



# Transformer Life Extension

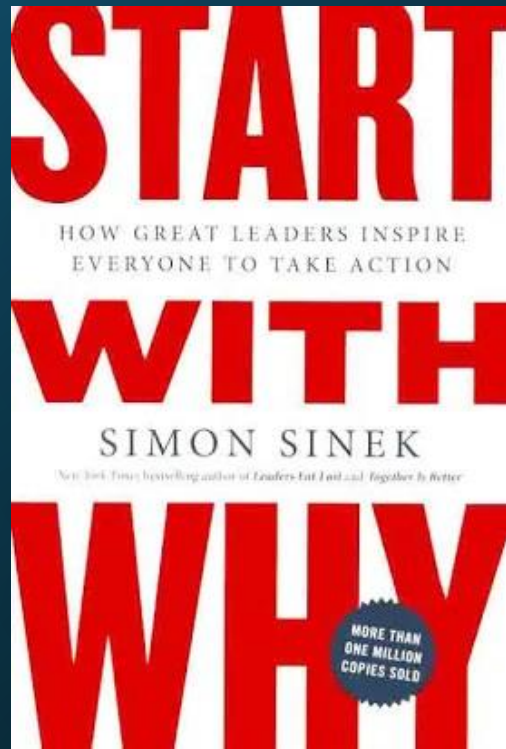
By: Eric Foster – Sales Engineer ETM

For: AAHE 2026 Spring Conference



# AAHE





Power  
Transformer  
Life Extension

Why?

How?

What?

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# *Why* Focus on Life Extension?



