



STATISTICS AND TYPES OF FAULTS

CONDITION MONITORING

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DIAGNOSIS AND PROGNOSIS



Failure is an event that results complete or partial loss of the object functionality.

Diagnosis (*detection of cause*)

Identification of the fault by monitoring symptoms.

Examples:

- Detection of certain harmonics in frequency spectrum
- Voltage is unbalanced
- Phase is dropped

Prognosis (*impact of fault*)

Studying of fault impact on various performance parameters.

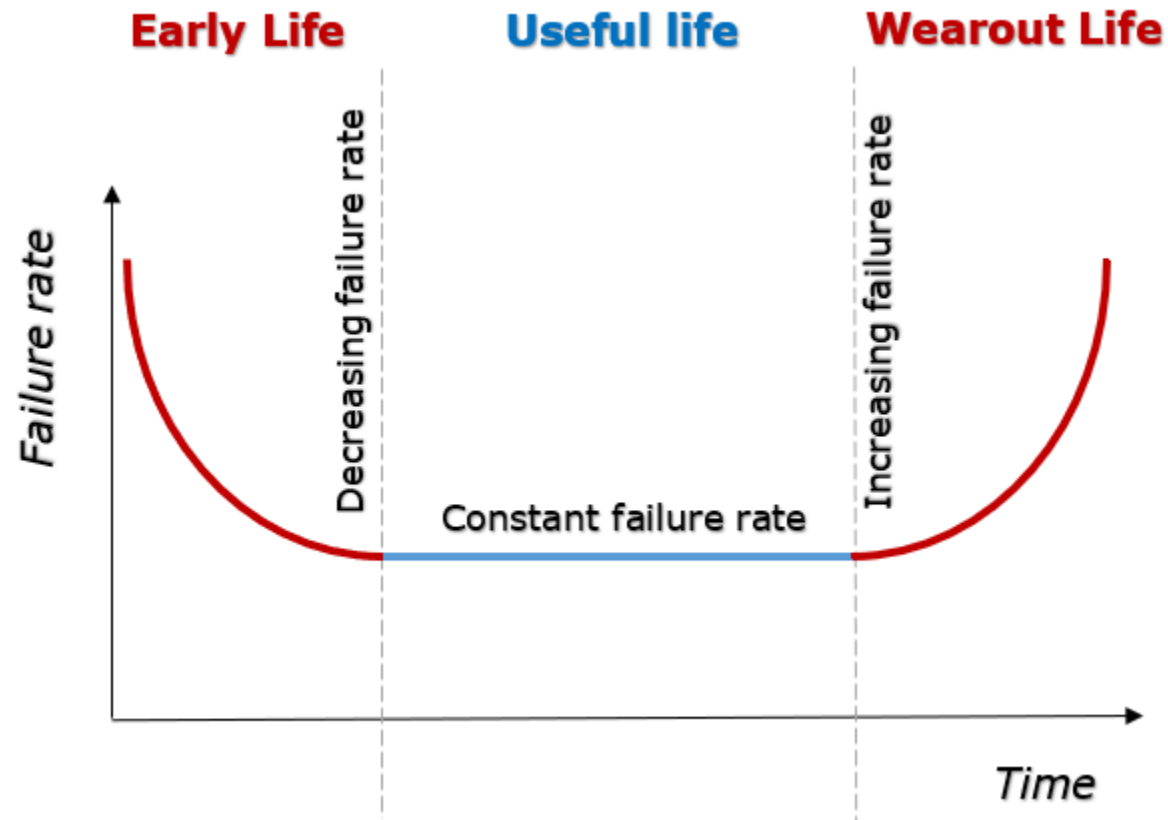
Examples:

- If bar is broken, the field is no longer uniformly distributed
- If one phase is dropped, the neutral current will increase

