

SF₆ Gas Emission Reduction
From
Gas Insulated Electrical Equipment
In Japan

The Federation of Electric Power Companies
The Japan Electrical Manufacturers'
Association
Japan

Contents

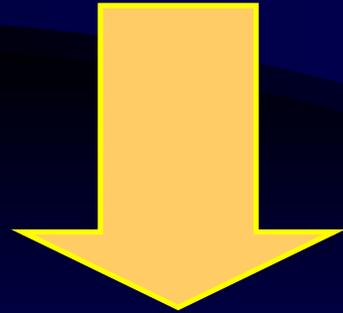
- **Joint Study**
- **Voluntary Action Plan**
- **SF₆ Gas Emission from 1996 to 1999**
- **Future Perspective for SF₆ Gas Emission**

Background on SF₆ Usage in Japan

Steady Expansion of Electricity Demand



Increase in the Amount of Equipment



Restriction in Japan

Difficulty of Land Acquisition
Severe Climate Condition

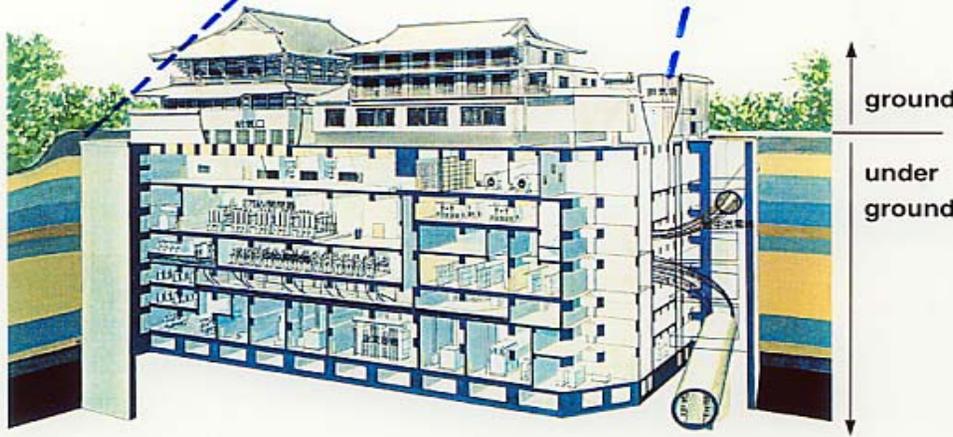
SF₆ Gas Insulated Equipment is Indispensable

Outlook of Substation

Gas Insulated Substation solves Scenic problem.



KITAKUMAGAYA-SUBSTATION(275kV,900 MVA)
(An air-insulated-type openair substation)



TAKANAWA-SUBSTATION(275kV,1020 MVA)
(A gas-insulated-type underground Substation)

**Space Saving
and Less Visual
Impact**

**By SF₆ Gas
Insulation**

Joint Study on SF₆ Emission Reduction

- **Principle**

- Effective substitute gas has not been found yet.
- It is necessary for us to continue the use of SF₆ gas from now on too.
- Countermeasures for the REDUCTION of SF₆ gas EMISSION are vital.

- **Membership**

- Representatives of:
 - Academy, electric power companies, electric equipment manufacturers, and gas producers in Japan

