Preliminary Results from Present Cigre Survey

Gas Insulated Substations (GIS)

DB status : August 2007

Focus on population cards and major failure cards (namely 2004 and 2005)

WG A3-06 Tutorial

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Seoul

TF GIS

D.Kopejtkova, M. Kudoke, H. Furuta

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WB A3.06 - Reliability of HV equipment – GIS population

OLD SURVEY :

GIS DATA AVAILABLE UP TO 31-12-1995

No. of GIS	2 115
No. of GIS CB-bays	13 696
No. of GIS CB-bay-years	118 483
No. of countries	30

NEW SURVEY:

GIS DATA AVAILABLE UP TO August 2007

No. of GIS	9 066 in 2004, 9 148 in 2005
No. of GIS CB-bays	21 110 in 2004, 20 815 in 2005
No. of GIS CB-bay-years for F rate calculation	42 328
No. of countries	22

WB A3.06 - Reliability of HV equipment – GIS population

Collected GIS service experience /CB-bay-years/ for failure rate calculation – 1995 (life time) & new survey comparison (4 years)
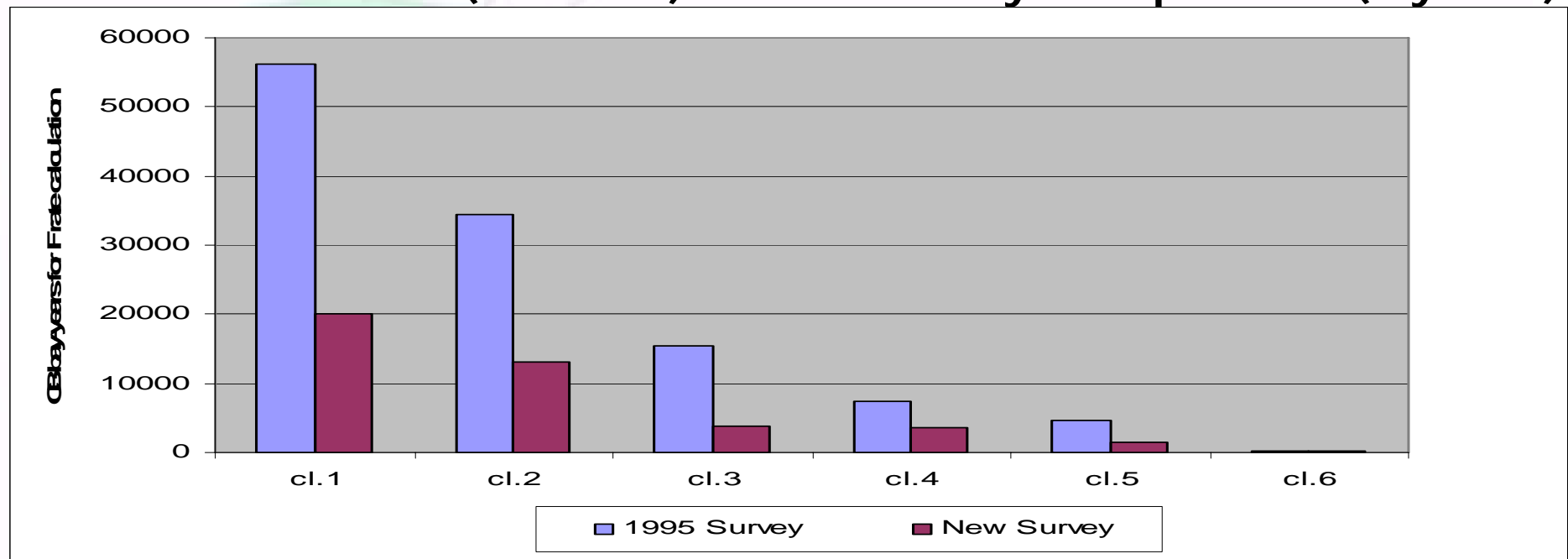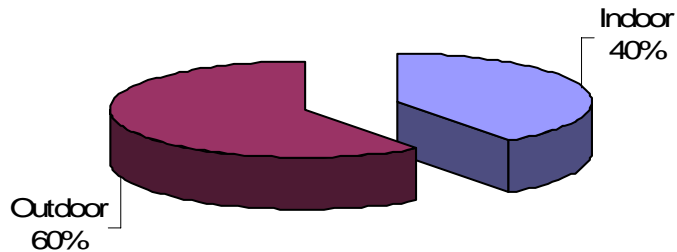

Voltage classes : 1 (60<= ... <100 kV), 2 (100<= ... <200 kV), 3 (200<= ... <300 kV),
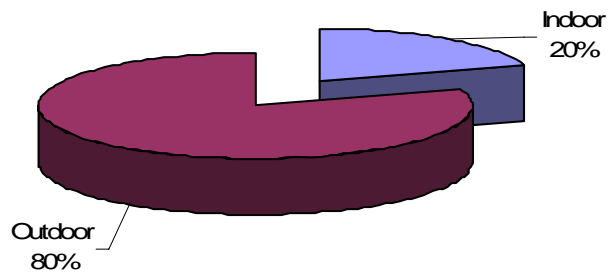4 (300<= ... <500 kV), 5 (500<= ... <700 kV), 6 (>=700 kV)

Influence of one dominant country (in both surveys) – new survey :
Total : 67% , Classes 1, 3 and 5 : 95% , Class 2 : 15%, Class 4 : 35%

