

Transmission specifications for schedule information distribution system such as PCS with output control  
function (less than 66kV)

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## 1. Overview

### 1.1 Purpose

This book describes the communication required for power companies (power transmission and distribution companies) to control the output of power plants (high and low voltage).

This describes the term.

### 1.2 Scope of this document

The scope of this document is shown in Figure 1.1.

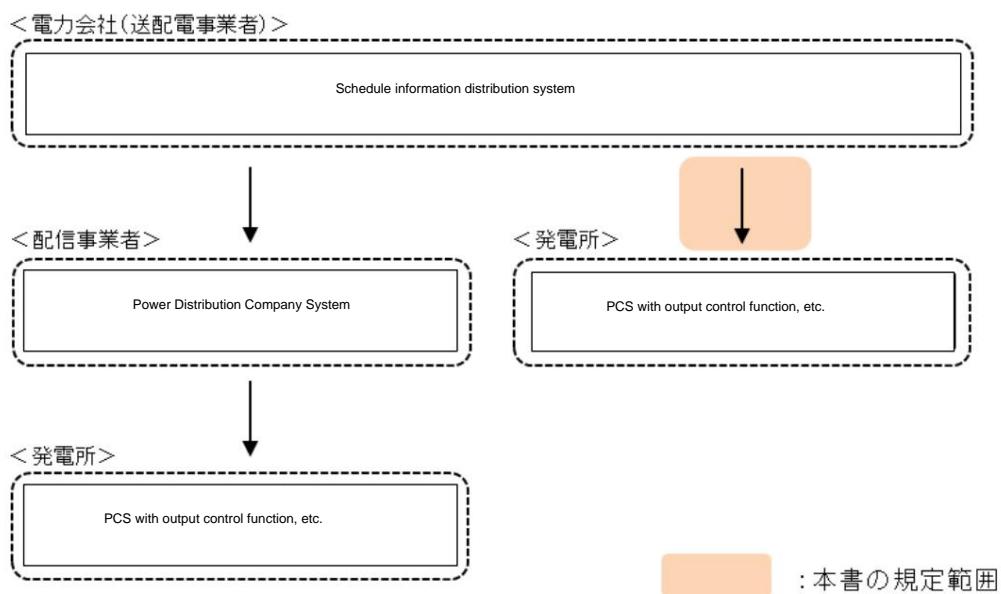


Figure 1.1 Scope of this document

### 1.3 References

- [1] Kyushu Electric Power Co., Inc. "Next-generation two-way communication output control emergency demonstration project" PCS with output control function (66kV Schedule Information Distribution System Transmission Specifications (Power Plant) Revised on December 10, 2015
- [2] Kyushu Electric Power Co., Inc. "Next-generation two-way communication output control emergency demonstration project" PCS with output control function (66kV Technical Specifications Established on June 16, 2015
- [3] Kyushu Electric Power Co., Inc. "Next-generation two-way communication output control emergency demonstration project" PCS with output control function (66kV Schedule Information Distribution System Fixed Schedule Download Specification November 6, 2015 revision

## 1.4 Definitions of Terms

Key terms are defined in Table 1.1.

Table 1.1 Definitions of terms

term	definition
Schedule information distribution system	<p>It is installed at the power company (power transmission and distribution company) and transmits output control (schedule) information to the power generation.</p> <p>A system that distributes information to various locations.</p>
PCS with output control function	<p>Output control from schedule information distribution system or distribution company system</p> <p>To obtain schedule information and control the output of generators based on that information.</p> <p>This device is installed in power plants for the purpose of</p>
Distribution provider system	<p>Output control (schedule) information received from the schedule information distribution system</p> <p>A system that distributes the information to PCSs with output control functions.</p> <p>This system is installed at distribution companies that act as intermediaries between power stations.</p>

## 2. Use Cases

The main use cases assumed in this document are shown in Table 2.1.

Table 2.1 Main use cases assumed in this document

Use Cases	overview	remarks
Fixed schedule distribution Before the start of the fiscal year, output control information for the next fiscal year (annual schedule) is	A use case for distributing the file (file) to a power plant.  This assumes that the software will be downloaded manually.	•Fixed monthly schedule  Also anticipated to distribute online  do.
Update schedule distribution A user who distributes annual schedule update information to power plants.	Scase.	

In addition, when installing a PCS with output control function, etc., the power plant is registered in the schedule information distribution system.

There is a use case for "ID registration confirmation" that aims to have the power plant confirm that the user is registered.

### 3. Basic information regarding schedule

#### 3.1 Power Plant ID

An ID consisting of 26 digits: receiving point identification number (22 digits) + branch number (3 digits) + checksum (1 digit).

The configuration of low-voltage power plant IDs is shown in Figure 3.1.

