# Organization for Cross-regional Coordination of Transmission Operators, JAPAN

# Annual Report

**- Fiscal Year 2016 -**

January 2017

電力広域的運営推進機関
Organization for Cross-regional Coordination of Transmission Operators,JAPAN
OCCTO

# Introduction

The Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO), is responsible for promoting cross-regional coordination of electric power business.

One of its responsibilities is in securing a stable electricity supply in both normal and abnormal conditions. The Organization monitors supply–demand and operating conditions of electricity networks nationwide for 24 hours and also assesses the condition of cross-regional networks in real-time such as supply–demand balance in regional service areas and monitoring cross-regional interconnection lines through the OCCTO system. In cases where the state of supply–demand is tight or might become tight due to disasters, the Organization instructs power exchanges in order to improve the conditions and secures a stable electricity supply.

In addition to the above short-term security, mid to long-term security of a stable electricity supply is also ensured. The Organization aggregates the Electricity Supply Plans of electric power companies, assesses and reviews the electricity demand forecast and supply capacity projection as well as the prospects of network system development. Furthermore, the Organization draws up a Cross-regional Network Development Plan including interconnection lines and takes the initiative in necessary system reinforcement.

Another business responsibility is in fostering the utilization environment of the electric power network in a fair and effective manner. The Organization develops rules for the electricity network which operators or users must comply to, and strives to operate electric power business adequately and smoothly. The Organization receives applications for accessing a network interconnection[1] in a neutral position. The Organization strives to develop an effective network system and reduces allocated construction fees of applicants for network use according to the effort such as hosting solicitation process for the generator interconnection which solicits applicants of sharers of construction cost. In addition, the Organization receives complaints or consultations concerning electricity business and implements mediation or arbitration between corresponding parties. Finally, the Organization operates and maintains a supplier switching support system which implements the smooth switching of retail contracts for ordinary residential customers.

Among the business stated above, the Organization aggregates and publishes the summary of the respective reports as an “Annual Report”.

With regards to securing a stable electricity supply in both normal and abnormal

1 This means an application for interconnection with the transmission network.

conditions, the annual report contains “Actual Supply and Demand in F.Y.2015” and “Actual Utilization of Cross-regional Interconnection Lines up to F.Y.2015”[2].

With regards to the mid to long-term security of a stable electricity supply, the report includes “Projection and Challenges Regarding Electricity Supply-Demand and Network based on the Aggregation of the Electricity Supply Plan for the Period F.Y.2016 to 2025” and “Review of the Adequate Level of Balancing Capacity in Each Regional Service Area” (The result of a review on soliciting Balancing Capacity for F.Y.2017).

With regards to fostering the utilization environment of the electric power network in a fair and effective manner, the Report covers “Actual Data of Preliminary Consultation, System Impact Study and Contract Applications in F.Y.2015”.

This Annual Report is prepared according to Article 181 of the Operational Rules of the Organization. The Organization considers that this report could assist the electricity business concerned or be used as a reference by those who have interests in the electricity business or a stable supply of electricity.

2 Conditions of transmission constraints nationwide are updated with data from the end of November 2016.

# CONTENTS

# I. Actual Supply and Demand

## 1. Actual Supply and Demand in F.Y.2015

As part of the Organization's role, nationwide demand and supply are monitored. Monitoring is implemented throughout the year, and an especially careful watch is provided during the summer peak period (July to September) and winter peak period (December to the following February). In addition, the Organization gives instructions for the improvement of situations to electric power companies if the supply–demand situation of electricity worsens or might worsen.

Regarding the supply and demand in F.Y.2015, actual data is summarized below in (1) Summer Peak Demand, (2) Winter Peak Demand and (3) Instruction given by the Organization. These actual data are published on the website[3] as "Outlook of Electricity Supply-Demand and Cross-regional Interconnection Lines", for further information, please see the report.

### (1) State of Demand and Supply on the Summer Peak Day

Table 1 shows the state of demand and supply on the summer peak demand day in regional service areas in F.Y. 2015 and their all-time records for summer peak demand.

The nationwide summer peak demand in F.Y.2015 was recorded on August 7, at 15:00. The peak demands were also recorded on that day in Tokyo (15:00), Hokuriku (12:00), and Shikoku (17:00), respectively. The time period of peak demand occurrence varies in regional service areas, in most areas it was record their time at 12:00 or 15:00, however, in Shikoku and Kyushu areas it was 17:00.

Table 1 State of Demand and Supply on the Summer Peak Demand Day in Regional Service Areas in F.Y. 2015[4 5 6] and their All-Time Records for Summer Peak Demand

| | F.Y.2015 | | | | | | | | | | All-Time-Record | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peak Demand [10⁴kW] | Occurrence date & time | | | Daily Max. Temperature [℃] | Supply Capacity [10⁴kW] | Reserve Margin [10⁴kW] | Reserve Margin [%] | Daily Energy Supply [10⁴kWh] | Daily Load Factor [%] | Peak Demand [10⁴kW] | Occurrence date & time | | | Daily Max. Temperature [℃] | Daily Energy Supply [10⁴kWh] | Daily Load Factor [%] |
| Hokkaido | 460 | 8/5 | Wed | 12 | 34.5 | 570 | 110 | 23.8 | 9,416 | 85.3% | 512 | 2008/9/22 | Mon | 19 | 26.2 | 9,947 | 80.9% |
| Tohoku | 1,434 | 8/6 | Thu | 15 | 36.1 | 1,632 | 198 | 13.8 | 27,620 | 80.3% | 1,571 | 2010/8/5 | Thu | 15 | 32.6 | 30,264 | 80.3% |
| Tokyo | 5,587 | 8/7 | Fri | 15 | 37.7 | 5,942 | 355 | 6.4 | 106,119 | 79.1% | 6,339 | 2007/8/22 | Wed | 15 | 37.0 | 119,557 | 78.6% |
| Chubu | 2,558 | 8/3 | Mon | 15 | 36.4 | 2,766 | 208 | 8.1 | 46,513 | 75.8% | 2,839 | 2008/8/5 | Tue | 15 | 37.8 | 52,823 | 77.5% |
| Hokuriku | 527 | 8/7 | Fri | 12 | 33.6 | 600 | 74 | 14.0 | 10,167 | 80.5% | 573 | 2010/8/5 | Thu | 15 | 37.6 | 11,105 | 80.7% |
| Kansai | 2,762 | 8/4 | Tue | 15 | 36.3 | 3,191 | 429 | 15.5 | 53,134 | 80.2% | 3,198 | 2010/8/19 | Thu | 15 | 36.6 | 60,612 | 79.0% |
| Chugoku | 1,101 | 8/6 | Thu | 15 | 35.5 | 1,220 | 119 | 10.8 | 21,327 | 80.7% | 1,236 | 2007/8/17 | Fri | 15 | 36.5 | 23,330 | 78.7% |
| Shikoku | 518 | 8/7 | Fri | 17 | 35.7 | 561 | 43 | 8.4 | 9,871 | 79.4% | 599 | 2008/8/4 | Mon | 15 | 35.8 | 11,313 | 78.7% |
| Kyushu | 1,554 | 8/6 | Thu | 17 | 35.5 | 1,756 | 202 | 13.0 | 30,927 | 82.9% | 1,778 | 2008/8/1 | Fri | 15 | 34.9 | 34,093 | 79.9% |
| Okinawa | 151 | 7/2 | Thu | 12 | 32.8 | 219 | 68 | 45.1 | 3,096 | 85.5% | 154 | 2009/8/3 | Mon | 21 | 34.4 | 3,210 | 86.7% |
| Nation wide | 16,454 | 8/7 | Fri | 15 | — | 18,346 | 1,892 | 11.5 | 316,473 | 80.1% | 18,221 | 2007/8/22 | Wed | 15 | — | 347,819 | 79.5% |

3 "Outlook of Electricity Supply-Demand and Cross-regional Interconnection Lines (Actual Data up to Fiscal Year 2015)" http://www.occto.or.jp/en/news/information/files/161025_outlook_of_electricity.pdf

### (2) State of Demand and Supply on the Winter Peak Day

Table 2 shows the state of demand and supply on the winter peak demand day in regional service areas in F.Y. 2015 and their all-time records for winter peak demand.

The winter peak demand in F.Y.2015 was recorded on January 18, at 18:00 in Hokkaido, and on January 25, at 10:00 in Chugoku. These were also the annual peak demand for the Hokkaido and Chugoku areas. In other areas, the summer peak demand was greater than that of winter in F.Y.2015, and the annual peak demand was recorded in the summer.

Table 2 State of Demand and Supply on the Winter Peak Demand Day in Regional Service Areas in F.Y. 2015[4] [5] [6] and their All-Time Records for Winter Peak Demand

| | F.Y.2015 | | | | | | | | | | All-Time-Record | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peak Demand [10⁴kW] | Occurrence date & time | | | Daily Mean Temperature [℃] | Supply Capacity [10⁴kW] | Reserve Margin [10⁴kW] | Reserve Margin [%] | Daily Energy Supply [10⁴kWh] | Daily Load Factor [%] | Peak Demand [10⁴kW] | Occurrence date & time | | | Daily Mean Temperature [℃] | Daily Energy Supply [10⁴kWh] | Daily Load Factor [%] |
| Hokkaido | 516 | 1/18 | Mon | 18 | −5.9 | 653 | 137 | 26.5 | 11,837 | 95.5% | 582 | 2011/1/12 | Wed | 18 | −6.8 | 12,730 | 91.1% |
| Tohoku | 1,355 | 1/25 | Mon | 18 | −0.9 | 1,530 | 175 | 12.9 | 29,671 | 91.3% | 1,491 | 2008/1/24 | Thu | 18 | 0.1 | 30,874 | 86.3% |
| Tokyo | 4,976 | 1/18 | Mon | 12 | 2.8 | 5,377 | 401 | 8.1 | 98,704 | 82.7% | 5,666 | 2008/1/23 | Wed | 18 | 3.0 | 112,696 | 82.9% |
| Chubu | 2,414 | 1/25 | Mon | 10 | 0.1 | 2,576 | 162 | 6.7 | 47,535 | 82.1% | 2,483 | 2008/2/14 | Thu | 10 | 2.0 | 50,327 | 84.5% |
| Hokuriku | 519 | 1/19 | Tue | 18 | 0.1 | 560 | 41 | 7.8 | 11,333 | 90.9% | 528 | 2011/1/20 | Thu | 18 | 0.5 | 11,576 | 91.3% |
| Kansai | 2,516 | 1/25 | Mon | 10 | 1.9 | 2,902 | 386 | 15.3 | 52,061 | 86.2% | 2,747 | 2011/2/14 | Mon | 17 | 1.8 | 55,132 | 83.6% |
| Chugoku | 1,111 | 1/25 | Mon | 10 | 0.8 | 1,239 | 129 | 11.6 | 23,023 | 86.4% | 1,104 | 2008/1/28 | Mon | 18 | 1.6 | 22,812 | 86.1% |
| Shikoku | 486 | 1/19 | Tue | 19 | 2.9 | 545 | 58 | 12.0 | 10,171 | 87.2% | 522 | 2012/2/2 | Thu | 19 | 0.8 | 10,799 | 86.2% |
| Kyushu | 1,545 | 1/25 | Mon | 11 | 2.1 | 1,871 | 326 | 21.1 | 31,945 | 86.1% | 1,545 | 2012/2/2 | Thu | 19 | −0.1 | 31,425 | 84.7% |
| Okinawa | 122 | 1/24 | Sun | 20 | 9.2 | 164 | 42 | 34.1 | 2,390 | 81.4% | 114 | 2011/1/31 | Mon | 20 | 11.8 | 2,230 | 81.4% |
| Nation wide | 15,185 | 1/25 | Mon | 10 | — | 17,689 | 2,503 | 16.5 | 317,826 | 87.2% | 16,140 | 2008/2/13 | Wed | 19 | — | 333,390.8 | 86.1% |

4 Daily mean temperatures are based on the data for the city where the headquarters of General T/D Companies' are located. (Except for Okinawa EPCO, data for Naha are applied. Those data are beyond April 2005.)

5 Daily Load Factor(%) = Daily Energy Requirement / (Daily Peak Demand ×24[h])

6 Values are expressed as generating and receiving end (which means the sum of the metered power generated by former vertically integrated electric power companies and the metered power received by other than former vertically integrated electric power companies that is supplied to the customers by general transmission and distribution companies).

### (3) Instruction for the Improvement of Supply–Demand Situations given by the Organization

The Organization monitors the nationwide electricity supply and demand 24-hours a day, assuring the necessary supply capacity at the units calculated for the day, and the following day or week. The Organization gives instruction for the improvement of situations to electric power companies including increased supply capacity, such as power exchange between the service areas, or decreasing demand, such as interruptible demand, if the supply–demand situation of electricity worsens or might worsen by a disaster or generator outage.

In F.Y.2015, the Organization gave the instruction for power exchange twice; once for the Tokyo area in April, and a second time for the Shikoku area in September, as indicated in Figure 1 and Table 3.

