INTEGRATED DISTRIBUTION SUBSTATION

COOPER Power Systems

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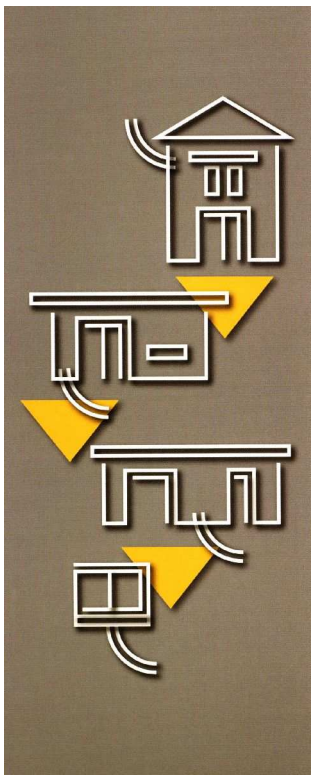
Increased reliability in an integrated SF6 – free compact package



Medium voltage underground distribution stations have progressed from a complex structure to a small compact until.

Following is the evolution of the technology:

Two-floor civil work building housed incoming overhead lines on the second floor. The first floor housed separate airbrake switches, protection, transformer, and low voltage gear.

One-floor civil work building housed incoming underground lines located in public areas. Building housed separate metal enclosed airbrake switching and protection cells, connected to an oil-filled transformer.

Pre-fabricated structure housed incoming under-ground lines located in public areas. Enclosure housed separate prefabricated metal Modula switching and protection cells filled with SF6 gas, connected to a silicone- or oil-filled transformer.

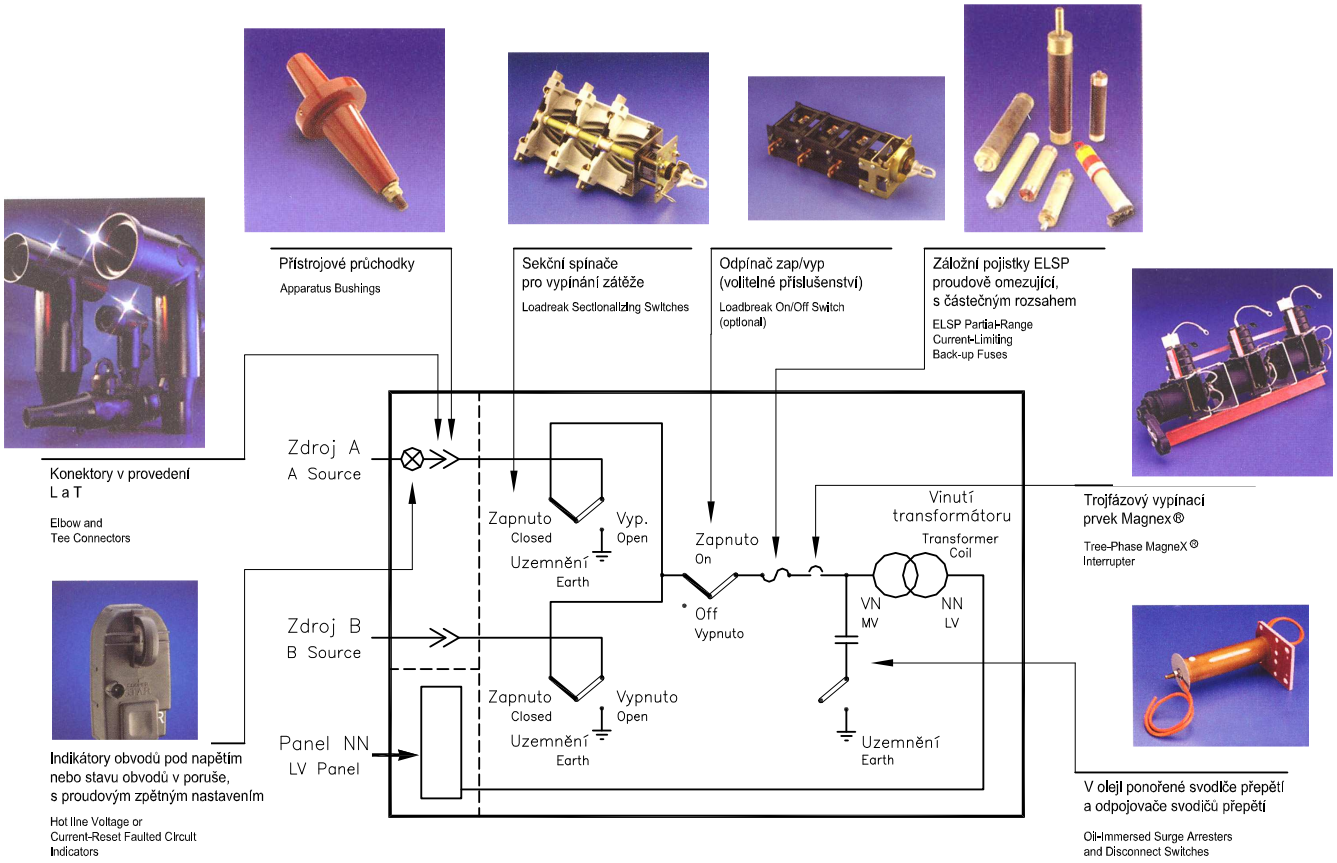
The integrated distribution substation integrates switching protection and transformation under non-toxic, biodegradable, high fire point, K-class dielectric fluid. Equipment requires no civil work structure as the incoming and outgoing cables are protected from the public with a high security enclosure.

