



Employment of various strategies in Eskom to optimize the management of transformer life cycle and making the transformers part of the smart grid solution

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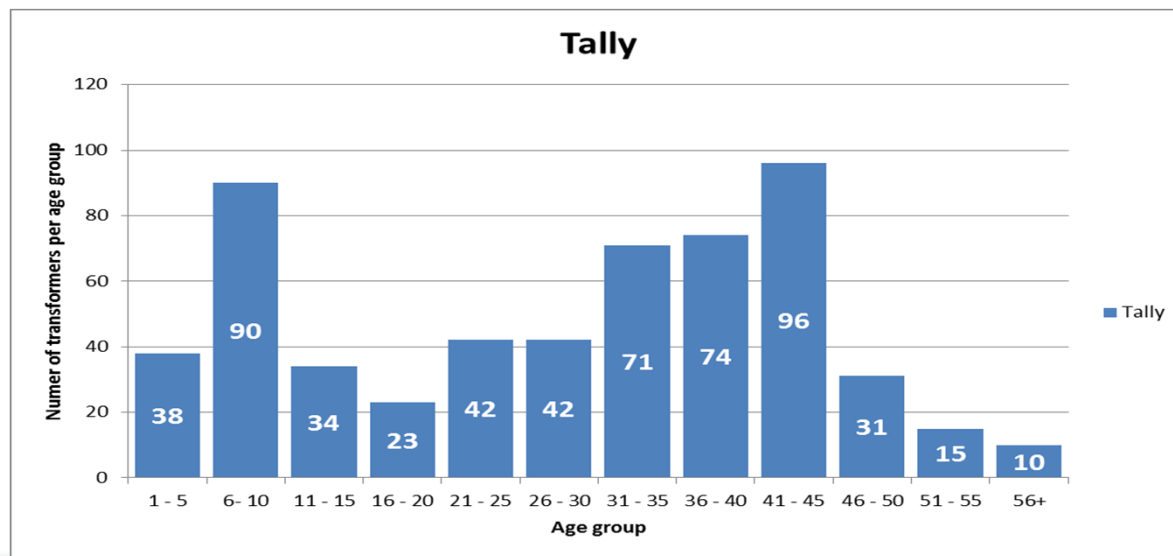


Overview

- Introduction
- Technology Strategy
- Online condition monitoring and control strategy
- Maintenance Strategy
- Asset management replacement strategy
- Conclusion

Introduction

- Eskom is operating about 6 000 power transformers rated at 2.5MVA and above.
- This fleet of transformers is made up of both the modern and the ancient designs.
- The average age of the fleet is about 28 years against the expected life of 35 to 40 years.



Optimization Drivers

- The limited funds to execute transformer replacement, while the aged fleet is growing.
- Sustainability of the network (difficult to secure outages for maintenance)
- The scarce skills to execute the required maintenance and diagnosis.
- The need to avoid contractual penalties with the Independent Power Producers (IPPs)