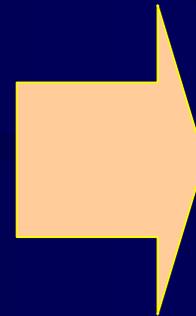
Joint Study on SF₆ Gas

**Academy
(Universities in Japan)**

**Electric Power
Companies**

**Electric Equipment
Manufacturers**

Gas Producers



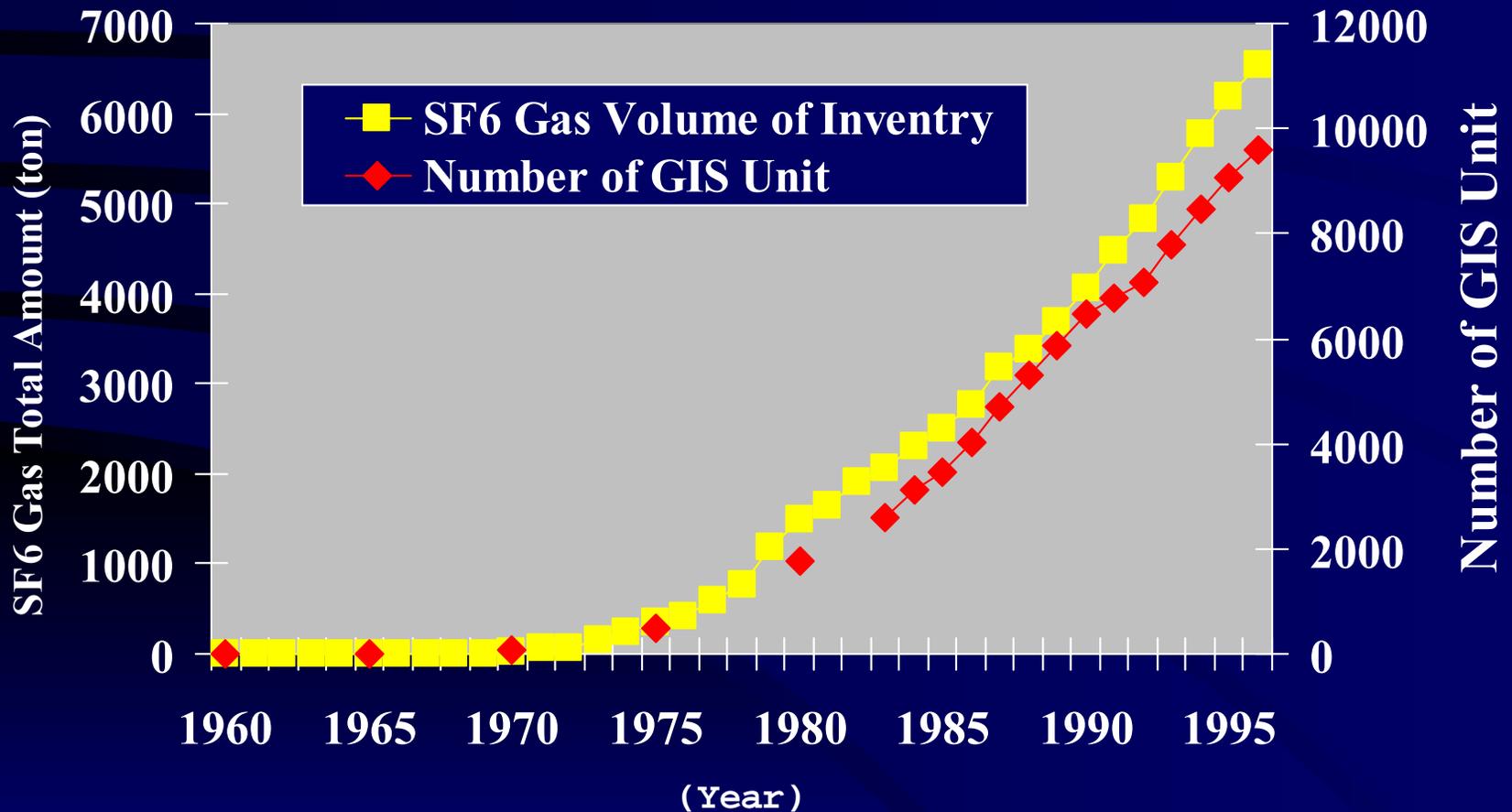
*Electric
Technology
Research
Association*

