

Using SynchroTeq Plus for Arc Furnace Applications

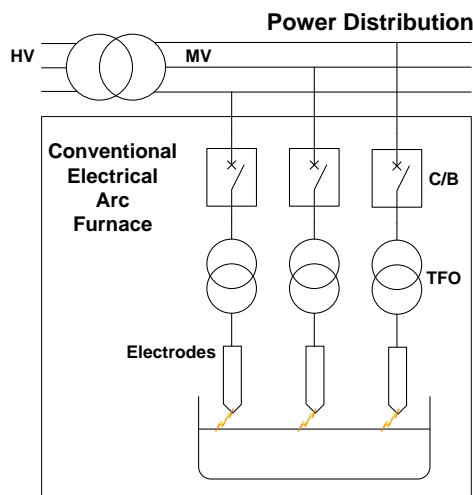
Increase Availability, Reduce Maintenance Costs and Downtime

Application Note 7



Worldwide, large metallurgical industries rely on electrically powered arc furnaces to refine ores into metal by a process called smelting (using heat and chemical agents to decompose the ore components). This is the base of silver, iron, copper and aluminum production.

Arc furnaces are also used in recycling plants where they melt scrap metal into high quality refined products such as stainless steel. While different technologies exist, most AC furnaces are energized at medium voltage (MV) level, through a circuit breaker and a large transformer (tens to hundreds of MVA). The secondary of the power transformer feeds bus bars connected to the furnace's electrodes.



Due to the physical nature of the smelting process, the circuit breaker may trip very often. A well-known issue is the re-energization of the power transformer after those tripping events. Generally, the electrodes are pulled up before the breaker closes and this action ends up as an unloaded energization of a power transformer.

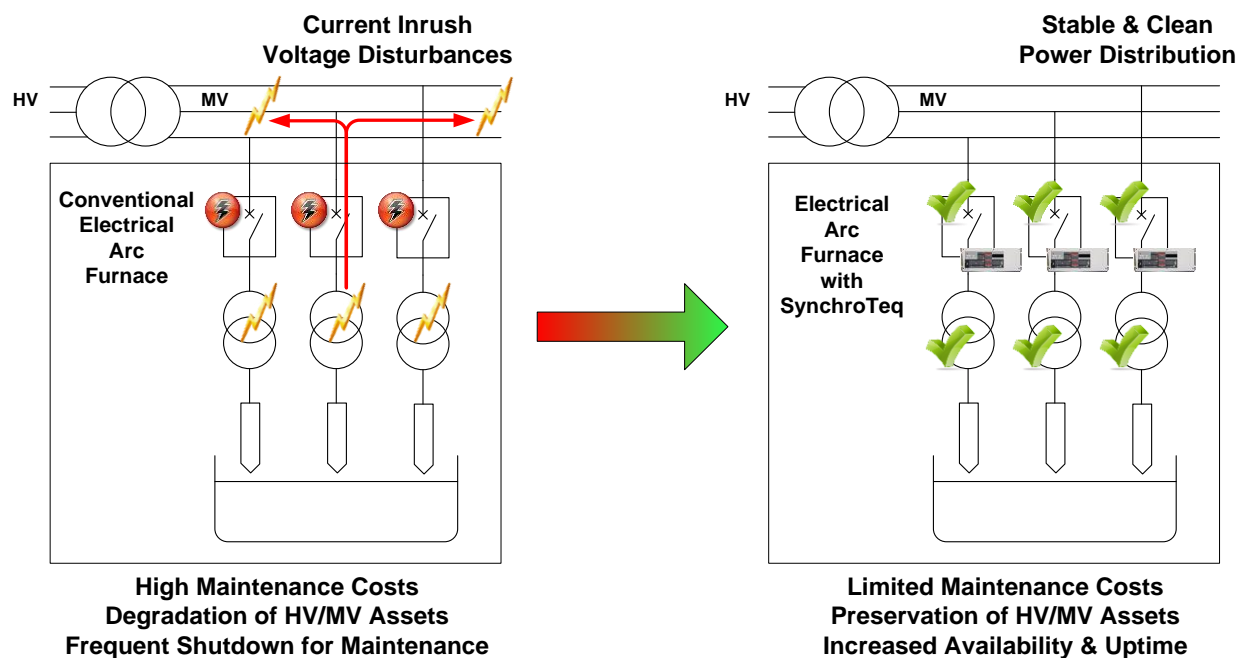
When performed in an uncontrolled way, this energization leads to very high inrush currents and voltage disturbances, which reduce the lifespan of both circuit breaker and power transformer.

