LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY

AMEU

Transformer Re-Design

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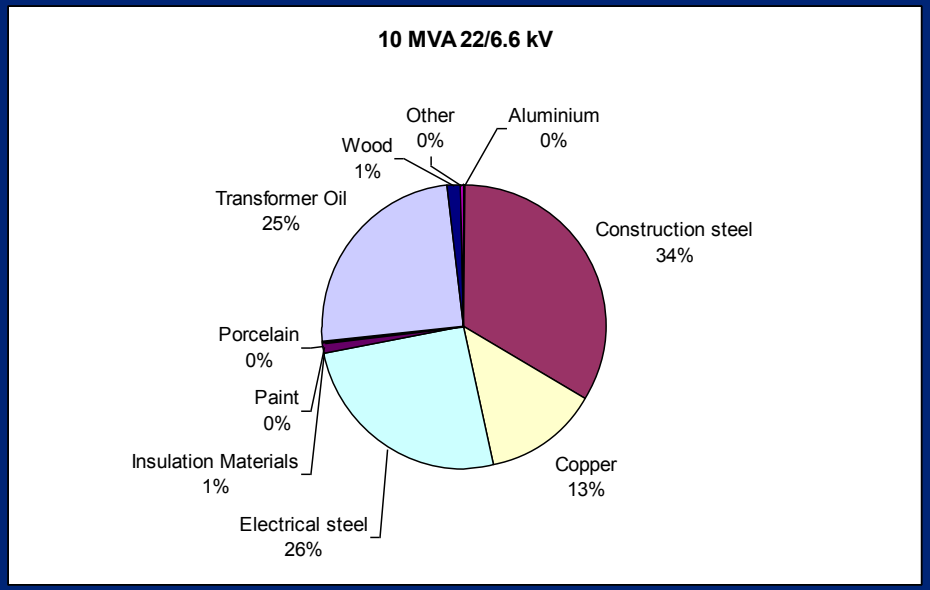
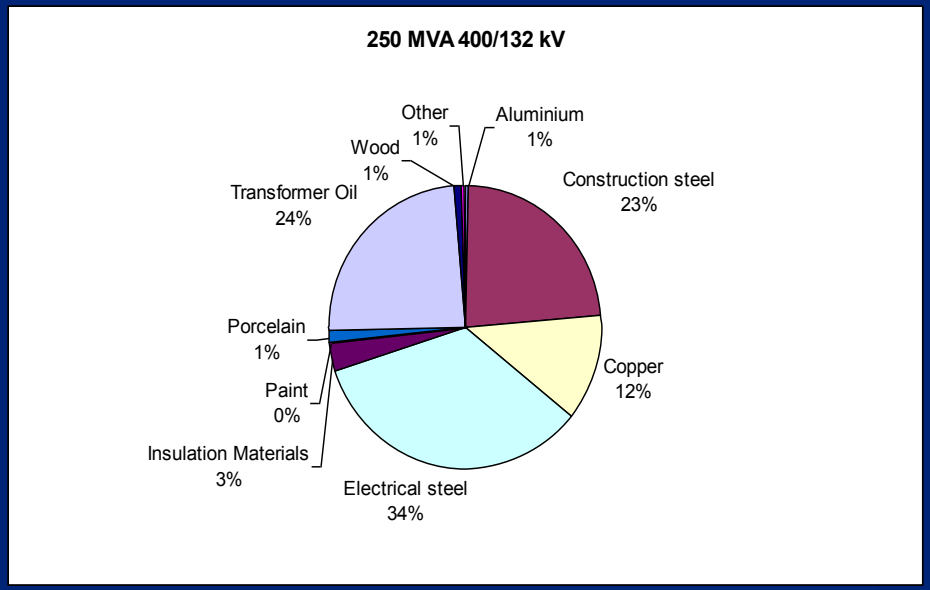
Transformers form an essential part of any electrical supply system, and although inherently reliable and long lived, they can represent a significant cost when circumstances dictate their replacement.

The longevity of transformers lies in the fact that they are essentially static devices, and the materials of which they are constructed do not age significantly.
The exception being the oil and paper insulation systems.





Transformer oil, tap changers and bushings can be replaced onsite as part of a normal maintenance program however paper degradation is non recoverable and is generally used as the primary indicator of an end of life condition.

Ultimate end of life is considered to be when the paper has lost its tensile strength (DP of 200)

Typical reasons for transformer replacement:

1. Premature failure
2. End of life
3. The requirements of the electrical system have changed.
4. Safety concerns
5. Consequential damage concerns

Repairing or remanufacturing the transformers can have a significant cost benefit especially when multiple units are involved.

