SUMITOMO ELECTRIC
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Sumitomo Electric Group Magazine

vol. 14

Innovative Development,
Imagination for the Dream,
Identity & Diversity

Feature

Challenge to Spread the Use of Renewable Energy

– Underpinning the largest wind farm in Japan –

SUMITOMO ELECTRIC GROUP

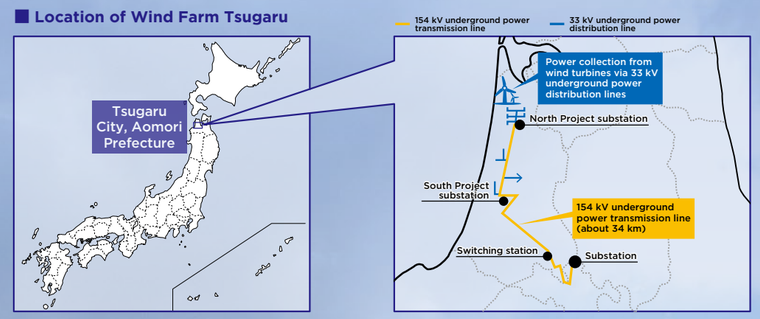
Japan's Potential Enhanced by Renewable Energy

– Creating a sustainable future –

Global warming is an urgent issue for our planet. Climate change, which is considered to be caused by global warming, has had various impacts and caused damage to various parts of the world. The global community has started to take action on a full scale to address global warming. The Paris Agreement was adopted at the 2015 United Nations Climate Change Conference (COP21). It aims to limit the global average temperature increase to below 2°C compared to pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C. The goal is to realize a decarbonized society, where emissions of greenhouse gases, including CO_2, are reduced to net-zero on a global scale. In response, certain countries, mainly in Europe, have launched national efforts to achieve a decarbonized society by 2050. It is still fresh in our memory that Japan also made a similar declaration in October 2020.

To realize a decarbonized society, it is considered to be effective to introduce renewable energy using wind power and photovoltaic power to replace fossil fuels. In 2012, the Japanese government launched the feed-in tariff (FIT) program to spread and expand the use of renewable energy in the aftermath of the Great East Japan Earthquake. Electric power companies were required to purchase electricity derived from renewable energy at a price designated by the national government for a certain period. This developed momentum toward the introduction of renewable energy. Against this backdrop, the Sumitomo Electric Group participated in Japan's largest wind power generation project in Tsugaru City, Aomori Prefecture. This adventurous challenge to establish a new business model for the Sumitomo Electric Group beyond the supply of electric cables was driven by the Group's sense of mission as a player in the electricity business to create a sustainable future.

Wind Farm Tsugaru and Mt. Iwaki



Significance of the Largest Onshore Wind Farm in Japan

A wind turbine installed on farmland

Tsugaru City, where wind conditions are among the best in Japan

Tsugaru City is situated in the northwestern part of Aomori Prefecture. Facing the Sea of Japan, the city is located on the vast Tsugaru Plain, which forms one of the largest granaries in Japan. The annual mean wind speed is over 7.0 m/sec. in the coastal area of the Sea of Japan, from the western part of Aomori Prefecture, including Tsugaru City, to Akita Prefecture in the south and Hokkaido in the north. This area is considered to be suitable for wind power generation. Here, the Wind Farm Tsugaru Wind Power Generation Project (name of the power plant: Wind Farm Tsugaru) is in operation. In the vast area along the area-wide agricultural road named the Melon Road (stretching about 10 km from north to south) in Tsugaru City, as many as 38 wind turbines in total (21 in the North Site, five in the Center Site, and 12 in the South Site) are in place. The scale is the largest in Japan. Commercial operation started in April 2020.

The project started more than 10 years ago. At that time, Japan was on the threshold of introducing renewable energy on a large scale. Green Power Investment Corporation (GPI) approached Tsugaru City because GPI recognized the city's future potential. Founded in 2004, GPI has consistently promoted the development, construction and operation of the renewable energy business. As a pioneer, it has made efforts to develop Japan's renewable energy industry. It has deployed renewable energy projects at eight locations across Japan, including projects for which construction is about to commence. Many new projects are being planned.

Yoshiyuki Mitsuhashi
Senior Managing Director and Deputy Head of Business Development, Green Power Investment Corporation

Yoshiyuki Mitsuhashi, Senior Managing Director and Deputy Head of Business Development of GPI, explained why the company focused on Tsugaru City.

"For a business operator engaged in the development of wind power generation projects, wind is the biggest factor for success. Feasibility depends largely on the strength of the wind that produces the electricity. In this context, many business operators, including GPI, pay attention to the coastal areas in Aomori, Akita and Hokkaido on the Sea of Japan because these areas meet all the requirements for good wind conditions, including the strength, direction and quality of the wind. Notably, the wind conditions in Tsugaru City are among the best in Japan. Many renewable energy companies have showed interest in launching wind power generation projects," said Mitsuhashi.

Melon Road

Largest onshore wind farm in Japan using 38 wind turbines with a total output of 121,600 kW

A wind power generation project starts with checking the wind conditions, securing the site and acquiring the right to connect a power transmission line to the grid (grid connection). To deliver electricity derived from wind power generation, it is necessary to transmit electricity by using the grid established by an electric power company. Wind power generation is unfeasible as a business without acquiring this right. Various methods have been used in the past to determine who would acquire this right. The winner of the Tsugaru right was selected by lottery. It was decided that GPI, which won the lottery, would promote the wind power generation project in Tsugaru City. GPI's plan was to construct the largest onshore wind farm in Japan using 38 wind turbines with a total output of 121,600 kW (about 120 MW), equivalent to the amount of electricity needed to power about 90,000 households. GPI acquired the grid connection right from an electric power company in 2011 when the Great East Japan Earthquake developed momentum toward introducing and using renewable energy. The feed-in tariff (FIT) program, which started in July 2012, spurred the introduction and use of renewable energy in Japan.

Placing priority on communication and collaboration with local communities

When the project was launched, it was not permitted to use farmland for other business purposes from the viewpoint of ensuring the food supply and national land conservation. However, Tsugaru City and renewable energy companies, including GPI, never gave up and continued to persuade the national government to change its position. Three years after acquiring the right to use the power transmission line, the national government acknowledged the contribution of renewable energy to farming, mountain and fishing villages. Finally, the Act on Promoting the Generation of Electricity from Renewable Energy Sources Harmonized with Sound Development of Agriculture, Forestry and Fisheries was enacted, opening the way for conversion of farmland. The act aims to create a mechanism for revitalizing farming, mountain and fishing villages by using local resources for the renewable energy business and using the profits, which are derived from selling electricity, for local communities while ensuring harmony with farming, forestry and fishery.

