Pilot project for the environmental technology verification

In the field of nonmetallic element-contaminated wastewater treatment technology

(Technology for treating wastewater containing boron or other nonmetallic elements)

Protocol for the verification tests on nonmetallic element-contaminated wastewater treatment technology (technology for treating wastewater containing boron or other nonmetallic elements)

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Water Environment Department

Environmental Management Bureau,

Ministry of the Environment

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Reference i

Main section

I. Introduction

1. Target technologies

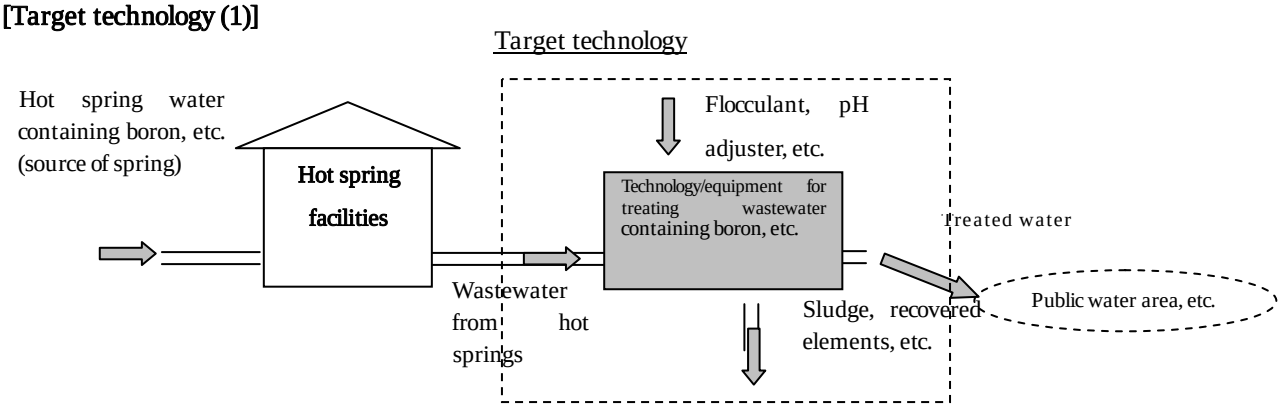
Nonmetallic element-contaminated wastewater treatment technologies (technologies for treating wastewater containing boron or other nonmetallic elements) covered by this protocol for the verification are those (equipment, etc.) that properly treat boron or other nonmetallic elements contained in hot spring water discharged from Japanese-style hotels or inns or in wastewater discharged from plating or metal processing businesses by ion adsorption, coagulating sedimentation, or other methods.

This protocol is for verification target technologies that are low in cost, compact, easy to maintain, and commercially available.

Technologies covered by this protocol for the verification include technologies for treating wastewater containing boron from hot spring facilities (boron from natural water) and those for treating wastewater containing boron from plating plants (man-induced boron). They are different in principle and capacity because discharges from sources differ in volume and patterns. This protocol for the verification categorizes wastewater treatment technologies into target technology (1) and target technology (2) according to whether they treat wastewater from hot spring inns or from plating plants.

Fig. 1 Images of target technologies

[Target technology (1)]



[Target technology (2)]

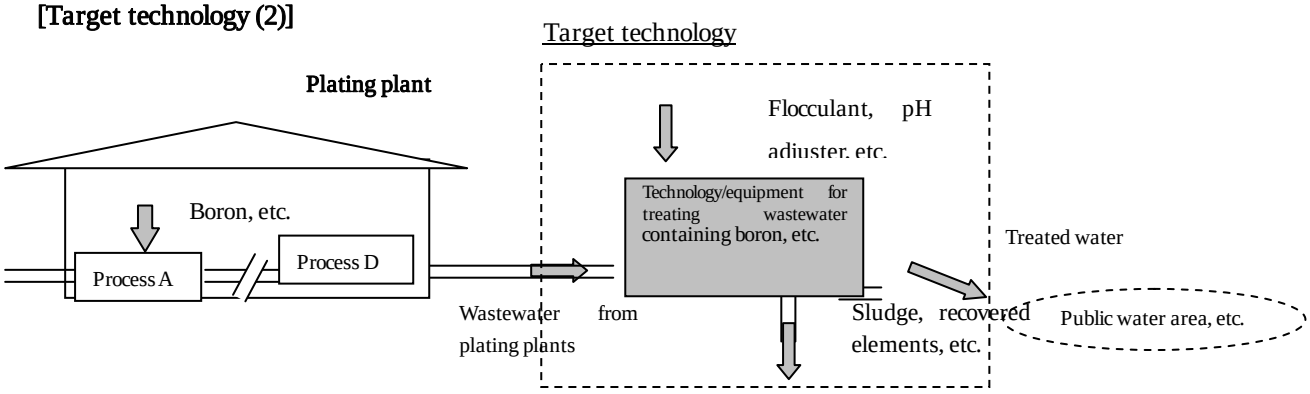


Figure 1 shows images of target technologies. This protocol targets two technologies: technologies for treating wastewater from hot spring inns (target technology (1)) and those for treating wastewater from plating plants (target technology (2)).

2. Types and outline for verification tests

(1) Types of verification tests

This verification test is intended to verify the following items by performing a series of operations of a target verification apparatus, including startup, running, and stopping, installed in a wastewater source:

- Environmental protective effect under practical operational conditions in the range specified by an environmental technology developer
- Energy, materials and cost required for operation
- Operational environment allowing normal operations
- Labor for operations and maintenance (hereinafter referred to as the "O&M")

A verification test conducted in a single Test Site is inadequate to give a full picture of the performance of a target verification technology, but is believed to provide adequate information to determine its applicability to treatment of similar types of wastewater (wastewater similar to that fed into the equipment). A target verification technology can be tested at two or more Test Sites if the environmental technology developer requests such.

(2) Verification testing process

The verification test will mainly be conducted according to the steps specified below:

i Preparing a Test Plan

The plan for the verification test (hereinafter referred to as the "Test Plan") will be prepared before the test is conducted. The Test Plan will be prepared by a Verification Organization in cooperation with an environmental technology developer and the owner of a Test Site.

The main activities in the planning stage are as follows:

- Specifying the individuals and organizations involved in the test
- Specifying the general and technology-specific objectives of the test
- Selecting a suitable Test Site
- Specifying verification and monitoring items
- Determining analytical and sampling methods and the test period
- Establishing a Test Plan that includes specific procedures, a schedule, and the individuals in charge, based on the results of the above items

ii Conducting a verification test

In this stage, a verification test will be conducted according to the Test Plan described above. The verification test verifies the conformity of a target verification apparatus with its objectives specified in the planning stage. The Verification Organization may, if necessary, subcontract part of the verification test to external test organizations.

iii Data assessment and reporting

In the final stage, all data collected will be analyzed for verification, and a report on the verification test (hereinafter referred to as the "Verification Report") will be compiled. A Verification Organization is responsible for analysis of the data and reporting. To accelerate the above process, the Verification Organization may subcontract an external organization to prepare a draft of the Verification Report.

The Verification Report will be submitted by the Verification Organization to the Ministry of the Environment. In the report, the suitability of the verification tests will be discussed by the working group on the nonmetallic element-contaminated wastewater treatment technology (hereinafter referred to as the "working group") of the committee on the pilot project for the environmental technology verification. After being approved by the Ministry of the Environment, the report will be disclosed to the public through a database on environmental technology managed by the Ministry of the Environment.

3. Definitions of terms and phrases

The definitions of the major terms and phrases are in accordance with those of the Japanese Industrial Standards (hereinafter referred to as "JIS"). The standards in JIS particularly relevant to this protocol for the verification (hereinafter referred to as "Protocol") are as follows:

JIS K 0094 "Sampling methods for industrial water and industrial wastewater"

JIS K 0102 "Testing methods for industrial waste water"

JIS B 8530 "Glossary of terms for pollution control equipment"

JIS B 9940 "Testing methods of pH controlling equipment" (pH represents the hydrogen ion concentration.)

JIS B 9941 "Testing methods of precipitation equipment"

JIS B 9942 "Testing methods of filtration equipment for clarifying"

JIS B 9943 "Testing methods of floatation equipment"

JIS B 9944 "Testing methods of activated sludge process equipment"

In addition, the terms and phrases used in this Protocol are defined as set forth in Table 1.

