

TOSHIBA

275kV-300MVA

GAS INSULATED TRANSFORMER



THE LARGEST-CAPACITY GAS INSULATED TRANSFORMER IN THE WORLD



Rising demand for electric power in large cities has encouraged large-scale substations to be tucked away underground in overpopulated urban areas, leading to strong demand for incombustible and non-explosive, large-capacity gas insulated transformers from the view point of accident prevention and compactness of equipment.

In line with this requirement, several types of large-capacity gas insulated transformer have been developed. Because the gas forced cooling type was considered to be available up to approximately 60MVA, all of these gas-insulated transformer are liquid cooled. But the liquid cooling type has the disadvantage of a complex structure for liquid cooling.

So, Toshiba aims at realization of gas forced cooling type gas insulated transformer, making best use of accumulated experience, latest analyzing technique and the results of innovative research activities.

As a result, Toshiba has delivered 275kV-300MVA gas cooled and gas insulated transformer, which structure is as simple as the oil immersed type and the largest capacity gas insulated transformer in the world.

ADVANTAGE OF GAS INSULATED TRANSFORMER

- 1 Nonflammability**
Gas insulated transformers, using incombustible SF₆ gas as insulation and cooling medium, enable to remove a fire fighting equipment from transformer room.
- 2 Non tank-explosion**
Pressure tank enables to withstand the pressure rise in case of internal fault.
- 3 Compactness**
Since conservator or pressure relief equipment is not necessary, height of transformer room can be reduced approximately 2 - 2.5 meter.
- 4 Easy installation**
Oil or liquid purifying process is not necessary in case of gas-insulated transformer.
- 5 Easy inspection and maintenance work**
Only SF₆ gas pressure shall be basically monitored during periodically inspection.