Kuramitsu Hiroaki
Mayor of Tsugaru City

Mitsuhashi said, "Enactment of this law prompted the full launch of the project. Notably, we placed top priority on gaining the understanding of local residents. Thus, we focused on communication and collaboration with local communities. We have abided by the policy of promoting the project with Tsugaru City—not treating it as a GPI project only—from the kickoff, to the commencement of power generation, and to the current operation phase."

In response to GPI's commitment, Tsugaru City took an important step. In 2016, the city formulated the Tsugaru City Renewable Energy Basic Plan, which laid the foundation to effectively use wind, a local resource that had remained untapped, revitalize local communities, and pursue both self-reliant development and use of renewable energy. Hiroaki Kuramitsu, who was the chairperson of the then newly established Tsugaru City Council for Revitalization of Farming, Mountain and Fishing Villages Through Promotion of the Use of Renewable Energy and currently serves as the city's mayor, expressed his expectations for the wind power generation project.

"The wind farm is expected to create jobs and increase tax revenue. In addition, GPI's project was highly advantageous for Tsugaru City, such as in the promotion of primary industry through original community benefit program paid from the profits. The most important part of implementing the project is coordination with residents. GPI undertook the entire process of obtaining consent from local residents toward the commencement of construction of the wind farm, such as gaining understanding about the project from landowners in the area where wind turbines were to be installed and requesting landowners to lease their land. After seeing GPI's community-based efforts to prepare for the commencement of construction, we judged that GPI was a trustworthy business operator. As a local government, we set up a council and held consultations with the national authorities toward the conversion of farmland. Efforts have been made in various parts of Japan to introduce renewable energy. It is important to ascertain whether it is worth working with a business operator for 20 years, which is a long period," said Kuramitsu.

GPI made preparations steadily toward construction of a power plant.

Solving an Unprecedented Problem of Long-Distance Cables

– Strength and synergies demonstrated by the Sumitomo Electric Group –

Wind turbine installation work(Photo courtesy of Kajima Corporation)

Offering solutions beyond the scope of an electric wire manufacturer

The Great East Japan Earthquake brought signs of structural changes in the electricity industry: expansion of renewable energy. Against this backdrop, the Sumitomo Electric Group was expected by renewable energy companies, which were new customers, to offer not only electric cables but also transmission and transformation solutions, including grid design to connect power plants to the grid.

With this in mind, Sumitomo Electric approached GPI, which had been attracting much attention compared to their competitors. The person in charge was Shuji Mayama, who is currently the chief engineer of the Power Cable Project Engineering Div. This was about five years ago, when GPI was conducting a specific study for Wind Farm Tsugaru.

"I tried all possible means to make an appointment with a person in charge at GPI, with which Sumitomo Electric did not have a relationship at that time. I was able to see General Manager Sakaki (who is currently the president of GPI). I clearly remember that it was difficult to obtain consent to our plan at first. However, I continued to explain the solutions of our group. Finally, GPI responded, 'We will commission the electrical design to Sumitomo Electric.' I was so excited. We collaborated with Nissin Electric Co., Ltd., which offers electricity receiving and transformation equipment, and Sumitomo Densetsu Co., Ltd., which performs electrical work, so that our group could supply all transmission and transformation equipment. Key persons from both companies were requested to be temporarily transferred to the project site while performing their jobs at their respective companies in order to create a cross-functional structure. Until the commencement of construction, we made strenuous efforts, including creating a basic design for the entire electric system, supporting the submittal of applications for authorization and studying the route. We had to study the design of the entire project, including the electricity receiving and transformation equipment and civil engineering work, which made me concerned at the beginning whether it would be possible to complete the construction of such a long-distance route in just two years. However, as I held discussions with engineers from the three companies, I became convinced that we could do it and recognized the significant value of our solutions beyond simply offering the products of the respective companies," said Mayama.

Shuji Mayama
Chief Engineer, Power Cable Project Engineering Div.

Kazuo Ota
Chief Engineer,
Electric Wire & Cable Energy Business Unit

Issues in long-distance electricity transmission — power transmission loss and route selection

Construction of Wind Farm Tsugaru, the largest onshore wind farm in Japan, posed unprecedented issues. According to the design, electricity generated by the respective wind turbines would be collected by 33 kV underground power collection cable. After step-up to 154 kV, electricity would be transmitted underground for a distance of about 34 km from the substation of an electric power company (Tohoku Electric Power Network Co., Inc.). As Kazuo Ota, who was the director in charge of transmission and transformation equipment at that time and currently serves as the chief engineer of the Electric Wire & Cable Energy Business Unit, points out, "Long-distance underground electricity transmission for a distance of 34 km was unprecedented in terms of scale back then."

"The distance of 34 km is the same as that from Tokyo to Yokohama. One of the issues was power transmission loss. We proposed changing the power transmission voltage from 66 kV, which had been initially planned, to 154 kV. This proposal was considered to be reasonable based on the principles of electricity. It significantly reduced the loss compared to power transmission at 66 kV. The number of cables installed and the weight of these cables were also reduced. This contributed to reducing the civil engineering work required for building conduits and improving the workability of cable installation along existing bridges.* However, another big issue was identified. It was necessary to resolve peculiar phenomena generated by grid connection of long-distance cables to an electric power system (e.g., voltage fluctuation, higher harmonic resonance). To implement measures against these peculiar phenomena, we had to study the electrical characteristics of cables and the design of transformation equipment in an integrated manner. This was a challenging task," says Ota.

Five peculiar phenomena were expected, as discussed below. Hiroyuki Uemura of the System Engineering Div. of Nissin Electric took on the challenge of solving the problems with engineers of Sumitomo Electric, including Ota. To build an optimal electricity system, Uemura was responsible for promoting the project smoothly and quickly in terms of the transmission and transformation equipment, which were key components of the wind farm, including discussion of engineering issues with the electric power company, preparation of design drawings, and fabrication, delivery and installation of the equipment. Now, what are the peculiar phenomena attributed to long-distance cables?

