News Release

Railway Technical Research Institute

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Superconducting Feeder Cable System
− Running Test Conducted on 1500 V DC Chuo Line −

The Railway Technical Research Institute has been developing the superconducting feeder cable system. Most recently, RTRI conducted a power feeding and shut-off test in cooperation with the East Japan Railway Company in order to apply the system to commercial service operation. The system was connected to the regular catenary system of the Chuo Line (1500V DC) and the tests were implemented while a test train was running on the track.

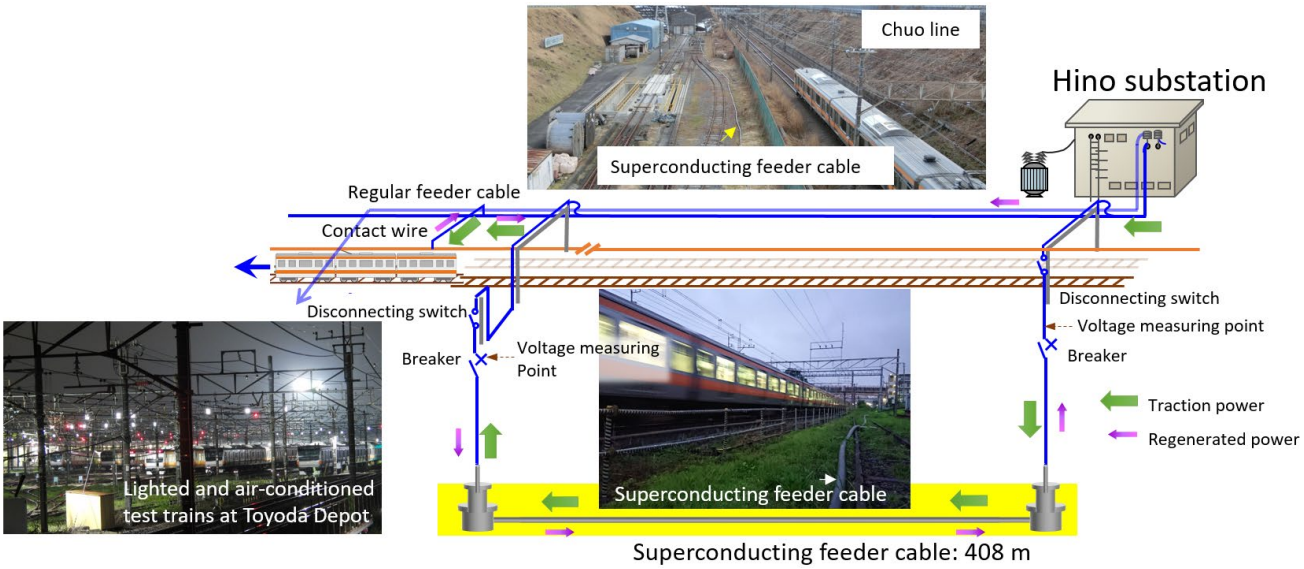


Figure 1: Superconducting feeder cable system at Hino Civil Engineering Testing Station

【Result of power feeding tests】

The purpose of this test is to confirm that the superconducting feeder cable system can transmit both the power to accelerate trains and the regenerated power created in braking (reverse-direction current) on a 1500V DC-powered railway line.

The superconducting feeder cable system (408m cable) placed in the Hino Civil Engineering Testing Station was cooled to cryogenic and superconducting condition with liquid nitrogen, and parallelly connected to the regular feeding circuit of Chuo line (Figure 1). Then, a test train (Series E233, 10-vehicle) ran on the line powered by the system, and at the Toyoda train depot, 10 test trainsets (Series E233, 10-vehicle) were powered by the regenerated current for lighting and air-conditioning.

Through this test, it was confirmed that up to 2200A or larger current flowed from the substation to the test train through this system while the train was being accelerated. Meanwhile, when brake was applied, regenerated power was transmitted in the reverse direction through the system to the trains standing in the Toyoda depot (Figure 2). The maximum amount of the current, 2258A, is the largest that flowed through this cable while an actual vehicle is running. Furthermore, it was confirmed that the test train was able to pass the section without any troubles.

