



Transforming ideas into movement

ABB vacuum cast coil dry transformers are doing excellent (under)ground work in Istanbul

RAFAEL BUENACASA, JOSÉ ANTONIO CANO, CARLOS GARCÍA QUIRÓS, BERTA OBIS – Istanbul is the only city in the world that belongs to two continents. It is perhaps the most important financial and cultural center in Turkey and certainly one of the most important in the world. As a thriving city with a population of over 13 million people, it may be surprising to learn that its transport network, by comparison with other major cities, is still in its infancy. While that may be the case, no effort is being spared in developing a rail network that will elevate Istanbul to the transport levels of other prominent cities.



Like many other cities of its size, Istanbul has been beset by serious traffic congestion problems for many years. To alleviate some of this congestion, construction of the first underground railway in Istanbul only started as recently as 1992, and the first line began operation in the second half of 2000. While this has gone a long way in helping to reduce the number of cars on the streets, much still needs to be done.

Since it began in 1992, construction work has been ongoing. For example, the Kirazli-Olimpiyat metro line is the third line built in Istanbul on the European side, while the Kartal-Kadikoy line was the first set up on the Asian side. ABB has been active in both projects as the supplier of choice of vacuum cast coil transformers. In fact, the company has supplied a total of 133 of these types of transformer: 47 vacuum cast coil transformers with a power rating ranging from 2,000 kVA to 3,300 kVA for the Kirazli-Olimpiyat metro line; and 86 dry transformers – 60 vacuum cast coil transformers with a power rating ranging from 250 kVA to 5,000 kVA, class 36 kV for distribution application, and 26 hi-T Plus vacuum cast coil 12 pulse rectifier transformers with a power rating of 3,300 kVA, class 36 kV for traction

applications – for the Kartal-Kadikoy line.

Why ABB transformers?

ABB vacuum cast coil dry transformers are moisture-proof, making them suitable for operation in humid or heavily polluted environments. They can operate in environments with humidity levels higher than 95 percent as well as at temperatures down to -25°C . In addition demanding installation requirements, such as reduced noise, vibration levels and limited space made them the ideal choice. Vacuum cast coil dry transformers are designed to withstand seismic conditions, and given Istanbul's geographical position, ie, close to an active fault in North Anatolia, which has been responsible for several earthquakes, the anti-vibration accessories played an important part in the final decision to commission ABB's transformers.

Over 100,000 units are currently in operation around the world, including the more than 1,600 dry type transformers (with power ratings up to 16,000 kVA) present in railway networks. This makes ABB the most experienced supplier of this type of transformer by far.

Vacuum cast coil dry transformers are produced in dedicated focus factories.

One such factory is located in Zaragoza, Spain, which manufactures customized transformers.

The portfolio of vacuum cast coil transformers for railway projects is broad. However, there are basically two main applications where they are mostly used: substation distribution and traction. Providing energy for the second requires a different, more restrictive solution, namely in the form of hi-T Plus transformers → 1.

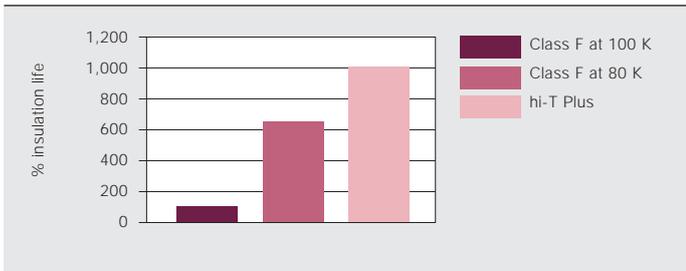
When heat is not a problem

ABB's hi-T Plus transformers differ from other vacuum cast coil transformers in that they can operate at much higher

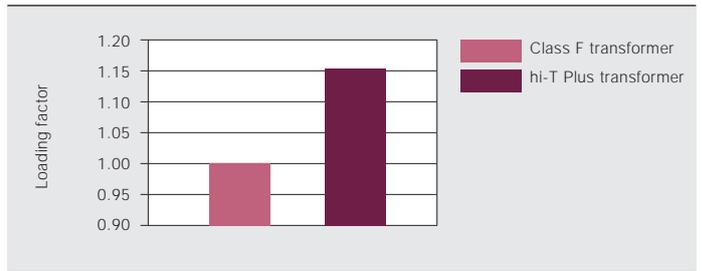
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temperatures – thus the hi-T in the name. This is possible by the use of upgraded thermal insulation, which in this case is a class H material. Traditional vacuum cast coil transformers use a class F insulating material. Materials belonging to insulation class H are known for their enhanced mechanical and dielectric properties and high heat resistance. This means the hi-T Plus transformer can easily withstand an average temperature rise of 125 K with-