**Chairman: Prof.
Takuma (Kyoto Univ.)
from 1996 to 1998**

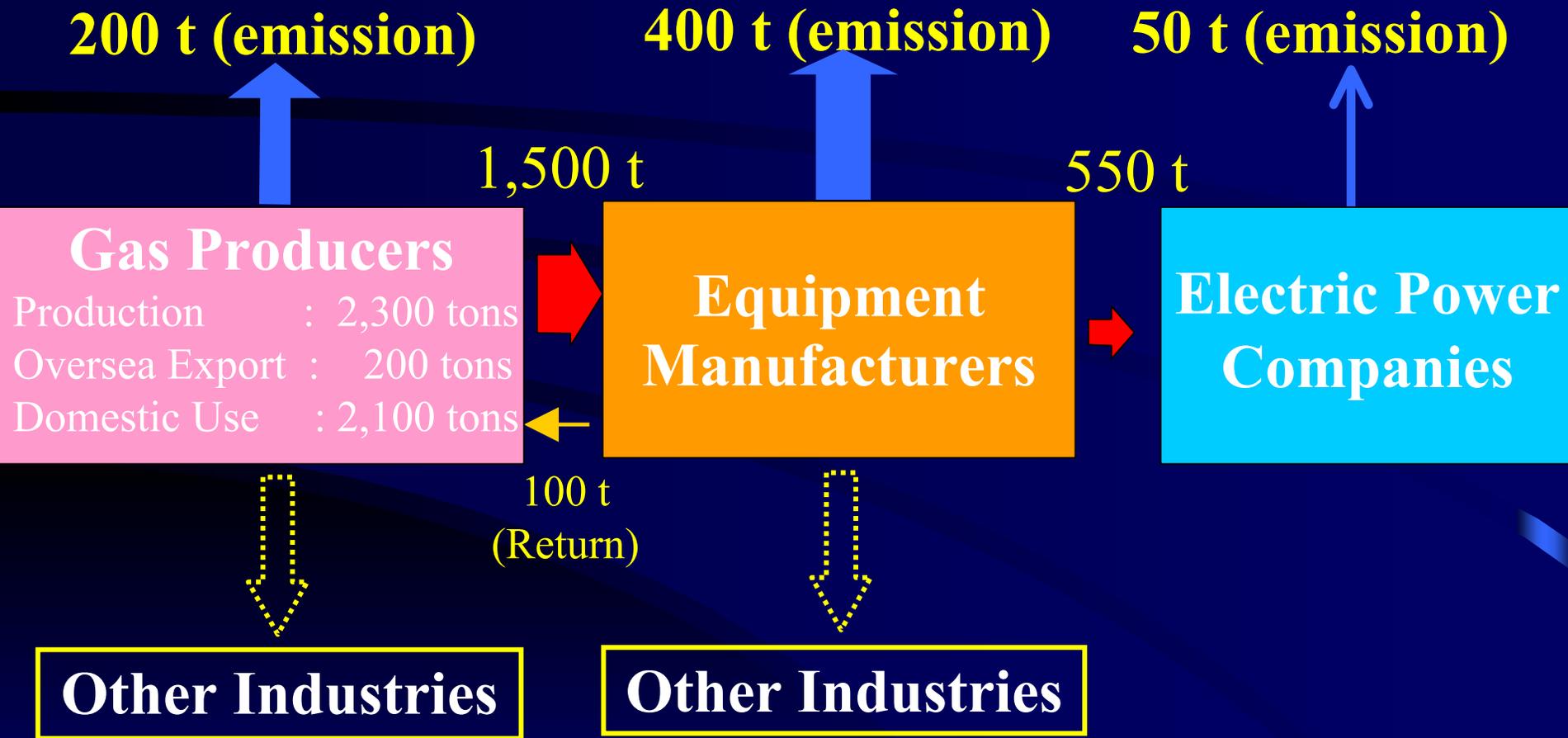
Joint Study on SF₆ Gas

- **Actual Usage in Japan**
 - Total SF₆ amount for electric industry
 - Annual increase of SF₆ in Japan
- **Investigation on Site**
 - Gas leakage rate
 - Gas purity & humidity
 - Decomposition product
- **Requirement for Reuse of SF₆**

SF₆ Amount and GIS Unit on Site



Averaged SF₆ Balance Sheet in Japan (From 1990 to 1995)

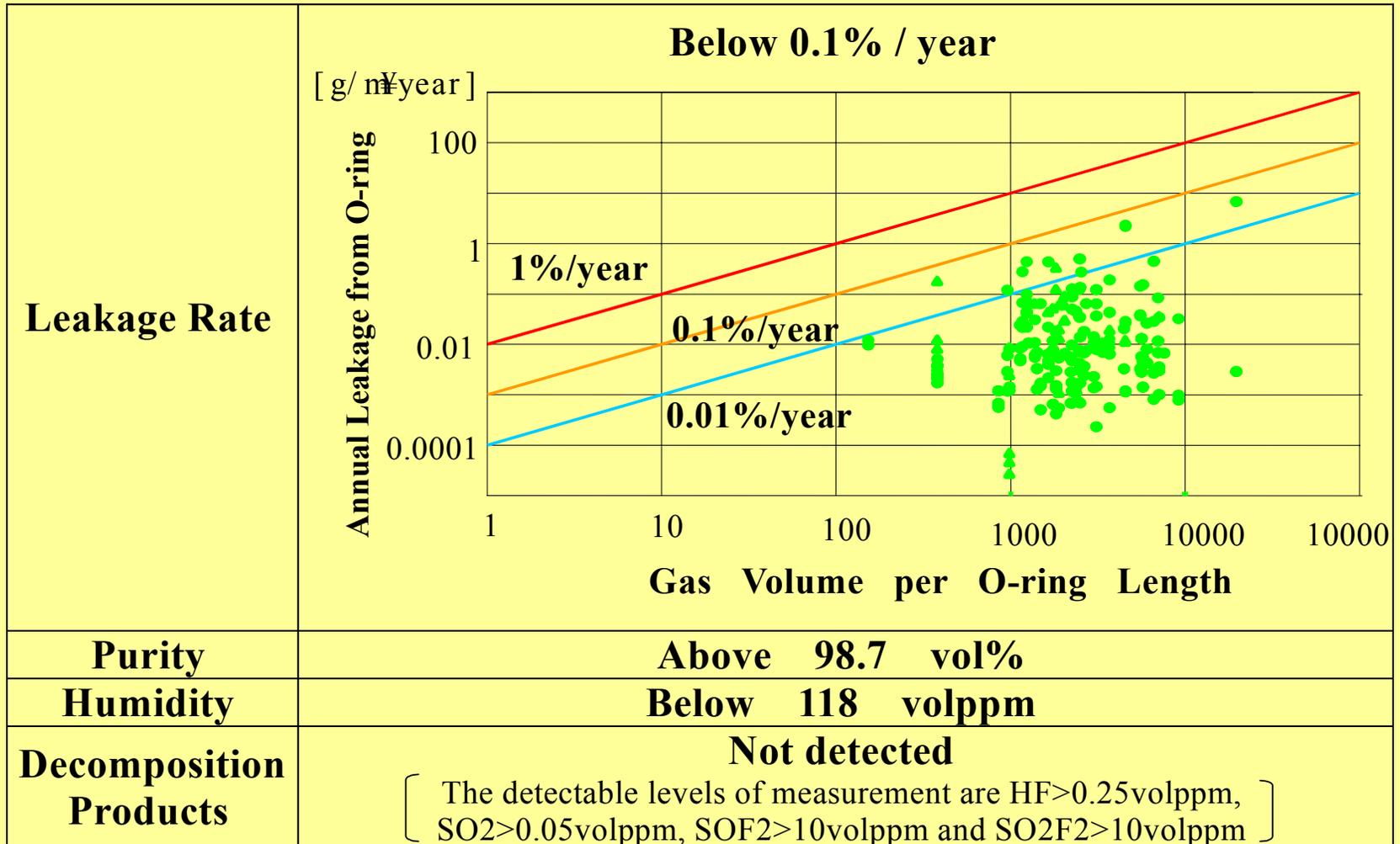


Actual Emissions at Electric Power Companies_(up to 1995)