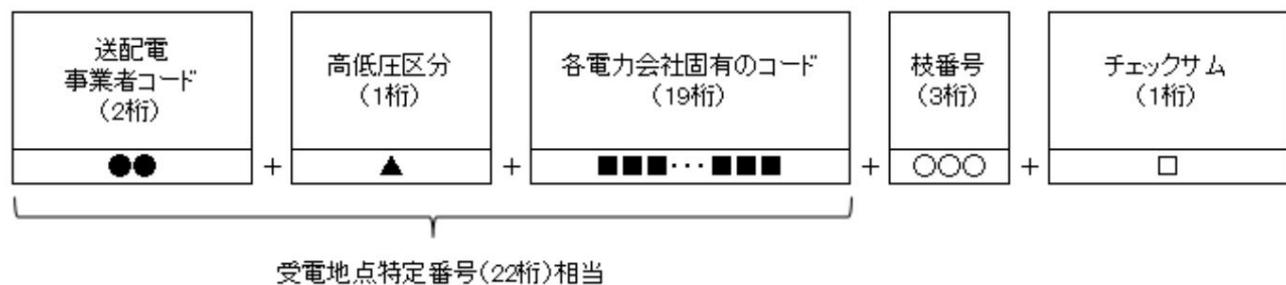


Figure 3.1 Power Plant ID

#### 3.2 Checksum

A checksum is set for the power plant ID and schedule to detect input errors and prevent data tampering.

The method for calculating the checksum for each data item is shown below.

##### (1) Power plant ID

The checksum of the plant ID shall be the last digit of the solution obtained by the following formula:

$$\begin{aligned}
 & (1 \text{ 衔目} \times 1) + (2 \text{ 衔目} \times 3) + (3 \text{ 衔目} \times 5) + (4 \text{ 衔目} \times 7) + (5 \text{ 衔目} \times 9) + \\
 & (6 \text{ 衔目} \times 1) + (7 \text{ 衔目} \times 3) + (8 \text{ 衔目} \times 5) + (9 \text{ 衔目} \times 7) + (10 \text{ 衔目} \times 9) + \\
 & (11 \text{ 衔目} \times 1) + (12 \text{ 衔目} \times 3) + (13 \text{ 衔目} \times 5) + (14 \text{ 衔目} \times 7) + (15 \text{ 衔目} \times 9) + \\
 & (16 \text{ 衔目} \times 1) + (17 \text{ 衔目} \times 3) + (18 \text{ 衔目} \times 5) + (19 \text{ 衔目} \times 7) + (20 \text{ 衔目} \times 9) + \\
 & (21 \text{ 衔目} \times 1) + (22 \text{ 衔目} \times 3) + (23 \text{ 衔目} \times 5) + (24 \text{ 衔目} \times 7) + (25 \text{ 衔目} \times 9)
 \end{aligned}$$

Example: If the power plant ID (excluding the checksum) is 1234567890123456789012345

$$\begin{aligned}
 & (1 \times 1) + (2 \times 3) + (3 \times 5) + (4 \times 7) + (5 \times 9) + \\
 & (6 \times 1) + (7 \times 3) + (8 \times 5) + (9 \times 7) + (0 \times 9) + \\
 & (1 \times 1) + (2 \times 3) + (3 \times 5) + (4 \times 7) + (5 \times 9) + \\
 & (6 \times 1) + (7 \times 3) + (8 \times 5) + (9 \times 7) + (0 \times 9) + \\
 & (1 \times 1) + (2 \times 3) + (3 \times 5) + (4 \times 7) + (5 \times 9) = 545
 \end{aligned}$$

—

The checksum is the last digit of the solution, "5".

(2) Fixed schedule, update schedule

The checksum of the fixed schedule and the updated schedule is the last two digits of the remainder of the solution obtained by the following formula:

Let us assume that.

$$\frac{(\text{出力制御率1} + \text{出力制御率2} + \text{出力制御率3} + \dots)}{(\text{制御年月日時分の月} + \text{制御年月日時分の日})}$$

Example) Output control rate 1:100 Output control rate 2:40 Output control rate 3:28

Control date and time: 201803271005

$$(100 + 40 + 28) \div (3 + 27) = 5 \text{ remainder } 18$$

—

The checksum will be the remainder "18".

#### 4. Data linkage

##### 4.1 Communication Overview

Communications between the power plant and the schedule information distribution system are carried out using Hyper Text Transfer Protocol Secure (HTTPS).

The communication is performed using secure communication provided by the Transport Layer Security (TLS) protocol (see Figure 4.1). This secure communication prevents data eavesdropping, falsification, and spoofing.

do.

To carry out this HTTPS communication, the power plant (client) side must have a root certificate and the schedule information distribution side must have a strict security policy.

The receiving system (server) is provided with a server certificate issued by a certification authority.

Authentication is performed during HTTPS communication.

An overview of HTTPS communication is shown in Table 4.1.

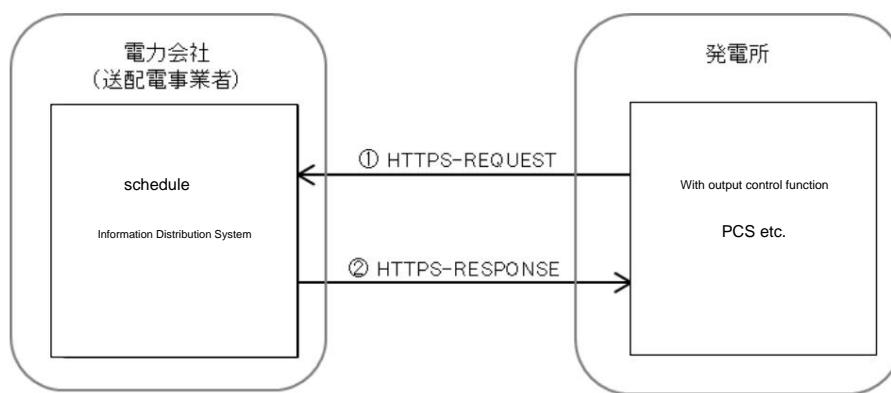


Figure 4.1 Communication Overview

Table 4.1 Communication Overview

Communication method	HTTPS (Hyper Text Transfer Protocol Secure)
Communication Protocol	TLS (Transport Layer Security) 1.2
	HTTP (Hypertext Transfer Protocol) 1.1
Cipher suites	TLS_RSA_WITH_AES_128_CBC_SHA256 TLS_RSA_WITH_AES_256_CBC_SHA256

##### 4.2 Overview of the collaboration

###### (1) Request from the power plant (HTTPS-REQUEST)

The power plant will use the URL and ports shown in Table 4.2 to send schedules and other information to the schedule information distribution system.

