

Quality Assurance of Transformer

- Ronnie Minhaz, P.Eng.

Quality Assurance of Transformer



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Transformer Consulting Services Inc.

Why Quality Assurance?



Purpose of Quality Assurance

- Operational reliability
- Life expectancy

Purpose of Quality Assurance

Operational reliability

- Withstand capability during fault (mainly electrical fault)

Purpose of Quality Assurance

Life expectancy

- Due to thermal
- Due to electrical

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Factory Location

Dry Area

Vs

Wet/Humid Area

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Age of the Factory

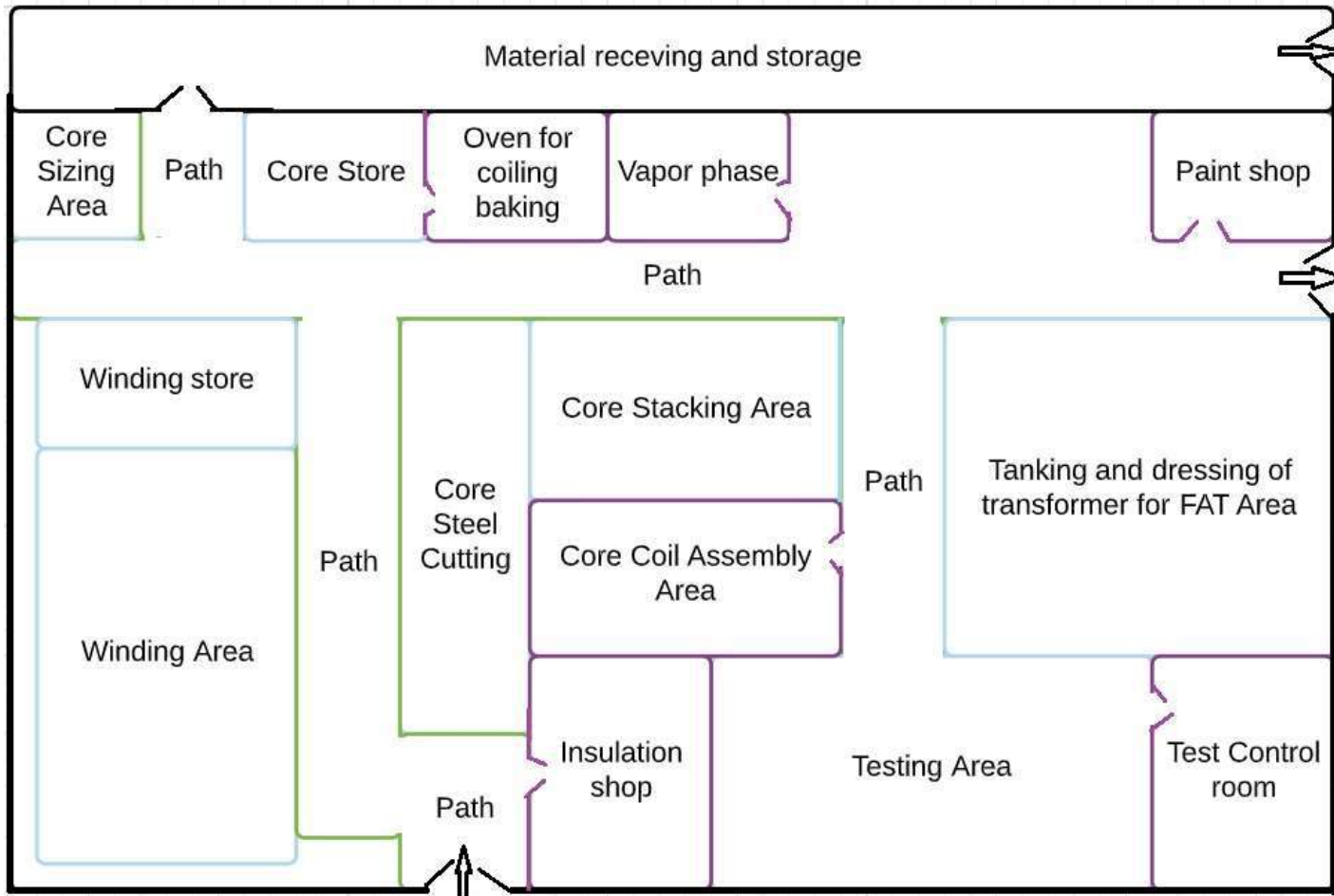
Old Factory

Vs

New Factory

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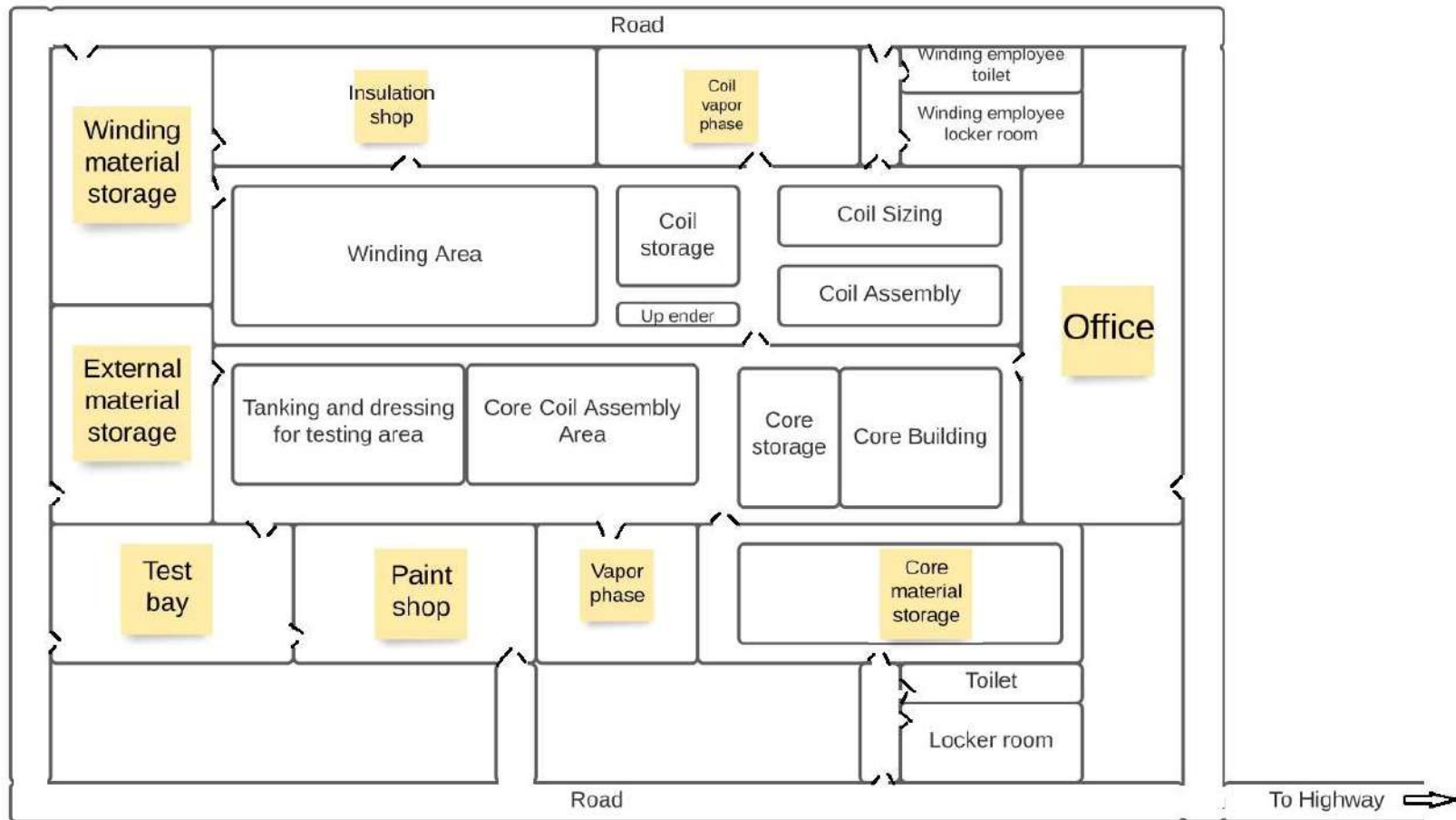
Old Factory Layout



Only the insulation shop, core coil assembly area, oven, vapor phase, test control room and paint are closed area. Rest are open.

