Safe and ecological

HiDry: dry-type power transformers for subtransmission (up to 145 kV / 63 MVA)
Dry-type transformers are used whenever safety for people, property and environment is of primary concern. In the past, dry transformers were used only on MV distribution applications, but world-wide trends, like urbanization and increased environmental awareness, motivated ABB to develop a product with superior safety and environmental consideration for subtransmission voltage class.

HiDry is the safest solution for the environment in transformer technology for distribution and subtransmission lines capable of reaching up to 63 MVA and 145 kV insulation level. HiDry is the safest because there is no chance of explosion or fire and it is the safest for the environment because it removes the potential of an oil spill or leak by reaching these voltage ratings using only dry-type technologies. For the owner, this means complete peace of mind when maintaining their power networks. These advantages make the HiDry a product very suitable for applications in urban substations, power generation plants, substations located near or in public buildings or sensitive ecosystems (by rivers, islands or forests), in underground locations and in crowded public places. This allows the power system to feed higher voltage directly to the main load centers, providing higher power and reducing distribution losses.

These transformers meet the 550 kV impulse test requirement and have already proven high reliability in a number of recent utility and industrial installations.

Traditionally dry-type transformers have been used for distribution and industrial applications, with rated power and voltage not higher than 15 MVA and 36 kV.

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1994 ABB introduced 52 kV voltage class and 200 kV impulse level.

2004 ABB launched 52 kV voltage class with 250 kV impulse level.

2010 72.5 kV voltage class, 63 MVA power rated and dry on-load tap changer (OLTC) available.

2016 After gaining years of field experience with 72.5 kV, ABB advanced the technology to 145 kV voltage class with 550 kV impulse level.
Why HiDry?

Reliability for your peace of mind
The major benefit is the lack of flammable liquids:

- A dry-type is non-explosive, self-extinguishing and has very little smoke produced during arcing failure.
- Therefore, it is ideally suited for indoor and underground installations.
- Since it does not need bushings, there are less potential failures and terrorist risk.
- Top management responsibility is minimized in case an incident happens.

Another benefit is the absence of gas (SF6), so there is no possibility of suffocation in the event of a leak.

In HiDry transformers, windings are epoxy encapsulated under vacuum, as a result, the transformer has a very strong short-circuit resistance resulting in a low failure rate during a system fault.

Increasing the installation and operating savings
When evaluating the case for using a dry-type transformers and comparing it to other technologies, it is important to consider all aspects and costs related to the whole system installation and not just the costs of the transformer.

Less code restrictions: lower civil works (no containment, no fire suppression, no fire rated walls, roofs, doors, etc); shorter runs of higher current cables (the transformer is closer or indoor installation to buildings); and lower building codes (easier project management).

- Less on site assembly (for units with no enclosure or with enclosure shipped assembled)
- No filling of oil on site, no assembly of radiators, bushings or other parts.
- No pressurized components.
- Lower maintenance required due to the absence of protection/motorization accessories for oil/gas.
- Better responsiveness in case of an incident (quicker repair or replacement of any transformer component, giving a faster recovery time, less down time).
- Reduced load losses at higher loadings.
- Lower insurance fees.

Furthermore, HiDry helps to improve the customer corporate image due to no environmental pollution, no leaks, spills, minimize consequences in case of incidents as well as an easier waste management at the end of life (no need to handle hazardous materials).
HiDry applications
What are the typical applications for HiDry?

For either new or retrofit indoor projects, HiDry is suitable for hospitals, shopping malls, skyscrapers, bank buildings, company headquarters, multipurpose cultural centers, sport stadiums, requesting high power for their operation. Traditionally, dry-type transformers are used due to safety reasons and installed in the basement or in adjacent buildings. Such buildings can now be served directly at subtransmission voltage and with higher power ratings.

Electric power plants and other public utilities require high reliability and safety for their installations. Blackouts can effect a large number of people having serious consequences. The same is true for industrial applications, especially in the fields of chemicals, oil and gas...

Water and ground water protection areas, harbours and docks, forestry fire risk areas, or applications in the field of renewable energies can all benefit from the environmental advantages of HiDry.