Table 1 Definitions of terms and phrases used in this Protocol

Term/Phrase	Definition
Target verification technology	A mechanism for the removal of water pollutants and improvement of water quality to be verified in the verification test. The target verification technology should have a clear scientific basis.
Target verification apparatus	An apparatus to be used in the verification test among the apparatuses/equipment representing the embodiments of the target verification technology
Verification items	Items to be analyzed for determination of the performance of a target verification apparatus
Monitoring items	Items to be monitored for inspection of the operational status and the prevention of adverse effects on the surrounding area
Test Site	An establishment where a target verification apparatus is to be installed and the verification test is to be conducted
Verification applicant	A person wishing to have his/her own technology verified. If the applied technology is selected as a target verification technology, the verification applicant will be referred to as an "environmental technology developer."
Environmental technology developer	A person who possesses a target verification technology. Until the applied technology is selected as a target verification technology, the person is referred to as a "verification applicant."
Operations and maintenance record	Records that describe all work performed for O&M at a Test Site

II. Verification test system

1. Ministry of the Environment

- Comprehensively administer the entire pilot project for the environmental technology verification
- Comprehensively discuss the verification test system
- Select target verification technology fields for the verification test
- Establish and administer the committee on the pilot project for the environmental technology verification and its working groups
- Create a protocol for the verification
- Select Verification Organizations
- Financially support Verification Organizations by bearing the expenses relevant to the verification tests
- Approve target verification technologies
- Approve reports on verification tests
- Create an Environmental Technologies Verification database (hereinafter referred to as “ETV database”) for their dissemination

2. The committee on the pilot project for the environmental technology verification

- Offer advice on the management of the entire pilot project for the environmental technology verification
- Offer advice on the comprehensive evaluation of verification test results

3. Working group on the nonmetallic element-contaminated wastewater treatment technology

- Offer advice on management of the entire pilot project for the environmental technology verification in the field of nonmetallic element-contaminated wastewater treatment technologies (technologies for treating wastewater containing boron or other nonmetallic elements)
- Offer advice on creating a protocol for the verification
- Offer advice on the selection of Verification Organizations
- Offer advice on approval of the Verification Report

4. Verification Organizations

- Administer and operate the verification test under the auspices of the Ministry of the Environment
- Construct the quality management system shown in Appendix 0
- (Invite target verification technologies from the public and select appropriate types.) Invite the public to register the technologies and products that are suitable as a target of the verification tests
- Establish and administer respective Technology Panels
- Approve Test Sites
- Establish a Test Plan in cooperation with environmental technology developers and the owners of Test Sites
- Conduct and manage the target verification tests based on the Test Plan
- Ensure the health and safety of all persons relevant to the verification tests at the Test Sites
- Set and adjust the test schedule by assuring the means of communication among all participants in the verification test, and providing transportation assistance and technical advice as necessary
- When the verification test is subcontracted to an external organization, ensure that the quality management system which is required in the Protocol is indeed functioning properly at the subcontractor
- Audit the procedures for the verification test

- Perform monitoring, measurement, and analysis under the auspices of the Ministry of the Environment
- Manage the data/information obtained in the verification tests
- Prepare the Verification Report based on analysis of the data on the verification test

5. Technology Panels

- Offer advice on the selection of target verification technologies
- Offer advice on the selection of Test Sites
- Offer advice on the preparation of the Test Plan
- Offer advice on the problems that may occur during the verification tests
- Offer advice on the issuance of the Verification Report
- Offer advice on dissemination of the technologies verified in the verification test

6. Environmental Technology Developers

- Propose Test Sites and provide necessary information to Verification Organizations to help them select an appropriate Test Site
- Cooperate with Verification Organizations in establishment of the Test Plan, such as by providing information required for the verification test
- Provide as many target verification apparatuses that can be used at the Test Site as required. In addition, provide the Verification Organization with its "O&M manual"
- Bear the costs and responsibility for the transportation, installation, removal, and others of the target verification apparatus, if necessary
- Bear, in principle, the costs for O&M of the target verification apparatus
- Provide technical support to the Verification Organization by assisting in the operation and measurement of the target verification apparatus during the verification test period, if necessary
- Provide engineers for O&M of the target verification apparatus, if necessary. The engineers should be properly qualified or experienced and have received adequate training
- Provide existing relevant performance data for the target verification technology if it has been tested at other sites
- Cooperate with the Verification Organization in preparing the Verification Report

7. Owners of Test Sites

- Cooperate with the Verification Organization, such as by providing information necessary for the verification test, in designing the Test Plan
- Cooperate in the verification test in accordance with the Test Plan
- Provide transportation and technical assistance in accordance with the agreement among the Verification Organization, environmental technology developer, and owner of the Test Site
- Report to the Verification Organization on any change or fluctuation in business activity that may affect the quality and flow rate of wastewater (wastewater fed into the equipment) at the Test Site

III. Selection of target verification technologies

1. Application

A verification applicant may apply to a Verification Organization for verification of the applicant's proprietary technology/product. Items to be specified in the application form are described below. The verification applicant should fill in the necessary information in the "Application form for verification" set forth in Appendix 1, and submit the application form together with the designated documents to the Verification Organization.

a. Company name, Address, Division of person in charge, Name of person in charge, etc.

b. In-house test results

c. Product data

d. Control points and the time and frequency of the control required for O&M

e. Target water quality

f. Developmental status and past delivery record

g. Innovativeness of the technology

h. Other relevant or unique features (if any)

i. Technical specification* for the target verification apparatus

j. O&M manual*

(Note) The documents designated with * should be attached to the application form.0

2. Selection of target verification technologies

Based on the description of the application and the advice from the Technology Panel, a Verification Organization selects target verification technologies and obtains approval from the Ministry of the Environment. The selection criteria are as follows:

a. Technological requirements:

- Does the applied technology fall under the technology of target verification technology fields described in "1. Target technologies" on page 1?
- Is the application form properly filled in?
- Is the technology at a commercialization stage?
- Were there any publicly-funded, similar verification tests of the same technology before?

b. Possibility of verification

- Is it possible to complete the verification from cost and organizational standpoints?
- Is it possible to establish a suitable Test Plan?

c. Environmental protective effect, etc.

- Is it possible to scientifically explain the principle and mechanism of the technology?
- Is there any possibility of the technology causing environmental side effects?
- Does it provide a high environmental protective effect?
- Is it an innovative technology?

At the selection stage, a verification applicant can confer with the Verification Organization concerning the specific methods of verification, including the period, date, and site of tests.

IV. Preparation for the verification tests

1. Selection of the Test Sites

Test Sites are to be decided by the Verification Organization, based on the proposal of the environmental technology developer if necessary. Both types of the following sites could be approved as a Test Site in this pilot project:

- Sites at which a target verification apparatus already in operation is installed
- Sites at which a target verification apparatus is to be newly installed for a verification test

In selecting a Test Site, the Verification Organization shall consider the following:

(1) Suitability for this technology field

Check that their business is suitable for this technology field. Check that influent wastewater to the target verification apparatus does not grossly deviate from the characteristics of general wastewater from hot springs or from plating plants.

(2) Suitability for the target verification technology

Check that their operations and influent wastewater are suitable for the technical specifications and features of the target verification technology.

(3) Suitability for a verification test

Check that the Test Site satisfies the requirements specified in this Protocol.

In cases in which target verification apparatuses are newly installed, the environmental technology developer, following due consideration with the owner of the Test Site for the purpose of harmonizing the tests with the environment surrounding the Test Site and ensuring that the test will have minimal influence on operation, will create an environment in which the verification test can be smoothly conducted. The environmental technology developer shall discuss sharing of the expenses for the operation of the Test Site (as well as sharing of work) depending on the conditions of the Test Site.

The environmental technology developer is responsible for restoring the Test Site to its original condition after completion of the verification test. When any modifications are required during the test period, the Verification Organization, owner of the Test Site, and environmental technology developer will consult regarding the modifications.

To consider these requirements of a Test Site, the Verification Organization shall collect the following information:

- Detailed description of the location of the Test Site and operational conditions of the establishment (e.g. inn with accommodation for 70 guests, plating plant with a 1 cubic meter plating bath, etc.)
- If there are regulations regarding the Test Site, the legal requirements
- Quality and flow rate of the influent wastewater (hot spring composition table, etc.) and operations that affect the inlet time, flow rate, and water quality
- Location of current facility and local map indicating the site where the target verification apparatus is to be installed
- Description of the method of installing the target verification apparatus, and of introducing influent wastewater to the target verification apparatus (Because the temperature of the wastewater and other conditions may affect the performance of the target verification apparatus, the location of the target verification apparatus should be described in detail so that the effect of temperature and other conditions can be determined.)
- Schematic diagram of wastewater treatment (including a pH controlling tank, cycle filtration equipment, and other systems for preprocessing, if any, and descriptions of the types of those systems and of how they should be managed) or schematic diagram of the drain system of the entire Test Site (if possible)

- Place where the effluent is to be discharged and method of disposing of sludge
- Appropriate monitoring the flow rate and sampling locations
- Other relevant or unique features of the Test Site

2. Checking of conditions before starting a verification test

The Verification Organization shall identify and collect information about the verification items and monitoring items to be obtained before starting a verification test in the Test Site. The Verification Organization shall take and analyze samples if necessary.

3. Determination of verification items

In consideration of the opinions of the environmental technology developer, the technical specification for the target verification apparatus, and influent characteristics at the Test Site, the Verification Organization will determine the verification items so that the performance of the target verification technology can be suitably verified. All the verification items thus determined will be described in the Test Plan. This Protocol lists the major verification items to be tested. The Verification Organization shall consider the necessity of testing additional verification items.

(1) Verification items regarding water quality

The possible verification items regarding water quality to be examined in the verification test are summarized in Table 2. Major items to be verified for reference are summarized in Table 3. Verification items regarding water quality are used primarily to verify the wastewater processing capacity and the stability of the operation of target verification apparatuses.

Table 2 Verification items regarding water quality

Verification item	Description
Boron concentration in treated water	Concentration of boron in treated water
Boron removal efficiency	Boron removal efficiency calculated from the amounts of boron in influent wastewater and in treated water

Table 3 Major items to be verified for reference

Verification item	Description
Boron recovery rate	(For a technology that can recover boron) Mass balance calculated from the amount of boron removed by the equipment to treat wastewater containing boron and other nonmetallic elements and the amount of boron recovered
Nonmetallic elements other than boron	(For a technology that can treat nonmetallic elements other than boron) Concentrations of nonmetallic elements other than boron, such as fluorine and arsenic
Water pollutants other than the above nonmetallic elements	pH, BOD, COD, and other factors of wastewater regulated by the Water Pollution Control Law, and concentrations of substances to be monitored according to the environmental standards for water quality

(2) Verification items regarding environmental load

The possible verification items regarding environmental load to be examined in the verification test are summarized in Table 4.