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New Factory Layout



Insulation shop, Winding shop, Core building area, Core coil assembly area and tanking area are fully climate controlled.

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Climate control in Factory

Fully climate control

Vs

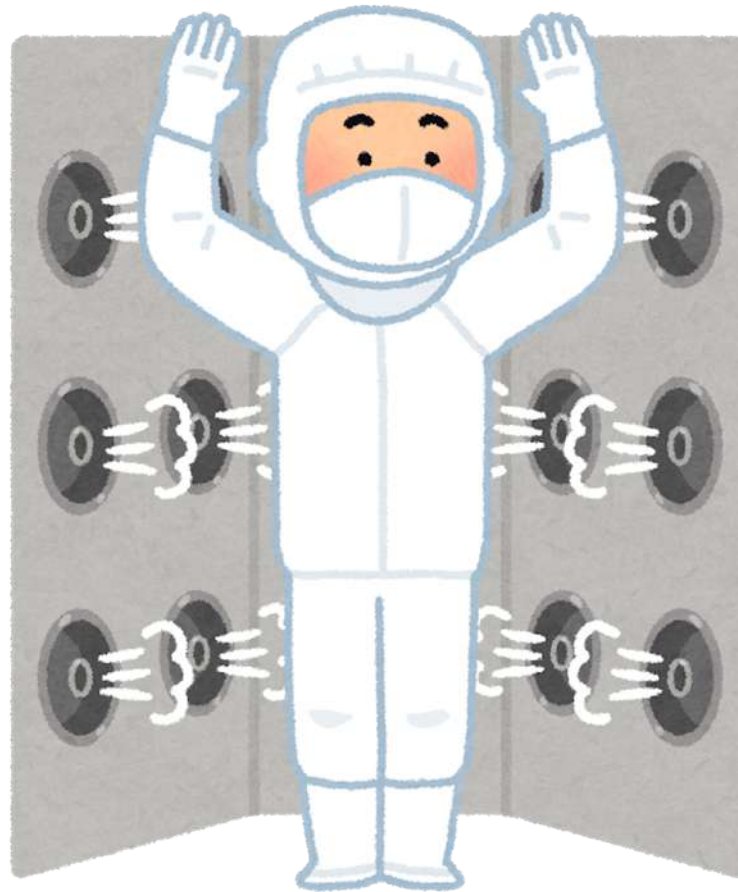
Partially climate control

Vs

No climate control

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Is everyone using it?