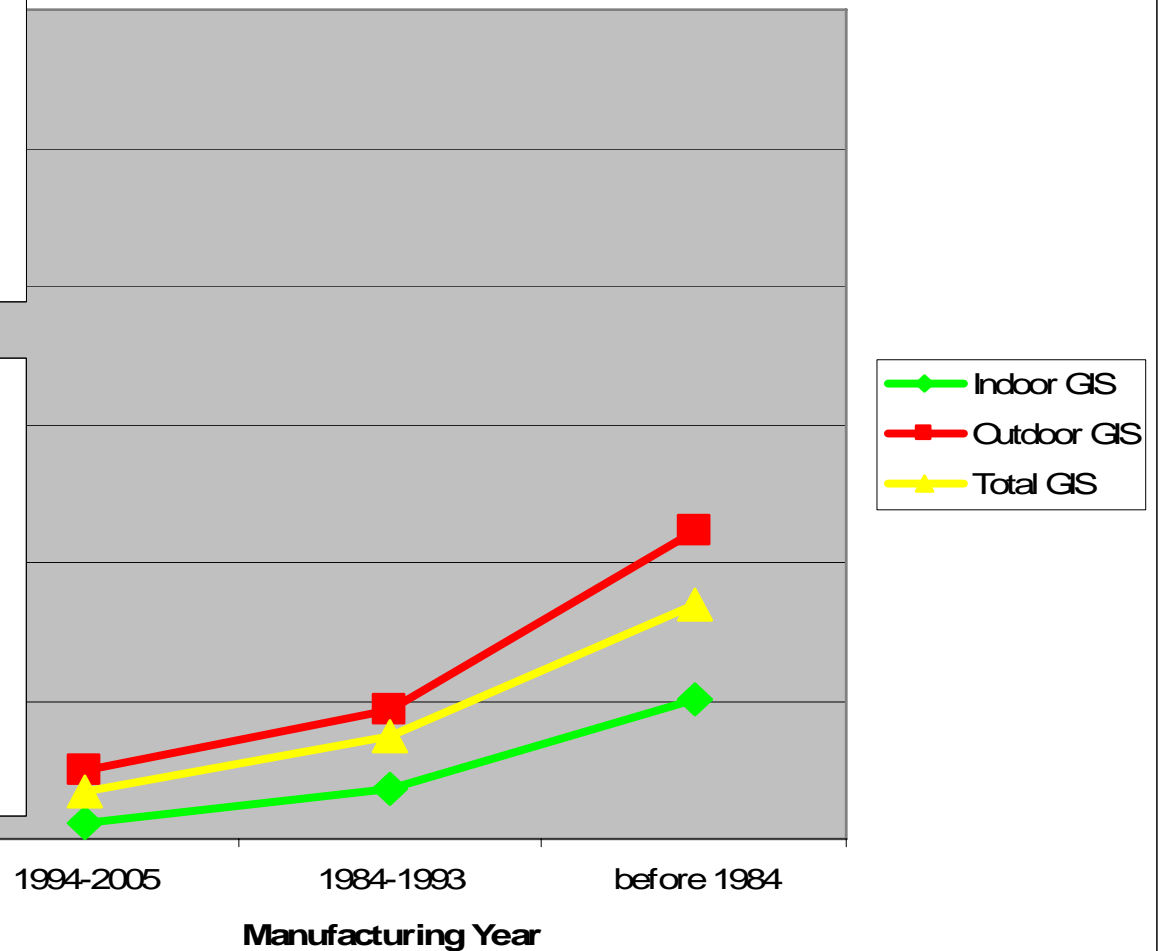# WB A3.06 - Reliability of HV equipment – GIS failure rate

New survey GIS experience location distribution

Indoor 40%

Outdoor 60%

New survey GIS MaF location distribution

Indoor 20%

Outdoor 80%

New survey major failure (MaF) rates location and age distribution

- Indoor GIS
- Outdoor GIS
- Total GIS

1994-2005   1984-1993   before 1984

Manufacturing Year