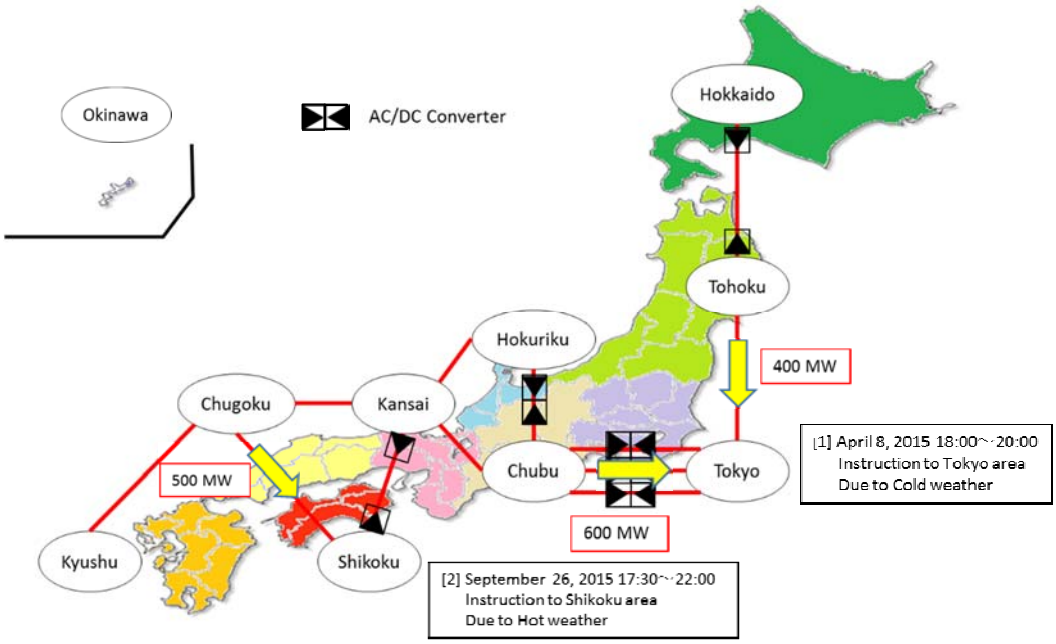



Figure 1 Instruction Summary in F.Y.2015

Table 3 Actual Instructions by the Organization in F.Y.2015

| | | |
|---|---|---|
| [1] | Date | April 8, 2015 at 17:30 |
| | Instruction | ・Chubu EPCO shall supply to Tokyo EPCO 600 MW of electricity from 18:00 till 21:00.<br>・Tohoku EPCO shall supply to Tokyo EPCO 400 MW of electricity from 18:00 till 21:00.<br>・Tokyo EPCO shall be supplied 1,000 MW of electricity by Chubu EPCO and Tohoku EPCO from 18:00 till 21:00. |
| | Reason | State of supply-demand might be worsened without power exchange through cross-regional interconnection lines due to demand increase by a temperature drop in the regional service area of Tokyo EPCO. |
| [2] | Date | September 26, 2015 at 16:30 |
| | Instruction | ・Chugoku EPCO shall supply to Shikoku EPCO 500 MW of electricity in maximum from 17:30 till 22:00.<br>・Shikoku EPCO shall be supplied 500 MW of electricity in maximum by Chugoku EPCO from 17:30 till 22:00. |
| | Reason | State of supply-demand might be worsened without power exchange through cross-regional interconnection lines due to demand increase by hot weather in the service area of Shikoku EPCO. |

In addition, the Organization is able to give other necessary instructions such as lending and delivering electrical facilities to/from/ with the members, however, there were no actual instructions during F.Y.2015.

## 2. Quality of Electricity Supply in F.Y.2015

Regarding the quality of electricity supply as indices of stable supply, actual data in F.Y.2015 is summarized below in (1) frequency, (2) voltage and (3) supply interruption. The actual data are published on the website[7] as "Report on the Quality of Electricity Supply", for further information, please see the report.

### (1) Actual Data of Frequency Nationwide

General Transmission and Distribution (T/D) Companies must endeavor to maintain the frequency value of the electricity supply at the levels specified by the ordinance of the Ministry of Economics, Trade and Industry (hereinafter, METI) in principle according to the Electricity Business Act (hereinafter, the Act). To comply with the ordinance, General T/D Companies set a standard frequency[8] in each regional service area and time kept ratio[9] as the control target[10] for standard frequency.

Table 4 shows the time kept ratio by regional service areas in F.Y.2015. The time kept ratio within the control target was achieved in 100% of all regional service areas. Thus, the frequency nationwide is evaluated to be maintained adequately in light of the frequency standard and control target.

Table 4 Time Kept Ratio by Regional Service Areas in F.Y.2015 [%]

| Variance | Hokkaido | Tohoku | Tokyo | Chubu | Hokuriku | Kansai | Chugoku | Shikoku | Kyushu | Okinawa |
|---|---|---|---|---|---|---|---|---|---|---|
| Within 0.1Hz | 99.83 | 99.89 | 99.85 | 99.22 | 99.18 | 99.22 | 99.23 | 99.22 | 99.22 | 99.89 |
| Within 0.2Hz | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Within 0.3Hz | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| 0.3Hz Over | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

7 "Report on the Quality of Electricity Supply Fiscal Year 2016"
http://www.occto.or.jp/en/news/information/files/170203_qualityofelectricity.pdf

8 50 Hz in the Hokkaido, Tohoku and Tokyo areas; 60 Hz in Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu and Okinawa areas.

9 The time kept ratio means ratio of time that the actual metered frequency is maintained within the given variance of the standard and is calculated as below.

Time Kept Ratio (%)= (Σ Time that actual metered frequency is maintained within a given variance of the standard)/ Total time in a given period ×100

10 Variance is within ±0.3 Hz for the standard in Hokkaido and Okinawa, in other areas variance is within ±0.2 Hz for the standard.

### (2) Actual Data of Voltage Nationwide

General T/D Companies are deemed to endeavor to maintain the voltage value of the electricity supply at the levels specified by the ordinance of the METI according to the Act. The value is specified within a certain scope[11] of standard voltage according to the ordinance.

Table 5 shows the total measured points, deviated points in measurement, and deviation ratio[12] by regional service area in F.Y.2015. In reviewing the actual data of F.Y.2015, no deviation from the voltage standard is observed nationwide. Thus, it is evaluated that voltage is maintained adequately in light of the voltage standard in each regional service area.

Table 5 Total Measured Points, Deviated Points in Measurement and Deviation Ratio (by regional service areas in F.Y.2015) [points,%]

| Voltage | | Hokkaido | Tohoku | Tokyo | Chubu | Hokuriku | Kansai | Chugoku | Shikoku | Kyushu | Okinawa |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100V | Total Measured Points | 387 | 691 | 1,483 | 954 | 220 | 1,370 | 475 | 224 | 643 | 107 |
| | Deviated Points | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Deviation Ratio | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 200V | Total Measured Points | 387 | 687 | 1,479 | 949 | 208 | 1,358 | 474 | 224 | 635 | 107 |
| | Deviated Points | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Deviation Ratio | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

11 For the standard voltage of 100V, target voltage control is within 101± 6 V and for 200 V, target voltage control is within 202 ±20 V.

12 Deviation Ratio (%) = Number of Deviated Points in Measurement/Total Measured Points ×100

### (3) Actual Data of Supply Interruption Nationwide

Table 6 shows the actual data of the system average interruption where interruptions have originated nationwide for F.Y.2015 expressed by the indices System Average Interruption Frequency Index (SAIFI)[13] and System Average Interruption Duration Index (SAIDI)[14].

The Kyushu and Okinawa areas have a higher SAIDI, this is likely to be attributed to natural disaster such as typhoons.

Table 6 System Average Interruption where Interruptions have Originated by Causes Nationwide for F.Y.2015[15]

| | | Hokkaido | Tohoku | Tokyo | Chubu | Hokuriku | Kansai | Chugoku | Shikoku | Kyushu | Okinawa | Nationwide |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAIFI [nos.] | Forced Outage | | | | | | | | | | | |
| | Generation | 0.06 | α | 0.03 | 0.01 | α | 0.02 | 0.01 | 0.01 | 0.03 | 0.21 | |
| | HV Lines | 0.09 | 0.08 | 0.03 | 0.06 | 0.03 | 0.04 | 0.16 | 0.11 | 0.12 | 0.82 | |
| | LV Lines | α | α | α | α | α | α | α | α | α | 0.01 | |
| | Total | 0.15 | 0.08 | 0.06 | 0.07 | 0.04 | 0.07 | 0.18 | 0.12 | 0.16 | 1.04 | 0.10 |
| | Planned Outage | | | | | | | | | | | |
| | Generation | α | α | α | α | α | α | α | 0.00 | 0.00 | α | |
| | HV Lines | α | 0.03 | 0.01 | 0.04 | 0.08 | α | 0.09 | 0.11 | 0.00 | 0.02 | |
| | LV Lines | α | 0.01 | α | 0.02 | 0.02 | 0.01 | 0.02 | 0.08 | 0.00 | 0.06 | |
| | Total | α | 0.04 | 0.01 | 0.06 | 0.10 | 0.01 | 0.11 | 0.19 | 0.00 | 0.08 | 0.03 |
| | Total Outage | | | | | | | | | | | |
| | Generation | 0.06 | α | 0.03 | 0.01 | α | 0.02 | 0.01 | 0.01 | 0.03 | 0.21 | |
| | HV Lines | 0.09 | 0.11 | 0.04 | 0.10 | 0.12 | 0.05 | 0.25 | 0.23 | 0.12 | 0.84 | |
| | LV Lines | α | 0.01 | α | 0.02 | 0.02 | 0.01 | 0.03 | 0.08 | α | 0.07 | |
| | Grand Total | 0.15 | 0.12 | 0.07 | 0.13 | 0.14 | 0.08 | 0.29 | 0.31 | 0.16 | 1.12 | 0.13 |
| SAIDI [min.] | Forced Outage | | | | | | | | | | | |
| | Generation | 3 | α | α | α | α | α | α | α | 1 | 6 | |
| | HV Lines | 7 | 10 | 5 | 4 | 2 | 3 | 16 | 13 | 100 | 136 | |
| | LV Lines | α | 1 | α | α | 2 | α | 1 | 1 | 1 | 8 | |
| | Total | 10 | 11 | 6 | 4 | 4 | 3 | 17 | 13 | 101 | 150 | 18 |
| | Planned Outage | | | | | | | | | | | |
| | Generation | α | α | α | α | α | α | α | 0 | 0 | α | |
| | HV Lines | α | 3 | 1 | 5 | 14 | α | 11 | 16 | 0 | 3 | |
| | LV Lines | α | 1 | α | 2 | 2 | 1 | 1 | 5 | 0 | 5 | |
| | Total | α | 4 | 1 | 7 | 16 | 1 | 12 | 21 | 0 | 8 | 4 |
| | Total Outage | | | | | | | | | | | |
| | Generation | 3 | α | α | α | α | α | α | α | 1 | 6 | |
| | HV Lines | 8 | 13 | 6 | 9 | 17 | 3 | 27 | 28 | 100 | 139 | |
| | LV Lines | α | 2 | α | 2 | 3 | 1 | 2 | 6 | 1 | 13 | |
| | Grand Total | 10 | 15 | 6 | 11 | 20 | 4 | 29 | 34 | 101 | 158 | 21 |

13 SAIFI (nos.) = Customers with Low Voltage Affected by Interruption/ Customers with Low Voltage Served at the beginning of the Fiscal Year

14 SAIDI (min.) =Interruption Duration(min.) × Customers with Low Voltage Affected by Interruption/Customers with Low Voltage Served at the beginning of the Fiscal Year

15 "α" is shown if data is a fraction less than a unit.

## II. Actual Utilization of Cross-regional Interconnection Lines

Regarding the actual utilization of Cross-regional Interconnection Lines, actual data up to F.Y.2015 is summarized below in 1. Actual utilization up to F.Y.2015, 2. Actual available transfer capability, and instructions given by the Organization are provided in 3. These actual data are published on the website[16] as "Outlook of Electricity Supply-Demand and Cross-regional Interconnection Lines", for further information, please see the report.

### 1. Actual Utilization of Cross-regional Interconnection Lines up to F.Y.2015

#### (1) Actual Utilization by Year

Figure 2 shows the actual utilization of cross-regional interconnection lines in regional service areas from F.Y.2010 to F.Y.2015.

In F.Y.2015, the greatest recordings of actual utilization of interconnection lines for the past 6 years are the flow directed to Hokkaido from Honshu (Tohoku), the flow directed to Tokyo from Chubu and the flow directed to Chugoku from Kyushu. In particular, the actual flow from Chubu to Tokyo has increased significantly. The flow from Tohoku to Tokyo and the flow from Kyushu to Chugoku have stayed in constantly higher level.

16 "Outlook of Electricity Supply-Demand and Cross-regional Interconnection Lines (Actual Data up to Fiscal Year 2015)" http://www.occto.or.jp/en/news/information/files/161025_outlook_of_electricity.pdf

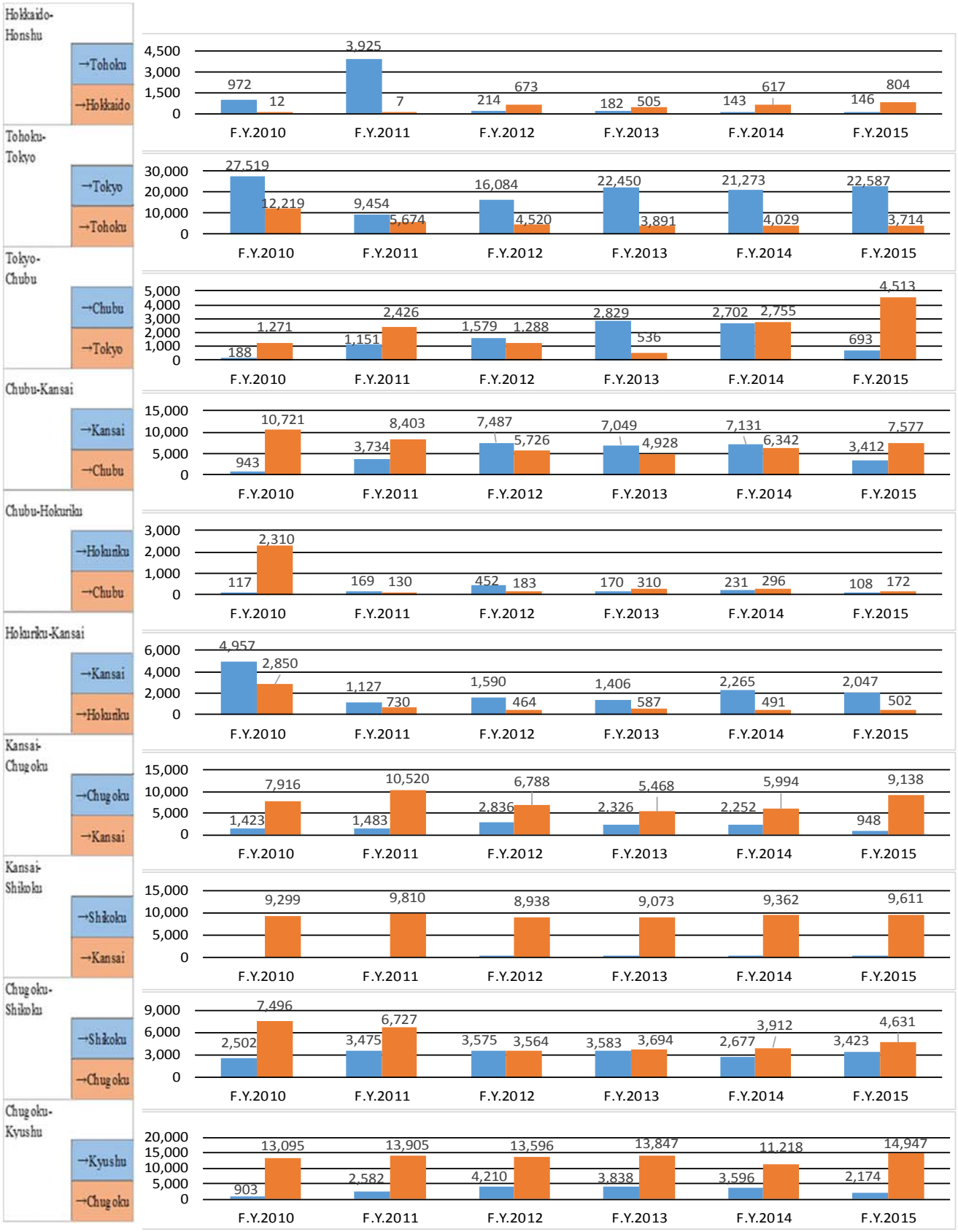



Figure 2 Annual Utilization of Cross-regional Interconnection Lines[17] in Regional Service Areas in F.Y.2010～2015

17 Based on the scheduled power flows of interconnection lines.

### (2) Actual Utilization by Transaction

Table 7 shows the monthly utilization of cross-regional interconnection lines by transaction in F.Y.2015. Actual utilization was generally high during July to September, and generally low in April and May as well as in the following March of F.Y.2015.