Which file to request.

Table 4.2 Request URL

Schedule Information	URL	https://re-ene03.pg.tepco.co.jp/ScheduleSenD/
Distribution System	Port 443	

In addition, a file request is made to the schedule information distribution system using POST (METHOD attribute).

The parameters for a file request are shown in Table 4.3.

Table 4.3 Request parameters

Logical Name	physical name	Data Types	explanation
Power Plant ID	power_plant_id	Character type 26 digits	-
MAC address mac_address		Character type 12 digits	Only hexadecimal values excluding conjunctions such as ":" and "-". And letters must be in uppercase. Example: "01-23-89-ab-cd-ef" "012389ABCDEF"
Schedule type schedule_kbn	4-digit character string	See Table 4.4	-

The schedule categories of the request parameters are shown in Table 4.4.

Table 4.4 Schedule Division

Segment value	explanation
999_Fixed schedule (annual)	The last digit <> is the item in the update schedule file. Specify the "Fixed schedule update flag" Specify which fixed schedule (annual) you want to obtain.
YYMM 20YY year MM month	When obtaining a fixed schedule (year and month), specify the year and month.
Fixed Schedule (Monthly)	-
0000 Update Schedule	-
8888 ID Registration Verification	Check whether the power plant ID is registered.

An example of the minimum required request for a file is shown in Figure 4.2.

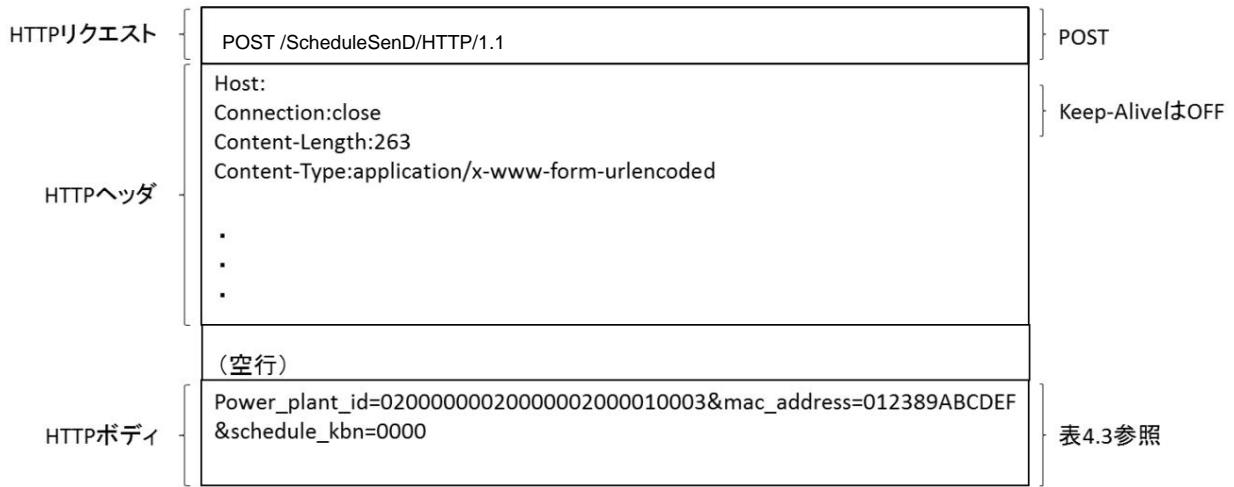


Figure 4.2 Example of a request

## (2) Response from the schedule information distribution system (HTTPS-RESPONSE)

The schedule information distribution system issues files based on the schedule classification requested by the power plant.

Respond to the power station.

A file response returns a multipart response (Content-Type: multipart/mixed). An example of a response (transmission file) is shown in Figure 4.3, and an example of a response (error file) is shown in Figure 4.4.

vinegar.

