



Safe and ecological

HiDry

Dry-type power transformers for subtransmission
of up to 72.5 kV / 40 MVA

Hitachi Energy dry-type power transformers reaching 72.5 kV operating voltage and 40 MVA rated power

Dry-type transformers are used whenever safety for people, property, and environment is of primary concern. In previous years, dry-type transformers were exclusively utilized in medium voltage (MV) distribution applications. However, due to worldwide trends, such as urbanization and increased environmental awareness, Hitachi Energy was motivated to develop a product that prioritizes superior safety and environmental considerations for sub-transmission voltage class.

HiDry is the safest solution for the environment in transformers technology for distribution and subtransmission lines, capable of reaching up to 40 MVA and 72.5 kV insulation level, due to:

- no chance of explosion or fire,
- removes potential oil spill or leaks, and
- complete peace of mind when maintaining power networks.

The 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.

HiDry transformers meet the 380 kV impulse test requirement and have already proven high reliability in a number of recent utility and industrial installations. Furthermore, our 145 kV transformers, currently in piloting stage, have been technically proven in meeting the 550 kV impulse test requirements and they are under operation for years.

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.

1994

Hitachi Energy introduced the 52 kV voltage class and 200 kV impulse level

2004

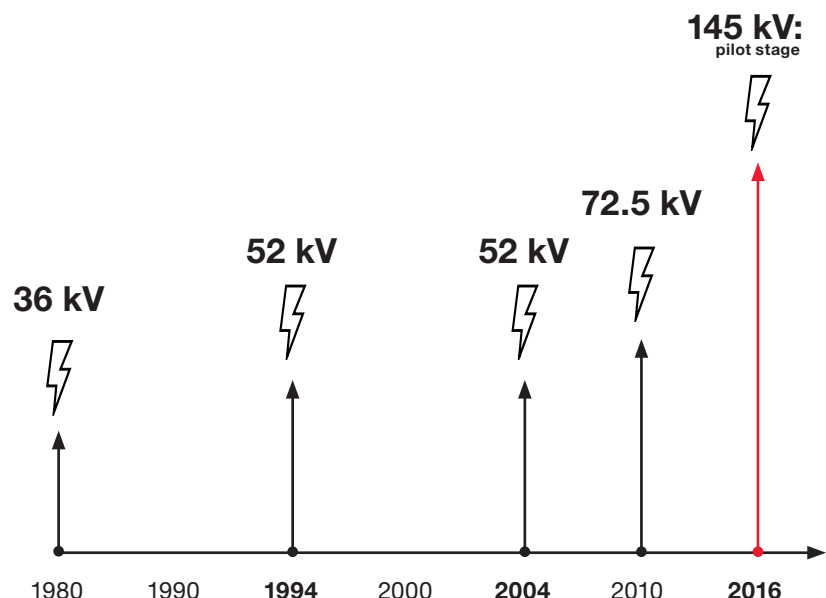
Hitachi Energy launched 52 kV voltage class with 250 kV impulse level.

2010

72.5 kV voltage class, 40 MVA power rated and dry on-load tap changer (OLTC) available.

2016

After gaining years of field experience with 72.5 kV, Hitachi Energy 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 transformer is non-explosive, self-extinguishing, and has very little smoke produced during arcing failure.
- It is ideally suited for indoor and underground installations.
- Since a dry-type transformer does not need bushings, there are less potential failures and terrorist risk.
- Top management responsibility is minimized in case an incident happens.
- No possibility of suffocation in the event of a leak due to the absence of gas (SF6)

In the HiDry transformers, windings are epoxy encapsulated under vacuum. 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

To make an evaluation to decide on using dry-type transformers over other technologies, it is crucial to take into account all aspects and costs related to the entire system installation. This means considering only the cost of the transformer, but also other expenses related to installation process. Therefore, it is important to look at the bigger picture and evaluate the entire system as a whole to make the most optimal decision.

Fewer code requirements for:

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

HiDry transformers help to improve the customer corporate image due to no environmental pollution, no leaks, no spills, minimize consequences in case of incidents, as well as 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, and requesting high power for operations. Traditionally, dry-type transformers are used for 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 affect a large number of people and can have 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. Dry-type transformers are removing these limitations and increase 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 and ecology are the main concerns.





01 Railways



03 Industries



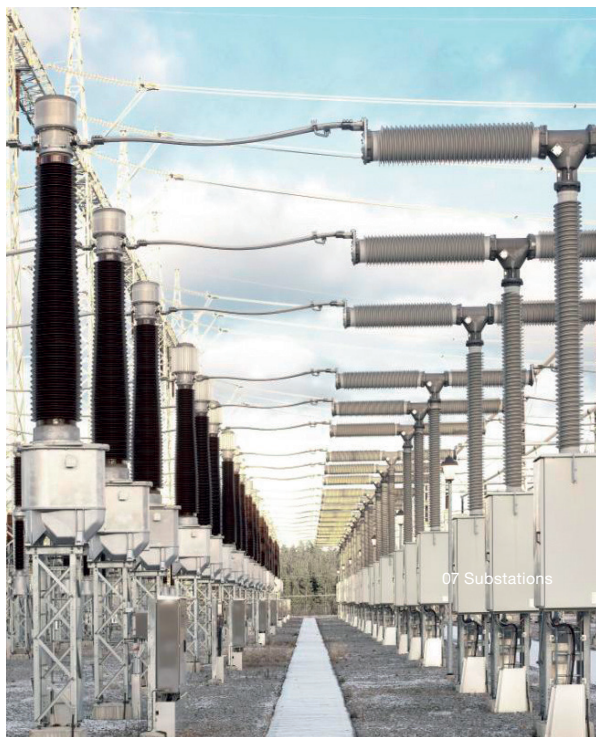
04 Hydro generation



05 Solar farms



06 Public buildings



07 Substations



08 Cities

Lightning impulse withstand voltage level of up to 550 kV

During product development, the use of computer simulation models and experimental testing on prototype units allowed Hitachi Energy 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-type transformers, verify that the insulation materials and overall transformers are of a very high quality. Hitachi Energy 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.

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. Larger stray fields create hot spots and additional eddy losses, which are strongly influenced by the winding design. Specifically, when the on-load tap-changer (OLTC) is positioned at its minimum, a section of the winding becomes de-energized. In this case, magnetic stray fields and eddy currents can be especially strong. As a result, conducting a finite element method (FEM) analysis is essential to ensure the proper design of the transformer.

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 ($\pm 8 \times 1.25\%$). The HiDry unit passed the test successfully, confirming the high reliability and excellent withstand capability against short-circuits, surpassing the conventional technologies.

In 2016, Hitachi Energy manufactured the 145 kV pilot, with 550 kV BIL lightning impulse level.

Standard	Lightning impulse (kV)	Applied voltage (kV)
IEC 60076-11	550	230
IEEE C57.12.01-2015	Up to 550	230



Dry-type transformers from CELSIA

Our portfolio: Customized designs to fit your application requirements

Customized designs

- Special and tailored design
- Transformers for indoor and outdoor installations
- Reduced loss transformers and balanced losses
- Reduced sound level
- Insulation material class F or H
- Variable speed drives (VSD) applications
- Step-up transformers/GSU transformers
- 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, which allows up to 20 percent 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 or grounding 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 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



Enclosed dry-type
transformers from REE

Hitachi Energy

Customer Connect Center

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