The design offers the following benefits:

- **easy installation**
- **superior transformer protection**
- **increased safety**
- **improved reliability**
- **environmentally friendly:**
  - **SF6-free**
  - **high fire point K-class fluid**

Millions og pad-mounted compact distribution substations have been installed in the last 40 years in the Americas and other countries. The design conforms to American Nationa Standards (ANSI®) which contain strict guidelines to ensure operational and enclosure integrity.

Key Components of the Integrated Distribution Substation



Component	Description	Ratings
1. Deadbreak or Loadbreak Elbow and Tee Connectors	• Fully screened and submersible connection suitable for indole and outdoor applications • Built-in electrical stress control • Moulded EPDM rubber construction immune to contamination • Built-in capacitive test point allows for easy check of circuit status	• Continuous current = 1250 A for 24 kV and 630 A for 36 kV • Short- time withstand current (1 s) up to 75 kA • Impulse withstand up to 170 kV
2. Deabreak or Loadbreak Apparatus Bushings	• Screened deadbreak design for use with liquid-filled equipment • Includes screen for controlling electrical stress with earthing place • Made for indoor or outdoor applications	• Continuous current = 1250 A for 24 kV and 630 A for 36 kV • Short- time withstand current (1 s) up to 75 kA • Impulse withstand up to 170 kV
3. Loadbreak Sectionalizing Switches	• Rotates to three positions for alternate source, open, and earth selection • Silver-plated copper contacts	• Continuous current = 400 A/24 kV • Short- time withstand current (2 s) = 16 kA, (1 s) = 20 kA • Short circuit making current (12 cycles) = 16 kA sym.
4. Loadbreak On/Off Switch (optional)	• Spring loaded activating mechanism ensures quick loadbreak or loadmake operation in less than 1 cycle • Minimal input torque required	• Continuous current = 400 A/27 kV • Momentary /10 cycles = 12 kA
5. ELSP Partial-Range Current-Limiting Back-up Fuses	• Hi-amp fuse coordinated with MagneX® interrupter gives full range of fault protection • Protects and isolates faulted equipment • Efficient energy limiting section	• Maximum interrupting current = 50 kA RMS sym.
6. Three-Phase Magnet interrupter	• Overcurrent protective device • Protects from damaging overloads, secondary, faults, and high fluid temperature • Three-phase gang trip • Externally resettable • Can be used to turn transformer on and off	• Continuous current = 42 A • Maximum interrupting current: 8,3 kV = 2500 A RMS, sym 15 kV = 1500 A RMS sym 23 kV = 500 A RMS sym 38 kV = 500 A RMS sym (delta connected version only) • Impulse withstand up to 150 kV
7. Oil-Immersed Surge Arresters	• Protects from reflected impulses in cable circuits • Non-linear metal oxide varistors provide exceptional surge protection • Eliminates the possibility of shortened arrester life due to external contamination, wildlife, vandalism or moisture ingress • Cooled by the oil for repeated surge duty	• Nominal discharge current = 10 kA for ratings 3-36 kV • High current impulse = 100 kA • Switching impulse residua voltage 250 A/ 2000 µs duration
Arrester Disconnect Switches	• Allows external means	• Suitable for applications up to 35 kV class, 150 kV impulse withstand

8. Hot Line Voltage Indicators	• Identifies energized circuits • Pulsating high intensity LED display • Housed in one-piece weatherproof housing • Used on connectors with voltage test point • Quick and easy installation	• Voltages: 4,16 to 35 kV • Fault Withstand Capability: 25 kA for 10 cycles • Self powered with minimum of 2400 V on circuit
Current-Reset Faulted Circuit Indicators (for multi-earthed systems)	• Locates faulted sections of cable • Variable-trip technology • Tough, durale construction – corrosion-proof, damage-resistant	• Fault Withstand Capability: 25 kA for10 cycles • Trip current: 100 A rise within 6 cycles • Self-powered on 2.0 A continuous current, no battery required
Dielectric Fluid		**Typical Values**
9. Envirotemp FR3 Fluid	• Optimal safety and environmental choice when compared to mineral oil • Completely biodegradable , seed-based, non-toxic fluid • K-Class, high fire and flash points • Extends insulating paper life by 5 to 8 times • UL Classified and FM Global Approved • Cooper fluid-immersed components have been tested and certified in Envirotemp FR3™ fluid	• Dielectric Strength = 56 kV • Fire Point = 360℃ • Flash Point = 330℃
Mineral Oil (optional)	• Type II with inhibitors for oxidation stability	• Dielectric Strength = 45 kV • Fire Point = 165℃ • Flash Point = 147℃

