Vienna 2011 SC A3
Technical Colloquium
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Use of Data from CIGRÉ High Voltage Equipment Reliability Survey

CIGRÉ WG A3-06

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Background-The Value of Reliability Data

- Reliability data helps decision makers in three key areas
  - New Asset/Design Performance
  - Existing Asset (equipment) Life Expectations
  - Network Performance
- Many electricity networks have an increasing aged population
  - Survey will help understand impact and mitigate
  - Plan for the future
    - Maintenance
    - Replacement
- Many electricity networks are new or expanding
  - Survey will help optimise new design
- Will help using a more statistical approach to asset management
  - Maintain
  - Renew
  - Replace

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Impacting The Future

- Research and Development
  - "Designing Out" Specific Failure Causes
- Improving Standards
  - Targeting Dominant Modes of Failure
- Design Optimization
  - Matching Asset Performance to Network Asset Requirements
- Reducing Manufacturing Costs
- Predicting Life Cycle Costs

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Asset (Equipment) Performance SF_6 Breaker Example

Operating mechanism	MaF frequency (per 100 CB years)	
	Present survey	Previous survey
1 : Hydraulic	0,19	0,31
2 : Pneumatic	0,13	0,27
3 : Spring	0,11	0,27
4 : Other	0,04	n.a.
Total	0,14	0,29

Measure → R&D → Manufacturing → Asset Performance

Design Optimization CB - IT - DE - Comparison

Equipment	CB	IT (per phase)	DE (DS + ES)
Typical number of equipment in substations per 1 CB-bay (example for double busbar)	1	1…2	4 (3+1)
MaF frequency per 3-phase equipment [failures per 100 equipment years]	0,30	0,16	0,21
Summarized MaF frequency of equal equipment per 1 CB-bay [failures per 100 equipment years]	0,30	0,16…0,32	0,84
Number of MaF in period of 1 CB-MaF	**1**	**0,5…1**	**2,5**

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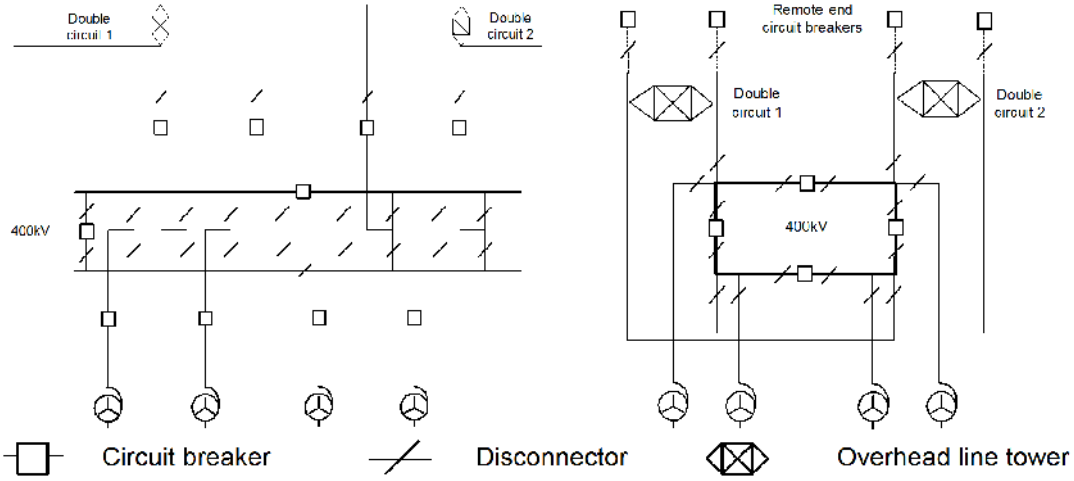
Impacting Current Operations

- Matching maintenance tasks to asset needs.
- Harmonizing asset availability with network availability requirements
- Targeting on-line monitoring investments
- Reducing the risk and impact of failure

Harmonizing Availability and Reliability Needs

- Compare reliability of two different substation layouts



Impacting End-of-life

- Differentiating between asset functional life and asset book life
- Making the decision to:
  - Continue to maintain
  - Renew
  - Replace

