the EU-F-Gas regulation and additional SF_6-voluntary commitment (in selected countries)
- Training & certification of staff handling/recovering SF_6
- Use of state-of-the-art equipment for SF_6 handling (factory, on-site service)
- Continuous improvement of products (more compact, less emission)

Conclusion

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- SF_6 → excellent insulation and arc quenching; no equivalent at the moment
- SF_6-technolgy → compact equipment with low material usage, high operational safety, minimized fire load, high availability
- Positive ecological balance → lower energy losses compared to conventional AIS solutions (therefore CO_2-reduction)
- Potent greenhouse gas → low leakage rates and handling losses necessary, reuse-concept to be considered during maintenance and end-of-life
- Further European & world-wide realization of emission reduction necessary

Thank you for your attention!

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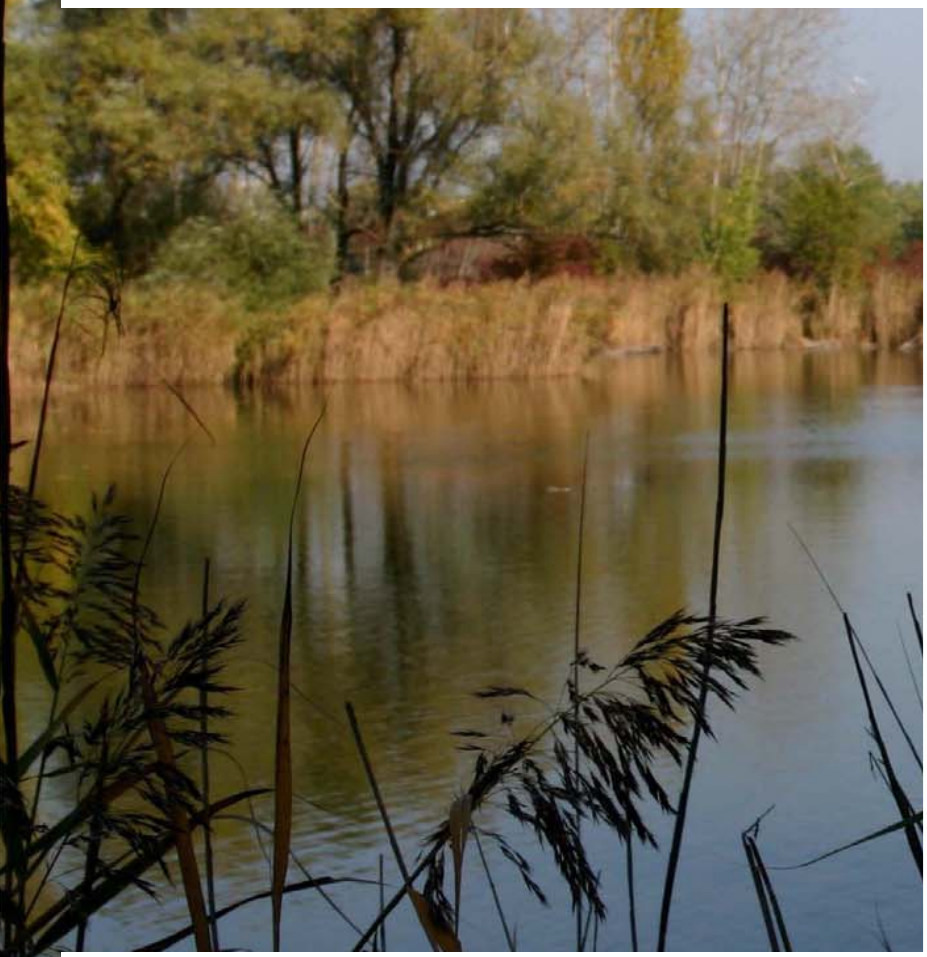

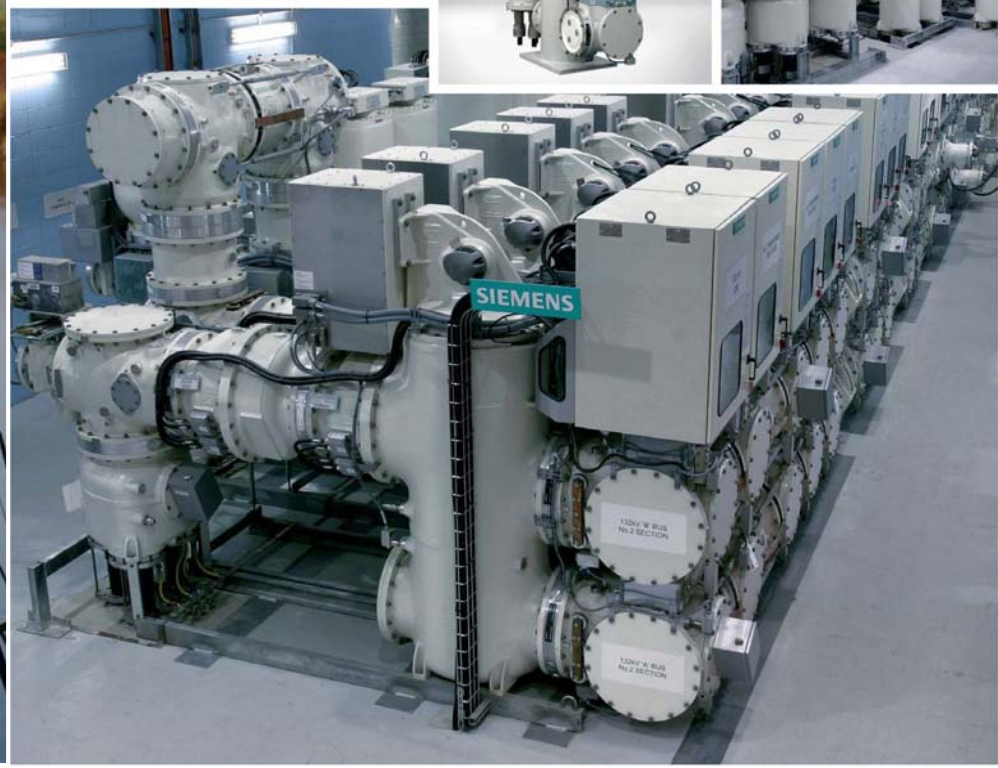

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