RELIABILITY OF ELECTRICAL EQUIPMENT

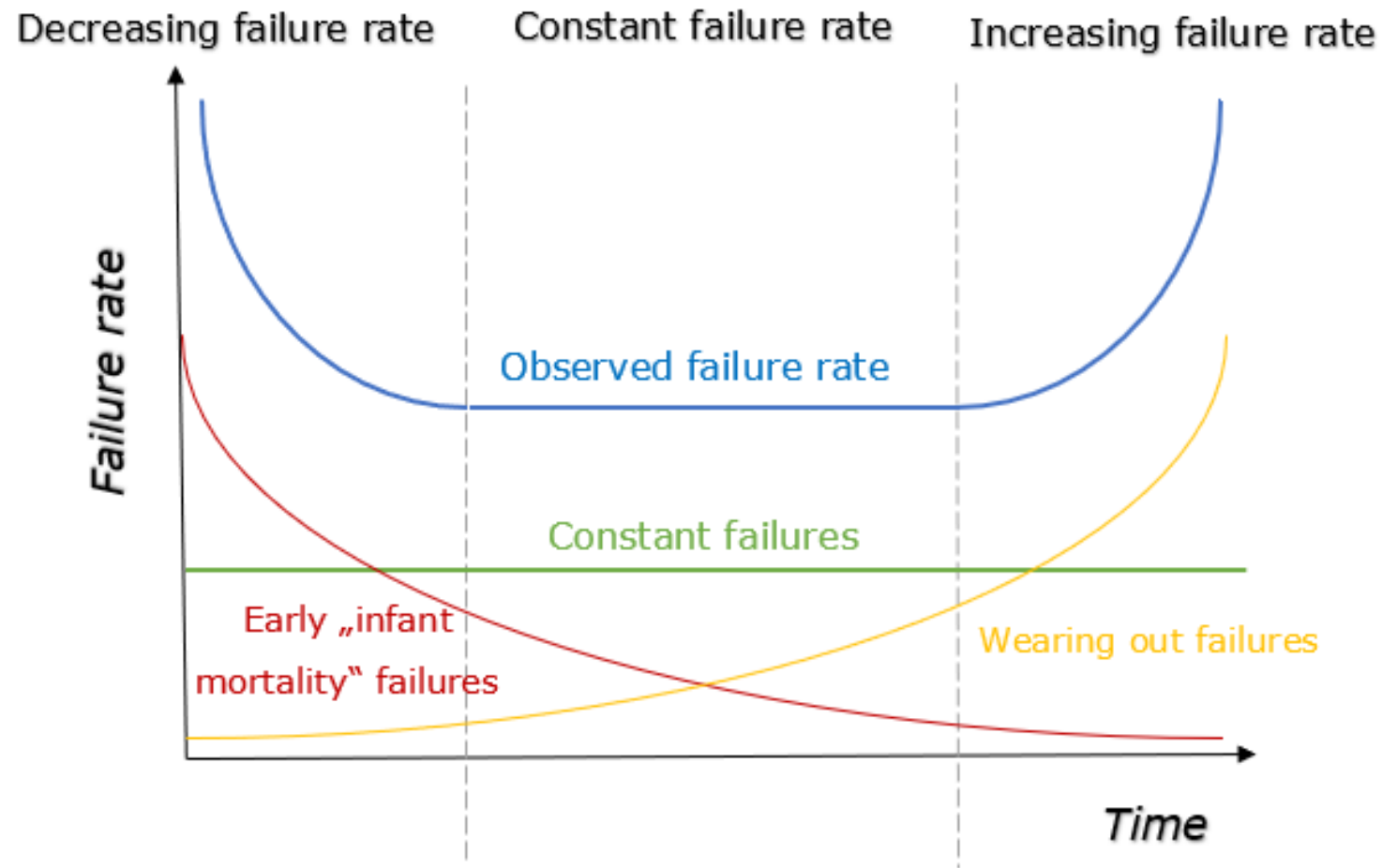
WEIBULL MODEL

Reliability is an ability of an object to perform desired operation and sustain it within a defined interval of time.