*To install cables along road bridges (steel bridges and prestressed concrete bridges).

Elucidating and solving the five peculiar phenomena that posed the biggest challenges

"In this project, it was necessary to install long-distance high-voltage cables, which were far longer than ordinary cables to substation for plants and buildings. We were requested by the electric power company to conduct an in-depth preliminary study before using such long-distance cables because peculiar phenomena were likely to occur during power transmission," said Uemura.

Many of the phenomena were outside the scope of knowledge and experience of the Sumitomo Electric Group. Uemura explained the measures that were implemented.

"The amount of electricity that accumulates in underground cables is significantly higher than that of overhead transmission lines due to the particular structure involved. We call it capacitance or charging capacity, which is extremely high for long-distance cables. This causes the five peculiar phenomena. We carefully studied the phenomena and came up with solutions.

The first problem was the impact on the fault trip operation in the event of a ground fault. Capacitance or charging capacity that accumulated in cables was likely to flow in together with the fault current, resulting in an increase in the fault current. This might not be able to operate normal fault tripping. To cancel the current that flowed in from the cables by using the current in the opposite direction, we installed a compensation reactor at the neutral point of the transformer.

The second problem was the charging capacity of the cables, which was likely to cause a deviation from the voltage fluctuation range specified by the electric power company. We set up a grid connection switching station to divide long-distance cables and installed a shunt reactor, a device for cancelling the charging capacity of the cables.

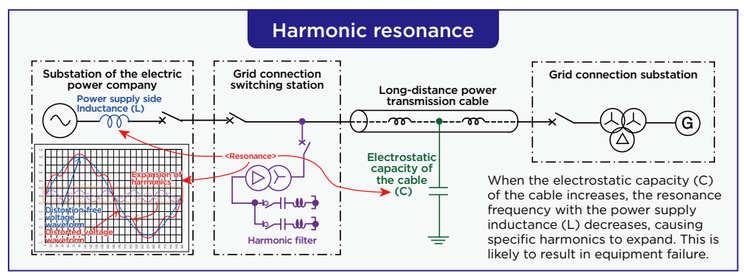
Hiroyuki Uemura
Chief Senior Staff, System Engineering Div.,
Power Supply & Environment System Business Unit,
Nissin Electric Co., Ltd.

The third problem was how to avoid damage to equipment due to overvoltage. Even if the circuit breaker at substation is opened to cause an outage, cables have the characteristic of retaining electricity (electric charge). When the circuit breaker is closed again, the equipment is likely to be damaged. We used a discharge device (Earthed voltage transformer) and verified that electricity could be discharged properly. The problem was solved.

The fourth problem was harmonic resonance. Harmonics refers to unnecessary frequencies such as five times or seven times higher than the commercial frequency (50 Hz/60 Hz) that distort the normal voltage waveform. The harmonic resonance problem occurs, when a frequency of preexisting harmonic voltage on the power network is nearly equal to the characteristic frequency which is dependent on the electrostatic capacitance of long-distance cables and the equivalent inductance of the electric power system. As the results, the specific harmonic voltages inherent in the power grid are likely to expand, resulting in overheating of the equipment. We installed a harmonic filter to suppress the harmonic resonance.

The fifth problem was the "zero missing" phenomenon due to the influence of the compensation reactor at the neutral point and shunt reactors installed in the substation. This refers to a phenomenon in which the fault current does not intersect the zero point as in the case of direct current, unlike the ordinary alternating current waveform, when a fault occurs. In this condition, the circuit breaker is likely to be damaged due to failure to trip of the fault current. We implemented measures such as increasing the resistance of the compensation reactor at the neutral point and disconnecting the shunt reactor in advance," said Uemura.

These efforts started in March 2017. After several rounds of discussion with the electric power company, it gave its approval in December of the same year. In fact, it took nine months to connect Wind Farm Tsugaru to the power grid.



To Ensure a Stable Supply of Large Amounts of Electricity

– Sumitomo Electric's front-line capabilities to give shape to design –

Construction work to bury power transmission lines

To offer the functionality of the group companies as a package

The Sumitomo Electric Group was preparing for commencement of the construction of Wind Farm Tsugaru, but it had not officially received an order. First, an order was placed for construction of the wind farm. Kajima Corporation, a major general contractor, received the order as an EPC contractor. EPC stands for engineering, procurement and construction, and refers to a project construction contract. It had been cooperating with GPI, as had the Sumitomo Electric Group, from an early stage in terms of the layout of wind turbines and construction design. Thus, the Sumitomo Electric Group had to receive an order from Kajima for the transmission and transformation equipment and construction. Masanori Sugiura of the Energy Solution Sales Div. was at the forefront of this process.

"Wind Farm Tsugaru was the first project for us to design the transmission and transformation equipment as a package. We did not have any in-house precedents or experience, so we faced obstacles when we conducted various studies. I remember searching for solutions blindly with cooperation from the personnel involved. I was in charge of negotiations and consultations with Kajima. This was also the first time for Kajima to handle a 100 MW-class power transmission system. At first, it was difficult to help them understand our highly technical proposal regarding both power transmission and transformation. We patiently continued to give in-depth explanations. I felt that communication gradually became smoother. Eventually, we could win the contract probably because Kajima highly evaluated our overall capability, including our proposal for the transmission and transformation package, product lineup of power transmission and distribution cables for any voltage, and the top manufacturing and construction capability in Japan to achieve a short construction period. It was in December 2017 when we overcame all technical issues. I had a strong sense of satisfaction that we were able to begin the next phase of this new challenge by taking full advantage of our overall capability, which is the strength of the Sumitomo Electric Group," said Sugiura.

Finally, construction of Wind Farm Tsugaru began.

Construction of a grid connection switching station

Collaboration among players in different business fields – Kajima, Sumitomo Electric and Sumitomo Densetsu

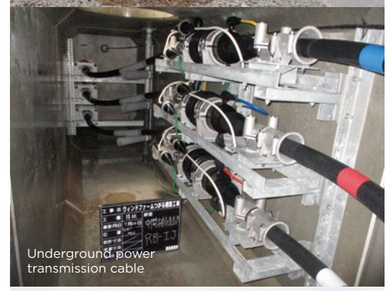
In December 2017, a groundbreaking ceremony was held to mark the start of overall construction. In July 2018, construction work to lay the 154 kV cables commenced. Subsequently, construction of connection equipment and electricity receiving and transformation equipment progressed as needed. Morimasa Akemoto, General Manager, Business Development, Civil Engineering Dept. of Tohoku Branch, Kajima Corporation was in charge of the overall wind farm construction project as the manager of the Wind Farm Tsugaru construction office. Akemoto had experience managing many construction sites before, but this was the largest project ever to undertake a package contract, including construction of the foundation of the power plant, design of the construction method, and construction of power collection, transmission and receiving equipment. This was a highly challenging mission.