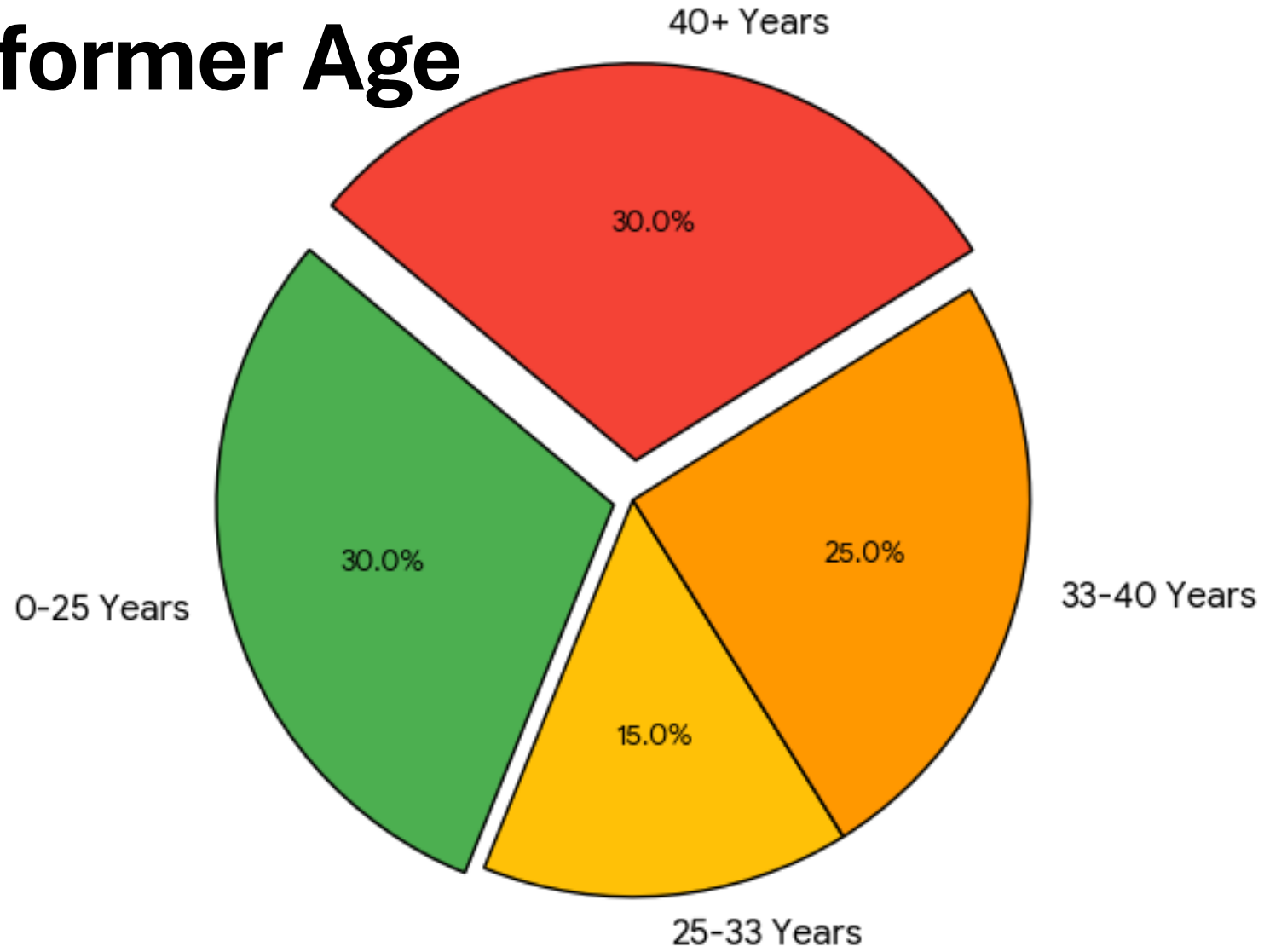
# Downtime is Expensive

Recent estimates indicate downtime costs hospitals around \$7,500 per minute, with some studies suggesting higher figures, potentially resulting in \$500,000 or more in losses for a 60-minute outage.



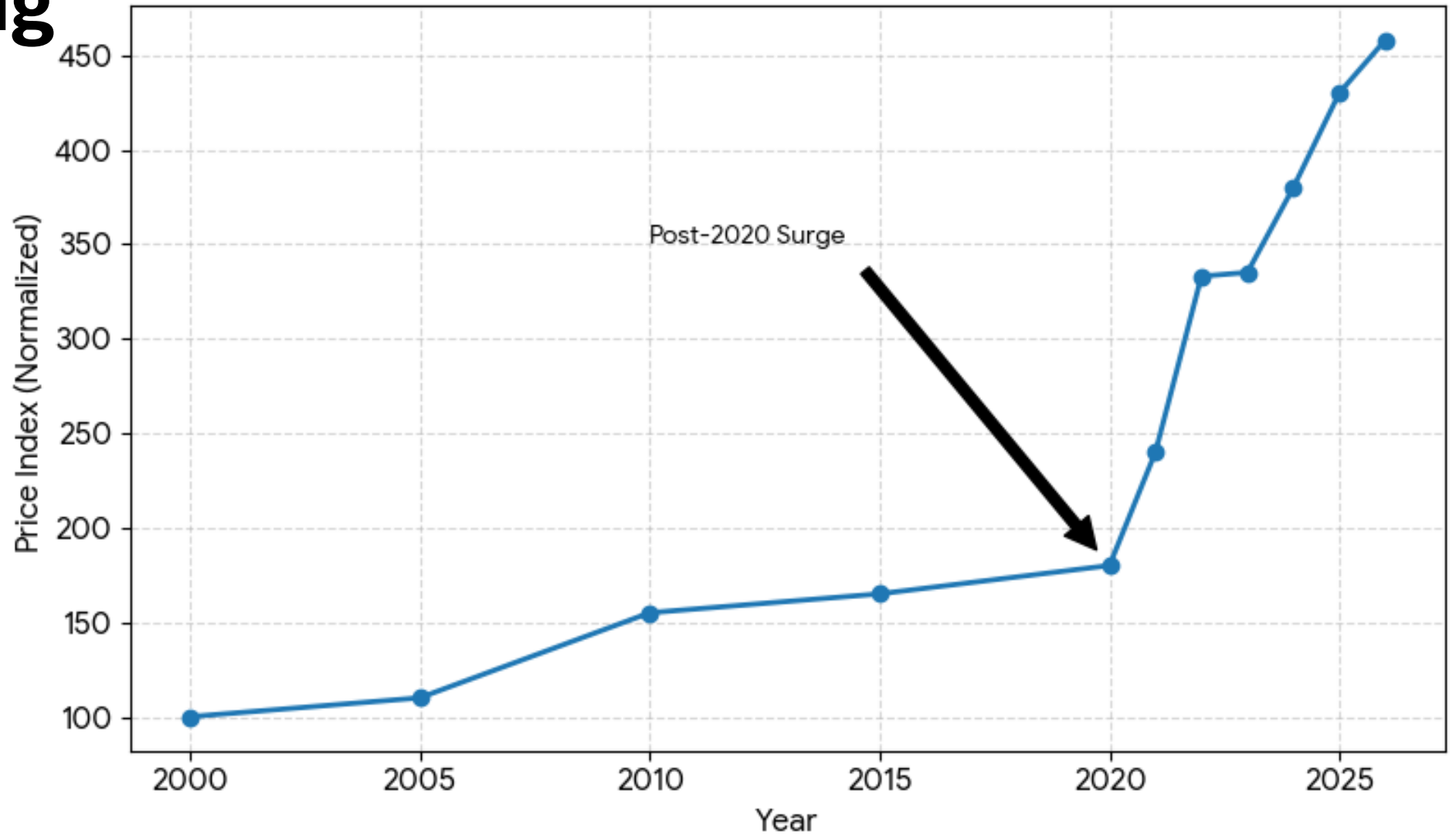
Estimated Age Distribution of U.S. Power Transformers

