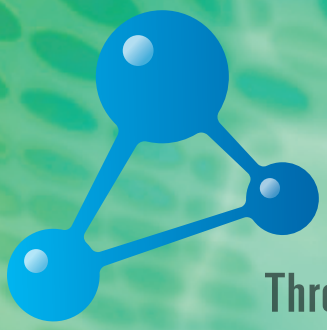
Fuji Electric

Innovating Energy Technology

Three Phase Encapsulated Type

SF_6 Gas Insulated Switchgear

Type SDH314/SDHa314 for 72.5 to 145 kV



GIS

Three Phase Encapsulated Type

SDH314/SDHa314

For 72.5 to 145 kV

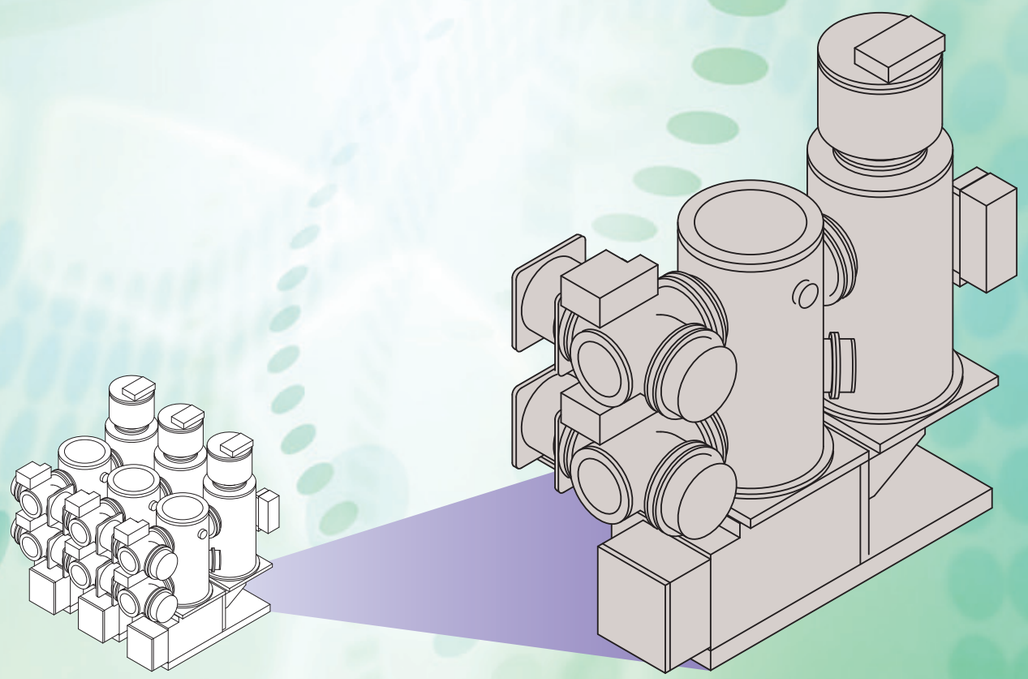
06B1-E-0002

Small Space Requirement, High Reliability and Safety — 72.5 to 145 kV GIS, SDH314/SDHa314

The number of application for SF_6 gas insulated switchgear has been tremendously growing all over the world, because it has many advantageous features as below:

- **Small space requirement**
- **High reliability**
- **Safety**
- **Good harmony with environment**
- **Long maintenance interval**
- **Short erection period at site**

Fuji started the development of SF_6 gas insulated switchgear (GIS) in the 1960's.
The first 72.5 kV GIS, which was of the phase segregated type, was put into operation in 1970.
Since then Fuji has also developed three phase encapsulated type GIS in addition to phase segregated one as our standard series of GIS.
Based on these experiences with high and long term technology, Fuji has successfully developed as a standard series of three phase encapsulated type GIS which realizes a quite compact and very reliable construction.
The 72.5 kV and above GIS is being manufactured in our substation equipment factory located in Chiba prefecture, Japan. The substation equipment factory has been recognized to be in accordance with the requirements of the quality standards ISO 9001.