"The project was promoted through collaboration among players in different business fields: Kajima, Sumitomo Electric and Sumitomo Densetsu. I focused on coordination because the corporate cultures and policies were different. There were as many as nearly 60 worksites. We had to construct 38 wind turbines and lay underground power transmission lines for a distance of about 34 km. The number of personnel involved in on-site operations was about 500 at the maximum. In promoting such a big project, I attached importance to creating an atmosphere where workers who participated in the project were able to feel that they were working on a common goal. I wanted to ensure that workers were motivated and glad to be involved in the on-site operations," said Akemoto.

Masanori Sugiura
Energy Solution Sales Div., Social Infrastructure Sales and Marketing Unit

The Sumitomo Electric Group and Kajima had worked together in past projects. However, this was the first time for Akemoto to work with the Sumitomo Electric Group. What was his impression?

"I must admit that I had confidence in the Sumitomo Electric Group in terms of engineering due to its track record and history. We had some disagreements, but we deeply trusted each other. Mutual trust was built based on a sense of commitment. We shared the same pride and passion, which only highly motivated people have, to complete the project within the schedule with determination and achieve a stable electricity supply. Our project was highly evaluated by GPI thanks to the Sumitomo Electric Group's efforts to solve difficult technical issues. I hope to work with the Sumitomo Electric Group again on a new wind power generation project, whether onshore or offshore, or within Japan or overseas," said Akemoto.



Underground power transmission cable

The construction work was performed even in the severe cold of winter

Wataru Sakaguchi
Chief, Tokyo Construction Group
Underground Cable Dept., Power Cable Project Engineering Div.

A mission to embody the performance of our products

Sumitomo Densetsu, one of the group companies, played a key role in this project for Kajima. To lay the power collection and power transmission cables, it was necessary to dig up the ground for a distance of about 56 km. The company also formulated a plan to build underground conduits under public roads and studied the civil engineering work of conduits by conducting a survey to select an appropriate route and holding consultations to obtain authorization. Sumitomo Densetsu promptly performed the construction work to lay the cables.

Wataru Sakaguchi of the Power Cable Project Engineering Div. of Sumitomo Electric was assigned to the team for the construction of substations and installation of cables concurrently with the civil engineering work by Sumitomo Densetsu. Sakaguchi joined this project from the survey phase and was officially assigned to the project with the commencement of cable installation in July 2018.

"August 1, 2019 was set as the date for 'power receiving.' Installation of transmission and transformation equipment and cables had to be fully completed by this date. Power receiving refers to connection to the grid of the electric power company without power generation. It was necessary to check whether the electrical equipment used for grid connection functioned properly by receiving electricity of 154 kV from the electric power company. This was an important milestone in the construction of the power plant. However, the city receives a lot of snowfall each year, and the construction period was virtually ten months. The schedule was very tight. We were responsible for embodying the performance of our products for delivery to customers. I thought that I could not make a mistake, but I was also confident that there would be no problem if I worked in the same way as I did at other sites. I was in charge of progress management while ensuring safety and quality. I had a strong sense of cooperation with Kajima in this process. At the end of the project, I was told by Manager Akemoto, 'This project could not be completed without Sumitomo Electric.' This was the highest compliment I could have received, which certainly gave me a feeling of satisfaction," said Sakaguchi.

The front-line capabilities of the Sumitomo Electric Group to give shape to design were demonstrated at this site. Wind Farm Tsugaru came into operation and started commercial operation in April 2020.

Morimasa Akemoto
General Manager, Business Development,
Civil Engineering Dept.
Tohoku Branch, Kajima Corporation

The maximum number of on-site staff was about 500.

To Create a Sustainable Future on a Global Scale

– Showcasing a vision of renewable energy in Japan –

The gallant sight of Wind Farm Tsugaru (Photo courtesy of Green Power Investment Corporation)

Goal of Tsugaru: "A city powered by clean energy"

At present, Wind Farm Tsugaru is operating stably. The 38 wind turbines have been gradually accepted as a new landmark of Tsugaru City. The electricity generated by Wind Farm Tsugaru is transmitted to Tohoku Electric Power Network. Some of the original community benefit program paid from the profits of power generation are used for a demonstration project to grow hydroponic melons, which are one of specialties of Tsugaru City. What does Tsugaru City think of wind power generation? What is the city's future vision? We asked Mayor Kuramitsu.

"GPI's project represents the ideal relationship between local communities and wind power generation. GPI is a business operator, but it is also our partner in deepening understanding of local communities, ensuring communication, thinking together what is necessary for Tsugaru City and what should be done, and taking action. In fact, specific efforts are underway to facilitate collaboration and conduct a study to revitalize agriculture, forestry and fishery. A study has been conducted on the possibility of establishing a large offshore wind power generation project. The city is confident that the wind is the most suitable for wind power generation in Japan. We hope to raise our profile as a center of wind power generation in Japan and a producer of clean energy. With the wind power generation facility in place, I will accelerate the revitalization of local communities and breathe new life into Tsugaru City in cooperation with the citizens," said Kuramitsu.

High hopes are pinned on the efforts to promote the development of local communities and revitalize local communities with wind power generation as a new beginning, which Kuramitsu mentioned. Tsugaru City also deserves much attention as a model of a sustainable city powered by renewable energy to help prevent global warming.

Trust built up through close communication with GPI

As a partner to expand and spread the use of renewable energy

The project was a turning point for both GPI and our electricity project business. The key point was the underground installation of long-distance high-voltage cables for a distance of about 34 km, which was a first for Japan.

"This was an unprecedented and extremely challenging mission. From the initial phase, we placed high trust in the Sumitomo Electric Group's engineering capabilities and high expectations on the group's overall capability. In fact, the project moved forward thanks to the Sumitomo Electric Group's solutions for the phenomena peculiar to long-distance high-voltage cables. The underground installation of long-distance high-voltage cables will become the industrial standard in the future. Since completing this project, we have embarked on new wind power generation projects in Tohoku and Hokkaido with support from the Sumitomo Electric Group. We will promote cooperation and collaboration with the Sumitomo Electric Group to expand the renewable energy business in Japan," said Mitsuhashi.

