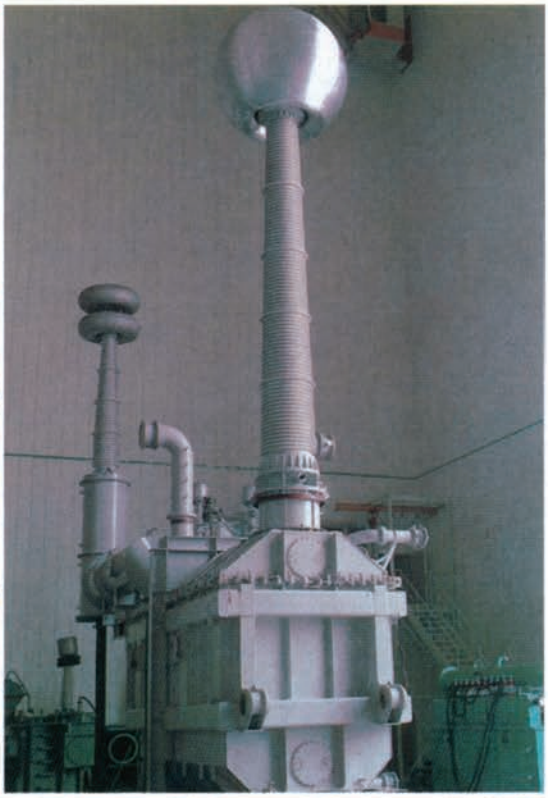
Fuji Electric

Innovating Energy Technology

Extra High Voltage Transformers



08A1-E-0002

Construction and Features

Iron Core

The iron core of transformer is of the so-called core type, the core plates are made of silicon steel sheet, Hi-B (high magnetic flux density) oriented silicon steel sheet, etc. The iron core is tightened by tempered plastic tape.
The steel plates which form the iron core are processed by a computer controlled automatic cutting line boasting the most advanced technology, and the cut ends are practically free from burrs. The laminated iron core is set vertically by using a special core lifting device to eliminate any possibility of inner stress.

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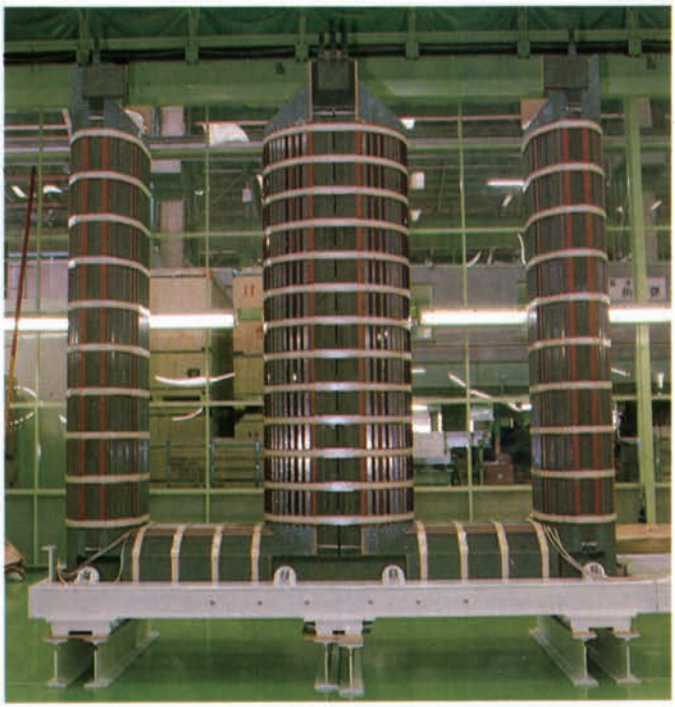

Tightening of core with intensified plastic band

AM147285

Automatic core cutting and stacking line

Winding

The winding of the transformer consists of an interleaved winding (high series capacitance winding) or a oscillation-free cylindrical layer winding having excellent impulse voltage characteristic. The winding configuration is optimized in consideration of voltage, capacity and transportation requirements.

