

Case Study

Improving Power Factor and Cutting Costs in Copper Manufacturing with Elspec's Power Quality Solution



The Challenge

A leading copper manufacturing company in India, faced utility penalties caused by exceeding its contract demand and maintaining a suboptimal power factor.

- Contract Demand: 1,810kVA
- Recorded Billing Demand: 2,019kVA → ₹619,561 (~\$7,400) monthly excess demand surcharges
- Average Power Factor: 0.94 (below the 0.95 incentive threshold).

Under the state's utility tariff structure, falling below 0.95 PF disqualifies facilities from receiving incentives, while exceeding contracted demand triggers heavy excess demand surcharges. This double financial impact significantly increased operational costs.

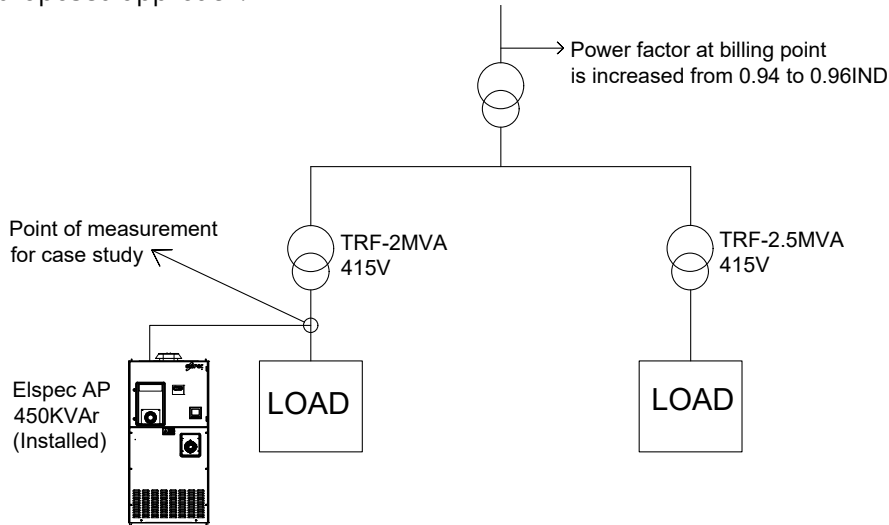
Why it Happens in Copper Industry

Copper manufacturing relies on energy-intensive processes such as smelting, refining, rolling mills, and continuous casting. These operations involve large induction furnaces, heavy-duty motors, and electrolysis systems, all of which are highly reactive and generate fluctuating load profiles. Without precise reactive power compensation, these conditions:

- Increase kVA demand charges due to excess apparent power, creating real challenges for maintaining PF compliance.
- Add stress to transformers and distribution assets, raising maintenance needs and energy losses.
- Risk process stability, as PF drops and voltage fluctuations can directly affect sensitive refining and casting operations.

Solution

As part of the customer's project, Elspec collaborated with PwC, one of India's leading energy consultancies. Both organizations independently carried out power quality assessments and engaged in detailed technical discussions to review the findings. Through this collaborative process, PwC and Elspec reached a shared conclusion, with PwC endorsing Elspec's recommended 450kvar power quality solution on one of the plant's 2 MVA low-voltage transformers, confirming its technical and operational feasibility. This joint validation by two industry leaders further strengthened confidence in the proposed approach.



- 4 Groups with smallest step of 30kVAR with 7% inductors for harmonic mitigation
- Transient-free thyristor switching for sub-cycle (<1 cycle) VAR compensation
- Integrated 1,000A breaker for safety and reliability

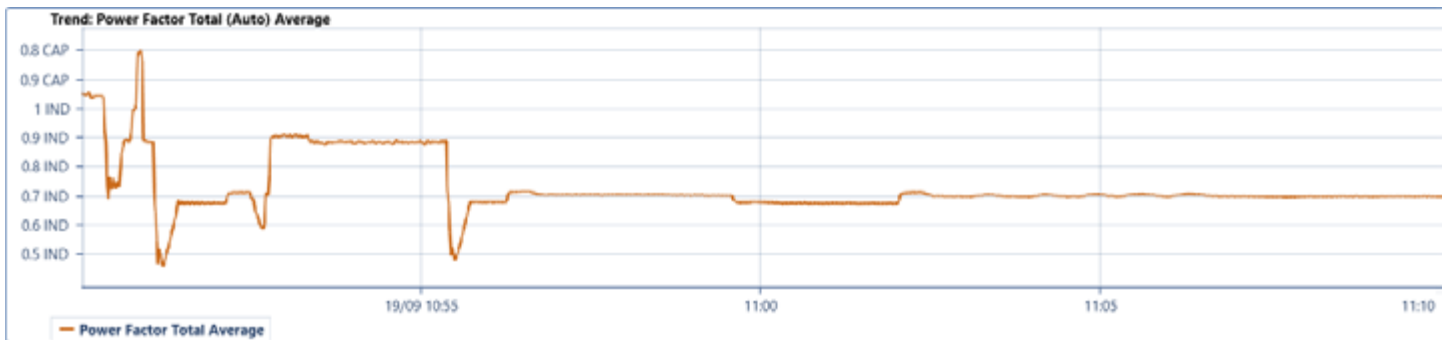
This design provided the speed and precision needed to maintain a PF 0.99IND on a particular feeder & improve PF at PCC point above 0.95 at all times and eliminate demand surcharges & pass the criteria for PF incentive.

