Agenda

Scope
- Introduction
- Portfolio
- NAL/C4 design principles
- Accessories and product configurations
- Fuse-switch coordination
- Application – configuration examples
- Summary

Presentation goals
- General recognition of portfolio & application
- Clear recognition of product values
Indoor air insulated switch-disconnectors

Introduction – indoor switches product classification
Indoor air insulated switch-disconnectors

Portfolio – indoor air insulated switch-disconnectors

**NAL/NALF/NALFWind**

- **IEC/CSA standards**
  - 4.16-36 kV
    - Rated current: ...1250A
    - STC: ...31.5 kA (1s)
    - Making: ...67 kA peak

**VersaRupter**

- **ANSI standard**
  - 4.73-34.5 kV
    - Rated current: ...1200A
    - STC: ...40 kA (3s)
    - Fault close: ...61 kA RMS

**C4**

- **IEC/VDE standard**
  - 12-24 kV
    - Rated current: ...1250A
    - STC: ...25 kA (3s)
    - Making: ...63 kA peak
### Indoor air insulated switch-disconnectors

Portfolio – NAL variants

<table>
<thead>
<tr>
<th>NAL/NALF</th>
<th>VersaRupter UR (USA)</th>
<th>NAL CSA (Canada)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC harsh condition variant with epoxy insulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– 12-24 kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Rated current: ...630A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• STC: ...31.5 kA (1s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Making: ...67 kA peak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI UR listed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– 4.73-13.8 kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Rated current: ...1200A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• STC: ...40 kA (3s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fault close:...61 kA RMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSA 22.2 compliance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– 4.16-34.5 kV</td>
<td></td>
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</tr>
<tr>
<td>• Rated current:...1200A</td>
<td></td>
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</tr>
<tr>
<td>• STC:...25 kA (3s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fault close:...40 kA RMS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Indoor air insulated switch-disconnectors

Portfolio – IEC indoor air insulated disconnectors and earthing switches

**OW/OWD/OJON**
Free standing disconnectors
– 12-36 kV
  • Rated current: 630-4600A
  • STC: ... 90 kA (1s)

**OJWN/EB**
Free standing earthing switches
– 12-36 kV
  • STC: ...40 kA (1s)
  • Making capacity: ...100kA peak

**EK6/STE**
Build in earthing switches
– 12-40.5 kV
  • STC: ...50 kA (1s)
  • Making capacity: ...120kA peak
Indoor air insulated switch-disconnectors

Portfolio – IEC indoor SF6 insulated load break switches and transient-free capacitor switch

**GSec**

- Load break switch
  - ...24kV/ ...800A
  - 375 mm panel width
  - Three positions
  - Electrical endurance: E3

**HySec**

- Circuit breaker with integrated disconnector/earthing
  - 24kV/630A
  - 500 mm panel width
  - Metallic partition

**DS1**

- IEC/ANSI Diode-based capacitor switch
  - 17.5 kV/630A IEC
  - 15.0 kV/600A ANSI
  - 10,000 CO full capacitive currents
  - 50,000 CO mechanical
Indoor air insulated switch-disconnectors

C4 design principles

**Compact design for panel applications**

Designed for narrow distribution switchgears

- Selectable components
  - Switch-disconnector main part – CK4
  - Switch-disconnector with fuse base with fuse tripping system - CS4 - and optional time delayed tripping system
  - Earthing switch with making capacity
  - Manual and motor drives
  - Auxiliary contacts
  - Applicable in ABB ZS8.4
Indoor air insulated switch-disconnectors

NAL design principles

Modular design for easy adaptation inside panels and compact transformer stations

The NAL can be easily configured in line with specific application requirements

- Main configurable components
  - Single or double spring mechanism
  - Fuse base with or w/o fuse tripping system – upper/lower
  - Earthing switch – upper/lower
  - Auxiliary contacts for switch and earthing switch
  - Motor drives – shaft and front mounted
  - Mechanical interlocks
  - Blown fuse indicator
  - Blocking and tripping coils
Indoor air insulated switch-disconnectors