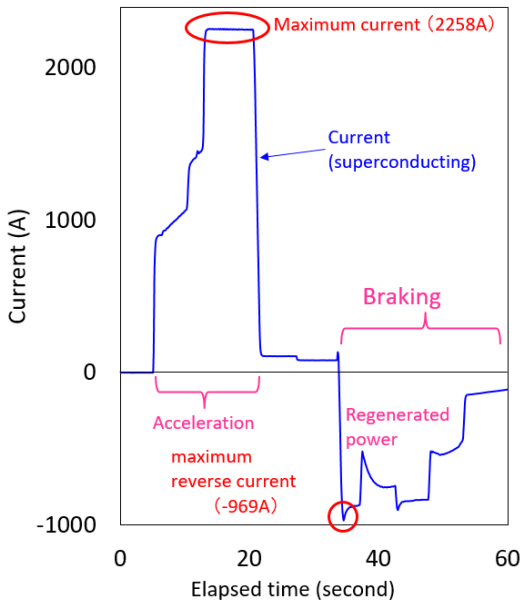
【Result of shut-off tests】

In the shut-off test, the superconducting feeder cable system is parallely connected to the regular power feeding circuit of a 1500V-DC-powered railway track and is shut off while a test train is running. The test confirms that, even after the superconducting system is shut off, the train is able to keep running, being powered by the regular feeding circuit.

As in the power-feeding test, the system under superconducting state was parallelly connected to the regular catenary system of the Chuo line (Figure 1) and the test train (Series-E233, 10-vehicle) ran on the track.

After the superconducting system was shut off from the regular circuit by a breaker during the acceleration, all the current flowing through the system was turned into the regular circuit (Figure 3, top) and the test train was able to continue acceleration, powered by the regular circuit (Figure 3, bottom).

This result has confirmed that, even if a trouble occurs to the superconducting cable system, trains can keep running by switching from superconducting to regular system. In addition, the voltage dropped 25V after the shut-off, while it was almost zero before shut-off. That result has confirmed the effect of the system to reduce the electrical resistance to zero (Figure 3, middle).



, Figure 2: Result of power feeding test

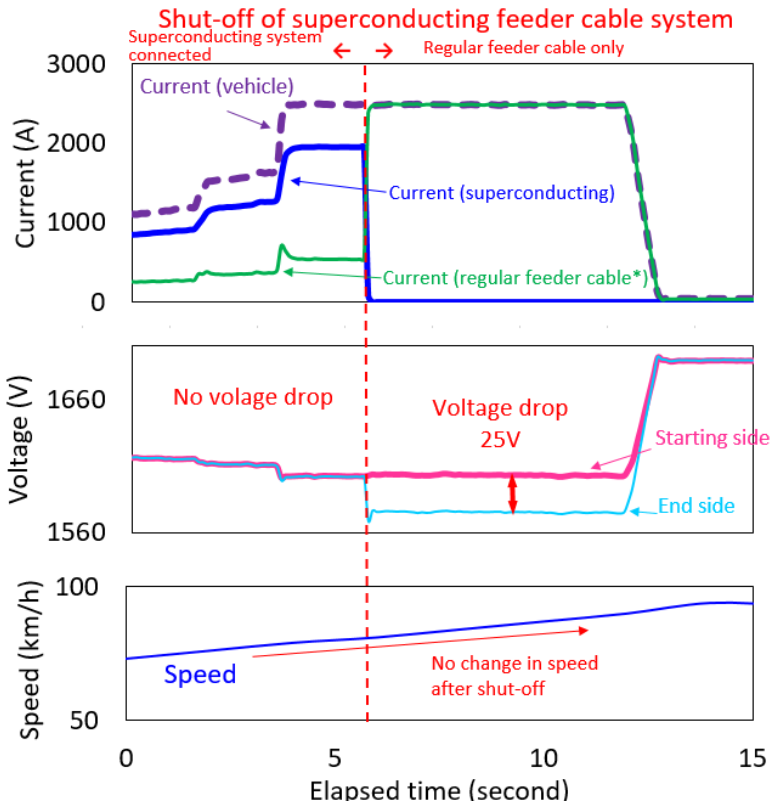


Figure 3: Result of shut-off test

* Since the cable connecting superconducting and regular feeder cable has electrical resistance, part of the current flowed through regular feeder cable.

RTRI will develop a system that accommodate the distances between actual substations (several kilometers or longer) and continue to address the issues to be cleared before introducing the superconducting cable to commercial services.

✧ The development of the superconducting feeder cables has been implemented as “the Program to Promote Strategic Innovation” and “the Program to Create Future Society “ by the Japan Science and Technology Agency (JST) and supported by the New Energy and Industrial Technology Development Organization (NEDO) and the Ministry of Land, Infrastructure, Transport and Tourism.