# Transformer Age



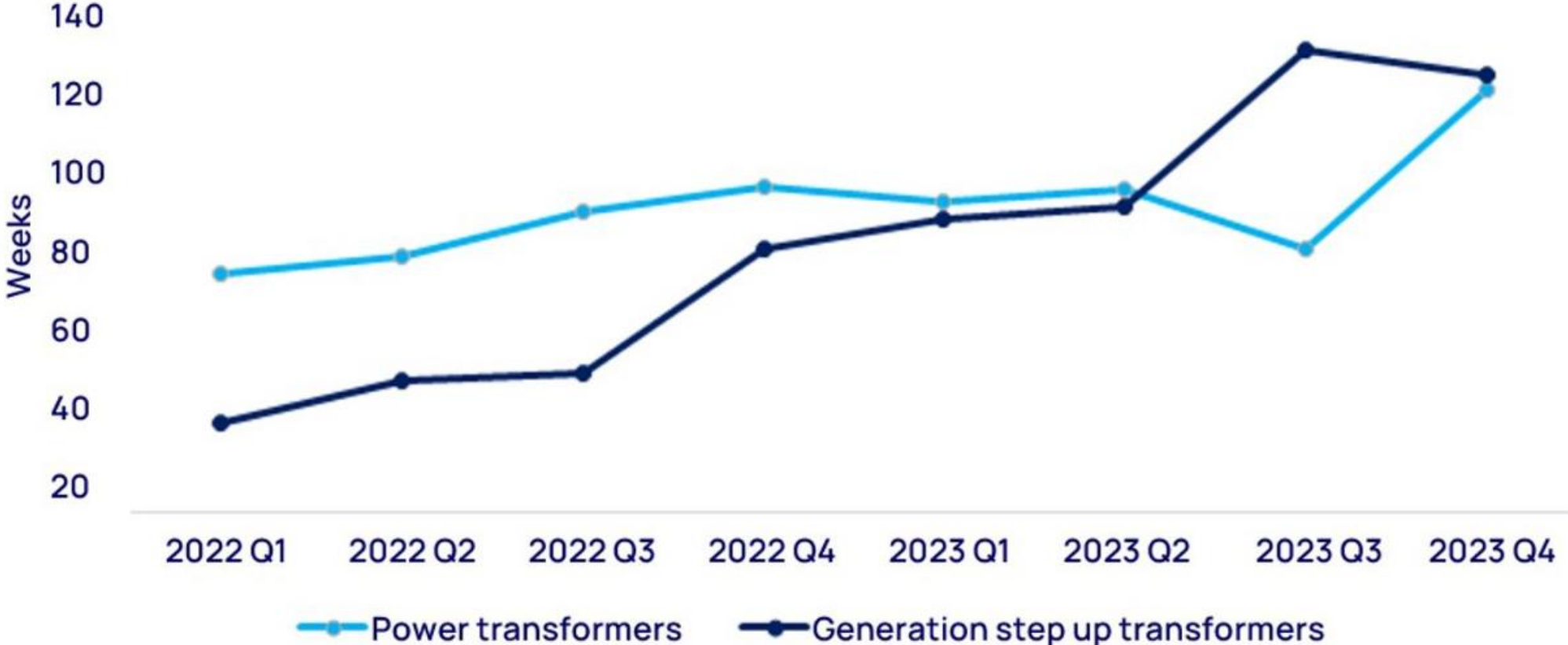
# Increasing Prices

Estimated PPI for Power Transformers (2000-2026)