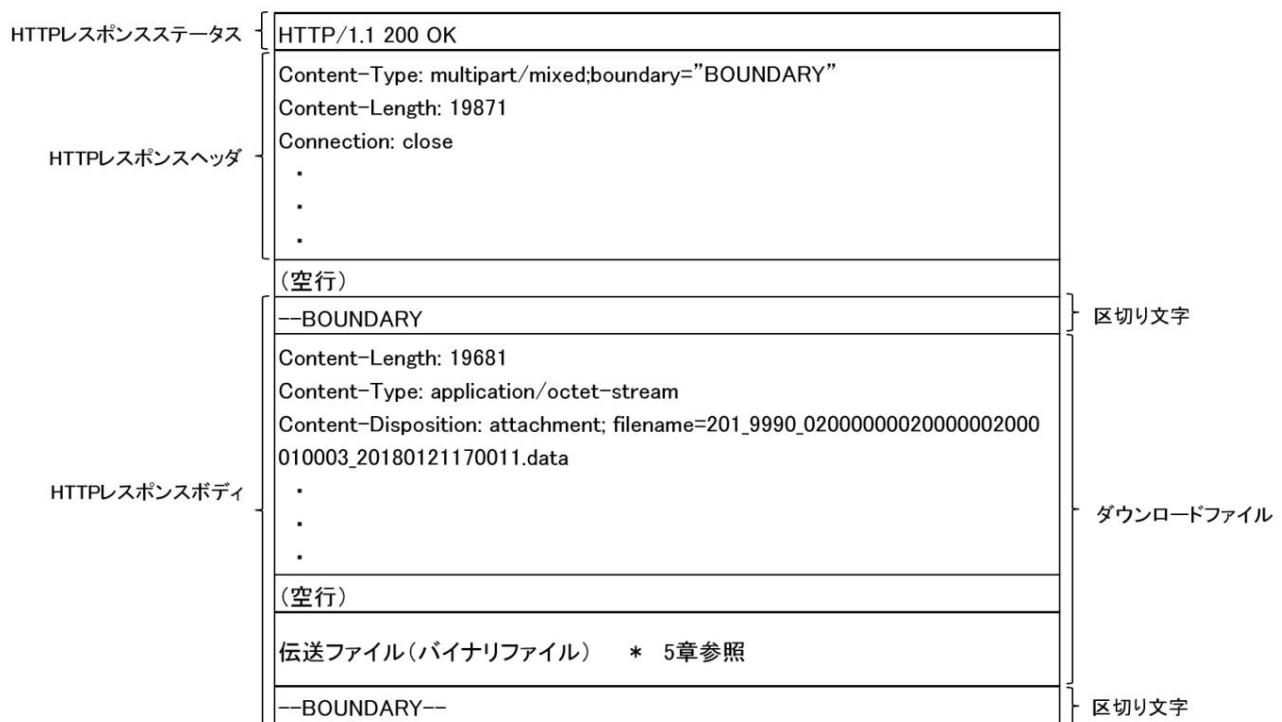


Figure 4.3 Response example (transmitted file)



Figure 4.4 Response example (error file)

An overview of the file is shown in Table 4.5. The file format is explained in Section 5.4.

Table 4.5 Overview of transmitted files

Transmission file	explanation	Format No.
Fixed schedule (annual)	Fixed schedule information for the year	201
Fixed Schedule (Monthly)	Fixed monthly schedule information	202
Update Schedule	Update schedule information	203
ID registration confirmation result	Power plant ID registration confirmation result information	301

Table 4.6 shows the response file to be transmitted to the power station for the requested schedule category.

Table 4.6 Schedule categories and transmission files

Schedule Category	Transmission file	Fixed	Fixed	Update	ID registration c
		Cage yyy -ru ( year )	Cage yyy -ru ( Month )	Cage yyy -ru	
		201	202	203	301
999_Fixed schedule (annual)		•			
YYMM Fixed Schedule (Monthly)			•		
0000 Update Schedule				•	
8888	ID Registration Confirmation				•

#### 4.3 Request Timing

(1) Fixed schedule (annual) and fixed schedule (monthly) requirements

If the "Fixed Schedule Update Flag" item in the update schedule file is changed, the schedule

Request for fixed schedule (annual) or fixed schedule (monthly) distribution to the information distribution system

Make a request.

The demand for this schedule information distribution system is concentrated in the distribution companies and power plants.

In order to prevent this, a time period during which requests can be made will be set up and the load will be distributed.

When this is done, it will be done during the time periods shown in Table 4.7, depending on the checksum value at the end of the power plant ID.

Table 4.7 Fixed Schedule Request Timing

Checksum	Request time zone
0	21:10:00 to 21:29:59
1	21:40:00 to 21:59:59
2	22:10:00 to 22:29:59
3	22:40:00 to 22:59:59
4	23:10:00 to 23:29:59
5	23:40:00 to 23:59:59
6	0:10:00 ~ 0:29:59
7	0:40:00 to 0:59:59
8	1:10:00 to 1:29:59
9	1:40:00 to 1:59:59

(2) Request for update schedule

The update schedule request from the power plant is based on the "Next Access Date and Time" item in the update schedule file.

The request is made at the time specified.

(3) Request for ID registration confirmation

ID registration confirmation is performed by the power plant making a request as necessary after receiving the power plant ID or after replacing equipment.

compliant.

## 5. Transmission files

Regarding the format of the transmission file that the schedule information distribution system responds to in response to a request from the power plant,

The following is shown:

### 5.1 File format and naming conventions

The format and file name of the file transmitted from the schedule information distribution system shall be as follows.

ÿ Format: Binary file

ÿ Character code: UTF-8

ÿ Byte order: network byte order

ÿ File name: CCC\_FFFF\_XXXXXXXXXXXXXXXXXXXX\_YYYYMMDDhhmmss.data

CCC: Format No. (without zero suppression)

\* See Table 4.5

FFFF: Requested schedule category (without zero suppression) \* See Table 4.4

XXXXXXXXXXXXXXXXXXXX: Power

plant ID YYYY: Year of the file creation date and time in the schedule information

distribution system MM: Month of the file creation date and time in the schedule

information distribution system DD: Day of the file creation date and time in the schedule

information distribution system hh: Hour of the file creation date and time in the schedule

information distribution system mm: Minute of the file creation date and time in the

schedule information distribution system ss: Second of the file creation date and time in the schedule information distribution system

Example: Fixed schedule (annual) for requests from power plant ID 12345678901234567890123455

File name when responding with (Format No. 201)

The response file was generated on May 5, 2018 at 10:05:20.