WB A3.06 - Reliability of HV equipment – GIS failure rate

New survey MaF rates voltage class and age distribution
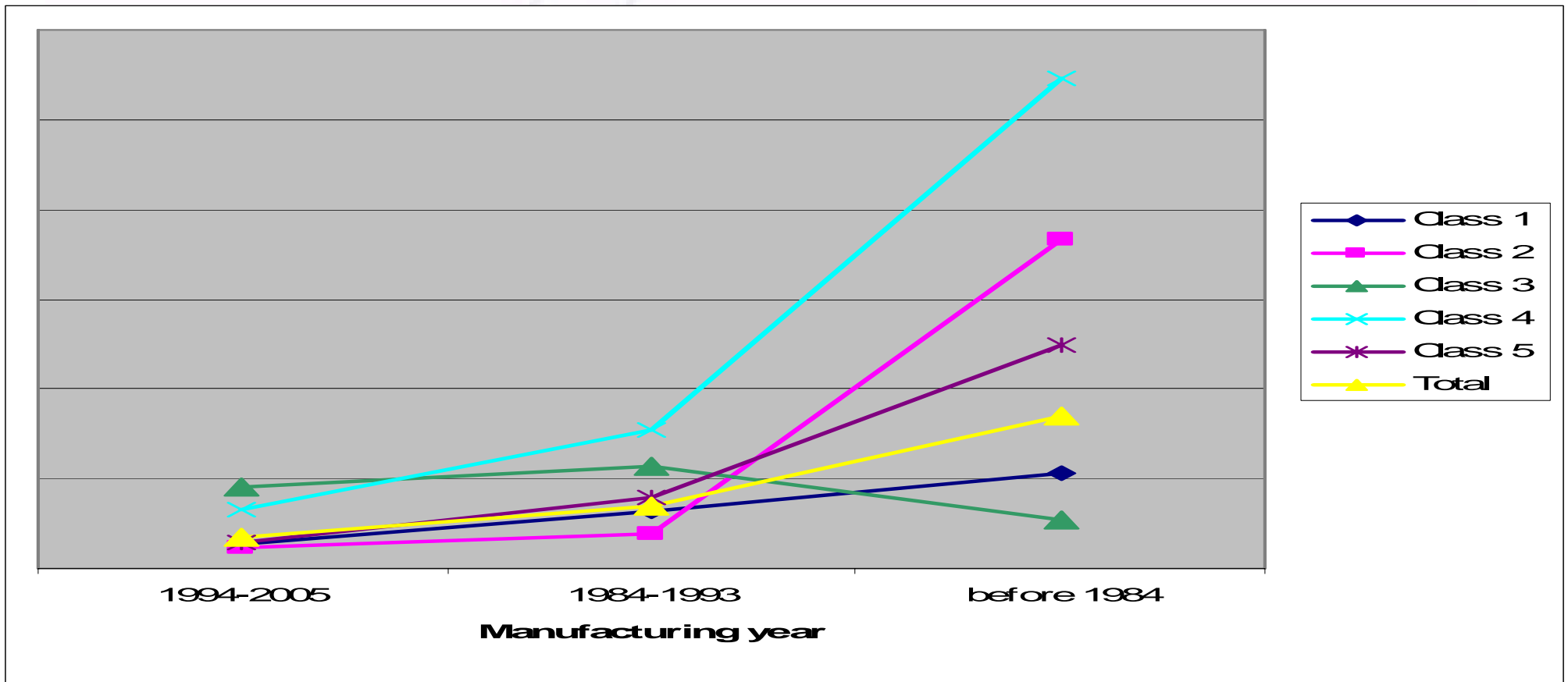
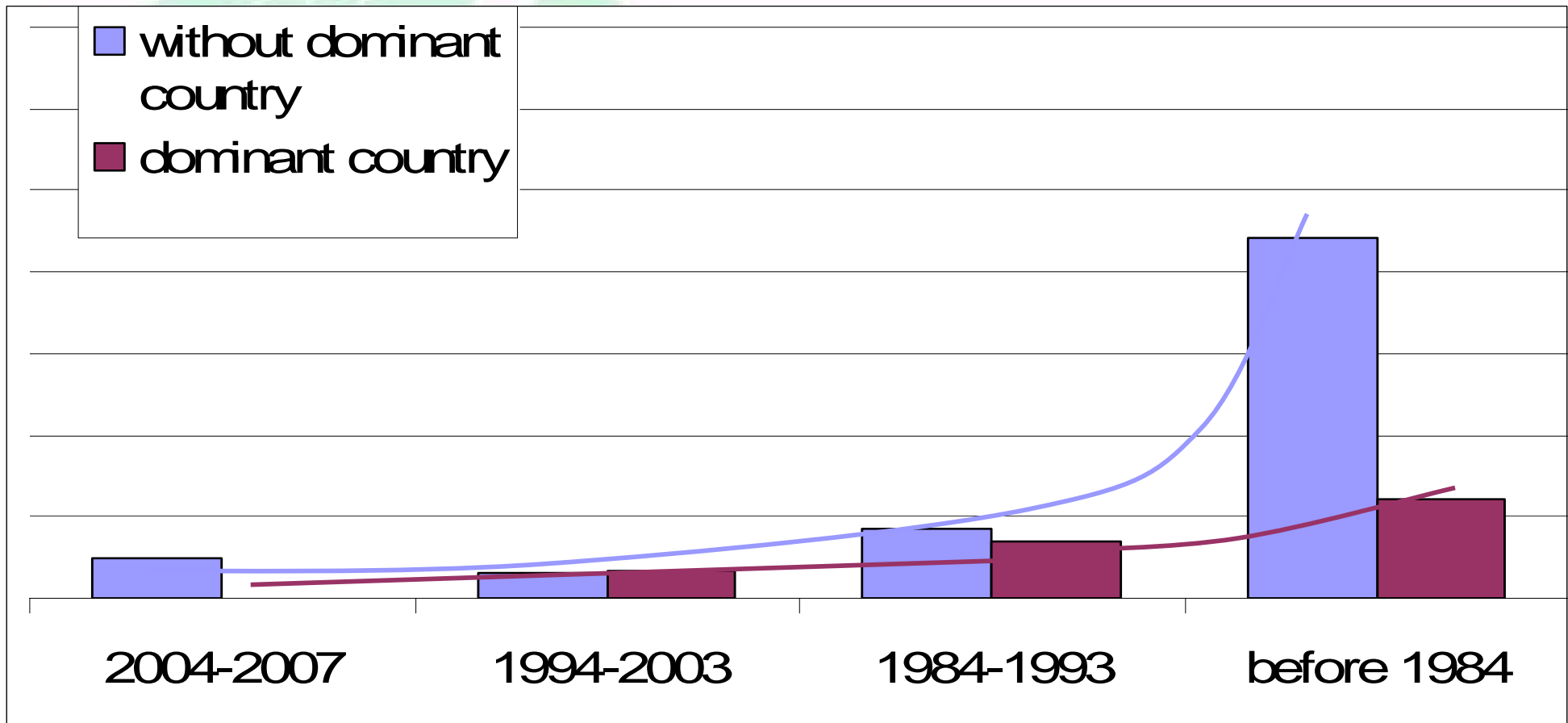Voltage classes : 1 (60<= ... <100 kV), 2 (100<= ... <200 kV), 3 (200<= ... <300 kV),
4 (300<= ... <500 kV), 5 (500<= ... <700 kV), 6 (>=700 kV)
One dominant country prevails in classes 1,3 and 5, Europe prevails in classes 2 and 4