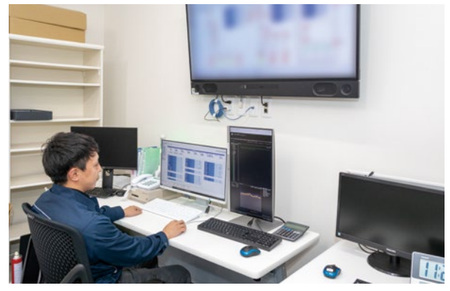
As GPI works actively to develop its renewable energy business, what future vision does it have?

"Because the Japanese government declared that it will achieve a carbon-free society by 2050, there has been growing momentum in Japan to use renewable energy as the main source of power. As a business operator, we will endeavor to increase the number of power generation sources, but we must consider how to efficiently supply renewable energy produced in local areas to large cities, where electricity demand is high. Of course, it is necessary to study new models of cooperation with electric power companies. Such efforts will improve Japan's energy situation. We hope to work with the Sumitomo Electric Group as a good partner into the future," said Mitsuhashi.

Contributing to the world by offering transmission and transformation solutions

A completed wind turbine and an adjacent substation

Grid connection switching station



Management system delivered by Sumitomo Electric

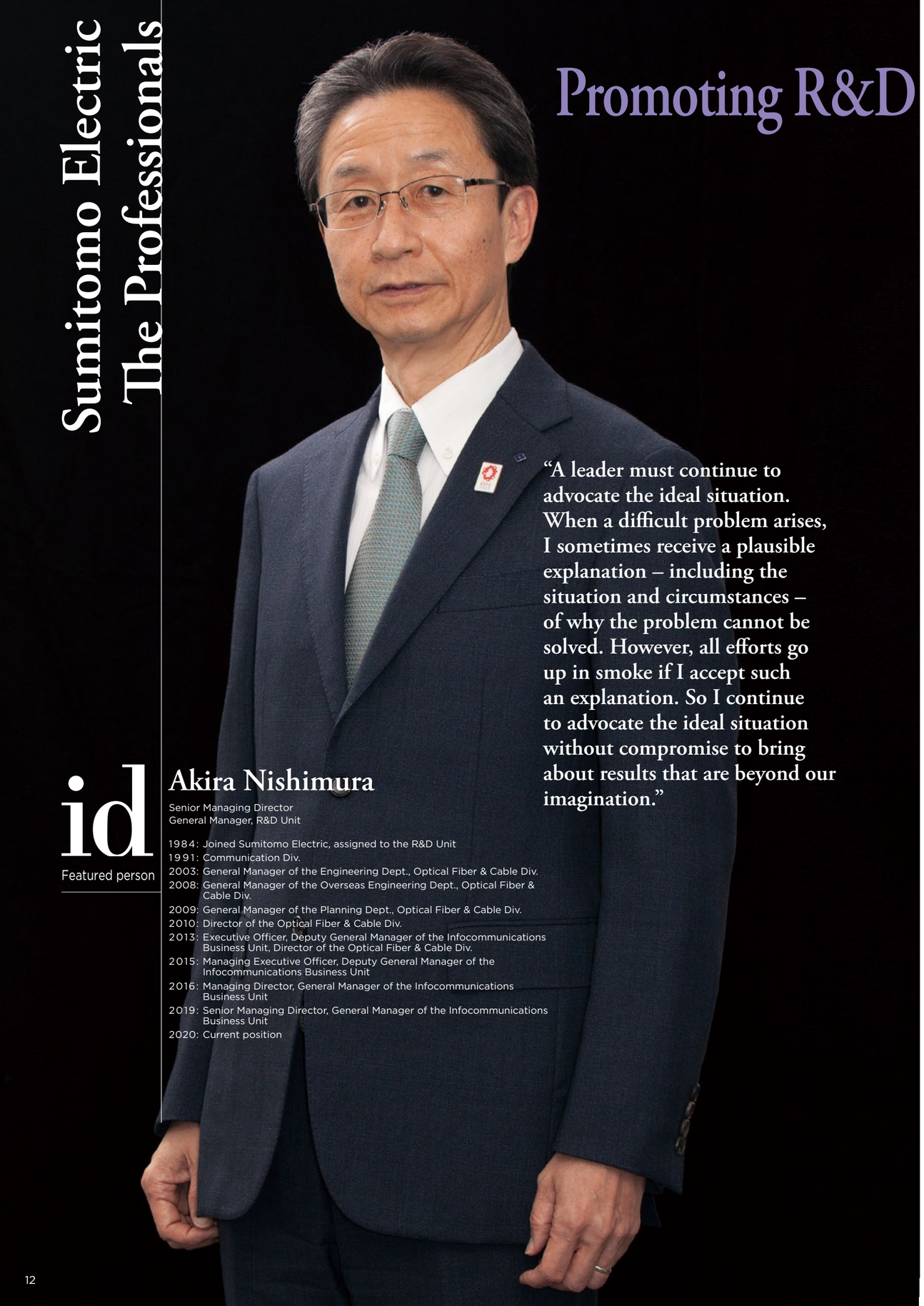
Kazuhira Harada
Director of the Power Cable Project Engineering Div.

The Sumitomo Electric Group's efforts in the Wind Farm Tsugaru project were breakthorugh in that the group offered comprehensive solutions to reliably achieve grid connection of the wind farm to the electric power system by both supplying power transmission and distribution cables and designing the system, including the transmission and transformation equipment, instead of simply supplying materials, such as electric cables. The Sumitomo Electric Group has a long history, but this was unprecedented in nature and therefore was considered to be an innovative project. What is the group's future policy for the renewable energy business? Kazuhira Harada, Director of the Power Cable Project Engineering Div., explained his thinking.