Measurement & Verification Approach : 2MVA TR

Power Factor

Before installation, Elspec's Class A analyzer with continuous waveform recording revealed frequent PF drops, sometimes to nearly 0.5 inductive, during load transitions and equipment start-ups. These events occurred even at light load, triggering penalties and lowering efficiency.

PF before:



Post-installation analysis in PQSCADA Sapphire confirmed that the solution responded instantly to both sudden load changes and low-load periods, maintaining a stable PF 0.99 IND above the incentive threshold.

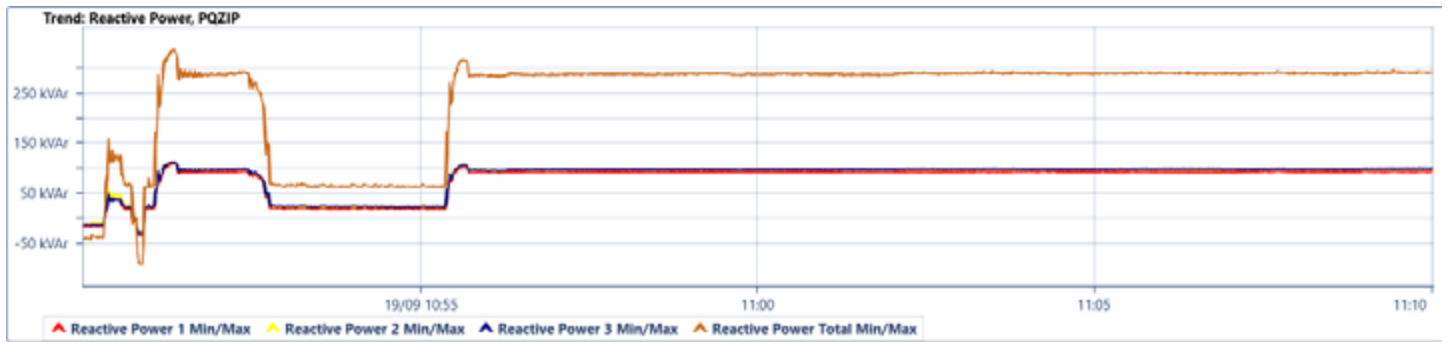
PF after:



Reactive Power Control

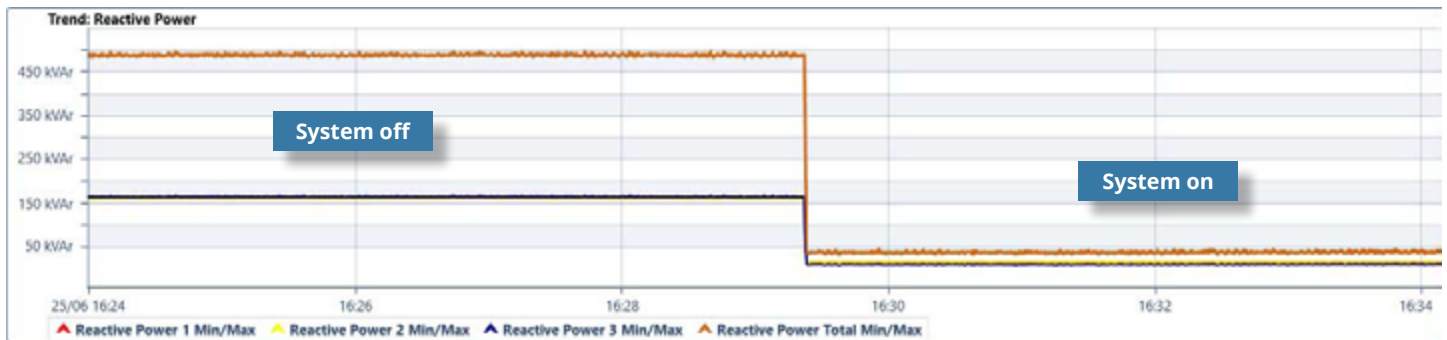
Prior to the solution installation, reactive power profile showed fluctuations, often exceeding 250kVAr, with rapid shifts during load changes. These spikes directly contributed to low power factor events and demand penalties.