Characteristic Features

Small overall dimensions make for minimum space requirements.
Therefore, the costs of foundations and buildings can be minimized.

The fully earthed enclosure protects operators not to touch live parts directly, prevents from radio interference, and realizes no atmospheric pollution.

The modular design principle applied realizes the standardization of components and parts.
This makes possible the large quantity production way which increases the reliability of components and parts with their easy stock control.

Unified SF_6 gas pressure throughout the switchgear makes simplified gas maintenance work.

Technical data

Rated voltage	[kV]		72.5	100	123	145
Rated power frequency withstand voltage	[kV]	Common values	140	185	230	275
		Across the isolating distance	160	210	265	315
Rated lightning impulse withstand voltage	[kV]	Common values	325	450	550	650
		Across the isolating distance	375	520	630	750
Rated normal current	[A]	Busbar	up to 3150			
		Others	up to 3150			
Rated short-circuit breaking current	[kA]		31.5/40 Note 1			
Rated short-time withstand current (3 s)	[kA]		31.5/40			
Rated peak withstand current	[kA]		80/100(50 Hz), 82/104(60 Hz)			
Rated SF_6 gas pressure, gauge (at 20 ℃)	[MPa]	Switchgear	0.6			
		Circuit breaker	0.6			
Rated break time of circuit breaker	[cycles]		3			
Rated operating sequence of circuit breaker			O-0.3 s-CO-3 min.-CO, O-3 min.-CO-3 min.-CO,CO-15 s-CO			

Applicable standards : IEC
Note 1
The following GIS type is applicable for each short-circuit breaking current rating.
Up to 31.5 kA: SDH314 with a CB operating mechanism of motor-charged spring type
40 kA : SDHa314 with a CB operating mechanism of oil hydraulic type

Typical Section of a Unit

Fig.1 Sectional view of a cable feeder unit with double busbar

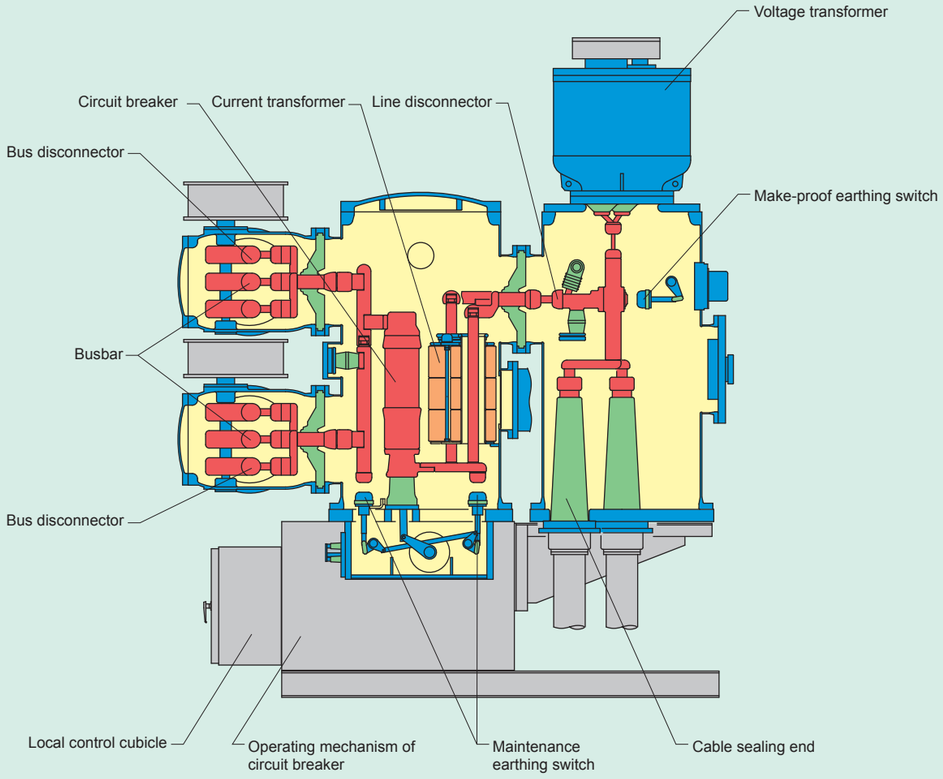
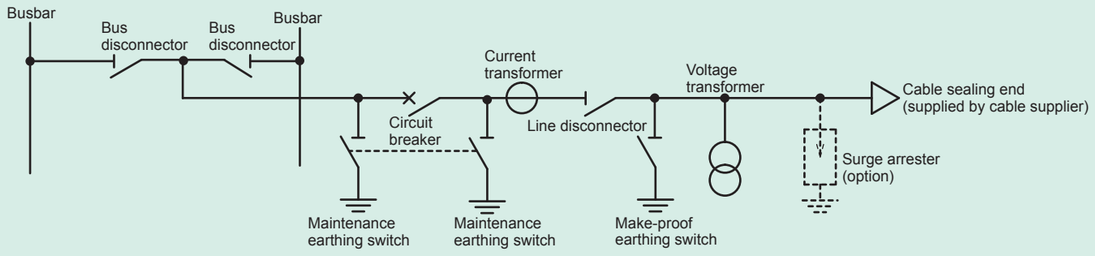