	Maintenance	Removal	Leakage
110kV or higher	Recovery down to 0.05 MPa(gage)	Fully released	0.1%/year
Lower than 110kV	Fully released		

Investigation on Site

(300 Points on 40 Circuit Breakers in Operation)



Quality Control Criteria for SF₆ Gas

		Permissible limits	Criteria
SF ₆ gas purity		95 vol. %	97 vol. %
Air		(5 vol. %)	(3 vol. %) including CF ₄
Water content	Equipment without current interruption	1000 ppm (vol.)	500 ppm (vol.)
	Equipment with current interruption	300 ppm (vol.)	150 ppm (vol.)
Dissolved gases/decomposition products		–	No color reaction in detecting tube

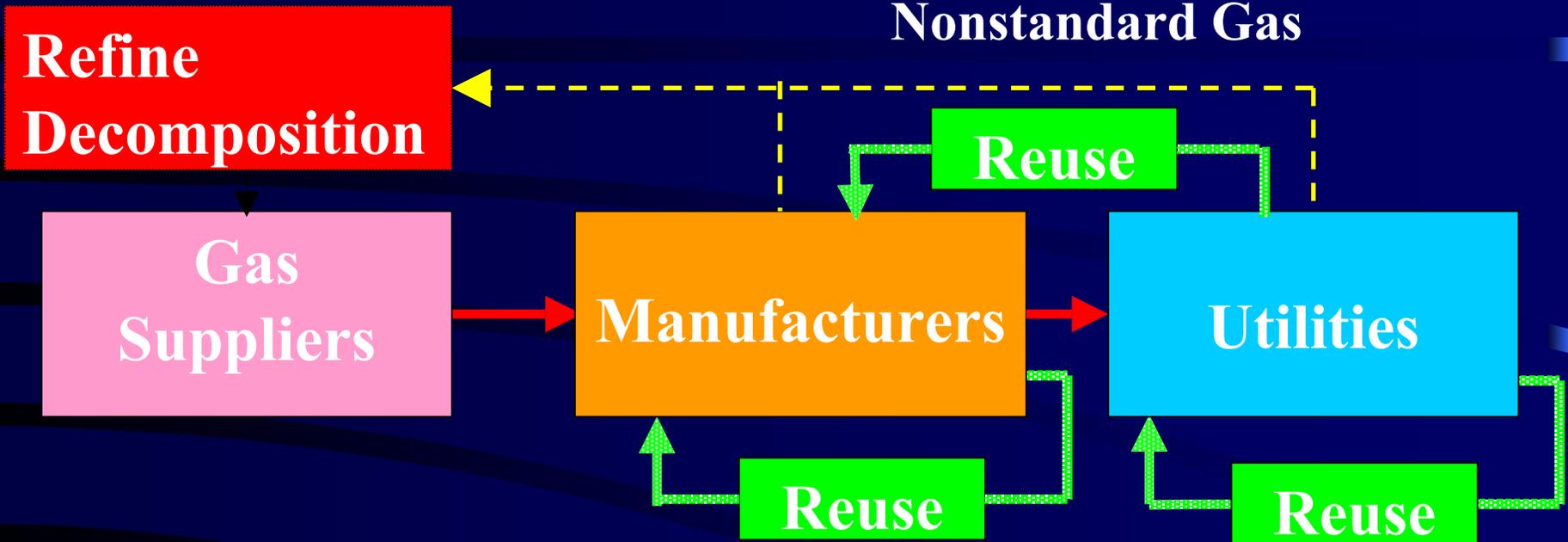


To Be Reused

Recovery Targets for SF₆ Gas

		Recovery terminal pressure		Recovery rate	
		Lower than 110 kV	110 kV or higher	Lower than 110 kV	110 kV or higher
Before 1995	During testing	No Recovery		No Recovery	
	During manufacture	0 - 0.05 MPa· G		Approx. 70%	
	During installation/ maintenance	No Recovery	0 - 0.05 MPa· G	No Recovery	Approx. 70%
	During removal	No Recovery		No Recovery	
In the future (from 2005 onward)	During testing/ Manufacture/ Installation/ maintenance	0.015 MPa· abs (114 Torr) or lower		97% or higher	
	During removal	0.005 MPa· abs (38 Torr) or lower		99% or higher	

SF₆ Gas Recycling Flow & Standard



Recycle Standard

Requirement for Reused SF ₆		SF ₆ Recovery Ratio in Internal Inspection
Purity	:97 vol %	90% in 2000
Humidity	:150 vol ppm	97% in 2005
Decomposition Products: Not Detected		