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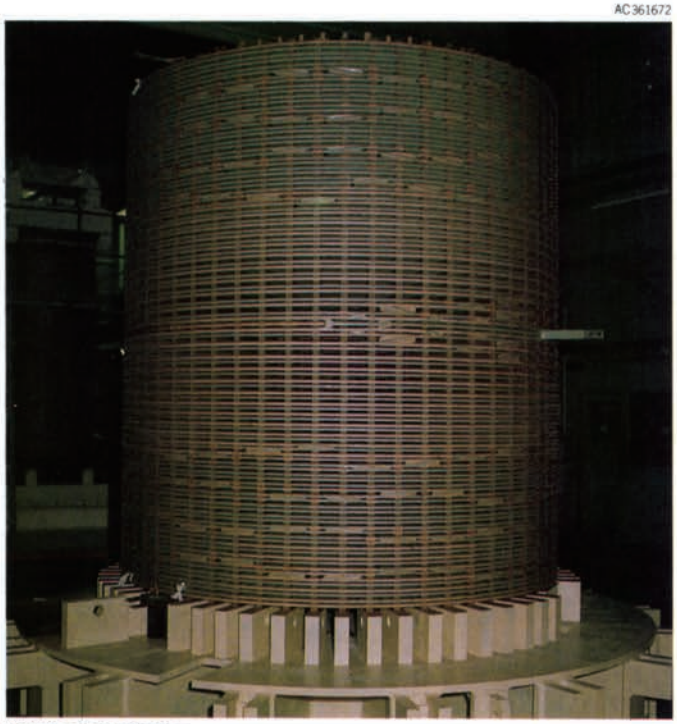
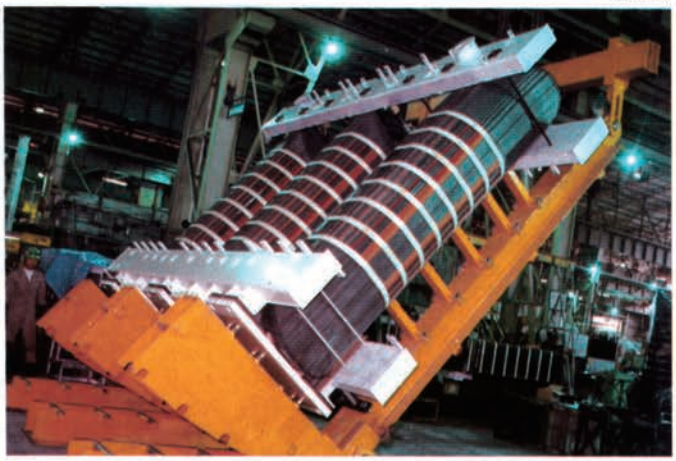