Table4 Major verification items regarding environmental load

Category	Verification item	Description	Major relevant cost
Environmental impact	Amount of sludge produced	Dry weight of sludge (kg/day) Wet weight of sludge (kg/day) and moisture content	Disposal cost
	Types and amounts of waste products other than sludge	Weights of different types of waste products (kg/day)	Disposal cost
	Noise	Noise level during operation of the apparatus (main unit)	—
	Odor	Odor emitted during operation of the apparatus (main unit)	—
	Qualitative evaluation such as ease of treatment of sludge, waste products and foul odor (ease of secondary treatment, effective use)	Ease of secondary treatment, effective use test, etc.	(As appropriate)

(3) Verification items regarding operations and maintenance

The verification items presumably required for quantitative and qualitative evaluation of the performance in and cost for O&M are summarized in Table 5.

Table 5 Major verification items regarding operations and maintenance

Category	Verification item	Description	Major relevant cost
Electricity use and material consumption	Electricity consumption	Electricity consumption for all target verification apparatuses (kWh/day)	Cost for electricity
	Types and amounts of wastewater treatment chemicals	As appropriate	Cost for chemicals
	Other consumables	As appropriate	Cost for consumables
O&M performance	Visual inspection of effluent quality	Color, turbidity, bubbles, production of solids, etc.	—
	Period required for startup of the target verification apparatus Period required for shutdown of the target verification apparatus	Time (in appropriate units)	—
	Number of operators, and the level of operator skill required for O&M of the target verification apparatus	Maximum number of operators and working days (man-days) for each operation item The technicality and difficulty of O&M shall be described.	—
	Evaluation of O&M manual	Readability, understandability and problems	—
	Reliability of the target verification apparatus	Causes of problems	—
	Method of restoring from problems	Ease of and problems in resumption	—

4. Selection of target water quality

The Verification Organization shall set target water quality to help the environmental technology developer define technical specifications. Two or more targets should be set in light of the characteristics of wastewater (influent wastewater fed into the equipment) at the Test Site. The environmental technology developer shall select a target from those listed in Table 6 for target technologies (1) and (2), and the Verification Organization shall mention the selected target water quality in the verification test results.

Table 6 Target water quality

Target technology	Target water quality (boron concentration in treated water)
Target technology (1) (Hot spring inn: large amount of wastewater)	• 10 mg/L (nationwide uniform standard set by the Water Pollution Control Law) • Level in the range of 10 mg/L to 500 mg/L set by the Verification Organization appropriately (e.g. half of the concentration of boron in wastewater (influent wastewater to the equipment) at the Test Site)
Target technology (2) (Plating plant: small amount of wastewater)	• 10 mg/L (nationwide uniform standard set by the Water Pollution Control Law) • Level in the range of 10 mg/L to 50 mg/L set by the Verification Organization appropriately (e.g. half of the concentration of boron in wastewater (influent wastewater to the equipment) at the Test Site)

Table 7 Regulations on wastewater in the Water Pollution Control Law (reference)

Class				Permissible limit (mg/L)		
				When the Water Pollution Control Law was established	Partial amendment of the enforcement order (Jul. 2001 to Jun. 2004)	After extended application of tentative measures (Jul. 2004 to Jun. 2007)
Boron and its compounds	Public waters other than sea areas	General industries (other than tentative measures)		(Not regulated by the Law)	10	10
		Tentative measures (partial)	Electroplating industry		70	50
			Hotel business (Hot spring facilities)		500	500
	Sea areas (all industries: no tentative measures)				230	230

5. Determination of monitoring items

The Verification Organization shall determine monitoring items that may affect proper operation or maintenance or wastewater treatment performance. All the monitoring items thus determined shall be described in the Test Plan. This Protocol lists major monitoring items, and the Verification Organization shall consider the necessity of testing additional monitoring items.

Major monitoring items are summarized in Table 8. The Verification Organization may discuss the required monitoring items in accordance with the O&M manual provided by the environmental technology developer as well as add other items that the organization recognizes as necessary. Items that affect the wastewater treatment performance and can be categorized as a secondary substance to be treated (for a technology that can also treat substances other than boron) shall be considered items to be verified for reference.

Table 8 Major monitoring items

Monitoring item		
Flow rates of influent wastewater/treated water (Daily changes, weekly changes in daily flow rates: Either of them if the flow rates are almost the same between influent wastewater and treated water)		
Item that affects wastewater treatment performance	Items to be monitored for both technologies (1) and (2)	pH (hydrogen ion concentration)
		BOD (biological oxygen demand)
		COD (chemical oxygen demand)
		SS (amount of suspended solids)
		n-HEX (content of normal-hexane extracts)
	Items to be monitored for technology (1)	Temperature
		Electric conductivity
		Chlorine concentration
		Hydrogen sulfide concentration
		Calcium concentration
		Iron concentration
	Items to be monitored for technology (2)	Nickel concentration
		Chromium concentration
		Fluoroborate concentration

6. Determination of the test period

The test period should be 3 continuous months after startup or a period in which all patterns of influent wastewater can be verified. The period of malfunction and shutdown should not exceed 10% of the entire period.

The following shall be considered in determining the test period:

- The test period should be 3 continuous months after startup or a period in which all patterns of influent wastewater can be verified.
- The period of malfunction and shutdown should not exceed 10% of the entire period.

7. Establishment of the Test Plan

The Verification Organizations should establish the Test Plan in consideration of the characteristics of the Test Site, the influent characteristics, technical specification for the target verification technology, and others.

The Verification Organizations establish the Test Plan, based on the information provided by the environmental technology developer and the owner of the Test Site, and the advice of the Technology Panel.

The items to be included in the Test Plan are listed in Appendix 2.

V. Verification test methods

1. Starting up the target verification apparatus

- The Verification Organization starts up the target verification apparatus in accordance with the O&M manual of the environmental technology developer. When an existing wastewater treatment facility is used as the target verification apparatus, the startup is not required.
- The Verification Organization starts up the apparatus for a period specified by the environmental technology developer. Following the startup period, the Verification Organization confirms that the target verification apparatus is operating in a stable manner for the verification test to be conducted as indicated in the O&M manual. When the apparatus is judged as being unstable, the Verification Organization continues the startup for a period of up to twice the predetermined period. If the apparatus is still unstable, the Test Plan shall be reexamined for modification and adjustment.
- Starts recording the monitoring items.
- The environmental technology developer specifies modifications regarding the equipment, O&M, and the operational conditions, to ensure that the target verification apparatus is operated in an efficient and stable manner in the start-up as well as the pre- and post-processing required.
- The Verification Organization records the conditions, findings, and results of the startup of the target verification apparatus, including pre- and post-processing during the startup period, and enters them in the Verification Report.
- The environmental technology developer should attach to all constituent devices of the target verification apparatus, where it is readily accessible, data plates indicating the following items:
  - Name of device/apparatus
  - Serial number
  - Production number
  - Company name, address, name of the person in charge, emergency contact address of the environmental technology developer
  - Electrical requirements (volts, phase, amps, and Hertz)
  - Precautions on transporting and handling
  - Cautions and alarms (ensure readability and visibility)
  - Volume or flow rate (if applicable)

2. Operations and maintenance

The target verification apparatus should be inspected periodically and kept in a suitable condition in order to maintain stable operation and thereby ensure proper operation and increase the efficiency of operation throughout the test period. Regardless of whether the Verification Organization or another organization is responsible for the O&M, all procedures involving inspection and O&M should be adjusted in advance by the Verification Organization, described in the Test Plan, and confirmed by the parties concerned. In any case, persons who have detailed knowledge of wastewater treatment and are familiar with the O&M of similar apparatuses should conduct the O&M.

(1) Regular operations and maintenance

- O&M to ensure proper operation of the target verification apparatus during the test period should be performed in accordance with the O&M manual.
- Calibration should be performed in accordance with the O&M manual. Calibration should also be performed at least as frequently as specified in the O&M manual. In addition, a record of calibration should be included in the record of O&M at the Test Site.
- Monitoring items should be kept within predetermined ranges to ensure proper operation of the apparatus.
- All these actions taken for O&M should be recorded. The record of each action for O&M should include the site, date, name of the person in charge, actions taken, findings at the Test Site/target verification

apparatus, and the results. These records should be included in the record of O&M at the Test Site, as well as in the Verification Report.

- In selecting the verification items regarding O&M, the problems that may arise when an operator is not sufficiently capable of conducting O&M should also be considered.
- To ensure stable operation of the target verification apparatus, these O&M activities may be conducted beyond the frequency or level specified in the O&M manual. In that case, the Verification Organization shall distinguish the O&M activities needed for the target verification technology from the actual O&M activities in preparing the Verification Report.

(2) Actions in the event of abnormal conditions

The Verification Organization will inform the environmental technology developer as soon as possible in the event of abnormal conditions. The Verification Organization should take the actions for restoring the apparatus to stable operation specified by the environmental technology developer. In the event of unforeseen circumstances, the Verification Organization will take the actions together with the environmental technology developer.

The data obtained under the abnormal conditions will not be used in the statistical analysis for the Verification Report, but shall be described and analyzed in the Verification Report. As soon as stable operation is resumed, alternative samples will be taken.

The conditions, cause and result, and method for resumption under abnormal conditions shall be described in the Verification Report. When the cause is unclear or it is not possible to judge whether the conditions are indeed unusual, the data obtained during the period is used in the statistical analysis for the Verification Report.

(3) Summarization of cost information

In cooperation with the environmental technology developer and the owner of the Test Site, the Verification Organization shall collect and sort the data required for cost estimation for O&M, such as the costs for processing sludge and waste, for electricity at the Test Site, for wastewater treatment chemicals, and for other consumables, to the extent possible.

3. Measurement methods

(1) Sampling

Samples for analysis are taken in accordance with the procedures described in the relevant JIS standards. The measurement methods for items of field research such as pH and temperature should be determined with reference to “JIS K 0094 7.2 Water temperature” and the like. In addition, the devices used for sampling should be specifically described in the Test Plan.