Fig.2 Single line diagram of a cable feeder unit with double busbar



Components and Construction

Circuit breaker

- A motor-charged spring (for up to 31.5 kA) or an oil hydraulic operating mechanism (for 40 kA) is applied.
- Three interrupters are commonly operated through insulating operating rods and a link mechanism.
- Combination of a puffer cylinder and an expansion chamber can achieve excellent breaking performance from small current to large current with a small operation power.
- Maintenance free up to 2,000 times load breaking

Fig.3a Outline of circuit breaker

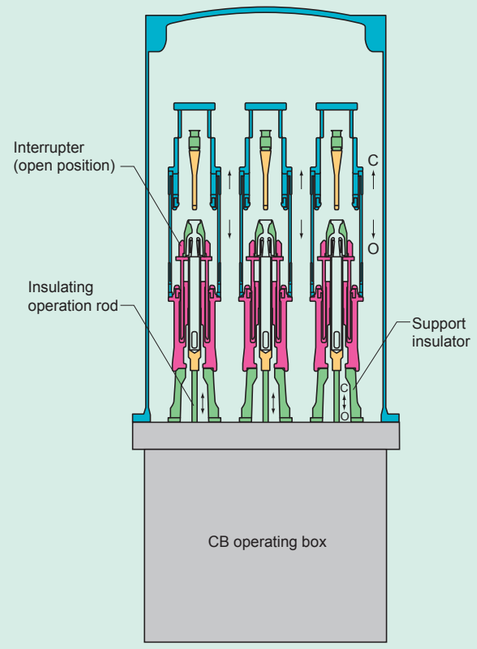
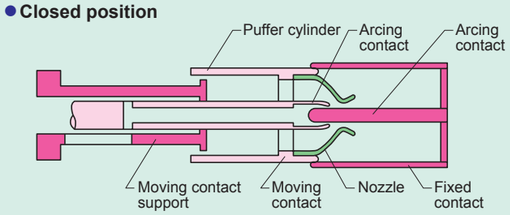


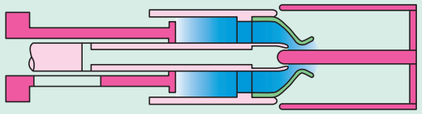
Fig.3b Principle of arc quenching

● **Closed position**



● **Opening(priming)**

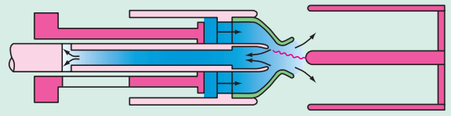
SF_6 gas in the puffer cylinder is being compressed.



When trip commences, the puffer cylinder is driven towards the moving contact support. The SF_6 gas trapped in the enclosed space is thereby compressed.

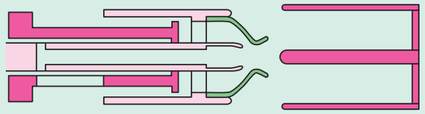
● **Opening(arc quenching)**

SF_6 gas flows during arc quenching.