Interleaved winding

AC291508

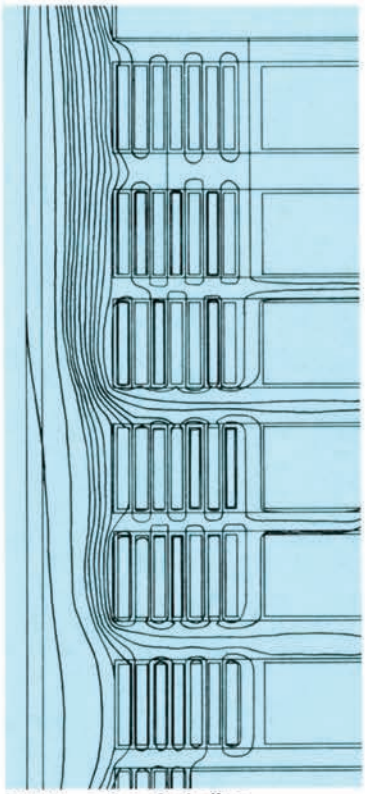


Core lifting device

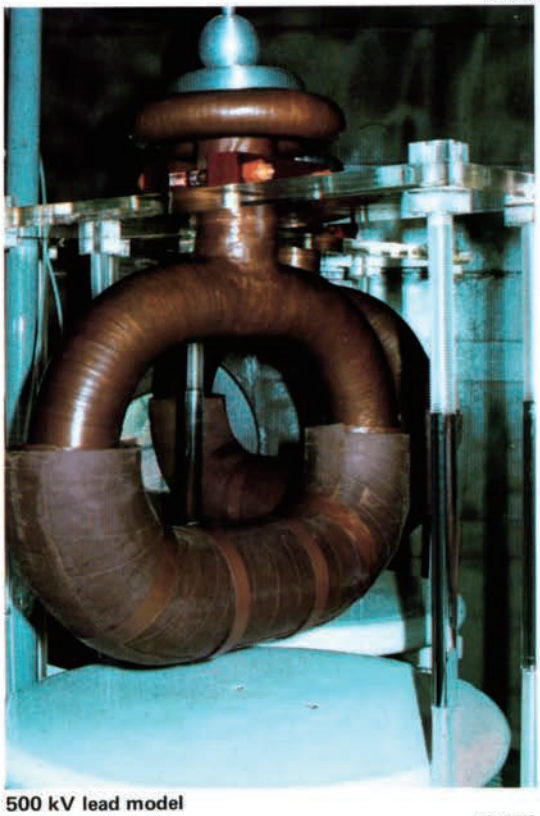
Insulation

The voltage generated in the winding and the strength of electric fields around the winding and leads are checked by field mapping method using a computer.
The winding is insulated by oil gap multi-layer split method using insulating barriers (molded).
Fabrication of insulating parts and winding, assembly, before installing in tank, assembly of on-load tap changer, etc., are all completed in a dust-proof air-conditioned room.