201\_9990\_12345678901234567890123455\_20180505100520.data

### 5.2 File Format

The transmission file consists of a header and a data section. The header outputs the number of data in the data section,

The data section outputs each format repeatedly for the number of data in the header section.

The format of the transmission file is shown in Figure 5.1.



Figure 5.1 Transmission file format

## 5.3 Binary Conversion Rules

The schedule information distribution system responds by sending a binary file as a transmission file as follows:

It is created according to the rules shown below.

(a) The header and data sections are converted to binary in hexadecimal (1 byte) units for each character. However,

The output control rate is converted to binary in hexadecimal (1 byte) for each data.

(b) The basic length is fixed. However, the output control rate part is variable length and can be bifurcated depending on the number of output control rate data.

This represents the number of bits.

An example of a binary update schedule is shown in Figure 5.2.

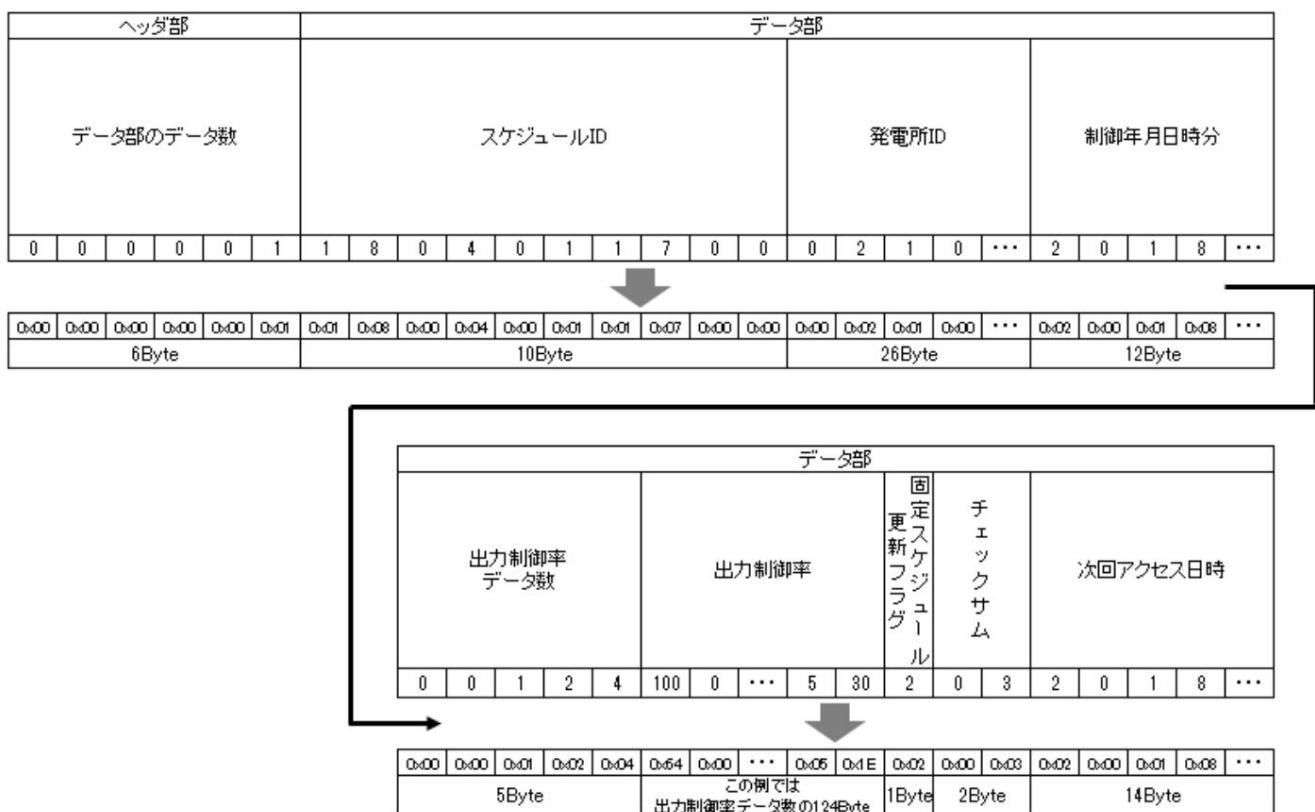


Figure 5.2 Example of binarization

#### 5.4 Data section format

The format of the data section of the transmission file is shown below.

##### (1) Fixed schedule (annual)

The format of the fixed schedule (annual) is shown below.