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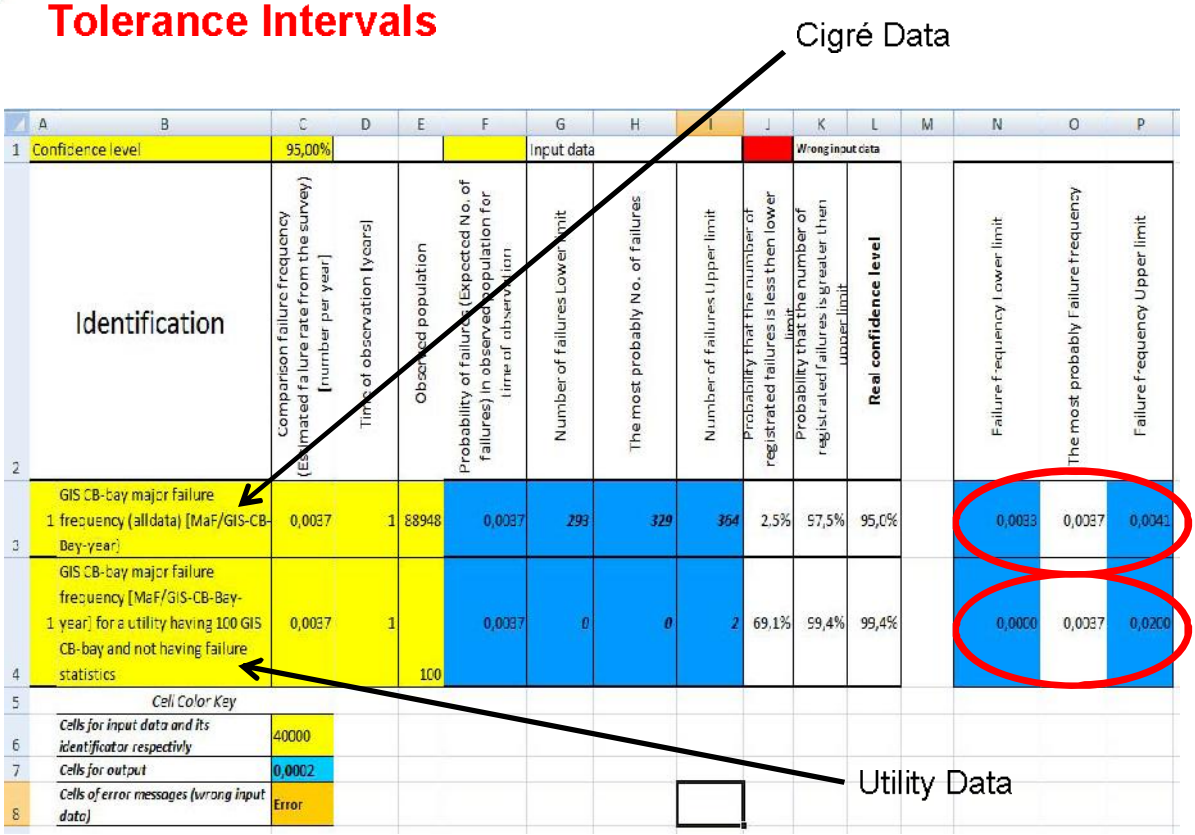
Does Age Matter?

40 Years Old

20 Years Old

Applying Survey Data to Utility

Tolerance Intervals



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Confidence level		95,00%				Input data				Wrong input data					
2	Identification		Comparison failure frequency (Estimated failure rate from the survey) [number per year]	Time of observation [years]	Observed population	Probability of failure (Expected No. of failures) in observed population for time of observation	Number of failures Lower limit	The most probably No. of failures	Number of failures Upper limit	Probability that the number of registrated failures is less then lower limit	Probability that the number of registrated failures is greater then upper limit	**Real confidence level**		Failure frequency Lower limit	The most probably Failure frequency	Failure frequency Upper limit
3	1	GIS CB-bay major failure frequency (alldata) [MaF/GIS-CB-Bey-year]	0,0037	1	88948	0,0037	*293*	*329*	*364*	2,5%	97,5%	95,0%		0,0033	0,0037	0,0041
4	1	GIS CB-bay major failure frequency [MaF/GIS-CB-Bey-year] for a utility having 100 GIS CB-bay and not having failure statistics	0,0037	1	100	0,0037	*0*	*0*	*2*	69,1%	99,4%	99,4%		0,0000	0,0037	0,0200
5		*Cell Color Key*														
6		*Cells for input data and its identificator respectivly*	40000													
7		*Cells for output*	0,0002													
8		*Cells of error messages (wrong input data)*	Error													

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- Benchmarking-compare utility failure data with Cigré data
- Utility has no failure data and desires to predict failure frequency based on Cigré
- Utility has failure data and desires to predict failure frequency based on historical data

Conclusion

- The survey will have numerous uses both for equipment and networks
- The results will be useful through the whole life cycle
  - Design
  - Manufacturing
  - Operation
  - Replacement

- The data is important
  - For aging equipment and networks
  - Planned new expansion

- Will aid in the adoption of statistical methods of asset management