Figure 3 shows the transition of cross-regional interconnection lines by transaction from F.Y.2010 to 2015. Though increasing compared to the previous year, the bilateral transaction has been in a decreasing trend from F.Y.2010 and has reached to quarter the level in the past 6 years. In contrast, decreasing compared to the previous year, the day-ahead transaction has been in an increasing trend from F.Y.2010 and reached double the level over the past 6 years.

Table 7 Monthly Utilization of Cross-regional Interconnection Lines by Transaction (F.Y.2015)[18]

[GWh]

| | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bi-lateral | 4,342 | 4,867 | 6,238 | 7,723 | 7,890 | 6,720 | 6,186 | 6,266 | 6,577 | 6,814 | 6,654 | 5,670 | 75,947 |
| Day-ahead | 920 | 958 | 842 | 1,473 | 1,346 | 1,375 | 1,115 | 947 | 1,013 | 1,003 | 1,079 | 1,083 | 13,152 |
| Hour-ahead | 155 | 168 | 173 | 178 | 190 | 233 | 209 | 169 | 174 | 139 | 101 | 162 | 2,050 |

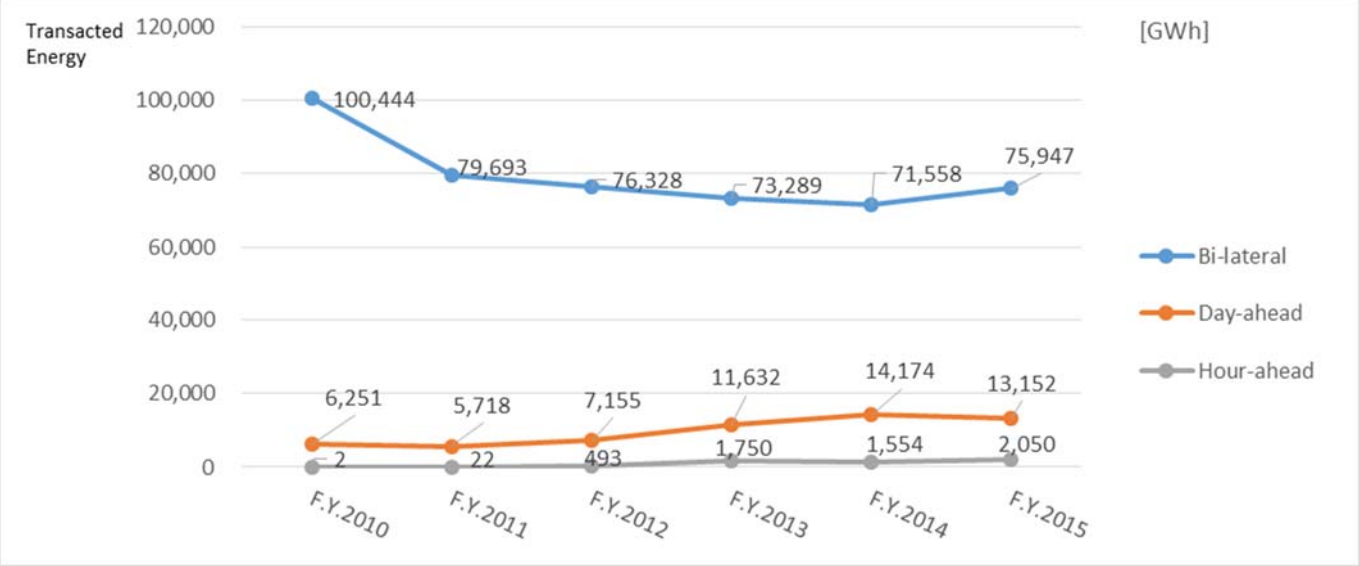


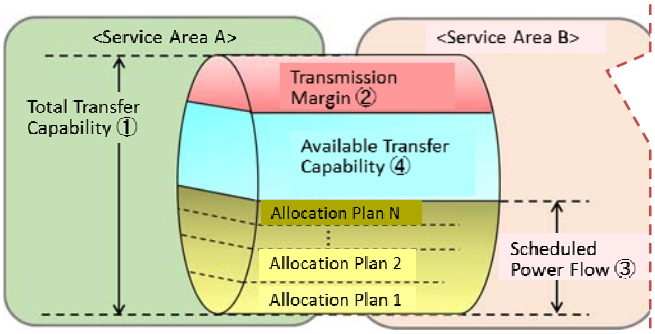

Figure 3 Transition of Cross-regional Interconnection Lines by Transaction(F.Y.2010～2015)

18 Values in red are annual maximum figures and values in blue are annual minimum figures.

## 2. Actual Available Transfer Capability for F.Y.2015

Figure 4 shows the utilization of interconnection line. Available transfer capability (ATC) means the capability which has Total transfer capability (TTC) – transmission margin –scheduled power flow[19].

Figure 5 shows how to look Available Transfer Capacity of Interconnection Line, and Figure 6 to Figure 15 on the following pages show actual ATC of Interconnection Lines for F.Y.2015, respectively[20].




① Total Transfer Capability(TTC) : means the maximum electricity that can be sent to the distribution facilities while securing supply reliability without damaging the transmission and distribution facilities.
②Transmission Margin : means the part of TTC to be saved for receiving electricity from other regional service areas through interconnection lines under abnormal state of electric network, supply shortage or other emergent situations, to keep stabilizing the electric network.
③Scheduled Power Flow : means the sum of the amount of electricity registered by users of the interconnection lines.

Figure 4 Utilization of Interconnection Lines

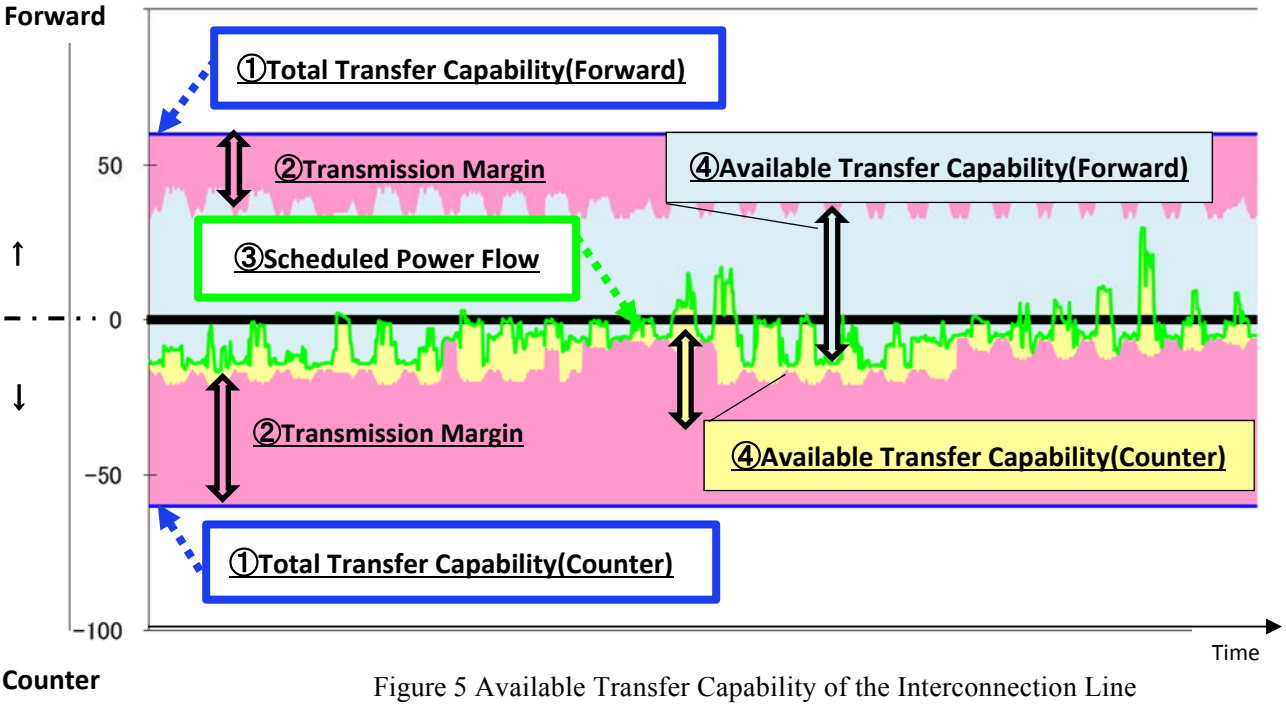



Figure 5 Available Transfer Capability of the Interconnection Line

19 Capability Allocation Plans of "Forward Flow" and "Counter Flow" are counterbalanced each other. On the graphs, counterbalanced figures of each SPF are spotted on as SPF, not spotting SPF of each direction, respectively.

20 Detailed Network System Information including actual ATC is available at the URL below (available in Japanese only).
http://occtonet.occto.or.jp/public/dfw/RP11/OCCTO/SD/LOGIN_login#

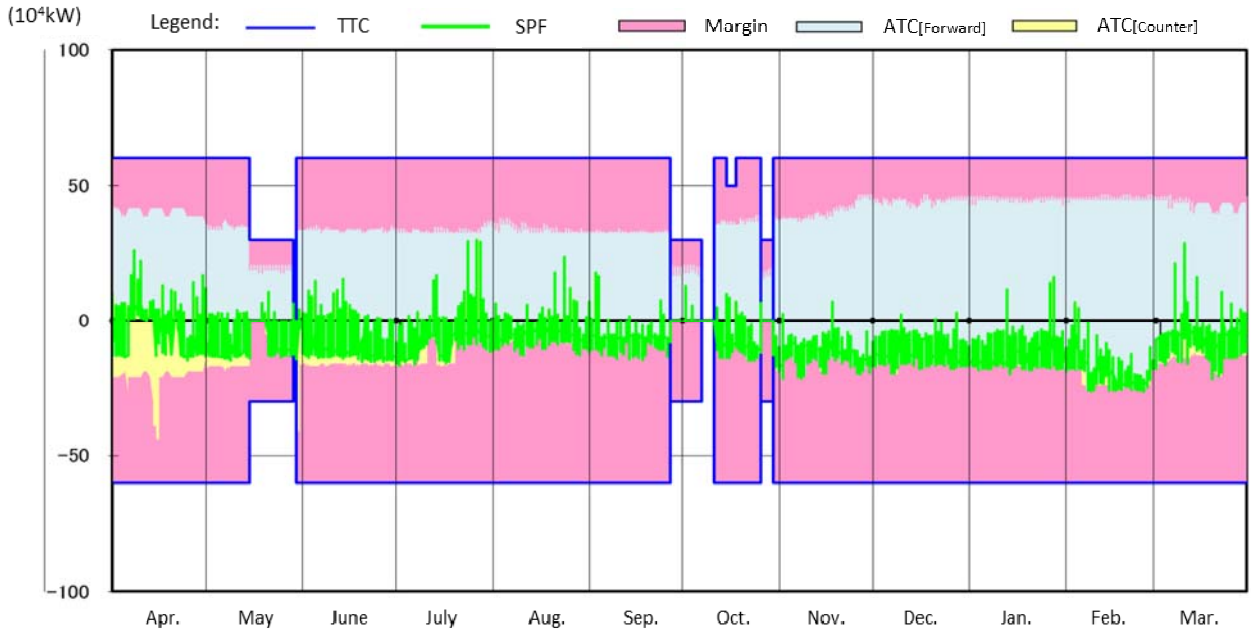



Figure 6 Actual ATC of Interconnection Facilities between Hokkaido and Tohoku [Hokkaido and Honshu AC/DC C.S.][21] in F.Y.2015