"We accumulated a lot of experience through the project. This has made it possible to further upgrade the transmission and transformation solutions of our group. In fact, our solutions have been highly evaluated by our customers. We have received orders for large-scale wind power generation projects one after another. To meet the growing social needs for renewable energy, we will demonstrate our overall capability through EPC functionality, which is derived from the collaboration within the group. Meanwhile, we must keep our attention focused on overseas markets. DC submarine cables, which represent our group's proprietary technology, were used for power transmission between the U.K. and Belgium. In Germany, Sumitomo Electric has been awarded a project to lay an underground cable of about 300 km, the longest in the world. Renewable energy projects have been gaining momentum, mainly in Europe. We hope to offer solutions of our group as full EPC-based packages to overseas markets and contribute to the world," said Harada.

In the Wind Farm Tsugaru project, the Sumitomo Electric Group opened up a new business horizon: the renewable energy field, which is indispensable to the creation of a sustainable future for the world. The Japanese government set a goal of achieving virtually net-zero greenhouse gas emissions by 2050. It is necessary to expand the scale of wind power generation and reinforce the power transmission network for wind power generation. The Sumitomo Electric Group believes that efforts to accurately identify renewable energy needs and offer comprehensive proposals and solutions on an ongoing basis will lead to the creation of a sustainable future.

Sumitomo Electric
The Professionals



Promoting R&D with the customers' viewpoint in mind

Environmental changes offer opportunities to change the game

"A leader must continue to advocate the ideal situation. When a difficult problem arises, I sometimes receive a plausible explanation – including the situation and circumstances – of why the problem cannot be solved. However, all efforts go up in smoke if I accept such an explanation. So I continue to advocate the ideal situation without compromise to bring about results that are beyond our imagination."

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Featured person

Akira Nishimura

Senior Managing Director
General Manager, R&D Unit

1984: Joined Sumitomo Electric, assigned to the R&D Unit
1991: Communication Div.
2003: General Manager of the Engineering Dept., Optical Fiber & Cable Div.
2008: General Manager of the Overseas Engineering Dept., Optical Fiber & Cable Div.
2009: General Manager of the Planning Dept., Optical Fiber & Cable Div.
2010: Director of the Optical Fiber & Cable Div.
2013: Executive Officer, Deputy General Manager of the Infocommunications Business Unit, Director of the Optical Fiber & Cable Div.
2015: Managing Executive Officer, Deputy General Manager of the Infocommunications Business Unit
2016: Managing Director, General Manager of the Infocommunications Business Unit
2019: Senior Managing Director, General Manager of the Infocommunications Business Unit
2020: Current position

Devoting my youth to R&D of optical cables

About 40 years ago, I was a university student but not the academic type. I spent most of my time mountain climbing and river trekking through club activities. Nevertheless, I studied hard at least during my two years at graduate school. I majored in applied mathematics and physics. My research theme was to convert data into mathematical equations and build mathematical models to be used for control theories. While I was job hunting, I hoped that I would be involved with actual products in some way. The field of applied mathematics and physics dealt with theory, so I wanted to handle something tangible in my career. At that time, I learned about the research that was being done on optical fiber at Sumitomo Electric from my senior in the laboratory. We were at the dawn of the era of optical fiber at that time. Optical fiber was expected to become an indispensable product for the society of the future. I thought that optical fiber had significant potential. I joined Sumitomo Electric because optical fiber was highly attractive. I also learned from some former students that the Company had a culture to assign young employees to important tasks. This was another reason that strongly motivated me to join Sumitomo Electric.

As optical fiber enticed me to join the Company, I requested that the Company assign me to a section involved in R&D of optical fiber and optical cables.* The Company agreed with my request, and I was assigned to the R&D Unit in Yokohama. At that time, optical cables had just begun to be introduced in Japan. There was a basic concept to connect all offices and households via an optical fiber network. The competition was very intense, and I literally devoted myself to research day and night so that our customer, a communication carrier, would use our optical fiber cables. We succeeded in increasing the fiber density (600 to 1,000 cores) to reduce the outside diameter of cables. When our proposal was finally adopted, I had a sense of accomplishment as a researcher.

Overcoming the challenge to expand sales for local communication carriers

I was directly engaged only in R&D during my first seven years after joining the Company and after I became Head of the R&D Unit in 2020. For more than 25 years, I was constantly affiliated with the Communication Division and Optical Fiber & Cable Div. I was involved in expanding sales of our optical cable products based on a technical approach to customers. In the early 2000s, we worked on a project which I clearly remember. Until then, we sold our products mainly to communication carriers. I was in charge of expanding sales in the local communication carriers. At that time, our share of this market was about 10%. I had to increase our share. Previously, the entire division had focused on major communication carriers, so it was necessary to change our mindset. As the leader of the operation group of the division, I asked that engineers be stationed at branches in the frontline and organized a team that enabled smooth collaboration and cooperation between the sales staff who received technical information from customers and engineers. I worked with the sales staff to build a structure to expand the Company's sales in this market. As a result, our share of this market expanded to over 50%. I was able to produce substantial results, which seemed to have impressed senior members who were working hard at the frontline of sales operations at that time. When I was appointed Managing Director, I received a congratulatory email from a retired employee. It contained a message that highly evaluated my efforts at that time. I felt grateful and deeply pleased because a person with whom I had worked valued not only the results but also the process.

Send-off party for a project in China (in February 2010, front row, fourth from the left)

I also faced difficulties after I was promoted as director of the division. Demand for optical cables in Japan slowed down, and the price also dropped. We had to change our policy and expand demand in foreign markets. However, the yen was getting stronger, and our export competitiveness was still low at that time. In addition, the Great East Japan Earthquake wreaked havoc on our plant, which put us in an extremely tough situation. To achieve a breakthrough, we worked as a team and continued to patiently make steady efforts, including extensive cost reduction efforts and expansion of sales both within Japan and overseas, and promotion of joint ventures in China. We managed to go back into the black in terms of operating income two years later. This strongly reminded me that we can produce results beyond our imagination by sharing a vision and joining our efforts through teamwork.

Communication capability: a must for researchers

In my work, I have always made it a rule to squarely face issues, make fair judgments, and fulfill my role. Notably, a leader must continue to advocate the ideal situation. When a difficult problem arises, I sometimes receive a plausible explanation—including the situation and circumstances—of why the problem cannot be solved. However, all efforts go up in smoke if I accept such an explanation. Continued efforts to advocate our ideal situation based on a correct understanding of the situation bring results beyond our imagination. Such an attitude of a leader helps fully unleash the potential of a team.

