About i-SPOT

Ishikari Superconducting DC Power Transmission System (i-SPOT) was established on Jan. 20, 2014, as a Collaborative Innovation Partnership(CIP), approved by the Ministry of Economy, Trade and Industry(METI), for the purpose of test research on superconducting DC power transmission and related technologies.

Activities

Aiming for social implementation of superconducting direct current transmission technology (SCDC), we will conduct the following issues.

(1) Design and construction of an actual operation system as a total system including SCDC.
(2) Evaluation of safety and reliability of SCDC.
(3) Development of an improved-cooling system by utilizing cold heat such as liquid hydrogen, LNG, etc.

Members

CHUBU UNIVERSITY
JFE Steel Corporation
JGC GROUP
SAKURA internet

Board members

President	Osamu Motojima (Director, Chubu University)
Executive Director	Noriyuki Inoue (Professor, Chubu University)
Director	Hideo Sato (General Manager, Tubular Business Planning & Marketing dept. JFE Steel Corp.)
Director	Kunihiro Tanaka (Representive director and president, SAKURA internet Inc.)
Auditor	Hisashi Yamamoto (Deputy Director, Research & Development Center, JGC Holdings Corp.)

Head office (in Chubu University)

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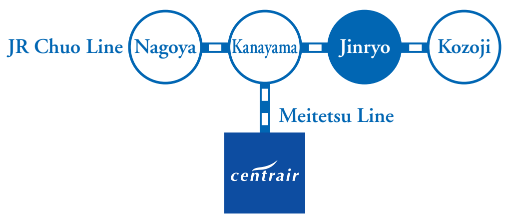
E-mail：info@i-spot.jp

Access

- **From Nagoya station**
  Take the JR Chuo Line (Local train) to Jinryo Sta.
  Meitetsu Bus for Chubu University. (Approx 10 minutes by bus.)
- **From Central Japan International Airport**
  Take the Meitetsu Line to Kanayama Sta.
  Then take the JR Chuo Line (Local train) to Jinryo Sta.
  Meitetsu Bus for Chubu University. (Approx 10 minutes by bus.)



Ishikari SCDC demonstration site

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TEL：+81-568(51)9872　FAX：+81-568(51)1172
E-mail：info@i-spot.jp

Access

- **From New Chitose International Airport**
  Take the JR Chitose Line to Teine Sta.
  Approx 20 minutes by taxi.

SCDC, [Superconducting DC Power Transmission] a Cool Solution for CN [Carbon Neutral]

I-SPOT

Ishikari Superconducting DC Power Transmission System (i-SPOT)
https://www.i-spot.jp

Superconducting DC power transmission (SCDC) that enables ultra-low loss power transmission

Out technology: Development of ultra-low loss cryogenic pipe

As a result of a four-year demonstration test at Ishikari using one of the world's longest (500m + 1km) SCDC test facility, it was confirmed that SCDC can reduce the transmission loss to 1/10 of the conventional AC transmission system.

The key technology for the reduction was the newly developed ultra-low loss cryogenic pipe. We have reduced the heat loss of the cryogenic pipe to less than half of the conventional amount, achieving the 1 W/m or less required for social implementation of SCDC. In addition, we have succeeded in significantly reducing the pressure loss in the liquid nitrogen circulation. These results provide the prospect of a cooling station interval of 20km or more, suggesting that SCDC will be an important component of the smart grid that is essential for the realization of a sustainable society of the future.

Contribution to CO_2 emission reduction

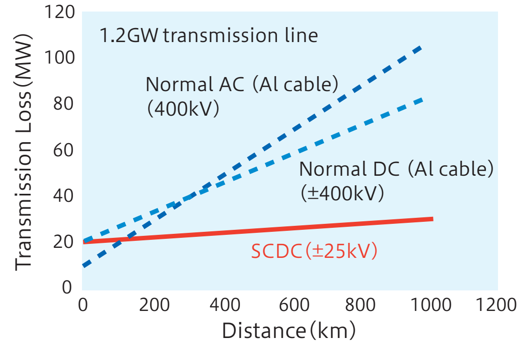
The large reduction of transmission loss in SCDC will contribute to CO_2 reduction. It is estimated that carbon dioxide emissions can be reduced by 1%* by converting 25% of the current power grid to SCDC.