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Inside Factory

Clean room

Vs

Non-clean room

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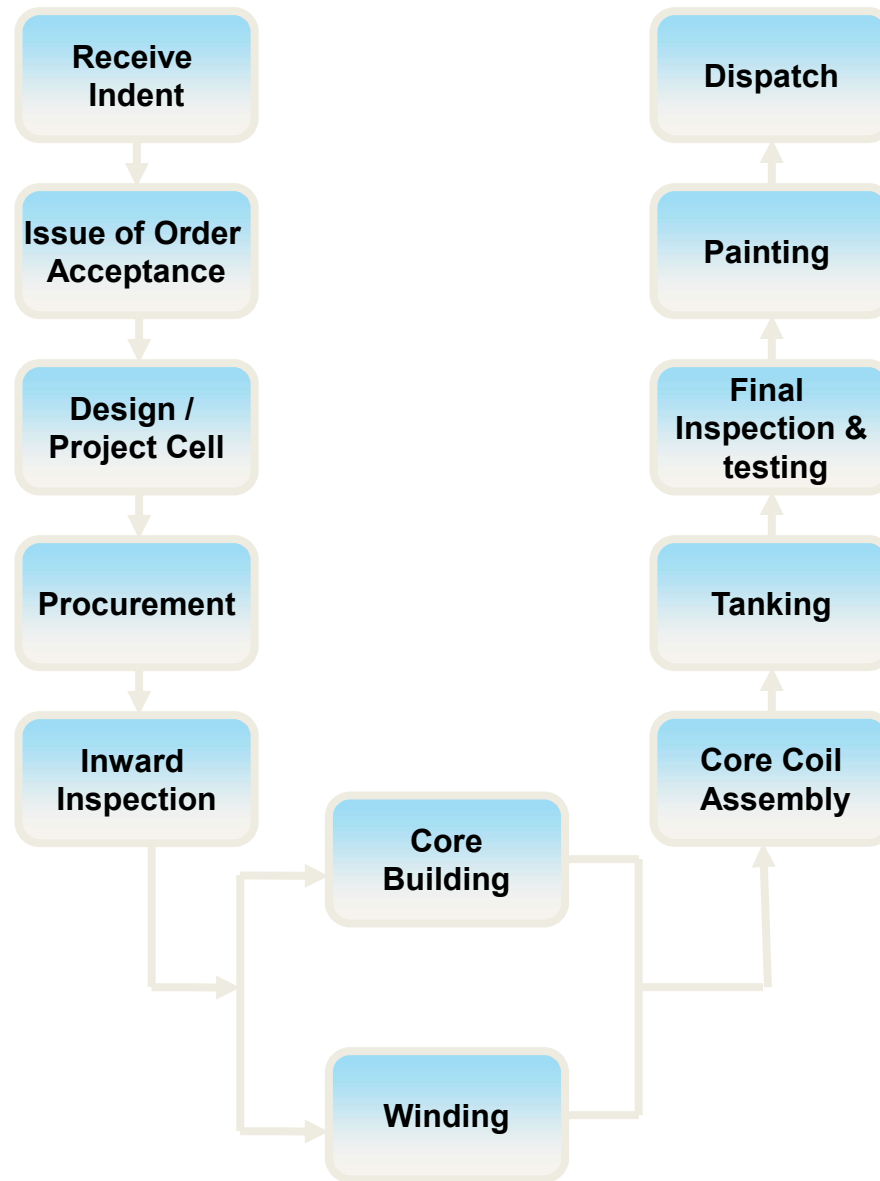
Cleaning approach

