Featured Topic: Contributing to a Zero-Carbon Society through Technology Development

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1. Decarbonization over the Power Cable Market

Efforts toward a Zero-Carbon society to curb global warming have become a major trend worldwide. Back in October 2020, the Japanese government proclaimed the target of achieving Carbon-Neutral by 2050, referred in "Green Growth Strategy," with a policy to make concerted efforts on the development of renewables and hydrogen energy sources, namely "carbon neutral innovation," with aims to strengthen the competitiveness of Japanese industry. In addition, a "Green Innovation Funding" was founded to promote it.

The Public-Private council set a high expectation on the offshore wind industry with a vision to achieve an ambitious target capacity of 30-45 GW by 2040. Meanwhile, these initiatives are facing challenges such as the disperse renewable energy resources and the impact of typhoons and other severe weather conditions on the offshore wind power facilities.

Europe, the preceding region to adopt renewable energy, has been engaged in identifying potential areas for harvesting renewable resources. The energy is then transmitted with direct current (DC) cables utilizing cross-border interconnectors to meet the demand for electricity over a large area. The transition and adoption of such energy schemes are rapidly underway worldwide, including India, United States, and China. In Japan, a master plan involving the construction of a large-scale and ultra-long-distance submarine cable system of 4-8 GW from Hokkaido (the northernmost island of Japan) to the Tokyo metropolitan area is under consideration. Furthermore, as the interest in floating wind turbines is likely to increase in the near future, the development of dynamic cables for such applications is needed.

2. Societal Contribution through Technological Development

Sumitomo Copper Rolling Works was founded in 1897 for the manufacturing and sales of copper plates, rods, and wires with raw copper mined from Mt. Besshi, which underpins the wire and cable business of Sumitomo Electric Industries, Ltd. In 1911, the 11 kV high-voltage underground power transmission cable manufactured by Sumitomo Electric was put to practical use for the first time in Japan. Since then, the Company has been developing high-voltage and high-capacity cables by fully utilizing its innovative technology in insulating materials and manufacturing technologies. With cross-linked polyethylene (XLPE) insulated cables, which are the mainstream at present, we have successfully put in practice the world's highest voltage of 500kV (AC) and 400kV (DC), contributing to technological innovation in energy infrastructure. In other respects, the Company has been contributing to the stable power supply with the development of preventive technology to detect "partial discharge," which eventually leads to breakdown, especially when power supply is interrupted by natural disasters or accidents, and by improving the accuracy of technologies to pinpoint the fault location along with short responsive time for cable repair along with strengthened service capacity to facilitate the maintenance works of aging circuitries.

In recent years, Sumitomo Electric Group companies have focused their R&D efforts on technologies such as power reservation batteries, IoT, and AI-based smart power management to resolve the instability of renewable energy.

Moreover, these companies are coping with the transition to circular economy internationally by developing new materials to increase the recyclability of decommissioned cables and reducing CO_2 emissions in manufacturing to minimize the environmental burden.

3. Development in DC Cable Technology

In 1954, the world's first DC submarine cable made of insulation paper impregnated with high-viscosity oil was used for DC power transmission between mainland Sweden and Gotland islands. Similarly, a DC 250 kV oil-filled (OF) cable was installed between Honshu (the main island of Japan) and Hokkaido, and since then, OF cables have been used globally.

Contrarily, XLPE cables, which have been studied since the 1970s, had the advantage of not leaking in the event of a marine accident. However, the problem of the deteriorating DC insulation performance due to the accumulations of space charge in the XLPE insulation remained to be solved.

Through years of research and development, including the introduction of inorganic additives to the insulating material with high space charge resistance, a 250 kV DC submarine XLPE cable was installed in 2012 linking Hokkaido and Honshu, which still holds the world's highest voltage record. Following the milestone above, Sumitomo Electric was awarded for the construction of a 140 km DC 400 kV interconnector, namely NEMO Link between the United Kingdom and Belgium. This was the world's first DC interconnector

project that adopted an XLPE cable operating at 400 kV. The NEMO Link has been transmitting power without fault since its completion in January 2019, contributing to the stable energy supply between the countries.