# Power transformer and GSU lead times benchmark: Q1 2022 – Q4 2023

## Lead Times



Source: Wood Mackenzie

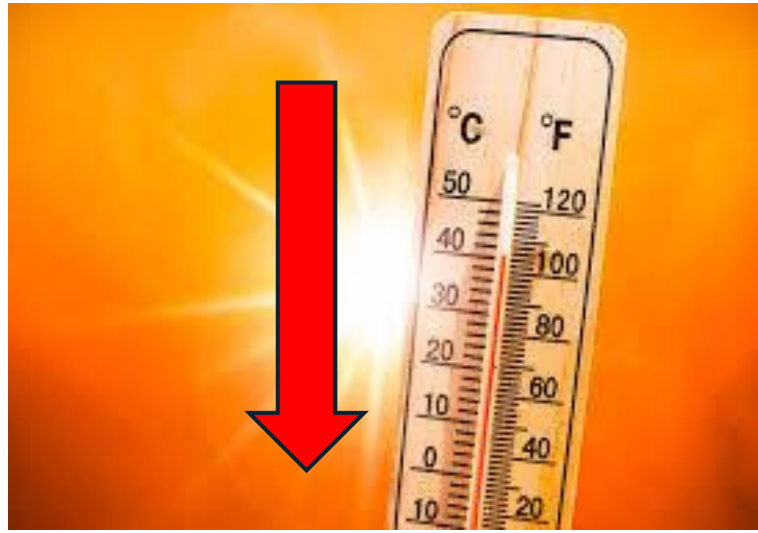
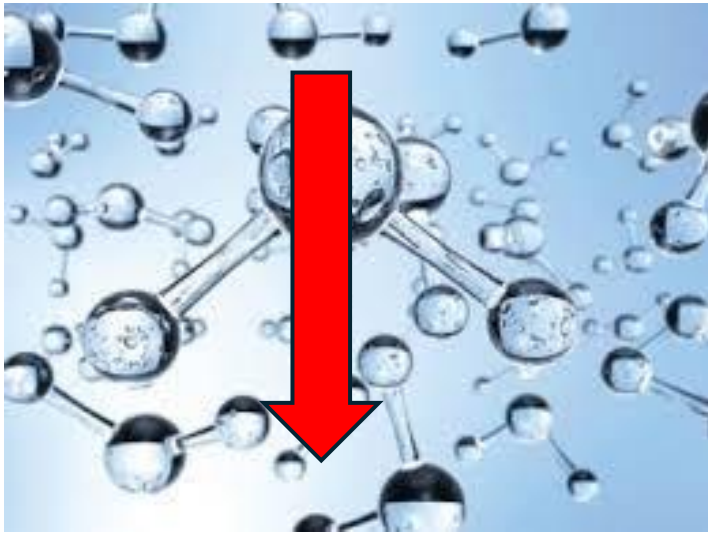
Catch Small  
Problems Early....