Example of one dominant country influence on MaF rates – comparison of the country MaF rates with the rest of the world results /MaF/ CB-bay-year/
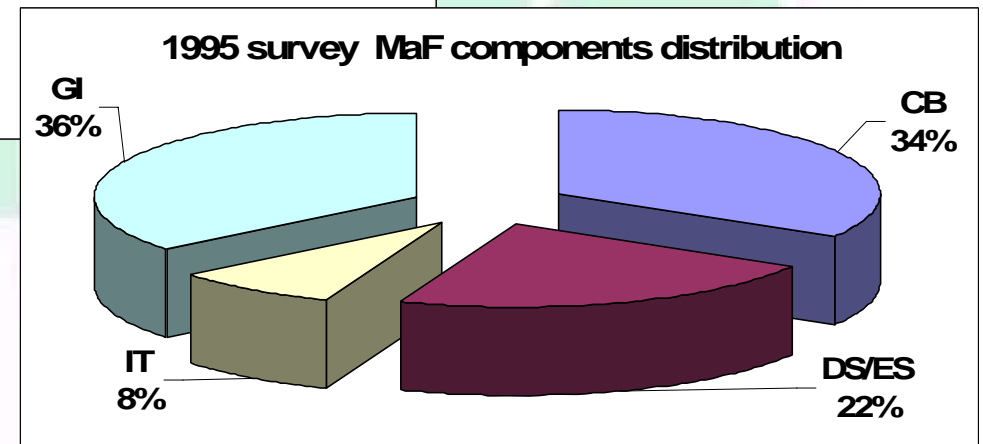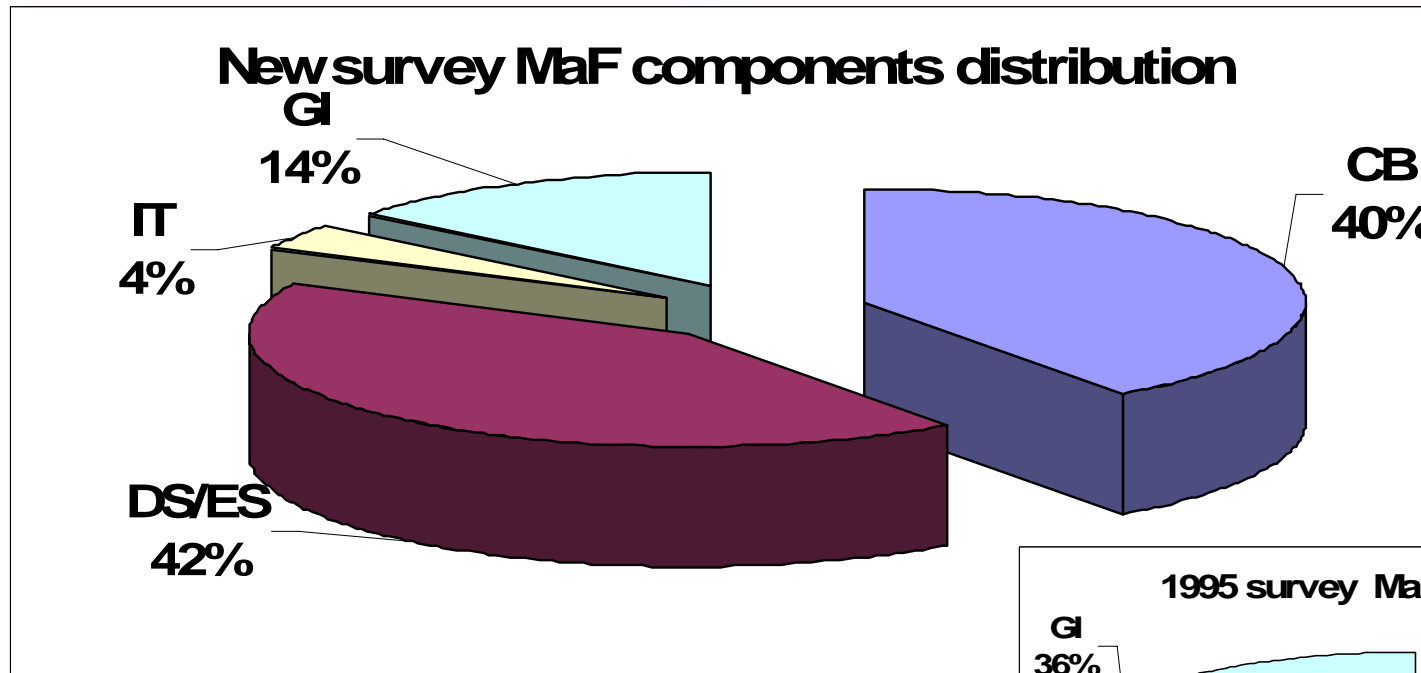