As the Head of the R&D Unit, I am responsible for managing all R&D, except for R&D undertaken by the Automotive Business Unit. "MoECo" (mobility, energy, and communications) has been promoted as a next-generation R&D field. Resources have been allocated to interdisciplinary fields as well. To achieve a decarbonized society, which has been attracting increasing attention, we have focused on developing technologies in the new energy field, and we remain committed to actively promoting the development of technology in this field.

I have a message for all young researchers. It is necessary to identify the value for customers and the advantages you can offer over your competitors from a broad perspective instead of sticking to what you think is important. Obviously, researchers conduct research for business reasons. To make business successful, it is essential to place top priority on the customers' viewpoint, not yours. Collaboration with external partners is also required through open innovation and other arrangements. This requires communication capability in addition to a broad perspective. The social environment has been changing significantly. This poses difficulties but also offers opportunities to change the game. To take advantage of such opportunities, it is necessary to quickly meet customers' needs and work with strong determination to accomplish the goal. To support young researchers who will be future leaders, we will develop and create an environment where they can have hope in the future and fully demonstrate their knowledge and talent.

*Optical fiber refers to a medium made from thin glass fiber for transmitting optical signals. Optical cables are designed to be durable for indoor and outdoor use by stranding optical fiber cores and providing a sheath.

Commencing Commercial Operation of India's First Ultra-High-Voltage Direct Current Transmission System Using DC-XLPE Cables

The consortium of Sumitomo Electric and Siemens Energy (Germany) constructed an ultra-high-voltage direct current (HVDC) transmission system, consisting of DC-XLPE cables and VSC*1 HVDC converter stations, the first of its kind in India. Commercial operation started in March 2021.

This project aimed to build a 2,000 MW transmission system, consisting of underground cables and aerial power transmission lines for a distance of 214 km between the HVDC converter stations in the southern part of India, in order to eliminate power shortages and stabilize the power transmission system. In ultra-high-voltage direct current transmission, a hybrid line of DC-XLPE cables and aerial transmission lines is highly difficult in terms of engineering due to the high load on the cables. Only two such projects had previously gone into operation around the world, both of which were awarded to Sumitomo Electric in Japan. This time, the Company manufactured and installed DC-XLPE cables using its proprietary DC-XLPE insulation material.*2

Project team members

India set the goal of achieving a renewable power generation capacity of 175 GW by 2022. The system serves as an important part of the infrastructure to achieve this goal and contributes to promoting efficient use of renewable energy. Sumitomo Electric and Siemens Energy remain committed to offering high-quality and safe products and technologies by taking full advantage of the experience gained in various countries as well as their mutual strength, and thereby contributing to realizing a society powered by clean energy.

*1 VSC (Voltage Sourced Converter): The construction space is smaller than that of conventional line commutated converters (LCCs). Recently, its use has been expanding mainly in Europe.

*2 Proprietary DC-XLPE insulation material: It was jointly developed with Electric Power Development Co., Ltd. (currently J-POWER Transmission Network Co., Ltd.).

To Become a Glorious Excellent Company

– The Sumitomo Electric Group Issues "Integrated Report 2020" –

Sumitomo Electric has issued its Integrated Report 2020 to help various stakeholders, including customers, suppliers, employees, local communities and shareholders, deepen their understanding of the Company.

This report explains how Sumitomo Electric creates value through its business. It presents a message from the chairman about Sumitomo Electric's value and strength and a message from the president about the Company's growth strategies. It also introduces its system of business deployment that contributes to the sustainable development of society through business in MoECo (mobility, energy and communications) and achieve long-term growth. In addition, the report presents messages from outside directors about corporate governance, which underpins management from a long-term perspective. It also provides information about the Company's business foundation in manufacturing, human resources and finance, which are the sources of its value creation.

Integrated Report 2020

We hope this report will provide insights into the approaches the Sumitomo Electric Group is taking to continuously expand its value and the value we provide to society.

We appreciate your feedback and requests and continually strive to create a report with even more substantial contents.

▶ **Sumitomo Electric Integrated Report**
https://sumitomoelectric.com/company/integrated

Introduction of new athletes who joined the Athletics Club

The Sumitomo Electric Group aims to contribute to the development of sports and local communities through activities to support sports. Notably, the Athletics Club has been redoubling its efforts to produce world-class athletes. This year, four track and field athletes joined the Company. Your warm support is highly appreciated.

Yuma Maruyama (decathlon)

Commitment and goal
The Athletics Club of Sumitomo Electric is known for sprinting and long-distance running. I will play an active role in raising the profile of the decathlon! I will make my dream come true by setting a Japan record!

Favorite aspects of track and field
It is an individual sport, but it requires teamwork and gives a sense of unity.

Most impressive competition
I participated in the Asian Junior Athletics Championships when I was a high school student. I won my event, and the national anthem that I heard on the dais was very impressive. I still remember the moment clearly.

Motto
Jita-kyoraku (make efforts for one's happiness and consider others' happiness as well)

A ritual before a competition
To clearly imagine myself winning my event and standing in the highest position on the dais

Specialty/hobby
My specialty is to make my shoulder blades stick out remarkably. My hobby is amateur astronomy.

Favorite food
Cream puffs

Favorite practice
Pole vaulting. I am 194 cm tall, and I can make my large body jump to a height of about 5 m. This action makes me feel extremely excited.

Personal strength that deserves attention during competitions
I enjoy competitions more than anybody else by involving spectators. I hope you will see me in a competition!

Inspiration/role model
Usain Bolt
He is the athlete who motivated me to take up track and field. He has been a superstar for me all the time. I want to become a Usain Bolt in decathlon!

Atsushi Kato (long-distance running)

Commitment and goal
I took up track and field about 10 years ago, but I have not won a ticket to an international competition. I will make efforts to become a world-class track athlete. The first step is to become an athlete trusted by team members. At the New Year Ekiden (All-Japan Men's Corporate Team Ekiden Championships), I will make a big effort so that my running leads the team to victory. I would appreciate your support.

Favorite aspects of track and field
It is simple but profound.

Most impressive competition
2020 All-Japan University Men's Ekiden

Motto
Effort is a treasure.

A ritual before a competition
Taking a deep breath

Specialty/hobby
Watching baseball games

Favorite food
Sushi

Favorite practice
Running at a constant speed of about 200 sec./km

Personal strength that deserves attention during competitions
Toughness when competing with other athletes

Inspiration/role model
Hyuga Endo (Sumitomo Electric)

Shuya Iwami (long-distance running)

Commitment and goal
I will make efforts to produce results at large events by following the example of highly competitive senior athletes. My goal is to do well at the New Year Ekiden and participate in the JAAF Athletics Championships!!