All employees part of cleaning process

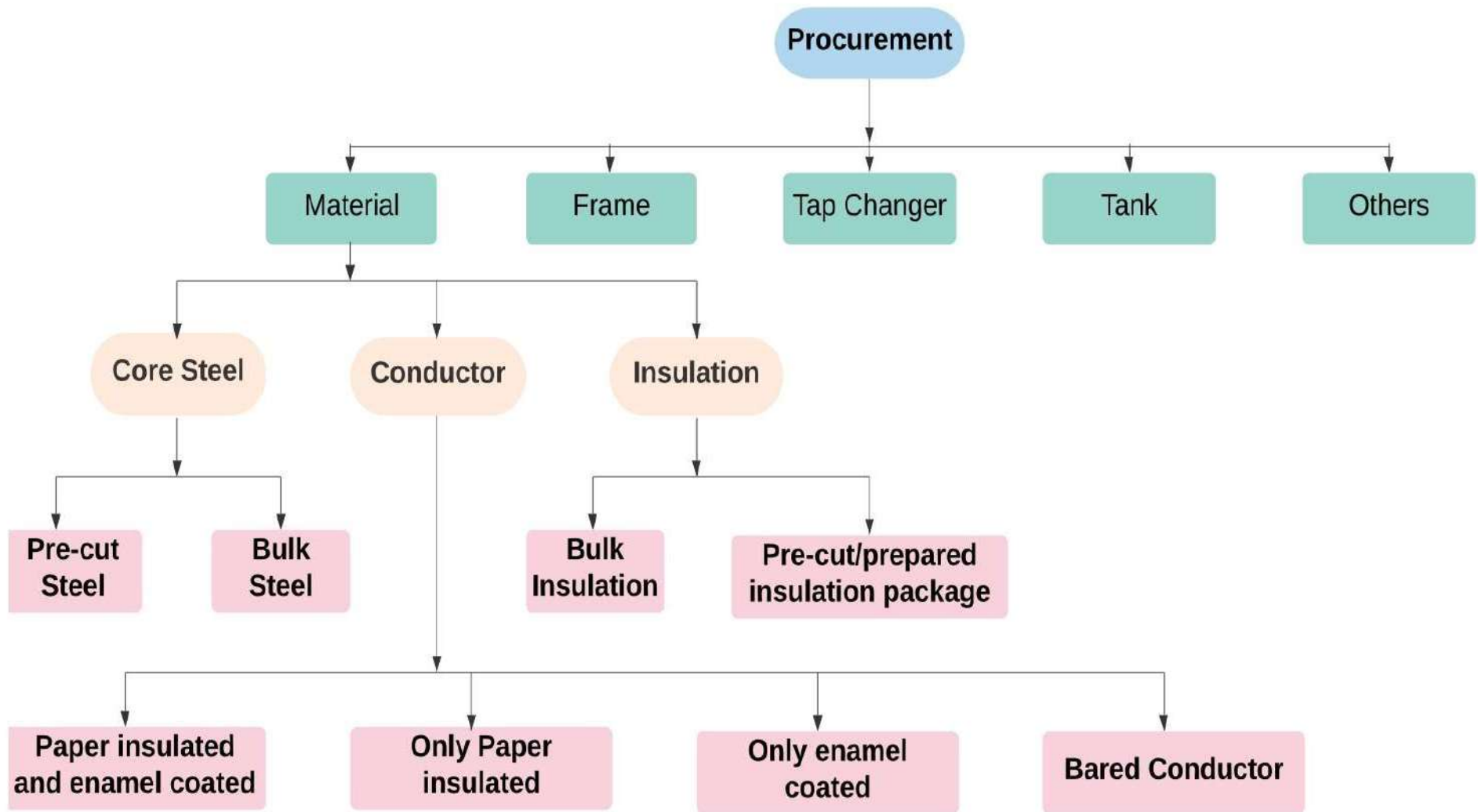
Vs

Cleaning company in charge of cleaning

Transformer Manufacturing Flow chart:



Procurement Flow chart:



Procurement : Core Steel



Pre-Cut by supplier

Procurement : Core Steel

Cut steel in house



Procurement : Conductor

Types of Conductor



Procurement : Insulation



Types of Insulation Paper

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Procurement : Insulation



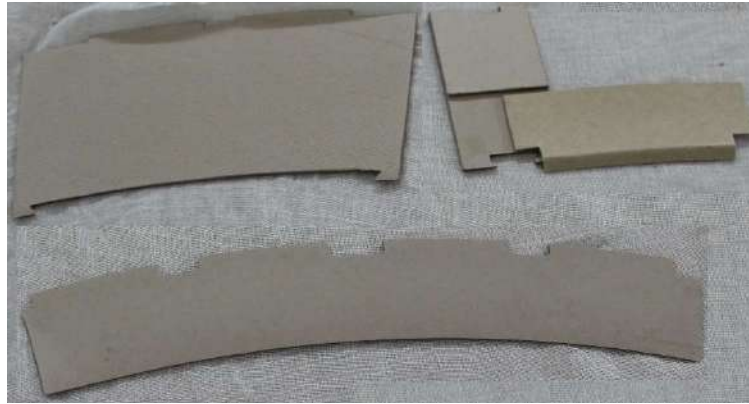
Types of Spacer

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Procurement : Insulation



Types of Strips



Line Shield



Types of Cooling Ducts



Types of Molded component



Riding Block

Procurement : Insulation



Transformer cylinder, end ring

Procurement : Insulation



Making insulation in house