Result of the Joint Study

1. Leakage Rate from Equipment in Operation:

>> Regarded as 0.1%/year _

2. Target for Recovery Rate at Each Stage:

>> Established

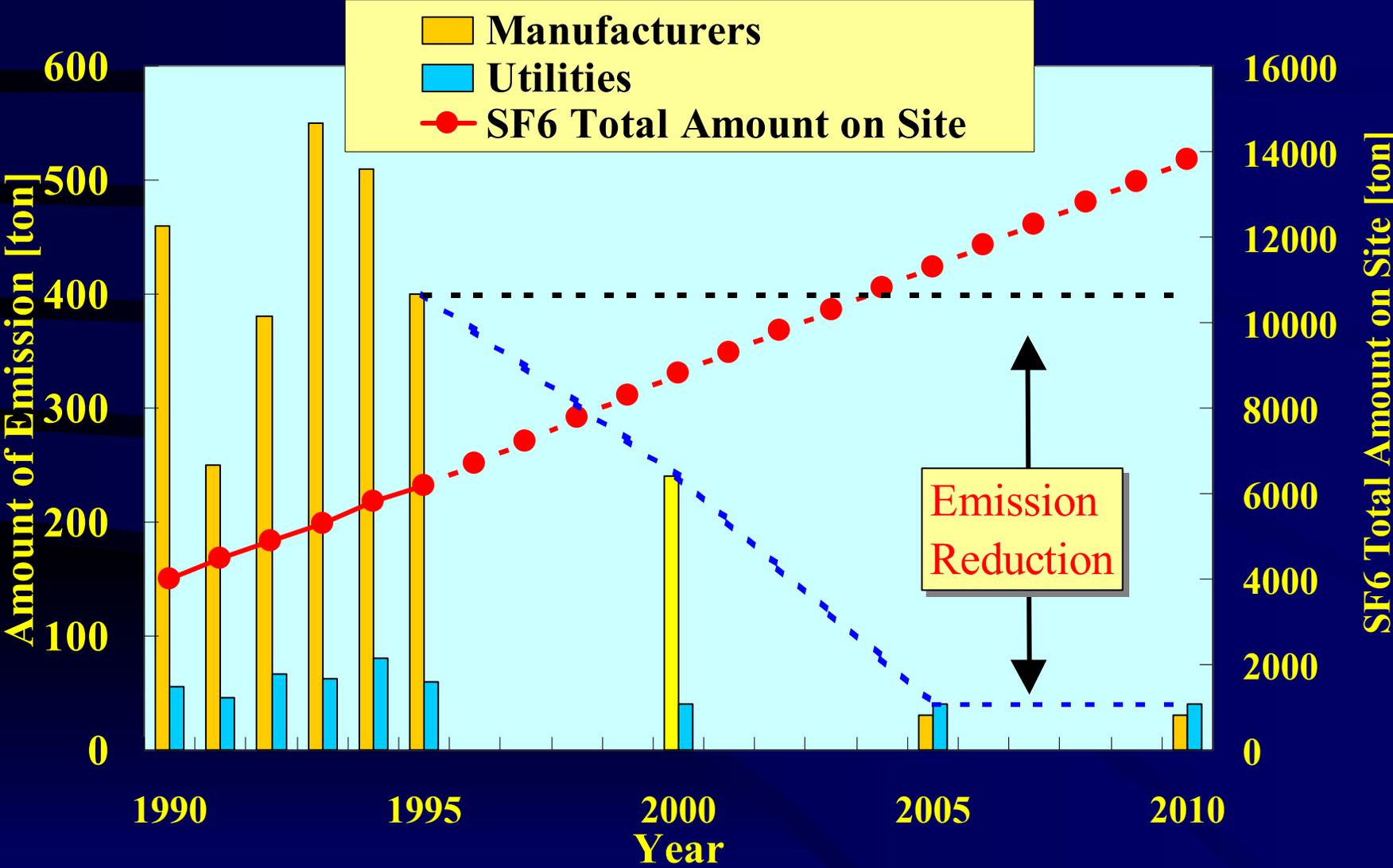
3. Quality Control Criteria for SF₆ Recycling:

>> Established

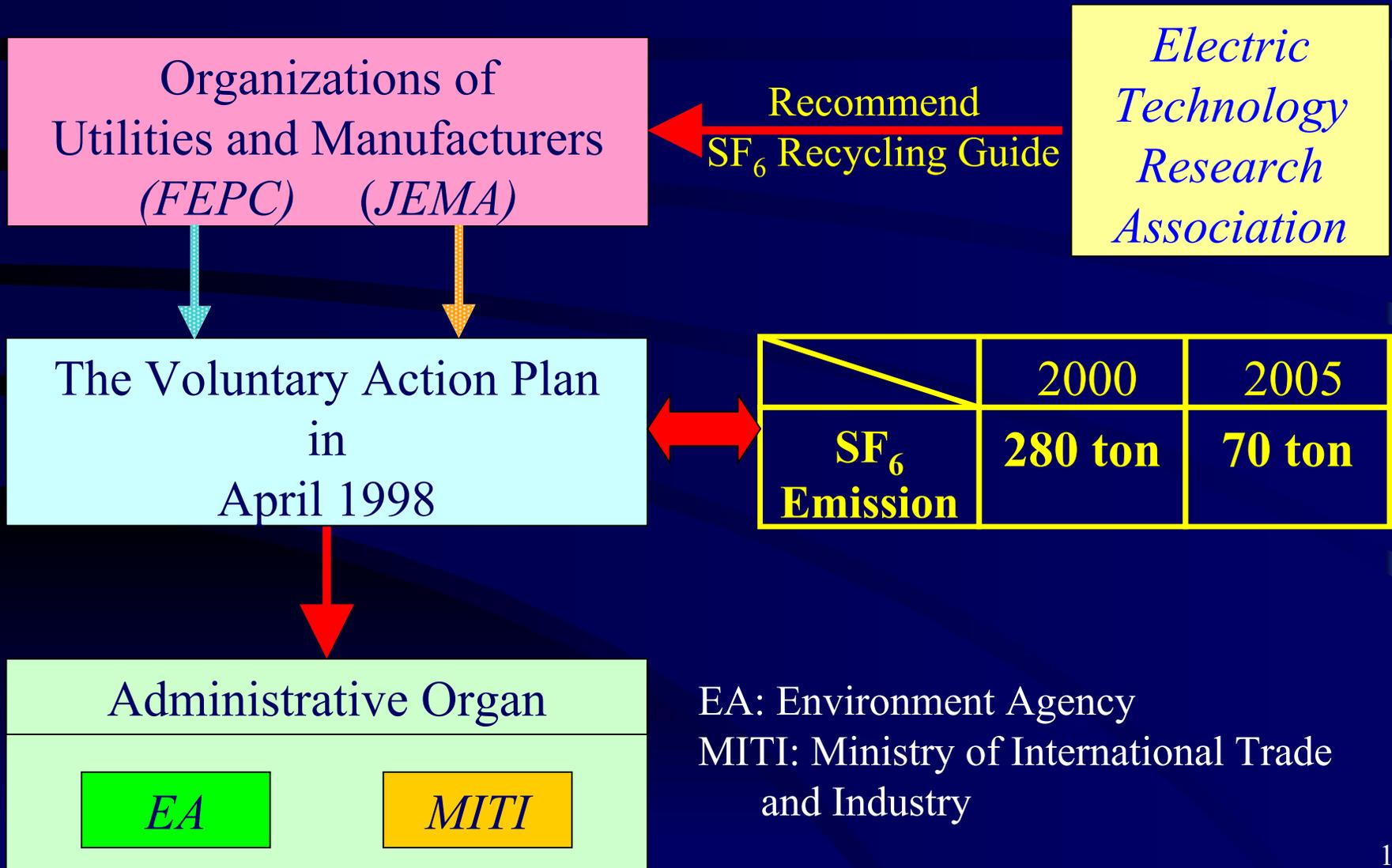
4. Gas Recycling Flow:

>> Agreed by the respective parties

SF₆ Emission in Manufacturers & Utilities



Voluntary Action Plan



Voluntary Actions By Electric Power Companies

Target for Recovery Rate

- Usage (during maintenance work)
 - 1990 – 1995 60% >> **by 2000 90%**
by 2005 97%
- Disposal (during replacement work)
 - 1990 – 1995 0% >> **by 2005 99%**

Voluntary Actions by Equipment Manufacturers (1)

Target for Emission

- Within 3% of purchased volume
- During equipment test in factory/installation on site

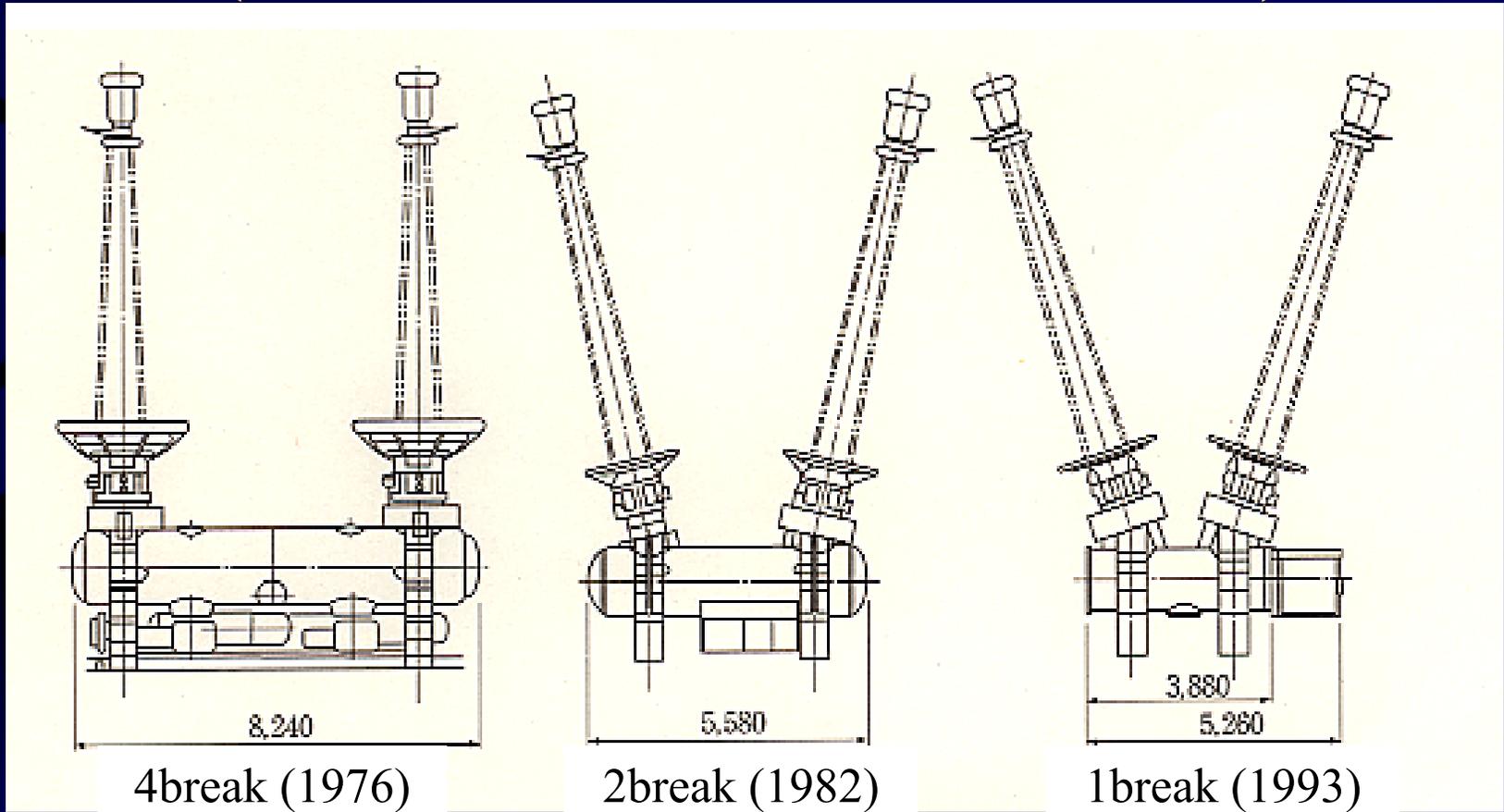
1990 – 1995 400 ton >> **by 2000 240 ton**
by 2005 30 ton