The Verification Organization determines the location, period, frequency, and the like of sampling, in accordance with JIS K 0094 “Sampling method of industrial water and wastewater.” In determining the date and frequency of sampling, the operation patterns of the Test Site and other information shall be taken into consideration to ensure the safety of operation.

> Excerpt of JIS K 0094 “5. Test items and amount of sample”
>
> Test items and amount of sample　The amount of sample differs depending on the combination of those as the number of test items, concentration of target component, and preserving treatment of sample. Generally speaking, one item needs about 0.5 liter to 1 liter, and 2 liter to 10 liter shall be enough for all tests. When sample is to be preserved instead of immediate test, considering the amount to be preserved in common to test items, the number of test containers and amount to be sampled shall be decided (refer to 7.). In case where an individual standard specifies the amount of sample to be taken, follow it.

Excerpt of JIS K 0094 “6. Items to be recorded when sampling”

Items to be recorded when sampling When sampling, the following items shall be recorded.

a) Name of sample and sample number

b) Name of sampling site and position of sampling (such as surface water or depth of sampling)

c) Date and time of sampling

d) Name of person carried sampling

e) Situation of sampling site (items probably giving influence on sample quality, such as rough sketch of sampling site)

f) Atmospheric temperature and water temperature when sampling

g) Other referential matters such as appearance of sample (color, turbidity or the like of sample), or existence of odor.

Excerpt of JIS K 0094 “10. Sampling of industrial wastewater”

Sampling site It shall be the discharging point of factory or workshop. Where it is difficult to sample at discharging point, the sampling site may be chosen where the same quality of wastewater can be sampled, for instance, the sewerage cesspool of wastewater channel or wastewater pipe line, or the discharging point of final conditioning tank or treating facilities for wastewater.

Sampling time and sampling frequency Sampling times shall be decided in light of regular operation hours or operation hours of the wastewater treatment facility. The frequency of sampling shall be decided according to the purpose of the test.

Remarks 1. Though sampling time and sampling frequency are decided according to the fluctuation of water quality, generally in case of daily test, make sampling 3 times or more in working time of a day (every 2 h or 3 h), but in case of less fluctuation of water quality, it may be lessened.

When making weekly water test, carry out whole-day water test by 2 days or 3 days in a week, and carry out this test for 4 weeks or more.

When making monthly water test, carry out whole-day water test by 2 days or 3 days a week in every other month. Alternatively, sample one time a day, whose time zone is shifted, with interval of 1 day or 2 days.

When obtaining average quality of water in a day, mixed sample (composite sample) in available. Conveniently, carry out sampling 3 times or more (for instance every 2 h or 3 h) in working time of one day to prepare mixed sample, however, it is advisable to mix at mixing ratio proportionally to the flow-rate change of industrial wastewater, and if the load capacity of wastewater quality is to be obtained, sampling method according to 4.2.2 would be better. When mixing of samples causes the reaction giving inferior influence for test, mixing sample cannot be done.

(2) Methods for measuring monitoring items

The flow rates of influent wastewater and treated water should be measured in accordance with the following:

- JIS K 0094 8. Measurement of flow rate, in “Sampling methods for industrial water and industrial wastewater”
- JIS Z 8762 “Measurement of fluid flow by means of orifice plates, nozzles, and venturi tubes inserted into circular cross-section conduits running full”
- JIS Z 8765 “Method of flow measurement by turbine meters”
- JIS Z 8766 “Vortex flowmeters - Methods of flow measurement”

If it is difficult to measure monitoring items by these methods, the Verification Organization may employ an alternative method on the advice of the committee on the pilot project for the environmental technology verification.

Monitoring items other than flow rates shall be measured according to MoE Notification No. 64, 1974 “Testing method regarding wastewater standards ordained by the Minister for the Environment in

accordance with the provision in the decree that specifies wastewater standards." If there is no appropriate method specified, consult the relevant JIS standards.

Excerpt of JIS K 0094 "8.6 Flow-rate measuring condition of wastewater and creation of measured value"

Unit of examination During the working period in a factory or workshop, or during the operating period of wastewater treatment facilities, choose days when there is no unusualness in the working time, the disposal amount of wastewater, and working condition, and then conduct the examination on the flow rate of wastewater by making at least one working day one unit.

Intervals of examination On the examination day, principally, perform the measurement of the amount of wastewater at an absolutely constant interval of 10 minutes or 15 minutes from the opening time of working or from the operating time of wastewater treatment facilities, and continue the measurement from the finish of working on that day to the opening of the next day's work or from the finish until the discharge of wastewater ends. In the case of no fluctuation in the flow rate of wastewater, the above time interval may be suitably prolonged.

(3) Measurement methods for verification items

i. Verification items regarding water quality

The measurement methods for verification items regarding water quality are summarized in Table 9. The measurement methods for major items to be verified for reference are summarized in Table 10. Measurement methods for items other than the test items specified below shall be specified in the Test Plan with reference to the relevant JIS standards and regulations.

Table 9 Measurement methods for verification items regarding water quality

Verification item	Method
Boron concentration in treated water	MoE Notification No. 64, 1974 "Testing method regarding wastewater standards ordained by the Minister for the Environment in accordance with the provision in the decree that specifies wastewater standards" shall be followed. (Methods specified in MoE Notification No. 59, 1971 "Environmental standards regarding water pollution" Appendix Table 7 or JIS K 0102 47)
Boron removal efficiency	Boron removal efficiency shall be calculated from the amounts of boron in influent wastewater and treated water. The amounts of boron in influent wastewater and treated water shall be calculated from the boron concentrations and the amounts of water in the measurement dates.

Table 10 Measurement methods for major items to be verified for reference

Verification item	Method
pH (hydrogen ion concentration)	MoE Notification No. 64, 1974 "Testing method regarding wastewater standards ordained by the Minister for the Environment in accordance with the provision in the decree that specifies wastewater standards" shall be followed. (Methods specified in JIS K 0102 12.1)
Boron recovery rate	Recovery rates shall be calculated from the amount of boron removed and the amount of born recovered in the test period (boron recovered in a place other than the Test Site can be included). The amount of removed boron shall be calculated from the amount of influent wastewater, the concentration of boron in the influent wastewater, the amount of treated water, and the concentration of boron in the treated water. Boron concentrations shall be determined by the methods for measuring verification items regarding the water quality mentioned above, and flow rates determined as a monitoring item shall be used. The amount of recovered boron shall be determined using a calibrated instrument. If solid boron is recovered, an electronic balance shall be used.
Nonmetallic elements other than boron	MoE Notification No. 64, 1974 "Testing method regarding wastewater standards ordained by the Minister for the Environment in accordance with the provision in the decree that specifies wastewater standards" shall be followed. If there is no appropriate method specified, the Verification Organization shall specify an appropriate method.
Water pollutants other than the above nonmetallic elements	

Ⅱ. Measurement methods for verification items regarding environmental load

The measurement methods for major verification items regarding environmental load are summarized in Table 11.

Measurement methods for items other than the test items specified below shall be specified in the Test Plan with reference to the relevant JIS standards and regulations. The Verification Organizations should describe the measurement items and measurement methods in the Verification Report.

Table 11 Measurement methods for major verification items regarding environmental load

Category	Verification item	Method
Environmental impact	Amount of sludge produced	Appropriately set by the Verification Organization.
	Types and amounts of waste products other than sludge	Appropriately set by the Verification Organization. Record handling categories such as industrial waste or general waste from business activities.
	Noise	Noise level during operation of the apparatus (main unit). Use a noise level meter, if possible.
	Odor	Determine odor concentrations by the triangle odor bag method, the triangle odor flask method or other methods.
	Qualitative evaluation such as ease of treatment of sludge, waste products and foul odor (ease of secondary treatment, effective use)	Describe ease of secondary treatment and the results of an effective use test.

(3) Measurement methods for verification items regarding operations and maintenance

The measurement methods for major verification items regarding operations and maintenance are summarized in Table 12.

The unit prices for estimation of the cost of electricity, water, and others shall be set appropriately by the Verification Organizations.

The Verification Organizations should describe the measurement items and measurement methods in the Verification Report.

Table 12 Measurement methods for major verification items regarding operations and maintenance

Category	Verification item	Method
Electricity use and material consumption	Electricity consumption	Determine from the value of the current integrators in all apparatuses when equipment is in operation and not in operation.
	Types and amounts of wastewater treatment chemicals	Determine by a constant rate pump or an indicator installed in the wall of the storage tank.
	Other consumables	Appropriately set by the Verification Organization.
O&M performance	Visual inspection of effluent quality	Describe color, turbidity, bubbles, production of solids, etc.
	Period required for startup of the target verification apparatus Period required for shutdown of the target verification apparatus	Time actually required (in appropriate units).
	Number of operators, and the level of operator skill required for O&M of the target verification apparatus	Evaluate based on the results of actual operation.
	Evaluation of O&M manual	Evaluate based on the results of actual use.
	Reliability of the target verification apparatus	Describe the causes of problems.
	Method of restoring from problems	Evaluate measures to combat a power failure based on the test results submitted by the environmental technology developer. Specifically, evaluate measures (1) when the target verification apparatus is shut down by a power failure and (2) when the power supply is resumed. Check ease of restoring from problems in the O&M manual and the results of actual operation.

VI. Preparation of the Verification Report

The results obtained in the verification test shall be reported in the Verification Report. All data, including the results of the verification test for the period from startup to the end of operation, all actions taken for O&M, and any changes during the test period, shall be described in the Verification Report.