NAL design principles

Unique combination of two arc extinguishing systems

Two active breaking systems during interruption process
- Gas blast (current dependent)
  - Whenever high overload current must be interrupted the high temperature appears inside arcing chamber, that activates intensive gas molecules release process
- Air blast (current independent)
  - Whenever NAL opens, air has been compressed inside cylinder of hollow insulator by moving up the piston, that is mechanically interlocked with main shaft
  - The compressed air is blown through arcing chamber to support interruption of small load currents
Indoor air insulated switch-disconnectors

NAL operation principles

**Unique combination of two arc extinguishing systems**

**Closed position**
- Main and arcing knives are closed
- Current floats through main knives

**Opening process**
- Main knives open first
- Current load stays on arcing knives only
- Arcing knives open and break load current

**Completely opened**
- All knives are disconnected
- Visible insulation break

**Closing process**
- Main knives close first
- Arcing knives close
- Load current is connected to terminals

NAL has very efficient combination of two arc extinguishing systems that supports 100 breaking operations at 630 A rated current value
Indoor air insulated switch-disconnectors

NAL design configurations

**Smart choice of available product basic variants**

**NAL variants**
- Pole distance
  - 12 kV – 150 mm, 170 mm and 210 mm,
  - 17.5 kV – 170 mm and 210 mm,
  - 24 kV – 170 mm*, 235 mm and 275 mm,
  - 36 kV – 360mm, 400 (NALFWind) mm
  *with insulation barriers
- Rated currents
  - 400, 630 and 1250 A at 12/17.5/24 kV,
  - 630/800/1000 A at 36 kV,
  - 200A at 36 kV NALFWind
- STC: 16-31.5 kA (1s)
- Making capacity: 50/67 kA (peak)
Indoor air insulated switch-disconnectors

NAL operating mechanism

Mechanisms:
- K – single spring, for manual operation
- A – double spring – opening spring may be charged that allows immediate opening of the switch by:
  • mechanical,
  • electrical,
  • fuse tripping release
Indoor air insulated switch-disconnectors

Earthing switches

Earthing switches available for NAL:
- Quick type E – earthing switch attached to the switch and/or to the fuse base insulators and equipped with quick spring mechanism with making capacity,
- Quick type EB – free standing earthing switch for assembling at both sides of the switch configuration or for independent application,
- Type LCES – without quick spring mechanism attached to the fuses bases and/or to the switch insulators
Indoor air insulated switch-disconnectors

Motor drive type MU

Mounted directly on the NAL shaft or on the front of application panel

Applicable for switchgears and transformer substations

- Local or remote control suitable for radio or internet operations and control
- Possible integration with SCADA system
- Ready for Smart Grid networks

Retrofit and new installations
Indoor air insulated switch-disconnectors

Motor drive type UEMC41

New motor drive (2016) for assembly frontally on the application panel or directly on the switch shaft

Suitable for switch-disconnectors, disconnectors and earthing switches due to adjustable rotating angle.

Control and commands send locally or remotely (radio, internet).

Operating time from 4 up to do 10 s depends on applicable switch and operating load.

Compliance with the following IEC standards:

- EN 60335-1, EN 62271-1,
- EN 62271-102, EN 62271-103

Retrofit and new installations
## Indoor air insulated switch-disconnectors

### Accessories for NAL

**Manual drive HE, coils and auxiliary contacts**

<table>
<thead>
<tr>
<th>Description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shunt trip coil mounted on all A-mechanisms. This coil is available for the following voltages: 24, 48, 110, 220 V DC and 110, 220 V AC. It shall always be connected in series with an auxiliary switch.</td>
<td><img src="image1" alt="Shunt trip coil" /></td>
</tr>
<tr>
<td>Manual operation of HE consists of lower part (can be equipped with blocking coil), upper part and connection rod.</td>
<td><img src="image2" alt="Manual operation" /></td>
</tr>
<tr>
<td>Auxiliary switch can be mounted on all switch disconnectors, max. 8NO and 8NC and on all earthing switches except LCES, max. 4NO + 4NC.</td>
<td><img src="image3" alt="Auxiliary switch" /></td>
</tr>
<tr>
<td>Auxiliary switch for blown fuse.</td>
<td><img src="image4" alt="Auxiliary switch" /></td>
</tr>
</tbody>
</table>

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**Duży wybór akcesoriów dom instalacji na rozłącznikach i uziemnikach**

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Indoor air insulated switch-disconnectors

Indoor switches application concept

Why do we use indoor switch-fuse combination?