RATINGS AND SPECIFICATION

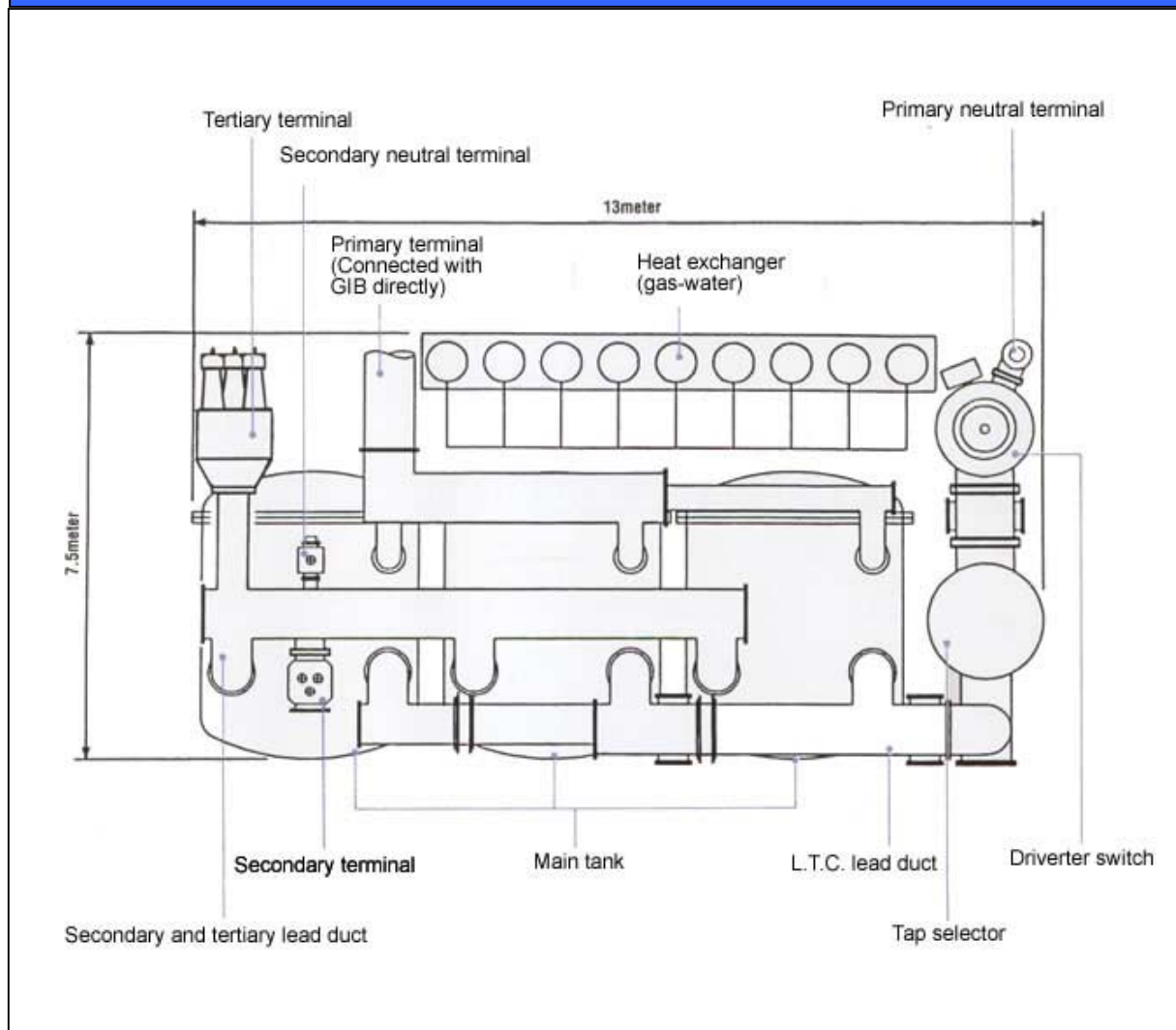
TRANSFORMER

TYPE		Indoor use, gas cooled three phase on-load tap changing gas insulated transformer
GAS PRESSURE		0.5Mpa (at 20 deg.-C)
VOLTAGE	PRIMARY	275kV (tap range: $\pm 10\%$, 23 taps)
	SECONDARY	66kV
	TERTIARY	21kV
	PRIMARY	300MVA
	SECONDARY	300MVA
	TERTIARY	90MVA
IMPEDANCE VOLTAGE		22% (at 300MVA BASE)
NOISE		85Bb

ON-LOAD TAP CHANGER

TYPE	Three phase type tap selector and diverter switch are installed separately from main tank
INSULATION MEDIUM	SF6gas
SWITCHING SYSTEM	Two resistor type
NUMBER OF VACUUM SWITCH	Four
STEP VOLTAGE	1500V
THROUGH CURRENT	870A
RATED STEP CAPACITY	1305kVA
INSULATION LEVEL (L.I.W.V.)	550kV

LAYOUT



DEVELOPMENT OF GAS INSULATED TRANSFORMER

REALIZATION OF GAS INSULATED TRANSFORMER

Since heat capacity of SF6 gas is so much smaller than that of insulating oil, the following measures are taken into account.

MEASURES TO IMPROVE THE COOLING CAPABILITY

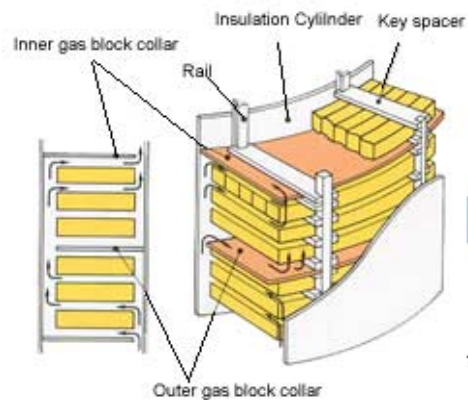
- 1 Raise the SF6 gas pressure to 0.5Mpa
- 2 Produce as large gas flow as possible by optimizing the layout of gas ducts in the windings
- 3 Develop high capacity gas blower with high reliability
- 4 Apply highly thermal-resistant insulating materials to raise the limit of winding temperature rises

