High Reliability with ABB Disconnector
Disconnectors
Critical Component of Substation Availability

To be replaced by other photo
This photo is not OK as showing unsafety working condition
Disconnectors in a substation

What is it?

A mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements (IEV 441-14-05)
Historically, bays were designed to make it possible to isolate the circuit breaker for maintenance

- The basis was that circuit breakers demanded more maintenance than disconnectors
- Typical maintenance intervals for earlier circuit breakers was 1-2 years and for disconnectors 4-5 years
- To avoid total outage of the busbar during disconnector maintenance a second busbar was used
Disconnector
Reliability with Minimum Maintenance

- Operates smoothly & consistently when command is given
- Consistent Main Circuit Resistance (mV drop) over life. Less losses.
- Short time current withstand capacity with some min. current carrying capability
- Minimum maintenance during Lifetime
  - Good lubricating system
  - Synthetic and dry lubrication
- Retains isolating properties
  - Links do not get disturbed
  - Permanent adjustments
- Good seismic withstand capability
- Constructional flexibility to suit various layouts & spaces in the S/S
Disconnectors
Various Environments and Conditions

- Wide Range of Temp.
- Ice Loads
- Earthquake Area
- Sea Coast, Pollution
- Winds, storms and other external impacts
Disconnectors
Reality and Consequences

- Unable to carry rated current due to deterioration of current carrying path
- Unable to close or open (correctly) due to deterioration of linkages etc.
- Failure of interlocks due to auxiliary switch malfunction
- Failure of electrical circuits due to poor enclosure.
- Failure to withstand seismic forces.
- Mechanical failures when installed in special layouts

- Grid collapse
- Unable to (close) energize circuit.
- More downtime for maintenance
- Spare inventory
- Unsafe operation
- Unable to isolate (open) the circuit

- Severe threat to safety
- Loss of revenue
## ABB Disconnectors
### Global Product Portfolio

### Specification Table:

<table>
<thead>
<tr>
<th>Model</th>
<th>Range</th>
<th>Range</th>
<th>Range</th>
<th>Range</th>
<th>Range</th>
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<tbody>
<tr>
<td>SDF</td>
<td>72-550kV</td>
<td>72-420kV</td>
<td>123-550kV</td>
<td>245-550kV</td>
<td>123-245kV</td>
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<tr>
<td>eDB</td>
<td>3150A, 50kA</td>
<td>5000A, 63kA</td>
<td>4000A, 63kA</td>
<td>4000A, 50kA</td>
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<td>GW54</td>
<td>5000A, 63kA</td>
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<td>4000A, 63kA</td>
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<td>GW57</td>
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<td>DSSP</td>
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</table>

### Remarks:
Higher rating upon request.
Horizontal Center-Break SDF
Customer Benefits

- Reduce energy loss from
  - Minimized contact resistance
  - Minimum number of joints with special material

- High reliability from special design
  - Special conducting material without external spring for contacts
  - Strong rotary pedestals
  - Dead center interlocking
  - Superior design of mechanical interlock

- Easy and quick erection
- Smooth operation and minimal maintenance
- Suitable for wide range of environmental conditions
Horizontal Center-Break SDF Structure

- Applied upto 550kV
- Each pole contains:
  - A base frame with two rotary pedestals
  - Two insulators
  - Current path
- Earthing Switch:
  - Both right and left side can be equipped with earthing switch
- Drive mechanism:
  - Motor/manual-operated drive
Horizontal Center-Break SDF Structure

1. Current path
2. Contact finger
3. Contact piece
4. Terminal plate
5. Rotary head
6. Insulator
7. Operating mechanism of disconnector
8. Diagonal rod
9. Base frame
10. Rotary pedestal
11. Coupling rod
12. Earthing contact
13. Earthing arm
14. Earthing contact finger
15. Operating mechanism of earthing switch
16. Earthing switch shaft
# Horizontal Center-Break SDF Parameters