Legend:
- without dominant country
- dominant country

Categories: 2004-2007, 1994-2003, 1984-1993, before 1984

WB A3.06 - Reliability of HV equipment – GIS failures

New survey MaF components distribution

- GI 14%
- IT 4%
- DS/ES 42%
- CB 40%

1995 survey MaF components distribution

- GI 36%
- CB 34%
- IT 8%
- DS/ES 22%

CB = Circuit breaker, DE = Disconnectors or earthing switches,
IT = Instrument transformers, GI = Other parts in GIS than CB, DE and IT (namely busbars and busducts)

WB A3.06 - Reliability of HV equipment – GIS failures
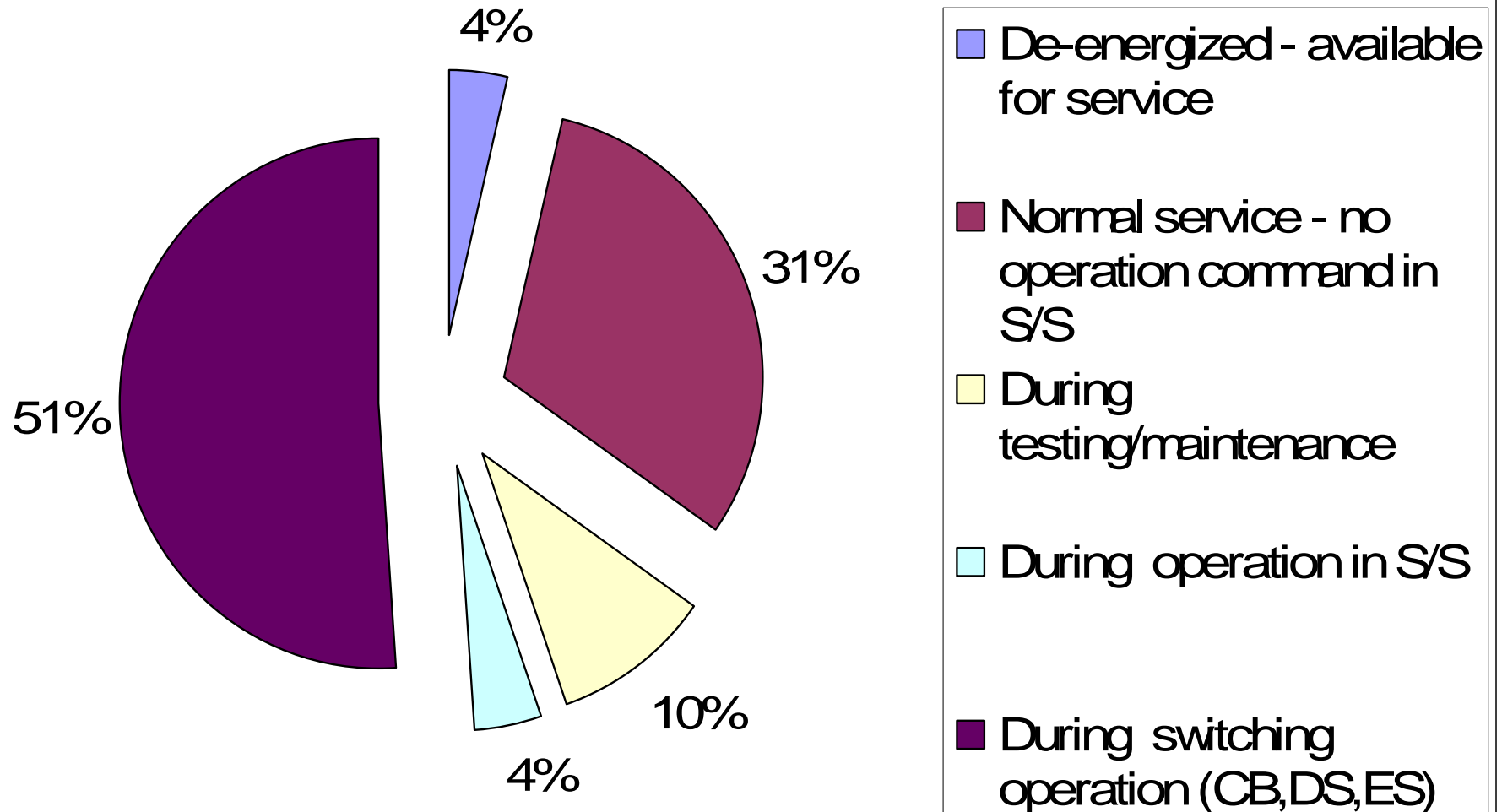
GIS age influence on MaF components distribution
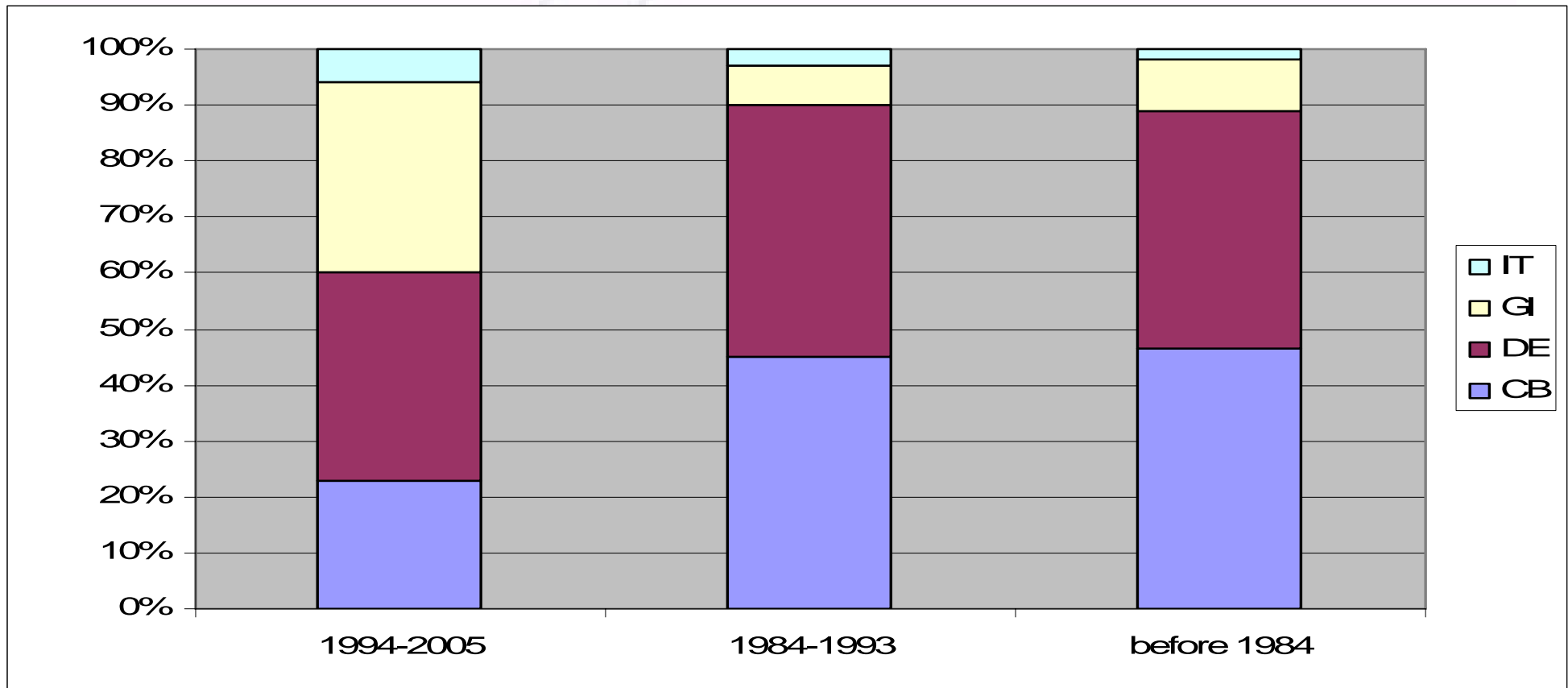
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WB A3.06 - Reliability of HV equipment – GIS failures