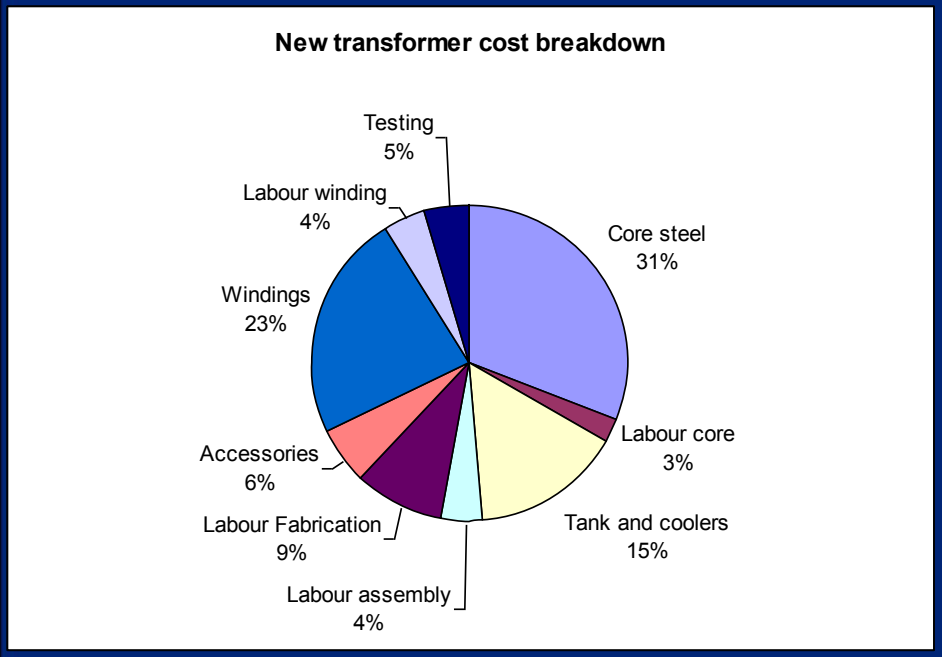
Typically a transformer which is completely re-fitted with new windings and insulation can cost as little as 60 – 70% of the price of a new unit and may be considered to be the equivalent of a new unit in terms of its expected lifespan.

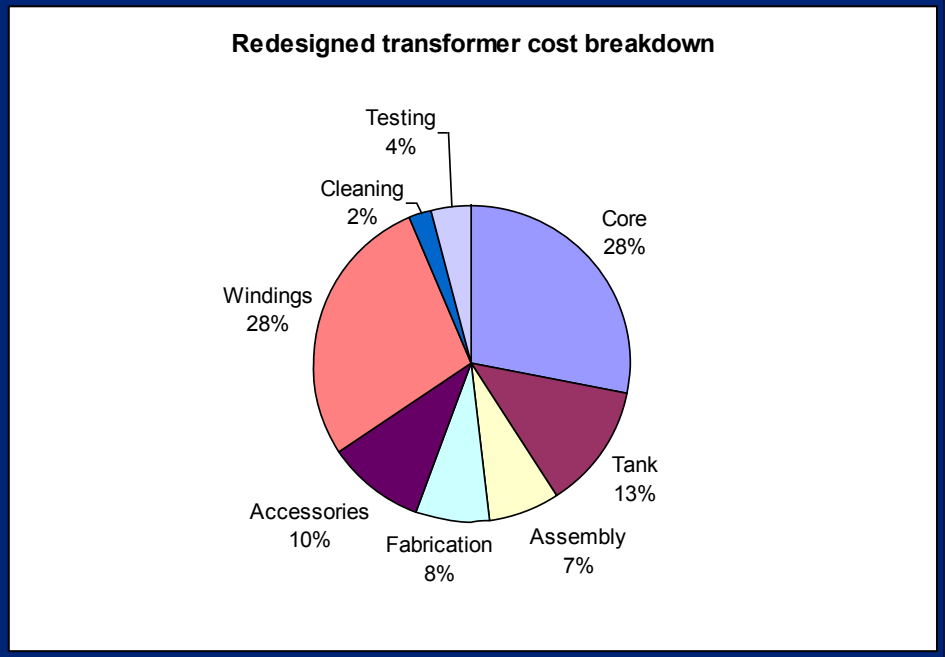
This option can also be beneficial since it utilises a basic design which has already proven itself suitable for a particular application.