Furthermore, the voltage disturbances can have collateral effects, such as protection relay operation affecting other processes in the plant.

SynchroTeq Plus - Controlled Switching Device (CSD) for high voltage circuit breakers – has been engineered by VIZIMAX in order to eliminate transients on power systems. Major utilities have used these systems for more than 20 years to control circuit breakers from a variety of manufacturers:

- To prevent restrikes and reigniting in circuit breakers,
- To limit inrush currents and avoid transient voltages within power lines, and
- To seamlessly energize power transformers of all voltages (kV) and capacities (MVA).

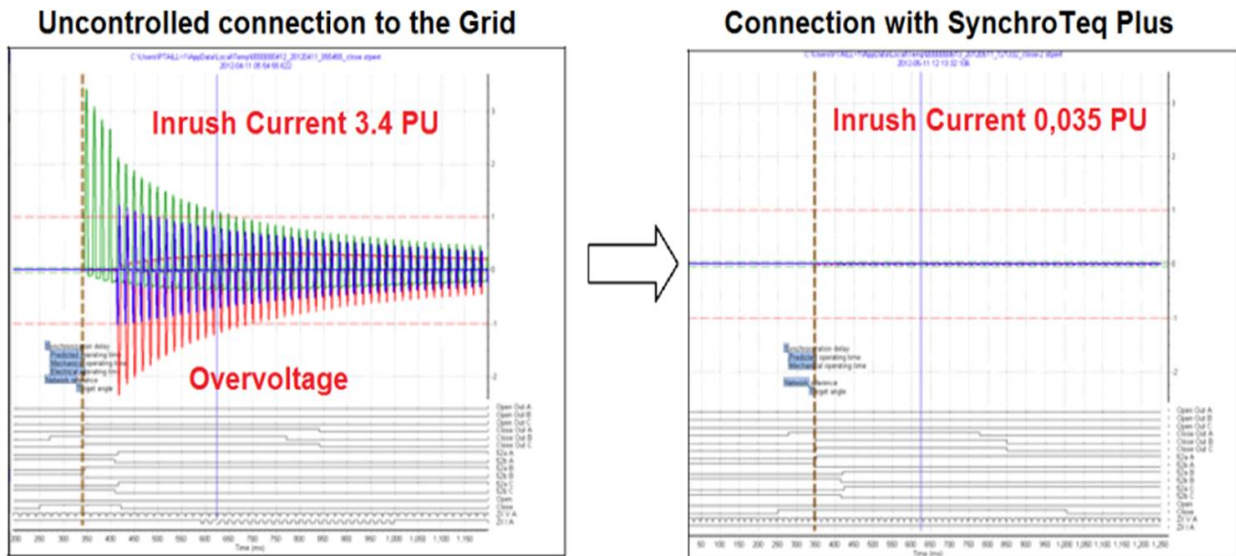
Within the metallurgical industry, results show that the same principles also apply for medium voltage (MV) arc furnace power transformer energization to the benefit of operations, maintenance, and asset managers.



When energizing the power transformer, the Controlled Switching Device controls the closing of the circuit breaker by taking into account the residual flux vectors in the transformer core resulting from its previous de-energization. This allows the reduction of the transformer inrush current and consequently decreases the electrical wear of the circuit breaker contacts, thus lowering maintenance costs and reducing risks of catastrophic failures.

The Control Switching Device is also used to allow the transformer de-energization by controlling the opening of the circuit breaker for either a manual command or a fault trip received from protection relays. This feature helps to control of arc produced in the circuit breaker during its operation which minimizes the electrical wear of the contacts and allows for a better control of the residual flux in the transformer core produced during its de-energization.