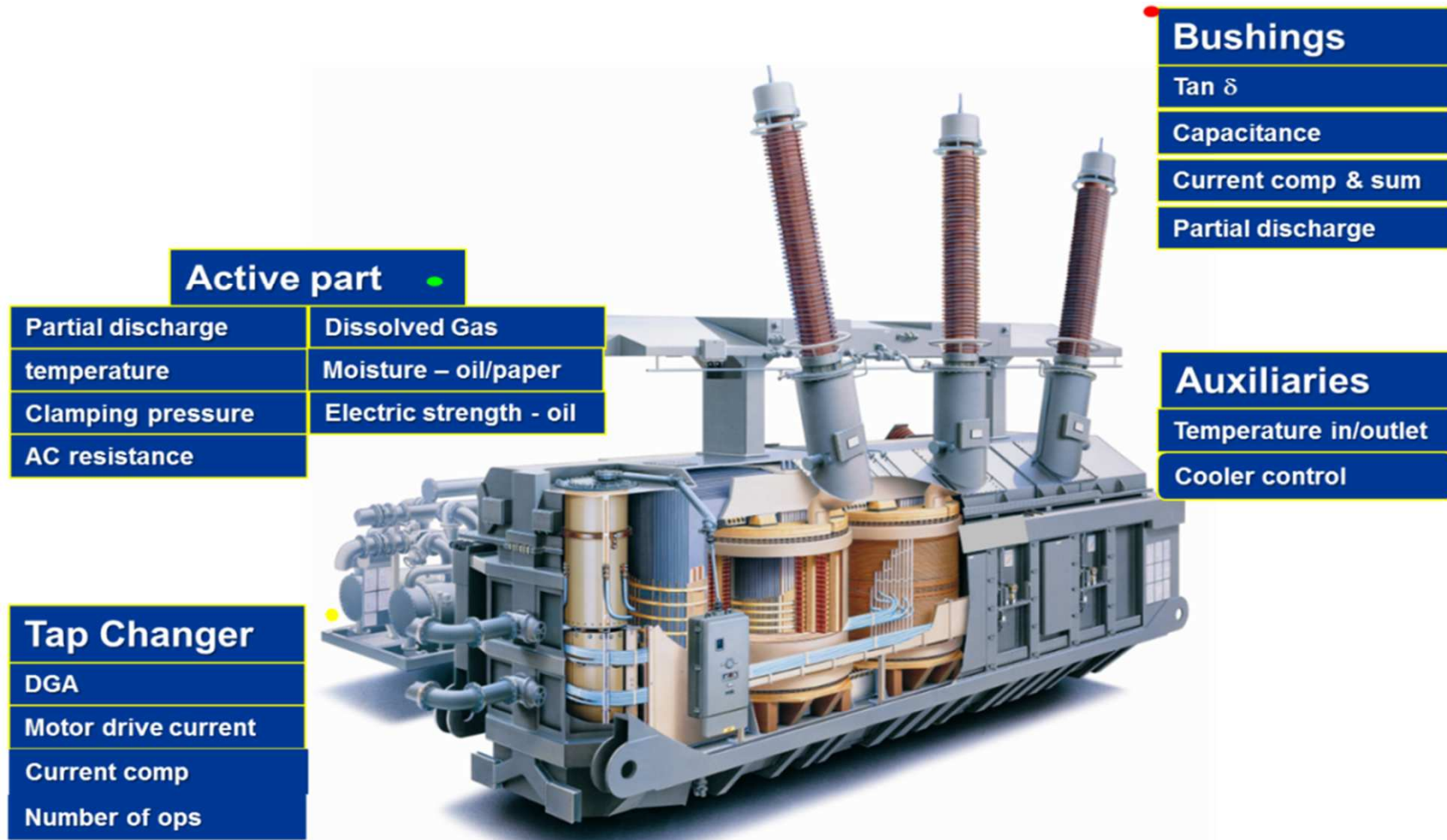
Technology Drivers

- The objectives of technology strategy is to make transformers:
 - Last longer
 - Safe to operate
 - Cost effective
 - Visible to operators and asset life managers
- Technologies can be retrofitted or specified in the procurement phase.
- Cost must be justified.