Photo 1. Submarine cable installation (NEMO project)

Recognition of the successful operation and achievements stated above led to the award of another contract from the German Transmission System Operator (GTSO) Amprion for a 525 kV DC XLPE cable system with a route length of 320 km. This system will transmit offshore wind energy generated in the North Sea to southern Germany, where electricity demand and consumption are high. Sumitomo Electric is the only Asian corporation qualified for the Pre-Qualification (PQ) process of the project, along with four others appointed by the Employer. Sumitomo Electric passed the stringent PQ test that continued for nearly two years. Construction is planned to begin circa 2024.

A collaboration with Siemens Energy in the sector of high-voltage DC power transmission started in 2017, and in the same year, a consortium between the two companies won an order for a 320 kV DC transmission project in southern India. In 2021, the consortium was awarded the 320 kV DC Greenlink project connecting Ireland and Great Britain with a target completion in 2024.

As the market and projected demand for cross-border interconnectors and large-scale offshore wind platforms that require export cables for transmitting electricity back to onshore power stations are expected to grow rapidly not only in Europe but also in Asia, where utilization of DC-XLPE cables is highly anticipated. Sumitomo Electric is confident with its technology to meet the market needs.

4. Development in Smart Energy System Technology

Sumitomo Electric strives in building a sustainable society with a focus on three mottos of “Minimize Environmental Burden,” “Improve Energy Quality,” and “Ensure Energy Security” in a drastically changing power systems today.

The utilization of renewable energies contributes to minimizing environmental burden, but at the same time, it is contradictory in that large-scale development of renewable sources to improve power quality brings environmental impact. Thus, it is equally important to use technologies like battery storage and smart power control in conjunction with the development of renewable energy. Technologies like redox flow battery storage systems for industrial or grids application, Power Depo III energy storage for households; taking advantage of IoT and AI in Energy Management Systems (EMS) – SPSS, *s*EMSA contributes to stable and economical energy management (Fig. 1). Proposals to solve the issues of energy security at regional industrial parks, residential areas, remote islands, etc. with the use of distributed photovoltaic systems in combination with energy management technologies, the Company will provide solutions to achieve energy saving, reduction in cost and CO_2 emissions.

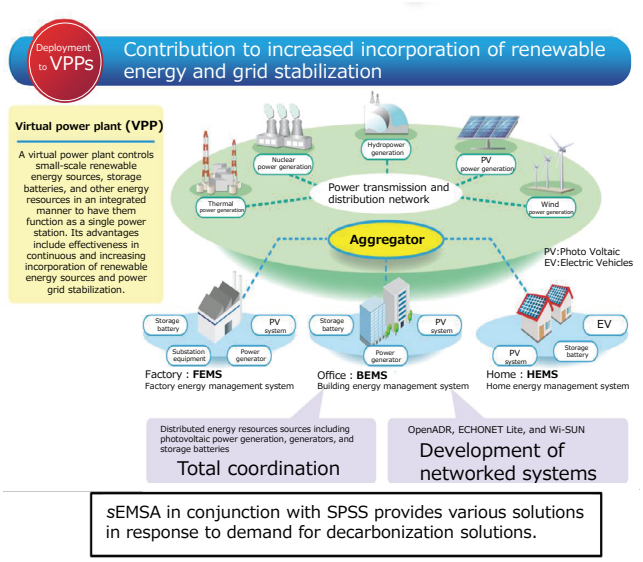

Fig. 1. Smart energy system

5. Conclusion

In Japan, the energy sector accounts for 40% of CO_2 emissions in total, as Sumitomo Electric is demonstrating its efforts and contribution toward a zero-carbon society; decarbonization of other sectors like transportation and heavy industries (petro-chemical, steel mill, etc.) is equally important. Furthermore, as the transportation sector is facing a major transition towards electrically driven vehicles, this change will have a significant impact on the energy sector. The impact will not merely be an increase in demand for electricity, but also a reduction in environmental burden through the use of storage batteries in these vehicles, the maintenance and improvement of power quality, and assurance of energy security. Sumitomo Electric is confident with the combination of its core technologies in the areas of mobility, energy, and communications to create new values.

Additionally, it is important to improve and refine the electricity storage technology for achieving a higher utility in renewable energy. In the near future, the development of low-cost, high-capacity storage batteries, hydrogen production using renewable energy, and the deployment of mobile hydrogen storage will be realized. For data centers, energy conservation is anticipated to be industrialized at the device level, which may initiate a new technological innovation.

Realizing a zero-carbon society by 2050 is a common challenge for humanity. Sumitomo Electric is committed to building a sustainable society with its core technologies focused on energy, while collaborating with stakeholders to provide new products and services.