* In total 33.9Gton CO_2 reduction (2018). We assume the power loss of the existing grid is about 4% and these are from thermal power plants.

Environmentally friendly and disaster resistant SCDC

Another advantage of SCDC is that we can transmit electricity for long distance with low voltage and with compact cable size. Therefore, it is possible to lay underground cables that are resistant to natural disasters at low cost and with small environmental impact.

Comparison of transmission losses

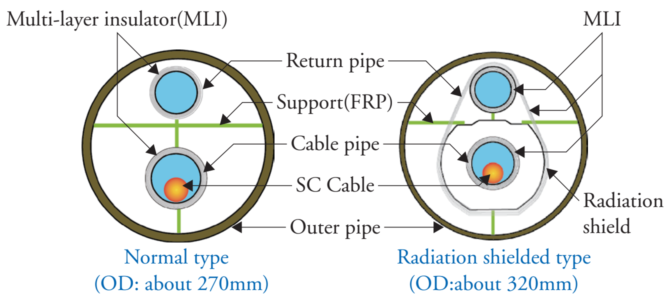


Transmission loss for normal conductor was due to ABB's public data. Superconducting power transmission is estimated for the case with heak leak for cooling system is 1W/m and refrigerator efficiency (COP) is 0.1.

Keypoint Ultra-low loss cryogenic pipe

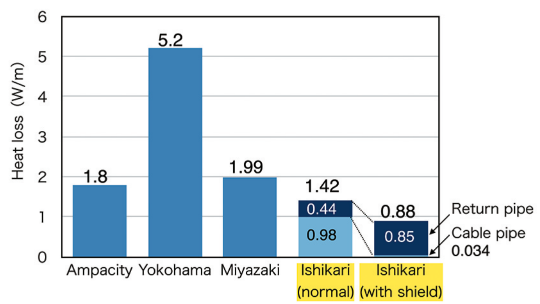
Since SCDC needs to be cooled to an extremely low temperature to keep a superconducting state, it is necessary to suppress heat intrusion (heat loss) from the outside. Our group has succeeded in keeping the heat loss of the cryogenic pipe very low by:

1. Smooth pipes are used for the inner pipes to reduce a pressure loss.
2. Two inner pipes are installed in a single outer pipe for liquid nitrogen circulation.
3. A radiation shield is adopted in one of the designs to reduce a heat leak to the cable pipe.



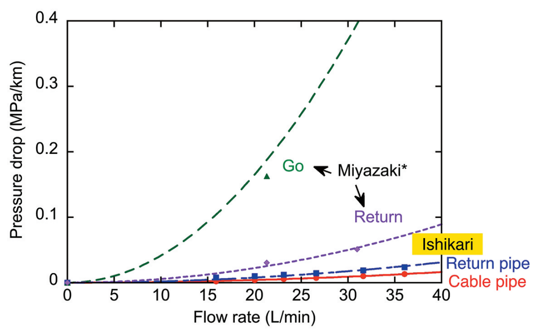
Cross sections of ultra-low loss cryogenic pipes (Ishikari)