RELIABILITY OF ELECTRICAL EQUIPMENT

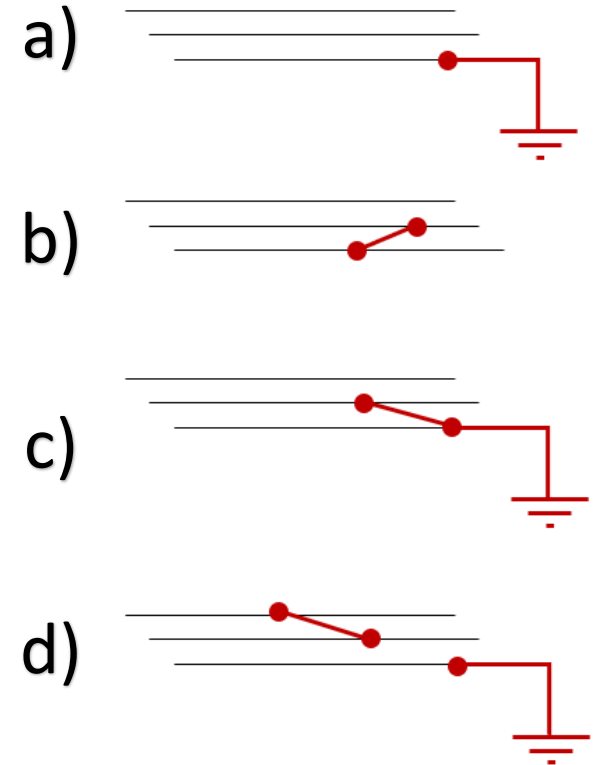
WEIBULL MODEL



COMMON ELECTRICAL FAULTS POWER SYSTEMS

Asymmetrical faults:

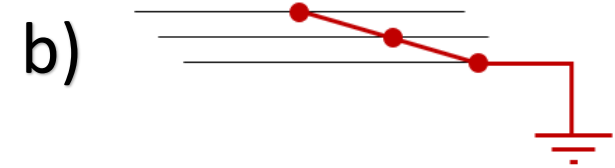
- a) Phase-to-Ground 70%
- b) Phase-to-Phase 15%
- c) Two Phases to Ground 10%
- d) Phase to Phase and Phase to Ground 2-3%



COMMON ELECTRICAL FAULTS POWER SYSTEMS

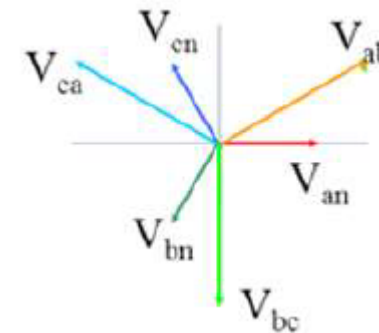
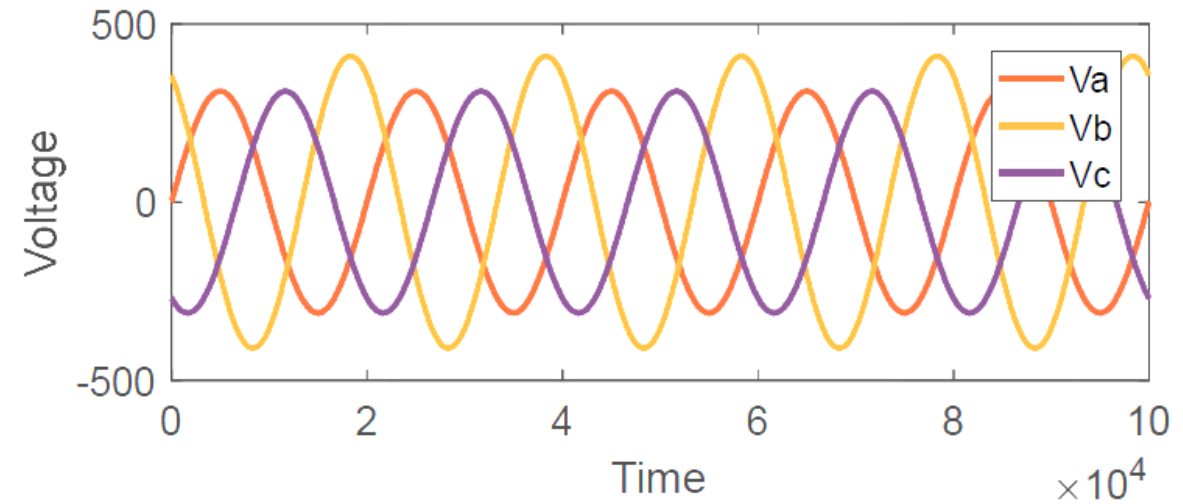
Symmetrical faults:

- a) Three Phases Short Circuited 2-3%
- b) Three Phases to Ground 2-3%



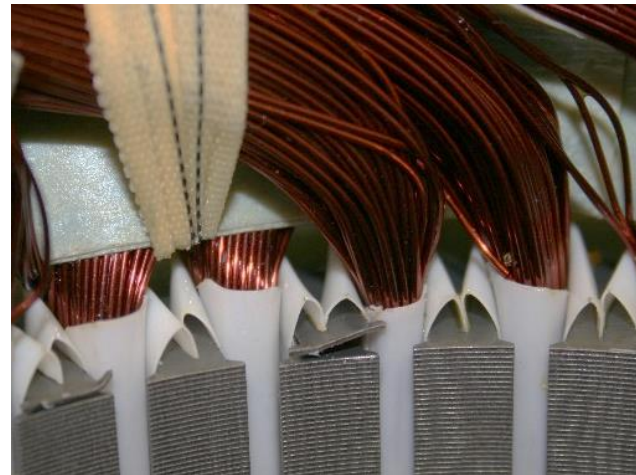
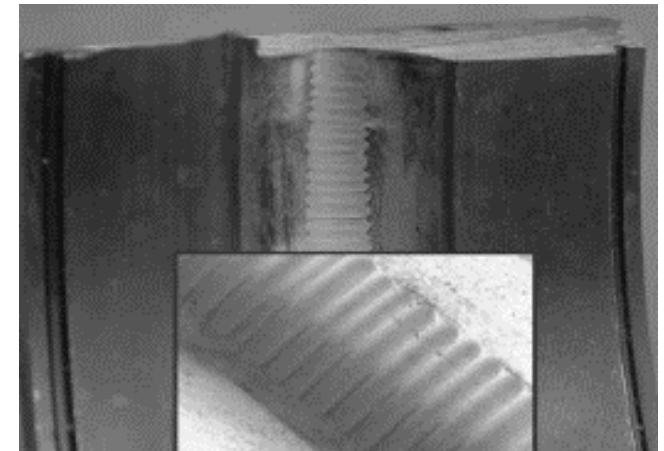
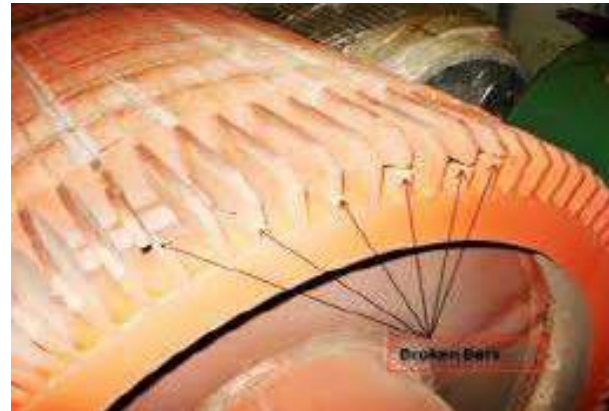
COMMON ELECTRICAL FAULTS MACHINES AND TRANSFORMERS