It's Cheaper That  
Way

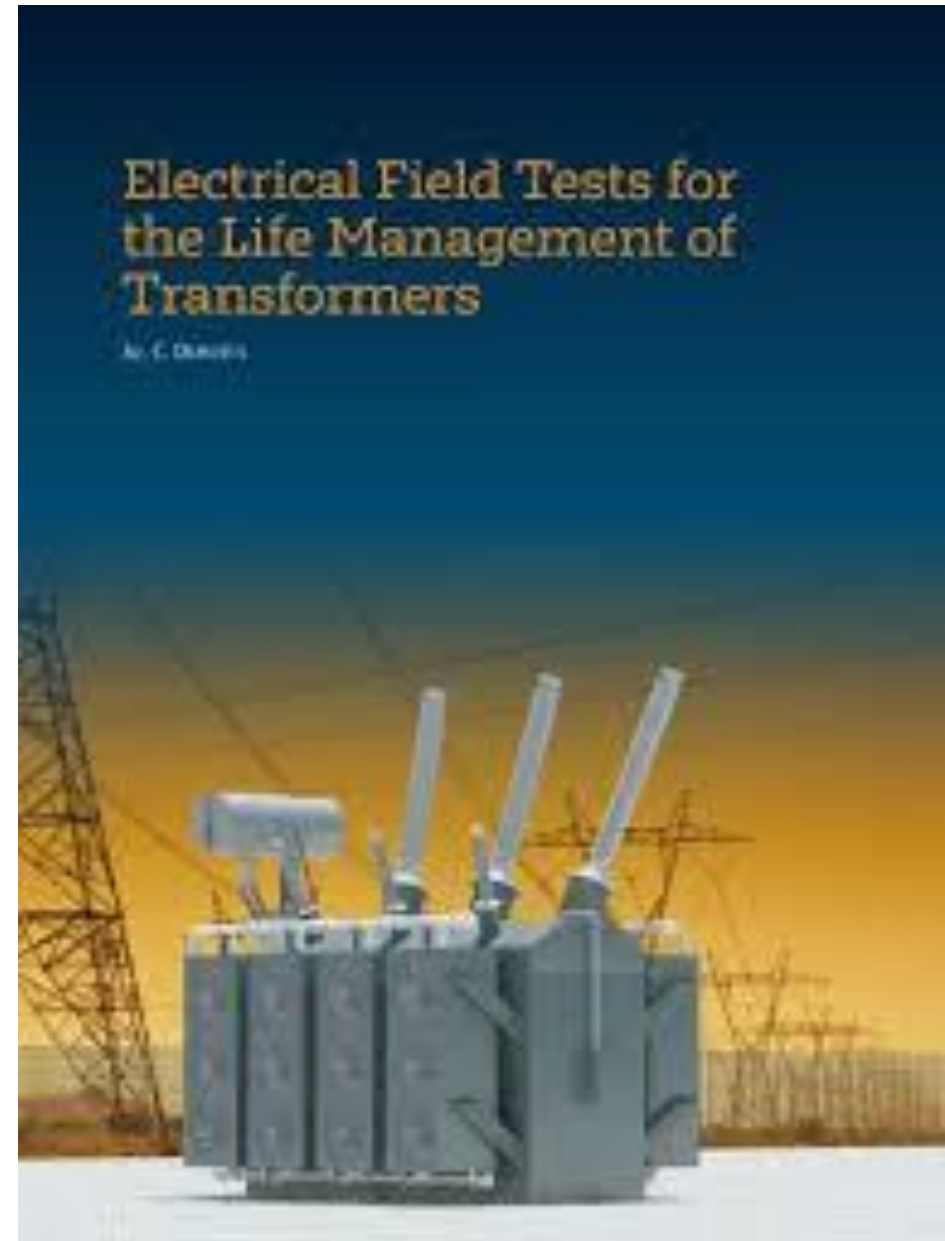


# *How To Implement Life Extension Strategies?*





# Valuable Resource for Testing Strategies



# Critical Dry-Type Transformers – Recommended Testing

- Annual
  - Power Factor
  - Variable Voltage Power Factor
  - Excitation
  - Freq Response of Stray Losses
  - Turns Ratio
  - Winding Resistance
  - Clean
  - Inspect
  - Change Filters
  - Check Torque
  - Check Fan Controllers
- Quarterly
  - Infrared Scans
  - Partial Discharge Scans
  - Check Fan Controllers
- 24x7
  - Metering (Volts/Amps/Harmonics)
  - Fan Monitoring
  - Temperature
  - Online Partial Discharge

# Critical Oil-Filled Transformers – Recommended Testing

- Annual
  - Power Factor
  - Var-Freq Power Factor
  - Excitation
  - Turns Ratio
  - Winding Resistance
  - Clean
  - Inspect
  - Check Torque
  - Check Fan Controllers
- Quarterly
  - Infrared Scans
  - Partial Discharge Scans
  - Check Fan Controllers
  - Oil Samples & DGA
- 24x7
  - Metering (Volts/Amps/Harmonics)
  - Fan Monitoring
  - Temperature
  - Online DGA
  - Online Partial Discharge

# How To Sell It Up the Chain

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- WIIFM?
- Cost per hour of downtime
- Why – How - What
- Failure Mode Effects Analysis
- Use Your Vendors/Service Providers
  - Writing Specifications
  - In the Boardroom