The Verification Report shall contain the following:

- Executive summary (Refer to Appendix 3.)
- Introduction and background
- Overview of the target verification technology and apparatus
    - Principle and configuration of the target verification technology
    - Specifications and capacity of the target verification apparatus
- Manufacturer of product (Name, address, TEL)
- Serial number
- Overview of the Test Site
    - Business conditions
    - Conditions of wastewater (influent wastewater fed into the equipment)
    - Location of the target verification technology
- Method and conditions of the verification test
    - Schedule of the entire verification test
    - Monitoring items (method and date)
    - Verification items regarding water quality (methods and dates of sampling, analysis, and calibration)
    - Verification items regarding environmental load (method and date)
    - Verification items regarding O&M (method and date)
- Results and discussions of the verification test (The measurement and analytical results shall be shown in tables and graphs.)
    - Monitoring items
    - Verification items regarding water quality
    - Verification items regarding environmental load
    - Verification items regarding O&M
    - Report of outliers
- Appendix
    - Quality control of data
    - Auditing of the quality management system

As basic materials of the Verification Report, the Verification Organization shall submit the O&M manual, records of O&M, records of sampling and analyses, records of auditing of the quality management system, and other records with the Verification Report to the Ministry of the Environment.

The Verification Organization prepares a draft of the Verification Report and, after obtaining the consent of the environmental technology developer concerning the description and discussions of the Technology Panel, finalizes the Verification Report. The Verification Report submitted to the Ministry of the Environment shall be discussed by the working group and approved by the Ministry of the Environment.

VII. Remarks in conducting the verification test

1. Quality control of data

(1) Data-quality index

It is absolutely necessary that the data on the verification items be accurate and reliable.

The data on the verification items contains errors and variation due to various factors, such as the individual who conducts measurement, the sample storage condition, the reagents used, the analytical environment, and the like, and thus the accuracy of the data should be controlled properly during the entire test period, from sampling and analytical procedures to the rounding up of the results.

Quantitative data-quality indexes (DQIs) could include the following:

- Precision (standard deviation or range obtained by measuring several subsamples of the same sample)
- Completeness (percentage of the number of valid samples that should have been taken)

When there is data that requires quality management using DQI, such as the measured values of the concentration of trace chemicals, that data should be identified. Acceptable limits and criteria, and evaluation procedures should be specified and described in the Test Plan, along with the above data.

Some verification items regarding water quality are not suitable for quality control with DQI due to their analytical procedures, and thus the accuracy of these items should be controlled in accordance particularly with the data management & verification method shown in Table 13, in addition to the standard operation rules which the organization employs.

These methods of accuracy control should be used in the handling of data that is to be given as the test results in the Verification Report, and the data for use in the calculation of these results.

Table 13 Methods for accuracy control

Verification item regarding water quality	Method for accuracy control
Boron concentration	Duplicate or triplicate sampling of approximately 10% of all the samples.

(2) Measurement and data acquisition

For quality control of data, the following requirements should be given during measurement and data acquisition:

- Any assumptions on which the Test Plan is based, as well as all sampling locations and the samples to be collected there, should be reported to and approved by the Technology Panel during design of the Test Plan.
- Any time sampling and analysis of samples are conducted, a record of these actions and confirmation should be kept.
- Any non-standard sampling methods and devices or analytical methods and instruments that may affect the representativeness of data should be validated and documented.
- The requirements for sample handling, storage location, and transportation should also be described. The description shall include sample labels, custody forms, and sample custody log.
- All analytical methods and instruments used should be documented.
- The requirements for the calibration of all analytical instruments and procedures, including the calibration standards, should be specified in the Test Plan.
- Any type of data not obtained by measurement, such as that obtained through interviews and the like, should be examined to determine the limitation on the use.

2. Management, analysis, and presentation of data

The data obtained in the verification test includes quantitative data such as that on verification items regarding water quality, flow rate, the amount of chemicals used for wastewater treatment, and the amount of waste sludge, as well as qualitative data such as that on the reliability and operability of the target verification apparatus and operators' demands. The methods for the management, analysis, and presentation of these data are as follows:

(1) Data management

Data should be managed securely, as described in "Appendix 0: Quality management system to be constructed at the Verification Organizations, 3. Quality management system, (3) Control of documents and records." A Verification Organization shall appoint a data quality manager.

(2) Data analysis and presentation

The data obtained in the verification test should be analyzed statistically and presented. All mathematical expressions used for statistical analysis shall be given in the Verification Report. The data not subjected to the statistical analysis (including that obtained under abnormal conditions) shall be reported in the section of "report of outliers" in the Verification Report.

i. Analysis and presentation of flow rates

- Table showing all flow rate data monitored
- Graph showing daily changes in flow rates
- Graph showing weekly changes in daily flow rates
- Graph showing daily variations in flow rates during the test period
- Box plot showing daily flow rates during the test period

ii. Analysis and presentation of verification items regarding water quality

- Graph showing all sampling results
- Graph showing daily changes in pollutant concentrations
- Graph showing weekly changes in pollutant concentrations
- Graph showing daily variations in pollutant concentrations during the test period
- Box plot showing pollutant concentrations during the test period

iii. Analysis and presentation of verification items regarding environmental load

- Measurements of measurement items (tables or graphs)
- Other findings

iv. Analysis and presentation of verification items regarding O&M

- Measurements of resource consumptions (tables or graphs)
- Findings on the number of operators and the level of operator skill required for O&M of the target verification apparatus
- Summary of the operability and reliability of the target verification apparatus (indicating both stable operation and abnormal conditions)
- Summary of the reliability of the target verification apparatus and the variations in verification items regarding O&M observed during the verification test
- Findings on evaluation of the O&M manual
- Monthly average maintenance hours
- Other findings

3. Environment, health and safety

The Verification Organization should take strict environment, health and safety measures with respect to the verification test. In establishing a Test Plan, relevant environmental problems and potential hazards regarding the verification test and Test Site should be identified, and countermeasures to combat them should be specified. The Verification Organization should inform the personnel at the Test Site, including employers and employees who are not involved in the verification test, of the potential hazards and the countermeasures to combat them. The following, among others, are to be discussed in establishing a Test Plan:

- Precaution regarding the operation of the target verification apparatus, emission of processed wastewater, and generation of waste
- Biological, chemical and electrical hazards
- Handling, storage and discharge of the chemicals relevant to the verification test
- Handling and discharge of residues and waste relevant to the verification test
- Material Safety Data Sheet
- Compliance with local regulations regarding electricity and plumbing
- Exhaust and ventilation systems, when gases are generated in the target verification apparatus
- Prevention of fires
- Confirmation of emergency contacts (emergency medical, fire fighting, etc.)
- Ensuring of occupational health and safety
- Others

The address and phone number of emergency contacts, and of the nearest hospital should be listed on one page. The sheet should be displayed in a suitable location, protected by a transparent plastic cover.

Appendix 0: Quality management system to be constructed at the Verification Organizations

Introduction

The Verification Organizations participating in the pilot project for the environmental technology verification should desirably construct the quality management system in accordance with JIS Q 17025:2000 (ISO/IEC 17025:1999) “General requirements for the competence of testing and calibration laboratories.” In this Appendix, some elements of the quality management system that are required to be constructed at Verification Organizations that do not have such a quality management system in accordance with the above standard will be described.

1. Scope

The quality management system specified in this Appendix is applicable to all departments or procedures relevant to the verification test in the Verification Organization. In addition, if part of the verification test is subcontracted to an external organization, that organization is also included in the scope of application.

The Verification Organization in which all departments relevant to the verification test have already received the following certification, JIS Q 17025:2000 (General requirements for the competence of testing and calibration laboratories) or JIS Q 9001:2000 (Quality management systems - Requirements), will be regarded as satisfying the requirements specified in this Appendix.

2. References

JIS Q 17025:2000 (ISO/IEC 17025:1999) General requirements for the competence of testing and calibration laboratories

JIS Q 9001:2000 (IS0 9001: 2000) Quality management systems – Requirements

3. Quality management system

(1) Organization and responsibility

The organization concerned shall be an entity that can be held legally responsible.

The responsibilities of key personnel in the organization relevant to the verification tests shall be clearly defined.

Appoint a member of the staff as a quality manager (however named) who, irrespective of his or her other duties and responsibilities, shall have defined responsibility and authority for ensuring that the quality system is implemented and followed at all times.

(2) Quality system

The organization concerned shall establish, implement, and maintain a quality management system appropriate to the scope of its activities regarding the verification test.

In the quality management system, the quality policy regarding the verification test and the procedures for the quality management system shall be documented. These documents shall be communicated to and understood by the appropriate personnel.

The policy shall include the following:

a) The organization’s commitment to ensuring the quality of verification tests

b) The organization’s statement on the quality standard of the verification tests

c) The objectives of the quality system

d) A description of the construction and implementation of the quality management system

In addition, the system for promoting verification tests, as well as the role, responsibility, and authority of the personnel concerned, shall be documented.

(3) Control of documents and records

The organization concerned shall control documents such as the standards regarding the verification tests (protocol for the verification and relevant standards) and the Test Plan, as well as drawings, software,

specifications, written directives, and manuals.

With respect to document control, the following shall be ensured:

a) All documents shall be reviewed and approved for use by authorized personnel prior to their issuance.

b) All documents shall contain a description of the relevant documents to ensure that appropriate documents can be found easily and are available at any time at all Test Sites.

c) Invalid and/or obsolete documents shall be promptly removed or be assuredly prevented from unintended use.

d) The management method for documents as data shall be specified and maintained.

e) The form for records and the location of documents, as well as the inspection method, shall be specified and maintained.

In addition, records regarding the verification tests shall be identified, properly collected, indexed, specified for usage, filed for applications, maintained, and adequately discharged, and the storage period for them shall be decided. In particular, records in the original copy of the test data, data and information that enable trace audits, records of calibrations, records of the persons involved, each individual report published, and copies of calibration certificates shall be stored for a predetermined period.