DK0155

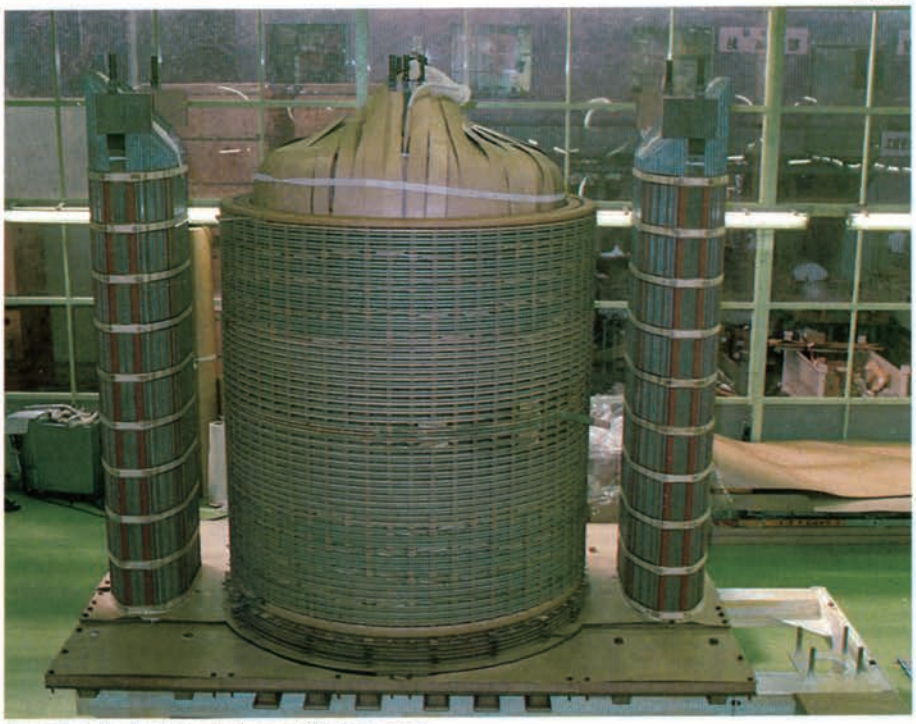


Field mapping of winding



500 kV lead model

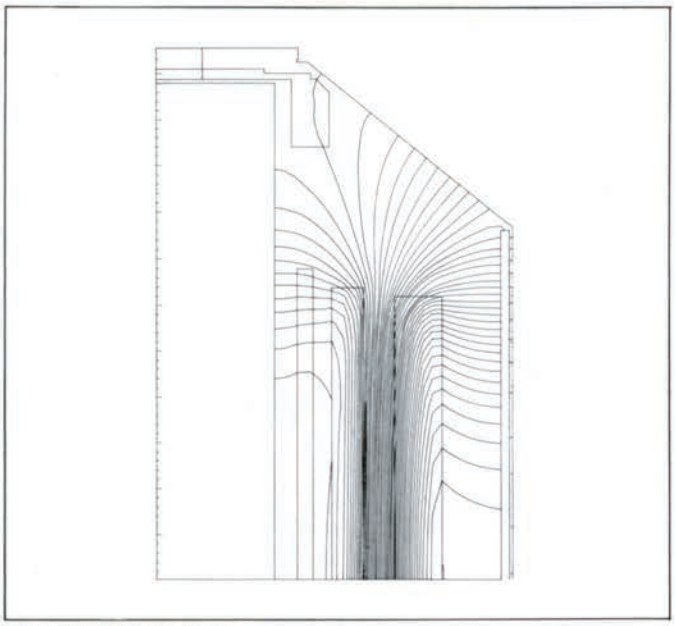
AC361838



Assembly in dust-proof air conditioned room

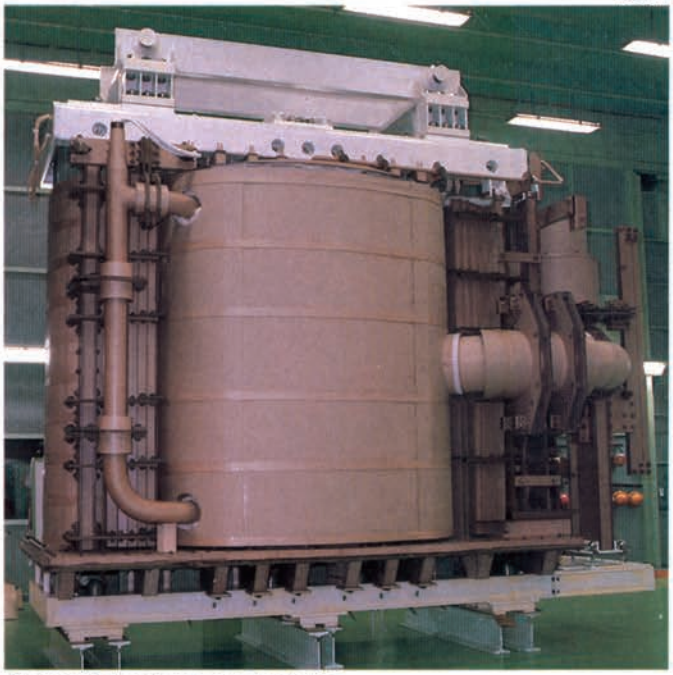
Reduction of Stray Loss

Leakage flux distribution is precisely calculated by a computer to minimize the generated loss. The structural factors and materials are carefully selected to prevent local overheating of parts. The internal wall of the tank is provided with silicon steel shields to minimize stray loss generated from the wall.



Magnetic field mapping

AC362493



Nonmetal structure around winding

Short-circuit Withstand Structure

Besides short-circuit tests using a number of model coils and transformers have been made to certify the short-circuit withstand strength, the electromagnetic strength is also precisely calculated by a computer. The winding is pretightened sufficiently and dried to avoid insulation deterioration.

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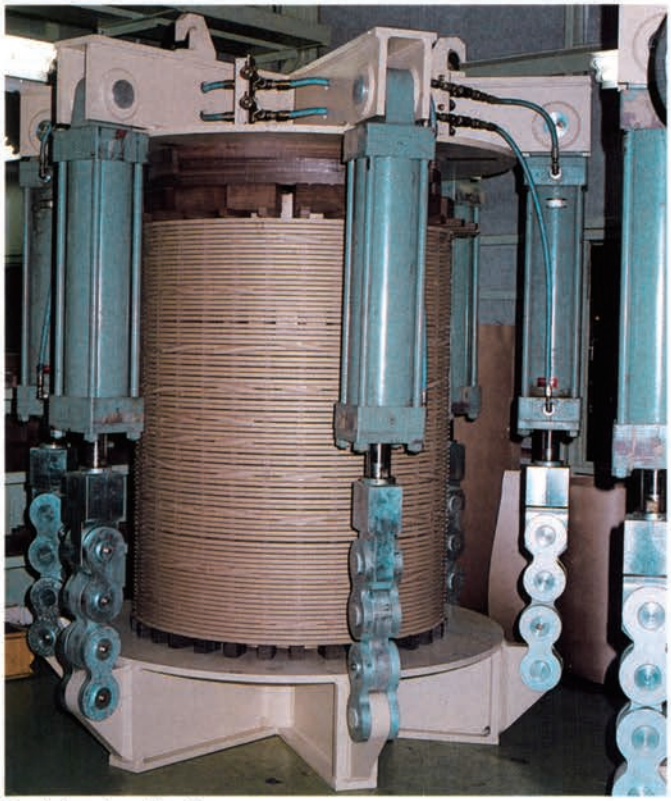