Heat leak of cryogenic pipes



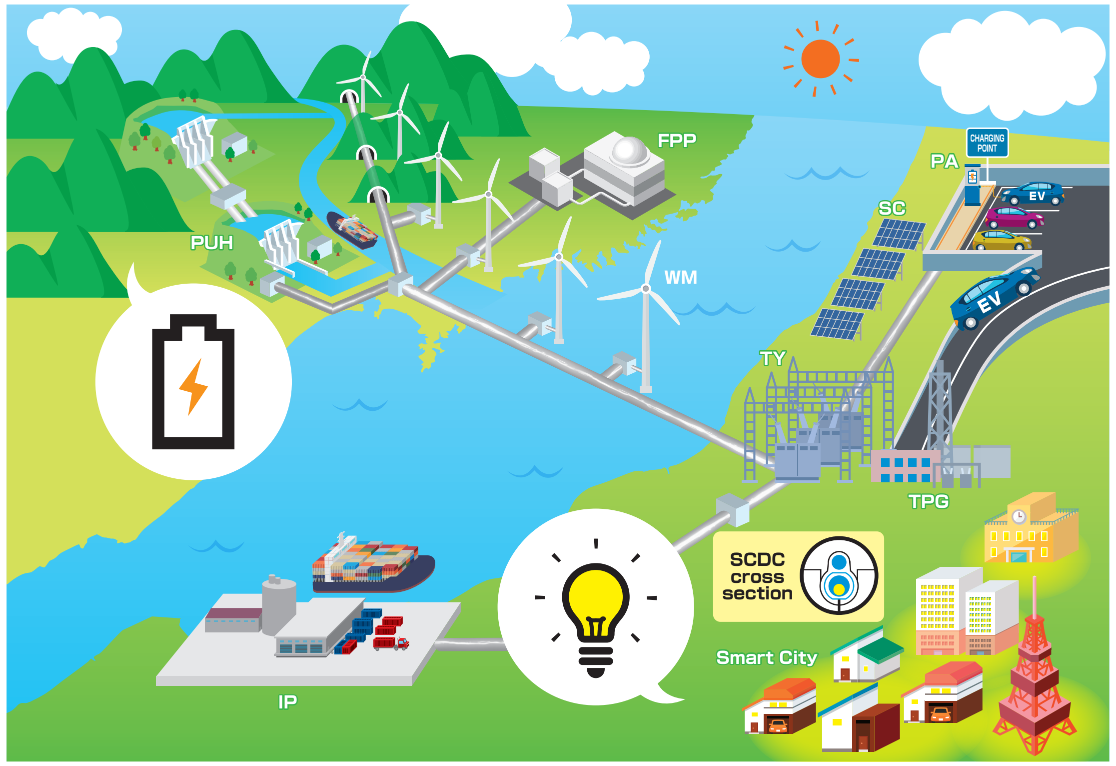
*Data are from published data

Pressure loss at cryogenic pipes



*Data of Miyazaki-project are from published data

Future smart energy system with SCDC as the basic infrastructure



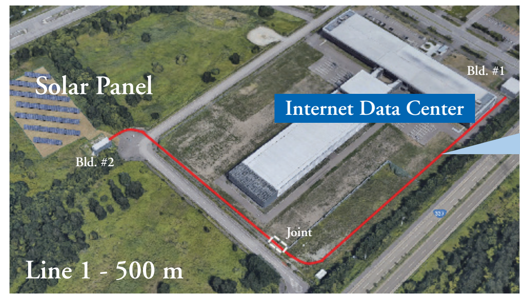
EV：Electric Vehicle PA：Parking Area IP：International Port
TY：Transformer substation Yard SC：Solar Cell PUH：PUmped storage Hydroelectric plant
TPG：Thermal Power Generation FPP：Fusion Power Plant WM：Wind Mill

Ishikari SCDC transmission demonstration test facilities

Ishikari SCDC transmission demonstration test facilities consist of the world's longest class 500m (line 1) and 1000m (line 2) cable systems, constructed in 2013 in the Ishikari New Port area of Hokkaido, in a national project, “Ishikari project”, supported by METI. While line 2 had been modified to two lines of 250m, all of these facilities are in use to support the R&D activities on SCDC and demonstration at large-scale.

			Line 1	Line 2
Length, type			Underground 500m line	Overland two 250m lines
Current, voltage			5kA, 20kV	2.5kA, 20kV
Cable	Type		BSCCO superconducting cable	
	Diameter		42mm	40mm
	Critical Current@77K	Outer conductor	> 6.3 kA	> 3.3 kA
		Inner conductor	> 6.6 kA	> 4.3 kA
Cooling system	Refrigerator	Main(2kW@77K)*1	1	2
		Sub(1kW@77K)*2	1	2
	LN2 circulator (100 kPa-40l/min)		2	3

*1 Turbo-Brayton refrigerator, *2 Stirling refrigerator

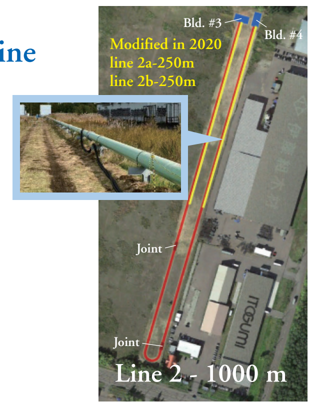


Line 1 : Underground 500-m cable line

(Connecting PV and Data Center)

Line 2 : Overland two 250-m lines

It used to be 1000-m line, but has recently been modified to two lines of 250m.



Superconducting cable core