Voluntary Actions by Equipment Manufacturers (2)

Target for Gas Recovery & Usage

- Development of high performance gas handling equipment
- Development of compact gas insulated equipment with minimum SF₆ gas

Compact Gas Insulated Equipment (550 kV Circuit Breaker)

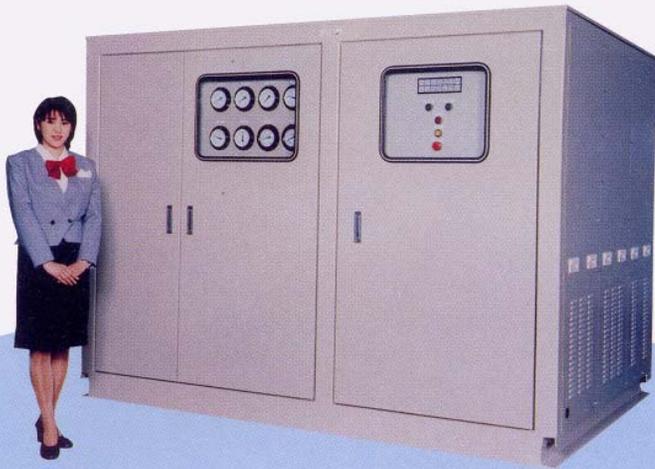


SF₆/Phase: 2000 kg

1050 kg

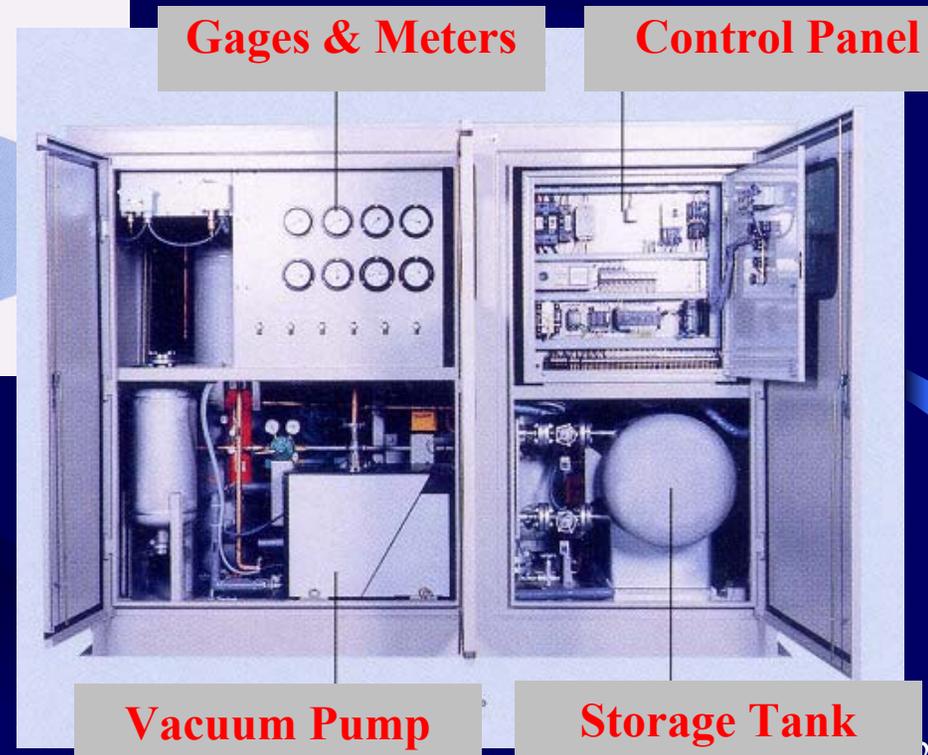
720 kg

SF₆ Gas Handling Equipment



Outline of Equipment

Dimensions:
2700(w)x2000(D)x2000(H)mm
Weight:3500kg(with 300L tank)