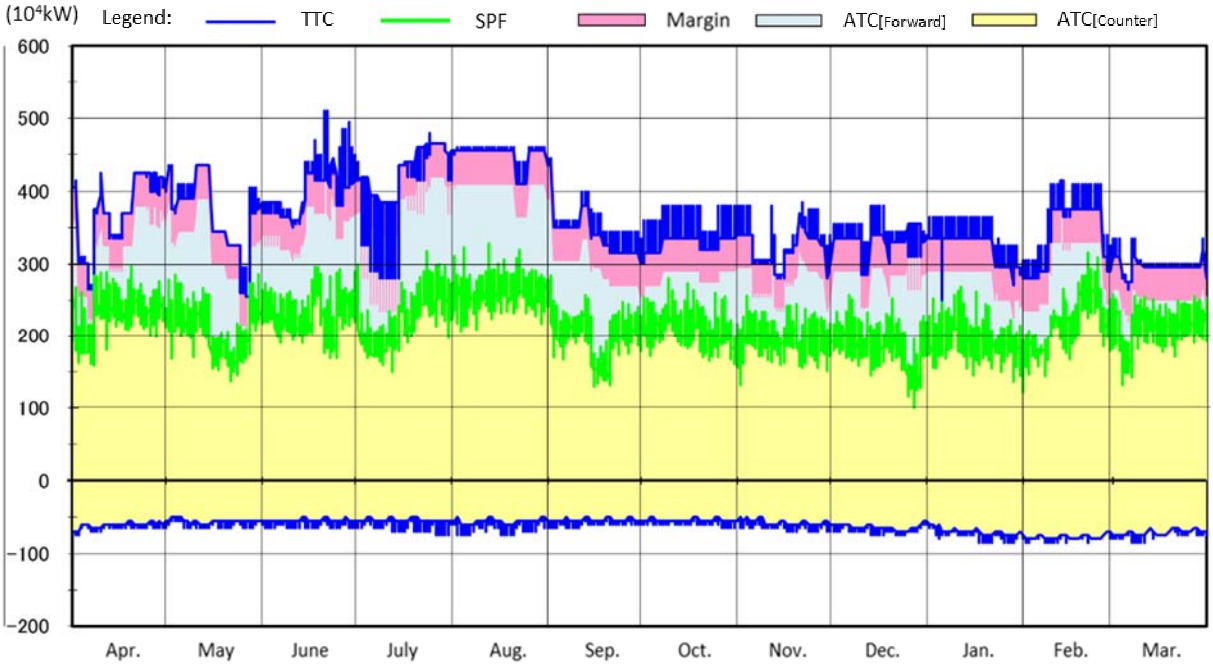



Figure 7 Actual ATC of Interconnection Facilities between Tohoku and Tokyo [Soma-Futaba Bulk Line][22] in F.Y.2015

21 Hokkaido→Tohoku[Honshu] as Forward(positive), Tohoku[Honshu]→Hokkaido as Counter(negative).

22 Tohoku→Tokyo as Forward(positive), Tokyo→Tohoku as Counter(negative).

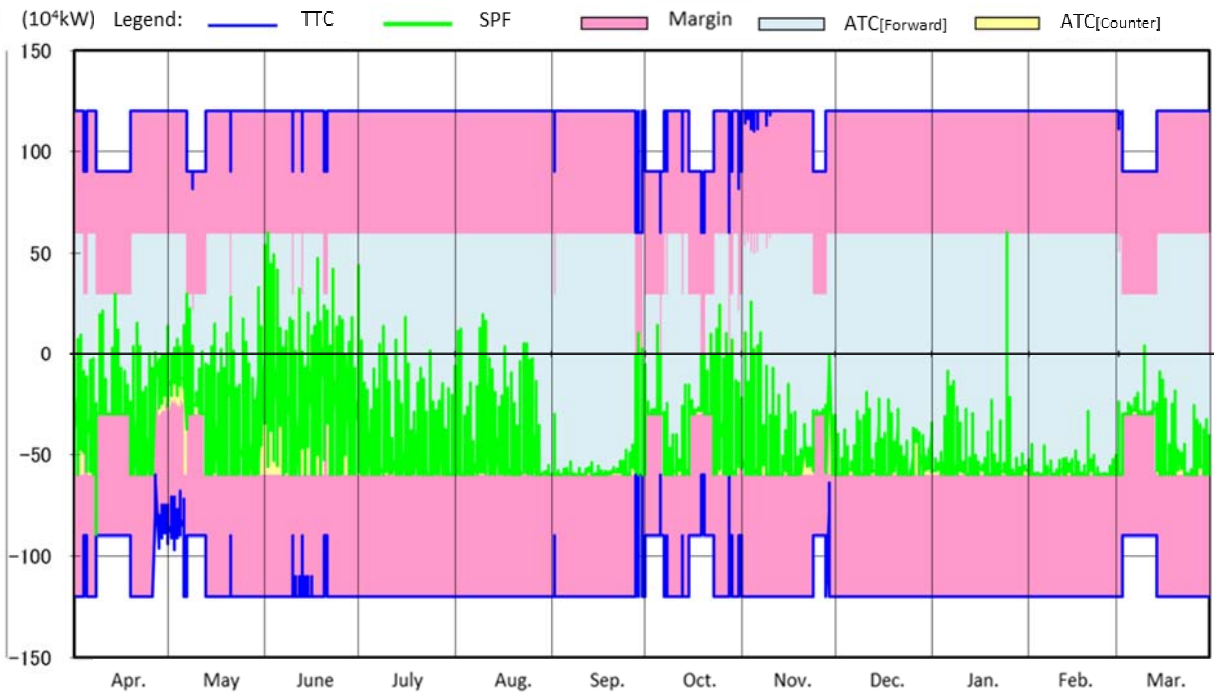



Figure 8 Actual ATC of Interconnection Facilities between Tokyo and Chubu [Sakuma, Shinshinano and Higashishimizu FC][23] in F.Y.2015

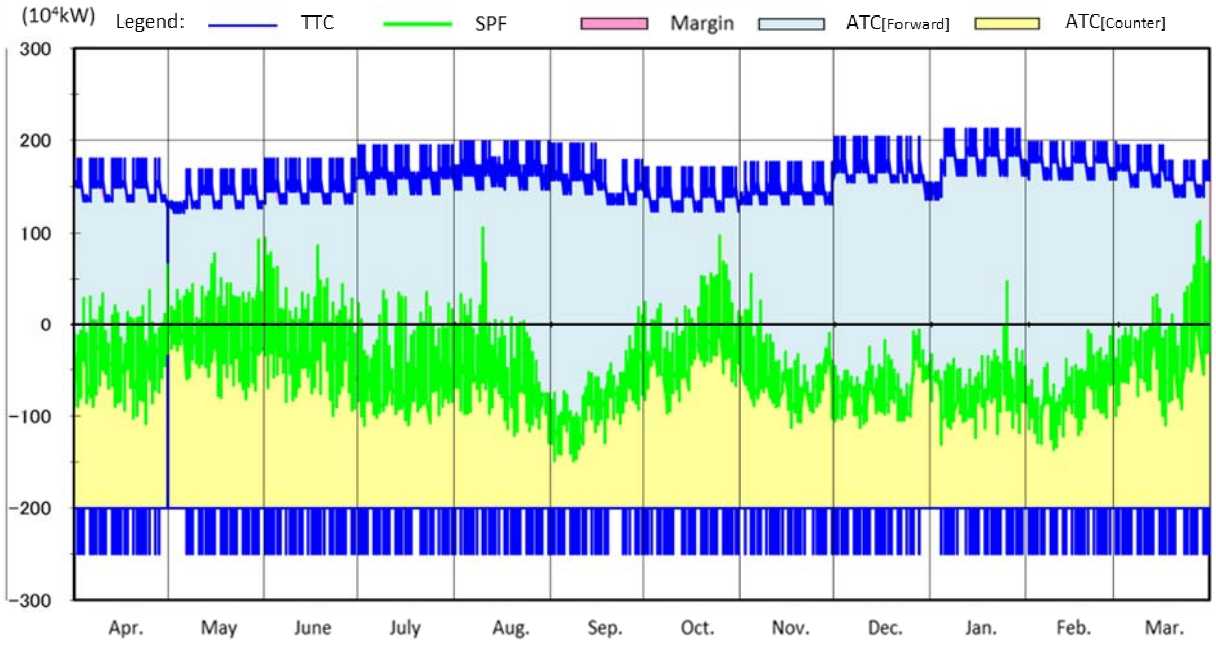



Figure 9 Actual ATC of Interconnection Facilities between Chubu and Kansai [Mie-Higashiomi Line][24] in F.Y.2015

23 Tokyo→Chubu as Forward(positive), Chubu→Tokyo as Counter(negative).

24 Chubu→Kansai as Forward(positive), Kansai→Chubu as Counter(negative).

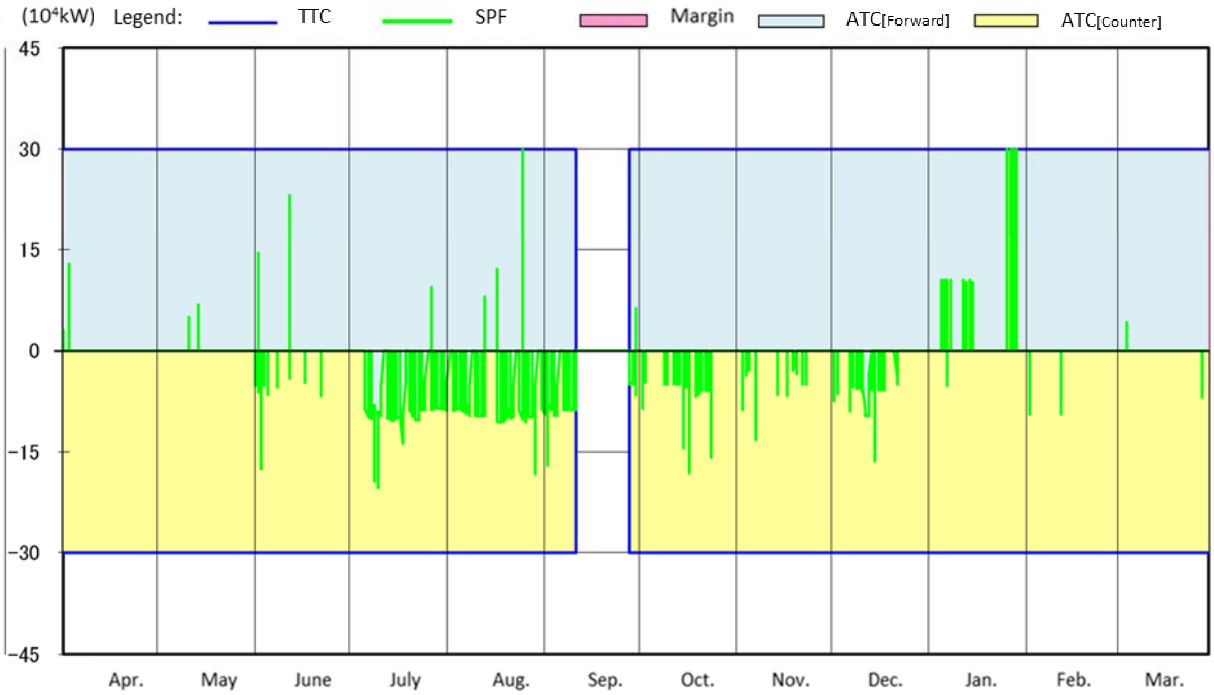



Figure 10 Actual ATC of Interconnection Facilities between Chubu and Hokuriku [Minami Fukumitsu HVDC BTB C.S. and Minami Fukumitsu Substation][25] in F.Y.2015

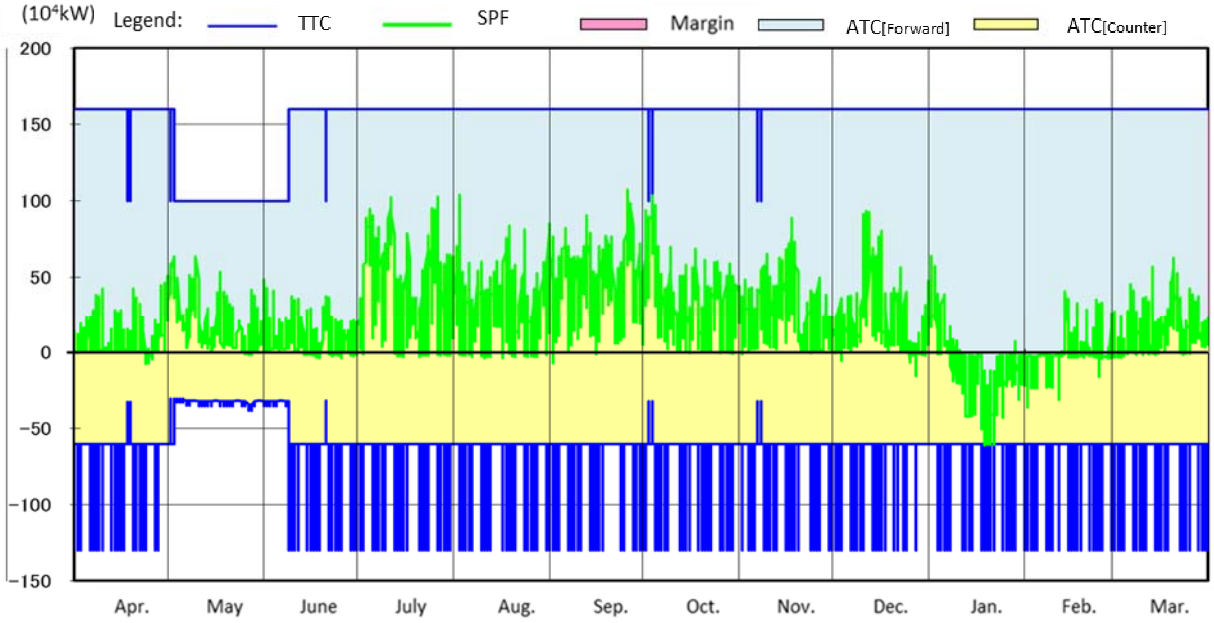



Figure 11 Actual ATC of Interconnection Facilities between Hokuriku and Kansai [Echizen-Reinan Line][26] in F.Y.2015