<table>
<thead>
<tr>
<th>Voltage</th>
<th>72.5 kV *</th>
<th>123 kV</th>
<th>146 kV</th>
<th>170 kV</th>
<th>245 kV</th>
<th>300 kV</th>
<th>362 kV</th>
<th>420 kV</th>
<th>550 kV</th>
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<td>SDF72.5</td>
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<td>SDF170</td>
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<td>SDF300</td>
<td>SDF362</td>
<td>SDF420</td>
<td>SDF550</td>
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<td>Rated voltage (U&lt;sub&gt;r&lt;/sub&gt;)</td>
<td>kV</td>
<td>72.5</td>
<td>123</td>
<td>146</td>
<td>170</td>
<td>245</td>
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<td>362</td>
<td>420</td>
</tr>
<tr>
<td>Rated frequency (f)</td>
<td>Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (I&lt;sub&gt;n&lt;/sub&gt;)</td>
<td>A</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Rated short-withstand current, rated duration of short circuit (I&lt;sub&gt;sh&lt;/sub&gt;)</td>
<td>kA, s</td>
<td></td>
<td></td>
<td></td>
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<td>Rated peak withstand current (I&lt;sub&gt;p&lt;/sub&gt;)</td>
<td>kA</td>
<td></td>
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<td>kV</td>
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<td>230</td>
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<td>325</td>
<td>450</td>
<td>385</td>
<td>450</td>
<td>520</td>
</tr>
<tr>
<td>To earth and between poles</td>
<td>kV</td>
<td>150</td>
<td>255</td>
<td>315</td>
<td>375</td>
<td>530</td>
<td>435</td>
<td>520</td>
<td>610</td>
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<tr>
<td>Across the isolating distance</td>
<td>kV</td>
<td>325</td>
<td>550</td>
<td>650</td>
<td>750</td>
<td>1050</td>
<td>1050</td>
<td>1175</td>
<td>1425</td>
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<tr>
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<td>kVp</td>
<td>375</td>
<td>650</td>
<td>750</td>
<td>660</td>
<td>1200</td>
<td>1050(+170)</td>
<td>1175(+205)</td>
<td>1425(+240)</td>
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<td>To earth and between poles</td>
<td>kVp</td>
<td>850</td>
<td>950</td>
<td>1050</td>
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<tr>
<td>Across the isolating distance</td>
<td>kVp</td>
<td>700(+245)</td>
<td>800(+295)</td>
<td>900(+345)</td>
<td>900(+450)</td>
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</tr>
</tbody>
</table>
Horizontal Center-Break SDF
Rotary Terminal Head – Current Transfer Joint

- Tulip type silver faced contact arrangement, protected from outdoor conditions
- Graphite and synthetic material bearings used for life long performance
- Permits 360° rotation of terminal
- Sliding surfaces locked and lubricated with dry lubricants (Delrin)
- Weather proof and high robustness
Horizontal Center-Break SDF
Contacts and Current Path

- Hot metalizing of Cu-Al joints to reduce galvanic voltage difference to avoid possible corrosion.
- No Separate springs
  - No rusting/ corrosion
  - No loose positions; minimum components & maintenance
  - Consistent Contact resistance over long periods.
- Minimum number of joints for SDF with welded tubular sections
- These all contribute in maintaining the circuit resistance to the optimum level and consistency during the service life of disconnector. Reduce energy loss
Horizontal Center-Break SDF
Turn Tables

- Turn table bearings totally protected from environments (i.e. ingress of dust/water)
- Two stainless steel bearings (double bearings) for reliable rotary movement and reduced friction
- High temperature stable grease used for lubrication. Lifetime lubrication. Virtually no maintenance
Horizontal Center-Break SDF Links

- Use of insulated rod end spherical stainless steel bearings, providing
  - Protection to galvanic corrosion
  - Three dimensional flexibility in movement
  - Giving reduced friction through the life
- Not require any lubrication
- Alignment in 3D avoiding stresses on bearing
Horizontal Center-Break SDF
Dead Center Locking

DEAD CENTER POSITION – 1

CLOSED

DEAD CENTER POSITION – 2

OPEN
• **Closed Position** (of a mechanical switching device)
  - The position in which the predetermined continuity of the main circuit of the device is secured

• **Open Position** (of a mechanical switching device)
  - The position in which the predetermined clearance between open contacts in the main circuit of the device is secured

• **Clause 5.104.3 Indication and signaling of position**
  - Indication and signaling of the closed and open position shall not take place unless the movable contacts have reached their closed or open position, respectively and the first paragraph of 5.104.1 is fulfilled