(4) Subcontracting of the tests

If the organization concerned subcontracts to perform the verification test, the organization shall select a competent external organization, and demand the same quality management as that of the Verification Organization.

(5) Purchase of goods and services

The organization concerned shall examine, by appropriate measures such as inspection, whether the goods and services purchased from external sources that may affect the quality of verification tests satisfy the requirements specified in the protocol for the verification, and shall not use them for the verification tests until this examination is completed.

In addition, the organization shall evaluate the suppliers of goods and services, and make a list of the approved suppliers.

(6) Control of complaints and nonconforming tests

The organization concerned shall have a system and method that shall be implemented when any of its verification tests or the results of these tests do not conform to the protocol for the verification or other specifications for any reason. The organization shall have a system and method for handling contingencies such as complaints from environmental technology developers, the inhibition of impartiality, information leaks, and others. These systems shall include the person in charge and personnel required for the handling of such cases.

(7) Corrective and preventive actions

When any of its verification tests or the results of these tests do not or may not conform to the protocol for the verification or other specifications, the organization concerned shall investigate the reasons and take corrective or preventive actions.

(8) Audit

The organization concerned shall conduct audits to judge whether the verification test has been properly conducted. When the verification test is subcontracted to an external organization, the operations of the subcontracted organization shall be audited.

The audit shall be conducted at least once during the test period. If the verification test lasts for 2 years or more, the audit shall be conducted periodically, and the frequency of the audit shall desirably be more than once per year.

In addition, the audit shall be conducted by personnel who are independent of the verification test to as great an extent as possible. The results of the audit shall be reported to the superintendent of the organization concerned.

4. Technical requirements

(1) Personnel

The organization concerned shall ensure the competence of all who operate specific equipment for the verification test, perform tests, evaluate results, and sign test reports. The personnel performing specific tasks shall be qualified on the basis of appropriate education, training, and/or demonstrated skills, as required.

(2) Accommodation and environmental conditions

The facilities for the verification test, including but not limited to energy sources, lighting, and environmental conditions, shall be such as to facilitate correct performance of the tests. The organization concerned shall ensure that the environmental conditions do not invalidate the results or adversely affect the required quality of any measurement. Particular care shall be taken when the verification test is undertaken at sites other than a permanent laboratory facility.

The organization concerned shall monitor, control, and record environmental conditions of the test in accordance with the protocol for the verification, the Test Plan, and other standards. Tests shall be stopped when the environmental conditions jeopardize the results of the tests.

(3) Test methods and method validation

The organization concerned shall use appropriate methods and procedures for all tests within its scope and determine the test methods in accordance with the protocol for the verification.

When the method to be used is not specified in the protocol for the verification, the organization concerned shall select either an appropriate method disclosed in international standards, regional or national standards, scientific texts, or the like, or a method specified by the manufacturer of the equipment. When it is necessary to use methods not covered by standard methods, these shall be subject to agreement with the verification applicant, and their validity shall be appropriately examined prior to use. Validation is the confirmation by examination that the requirements for a specific intended use are fulfilled. The validation shall be conducted based on discussion and subsequent approval by the Technology Panel.

When computers or automated equipment are used for data management, the organization concerned shall provide suitable environmental and operational conditions for the purpose of managing the computers and automated equipment properly, to ensure that there is no loss or improper conversion of data as a result of accidental erasure.

(4) Equipment

The organization concerned shall be furnished with (or leased) all items of the equipment required for the execution of verification tests. If a piece of equipment can only be operated by authorized personnel, the organization concerned shall specify the equipment. Equipment that has been subjected to overloading or mishandling, gives suspect results, or has been shown to be defective or outside specified limits, shall be taken out of service until it has been repaired and confirmed to perform correctly.

(5) Measurement traceability

All equipment used for tests that has a significant effect on the accuracy or validity of the result of the verification test shall be calibrated before being put into service.

(6) Sampling

The organization concerned shall take samples of reagents, materials, or products in accordance with the protocol for the verification.

(7) Handling of test and calibration items

If necessary, the organization concerned shall transport, receive, handle, protect, store, retain, and/or dispose of test items in accordance with the protocol for the verification.

(8) Verification of data and assurance of test result quality

The data resulting from the verification test shall be recorded in such a way that trends are detectable and, where practicable, statistical techniques shall be applied to the review of the results. This verification shall be conducted by a person other than the one who conducts the verification test.

(9) Reporting the results

The organization concerned shall report the results of the test conducted accurately, clearly, unambiguously, and objectively in accordance with the protocol of the verification tests.

Appendix 1: Application form for verification

A verification applicant should submit the application form specified below.

If apparatuses of the same series that treat different types of solvent or are different in size are available, the target apparatus shall be described.

[Applicant]

Company name*	
Address*	
Division and name of person in charge*	
Contact address*	TEL: FAX:
	e-mail:
Name of technology/product*	

1.Overview of the technology

Configuration and process flow diagram
Principle
Features/selling points

2. In-house test results

Person in charge of measurement*	Seal
Date of measurement*	

Water quality/water volume*

Measurements of the volume of water, quality of influent water (boron concentrations, etc.), and quality of treated water (boron concentration, etc.) shall be presented. Target water quality set in advance, if any, shall also be presented. Ideally, measurements in the Test Site should be presented. If detailed test results can be presented, present them on a separate sheet and indicate that in this field.

Environmental impact and electricity use and material consumption*

Item	Unit	Measurement value, etc.
Amount of waste sludge	kg/day	
Amount of generated waste	kg/day	
Possibility of generating noise and foul odor		
Electricity and other power use	kWh/day	
( )	kg/day	
Types and amount of wastewater treatment chemicals* ( )	kg/day	
Give the chemical names in parentheses ( )	kg/day	
( )	kg/day	
Amount of other consumables ( )	kg/day	
Give the consumable names in parentheses ( )	kg/day	

O&M*

Control item Give control items such as "refilling of wastewater treatment chemicals," "sludge/waste treatment," and "periodic inspection."	Time required for each control	Frequency of control Circle month, week, or day. Give the number of times in parentheses.
	( ) min	( ) times per (month, week, or day)
	( ) min	( ) times per (month, week, or day)
	( ) min	( ) times per (month, week, or day)
	( ) min	( ) times per (month, week, or day)

3. Product data (Describe the apparatus installed at the Test Site.)

Item		Description
Name of the target verification apparatus*		
Serial number		
Name of the manufacturer*		
Contact address*	TEL	(　　)　　－
	Website	http://
	E-mail	@
	FAX	(　　)　　－
Dimensions*	W（mm）	
	D（mm）	
	H（mm）	
Weight (kg)		
Necessity of pre- and post-treatment*		No Yes Describe in detail:
Additional equipment*		No Yes Describe in detail:
Life of the target verification apparatus*		

	Expense item	Unit cost	Quantity	Total
Approximate cost Examples of expense items of the initial cost: Civil work, construction, equipment, etc. Examples of expense items of the running cost: Wastewater treatment chemicals, consumables, sludge and waste disposal, electricity, etc.	Initial cost			
	Running cost (per month)			
	Yen/m^3 of treated water			

4. Developmental status and past delivery record*

Check the number that best describes the current situation.

1. The apparatus is only available as a pilot unit and is not commercialized.
2. The apparatus has already been commercialized and is available as a product.
3. The apparatus has past delivery records.

Describe the past records in detail:

5. Innovativeness of the technology

Describe the innovativeness of the technology, patents, utility model patents, or others filed or granted, scientific papers disclosed, past awards, and the like.

6. Test Site*

7. Other relevant or unique features (if any)

[Documents to be attached to this application form]

- ○ Technical specification for the technology/product
- ○ In-house test results
- ○ Written approval of the verification test by the owner of the Test Site
- ○ O&M manual

An O&M manual is a document that describes methods for operating and maintaining a target verification apparatus. An O&M manual shall contain the following information:

- Method for installing the target verification apparatus
- Method for operating the target verification apparatus (standard operational pattern, required treatment time, etc.)
- Method for maintenance and management
- Troubleshooting

Appendix 2: Test Plan

The Test Plan provides a general description of the objectives and procedures of verification tests, such as the design of verification tests and the various procedures in the verification tests. The content of the Test Plan may vary according to circumstances, but should include at least the following:

1. Cover sheet/approval of the verification test participants/table of contents

A cover sheet for the Test Plan, names of pilot project participants (responsible official of the Verification Organization and the environmental technology developer) who approved the Test Plan, and the table of contents shall be given.

2. Participating organizations and personnel responsibilities

The organizations participating in the verification tests and the responsibilities of the representatives shall be described.

3. Test Site description

- Name, location, address, and owner of the Test Site
- Information on the business conditions of the Test Site (type of business (inn, plating plant, etc.), business scale (how many guests can be accommodated, plating bath capacity, etc.), number of employees, number of guests per month, plating work rates, etc.)
- Current flow rate, water quality, processing condition of wastewater
- Location of the target verification apparatus, method of feeding wastewater to the target verification apparatus, wastewater distribution diagram of the entire establishment

4. The target verification technology and apparatus description

- Principle of the target verification apparatus, system configuration including pre- and post-processing
- Capacity of the flow rate and pollutant load, dimensions and weight of the target verification apparatus
- Required consumables, expendables, electricity and other resource consumptions
- Work items required for the O&M of the target verification apparatus
- Wastewater discharged from the target verification apparatus
- Control of the processing conditions required by the target verification apparatus (addition of salts, pH control, n-HEX concentrations, etc.)
- Physical and chemical nature and frequency of the generation of sludge and waste, precautions on handling
- The level of operator skill required to successfully operate and manage the target verification apparatus
- Noise and foul odor control, housing requirement

5. Details of the verification test

(1) Test period

- Test period and entire schedule

(2) Startup of the target verification apparatus (only when the target verification apparatus is newly installed)

- Startup schedule for the target verification apparatus
- Remarks on startup (flow rate, type and conc. of additives, calibration and adjustment of constituent parts, etc.)