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Inward Inspection



Core steel packed to prevent rust

Hole in the packing of the conductor reel/drum



Core steel on the floor

Quality Assurance: Shop floor Iron filing in the shop floor



Iron filing from the crane operation can cause failure

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Core Building/Stacking

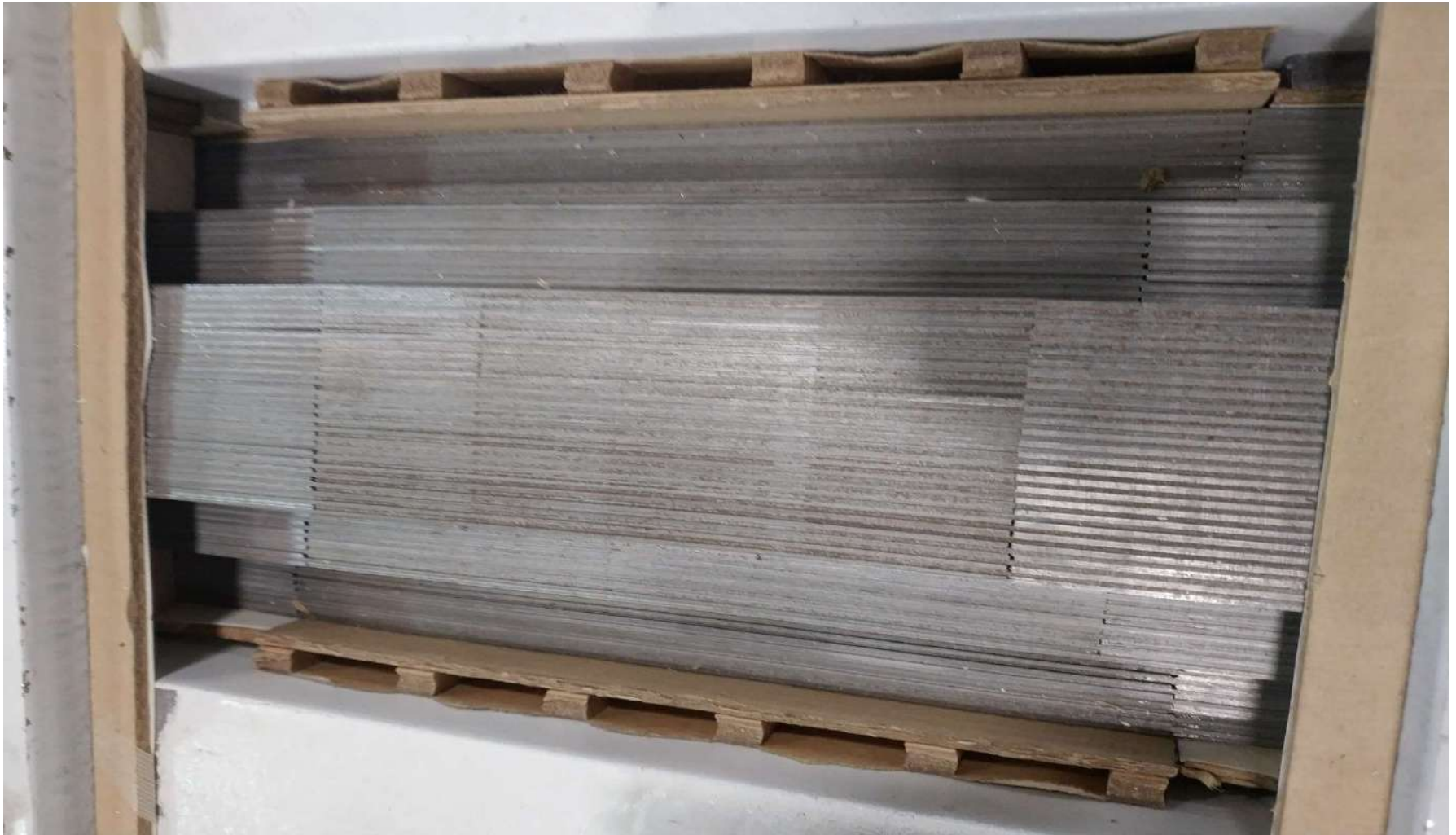
Core Stacking without
stacking bed



Core Stacking in
stacking bed



Quality Assurance: Core



Rust in Core

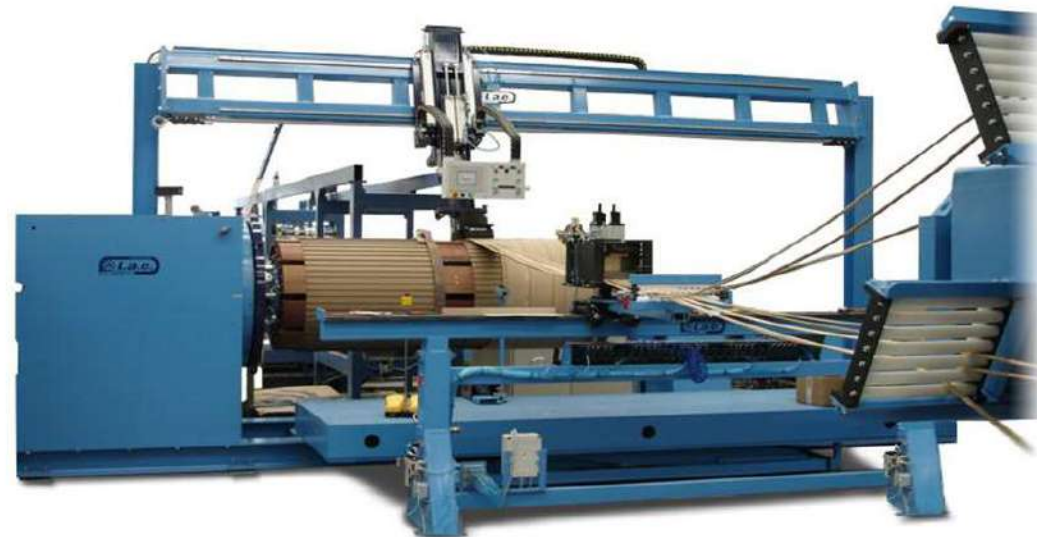
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Winding: Horizontal Winding Machine