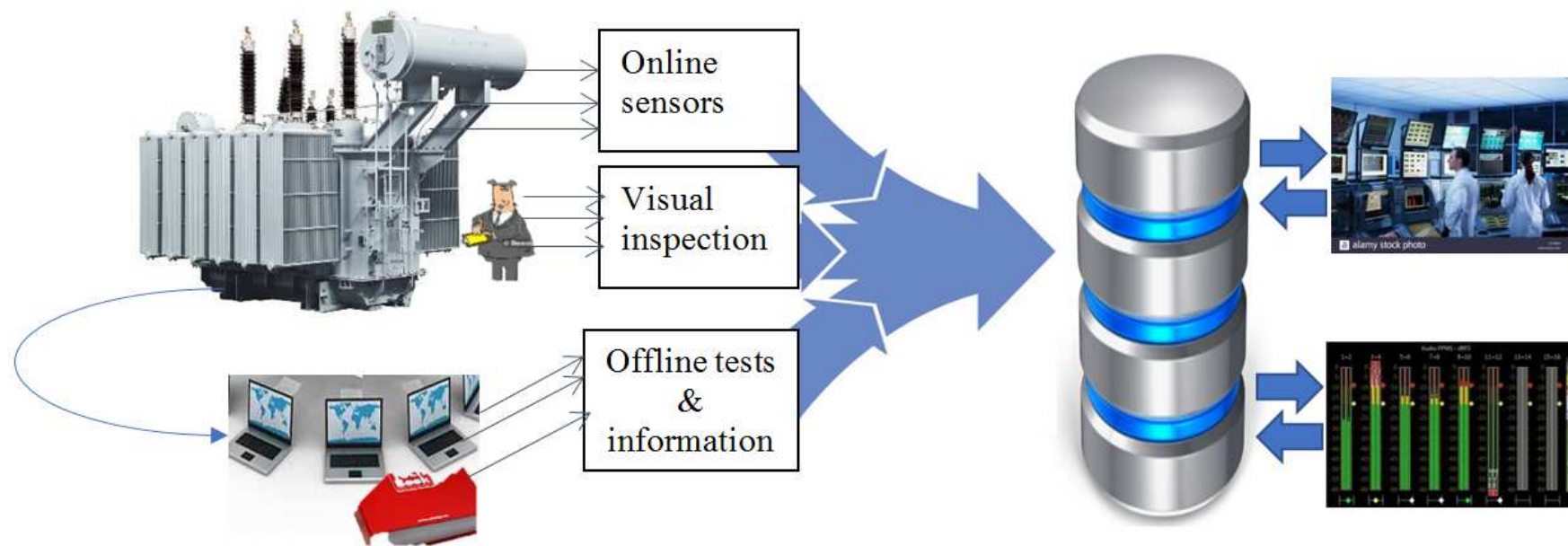
Employed Technologies

- Vacuum Tap Changers
- Dry Condenser Bushings
- Environmentally Friendly Oils
- Variable Shunt Reactors
- Integrated Condition Monitoring
- Low loss transformers
- Thermally Upgraded Paper
- Fibre-optic hot spot measurements
- Self-dehydrating Breathers
- Online Moisture management/removal

Online condition monitoring and control



Integrated Condition Monitoring Framework



Maintenance Strategy

- Move from time/duty based to condition based
- Tap Changers
- Insulation Preservation Systems
- Partial Drain Requirements

Gas Type (ppm)	Oil OLTC gases	Vacuum OLTC gases (retrofit)
Methane (CH ₄)	89	2
Hydrogen (H ₂)	231	6
Acetylene (C ₂ H ₂)	2764	0
Ethylene (C ₂ H ₄)	513	0
Ethane (C ₂ H ₆)	66	0
Carbon Dioxide (CO ₂)	504	552
Carbon Monoxide (CO)	12	11
Electric strength	73	60
Moisture in oil	17	14

Asset management replacement strategy

- Desired to proactively replace old assets before they can fail.
- Limited funds available to execute such replacements.
- Takes years from the time the asset is identified as a high risk to the time of replacement.
- Through condition monitoring strategy and the substation visualization this can be improved in order to allow the business to be more cost-effective.

Developing Economies

- Technology can assist in operating transformers more effectively.
- Large capital cost can be offset by increased return on investments
- Developing skills is of utmost importance.
- Development of internal maintenance skills should also be prioritized.

Conclusion

- Eskom employs a large variety of strategies in a effort to increase return on investment while maintaining network security.
- Technologies should be considered at specification stage of transformer.
- Move towards increased visualization of transformers.
- Correct implementation of various strategies is of utmost importance.