25 Chubu→Hokuriku as Forward(positive), Hokuriku→Chubu as Counter(negative).

26 Hokuriku→Kansai as Forward(positive), Kansai→Hokuriku as Counter(negative).

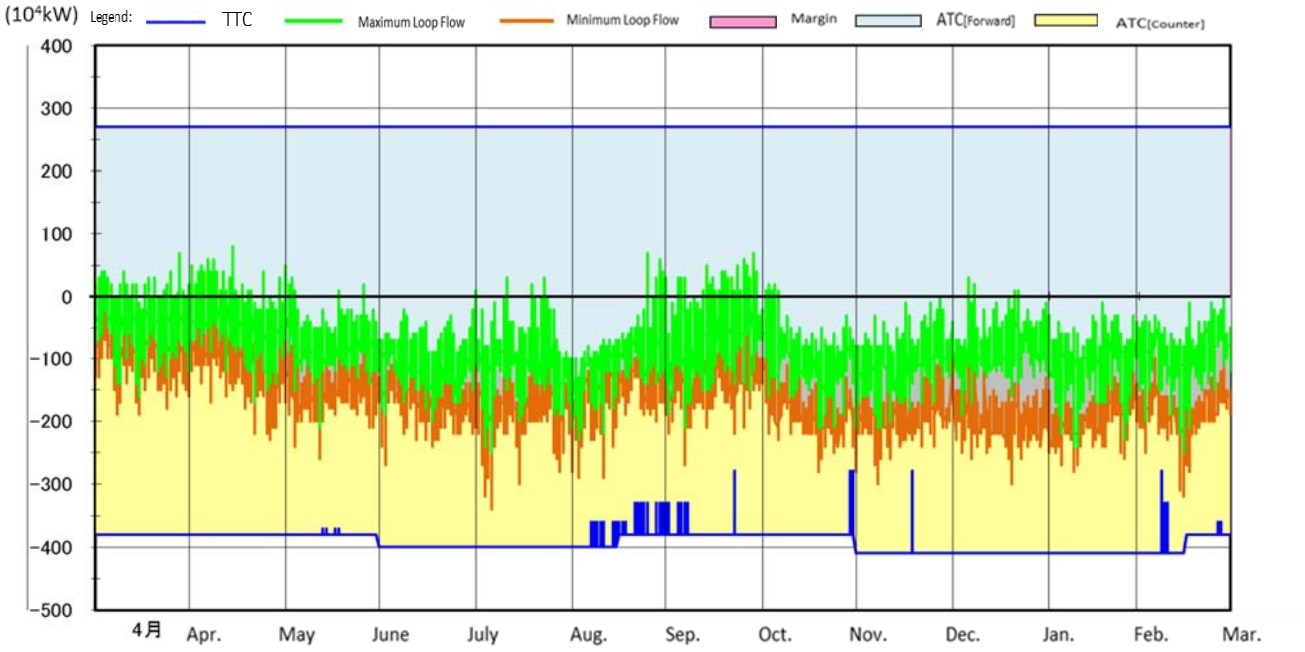



Figure 12 Actual ATC of Interconnection Facilities between Kansai and Chugoku [Seiban-Higashi Okayama Line, Yamazaki-Chizu Line][27] [28] in F.Y.2015

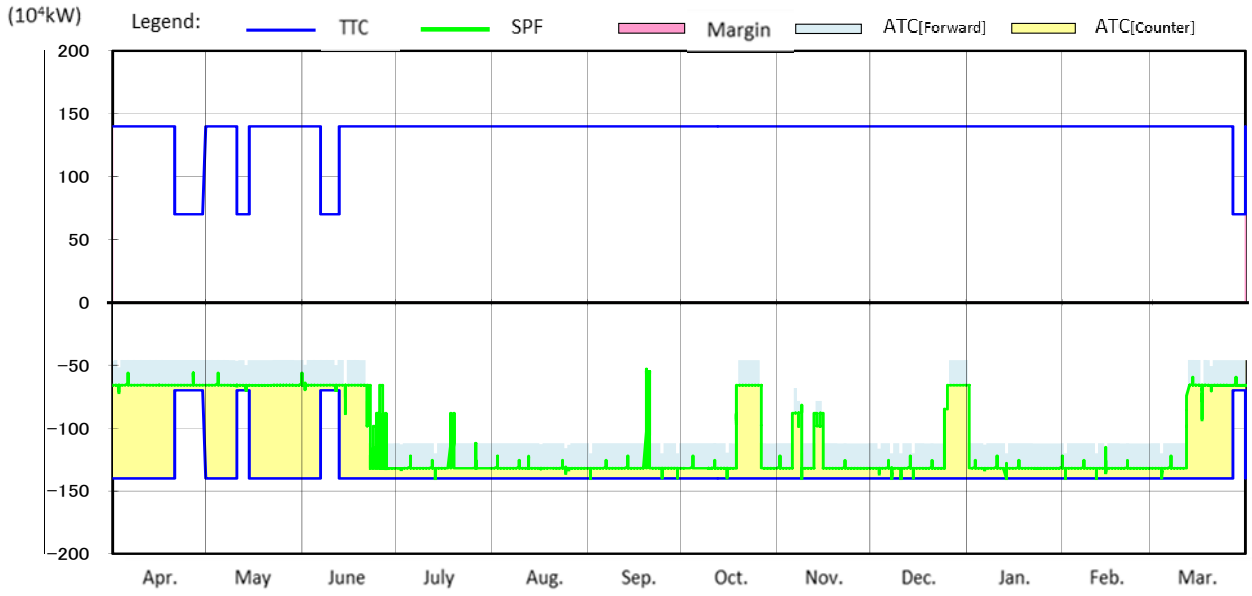



Figure 13 Actual ATC of Interconnection Facilities between Kansai and Shikoku [Kihoku and Anan AC/DC C.S.][29] [30] in F.Y.2015

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27 Kansai→Chugoku as Forward(positive), Chugoku→Kansai as Counter(negative)

28 ATC of Forward direction is calculated with Maximum Loop Flow as Scheduled Power Flow.
ATC of Counter direction is calculated with Minimum Loop Flow as Scheduled Power Flow.
Further, Capability of Loop Flow between Kansai and Chugoku is selected from total SPFs of below ①～④.
①Seiban-Higashi Okayama Line and Yamazaki-Chizu Line ②Seiban-Higashi Okayama Line and Chugoku Higashi Bulk Line
③Shin Okayama Bulk Line and Yamazaki-Chizu Line ④Shin Okayama Bulk Line and Chugoku Higashi Bulk Line

29 Kansai→Shikoku as Forward(positive), Shikoku→Kansai as Counter(negative).

30 ATC on Forward is calculated and chosen of either smaller.
・TTC on Kansai-Shikoku －SPF on Kansai-Shikoku －Margin
・TTC of Minami Awa bulk line－(Supply Capacity of Tachibanawan Thermal Power Station－SPF of Anan-Kihoku DC bulk line)

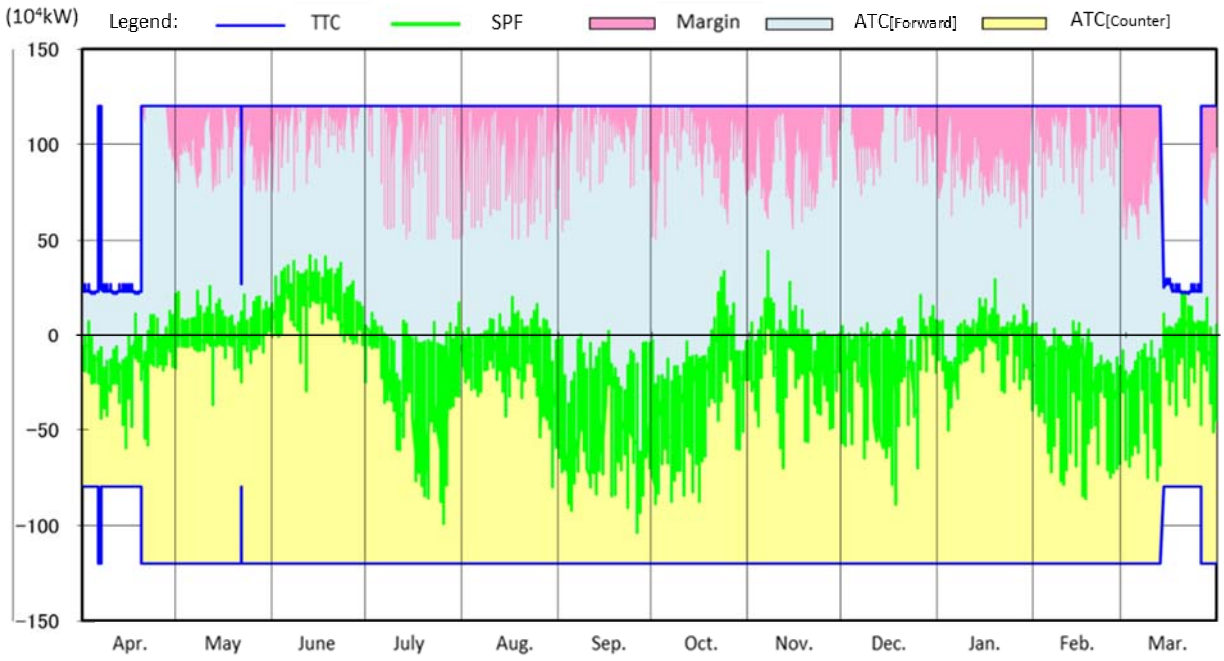


Figure 14 Actual ATC of Interconnection Facilities between Chugoku and Shikoku [Honshi Interconnection Line][31] in F.Y.2015

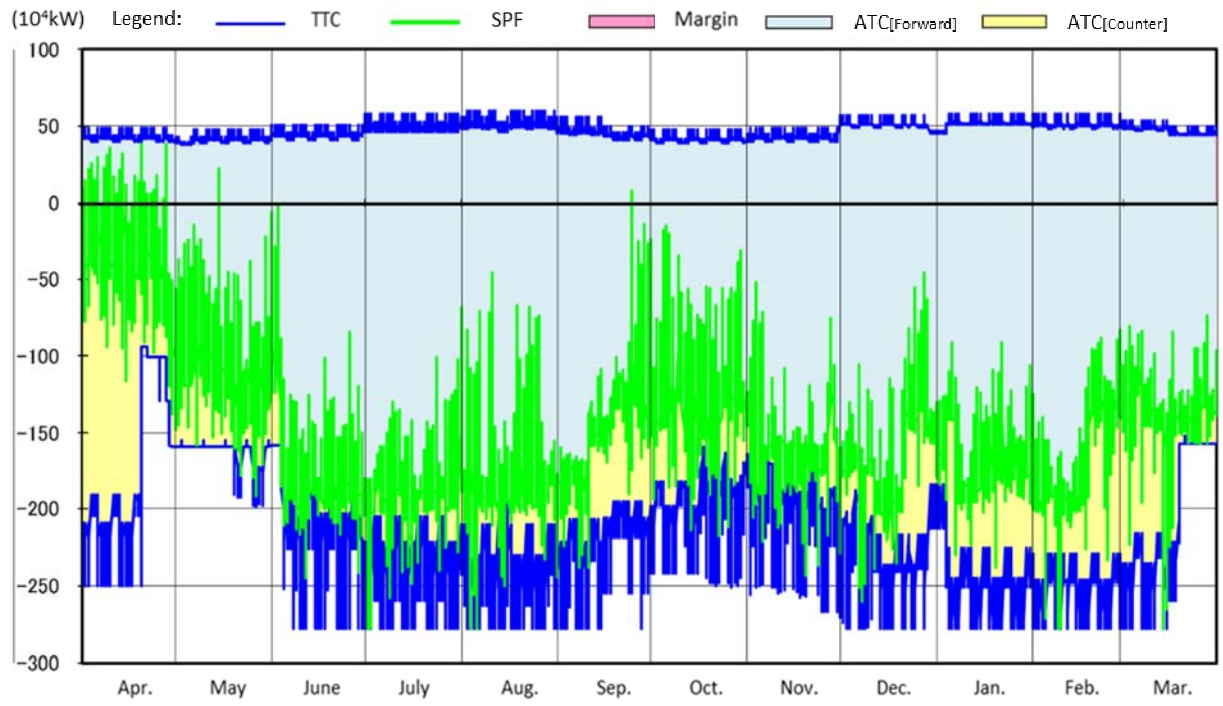


Figure 15 Actual ATC of Interconnection Facilities between Chugoku and Kyushu [Kanmon Interconnection Line][32] in F.Y.2015

31 Chugoku→Shikoku as Forward (positive), Shikoku→Chugoku as Counter (negative).

32 Chugoku→Kyushu as Forward (positive), Kyushu→Chugoku as Counter (negative).

### 3. Condition of Transmission Constraints in Nationwide (as of the end of November 2016)

The Organization monitors the supply-demand status of the cross-regional network[33] among the power network nationwide.

Figure 16 shows a transmission constraints map indicating the network constraints of the cross-regional network.

This map is aggregated by the Organization based on the data of transmission constraints in regional service areas as of the end of November 2016 published by the General T/D Company. The latest transmission constraints of a cross-regional network including those of lower voltage network are published on the websites of General T/D Companies[34] and periodically updated.

33 Cross-regional interconnection system is comprised of inter-regional interconnection lines and intra-regional bulk transmission lines within 2 classes from the highest voltage.

