CIGRE WG A3.06

Reliability of High Voltage Equipment

Intermediate Results

Circuit Breakers
CIGRE WG A3.06  Reliability of High Voltage Equipment
Intermediate Results

Old Survey  1988-91

70,708 CB years
22 countries

New Survey

55.088 CB / 2004
46.470 CB / 2005
6.329 CB / 2006
14.763 CB / 2007

122.650 CB years
21 countries
Age Distribution
Total 122650 CB years

Age Distribution
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Population data
CIRCUIT BREAKERS
Voltage distribution
Old survey

300 ≤ V < 500
14%

500 ≤ V < 700
3%

700 ≤ V
0%

200 ≤ V < 300
15%

100 ≤ V < 200
33%

Voltage distribution
New survey

300 ≤ ... <500 kV
10.2%

500 ≤ ... <700 kV
2.7%

63 ≤ V < 100
35%

>= 700 kV
0.1%

100 ≤ ... <200 kV
35.7%

200 ≤ ... <300 kV
14.5%

60 ≤ ... <100 kV
36.7%

Population data
Type of enclosure

Old survey

Non metal enclosed 57%
Metall encosed 43%

New survey

Non metal enclosed 38%
Dead tank 29%
GIS - 3 phase 15%
GIS - 1 phase 18%
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Location
Old survey

Indoors 15%
Outdoors 85%

Location
New survey

Indoor 16%
Outdoor 84%

Population data

Location

CIRCUIT BREAKERS
Type of operating mechanism

Old survey

- Pneumatic: 30%
- Hydraulic: 52%
- Spring: 18%

New survey

- Pneumatic: 23%
- Hydraulic: 27%
- Spring: 49%
- Other: 1%

Population data
Maintenance philosophy
New survey

- Combination 37.9%
- Run to failure 0.0%
- Condition based 4.7%
- Time based 57.2%
- Other 0.2%
Failure Distribution
Old Survey
1988-91

Minor: 3358
Major: 475

New Survey
up to 2007:
2342 reports

Failure classification
old survey

major
12%

minor
88%

Failure classification
new survey

major

minor
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Contribution of environment

Contribution environment "major"
Old survey
- Sudden variation in temperature: 2%
- Rain: 0%
- Strong wind: 1%
- Snow, ice or hoar-frost: 1%
- Corrosive atmosphere: 0%
- Fog or high humidity: 1%
- Pollution including dust: 0%
- Lightning: 3%
- Others: 1%

No contribution 91%

Contribution environment "major"
New survey
- No contribution 93%
- Others 7%
Service conditions / New survey

1 de-energized - Available for service
2 Normal service - no operation command
3 Normal service operation demanded
4 Fault clearing operation
5 Operation occurred without command
6 During or directly after testing / maintenance

Service conditions

Old survey

- In service or available for service
- During maintenance
- Other cases

Failure data

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CIRCUIT BREAKERS
1+2  Does not close / open on command
20  Locking in open or closed position by the control system
21  Loss of mechanical integrity
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Intermediate Results

Components responsible for major failures

- Component at service voltage
- Electrical control and auxiliary circuits
- Operating mechanism
- Kinematic chain

New survey%
Old survey%

Components responsible
Components responsible for MF dependence on age

- Electrical control and auxiliary circuits
- Operating mechanism
- Component at service voltage
- Kinematic chain

Failure data

Components responsible
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CIRCUIT BREAKERS

- The majority of the CB´s is used at service voltages between 60 and 200 kV
- The majority of the CB´s is installed outdoors
- 54% of the CB´s are used for overhead line switching
- The mainly used type of operating mechanism has changed from hydraulic to spring design
- Most of the failures seem to happen during normal service
- Leakage of SF6 or oil seems still to be a problem
- Operating mechanisms are still the most reported components responsible for mayor failures But getting better!

Main Conclusions
CIGRE WG A3.06
Intermediate Results
Circuit Breakers

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