New survey service conditions when MaF discovered distribution

- 4%
- 31%
- 51%
- 10%
- 4%

Legend:
- De-energized - available for service
- Normal service - no operation command in S/S
- During testing/maintenance
- During operation in S/S
- During switching operation (CB,DS,ES)

WB A3.06 - Reliability of HV equipment – GIS failures

GIS MaF mode distribution /% of MaF/ - 1995 & new survey comparison
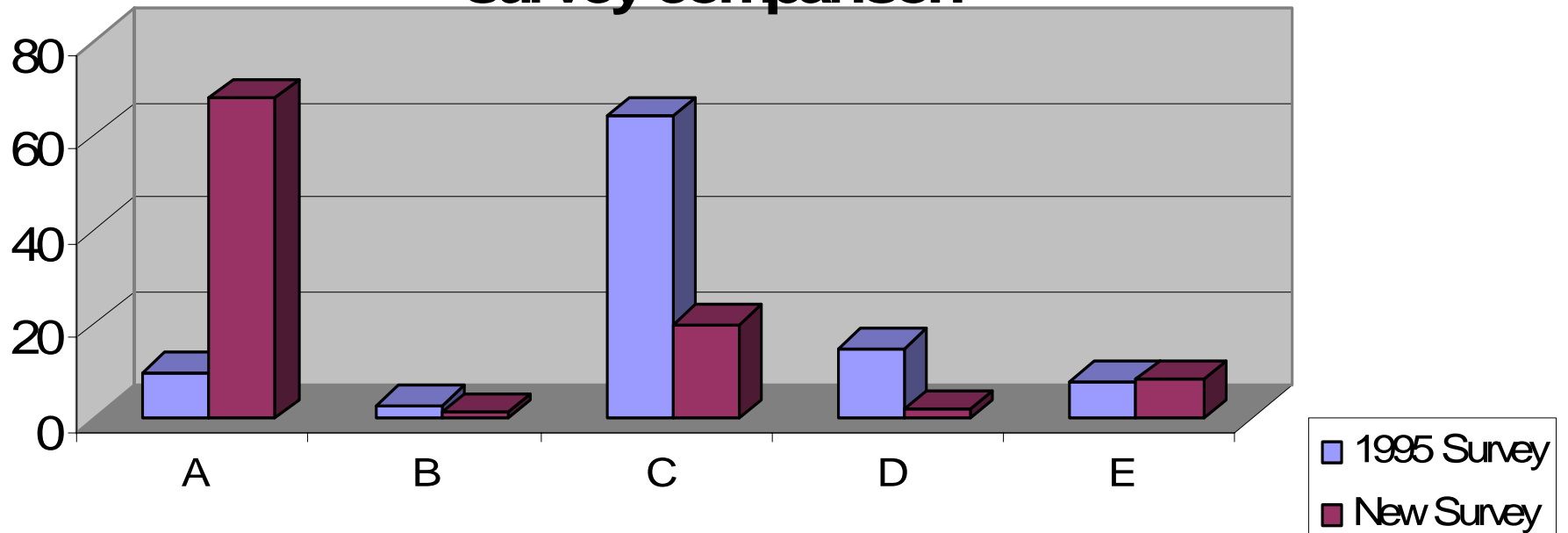
A - Failing to perform requested operation or function resp.
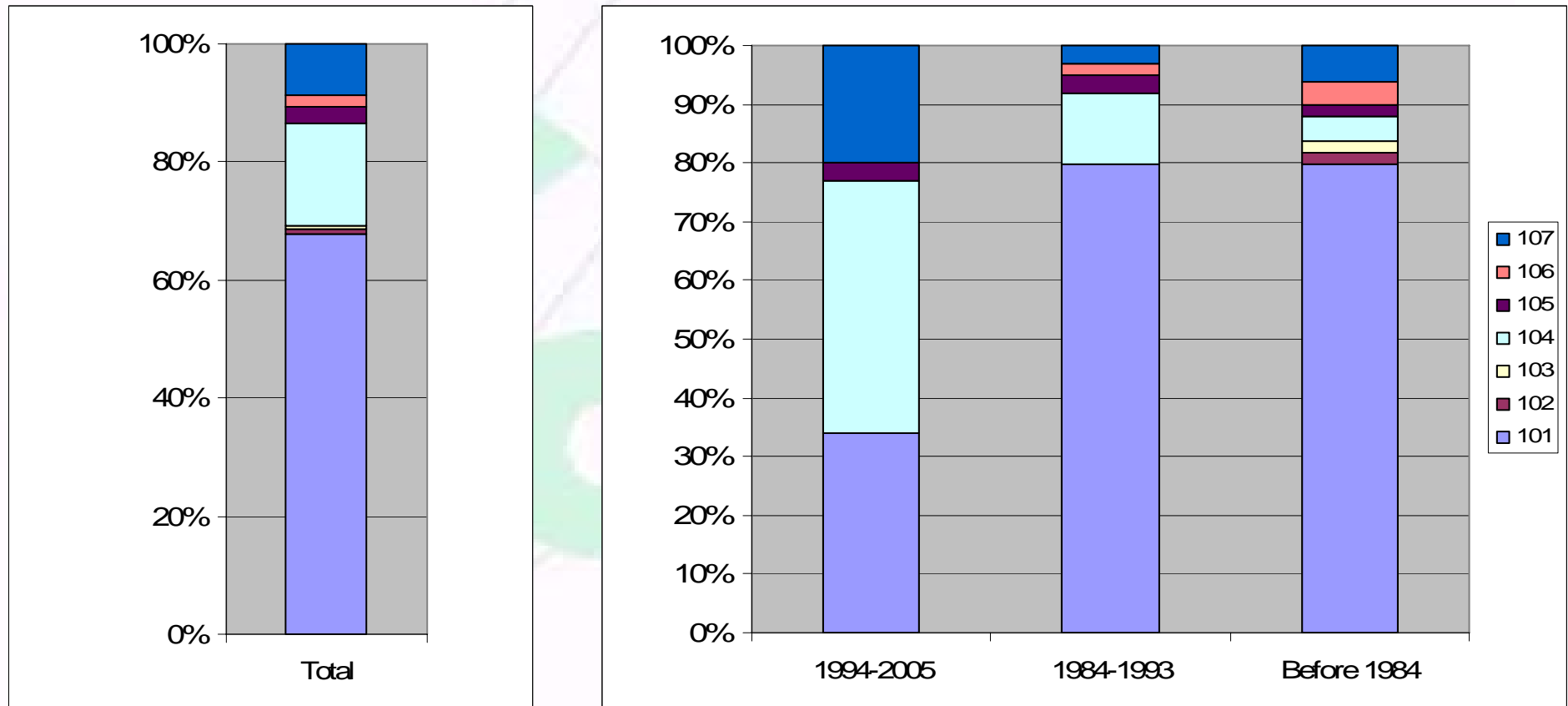B - Loss of electrical connections integrity
C - Dielectric breakdown
D - Loss of mechanical integrity (big SF6 leakage incl.)
E- Other

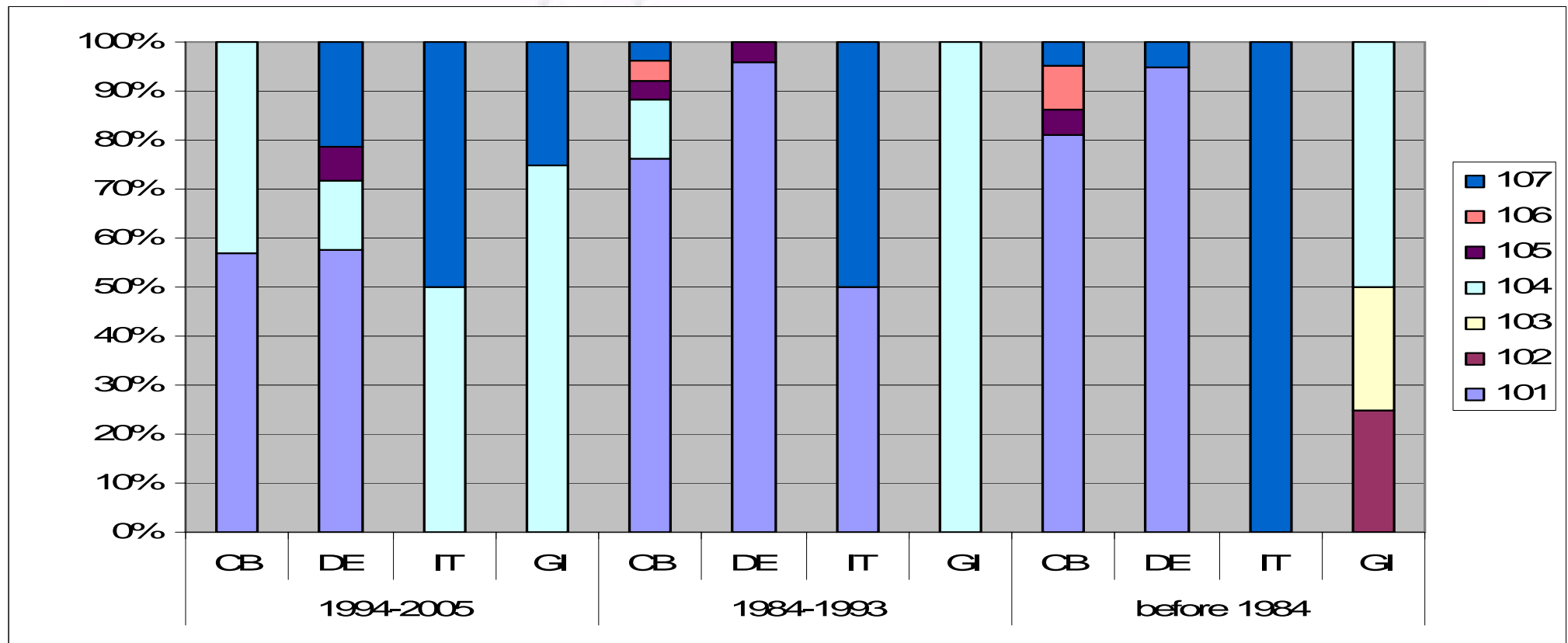# WB A3.06 - Reliability of HV equipment – GIS failures