IDS – Big Advantages in a Small Space

Cost Savings

- Minimum real estate reguired
- Minimal civil work needed (no building or vault structure) for outdoor applications
- Integrated single casing from one manufacturer – no need to purchase and stock three separate components
- Minimum installation costs
- Reduced external cabling and connectors
- Envirotemp FR3 less – flammable fluid allows indoor installations without sprinkler or vault requirements

Safety

- Envirotemp FR3 K-Class fluid essentially eliminates transformer pool fires
- Magnex interrupter is an overcurrent protection device that also senses high fluid temperature
- Deadfront with screened connectors eliminates flashover
- Capable of operating under a flood condition
- Integrated enclosure cubicle is aloe access to authorized personnel only

Environmental Benefits

- SF6-free
  - Eliminates ozone depleting SF6 gas used in RMU switching modules
  - Eliminates SF6 arcing by-products
  - 1997 Kyoto protocol – developed countries agreed to reduce overall emissions of greenhouse gases, which includes SF6 by 5,2% over the period 2008 - 2012
  - Liquid-filled equipment will help meet this goal
  - Envirotemp FR3 fluid is a renewable seed based oil option which is non-toxic and biodegradable
- Low profile design blends in with the environment

Operational Integrity

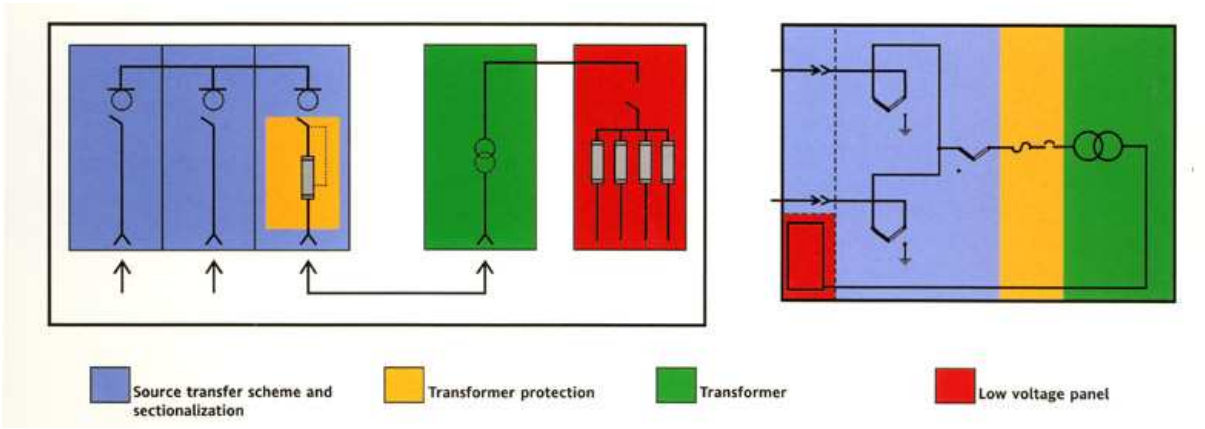
- Envirotemp FR3 fluid extends insulation paper thermal life and increases overload capabilities
- Components are assembled and tested as an integral unit under fluid at the factory

Lower load losses due to elimination of cable and connections from each component

Comparison of a Typical RMU Station to the IDS

Typical RMU MV/LV Substation
Conventional RMU-based MV/LV stations incorporate medium voltage primary switching filled with SF6 gas and overcurrent protection in cells separate from the transformer and cabled/bused to it. The low voltage panel is also housed in a separate cell. To ensure public safety and improve aesthetics, the entire substation is packaged into a kiosk.

Integrated Distribution Substation
The IDS incorporates medium voltage switching, medium voltage protection, transformation and low voltage protection in a single enclosure. The IDS provides a secure, aesthetically pleasing, unit that minimizes costs and drastically reduces space requirements.



Source transfer scheme and sectionalization = schéma přenosu energie ze zdroje a dílčí dělení
Transformer protection = ochrana transformátoru (ELSP Partial-Range Current = Záložní pojistky ELSP)
Transformer = transformátor
Low voltage panel = panel NN