ADVANTAGE OF GAS INSULATED TRANSFORMER

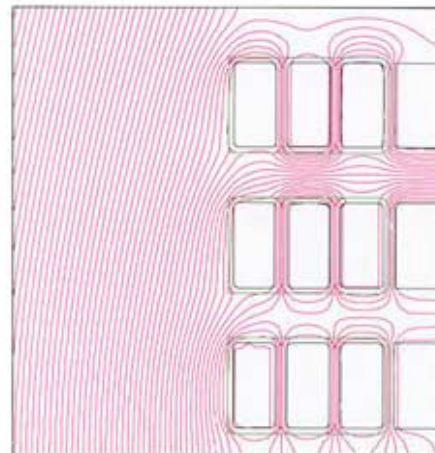
- 1 Higher reliability with simple internal structure
- 2 Easy installation without oil-purifying process
- 3 Easy inspection and maintenance work because of SF6 gas insulation
- 4 Better compatibility with gas insulated switchgear (GIS)

BEST USE OF LATEST ANALYZING TECHNIQUE

Since it is necessary that SF6 gas flows uniformly into the respective windings, Toshiba fully utilized computer aided engineering (C.A.E.) method to achieve the expected gas flow and the results of study were confirmed by models.



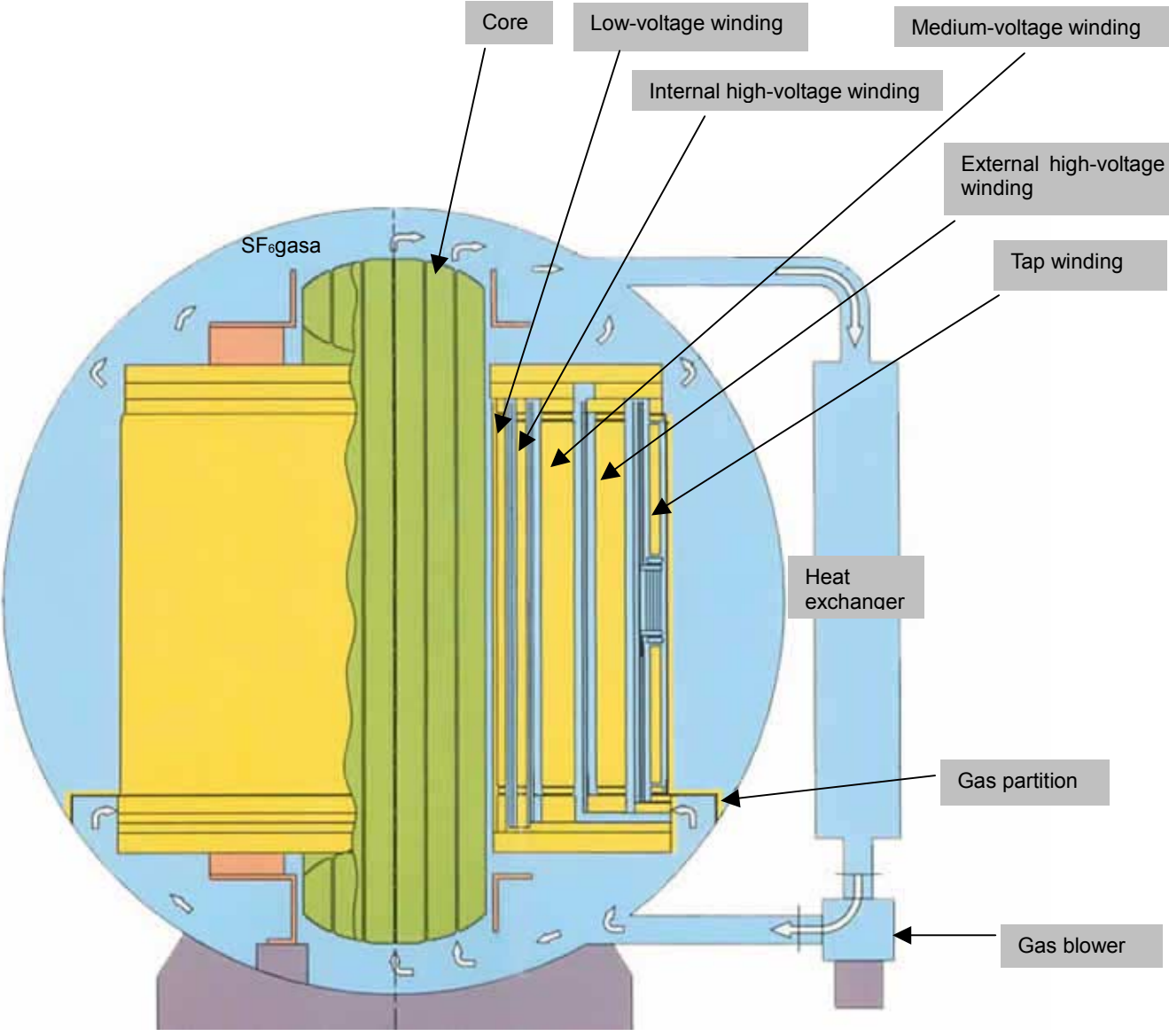
Example of C.A.E. Analysis
(Gas flow analysis in disc winding block)