1. Unbalanced supply voltage
2. Overvoltage
3. Phase reversal
4. Overload



COMMON MECHANICAL FAULTS

1. Stator faults
2. Rotor faults
3. Eccentricity
4. Bearing faults
5. Overload couplings
6. Winding insulation faults



COMMON ENVIRONMENTAL FAULTS

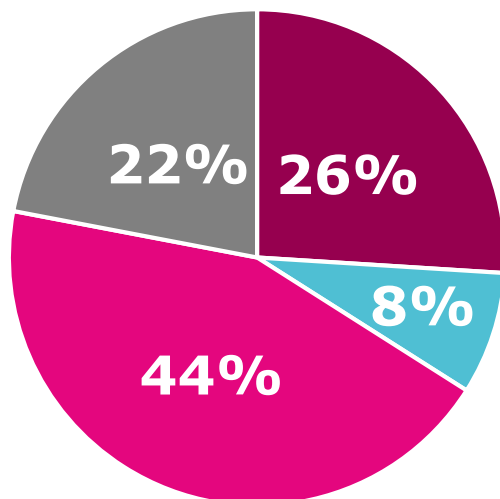


1. Ambient high/low temperature,
2. Cooling system failure,
3. Moisture,
4. Dust and dirt,
5. Vibrations due to bad foundation...

FAULT CONTRIBUTION IN ELECTRICAL MACHINES COMPARISON OF THE SURVEYS

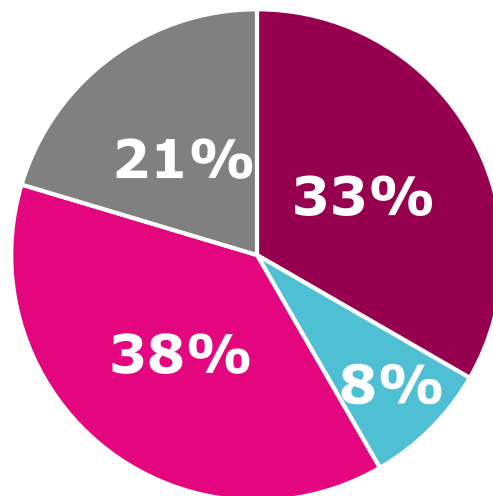


IEEE-IAS % of failures



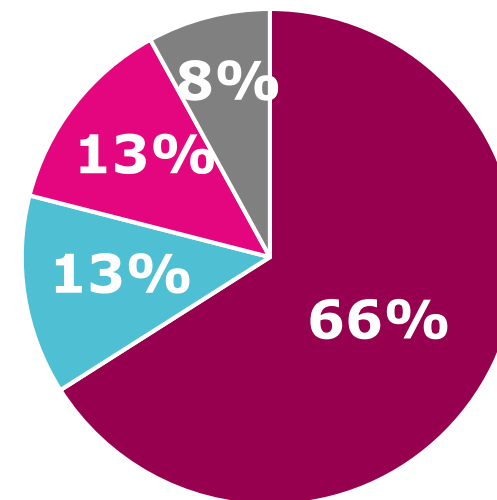
■ Stator fault ■ Rotor fault ■ Bearing fault ■ Other

EPRI % of failures



■ Stator fault ■ Rotor fault ■ Bearing fault ■ Other

Allianz % of failures



■ Stator fault ■ Rotor fault ■ Bearing fault ■ Other

FAULT DIAGNOSIS CATEGORIES (1)



1. Temperature measurement

(local point measurement, thermal imaging, temperature measuring of cooling fluid)

2. Electromagnetic field monitoring

(changes in normal distribution of magnetic field)

3. Radio-frequency emissions monitoring

(radiated emission produced by the windings, inverters and supply cables)

4. Chemical analysis

(oil analysis, chemical analysis insulation degradation, coolant gas analysis)

FAULT DIAGNOSIS CATEGORIES (2)

5. Acoustic noise measurement

(rolling element failure, high-frequency noise)

6. Motor-current signature analysis (MCSA)

(winding short circuit, broken rotor bar(s), eccentricity, bearing fault)

7. Noise and vibration monitoring

(bearing faults, eccentricity)

8. Model, artificial intelligence, neural network techniques

(neural network, fuzzy logic, pattern recognition, etc)



**TAL
TECH**
EMG

THANK YOU!