As soon as the arcing contacts separate, the compressed SF_6 gas flows through the arc quenching nozzle and extinguishes the arc.

● **Open position**



Busbar

Three phase conductors made of aluminium or copper, depending on the current rating, are supported by gas tight insulators.

Disconnectors and earthing switches

Line disconnector is incorporated together with a make-proof earthing switch in one housing as a combined disconnector/ earthing switch.
Bus disconnector is assembled in each busbar compartment.
The disconnector have a switching capability of bus-transfer current, small capacitive current as bus charging and small inductive current as transformer magnetizing current, if required.
Maintenance earthing switches on the both sides of the circuit breaker are linked together by an operating rod and operated by a common operating mechanism.
Earthed side of the earthing switch is brought out from the earthed metal housing and earthed to it through a removable link for primary injection test.
Disconnectors and earthing switches are normally motor or manual-operated.
The make-proof earthing switch is provided with a motor-charged spring operation mechanism.

Current transformer

The current transformer is of foil-insulated type with ring core mounted in the CB enclosure. SF_6 gas provides the high-voltage insulation.

Voltage transformer

The voltage transformer is of induction type. SF_6 gas provides the high-voltage insulation.

Surge arrester

The surge arrester consists of zinc oxide(ZnO) element with excellent low residual voltage characteristics and long service life.

Fig.4 Line disconnector and earthing switch

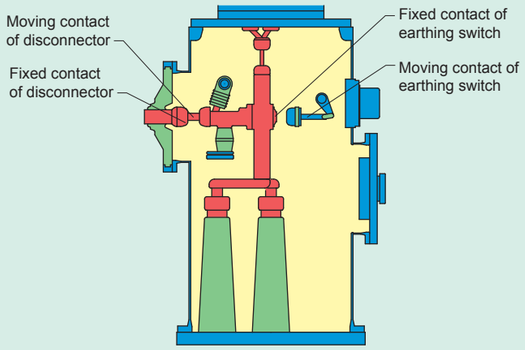
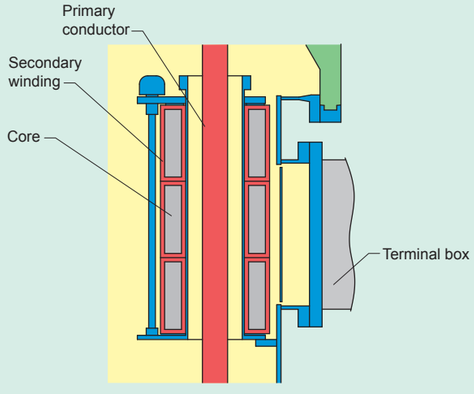


Fig.5 Current transformer



SF_6 gas system

Rated SF_6 gas pressure is unified at 0.6MPa (gauge) for all compartments.
SF_6 gas pressure changes depending on the ambient temperature as shown in Fig.6.
The monitoring of SF_6 gas is carried out by means of temperature compensated pressure switches in the manner as tabled below.

[at 20 ℃]

Components	Rated SF_6 gas pressure [MPa]	Low alarm pressure [MPa]	Operation lockout pressure [MPa]
Circuit breakers	0.6	0.55	0.5
Disconnectors and earthing switches	0.6	0.55	Note 2
Other components	0.6	0.55	—

Note 2 : Operation lockout at 0.5 MPa (at 20 ℃) is upon request.

