NALFWind for wind & solar farms
Indoor switches technology
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Agenda

Indoor air insulated NALF Wind switch-fuse combination

Scope

- Introduction
- Wind tower connection to grid - medium voltage component design
- Portfolio
- CSS Application
- Summary – Customer benefits
Introduction

**Windfarm challenges**

The worldwide demand for renewable energy is growing constantly, with wind power as one of the fastest growing sectors. To meet the current and future needs of network operators, manufacturers and designers of wind power systems need to be able to call on both advanced technologies and in-depth knowledge.

More and more demanding expectations to reduce cost of generated energy have required both design and performance optimization of wind farms, especially considering available alternative renewables energy sources (solar, biomass, biogas, hydro etc.).
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Introduction

Grid connection schemes

The electrical installation in the area of connection between wind tower and the grid needs to be optimized;
- The process considers both connecting lines (cables, overhead lines) switching & protection equipment and transformers;
- The cost efficient scheme require balance between functionality and performance;

All these is achievable today!
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Wind farm typical application concepts for MV installations

**Nacelle design principles**

Transformer inside wind tower
- Nacelle with gear box - generator voltage is increased by transformer, transferred by HV cable down to further connecting points

Transformer outside wind tower
- Generator voltage 0.69 kV is transferred down by LV cable that are coming to transformer substation outdoor or indoor one

Applicable inside nacelle without transformers
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Wind farm typical application concepts for MV installations

- **MV Switchgears**
  - Gas insulated up to 40.5kV
  - Air and Gas insulated up to 40.5kV

- RMU: Secondary switchgear

- Outdoor live tank circuit breakers
  - up to 40.5kV

- Outdoor dead tank vacuum circuit breakers
  - up to 38kV

- Vacuum contactors
  - up to 12kV

- Reclosers
  - up to 38kV

- Compact Secondary Substations
  - Steel, concrete and GRP up to 40.5kV

- NALFWind: Indoor fuse-switch combination
  - up to 3 MVA / 36kV

- Protection & Control Relays

- Indoor Circuit Breakers
  - Vacuum and SF6 CBs up to 40.5kV

- E-Houses
  - Pre-fabricated units, Module Substations, Skid-Mounted Modules

- Energy Storage Modules
  - up to 40.5kV / 4 MW
# NALFWind for wind & solar farms

## Technology comparison

<table>
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<tr>
<th><strong>Switch-fuse combination open air</strong></th>
<th><strong>RMU switch-fuse combination</strong></th>
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<tr>
<td><strong>Features</strong></td>
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<td>- Electrical &amp; mechanical performance level M1/ E1 according to IEC</td>
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<td>- <strong>High capability for transformer protection by current limiting fuses up to 3000kVA</strong></td>
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<tr>
<td>- Visible insulation gap</td>
<td>- Mechanical switch position indicator</td>
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<tr>
<td>- <strong>Easy access to all breaking components</strong></td>
<td>- Breaking components placed inside closed tank</td>
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<tr>
<td>- Limited maintenance</td>
<td>- <strong>Maintenance free</strong></td>
</tr>
<tr>
<td>- Possibility to use inside/ outside wind towers (inside in big nacelle only)</td>
<td>- Possibility to use inside and outside wind towers (including installation thru narrow door gate)</td>
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*ABB offers best solutions for wind/solar installations*
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Technology comparison

**SD vs. CB**

Both switch-fuse combination and circuit breaker offers similar functionality for switching and protection of transformers.

The circuit breaker pros is higher breaking performance

The switch-fuse combination pros is optimized cost with required performance

Protection by breaker require:
- Breaker
- Relay
- CT
- Disconnector or withdrawable breaker
- Earthing switch (optional)

Protection by switch-fuse combination require:
- Switch-fuse combination with current limiting fuses
- Earthing switch (optional)
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NALFWind design principles

**Modular design for easy adaptation inside compact transformer stations**

The NALFWind is 36 kV air-insulated switch-fuse combination with short circuit breaking current 31.5 kA (with CEF-S 63 A fuses)

- Main configurable components
  - Fuse base with fuse tripping system and blown fuse indicator – protection up to 3000 kVA at 36 kV with CEF-S 30/40.5 kV 63 A fast acting fuses
  - Earthing switch with making capacity of 79 kA (peak with CEF-S 63 A fuses)
  - Auxiliary contacts for switch and earthing switch
  - Motor drives – shaft and front mounted
  - Mechanical/electrical interlocks
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CSS application concept

NALFWind in CSS

Proposal for ABB CSS Mercure family CSS with NALFWind 36 kV switch-fuse combination with upper fuse base and CEF-S 30/40.5 kV fast acting current limiting fuses.

- Optional equipment:
  - Earthing switch with making capacity.
  - Passive voltage indicators type VV-B
NALFWind configuration for arrangement inside substation with optimized connection with transformer.

- Highlights:
  - HV transformer terminals should be connected to HV fuse base;
  - Earthing switch should be available at fuse base side
  - Switch arcing chamber should be position down to ground
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CSS application concept

NALFWind in CSS

ABB’s NALFWind 36 kV switch-fuse combination units has been incorporated into 163 units of transformer/network protection substations in De Aar South African 138 MW Wind Farm project as the most cost-efficient solution.

The NALFWind and NAL were delivered to many wind projects worldwide (UK, Brazil, Sweden, South Africa).

The NALFWind product name and design principles have been TM protected.
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CSS application concept

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CSS application highlights

**NALFWind in CSS**

**Fast interruption time**

- Very fast clearance of short circuit currents due to use of fast acting CEF-S current limiting fuses that operates within few ms vs over 90 ms available for CB with protection relay and CT

- Full range protection for overload currents based on IEC 62271-105 principles

![Diagram showing interruption time](image)

- $T_0$: Response time of the protection relay: 10 - 20 ms
- $T_1$: Operating time of the protection relay: 30 - 40 ms
- $T_2$: Operating time of the circuit-breaker: 40 - 80 ms
- $T_3$: Arc duration: 10 - 20 ms

- Total time of current flow through current limiting fuse: $T = 2$ ms
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CSS application highlights

NALFWind in CSS

LV side protection

- Protection against short circuit that appears on LV transformer side thanks to MV CEF-S fuses with specially designed higher sensitivity for overload currents at 0.1 s

- Easy protection coordination with transformer characteristic including overload range
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Summary – Customer benefits

NALFWind in CSS

New indoor air insulated switch-fuse combination with integrated earthing switch for transformer protection (up to 3 MVA at 36 kV) and completely new patented interruption system

Safety: Made to IEC standards (IEC 62271) smart design (without piston system), visible insulation break, passive voltage indicators – Reduced maintenance cost

Reliability: Stringent testing of each unit, high and unique (in air insulation) interrupting capacity – Optimized investment return

Performance: Best protecting and breaking solution for transformer protections with air insulation technology – Extended insulation lifetime and lower transformer protection cost