(3) Monitoring

- Locations for monitoring the flow rate, monitoring method and instrument, monitoring schedule
- Measurement/monitoring methods for other monitoring items and work schedule

(4) Target water quality

- Selected target technology type (target technology (1) or (2)) and target water quality

(5) Verification test for verification items regarding water quality

- Verification items regarding water quality
- Sampling method, devices for sampling, sampling schedule (frequency), storage method, storage period
- Analytical methods and instruments, analytical schedule
- Calibration method and calibration schedule

(6) Verification test for verification items regarding environmental load

- Verification items regarding environmental load
- Analytical methods and instruments, analytical schedule

(7) Verification tests for verification items regarding operations and maintenance

- Verification items regarding operations and maintenance
- Operational schedule, person in charge, and documentation formats
- Methods of evaluating the data provided by the environmental technology developer
- Other verification items, evaluation methods, and information collection schedule

6. Quality control of data

- Types of data that use a data quality index (DQI), such as precision, completeness, etc., as well as the method
- Necessity of providing additional quality-control information, such as data on the calibration of devices for sampling and analytical instruments, relevant information, etc. (All unprocessed data will be described in the Verification Report as an Appendix.)

7. Management, analysis and presentation of data

(1) Data management

Data that are produced in the verification test and are to be managed, and forms in which the data should be managed shall be specified.

(2) Analysis and presentation

Methods of data analysis and presentation format of data shall be specified in the Test Plan.

8. Audit

An audit schedule, audit procedures, and information on the audit group shall be specified in the Test Plan.

9. Appendix

The following should be described in the Test Plan as an Appendix:

- O&M manual provided by the environmental technology developer
- Historical data on the flow rate and quality of influent wastewater
- Other literature and data for reference

Appendix 3: Form of Verification Report

Target verification technology/environmental technology developer	
Verification Organization	
Verification test period	From to

1.Overview of the target verification technology

Flow sheet (Diagram)	Principle

2. Overview of the verification test

○ Overview of the Test Site

Type of business	Hot spring inn (target technology (1))/Plating plant (target technology (2))
Business scale	
Address	
Amount of wastewater discharged during the test period	

○ Specifications and capacity of the target verification apparatus

Classificatio	Item	Specifications and capacity
Facility overview	Name/type	
	Dimensions (mm), weight	
Design conditions	Substance(s) to be treated	
	Amount of influent wastewater per day (m^3/day)	
	Inlet time (hours)	
	Amount of influent wastewater per hour (m^3/h)	
	Quality of influent wastewater	
	Quality of treated water (target water quality)	
	Treatment method	
Others		

3. Results of the verification test

This test is intended to verify the performance of a target verification apparatus to treat all boron elements, and fluoroborates, which are difficult to treat, may be counted as boron not treated.

○ Verification items regarding water quality and target water quality

Item	Unit	Target water quality	Verification results (Minimum value to maximum value, median value)		
			Influent wastewater	Treated water	Removal efficiency
Boron	mg/L				

(Data for reference)

Item	Substance (or factor of water pollution)	Unit	Verification results (Minimum value to maximum value, median value)		
			Influent wastewater	Treated water	Removal efficiency
Nonmetallic elements other than boron		mg/L	~	~	~
		mg/L	~	~	~
Others		mg/L	~	~	~
		mg/L	~	~	~

Item	Unit	Verification results (Minimum value to maximum value, median value)
Boron recovery rate	%	~

(Attach box plots for the verification items regarding water quality to show the quality of influent wastewater and treated water.)

○ Items regarding environmental impact

Item	Unit	Verification results
Amount of generated sludge	kg/day	
Amount of generated waste	kg/day	
Noise		
Foul odor		

○ Items regarding used resources

Item	Unit	Verification results
Electricity consumption	kWh/day	
Amount of chemicals used for treatment		

○ Items regarding O&M

Control item	Time required for each control	Frequency of control

○ Qualitative findings

Item	Findings
Findings regarding water quality	
Period required for startup of the target verification apparatus	
Period required for shutting down the target verification apparatus	
Number of operators required for O&M	
Skill of operators required for O&M	
Evaluation of O&M manual	
Reliability of the target verification apparatus	
Method of restoring from problems	
Others	

(Reference information)

Note: All information on this page is provided by the environmental technology developer in an application for a verification test at its own responsibility. The Ministry of the Environment and the Verification Organization assume no responsibility for the information.

○ Product data

Item		Description (to be filled in by the environmental technology developer)
Name		
Type		
Name of manufacturer (distributing agent)		
Contact address	TEL/FAX	TEL (　　) —　　FAX (　　) —
	Website	
	E-mail	
Dimensions, weight		
Necessity of pre- and post-treatment		No Yes (Describe in detail:)
Additional equipment		No Yes (Describe in detail:)
Life of the target verification apparatus		
Period of time required for startup		

Approximate cost	Expense item	Unit cost	Quantity	Total
	Initial cost			
	Running cost (per month)			
	Yen/m^3 of treated water			

○ Other information provided by the manufacturer

Reference

Ⅰ.Brief overview of the pilot project for the environmental technology verification

1. Objectives

Many innovative environmental technologies that are already at a practically applicable stage and seem to be useful have not come into wide use because end users, including local municipal entities, companies, consumers, and the like, cannot use the technologies with confidence due to the lack of objective evaluation of the environmental protective effect and the like.

Accordingly, in this pilot project for the environmental technology verification, with respect to the innovative environmental technologies that have not been widely accepted as described above, the environment protective effect and others will be objectively verified by an independent organization on an experimental basis.

It is hoped that the pilot project for the environmental technology verification will accelerate the dissemination of the environmental technologies developed by venture companies and the like, and contribute to the activation of economic activity through environmental protection and the advancement of regional environmental industries.

2. What the “verification” means

In the pilot project for the environmental technology verification, the environmental protective effect and the like of particular environmental technologies will be verified through the collection of objective data based on various tests and others. There is a similar term, “certification,” in which the suitability to the standard of an environmental technology is judged in terms of the performance that a technology should provide. The present project does not conduct such “certification.”

3. System for promoting the project

The pilot project for the environmental technology verification will be conducted by the Ministry of the Environment in cooperation with the “Verification Organizations” (local municipal entities, etc.), which are independent organizations that conduct technology verification under the entrustment and contract of the Ministry of the Environment.

4. Procedures of the project

The pilot project for the environmental technology verification will generally be conducted in accordance with the following procedures:

(1) The Ministry of the Environment will identify the needs of the technology developers / distributing agents, users, and others, through the use of questionnaires or the like.

(2) The Ministry of the Environment will select target verification technology fields based on discussions in the committee on the pilot project for the environmental technology verification.

(3) The Ministry of the Environment will prepare a “protocol for the verification,” which establishes the specific methods of technology verification regarding the selected target verification technology fields.

(4) The Ministry of the Environment will select the “Verification Organizations,” which are the independent organizations that conduct the verification tests.

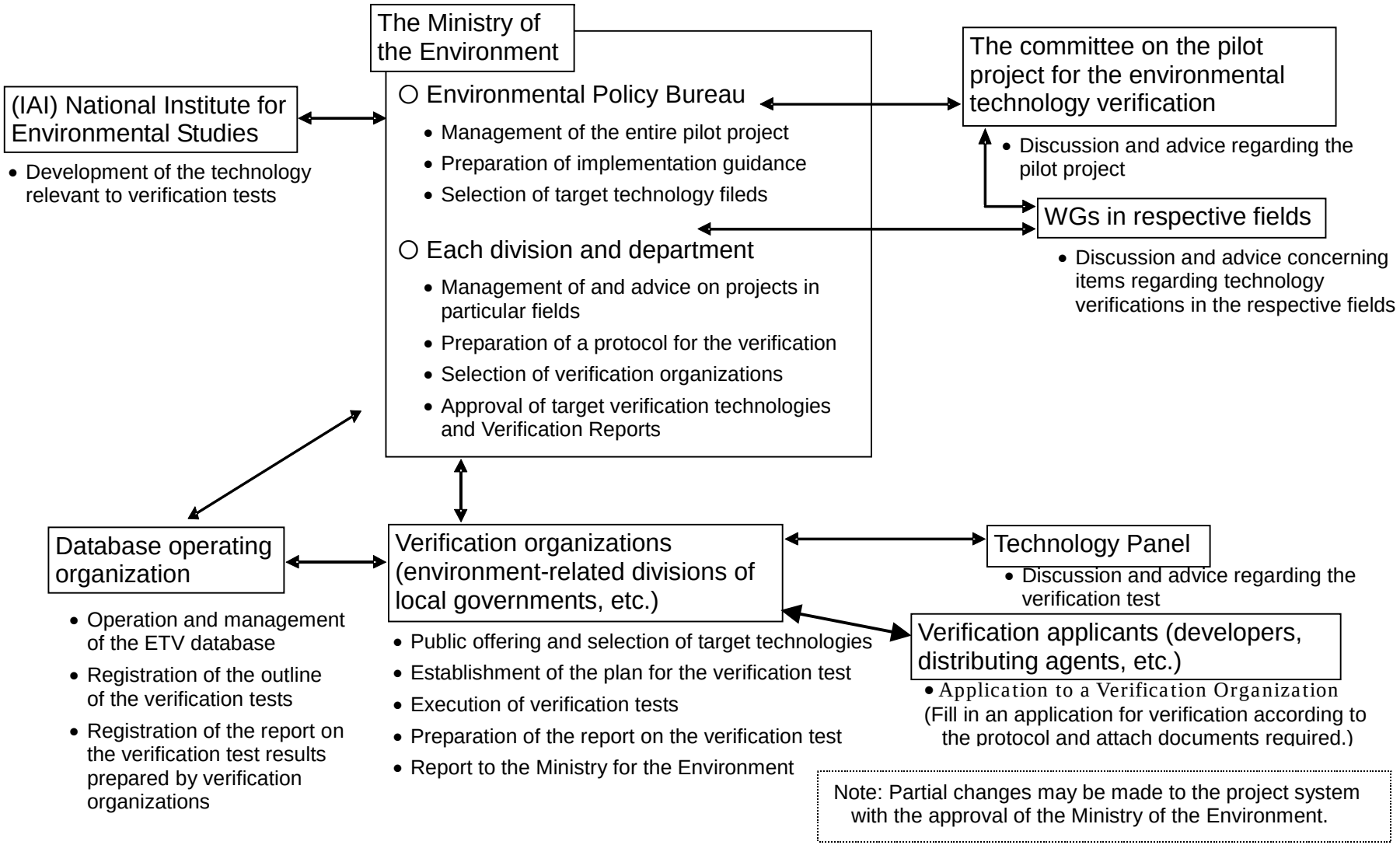
(5) The Verification Organizations will invite applications from companies and the like for the technology to be verified.