Objectives
– Melt fuse must be replaced to continue energy supply

Values
– Load break switches and switch-fuse combinations are commonly applicable as line and transformer switches as economic alternative to circuit breakers
– Capable to interrupt full range overload and short circuits current due to high breaking performance of fuses and automatic fuse tripping system IEC 62271-105
– Significant reduction of prospective current value due to extremely fast operating time of current limiting fuses
### Indoor air insulated switch-disconnectors

Switch-fuse combination according to IEC 62271-105

<table>
<thead>
<tr>
<th><strong>Switch-disconnector</strong></th>
<th><strong>Current limiting fuses</strong></th>
<th><strong>Switch-fuse combination</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Switch-disconnector" /></td>
<td><img src="image2.png" alt="Current limiting fuses" /></td>
<td><img src="image3.png" alt="Switch-fuse combination" /></td>
</tr>
</tbody>
</table>

- Interruption of overload currents up to few kA only with visible insulation break
- Interruption of high short circuit currents without visible insulation break
- Interruption of both small and high overload currents with visible insulation break

The real and cost efficient full range protection
Indoor air insulated switch-disconnectors

NAL/VR Application inside substations IEC and ANSI

**ABB CSS IEC**

Compact design with side mounted switches, NALF in upper level and up to three NAL in lower level

**OEM CSS IEC**

Back or side mounted switches, stations with transformers or coupling units

**CSS ANSI**

Back mounted switches in padmounts Dead-Front and Live-Front types

Easy application in compact substation, remote and manually operated
Indoor air insulated switch-disconnectors

NAL/VR application inside air insulated switchgears

**ABB ZS1 IEC (on the picture)/panel builders**

Highlights for typical panel applications

- **ZS1 primary**
  - Switch on the side in common compartment with IT (12-24 kV)
  - Doors interlocked
  - Manual and motor drives

- **Panel builder primary and secondary**
  - Switch on the side IEC or on the back ANSI
  - IEC compact secondary panels (615 mm for 24 kV)
  - With or w/o fuse holders
Indoor air insulated switch-disconnectors
NAL application inside open switchgears

Old distribution stations IEC

Highlights for retrofit of old distribution stations

- Open cells stations
  - Switch on the back operated from front of installation (12-24 kV)
  - Simplified access prevention (fence protection only)
  - Installed in concrete housing connected to overhead lines
  - Manual or motorized

Retrofit of old distribution stations
Indoor air insulated switch-disconnectors

Aplikacje NAL

NAL Applications
author: Adam Durski

Double click on the slide in presentation mode to access this chapter
Indoor air insulated switch-disconnectors

C4 application inside air insulated switchgears

ABB ZS8.4 IEC distribution switchgear

Air insulated switchgear with partition class PI or PM designed for industry, power supply and distribution network application.

- Open cells stations
  - 12 kV, 1250 A, 25 kA
  - 17.5 kV, 1250 A, 25 kA
  - 24 kV, 1250 A, 25 kA
- Technical design according to IEC 62271-200
- With rod-type switch-disconnector C4 series (CK4 and CS4)
- Applicable in third party panels as well
Indoor air insulated switch-disconnectors

NALFWind™ for wind farms

NALFWind 36 kV switch-fuse combination for transformer substations

- Transformer connected with generator by LV cables
  - Optimized cost of MV/LV arrangement

- Innovative protection of transformer
  - LV/MV protection by fast acting ABB CEF-S current limiting fuses

- NALFWind™ – a 36kV switch-fuse combination developed for the competitive design of wind farms transformers up to 3000 kVA@36kV

Optimized solution for 36 kV on shore wind farms
Indoor air insulated switch-disconnectors

Summary

Indoor air switches our values

The indoor switches are the main solution for protection of distribution transformers and cable switches we are part of EPMV Apparatus Group offering:

- Valuable 40 years presence on the application market across the globe with over 600,000 installed switches
- Technical support for product configuration and selection for specific requirements
- Motorized switches for network automations
- Competitive solution for wind/solar farms
- Best electrical performance classes

Take us home and enjoy it!