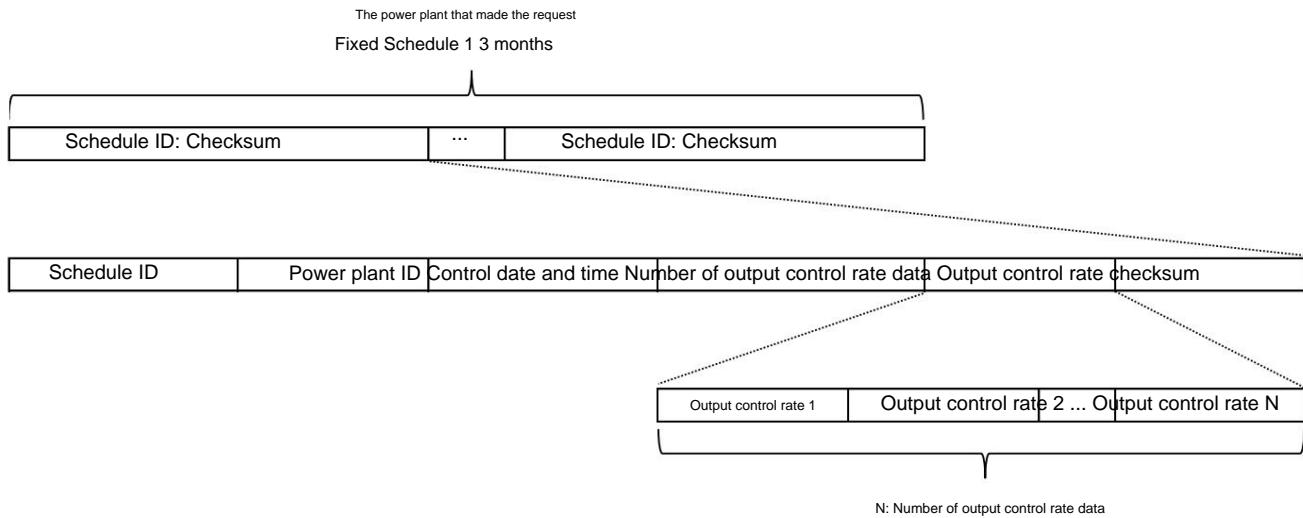
[Format No.: 201]

item	Number of bytes	explanation
Schedule ID	10Byte	-
Power Plant ID	26Byte	-
Control date and time	12Byte	Set the date, time, and minute for the first schedule frame. Format: YYYYMMDDhhmm *DDhhmm is "010000"
Output Control Rate Number of data	5 Byte	Number of output control rate data (maximum 1488) *The maximum number of days in the month is 1488, divided into 30 minutes. (24 hours ÷ 0.5 hours × 31 days)
Output Control Rate	1Byte x number of data	units: % Repeat for the number of output control rate data (maximum 1488)
Checksum	2 Bytes	-

(supplementary explanation)

The request outputs information for a fixed 13-month schedule for the plant.

The image of the file at this time is shown below.



## (2) Fixed schedule (monthly)

The format of the fixed schedule (monthly) is shown below.

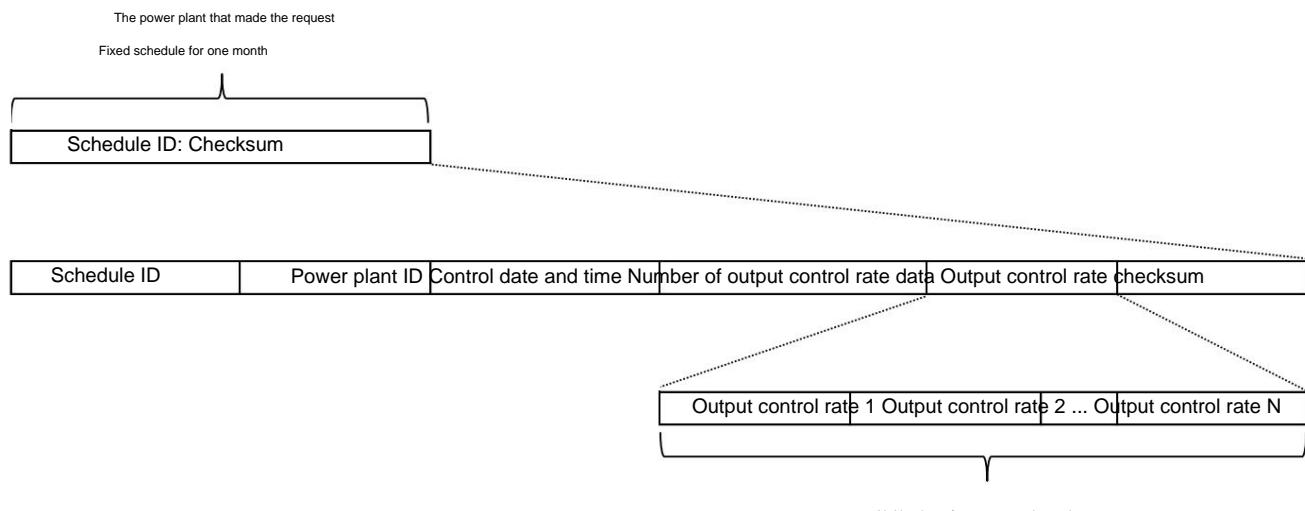
[Format No.: 202]

item	Number of bytes	explanation
Schedule ID	10Byte	-
Power Plant ID	26Byte	-
Control date and time	12Byte Set the date, time, and minute for the first schedule frame. Format: YYYYMMDDhhmm *DDhhmm is "010000"	
Output Control Rate Number of data	5 Byte	Number of output control rate data (maximum 1488)  *The maximum number of days in the month is 1488, divided into 30 minutes. (24 hours ÷ 0.5 hours × 31 days)
Output Control Rate	1Byte x number of data units: %	Repeat for the number of output control rate data (maximum 1488)
Checksum	2 Bytes	-

(supplementary explanation)

The request outputs one month's worth of fixed schedule information for the power plant.