At subtransmission level, in case of indoor installations, GIS switchgear equipment is used and the transformers are often placed outdoors. The dry-type transformer is removing these limitations and increasing the possibilities and flexibility for indoor substation designs, reducing insurance costs and other liabilities.

HiDry is the best choice for specific niche markets, where safety or ecology are main concerns.
HiDry technology and lightning impulse withstand voltage level up to 550 kV

During product development, the use of computer simulation models and experimental testing on prototype units allowed ABB to develop new concepts. This has led to advances in our compact insulation configuration using air and solid materials. The use of F and H class insulation materials, with a high temperature difference to the ambient air, allows efficient transformer cooling.

Partial discharge measurements below the 10 pC limit for dry-transformers, verify that the insulation materials and overall transformer are of a very high quality. ABB HiDry power transformers have been tested beyond their limits to guarantee a large safety margin and customer peace of mind.

Detailed engineering analysis (design modeling, based on FEM-Finite Elements Model) of the four disciplines has been performed: electrical, magnetic, thermal and mechanical.

The electrical analysis for example provided details of the voltage distribution present inside the winding during lightning impulse testing. The HiDry design is much more demanding and requires a number of special manufacturing processes such as high voltage terminals with special execution, strengthened insulation, rounded decks, adjusted clearances and special supports to increase creepage distances.

Also magnetic stray fields can cause eddy currents in the windings which can become very significant with increased power ratings and growing cross section of the conductors. The larger stray fields also create additional eddy losses and hot spots. These eddy losses strongly depend on the winding design. When the OLTC is at its minimum position a section of the winding is de-energized, in this case, the magnetic stray fields and eddy currents are especially strong and FEM analysis is a must to ensure a correct design.

After analyzing all dynamic forces and stresses during a short circuit in a dry-type transformer, a short-circuit withstand test was performed in 2014 on a 31.5 MVA, 66/22 kV including the OLTC (± 8 x 1.25%). The HiDry unit passed the test successfully, confirming the high reliability and excellent withstand capability against short-circuits, surpassing the conventional technologies.

In 2016, ABB developed the 145 kV, with 550 kV BIL lightning impulse level.

HiDry fulfills the following dielectric test voltage level requirements:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Lightning impulse (kV)</th>
<th>Applied voltage (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60076-11</td>
<td>550</td>
<td>230</td>
</tr>
<tr>
<td>IEEE C57.12.01-2015</td>
<td>Up to 550</td>
<td>230</td>
</tr>
</tbody>
</table>

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31.5 MVA HiDry unit for Enel-Endesa urban substation (in Seville, Spain). This unit passed the withstand short-circuit test at first

Calculation of losses in structural components
Our portfolio: customized designs to fit your application requirements

Customized designs

- Special and tailored design
- Transformers for indoor and outdoor installations
- Reduced loss transformers, balanced losses
- Reduced sound level
- Insulation material class F or H
- Variable speed drives (VSD) applications
- Step-up transformer / GSU transformer
- Multiple high voltage and low voltage inputs
- Air gap core
- Electrostatic shield
- Rectifiers
- Vibrations / seismic

Other accessories

- On-load tap changer with up to 17 positions, motor drive, automatic voltage regulator (AVR) and lamp indicator
- Antivibration pads
- Space heaters
- Cooling fans (allowing up to 20% power increase)
- Special high voltage connections
- Surge arresters
- Wall bushings
- High voltage isolated phase bus (IPB with enclosure)
- Current transformer on HV, MV and neutral side
- Earthing bullets / ground studs
- Enclosure with protection up to IPX4D and NEMA 1, 2, 3R and 3RX
- High voltage and low voltage termination compartments
- Bus duct
- Air forced water forced IP54 enclosures with hydrocoolers
- Digital temperature control relay by infrared sensors (alarm – tripping and fault switches, and software available)
- Digital temperature control relay including RS485 digital signal and 4 - 20 mA analogical signal
- PT100 RTD sensors for core temperature monitoring
- Arc fault protection system
- Dial thermometer
- Skids
- Special accessories: upon customer request