Gages & Meters

Control Panel

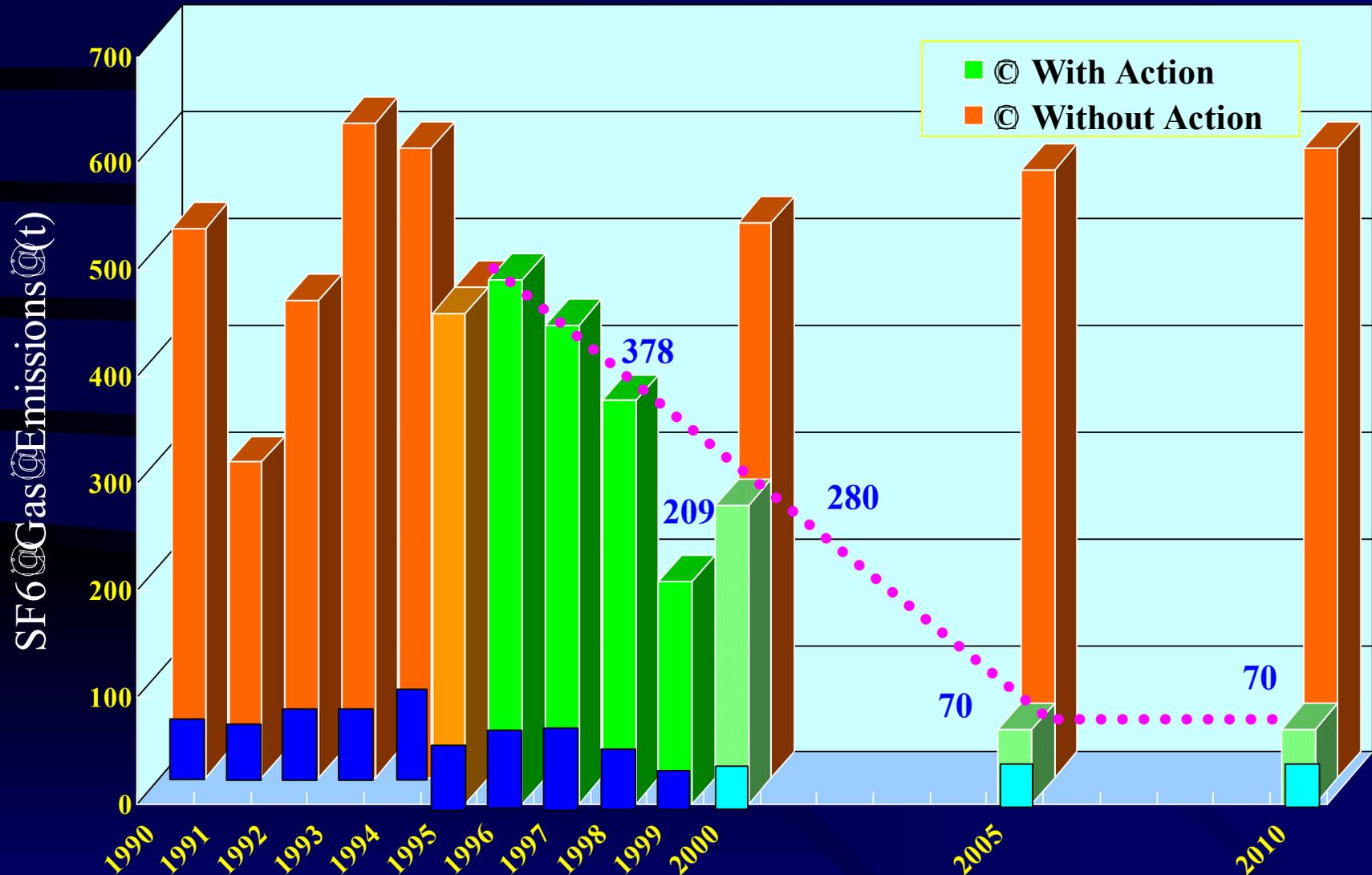
Vacuum Pump

Storage Tank

Voluntary Actions By the Concerned Parties

- **Improvement of Gas Inventory System**
 - Record of SF₆ gas amount at every job
 - Annual report to government relating to progress of SF₆ gas recovery
- **Promotion of Gas Recovery**
 - Achieving the target values
- **Promotion of Gas Recycling System**
 - Re-use in the electric power industry

Estimation of SF₆ Gas Emissions



Future Perspective for SF₆ Gas Emission

- Excellent characteristics of SF₆ gas
- Effective substitute gas has not been found yet
- We have to use SF₆ gas with great care
- Emission to environment should be reduced, aiming at the target values
- **Electric Power Industry Total:**
450 ton (1990 - 1995) >> **Approx. 70 ton (2005)**

Thank you for your attention