Example of dielectric-field strength analysis
(Analysis between windings, and between turns)

DEVELOPMENT OF GAS INSULATED TRANSFORMER

INTERNAL STRUCTURE OF GASINSULATED TRANSFORMER



VERIFICATION FOR RELIABILITY

Toshiba carried out the verification of gas insulated transformer from the viewpoint of both insulation and cooling at every possible stage such as partial model, full scale model and Prototype in parallel with C.A.E. analysis, and we confirmed that characteristics of gas insulated transformer fully meet the specification.

TEST ON FULL SCALE INSULATION MODEL



TEST ON FULL SCALE COOLING MODEL



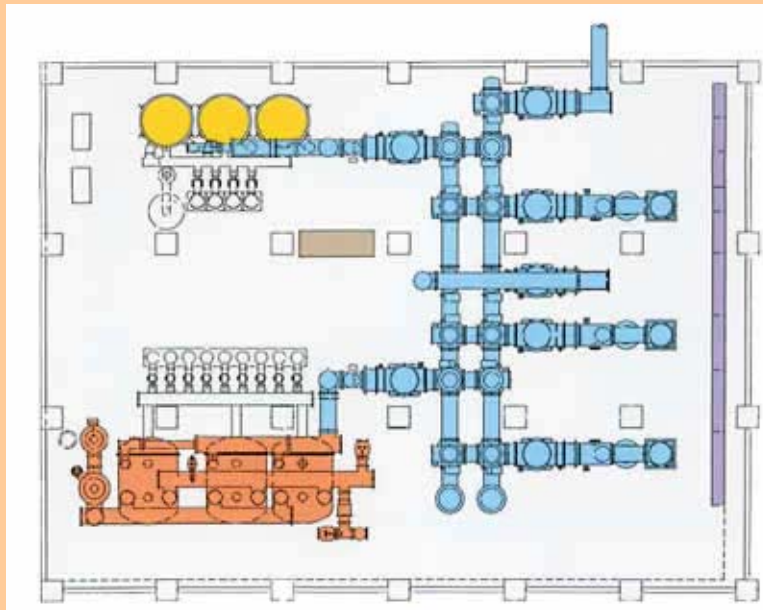
VERIFICATION ON PROTOTYPE TRANSFORMER








GAS INSULATED SUBSTATION

LAYOUT EXAMPLE OF GAS INSULATED

Since gas insulated transformer does not need the conservator, the height of transformer room can be reduced. In addition, its nonflammability and non tank-explosion characteristics can remove the fire fighting equipment from transformer room. As a result, gas insulated transformer, gas insulated shunt reactor, GIS and control panels can be installed in the same room, and such installation realizes the fully SF6 gas insulated substation.



-  Gas insulated transformer
-  Gas insulated switchgear (GIS)
-  Gas insulated shunt reactor
-  Cooling system control panel
-  Protective relaying equipment

275kV-150MVA GAS INSULATED SHUNT REACTOR

Toshiba has already realized the 275kV-150MVA gas insulated shunt reactor and it is now under commercial operation with satisfactory service records.

Type	Indoor use, gas cooled type
Gas pressure	0.5Mpa (at 20deg.-c)
Rated voltage	275kV
Capacity	150MVA
Core structure	Radical core with gap
Noise level	85dB



TOSHIBA

TOSHIBA CORPORATION

POWER SYSTEM COMPANY

1-1, SHIBAURA 1-CHOME, MINATO-KU, TOKYO 105-8001, JAPAN

PHONE: +81-3-3457-3770