The image of the file at this time is shown below.



## (3) Update Schedule

The format of the update schedule is shown below.

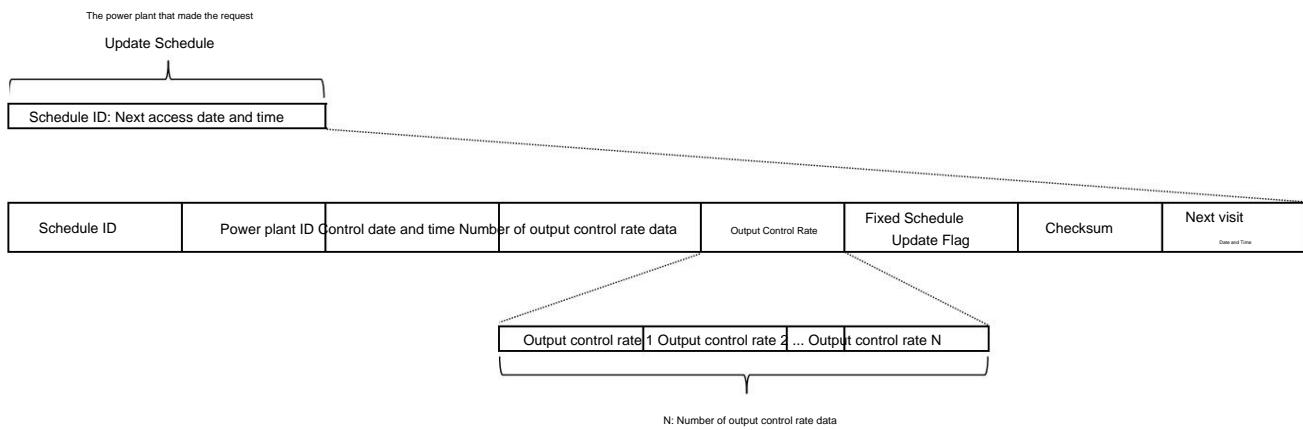
[Format No.: 203]

item	Number of bytes	explanation
Schedule ID	10Byte	-
Power Plant ID	26Byte	-
Control date and time	12Byte	Set the date, time, and minute for the first schedule frame. Format: YYYYMMDDhhmm
Output Control Rate Number of data	5 Byte	Number of output control rate data (max. 336)  *Maximum 336 is the maximum number of days updated in 30-minute intervals. (24 hours ÷ 0.5 hours × 7 days)
Output Control Rate	1Byte x number of data units: %	Repeat for the number of output control rate data (maximum 336)
Fixed Schedule Update Flag	1Byte	The count is incremented when the fixed schedule is updated. A flag that notifies you that a schedule is available.
Checksum	2 Bytes	-
Next access date and time	14 Byte	Set the next delivery date and time. Format: YYYYMMDDhhmmss

(supplementary explanation)

The update schedule information for the requested plant will be output for up to 7 days.

The image of the file at this time is shown below.



## (4) ID registration confirmation results

The format of the power plant registration confirmation result is shown below.

[Format No.: 301]

item	Number of bytes	explanation
Power Plant ID	26Byte	-
Registration confirmation result	1Byte	0: ID registered 1: ID not registered

(supplementary explanation)

One registration confirmation result for the requested power plant is output.

The response shall be in one file.

The image of the file at this time is shown below.

Power Plant ID	Registration confirmation result
----------------	----------------------------------

## 6. Linkage Error

When a request from the power plant to the schedule information distribution system occurs,

In addition to simple communication errors between systems, there are also "response errors" and "application errors."

The two are described below.

### 6.1 Response Error

Response errors are identified by HTTP status codes, as shown in Table 6.1.

Table 6.1 HTTP status codes

HTTP Status Code	Response Meaning	Need to retry?
1xx	information	Essential
2xx	success	Unnecessary
3xx	redirection	Essential
4xx	Client Error	Unnecessary*
5xx	Server Error	Essential

\* Immediate retry is not necessary, but retrying once a day is recommended.

Table 6.2 shows the retry timing for HTTP status codes other than "2xx" and "4xx".

However, if an error occurs during a manual request, such as during initial installation, the system will retry from time to time.

Table 6.2 Retry timing when a response error occurs

Schedule Category	timing	retry Number of times	Retry Error Retry timing
999_Fixed schedule (yearly)	Retry after 5 minutes	5 times the next day at the specified time	
YYMM_Fixed Schedule (Monthly)	Retry in 5 minutes	The next day's designated time slot	
0000_Update Schedule	Next access time After 30 minutes	Please retry in 30 minutes. continuation	
8888_ID Registration Confirmation	Retry at any time	-	-

## 6.2 Application Error

If the request information is incorrect or there is no information for the request, an error file is returned.

The power plant will deal with the issues reported in the error file and retry.

### (1) File format and naming rules

The format and file name of the error file transmitted from the schedule information distribution system are as follows:

do.