# FMEA Example

Process Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v	Potential Cause(s)/ Mechanism(s) of Failure	O c c r	Current Process Controls	D e t c	R P N	Recommended Action(s)	Responsibility and Target Completion Date	Action Results	
											Actions Taken	Estimate to Fix
Safety	Arc Flash	Fatality	9	Inadequate Preventive Maintenance	9		5	405	PM every 18 - 24 months maximum			\$50,000
Safety	Shock	Fatality	9	No updated one-line diagram	9		5	405	Updated One-Line on the Gear			\$25,000
Reliability	Limited Spare Parts	Increased downtime	5	Minimized Inventory	9		5	225	Buy 1 spare Main/Tie and 2 spare 800A feeder breakers			\$40,000
Reliability	Inadequate Preventive Maintenance	Increased downtime	5	Not in the Budget	9		1	45	PM every 18 - 24 months maximum			\$50,000
Reliability	Inadequate Preventive Maintenance	Shortened Equipment Lifetime	5	Outage Time	9		5	45	PM every 18 - 24 months maximum	Don T & Mike R - 1/1/2025.	PM Schedueld for Memorial Day Weekend	\$50,000
Reliability	Limited Spare Parts	Increased downtime	1	Obsolete Make/Model	9		5	45	Budget new lineup - assume 24 month lead time			\$1,200,000
Reliability	Overloaded?	Shortened Equipment Lifetime	1	Too many loads	5		9	45	Add high end metering			\$30,000
Reliability	No Online Monitoring	Increased downtime	1	Not in the Budget	9		1	9	Temp sensors on Xfmr at a minimum			\$75,000
Safety	Arc Flash	Fatality	1	Not in the Budget	1		1	1	Current AF Study			\$15,000
Reliability	Drawings	Increased downtime	1	No schematics/wiring diagrams	1		9	9	Updated drawings in the room & on the server			\$50,000
									Environmental			

# What Does Success Look Like?



# Success

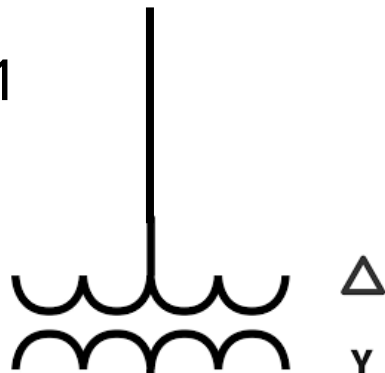
- Less Firefighting – More Strategic Planning
- Better Work/Life Balance
- Better KPI's
- Less Turnover
- **Continuous Improvement**



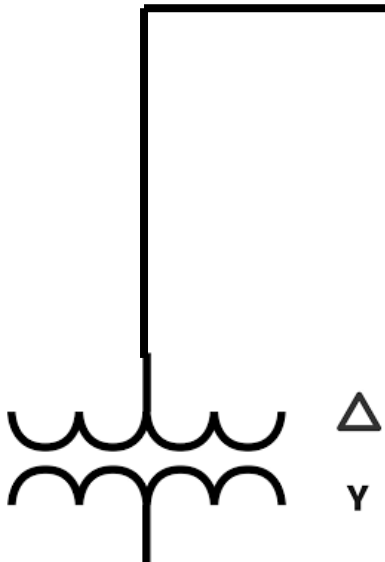
EXERCISE

# **Rack & Stack**

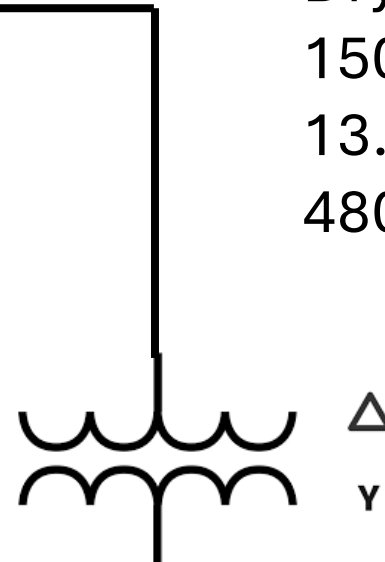
Transformer T-1  
Oil Filled  
5 MVA  
69kV-13.8kV



Transformer T-2  
Dry-Type  
2500 kVA  
13.8kV –  
480/277V



Transformer T-3  
Dry-Type  
1500 kVA  
13.8kV –  
480/277V



# Transformer T-1

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- Age = 20 years
  - Visual Inspection = Good
  - Oil Samples = Good
  - Electrical Tests = Not tested since 2008
  - Monitoring = None
  - Monitoring Cost = \$75K + \$10K per year
  - Replacement Cost = \$200K
  - Lead Time = 130 weeks
- 



## Transformer T-2

- Age = 40 years
- Visual Inspection = Dirty
- Fan Controller = inoperable
- Electrical Tests = power factor over 5% and trending upward each year
- Replacement Cost = \$100K
- Lead Time = 20 weeks
- Feeds parking garage, break room, day care, cafeteria





# Transformer T-3

- Age = 5 years
- Visual Inspection = Clean
- Fan Controller = Operable
- Electrical Tests = Good
- Replacement Cost = \$40K
- Lead Time = 20 weeks
- Feeds Chiller, CT, OR #2, OR #4

Thank You