

Renewal of Substation Facilities for Megumino Substation of Hokkaido Railway Company

Keywords Chitose Line, Megumino Substation, AC traction power facility, Cubicle type gas-insulated switchgear

Abstract

Power intake facilities, AC traction power feeder facilities, and switchgears for railway systems were manufactured and supplied to the Megumino Substation of Hokkaido Railway Company, Hokkaido, Japan. Cubicle type Gas Insulated Switchgears (C-GIS) were adopted for the space saving for these power intake and AC traction power feeder facilities. For the control of switchgears for railway systems, Programmable Logic Controller (PLC) were made redundant to reinforce reliability.

1 Preface

Due to the obsolescence of substation equipment, renewal work was needed for the Megumino Substation. With an increase in passengers at the Chitose Airport, it also became necessary to expand the transformer capacity to improve convenience. Taking this opportunity, a one-circuit power receiving system was improved to a two-circuit power system (regular – standby) and the traction power transformer was increased from one to two units to increase reliability in the power source. To secure the redundancy of the main circuit, Programmable Logic Controllers (PLCs) and protective relays were arranged into a duplex configuration to reinforce the function of railway control switchgears. This paper introduces the facility features for the Megumino Substation.

2 Configuration of Facilities

At the Megumino Substation, a 66 kV intake power is received through two circuits from the Hokkaido Electric Power Network, Inc. The received 66 kV power is stepped down to a 44 kV single-phase two-circuit system by a traction power transformer, and to a 6.9 kV three-phase system with the use of tertiary winding of this transformer. Fig. 1 shows a main circuit connection diagram of the Megumino Substation.

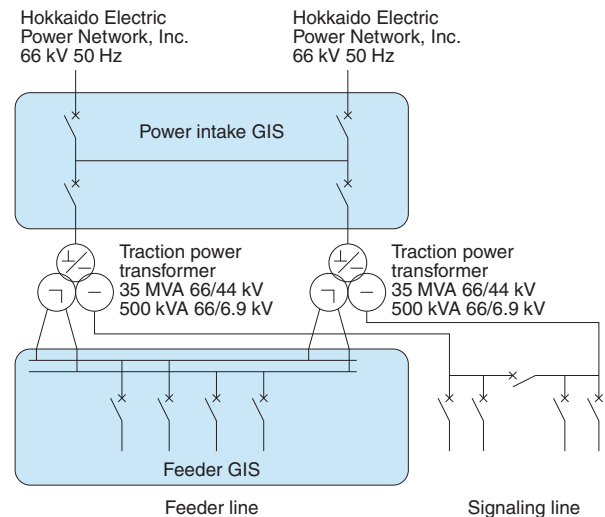


Fig. 1 Main Circuit Connection Diagram of Megumino Substation

The 66 kV intake power is received from Hokkaido Electric Power Network, Inc. through two circuits for regular and standby use. Two traction power transformers are installed in this substation.

3 Specifications of Equipment

3.1 Cubicle Type Gas Insulated Switchgear (C-GIS) for Power Intake and Feeder Systems

Compared with the existing conduit-type GIS, the newly installed C-GIS is a compact design thanks to the improved accuracy for analytical technologies such as optical allocation of equipment units and improved electric field structures. As a result, the installation space was significantly reduced. In addition, the total amount of insulation gas is reduced due to the reduction of gas pressure.



Fig. 2 C-GIS

An external appearance of the power intake C-GIS is shown. Space saving and labor saving are realized, and maintainability is improved using Vacuum Circuit-Breakers (VCBs).

Fig. 2 shows an external appearance of the C-GIS. Major specifications of equipment are as itemized below.

- (1) Type: C-GIS
- (2) Insulation medium: SF₆ gas
- (3) Rated voltage: 72 kV
- (4) Rated current: 1200 A
- (5) Rated interruption current: 25 kA

3.2 Traction Power Transformer

Since the 66 kV power intake transformer is required to produce a 44 kV single-phase traction power supply, the Scott connection system is adopted for this transformer. In addition, this 66 kV power intake transformer is required to produce a 6.9 kV single-phase power supply for signaling. For this reason, this transformer is provided with a built-in tertiary winding due to the limited installation space. Since the Scott connection is additionally provided, the original transformer capacity of 30 MVA has been increased to 35 MVA. **Fig. 3** shows an external appearance of a traction power transformer. Major specifications of this transformer are as follows:

- (1) Type: Outdoor, oil-immersed self-cooled type
- (2) Rated capacity: 35 MVA/500 kVA
- (3) Type of rating: Continuous (300% for 2 minutes)
- (4) Total number: 3/1, 1/1
- (5) Rated primary voltage: F69-R66-F63-F60 kV
- (6) Rated secondary voltage: 44 kV
- (7) Rated tertiary voltage: 6.9 kV

3.3 Switchboards for Railways

3.3.1 Supervisory Control Panels

For supervisory control panels, the PLCs are duplexed to secure reliability. For better operability



Fig. 3 Traction Power Transformer

An external appearance of a traction power transformer is shown.

and visibility, the operational block is configured by combining mimic busbars, indicator lamps, and switches that were formerly adopted.

Regarding failure display information, conventional indicators were modified into LCD displays in order to enhance maintenance and security convenience. As a result of this improvement, a large volume of information, such as operational history, can be added.

3.3.2 Protective Interlock Equipment

For protective relay panels, equipment of the same product series as for JR Shinkansen facilities is adopted. Similarly, a duplex system is adopted to have auto-checking functions so that high reliability can be realized.

3.3.3 Telemetry Panels

The telemetry panels are provided with added functions useful for security and maintenance. In addition to the basic functions of load data telemetry and establishment of daily and monthly reports, it is possible to record waveforms at the time of a failure, the number of CB tripping actions, and the duration of equipment operation.

4 Postscript

The Megumino Substation was designed with improvements to safety, environmental consideration, labor saving, and reliability in mind, and we supplied such equipment.

Going forward, we hope that the Megumino Substation will continue to work as a facility for safe and stable transportation.

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