34 Hokkaido Electric Power Co., Inc.: http://www.hepco.co.jp/corporate/con_service/bid_info.html
Tohoku Electric Power Co., Inc.: http://www.tohoku-epco.co.jp/jiyuka/04.htm
TEPCO Power Grid, Inc.: http://www.tepco.co.jp/pg/consignment/system/index-j.html
Chubu Electric Power Co., Inc.: http://www.chuden.co.jp/corporate/study/free/rule/map/index.html
Hokuriku Electric Power Co., Inc.: http://www.rikuden.co.jp/rule/U_154seiyaku.html
The Kansai Electric Power Co., Inc.: http://www.kepco.co.jp/corporate/takusou/disclosure/ryutusetsubi.html
The Chugoku Electric Power Co., Inc.: http://www.energia.co.jp/retailer/keitou/access.html
Shikoku Electric Power Co., Inc.: http://www.yonden.co.jp/business/jiyuuka/tender/index.html
Kyushu Electric Power Co., Inc.: http://www.kyuden.co.jp/wheeling_disclosure.html
The Okinawa Electric Power Co., Inc.: http://www.okiden.co.jp/business/free/rule02.html

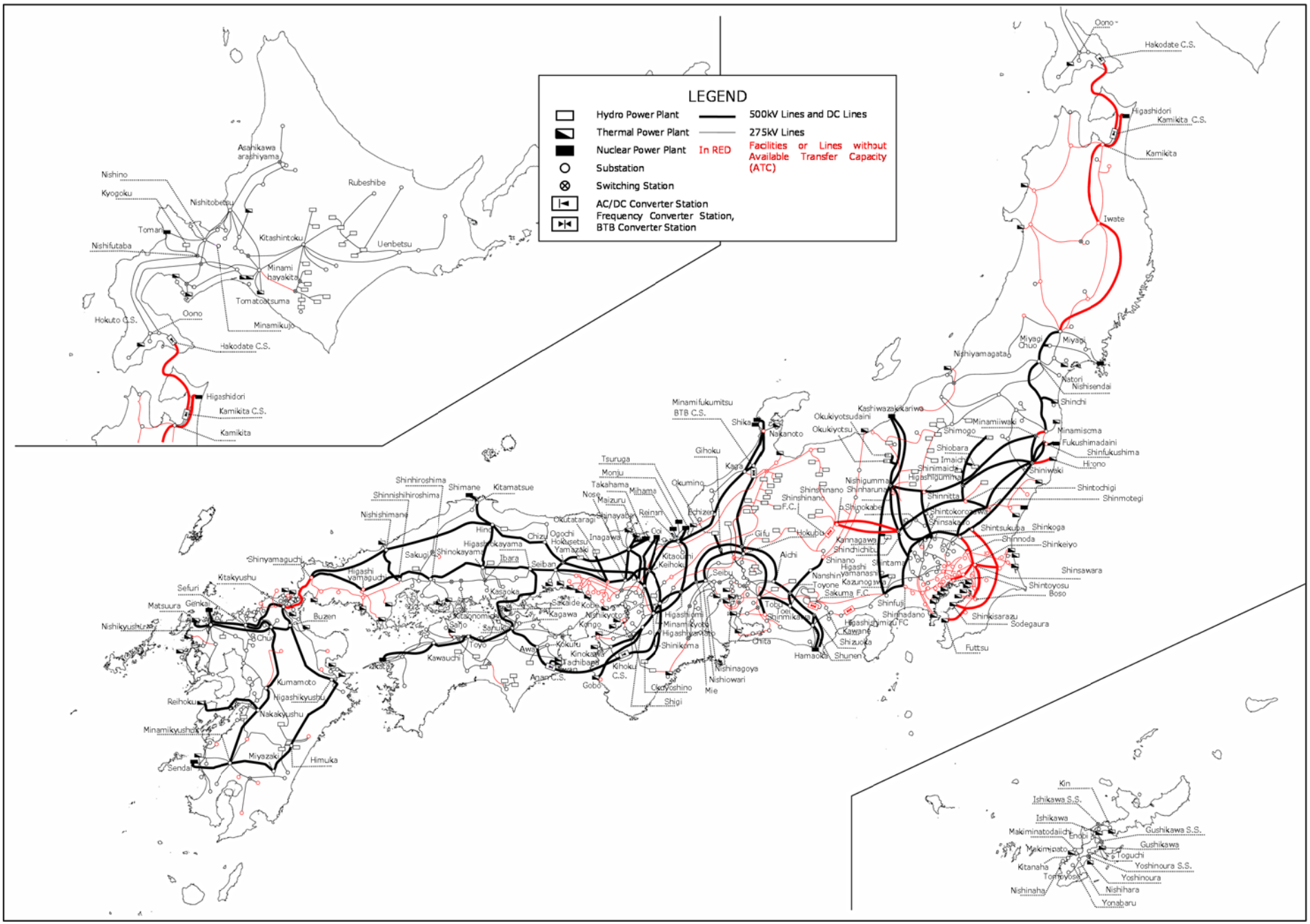


Figure 16 Transmission Constraints Map Nationwide (as of the end of November 2016, published by the General T/D Company and aggregated by the Organization)

## III. Network Access Business

Applicants for network interconnection shall judge the feasibility of interconnecting generators based on the result of preliminary consultation or system impact studies by the General T/D Companies or the Organization, and apply for a generator interconnection contract. Figure 17 shows flows of the proceedings and Table 8 shows a summarization of the proceedings.

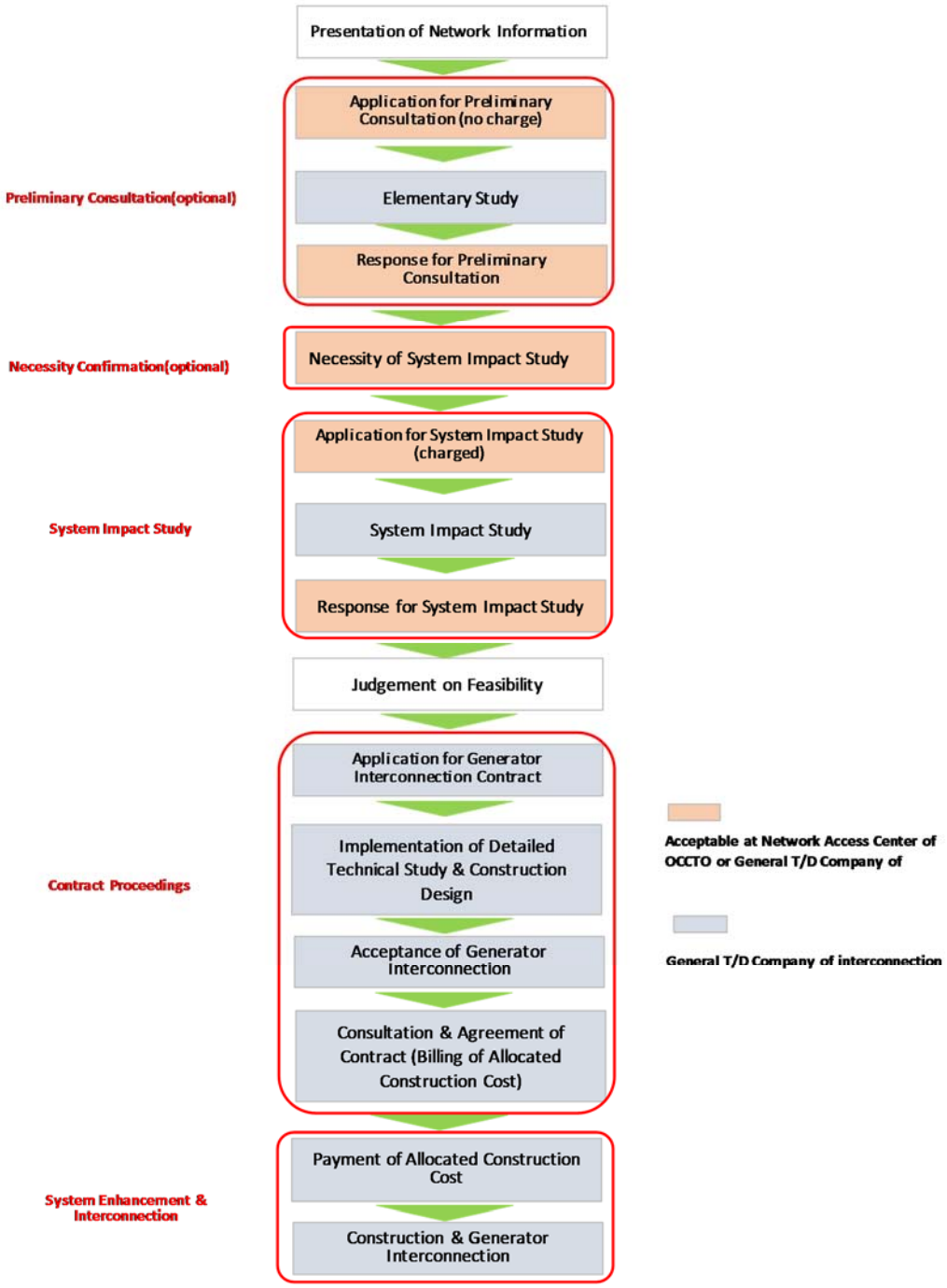


Figure 17 Proceedings Flow of Network Access Business

Table 8 Summarization of the Proceedings of Network Access Business

| | Items of Review | Reviewing Period | Necessity | Applied to: |
|---|---|---|---|---|
| Preliminary Consultation | ・Interconnection constraints due to thermal rating<br>・Direct distance from installed location of generation facilities to interconnection point | 1 month | Facultative | OCCTO [35]<br>General T/D Company |
| System Impact Study | ・Summary of construction of network interconnection (generator grid connection or system enhancement)<br>・Estimated construction cost, Estimated amount of allocation to the construction cost<br>・Necessary period of construction | 3 months | Necessary for contract application | OCCTO [35]<br>General T/D Company |
| Contract Application | ・Items corresponding to System Impact Study based on various conditions of electric network at the contract application | 6 months (ordinal application)<br>9 months (simultaneous application[36]) | Necessary for acceptance of generator interconnection | General T/D Company |

Network Access Business in F.Y.2015 is summarized in (1) actual data for preliminary consultation, system impact study and contract application, and (2) actual data for the solicitation process for generator interconnection which solicits applicants who jointly share the necessary construction cost in the interconnection. These actual data have been published[37] on the website of the Organization as "Information Disclosure on Network Access Business of F.Y.2015 (received and responded)", for further information, please refer to the publication.

35 The Organization receives the application of generation facilities total installed capacity of 10,000kW and over.

36 In a case where the applicant for network interconnection falls under the specified supplier defined in the FIT Act, the applicant may apply for a contract regarding generator interconnection simultaneously with an application for the system impact study or before receiving the response to the study.

37 "Publication of information for Network Access Business received and responded in F.Y.2015" (available in Japanese only)
http://www.occto.or.jp/keito/akusesu/2016_0706_keitou_gyoumukaizen.html

## 1. Actual Data of Preliminary Consultation, System Impact Study and Contract Application in F.Y.2015

Table 9 shows the actual reception of the preliminary consultation, system impact study and contract applications[38] for generators installed with a capacity of 500 kW and over by the Organization or General T/D Companies in F.Y.2015.

The actual reception of the preliminary consultation in F.Y.2015 totaled 14,345 nationwide. The largest number of 4,629 receptions were by TEPCO Power Grid (a spin-off company of the former TEPCO), followed by Tohoku EPCO with 2,300 receptions.

The actual reception of the system impact study in F.Y.2015 totaled 2,313 nationwide. The largest number of 638 receptions were also by the TEPCO Power Grid, followed by Tohoku EPCO with 369 receptions.

The actual reception of contract application in F.Y.2015 totaled 1,404 nationwide. The largest number of 447 receptions were by Kyushu EPCO, followed by Tohoku EPCO with 217 receptions.

The number of receptions does not necessarily correlate with the scale of peak demand[39] in each regional service area.

The Organization receives applications of generators installed with a capacity of 10,000 kW and over. There were 100 receptions of preliminary consultation and 70 receptions of the system impact study in F.Y.2015.

Table 9 Actual data of the Preliminary Consultation, System Impact Study and Contract Application in F.Y.2015
[Generators installed with a capacity of 500 kW and over]

| Applied to: | Preliminary Consultation | System Impact Study[40] | Contract Application |
|---|---|---|---|
| OCCTO | 100 | 70 | - |
| Hokkaido | 396 | 43 | 26 |
| Tohoku | 2,300 | 369 | 217 |
| Tokyo | 4,629 | 638 | 161 |
| Chubu | 2,059 | 290 | 209 |
| Hokuriku | 332 | 56 | 38 |
| Kansai | 1,930 | 262 | 190 |
| Chugoku | 1,123 | 191 | 64 |
| Shikoku | 425 | 92 | 51 |
| Kyushu | 1,038 | 300 | 447 |
| Okinawa | 13 | 2 | 1 |
| Nationwide | 14,345 | 2,313 | 1,404 |

38 Contract applications are received solely by General T/D Companies.

39 Peak demands in each regional service area for F.Y.2015 are shown Table 1 on P3 and Table 2 on P4. Compared with those in Table 1, peak demand in the Tohoku area is equivalent to a quarter of that in the Tokyo area and in the fifth position of all areas. In addition, the peak demand in the Kyushu area is equivalent to three-tenths of that in the Tokyo area and in fourth position of all areas.

40 Excluding application of system impact study based on the application summary of solicitation process for the generator interconnection.

Figure 17 and 18 show actual receptions and the ratio[41] of system impact study by generating sources in each regional service area and nationwide, respectively. In general, applications for solar power is dominant nationwide as well as in each regional service area, accounting for 75% of total receptions. Followed by applications for biomass and wind power. For wind power, applications are gathered in the Tohoku and Kyushu areas, and for thermal power, they are concentrated in Tokyo and Kansai areas.

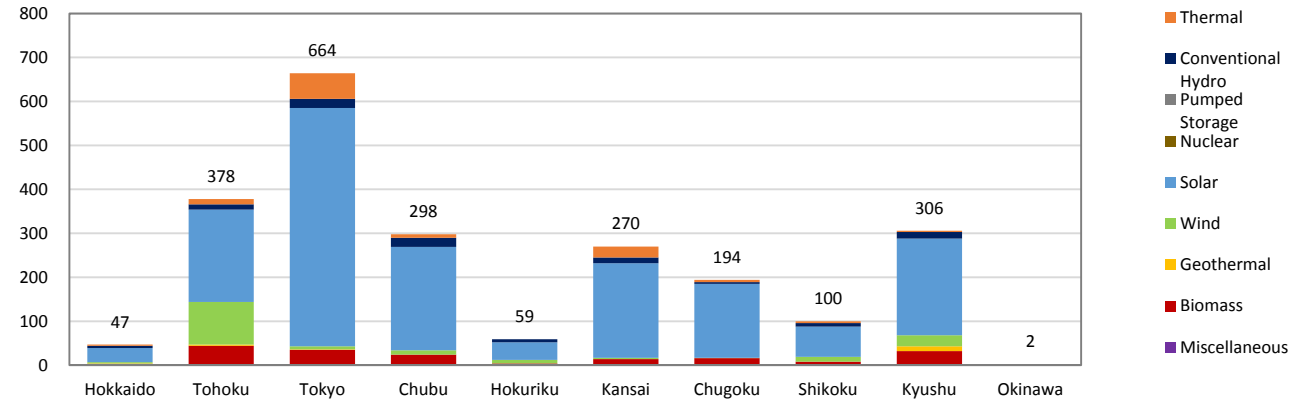


Figure 17 Actual Receptions of System Impact Study by Regional Service Areas and Generating Sources in F.Y.2015

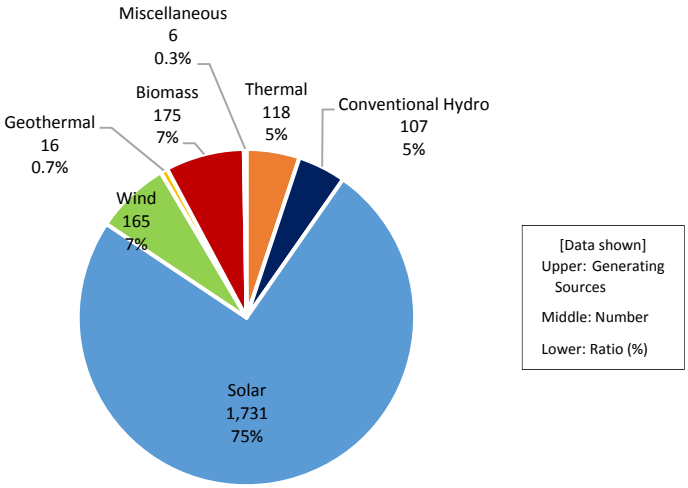


Figure 18 Actual Receptions of System Impact Study by Generating Sources (nationwide and in F.Y.2015)

41 In cases where one system impact study is comprised of multiple generating sources, it is counted in multiples of the corresponding generating sources. Therefore, the total number of receptions may not equal the sum of all receptions by the generating sources.