Pretightening of coil

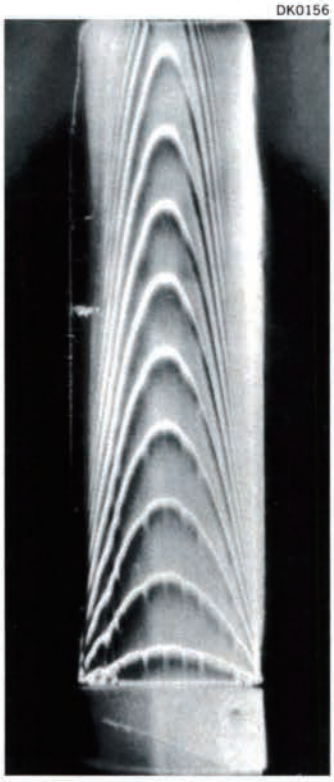
AC317422

Silicon steel shields

Cooling

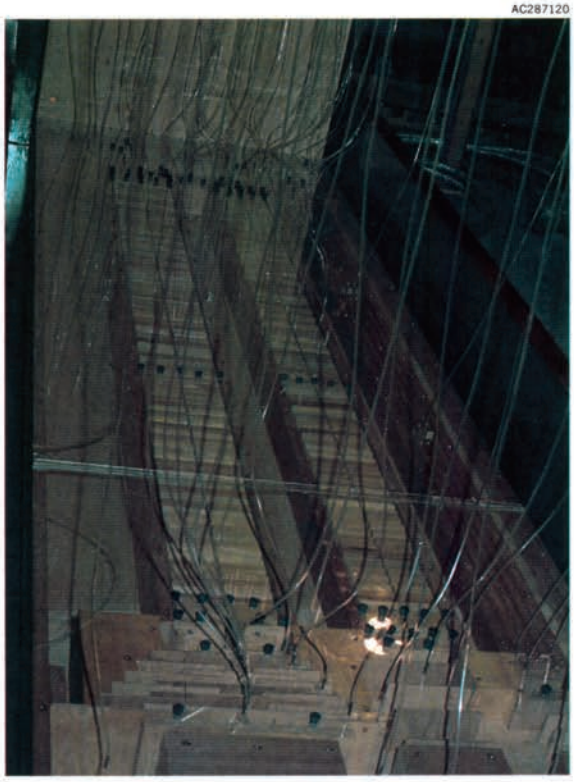
Cooling system is very important for high voltage, large capacity transformers. In Fuji, the distribution of winding temperature rise and oil distribution in winding are tested by model windings and analysed by finite element method and schlieren method to improve the reliability of the cooling system.
Large sized iron cores are equipped with cooling oil ducts to maintain the temperature rise in the cores below the allowable limit.
The winding is also provided with an oil duct within the coil to increase the cooling efficiency.
For forced-oil cooling type transformers with a number of windings, the oil flow is measured using a model having actual sectional area to obtain a uniform temperature rise on every part of the windings.
In addition, local overheating inside and outside the transformer, temperature rise of current carrying parts and temperature distribution are precisely measured with a thermal image monitor (infrared ray temperature measuring device) to enhance the reliability of the transformer.

DK0156



Picture of schlieren

AC287120



Model of winding sectional area for oil flow examination

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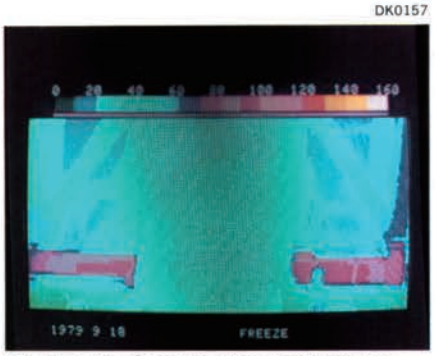
Thermal image monitor (a) Appearance of (thermal image) outer view of prob-eye

DK0157



(b) Results of temperature measurement

Fabrication (Examples)