SynchroTeq Plus has been successfully installed and proven on series of power transformers within high voltage transmission networks, and for the smooth energization of power transformers and the connection to the transmission and distribution grids of generation sites (either conventional or renewable energy sites).



These successes, and the similitude between those issues to be solved in arc furnaces, and those already addressed in other EHV/HV power transformer energization, have led VIZIMAX to demonstrate its SynchroTeq Plus technology in pilot smelting installations.

The observed performances allow for the following benefits:

- **Increased facility uptime** through the decreased number of scheduled furnace shutdowns for maintenance, allowing for longer production periods and increased return on investment (ROI).
- **Preservation of costly power transformers** through seamless energization with no inrush current and therefore no mechanical stress.
- **Lower maintenance costs and capital expenditures** on circuit breakers since they will be prone to resist to their rated mechanical endurance (instead of replacing them at regular intervals due to electrically damaged nozzles) due to the elimination of high inrush currents.
- **More clean and stable power distribution** thus preserving other assets from malfunctions due to the elimination of inrush currents and voltage disturbances conveyed over the power distribution within facilities.

Conclusion

SynchroTeq Plus deployments in arc furnace applications prove to generate clear advantages and benefits for industry owners and managers.

SynchroTeq Plus in brief

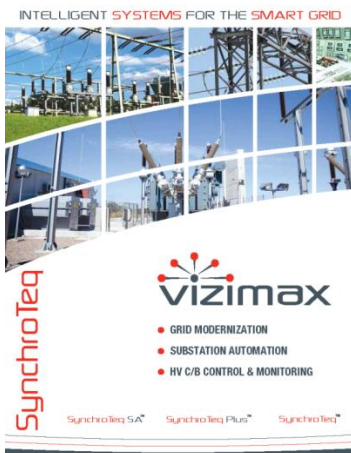
Designed as a manufacturer agnostic solution, SynchroTeq Plus can be used with HV/MV circuit breakers from any vendors and technology, and is successfully deployed worldwide on new and existing C/Bs.

Sequence-of-Events Recorder - SER

SynchroTeq Plus generates events and alarms related to all switching operations. Up to 2,000 events are stored in non-volatile memory, time-stamped (native NTP & PTP/IEEE1588 time synchronization support) and flagged according to their link with five major categories: SynchroTeq Plus internal, sensor, C/B, C/B operation timing and Residual flux alarms.

Advanced real-time monitoring assets

Thanks to its secure web-based operation interface, SynchroTeq Plus allows real-time monitoring and visualization of event journal (SER), digital statuses, values and fluctuations of critical parameters including network's voltages, currents, C/B operation timings and parameters, ambient temperature, C/B's idle time and drive mechanism pressure.



- **Smart upgrade of existing C/Bs (retrofit)**, with controlled switching & monitoring features
- **Monitors C/B degradation** to prevent mechanical/electrical failure.
- **Manages future maintenance** and repair based on live acquisition, SER and alarms.
- **Improves the stability and reliability** of power networks and HV/MV assets.
- **Modular platform** also suitable for advanced switching in TFO, MSR, FLT, Power Line projects



<p>North America 2284, de la Province Street Longueuil (Qc) Canada J4G 1G1</p> <p>T : +1 450 679-0003 F : +1 450 679-9051 sales@vizimax.com www.vizimax.com</p>	<p>Europe, Middle East, Russia 475 Louise Avenue 1050 Brussels</p> <p>T : +32 2 669 0735 F : +32 2 669 0739 sales@vizimax.com www.vizimax.com</p>	<p>India HIG-408, Street no.12 Madhavanagar, Ramachandrapuram Hyderabad-502032, India</p> <p>Mob : +91 9848822724 sales@vizimax.com www.vizimax.com</p>	<p>Latin America Alameda Itù # 1267, Conj. 122 Jardins, CEP 01421-001 São Paulo • SP • Brazil</p> <p>T: 55-11-96307-6174 F: 55-11-3081-9077 sales@vizimax.com</p>
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