## 2. Actual Data of the Solicitation Process for the Generator Interconnection in F.Y.2015

For interconnection of network access applications, the result of system impact studies by the General T/D Companies shows there are cases where there is a necessity for large-scale system reinforcement works due to the insufficient capability of transmission facilities. The solicitation process for the generation of an interconnection is a scheme that plans the effective formation of electricity facilities and reduces the cost burden of each applicant by planning system reinforcement to include adjacent cases and soliciting applicants who can jointly share the necessary construction costs.

Table 10 shows a list of implemented cases of the solicitation process for generation interconnection in F.Y. 2015. These cases were ongoing[42] as of the end of F.Y. 2015.

Table 10 List of Implemented cases of Solicitation Process for Generator Interconnection[43] in F.Y. 2015

| Regional Service Area | Cases[44] | Target area of Solicitation | Host | Date of Commencement Order |
|---|---|---|---|---|
| Tohoku | 3 | Soma area, Fukushima pref. | Tohoku EPCO | January 19, 2016 |
| | | Naruko-Iwadeyama area, Miyagi pref. | Tohoku EPCO | March 15, 2016 |
| | | Miyako-Kuji area, Iwate pref. | Tohoku EPCO | March 29, 2016 |
| Tokyo | 5 | Western part of Gunma pref. | Tokyo EPCO | October 27, 2015 |
| | | Northern & Central parts of Tochigi pref. | Tokyo EPCO | October 27, 2015 |
| | | Northwestern part of Yamanashi pref. | Tokyo EPCO | October 27, 2015 |
| | | Southern part of Chiba pref. | Tokyo EPCO | October 27, 2015 |
| | | Midwestern part of Chiba pref. | Tokyo EPCO | October 27, 2015 |
| Chugoku | 1 | Northeastern part of Okayama pref. | Chugoku EPCO | March 31, 2016 |
| Nationwide | 9 | | | |

42 The latest information of ongoing cases has been published on the website of the Organization (available in Japanese only).
http://www.occto.or.jp/keito/akusesu/boshu_process_oshirase.html
Apart from the case in the Midwestern part of Chiba pref., which commenced on October 27, 2015 and was completed on December 14, 2016.

43 Kyushu EPCO started its original schemes for the reinforcement of upper systems before the Organization had been established. The schemes are not listed above since they are different from the solicitation process for generator interconnection.

44 This list aggregates the cases of commencement order for solicitation process for generator interconnection, not the cases of application received.

## IV. Projection and Challenges regarding Electricity Supply–Demand and Network based on the Aggregation of Electricity Supply Plan

According to Article 29 of the Electricity Business Act, electric power companies shall draw up and submit every year an electricity supply plan which clarifies the prospect of electricity supply and, installation and operation of electric power facilities for the coming 10 year period to the Minister of Economy, Trade and Industry. The Organization aggregates the electricity supply plans, reviews actual and prospects of supply–demand in the short, mid and long-term with installation plans of generating plants or transmission lines, and sends the aggregated results with its opinion if any, to the Minister of Economy, Trade and Industry.

The results of the aggregation appear in the following: 1. Projection of supply–demand Balance for 10 years, 2. Challenges to supply–demand balance, and 3. Projection of network development. The aggregated electricity supply plan of F.Y.2016 is published on the website[45]. For further information, please refer to the document.

In addition, the prospects of cross-regional network development is shown in 4. Cross-regional network development.

### 1. Projection of the Supply–Demand Balance for 10 years (F.Y.2016 to 2025)

Table 11 shows the annual projection of the reserve margin in August in each regional service area.

Reserve margins are expected to ensure criteria of 8%[46] in each regional service area and year when considering the added power exchange from other areas by utilizing interconnection facilities except for Tokyo EPCO in F.Y.2021 and F.Y.2022. In the Okinawa EPCO regional service area, as an isolated island system, sufficient supply capacity is ensured through the projection period[47].

Reserve margins of the Tokyo EPCO area are under the criteria of 8% in F.Y.2021 and F.Y.2022 even when considering the added power exchange from other areas by utilizing interconnection facilities. However, with the aggregation of electricity supply plans, based on facts such as not capturing whole development plans of generation facilities other than electric power companies[48] and

45 "Aggregation of Electricity Supply Plan F.Y.2016"
http://www.occto.or.jp/en/companies/supply/aggregation_supply_plan_2016.html

46 The conventional criteria of supply–demand evaluation is in review at the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply-Demand Balance Evaluation launched by the Organization. Evaluation for this time provisionally applies the convention that reserve margin (%) in the regional service area is secured at 8% and over.

47 Okinawa EPCO regional service area is a small and isolated island system. The reserve margin criteria is exceptionally applied to secure the supply capacity over peak demand against the interruption of the largest generating unit so that a stable supply can be maintained.

48 As there are transitional measures of introducing a business license system, even electric power companies who are willing to develop major generating plants may acquire a business license of a Generation Companies until the commencement of its business. Therefore, such companies are without obligation of submitting electricity supply plan. Thus, the Organization could not capture development plans of such companies at the aggregation of electricity supply plans of F.Y.2016.

supply capacities of nuclear power plants almost reported as "Unknown" (= zero)[49], the Organization has judged that the stable supply of electricity shall not be immediately jeopardized. In consideration of the above stated circumstances and risk analyses of supply–demand fluctuation[50], the Organization shall continue to observe the supply–demand balance closely.

Table 12 shows the annual projection of the reserve margin in January for the possible winter peak areas of Hokkaido and Tohoku, the Organization foresees the possibility of ensuring a reserve margin of 8% and over during the projection period.

49 According to "Procedures for Electricity Supply Plans of F.Y.2016" (published in Mar. 2016, by the Agency for Natural Resources and Energy), the Electric Power Company shall submit its plan as "Items regarding nuclear power plants or units which the Electric Power Company is unable to determine their re-operation date shall be reported as 'unknown' and calculate its supply capacity as 'zero'." Thus, supply capacity of other generating sources shall be calculated based on the above condition.

50 Risk analyses of supply–demand fluctuation during F.Y.2016 to 2025 was implemented on the 12th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply-Demand Balance Evaluation (Dec.22, 2016). Risks regarding the upward fluctuation of peak demand by economic activity, careful watch is continuously needed for the economic growth and progress of energy conservation for the future. Risks regarding the unplanned outage of a nuclear power plant, security of reserve margin of 8% are confirmed by power exchange from other areas utilizing available transfer capability of cross-regional interconnection line for the regional service area where supply capacity of nuclear power plant is included in its supply portfolio. Moreover, risks regarding the significant downward fluctuation of supply capacity due to cancellation of the development plan by the electric power company, necessary supply capacity is expected to be effectively ensured in the mid to long-term by the introduction of the capacity mechanism scheme.
"Necessity judgment of starting safeguard measures for generator procurement subject to 2nd year through 10th year of the electricity supply plan" (available in Japanese only)
http://www.occto.or.jp/oshirase/kakusfuiinkai/files/chousei_jukyu_12_02.pdf

Table 11 Annual Projection of the Reserve Margin in August in Each Regional Service Area and Nationwide (with additional generating surplus and power exchange through cross-regional interconnection lines, F.Y.2016 to 2025)[51]

Area and year of Below Criteria of 8% | Area and year of Improved above Criteria | Area and year of Contributors to improvement

| | F.Y.2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hokkaido | 21.4% | 19.8% | 35.2% | 47.5% | 45.8% | 41.0% | 39.4% | 40.8% | 50.0% | 48.5% |
| Tohoku | 14.1% | 16.2% | 15.2% | 15.9% | 17.3% | 8.0% | 8.0% | 18.2% | 18.0% | 17.7% |
| Tokyo | 9.8% | 9.8% | 12.1% | 8.8% | 9.2% | 7.4% | 5.1% | 9.0% | 11.2% | 10.3% |
| 50Hz areas Total | 11.3% | 11.6% | 14.1% | 12.5% | 13.0% | 9.6% | 7.8% | 12.7% | 14.9% | 14.0% |
| Chubu | 12.3% | 8.3% | 8.2% | 8.8% | 10.2% | 11.0% | 8.8% | 8.6% | 8.4% | 8.1% |
| Hokuriku | 16.8% | 13.0% | 12.0% | 12.7% | 12.1% | 11.5% | 10.7% | 10.1% | 9.4% | 9.6% |
| Kansai | 13.3% | 9.7% | 12.7% | 11.9% | 9.6% | 8.0% | 10.3% | 12.7% | 12.8% | 13.0% |
| Chugoku | 19.2% | 20.4% | 21.4% | 12.6% | 17.8% | 11.7% | 17.2% | 22.9% | 22.6% | 22.1% |
| Shikoku | 13.1% | 15.3% | 14.4% | 14.3% | 14.8% | 14.7% | 12.1% | 17.4% | 17.5% | 17.5% |
| Kyushu | 17.5% | 14.1% | 8.7% | 8.6% | 16.5% | 16.0% | 15.7% | 15.3% | 14.9% | 14.5% |
| 60Hz areas Total | 14.7% | 11.9% | 11.9% | 10.7% | 12.4% | 11.3% | 11.8% | 13.4% | 13.2% | 13.1% |
| Interconnected | 13.2% | 11.8% | 12.9% | 11.5% | 12.7% | 10.5% | 10.0% | 13.1% | 14.0% | 13.5% |
| Okinawa | 50.5% | 47.1% | 50.5% | 53.8% | 40.2% | 43.9% | 43.4% | 43.3% | 51.9% | 41.3% |
| Nationwide | 13.5% | 12.1% | 13.2% | 11.9% | 12.9% | 10.8% | 10.3% | 13.3% | 14.3% | 13.8% |

Table 12 Annual Projection of Reserve Margin in January for Winter Peaking Areas of Hokkaido and Tohoku (with additional generating surplus and power exchange through cross-regional interconnection lines, F.Y.2016 to 2025) [52]

| | F.Y.2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hokkaido | 17.1% | 14.2% | 11.9% | 23.2% | 21.8% | 19.2% | 18.0% | 26.4% | 25.1% | 23.8% |
| Tohoku | 10.7% | 9.6% | 10.2% | 10.1% | 10.9% | 9.6% | 8.7% | 10.0% | 9.1% | 8.2% |

51 The value in the blue cell is an area and year which has above 8% reserve margin in case adding generation surplus of the Generation Company whose electricity supply plan is aggregated by June 10, 2016 as well as adding power exchange (received) from other area and year utilizing cross-regional interconnection line. On the other hand, despite these efforts, if the reserve margin does not reach 8%, the corresponding cell is in red.
A corresponding cell of area and year which becomes contributor to power exchange (sent) is in green.

52 The value in the blue cell is an area and year which has more than an 8% reserve margin in the case of adding generation surplus of Generation Company whose electricity supply plan is aggregated by June 10, 2016.

## 2. Challenges to Supply–Demand Balance Based on the Aggregation of the Electricity Supply Plan

In the submission of the aggregated electricity supply plan of F.Y.2016 to the Minister of Economy, Trade and Industry, the Organization has added two opinions to the aggregated result.

(1) Effectiveness in Procuring the Supply Capacity of Retail Companies

Aggregation of the electricity supply plan in F.Y.2016 indicates that many Retail Companies plan their supply capacity of mid- to long-term as "undetermined" and are going to procure them by the transaction at the Japan Electric Power eXchange (JEPX) or a newly agreed bilateral contract in the future. (See Figure 18). Generation Companies cannot have corroboration that their generation facility shall be operated as expected without a long-term bilateral contract with Retail Companies. As a result, new development or a switch of generation facilities are not likely to proceed as planned, and insufficient supply capacity procured in the market to the demand will be concerned.

