

TOTAL POWER FACTOR & HARMONIC SOLUTIONS

Qual-Tech Engineers has the unique ability to furnish a complete project from analysis to commissioning. All of the services required to assure an appropriate solution can be supplied. It could include a power factor and harmonic audit with recommendations on changes in system operating procedures, or it could include a complete turnkey solution including the equipment to solve the problem.

Turnkey responsibility will save the user time and money by providing convenience, scheduling management, and coordination of the project. Qual-Tech strives to provide solutions that are reliable and complete, that are flexible with regard to future system changes, and that have a self-protecting equipment package.



12.47 kV, 4th Harmonic Filter Banks – Each with Two 1200 kvar Steps



Conversion of 4.16 kV, 1200 kvar Capacitor Bank to 1900 kvar, 4th Harmonic Filter Bank

Total Power Factor & Harmonic Solutions

- 1. Power Factor Analysis
- 2. Harmonic Audit
- 3. System Analysis & Recommendations
- 4. Equipment & Installation Specifications
- 5. Equipment Package
- 6. Installation
- 7. Commissioning

Qual-Tech Turnkey Advantages

- One Point of Responsibility
- Reliable & Complete System Solutions
- Flexible Design for Future Changes
- Self-Protecting Equipment Package
- The Total Solution

1. POWER FACTOR ANALYSIS

- Determine Savings & Kvar Required
- Evaluate Power Factor Control Methods
 - ♦ Adjust Transformer Taps
 - ♦ Adjust Field of Synchronous Machines
 - Do Not Oversize Motors or SCR Drives
 - Add Synchronous Condenser(s)
 - Add Capacitor Bank(s)
 - Add Harmonic Filter(s)



480 Volt, 400 kvar, 5th Harmonic Metal-Enclosed Filter Assembly

2. HARMONIC AUDIT

- Document Harmonic Producing Loads
- Review System Operating Conditions
- Document Future System Changes
- Review Harmonic Related Problems
- Measure Harmonic Distortion
 - Average, Maximum, & Statistical Data
 - Background Distortion Levels

3. SYSTEM ANALYSIS & RECOMMENDATIONS

- Simulate the System
- Evaluate Possible Alternatives
- Design Filters if Required
- Finalize Designs to Meet the Criteria
- Make Solution Recommendations



13.8 kV, 3.5 Mvar, 11th Harmonic High-Pass Filter Bank with Enclosed Resistor on Top

Methods of Controlling Harmonic Distortion

- No 3-Pulse or SCR/Diode Rectifiers
- Specify I_{THD} < 40% for 3-Phase Devices
- Reactance With SCR's To Limit Notch
- Delta/Delta & Delta/Wye Transformers
- 12-Pulse or Higher for Large Drives
- Avoid Resonance Conditions
- Apply Harmonic Filters

Harmonic Related Problems

- Transformers & Motors Overheating
- Unexplained Fuse Blowings
- Nuisance Breaker Trips
- Electronic Equipment Misoperation
- Equipment Failure
- Telephone Interference

4. EQUIPMENT & INSTALLATION SPECIFICATIONS

- Equipment Specification
 - Complies with ANSI/IEEE Standards
 - Enclosure/Structure Suitable for Location
 - Self-Protecting Design Features
 - Enhanced Safety & Maintenance
 - ◆ Can Incorporate Customer Desired Features
- Installation Specification
 - Sets High Standard of Workmanship

5. EQUIPMENT PACKAGE

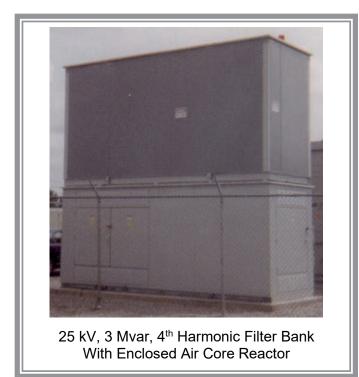
- Metal Enclosed or Open Air
- Flexible Design for Future Changes
- Self Protecting Design

6. INSTALLATION

- Continuous Supervision of Contractors
- Coordination with Plant Activities
- Provide Foundations and/or Structures
- Equipment Delivery and Placement
- Connections to Electrical System
- Changes to Existing Electrical System
- Drawings (As Built)

7. COMMISSIONING

- Detailed Factory Equipment Checkout
- Detailed Field Equipment Checkout
- Harmonic Audit
- Power Factor Evaluation
- Operation & Maintenance Manual





138 kV, 62 Mvar, 5th Harmonic, Open Air Filter Bank

Harmonic Limitations

- System Harmonic Limits
 - Voltage Distortion (5% at < 69 kV)
 - Current Distortion (5% to 20% at < 69 kV)
 - Limits 50% Higher for Short Periods
- Equipment Harmonic Limitations
 - Transformers (ANSI/IEEE C57)
 - Motors (NEMA MG-1)
 - Capacitors (ANSI/IEEE 18)

Solution Criteria

- Reduce Utility Bills
- Reduce System Losses
- Reduce Equipment Loading
- Increase Plant Uptime
- Increase Equipment Life
- Meet Harmonic Limitations