ÿ Format: Text file

ÿ Character code: UTF-8

ÿ Line break: None

ÿ File name: ERR\_FFFF\_XXXXXXXXXXXXXXXXXXXXXX\_YYYYMMDDhhmmss.data

FFFF: Requested schedule category (zero padding, first 4 digits if request is 5 or more digits)

\*See Table 4.4

XXXXXXXXXXXXXXXXXXXXXX: Power plant ID (zero padding, if request is 27 or more digits,

26 digits)

YYYY: The year when the file was created in the schedule information distribution system

MM: Month of file creation date and time in the schedule information distribution system

DD: Day of file creation date and time in the schedule information distribution system hh:

Hour of file creation date and time in the schedule information distribution system mm:

Minute of file creation date and time in the schedule information distribution system ss:

Second of file creation date and time in the schedule information distribution system

Example: Fixed schedule (annual) for requests from power plant ID 12345678901234567890123455

Error file name when responding with (Format No. 201)

The response file was generated on May 5, 2018 at 10:05:20.

ERR\_9990\_12345678901234567890123455\_20180505100520.data

### (2) File format

item	Data Types	explanation
Error Message	6 characters + Maximum 128 double-byte characters (variable length)	Error code + half-width space + error message Output.

(supplementary explanation)

Only one target error is output per file. The output image

of the file is shown below.

E1001 Please set the schedule category using four digits.

### (3) Error Message

The error code system output to the error file is shown in Table 6.3.

Table 6.3 Error code system

digit	explanation
1st digit	Message Level E: Error
Second digit	Error location 1: Power Plant 0: Schedule information distribution system
3rd to 5th digits: sequential number	

Table 6.4 shows a list of error messages output by this system.

Table 6.4 Error messages

Error Message
E1001 Please set the schedule category using four digits.
E1002 The schedule category is set to something other than half-width numbers.
E1003 The schedule category is specified incorrectly.
E1006 Please set the power plant ID to 26 digits.
E1007 The power plant ID is set to something other than half-width numbers.
E1008 Please set the MAC address to 12 digits.
E1009 The MAC address contains characters other than alphanumeric characters.
E1010 Please set the alphanumeric characters in the MAC address in uppercase.
E0001 There is no fixed annual schedule for distribution.
E0002 There is no fixed monthly schedule to distribute.
E0003 There is no update schedule to distribute.

## 7. Time Synchronization

### 7.1 Overview of Time Synchronization

Time synchronization is performed between the schedule information distribution system and the power plant using the Network Time Protocol (NTP).

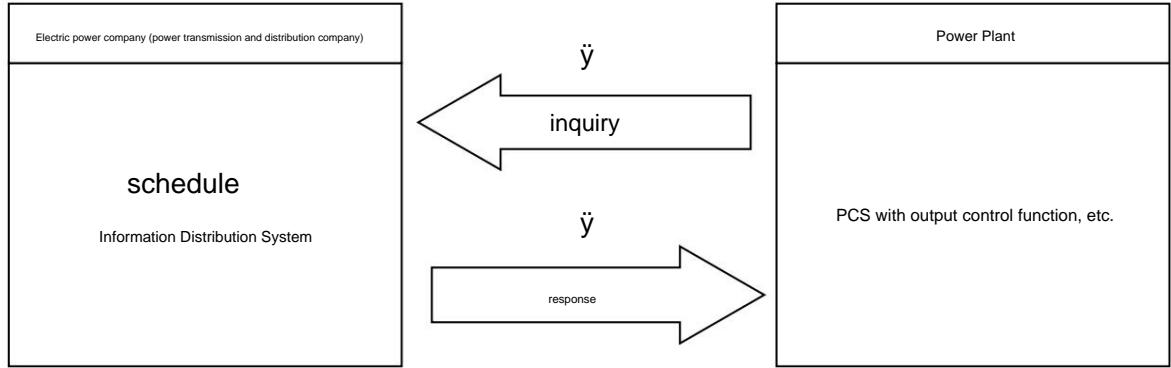


Figure 7.1 Overview of time synchronization

### 7.2 Time Synchronization Protocol

This article describes the client connection method and NTP server settings.

#### (1) Client connection method

Table 7.1 Client connection methods

Communication Protocol	NTP (Network Time Protocol)
Time synchronization method	Step Mode

#### (2) NTP server settings

Table 7.2 NTP server settings

NTP Server	FQDN	re-ene03.pg.tepco.co.jp
	port	one two three

### 7.3 Time Synchronization Timing

Time synchronization between the schedule information distribution system and the power plant will be performed at the times shown in Table 7.3.

Table 7.3 Time synchronization timing

Synchronization Timing	Implementation time period
First communication Before ID authentication (including when replacing equipment)	any
When power is turned on	any
Regular updates (up to once/day)	(*)
Other manual execution (error retry, etc.)	any

(\*) A request that can be made to distribute the load of requests to the schedule information distribution system.

Set a time period.

The time period during which requests can be made is determined by the checksum at the end of the power plant ID, and is as shown in Table 7.4.

If an error occurs during the period, the system will retry at 1-minute intervals (up to 5 times). If an error occurs again,

Continue retrying after 30 minutes.

Table 7.4 Regular update timing

Checksum	Implementation time period
0	21:00:00 to 21:09:59
1	21:30:00 to 21:39:59
2	22:00:00 to 22:09:59
3	22:30:00 to 22:39:59
4	23:00:00 to 23:09:59
5	23:30:00 to 23:39:59
6	0:00:00 to 0:09:59
7	0:30:00 to 0:39:59
8	1:00:00 to 1:09:59
9	1:30:00 to 1:39:59