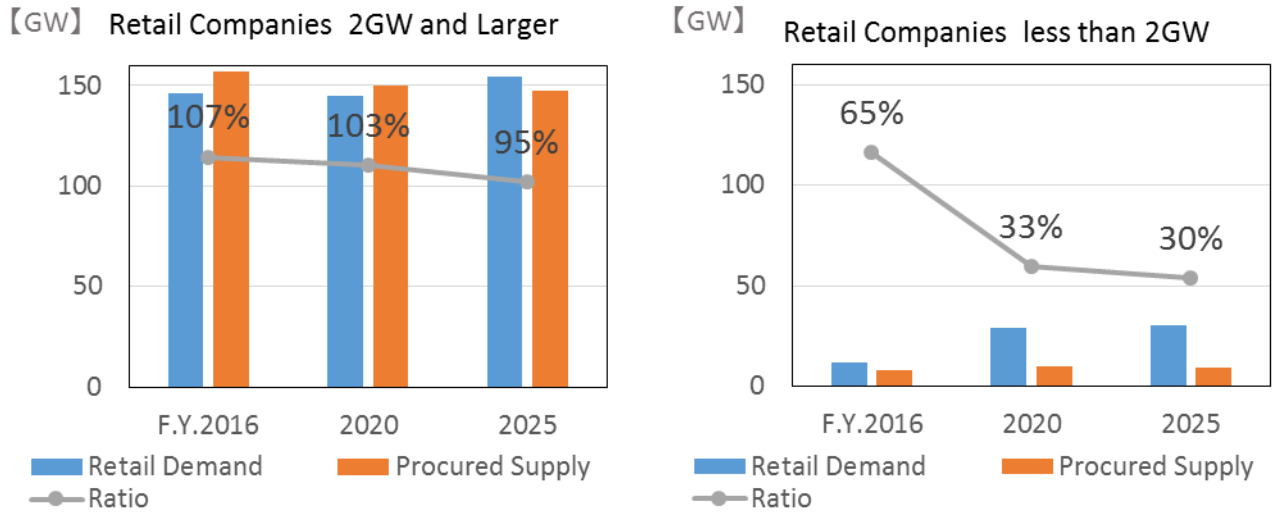


Figure 5 Projection of Supply Capacity Procured by Retail Companies (F.Y.2016 to 2025)

The Organization shall further review future prospects of electricity supply–demand balance and necessity of generation procurement in implementing the risk analysis of electricity supply–demand with a careful observation of the condition stated above[53]. The Organization recommends the Government proceeds to review the effective supply capacity procurement including the introduction of a capacity mechanism (a scheme that pays the price of capacity [kW price] equivalent to its value recognizing the existence of generation as supply capacity) for the security of stable electricity supply in accordance with the cost paid by the public not in excessive manner.

53 Starting safeguard measures for generator procurement aimed at security of supply capacity during F.Y.2016 to 2025 was judged unnecessary on the 12th meeting of Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply-Demand Balance Evaluation (Dec.22, 2016).

(2) Measures against a Major Disturbance of Rare Occurrence

Electric power companies expressed the concern stated below by the aggregation of electricity supply plans to the Organization.

[1] According to the re-operation of a nuclear power plant or integration of renewable energy, aged thermal power plants with relatively weak competitiveness such as oil-fired thermal power plants will be gradually retired from service. In these circumstances, if a major disturbance of rare frequency, on a large scale and over a long period might occur, such as the Great East Japan Earthquake, insufficient supply capacity is projected to lead to electricity supply–demand in severe conditions. Thus, to ensure supply capacity, an oil-fired thermal power plants will need to be considered based on the assumption that, even at a rare frequency, a major disturbance might occur.

[2] For measures available as alternatives of supply capacity in an emergency, such as an interruptible demand contract, former vertically-integrated electric power companies can maintain those contracts at a recent year's level in light of the risk management for the emergency. However, they consider the contracts difficult to maintain because of the competitive environment and their cost. Thus, the treatment of these contracts must be considered anew hereafter

The Organization also recognizes major disturbances as major challenges with regards to risk management. The Organization shall discuss risk management of major disturbances with rare occurrence[54], and its measures including generator procurement and others. The Organization recommends the Government sends opinions to proceed with reviews regarding the measures for dealing with major disturbances with rare occurrence while organizing the concept of major disturbances with rare occurrence.

54 On the 10th meeting of the Study Committee on Regulating and Marginal Supply Capability and Long-Term Supply-Demand Balance Evaluation (Oct.31, 2016), the Organization has concluded that supply capacity saved for major disturbances of rare occurrence shall be continually reviewed and its quantity or characteristics based on the transition of discussion for the capacity mechanism scheme, as well as reviewing its necessity by the Government shall be desired (available in Japanese only).
http://www.occto.or.jp/oshirase/kakusfuiinkai/files/chousei_jukyu_10_02.pdf

## 3. Projection of Network Development based on the Aggregation of Electricity Supply Plan (F.Y.2016 to 2025)

Based on the aggregation of the electricity supply plan F.Y.2016, Figure 6 shows the projection of the network development plan during the period.

Network development plans up to F.Y.2025 are compromised of new installations or extensions including 423 km of major transmission lines, 15,440 MVA of major substations and 1,200 MW of converter stations. Regarding cross-regional interconnection lines development, there is no change from the previous plan, new installation of a Hokuto-Imabetsu DC bulk line, Hida-Shinano DC bulk line and Sekigahara-Kita Oomi line are planned.

**Development Plans of Major Transmission Lines**

| Classification | Overhead (km) | Underground (km) | Total (km) |
|---|---|---|---|
| Newly Installed or Extended | 384 | 39 | 423 |
| Retirement | △72 | △0 | △72 |
| Total | 312 | 39 | 351 |

* Plan with undefined in-service date is not included.

**Development Plans of Major Substations**

| Classification | Substation (MVA) | Converter Station (MW) |
|---|---|---|
| Newly Installed or Extended | 15,440 | 1,200 |
| Retirement | △2,000 | 0 |
| Total | 13,440 | 1,200 |

**Development Plans of Major Cross-regional Transmission Lines**

| Interconnected Regions | Name | Capacity | In-Service Date |
|---|---|---|---|
| Hokkaido～Tohoku | Hokuto-Imabetsu DC Line | 300MW | March 2019 |
| Tokyo～Chubu | Hida-Shinano DC Line | 900MW | F.Y.2020 |
| Chubu～Kansai | Sekigahara-Kita Oomi Line | - | Unknown |

Subject to submission: Transmission Lines of 250kV and over, and within 2 classes from the highest voltage in the regional service areas (In Okinawa EPCO area, 132kV and over).

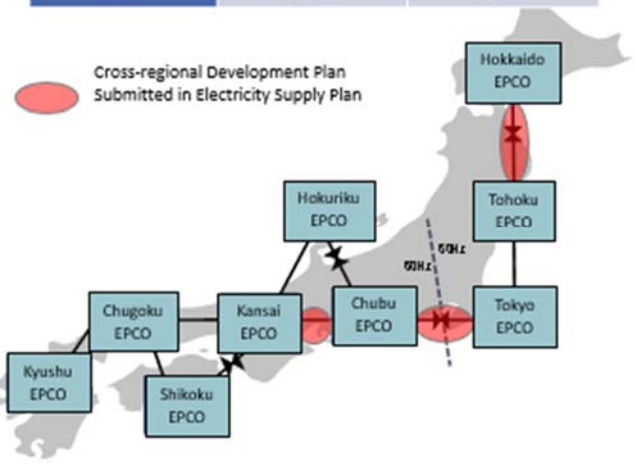


Figure 6 Projection of the Network Development Plan up to F.Y.2025

## 4. Cross-regional Network Development

The Organization has developed and published[55] Cross-regional Network Development Plan regarding the cross-regional interconnection between Tokyo EPCO and Chubu EPCO in June 2016.

The plan has been developed according to the request of the technical review by the Subcommittee on Electricity Supply-Demand Verification to the Organization. The subcommittee is under the Strategic Policy Committee of Advisory Committee for Natural Resources and Energy, and recommends enhancing interconnected capacity between Tokyo and Chubu up to 3,000 MW in the point of view that a more economical and stable supply against major natural disasters of rare occurrence shall be secured.

The development plan indicates that the enhancement of 900 MW with an already planned 2,100 MW[56] (e.g. up to 3,000 MW) shall be necessary. The enhancement enables a possible response to supply shortage with utilizing power exchange between Eastern Japan and Western Japan, evoked by a cross-regional interruption of major generating units either in the 50Hz area or 60Hz area at the occurrence of a major natural disaster. As well as the effect of market activation such as increasing the power trades between the 50 Hz areas and the 60 Hz areas shall be expected.

In addition, according to filings of market enlargement by electric power suppliers, the Organization has proceeded to develop a plan regarding cross-regional interconnection between Tohoku and Tokyo, and has published[57] the basic requirements in September 2015. In December 2016, the planning process was at the stage of implementation plan, implementing entity, beneficiary and its cost allocation ratio are established and a consensus reached on cost allocation to the claimants and applicants. Finally, the plan shall be comprehended to Cross-regional Network Development Plan and be accomplished in February 2017.

The enhancement plan between Tohoku and Tokyo will bring transfer capability from 5,730 MW to 10,280 MW, and further market enlargement and reliability upgrade shall be realized.

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55 "Planning of the Cross-regional Network Development Plan for Interconnection Facilities between Tokyo and Chubu" (available in Japanese only).
http://www.occto.or.jp/en/press/2016/2016-0629-FC.html

56 900 MW enhancement between Tokyo and Chubu indicated in Figure 19 is included in the above mentioned 2,100 MW development plan.

57 "Determination of the basic requirement and scope of beneficiaries of the Cross-regional Network Development Plan for Interconnection Facilities Between Tohoku and Tokyo" (available in Japanese only)
http://www.occto.or.jp/keito/seibi/2015_0930_tohoku-tokyo_seibikeikaku_kihonyouken.html

## V. Review of the Adequate Level of Balancing Capacity in Each Regional Service Area (Results of the review on soliciting balancing capacity for F.Y.2017 )

The Organization has determined and published[58] the calculation method of the required amount for soliciting balancing capacity for F.Y.2017 in October 2016 under the review of the adequate level of balancing capacity in each regional service area[59] according to Article 182 of the Operational Rules of the Organization.

Forms of securing generators by General T/D Companies are classified as follows according to "Guidelines on the solution of Balancing Capacity solicited and procured by General T/D Companies (hereinafter, "Guidelines on solicitation") ordered by METI[60].

Generator I: Generator secured in standing as exclusive to General T/D Company

Generator II: Generator for both supply capacity of Retail Company and balancing capacity of General T/D Company

In addition, the Organization has decided to secure balancing capacity against severe climate peak load (hereinafter, Generator I'). Severe climate peak load (H1) means the extreme peak load due to a heat wave in the summer or intense cold in the winter with an occurrence considered to be once in 10 years. The Organization shall be required to prepare supply capacity for this H1 peak load without generator outage not to induce rotating blackout.

Figure 20 shows generator classification such as forms of securing a generator by General T/D Company.

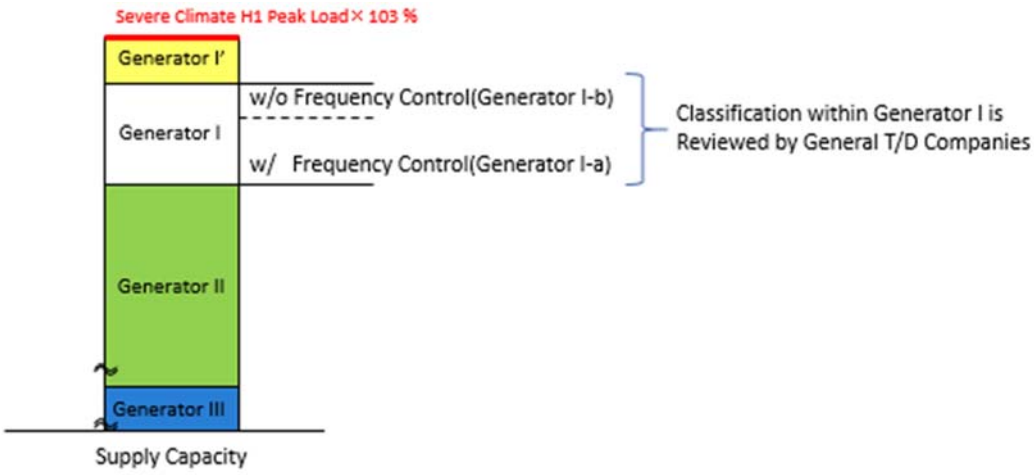


Figure 20 Generator Classification

58 "Required amount for soliciting balancing capacity for F.Y.2017" (available in Japanese only)
https://www.occto.or.jp/koiki/koukai/2017_chouseiryoku_hitsuyouryou.html

59 Detailed review is published on the website (available in Japanese only).
http://www.occto.or.jp/oshirase/kakusfuiinkai/2015-0501-1313-40.html

60 News release on the website of METI (available in Japanese only)
http://www.meti.go.jp/press/2016/10/20161017002/20161017002.html

As for required Generator I, the Organization has provisionally determined as follows estimates based on the actual data including demand forecast errors. This provisional determination is attributable to four emerging challenges: [1] Analysis is not implemented for the time period of unavailable surplus of Generator II; [2] The estimated result is calculated with data of F.Y.2016 only, so the difference among other fiscal years are not considered; [3] Analysis is not implemented for the actual winter peak load in spite of the existence of some winter peak areas; and [4] It is difficult to determine whether deviation of demand forecast error will converge in the future.

<Required Generator I> calculated as follows:

<Other than Okinawa areas>

**Generator I ＝ Average Value of the 3 Highest Daily Load × 7 %**

・ **"Average Value of the 3 Highest Daily Load" is defined in the "Premises of Demand Forecast " by the Organization.**

<Okinawa area>

**Generator I ＝ Capacity equivalent to Maximum Generating Unit in the area**
**＋ Balancing Capacity w/Frequency Control(Generator I-a) required**

・ **"Capacity equivalent to Maximum Generating Unit in the area" means a single unit with its generating capacity at the greatest in the regional service area**

・**Balancing Capacity w/Frequency Control(Generator I-a) required is calculated by Okinawa EPCO.**

The Required Generator I' is defined based on the purpose of its security.

<Required Generator I'> calculated as follows:

**Generator I' ＝ (Severe Weather H1 Peak Load × 103 %) － (Average Value of the 3 Highest Daily Load × 101 % ＋ Required Generator I )**

・**If calculated value is less than zero, Generator I' is not procured.**

Insufficient supply capacity against severe climate weather H1 peak load is likely to be turned out within a limited time of the year. In addition, severe climate H1 peak load will be foreseeable of its occurrence by weather forecast or load trend of the day to some extent. Thus, Generator I' includes demand response measures such as "Negawatt trading" scheme with limited hours and frequency other than conventional generators.

Generator II is classified as "soliciting without upper limit of required amount" in the guidelines, the required amount is not specified.

General Planning Department
Organization for Cross-regional Coordination of
Transmission Operators, JAPAN
Phone: +81-3-6632-0902
http://www.occto.or.jp/