GIS age influence on MaF mode distribution

101 = Failing to perform requested operation or function, 102 = Loss of electrical connection integrity in primary, 103 = Loss of electrical connection integrity in secondary, 104 = Dielectric breakdown in normal service (without switching operation), 105 = Dielectric breakdown in connection with switching operation, 106 = Loss of mechanical integrity, 107 = Unknown or other than options in the questionnaire

WB A3.06 - Reliability of HV equipment – GIS failures

GIS component & age influence on MaF mode distribution

101 = Failing to perform requested operation or function, 102 = Loss of electrical connection integrity in primary, 103 = Loss of electrical connection integrity in secondary, 104 = Dielectric breakdown in normal service (without switching operation), 105 = Dielectric breakdown in connection with switching operation, 106 = Loss of mechanical integrity, 107 = Unknown or other than options in the questionnaire

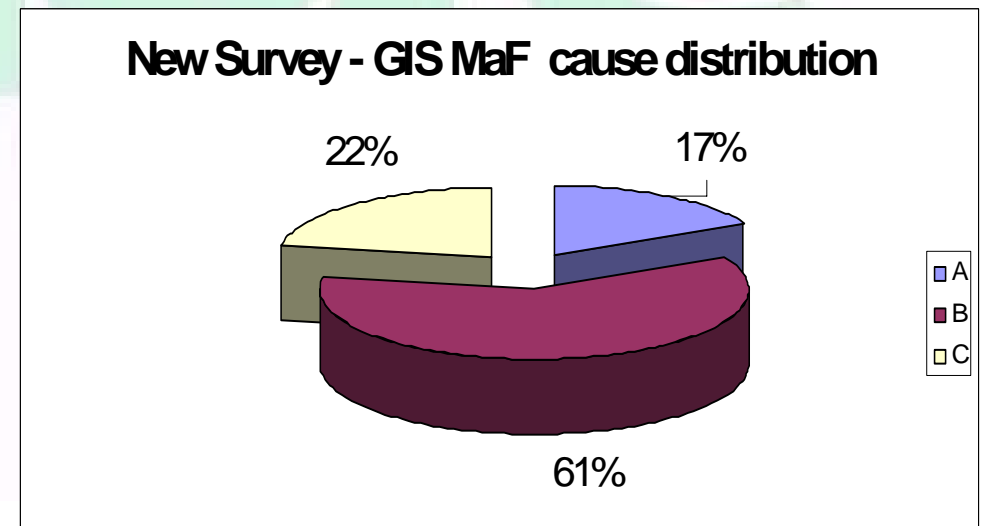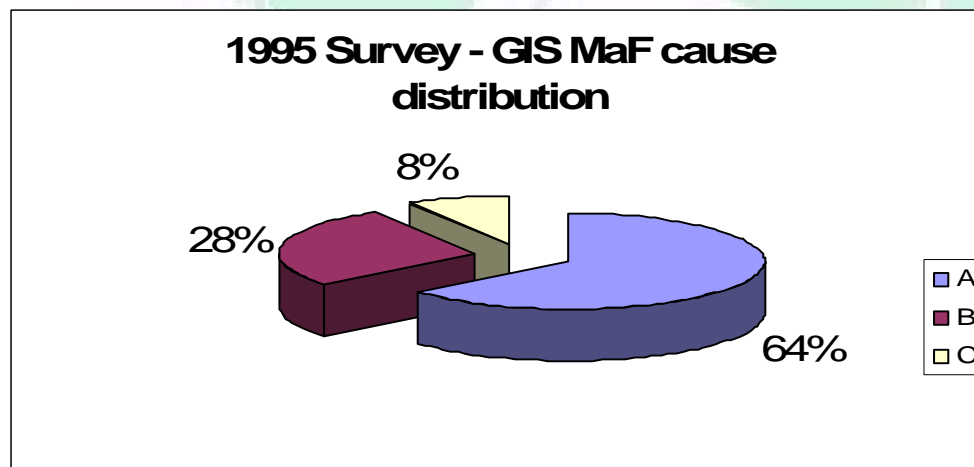# WB A3.06 - Reliability of HV equipment – GIS failures

A - Cause introduced during a period before putting into service

Design fault (manufacturer), Engineering fault (utility), Manufacturing fault, Incorrect transport or erection, Inadequate instructions for transport, erection, operation, Other before PTS