1st paragraph of Clause 5.104.1: Disconnectors and earthing switches, including their operating mechanisms, shall be designed in such a way that they cannot come out of their open or closed position by gravity, wind pressure, vibrations, reasonable shocks or accidental touching of the connecting rods of their operating system
Horizontal Center-Break SDF Drive Mechanism

- Available for both motor drive and manual types
- All mounting nuts & bolts are of non-corrosive material
- Aux. Switches are suitable for SCADA applications and can be changed from NO to NC and vice-versa even at site
- Aluminium cabinet and powder coated with Polyurethane paints, giving lasting protection to corrosion
- Stainless steel door hinges do not allow door jamming even after many years
- In-built safety mechanism safety release as standard feature – main arms cannot rotate more than 90 degrees in manual or motorized mode
Horizontal Center-Break SDF
Contact Alignment and Base Adjustment

- Contact alignment is essential to avoid undue mechanical & thermal stress and create long term reliability
- Cylindrical form can provide the absolute rotational alignment
- No loose shim requirement for arm alignment
- Provide flexibility with simplicity
Horizontal Center-Break SDF
Modular Transport Assembly
Horizontal Center-Break SDF
Various Arrangements
Horizontal Center-Break SDF
Vertical Mounting
Horizontal Center-Break SDF
Integrated or Stand-Alone Earth Switch
Horizontal Center-Break SDF
Special Installation
Horizontal Center-Break SDF Special Installation

- (Above) 245kV substation in Columbia; Gantry mounted at elevated height. Operating mechanism at working height
- (Left) 145kV substation in Bangladesh
Horizontal Center-Break SDF
Special Installation

- At 123kV level, Al Archa, Kyrgyzstan
- Disconnector with 3 drives on one phase
- Reliable operation in minimum ambient temperatures down to –40 deg.C
- Tandem Arrangement
Horizontal Double-Break eDB
Customer Benefits

- Reduce energy loss from
  - Minimized contact resistance
  - Special profile for current path
- High reliability from special design
  - Special conducting material without external spring for contacts
  - Strong rotary pedestals
  - Dead center interlocking
  - Superior design of mechanical interlock
- Easy and quick erection
- Smooth operation and minimal maintenance
- Suitable for wide range of environmental conditions
Horizontal Double-Break eDB Structure

- Applied upto 420kV
- Each pole contains:
  - A base frame with one rotary pedestal
  - Three insulators
  - Current path
- Earthing Switch:
  - Both right and left side can be equipped with earthing switch
- Drive mechanism:
  - Motor/manual-operated drive
Horizontal Double-Break eDB
Structure

1. Current path
2. Contact finger
3. Fixed contact
4. Terminal plate
5. Operating rod
6. Insulator
7. Operating mechanism of disconnector
8. Base frame
9. Rotary pedestal
10. Operating rod of earthing switch
11. Earthing contact
12. Earthing arm
13. Earthing contact finger
14. Operating mechanism of earthing switch
15. Earthing switch shaft
## Horizontal Double-Break eDB Parameters

<table>
<thead>
<tr>
<th>Technical Data Voltage</th>
<th>72.5 kV *</th>
<th>123 kV</th>
<th>145 kV</th>
<th>170 kV</th>
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<td>eDB123</td>
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<td>eDB300</td>
<td>eDB362</td>
<td>eDB420</td>
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<td>kV</td>
<td>72.5</td>
<td>123</td>
<td>145</td>
<td>170</td>
<td>245</td>
<td>300</td>
<td>362</td>
</tr>
<tr>
<td>Rated frequency (f)</td>
<td>Hz</td>
<td>50/60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current (I)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1600</td>
<td>2500</td>
</tr>
<tr>
<td>Rated short-time withstand current, rated duration of short circuit (Iₜₜ)</td>
<td>kA, s</td>
<td>40/50/60, 1***</td>
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<tr>
<td>Rated peak withstand current (Iₚₚ)</td>
<td>kAₚₚ</td>
<td>2.5x Iₜₜ (for 50 Hz) / 2.6x Iₜₜ (for 60 Hz)</td>
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</tbody>
</table>

### Basic Insulation Level

#### Power frequency withstand voltage for 1 minute
- To earth and between poles: kV
  - 140
  - 230
  - 275
  - 325
  - 460
  - 395
  - 450
  - 520
- Across the isolating distance: kV
  - 160
  - 265
  - 315
  - 375
  - 530
  - 435
  - 520
  - 610