Favorite aspects of track and field
A sense of accomplishment after a good run

Most impressive competition
Hakone Ekiden (Tokyo-Hakone Round-Trip College Ekiden Race)

Motto
At the critical moment, get the result

A ritual before a competition
Taking a stroll

Specialty/hobby
Watching TV

Favorite food
Buta kimchi (stir-fried pork and kimchi)

Favorite practice
Physical training/roadwork/practice in the morning

Personal strength that deserves attention during competitions
Steady pace

Inspiration/role model
Senior athletes in Sumitomo Electric Athletic Club

Keita Yoshida (long-distance running)

Commitment and goal
I will do my daily practice with a sense of appreciation because I can do track and field despite this difficult situation. My goal is to compete in international events. I will increase my speed in track events and then test my abilities in the marathon.
I will make a fresh start. I would appreciate your support.

Favorite aspects of track and field
A sense of accomplishment when I surpass my personal best

Most impressive competition
When my team won the overall title in the Hakone Ekiden (I was a junior at university.)

Motto
Live a life that I choose with strong determination

A ritual before a competition
Keeping up my usual practice

Specialty/hobby
Mechanical puzzles, video games

Favorite food
Omurice

Favorite practice
Roadwork/practice in the evening

Personal strength that deserves attention during competitions
Stability

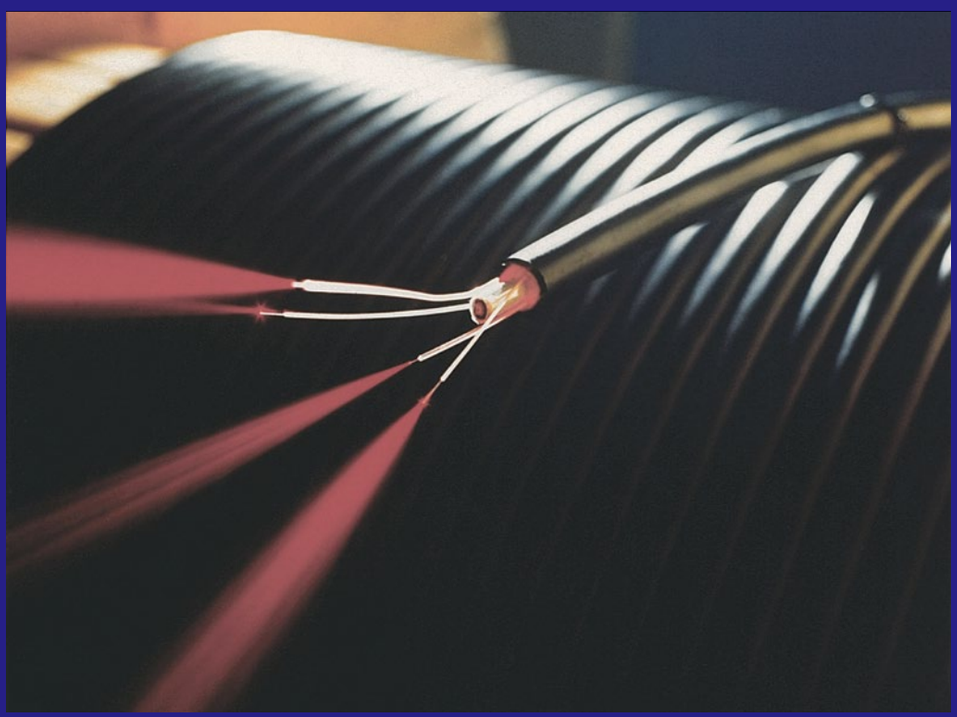
Inspiration/role model
Kazuki Tamura (Sumitomo Electric)

Information about the Athletics Club is also available on Twitter and Instagram. Please support the club by following the accounts and liking the posts.
Twitter @sei_trackfield **Instagram @sei_trackfield (Enter two single-byte underbars (_).)**

A Picture of Sumitomo Electric in Those Days

1974

Commencement of Manufacture of Optical Fiber Cables



Optical fiber cable (The red laser beams have been added to the original photo by photomontage.)

Decision to Launch a New Business

An optical fiber consists of glass fiber, which is as thin as a human hair. It is a high-performance medium capable of transmitting optical signals to a destination dozens of kilometers away by keeping the signals in its cores. In response to a report made by employees who attended the first international conference on trunk transmission lines held in the U.K. in 1970,*1 Sumitomo Electric increased the number of its researchers and embarked on the development of optical fiber. In 1973, Director Komatsu and Deputy Director Nakahara of the Communication Division at that time attended the Executive Council and stated, "Optical fiber will become a crucial technology in the communication field in the future." They explained to management the need to launch full-scale efforts to develop optical fiber and establish a business. This was an important business decision that determined the future of the Company. Even though the advent of an optical network society, in which we live today, was unimaginable, the management at that time, including President Isamu Sakamoto, was convinced that practical applications would be attained in the not-so-distant future due to the rapid progress in the competition to develop the new technology in foreign markets, and that optical fiber would become the core technology of the upcoming information society. It was decided to invest in the new business. In 1974, Sumitomo Electric became the first company in Japan to establish a pilot plant for manufacturing optical fiber, at the Yokohama Works. It started to develop and manufacture optical fiber cables on a full scale. In the same year, the Company filed a basic patent application regarding the VAD method,*2 an optical fiber manufacturing method that later became the most widespread method used throughout the world.

The first optical fiber cables exported by Sumitomo Electric in 1978 were used to connect telephone offices at a theme park in Florida (U.S.). In the 1990s, demand for optical fiber cables increased dramatically. Sumitomo Electric's products contributed to the widespread use of the Internet as well as larger-capacity and higher-speed communication. Today, optical fiber cables underpin our society where cloud services have become the norm.

*1 Conference on Trunk Telecommunications by Guided Waves

*2 VAD method: Vapor-phase axial deposition method. This is a method of manufacturing high-quality optical fiber suitable for mass production.

•Also refer to id Vol. 06 Feature: The Forefront of Optical Fiber Development for the Cloud Society.
https://global-sei.com/id/2018/12/

id vol.14

Information and videos not posted in this magazine are found on the "id" special site
https://global-sei.com/id/

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