Fig.6 Pressure-temperature characteristic curve of SF_6 gas

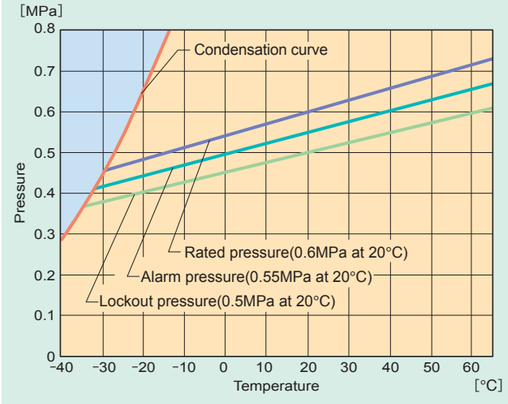
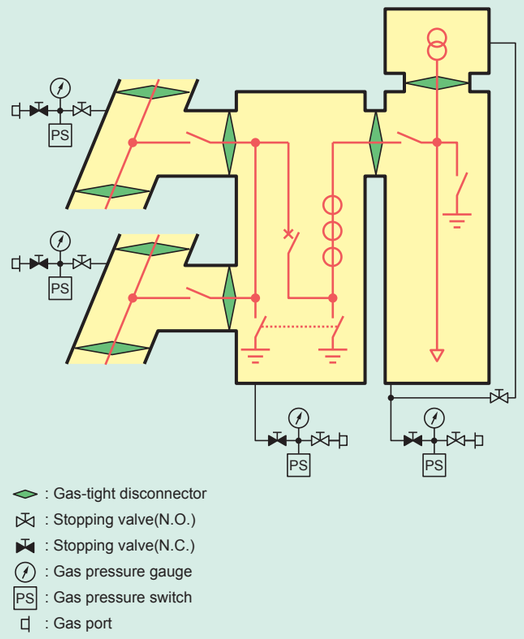


Fig.7 shows the typical gas zones and gas monitoring system.
The SF_6 gas filled disconnector/busbar compartment is sealed off from the adjacent unit by gas tight and arc-proof disconnectors.
A similar insulator seals off this compartment from the circuit breaker.
All gas zones are monitored by gas density relays.
The switchgear has a very low gas leakage rate. Guaranteed gas loss is less than 0.5 % per annum.

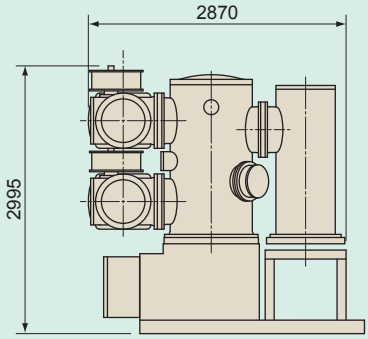
Fig.7 SF_6 gas system



Typical Arrangement

[Unit : mm]

Fig.8 Cable feeder unit with double busber(Tr.bay)



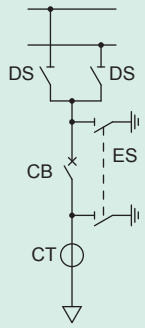
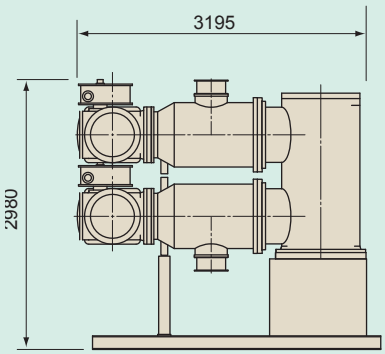


Fig.9 Bus coupler unit



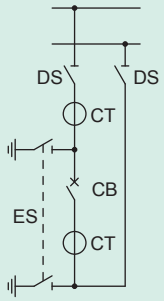
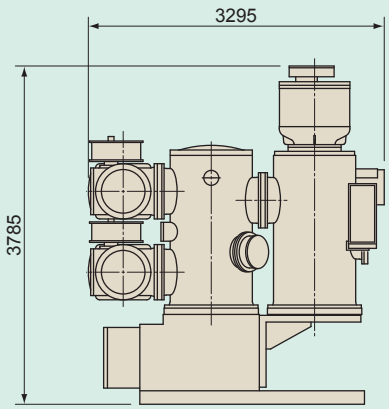
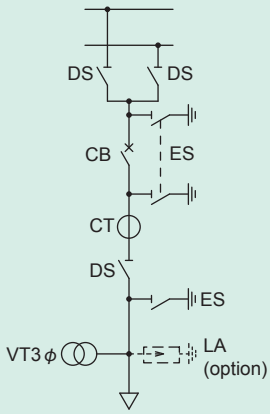


Fig.10 Cable feeder unit with double busbar





Printed on recycled paper

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2013-3(C2013/C2002)DE-H/CTP3M Printed in Japan