Before:



Elspec's solution stabilized and precisely managed reactive power, using transient-free step switching to match compensation to load requirements. The system's transient-free thyristor switching allowed it to instantly adjust reactive power output, keeping it aligned with load requirements.

After:



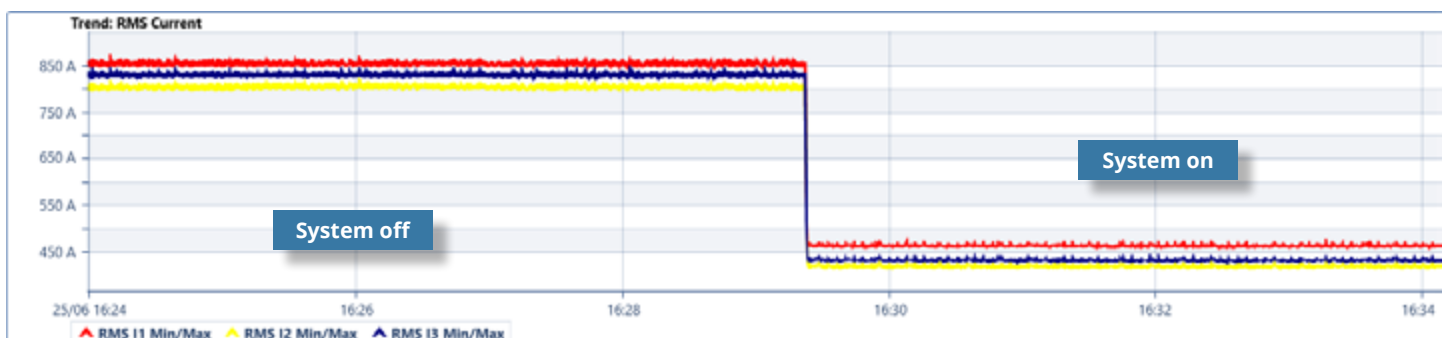
Reduced Current Draw

Before installation, the customer's current profile showed significant fluctuations, with load current fluctuated sharply between ~200A and over 600A, reflecting the plant's dynamic load profile and raising apparent power demand.

Before:



After:



Key Results

Meeting Utility Requirements – Penalties Eliminated

- PF improved from 0.94 to 0.99 on the targeted 2MVA transformer, raising PCC PF to 0.969IND
- All maximum demand surcharges removed
- Monthly PF incentive of ₹37,711 (≈\$450) now applies after raising PCC PF to 0.969IND

Optimized Transformer Performance

- Lower apparent power stress on the 2MVA transformer
- Reduced overheating risk and longer equipment life

Continuous PF Compliance

- Stable PF ≥ 0.96 IND, even at low load
- Full compliance with state regulations and tariff incentives

Billing Impact

After installing Elspec's power quality solution- RTPFC System, the customer achieved a significant operational and financial improvement. On the specific transformer where the system was installed, the power factor rose to 0.99, raising the overall PCC (Point of Common Coupling) power factor to 0.969 - above the 0.95 threshold required for incentives. This eliminated the monthly excess demand surcharge of ₹619,561 (≈\$7,400) recorded in July 2024 and added a new monthly PF incentive of ₹37,711 (≈\$450). As a result, the net payable amount dropped from ₹6.32M (≈\$75,846) to ₹4.55M (≈\$54,616).

Parameter	Before Installation (July 2024)	After Installation (July 2025)
Contract Demand (kVA)*	1,810	2,010
Recorded Billing Demand (kVA)	2,019	1,613.4
Average Power Factor	0.946	0.969
Excess Demand Surcharge	₹619,561 (≈\$7,435)	₹0 (≈\$0)
PF Incentive	₹0 (≈\$0)	₹37,711 (≈\$450)
Net Payable Amount	₹6,320,514 (≈\$75,846)	₹4,551,293 (≈\$54,616)
Monthly Savings/Benefit	₹0 (≈\$0)	₹657,272 (≈\$7,887)

*The contract demand in 2025 was raised from 1,810 kVA to 2,010 kVA to meet the plant's increased power requirements.

Encouraged by these results, the customer has ordered a second Elspec system for their remaining transformer. This next phase will further optimize power factor across the entire facility, enhance savings, and ensure long-term grid compliance and operational reliability of the copper manufacturing process.



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