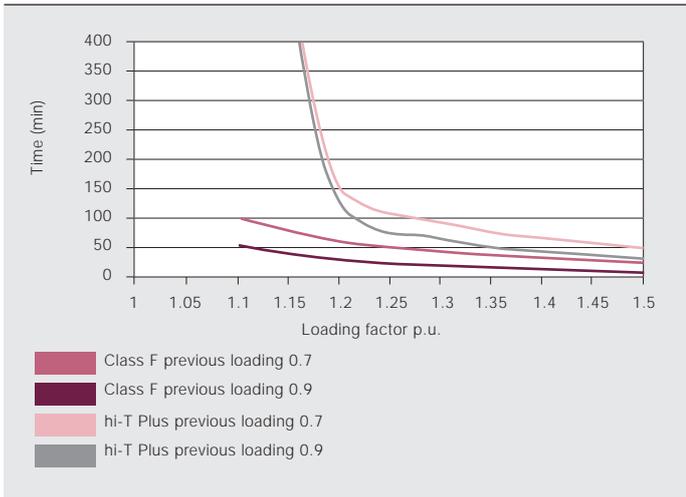
2 Expected insulation lifetime taking Class F at 100K as 100 percent



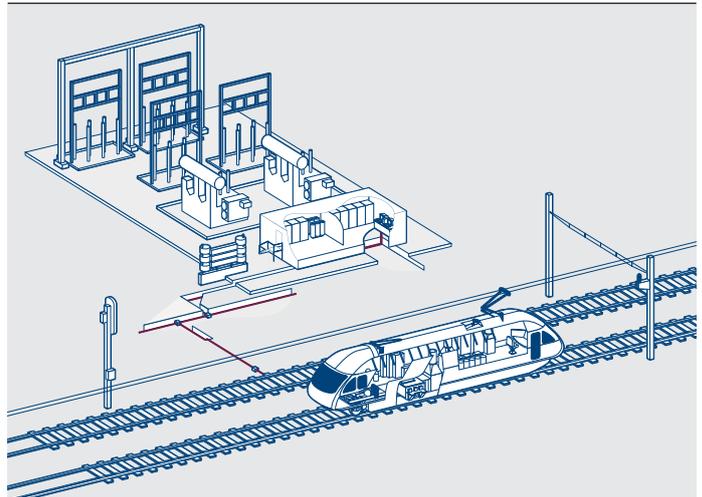
3 The overloading capabilities of the hi-T Plus transformer



4 hi-T Plus transformer capabilities without loss of life



A fixed railway substation. See page 72 for a detailed description



out affecting its insulation lifetime → 2. In fact this class H device has the added benefit of an increased insulation lifetime, and is by far the best choice for networks with high harmonic distortion, load peaks, sudden overloads and high un-

its superb overloading capabilities, ie, continuous overloading, even at full rated power, will not decrease the lifetime of the device → 3 and → 4. The transformers are designed to work under overloading conditions at a temperature never exceeding their insulation class, thereby ensuring that degradation never occurs during these cycles.

Compared to other vacuum cast coil transformers, ABB's hi-T Plus transformers can operate at much higher temperatures because the thermal insulation uses a class H material.

These technical advantages, combined with the fact that it works within class B temperature rise limits, ie, a maximum average winding temperature rise of 80 K is allowed, enable a reduction in the transformer footprint of a hi-T Plus device with the same power rating as its F-class counterpart. This in turn enables engineering companies and end-users to reduce their operating costs.

foreseen ambient temperatures. However, by design the rated temperature rise is limited to 100 K for a maximum ambient temperature of 40 °C. In addition, the hi-T Plus transformer is characterized by

Transformer rated power for railway applications is identified with one of the cycles included within the EN50329 or IEC60146 standards. Moreover, harmonics are taken into consideration, and if no information is available, standard values are taken as reference. This removes any uncertainties that, in the past, were usually solved by oversizing the transformer or limiting its temperature rise.

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