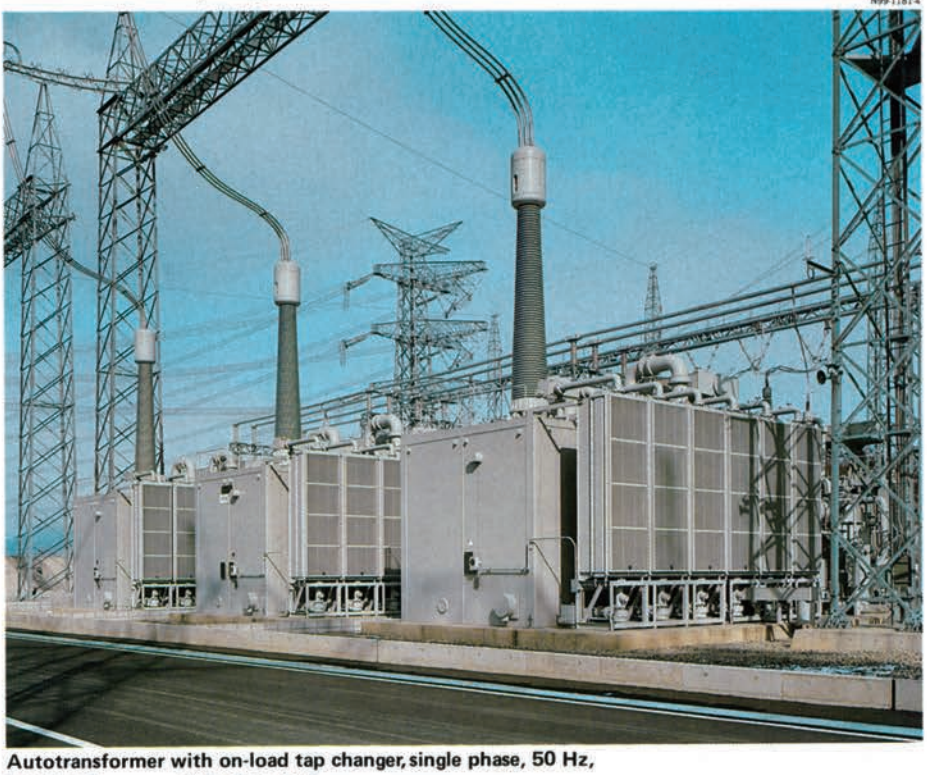
N99-1182-4

UHV testing transformer, single-phase,
50 Hz, 25/900 kV

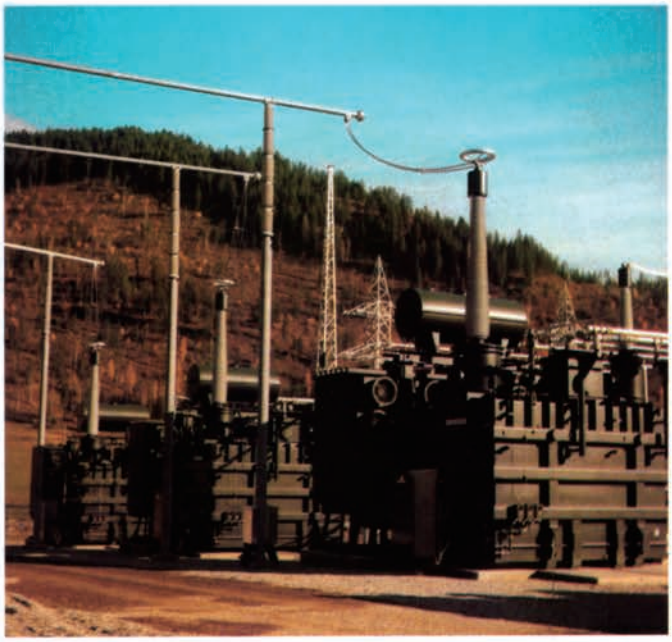
N99-968-22

Autotransformer with on-load tap changer
single-phase, 60 Hz, $\frac{500}{\sqrt{3}}/\frac{275}{\sqrt{3}}/73.5$ kV, $\frac{1000}{3}/\frac{1000}{3}/\frac{300}{3}$ MVA (1000 MVA bank)

N99-1181-4

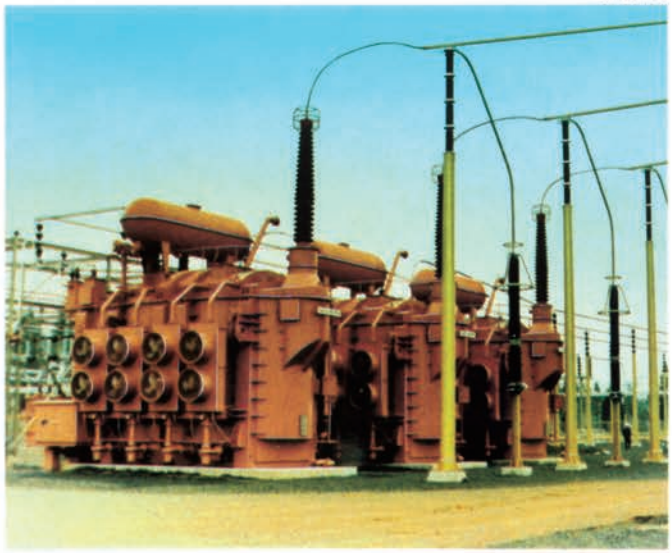


Autotransformer with on-load tap changer, single phase, 50 Hz,
$\frac{525}{\sqrt{3}}/\frac{275}{\sqrt{3}}/63$ kV, $\frac{670}{3}/\frac{670}{3}/\frac{200}{3}$ MVA (670 MVA bank)