Repair
- Lowest cost
- Perpetuates existing design flaws

Re-Design
- Basic cost not significantly higher
- Corrects design shortcomings
- Can change or improve operational parameters
- Can utilise latest materials and technology

To achieve the best solution the Client must be fully aware of his actual requirements and not create an unrealistic “wish list”





The above indicates a potential saving of 41 %
over the price of a new unit (Distribution class transformers)
With equivalent expected lifespan

Typical elements which can be modified with a re-design are:

- Voltage ratios and rated voltages
- Vector group
- Short circuit Impedance's
- Short circuit withstand capability
- Cooling systems
- Losses – Stray and load losses
- Increased power ratings or lower operating temperatures. (typically 20-30%)
- Improved built in protection and condition monitoring systems
- Detection and elimination of potential problem areas in the design

Insulation

Standard Kraft paper – Class A – 105 ^{o}C

Thermally upgraded paper – Class E - 120 ^{o}C

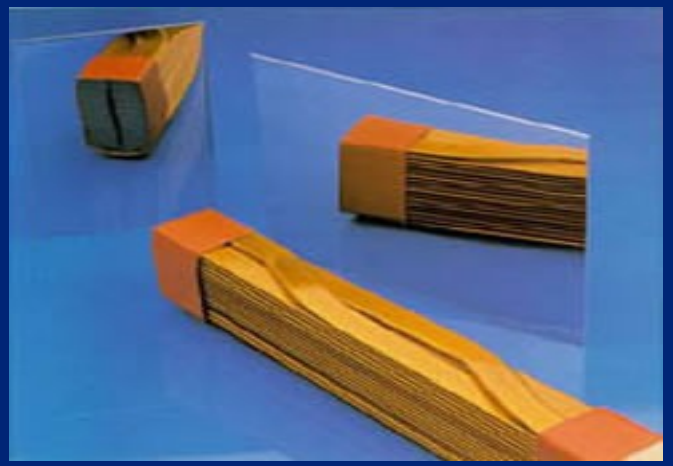
Nomex paper – Class H – 180 ^{o}C

Conductor

Standard rectangular conductor

Paper insulated CTC conductor

Netting tape CTC conductor



Epoxy bonded CTC conductor

Bushings

Resin bonded paper (Porcelain)

- Obsolete

Oil impregnated paper (Porcelain)

Resin impregnated paper (Silicon rubber)

- Improved safety
- Reduced fire risk

Resin impregnated fibreglass

- High temperature class
- Still in development

OLTC

High speed resistor type

Vacuum switch type

- Low to zero maintenance
- Gaining acceptance
- Can be retro-fitted

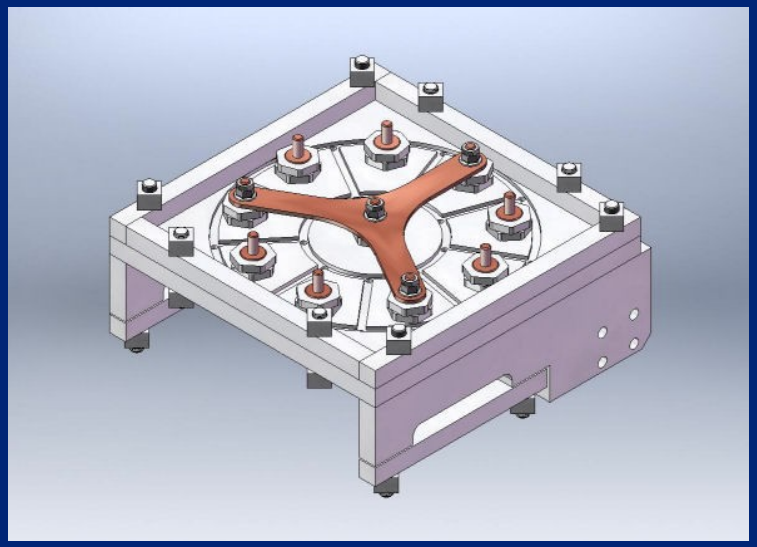
OCTS

OCTS

Bolted link board

Fixed tap (No tapping)

- Problem with coking due to long term static operation
- Robust bolted connections



Conclusion

Transformer design is basically a trade off of desired performance criteria, and can be approached in a number of ways depending on the relative importance of the various requirements.

In re-designing a transformer utilising the existing core and structural elements, it is possible to enhance critical performance criteria to achieve an optimal design which is equivalent to a new unit at a reduced cost.