(6) The Verification Organization will select the technologies to be verified in the project from among the applications, following discussion in a panel consisting of the specialists.

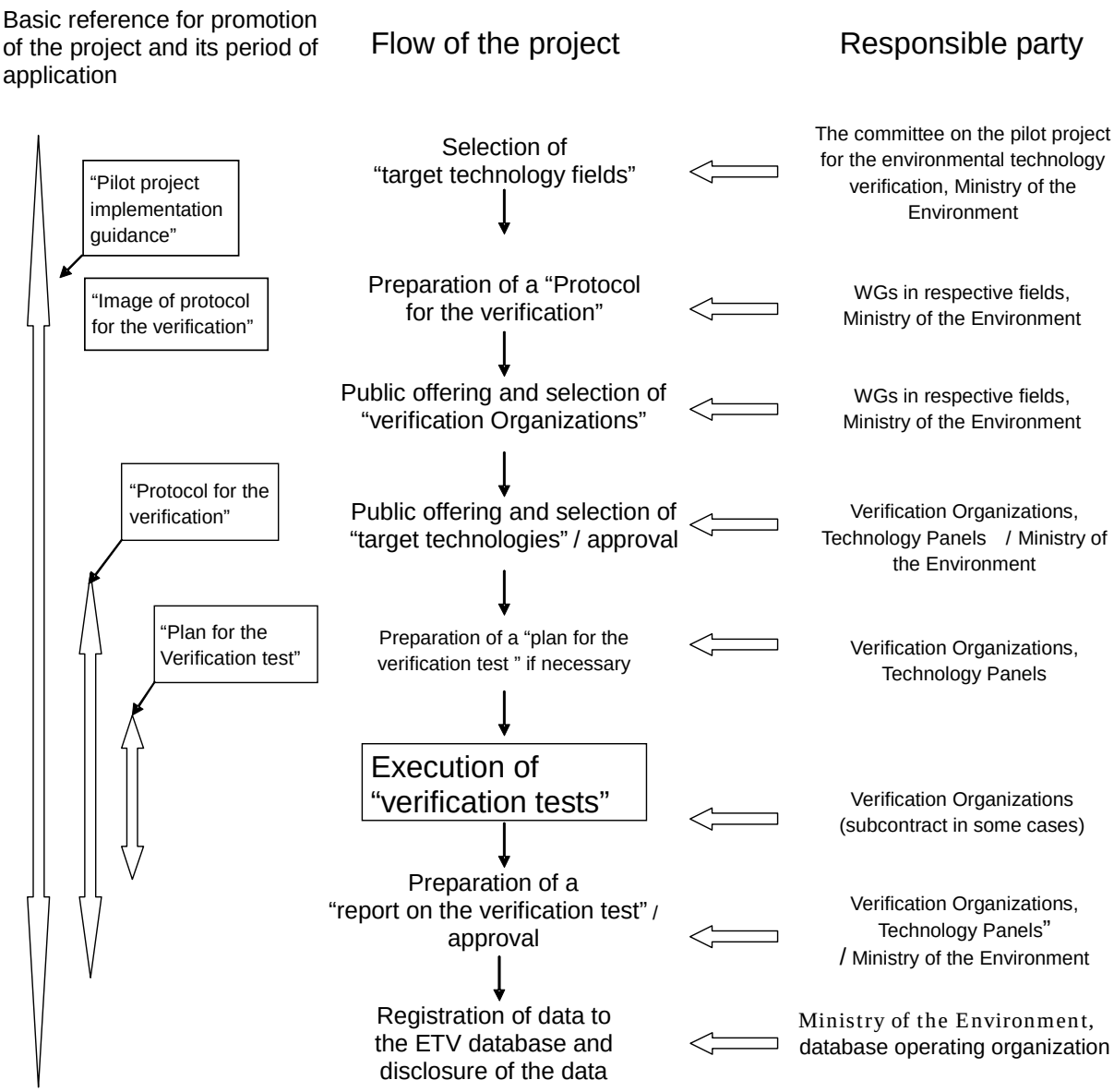
(7) The Verification Organizations will conduct verification tests on the selected technologies in accordance with the protocol for the verification.

(8) The Verification Organizations will summarize the results of the test in report form, notify the technology developers/distributing agents of them, and report to the Ministry of the Environment. In addition, the report will be registered in a database on the Internet and made available to the public.

II. System for promotion of the “pilot project for the environmental technology verification”



III. Flow of the pilot project for the environmental technology verification



IV. Prospectus for organizing the working group on the nonmetallic element-contaminated wastewater treatment technology in the committee on the pilot project for the environmental technology verification for 2004

1. Objective of the working group

The working group on the nonmetallic element-contaminated wastewater treatment technology (hereinafter referred as "working group") is established for the purpose of discussing based on specialized knowledge "nonmetallic element-contaminated wastewater treatment technology (technology for treating wastewater containing boron or other nonmetallic elements)," a technology field in which technology verification is scheduled to be conducted in 2004, in the pilot project for the environmental technology verification and thus promoting the project smoothly and efficiently.

2. Items to be investigated and discussed

(1) Field of nonmetallic element-contaminated wastewater treatment technology (technology for treating wastewater containing boron or other nonmetallic elements)

i. Preparation of a protocol for the verification

ii. Selection of Verification Organizations

iii. Confirmation of Verification Reports

iv. Other items relevant to execution of the project

(2) How future verification tests shall be conducted, and the selection of candidate technology fields

3. Organization and others

(1) The working group consists of 10 or fewer members.

(2) The working group has a chairperson.

(3) The chairperson will supervise the working group.

(4) The members will be appointed by UFJ Institute Ltd., from among academic experts, well-informed individuals, and the like relevant to verification tests on nonmetallic element-contaminated wastewater treatment technology, with the approval of the Water Environment Department of the Ministry of the Environment.

(5) The members will be under commission for the period from the date of appointment by UFJ Institute Ltd. to the end of the same fiscal year.

(6) In addition, participants and interested parties in the pilot project for the environmental technology verification may also attend the meetings of the working group as observers and the like, if necessary.

4. Disclosure of the discussion and others, etc.

Meetings of the working group will, in principle, be held in public. However, the chairperson may hold a closed meeting of the working group if a public meeting may cause significant obstacles to fair and neutral discussion, and provide particular individuals with unfair benefit or detriment.

5. Secretariat

The general affairs of the working group will be processed by UFJ Institute Ltd., with the consent of the Water Environment Department of the Ministry of the Environment.

The committee on the pilot project for the environmental technology verification for 2004

List of the members of the working group on the nonmetallic element-contaminated wastewater treatment technology

Yukio Kosaka	Leader of the Resource and Environmental Science Group, Product Development Division, Tokyo Metropolitan Industrial Technology Research Institute
Hideo Takizawa	Researcher, Division 1, Hot Spring Research Center
Makoto Natori	Adviser, International Environmental Technology Cooperation Center, The Japan Society of Industrial Machinery Manufacturers
Masanori Fujita	Professor, Graduate School of Engineering, Osaka University
Akira Miyazaki	Assistant Director, Tsukuba Center, National Institute of Advanced Industrial Science and Technology

< Secretariat (Ministry of the Environment) >

Susumu Ota	Director, Water Environment Management Division, Water Environment Department, Environmental Management Bureau
Masaaki Murayama	Deputy Director, Water Environment Management Division, Water Environment Department, Environmental Management Bureau
Nobuhito Nakanishi	Wastewater Standard Manager, Water Environment Management Division, Water Environment Department, Environmental Management Bureau
Kazuhisa Matsuda	Deputy Director, Policy Planning Division, Water Environment Department, Environmental Management Bureau
Kenji Ueda	Deputy Director, Office of Environmental Research and Technology, Environmental Policy Bureau

< Secretariat (UFJ Institute Ltd.) >

Shintaro Munakata	Researcher, Environmental Policy Consulting Department
Naoki Yoshizawa	Researcher, Environmental Policy Consulting Department
Kotaro Shimizu	Researcher, Environmental Policy Consulting Department

V. Particulars discussed in the working group on the nonmetallic element-contaminated wastewater treatment technology

(FY2004)

First meeting: 16:00 to 17:45. January 20, 2005

- Pilot project for the environmental technology verification
- Technologies for treating wastewater containing boron or other nonmetallic elements
- Protocol for the verification (first draft)

February 9, 2005 to March 2, 2005

- Invite public opinion on the protocol for the verification (second draft)

Second meeting: 14:00 to 16:00. March 16. 2005

- Protocol for the verification (third draft)
- Public offering and selection of Verification Organizations