Old Horizontal winding machine without breaking mechanism



New Horizontal winding machine with breaking and tension mechanism



Winding: Vertical Winding Machine



Old Vertical winding machine without breaking mechanism



New Vertical winding machine with breaking and tension mechanism

Quality Assurance: Winding



Loose turn to create space for conductor to move



400 millimeter reduction during coil sizing

Core Coil Assembly



Coil preparation for nesting



Coil nesting in Core

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Lead Braising



Gas welding



Induction machine

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Pre-Vapor Phase



Extended period of vapor phase will require a lot of energy usage

Quality Assurance: Core Coil Assembly

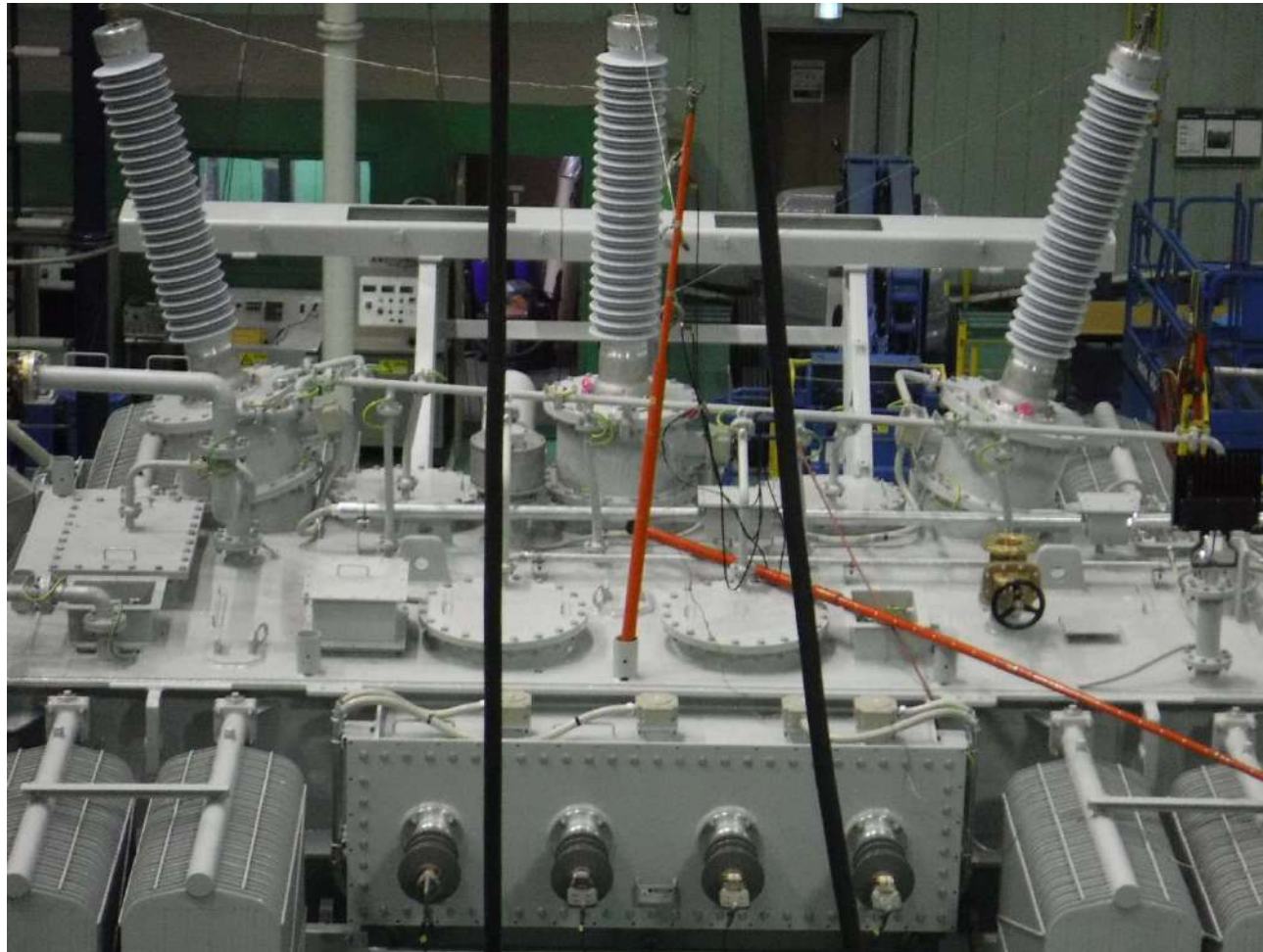
Vapor Phase



Extract moisture up to certain point to have certain Power Factor during FAT

Quality Assurance: FAT

Passed FAT but still reliability and longevity compromised



Pure refined oil and controlled FAT environment can compensate aggressive design and contamination (dust, moisture etc.) during manufacturing

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QA/QC management

Is ISO certification good enough?

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QA/QC management

- Is there any check and balance in the QA/QC process?
- Is the process properly documented?
- How often auditing take place?

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Non-Conformance Report (NCR)

- Is NCR a good indication for factory compliance to QA/QC?
- Is there any lesson learned session on issued NCR?

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Subcontractors/Suppliers

- Is there any procedure to ensure subcontractors/suppliers are compliant to QA/QC?
- How often subcontractors/suppliers are being audited?

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Training for all employees

Continuous training

Vs

Occasional/no training

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What could be viable solution?

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Viabile Solution

- Factory audit
- Design review
- QA inspection during manufacturing

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Factory Audit

What to look into during factory audit?

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Design Review

How design review helps to ensure quality?

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QA inspection(s)

- Core and Coil inspection
- Coil nesting in core
- Pre-vapor phase inspection
- Pre-tanking inspection
- FAT witness
- Inspection prior to shipping

Q&A?

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