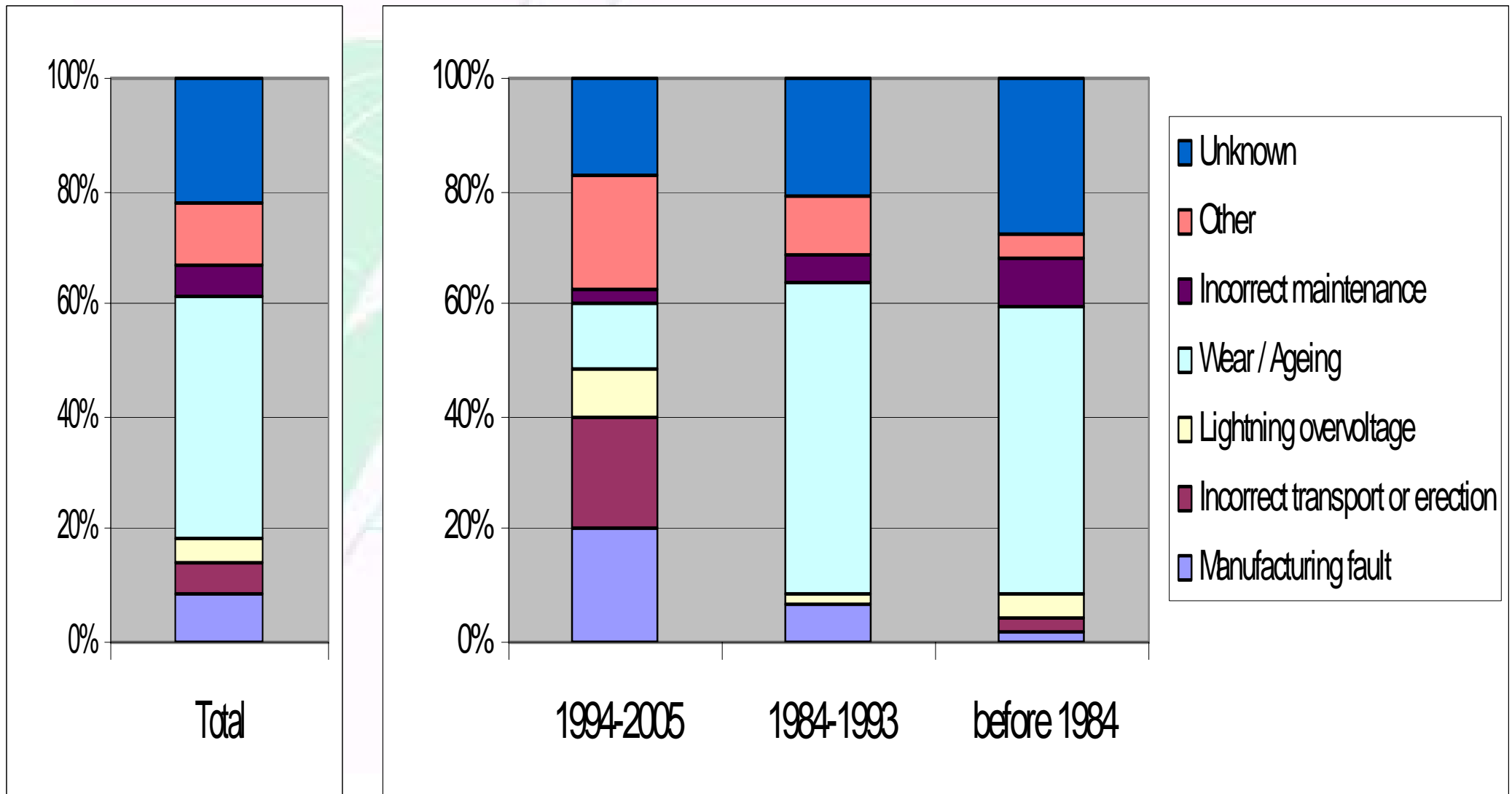## B - Cause introduced during service

Current in excess of rating, Voltage at power frequency in excess of rating, Switching overvoltage in excess of rating, Lightning overvoltage in excess of rating, Mechanical stress in excess of rating, Environmental stresses (other than lightning), Corrosion, Wear / Ageing, Incorrect operation, Incorrect monitoring, Electrical failure of adjacent Equipment, Mechanical failure of adjacent equipment, Human error, Incorrect maintenance, External damage caused by animals, humans etc. Other abnormal service conditions
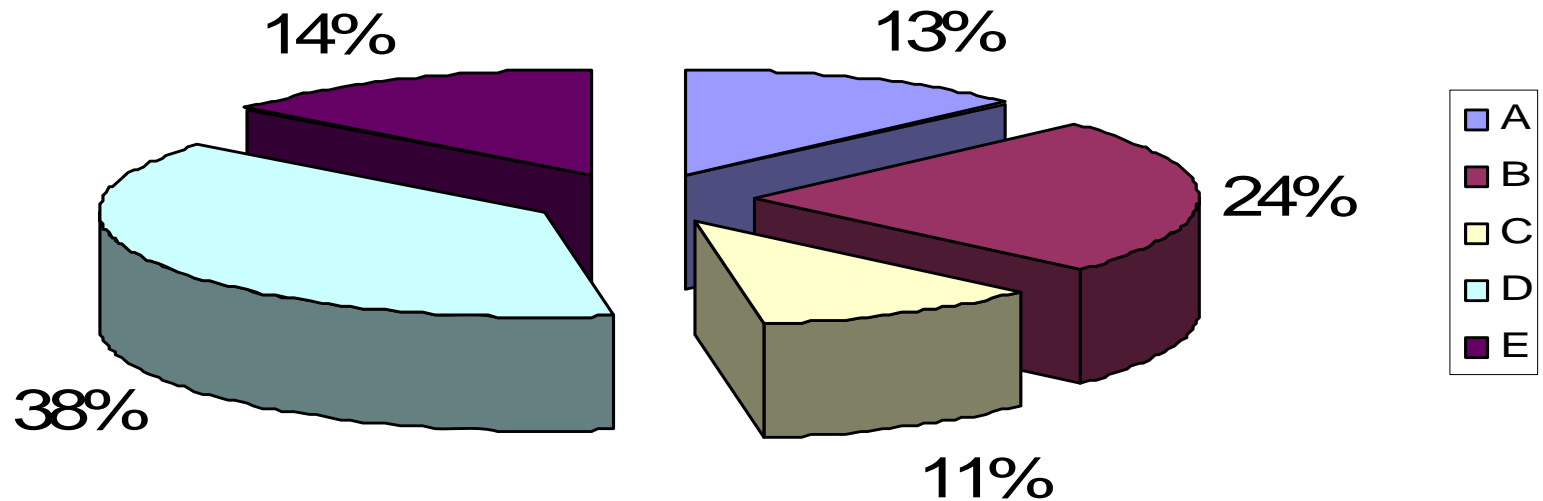
C - Unknown other causes

1995 Survey - GIS MaF cause distribution

8%
28%
64%

- A
- B
- C

New Survey - GIS MaF cause distribution

22%
17%
61%

- A
- B
- C

WB A3.06 - Reliability of HV equipment – GIS failures

GIS age influence on MaF primary cause distribution

Legend:
- Unknown
- Other
- Incorrect maintenance
- Wear / Ageing
- Lightning overvoltage
- Incorrect transport or erection
- Manufacturing fault

Left chart: Total
Right chart: 1994-2005, 1984-1993, before 1984

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New survey MaF origin distribution

14% 13% 24% 11% 38%

Legend:
- A
- B
- C
- D
- E

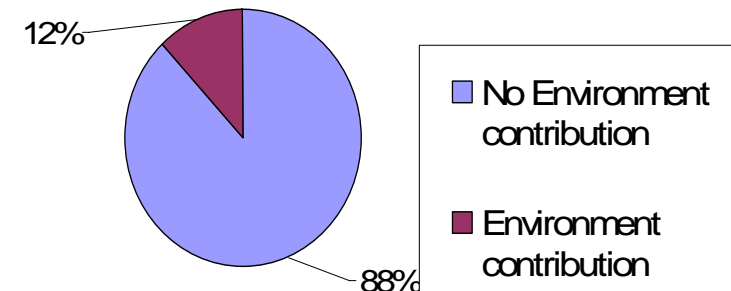A- Mechanical in other parts than operating mechanism
B- Mechanical in operating mechanism
C- Electrical in main circuit
D- Electrical in secondary circuit
E- Unknown

New survey MaF environmental contribution distribution

12% 88%

- No Environment contribution
- Environment contribution

Thank you for your attention

Questions?