#### Lightning impulse withstand voltage
- To earth and between poles: kVₚₚ
  - 325
  - 550
  - 650
  - 750
  - 1050
  - 1050
  - 1175
  - 1425
- Across the isolating distance: kVₚₚ
  - 375
  - 650
  - 750
  - 860
  - 1200
  - 1050
  - 1175
  - 1425

#### Switching impulse withstand voltage
- To earth and between poles: kVₚₚ
  - 850
  - 950
  - 1050
- Across the isolating distance: kVₚₚ
  - 700(+245)
  - 800(+295)
  - 900(+345)
Horizontal Double-Break eDB Contacts and Current Path

- Hot metalizing of Cu-Al joints to reduce galvanic voltage difference to avoid possible corrosion.
- No Separate springs
  - No rusting/corrosion
  - No loose positions; minimum components & maintenance
  - Consistent Contact resistance over long periods.
- Special profile designed for the current path
- These all contribute in maintaining the circuit resistance to the optimum level and consistency during the service life of disconnector. Reduce energy loss
Horizontal Double-Break eDB
Turn Tables

- Turn table bearings totally protected from environments (i.e. ingress of dust/water)
- Two stainless steel bearings (double bearings) for reliable rotary movement and reduced friction
- High temperature stable grease used for lubrication. Lifetime lubrication. Virtually no maintenance
Horizontal Double-Break eDB Links

- Use of insulated rod end spherical stainless steel bearings, providing
  - Protection to galvanic corrosion
  - Three dimensional flexibility in movement
  - Giving reduced friction through the life
- Not require any lubrication
- Alignment in 3D avoiding stresses on bearing

Bearing after 10 years in field
Horizontal Double-Break eDB
Dead Center Locking

DEAD CENTER POSITION – 1
CLOSED

DEAD CENTER POSITION – 2
OPEN

SDF picture but also applicable for eDB
Horizontal Double-Break eDB Position Signal

- **Closed Position** (of a mechanical switching device)
  - The position in which the predetermined continuity of the main circuit of the device is secured

- **Open Position** (of a mechanical switching device)
  - The position in which the predetermined clearance between open contacts in the main circuit of the device is secured

- **Clause 5.104.3 Indication and signaling of position**
  - Indication and signaling of the closed and open position shall not take place unless the movable contacts have reached their closed or open position, respectively and the first paragraph of 5.104.1 is fulfilled

1st paragraph of Clause 5.104.1: Disconnectors and earthing switches, including their operating mechanisms, shall be designed in such a way that they cannot come out of their open or closed position by gravity, wind pressure, vibrations, reasonable shocks or accidental touching of the connecting rods of their operating system.
Horizontal Double-Break eDB Drive Mechanism

- Available for both motor drive and manual types
- All mounting nuts & bolts are of non-corrosive material
- Aux. Switches are suitable for SCADA applications and can be changed from NO to NC and vice-versa even at site
- Aluminium cabinet and powder coated with Polyurethane paints, giving lasting protection to corrosion
- Stainless steel door hinges do not allow door jamming even after many years
- In-built safety mechanism safety release as standard feature – main arms cannot rotate more than 90 degrees in manual or motorized mode
Contact alignment is essential to avoid undue mechanical & thermal stress and create long term reliability.

- The current carrying conductors and rotary pedestals are designed for easy adjusting and alignment.
- No loose shim requirement for the alignment.
- Provide flexibility with simplicity.
Horizontal Double-Break eDB
Various Arrangement

- Parallel Installation
- Series Installation
- Under hung
- On gantry
- etc..
Horizontal Double-Break eDB
Integrated or Stand-Alone Earth Switch
Horizontal Double-Break eDB
420kV eDB at Adani Power at Mundra, India
Pantograph GW54
Customer benefits

- Solid pantograph arms
  - Four arms to provide rigid construction
  - Parallel connection to lower circuit resistance
  - Large open/close range to provide reliable on-position connection
  - Large contacting area between fixed and moving contacts to provide excellent electricity conductability

- All joints are connected through rotating contacts, which has incomparable performance on reliability, sealing, conductivity and anti-corrosion
- Transmission parts are insulated from conducting parts by Nylon tubes
- The mechanism is housed in an aluminum enclosure, protecting it against ice and pollution
Pantograph GW54
Structure