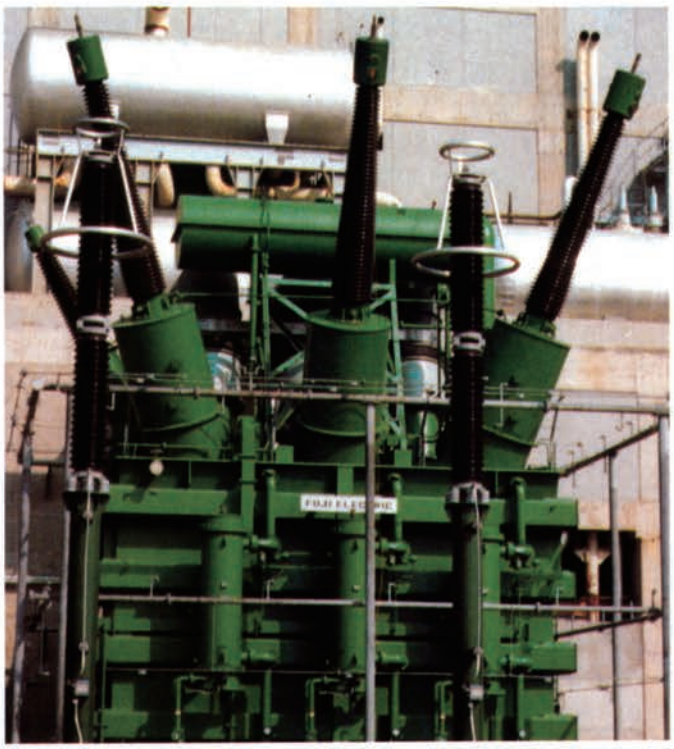


Auto transformer, single phase, 60 Hz,
$\frac{512.5}{\sqrt{3}}/\frac{242}{\sqrt{3}}$/12.6 kV, $\frac{1200}{3}/\frac{1200}{3}/\frac{150}{3}$ MVA (1200 MVA bank)

N89-1004-1

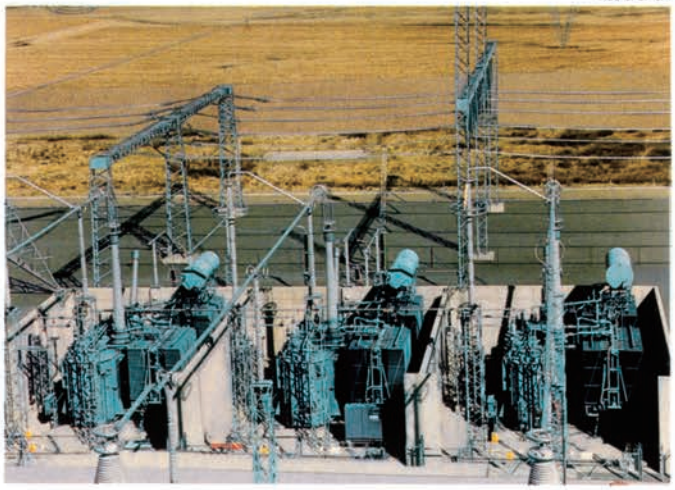


Auto transformer, single phase, 60 Hz,
$\frac{525}{\sqrt{3}}/\frac{241.5}{\sqrt{3}}$/34.5 kV, $\frac{900}{3}/\frac{900}{3}/\frac{75}{3}$ MVA (900 MVA bank)



Three-phase transformer 60 Hz, 24/432 kV, 500 MVA

N99-1707-1A



Auto transformer with on-load tap changer, single-phase
50 Hz, $\frac{765}{\sqrt{3}}/\frac{400}{\sqrt{3}}$/33 kV, $\frac{2000}{3}/\frac{2000}{3}/\frac{2}{3}$ MVA

Printed on recycled paper

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2012-7(B1996a/J1983)DE-H/2 Ek Printed in Japan