- Applied to 145/245/550kV S/S
- Each pole contains:
  - A transmission mechanism
  - One rotating insulator
  - One supporting insulator
  - Main Blade
    - Four telescopic booms
    - Silver plated copper contacts
- Earthing Switch:
  - Can be equipped with one earthing switch
- Drive mechanism:
  - Motor/manual-operated drive
Pantograph GW54 Structure

1. Base
2. Post insulator
3. Rotating insulator
4. Earth received contact
5. Pantograph
6. Fixed contact
7. Earthing switch
8. Vertical rod
9. Mechanism for main blade
10. Mechanism for earthing switch
## Pantograph GW54 Parameters

### Technical data – GW54

<table>
<thead>
<tr>
<th>Parameter</th>
<th>kW</th>
<th>123</th>
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<tr>
<td>Rated voltage (Ur)</td>
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<tr>
<td>Rated frequency (fr)</td>
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<td>40/3</td>
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<td>63/3</td>
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<td>kA/s</td>
<td>40/3</td>
<td>40/3</td>
<td>50/3</td>
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<td>Rated power frequency withstand voltage for 1 minute</td>
<td>kV</td>
<td>230</td>
<td>275</td>
<td>460</td>
<td>620</td>
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<tr>
<td>To earth and between poles</td>
<td>kV</td>
<td>230</td>
<td>275</td>
<td>460</td>
<td>620</td>
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<tr>
<td>Across the isolating distance</td>
<td>kV</td>
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<td>315</td>
<td>530</td>
<td>800</td>
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<td>Rated lightning impulse withstand voltage (1.2/50 μs)</td>
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<td>1050</td>
<td>1550</td>
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<td>To earth and between poles</td>
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<td>550</td>
<td>650</td>
<td>1050</td>
<td>1550</td>
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<td>750</td>
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<td>750</td>
<td>1200</td>
<td>1550+315</td>
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<td>kVp</td>
<td>900+450</td>
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</table>
Pantograph GW54
Arms and Contacts

- Each main blade includes:
  - One mechanism
  - Four pantograph arms
  - Four moving contacts
  - One fixed contacts

- Contacts are made of electrolytic copper and silver plated to prevent from oxidation and also provide high contact.

- By design, the contact pressure increases during short circuit. Prevent arcs and failure.
Pantograph GW54
Arms and Contacts

- Solid pantograph arms:
  - Stable double arms design with conductive bearing.
  - Parallel connection to lower circuit resistance
- Mechanical and electrical separation:
  - Mechanical transmission parts are insulated from conducting parts by Nylon tubes.
- Contacts:
  - Electrolytic copper plated with silver
  - Large electricity conductive area
  - Maximum rated current is 5000 A
- Mechanism housed in an aluminum enclosure against pollution and ice
Pantograph GW54
Driving System of Main Blade

- The pantograph mechanism is installed on the support insulator, and transfers the movement from the rotating insulator to the arms of the pantograph.

- The springs that compensate the weight of the pantograph arms are also installed in this housing.

- Each pantograph is equipped with four aluminum arms to ensure a rigid construction with a very high short circuit rating.
Pantograph GW54
Motion Transmission
Pantograph GW54
Turning Conductive Bearing

- Tin-bronze bearing
- Fully sealed
- Contact resistance is only 9 mOhm
- Tightly connected
- High hardness, no breaking off and no corrosion
- Good conductivity
Pantograph GW54
Mechanism

Function

- Motor Drive
- Manual Drive
- Interlock
- Local and Remote Control

*Large box* to facilitate easy wiring, operation, maintenance

Up to 32 *auxiliary contacts* can be provided

Reliable Motor gears

*Maintenance free*

IP55 (higher IP on request)
Pantograph GW54
245kV Disconnector
Pantograph GW54
245kV Disconnector
ABB Disconnector – Robust and Reliable Offerings
Strong Solution to System Availability

- Operates correctly consistently when command is given
- Gives consistent & less Main Circuit Resistance (mV drop) over lifetime
- Has good short time current withstand capacity
- Needs little Lubrication with permanent adjustments
- Strong seismic capability
- Provides adequate isolation during maintenance

ABB Disconnector
RELIABLE solution
Saves Energy Time & Money!
Power and productivity for a better world™