

**Ministry of Power
The Republic of Ghana**

**Project on Electrical Engineers Training
for African Countries
in the Republic of Ghana**

**Project Completion Report
(Separate Volume)**

August 2016

**JAPAN INTERNATIONAL COOPERATION AGENCY
NEW JEC Inc.**

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(1) Monitoring Report

1) Monitoring Plan for Training Courses (Mar.2014)

1. Establishment of Monitoring Framework

As training courses carry out, project team (hereinafter referred as “PT”) will establish monitoring framework for the training course and measure the effect of training from following three perspectives. Result of monitoring will feed back to training courses.

- ① Effectiveness measurement of the training courses
- ② Confirmation of accordance with needs of electrical engineers/technicians training
- ③ Assessment on utilization of trained skills at practical work

(1) Effectiveness Measurement of the Training Courses

In order to verify trainees’ technical/ engineering understanding, PT is planning to measure the effect of training courses. Effectiveness of training courses is clarified by before-and-after performance review. Performance review is carried out at beginning and end of the training courses and measured trainees’ depth of understanding comparing with the difference of them. This performance review will be done by questionnaire and/or interview. If there are items that is not confirmed the effectiveness of increasing trainees’ capacity, ineffective reasons (training materials, method of teaching and etc.) should be identified as much as possible through interviews during the appraisal meeting and then they should be reflected to the training courses.

In addition to the above, questionnaire survey for supervisors whose staff took a training course would be carried out 2-3months after the training courses. PT will ask them to evaluate trainees’ engineering/ technical capacity and identify problematic and shortage points of training courses. Based on these results, training materials, teaching method and etc. should be revised and updated.

(2) Confirmation of Accordance with Needs of Electrical Engineers/technicians Training

During the appraisal meeting, PT confirms whether trainees could improve their skill that they expected in the training course and identifies points what are lack of in the training courses.

If there is lack of technical contents as results of monitoring activities, syllabus and curriculum should be revised as needed and training materials and teaching method should be also reviewed. PT strives to provide training courses that meet trainees’ expectations and have a high satisfaction level.

(3) Assessment on utilization of trained skills at practical work

In order to develop the practical training courses that are described as the basic policy of the project, it is crucially important for trainees to utilize the expertise and knowledge that is learnt from the training courses in their practical work. To confirm this point, trainees are

required to develop their action plan that is indicated how to use technique and knowledge by the appraisal meeting.

Moreover, PT will carry out a Post-training Review after 6 months of the training courses and trainees will report the status of the achievement of action plan. As a result of this review, PT will evaluate degree of utilization techniques and knowledge which are learnt in the training courses.

In addition, trainees will also report what kind of technique and knowledge is required at their practical work and these should be stored and utilize improvement of the training courses.

Monitoring framework is planning to be developed through the collaborative work with instructors and administrators of ECG Training Center on above-mentioned monitoring activities (1)-(3).

Additionally, in order to be sustainable monitoring framework, following a) and b) are important; a) clarification of methodology and b) clarification of the division of the roles between concerning organizations and personnel. Terms of Reference (TOR) on training course monitoring should be focused on organization operation of the ECG Training Center.

Flowchart of monitoring framework is shown as Fig. 1.

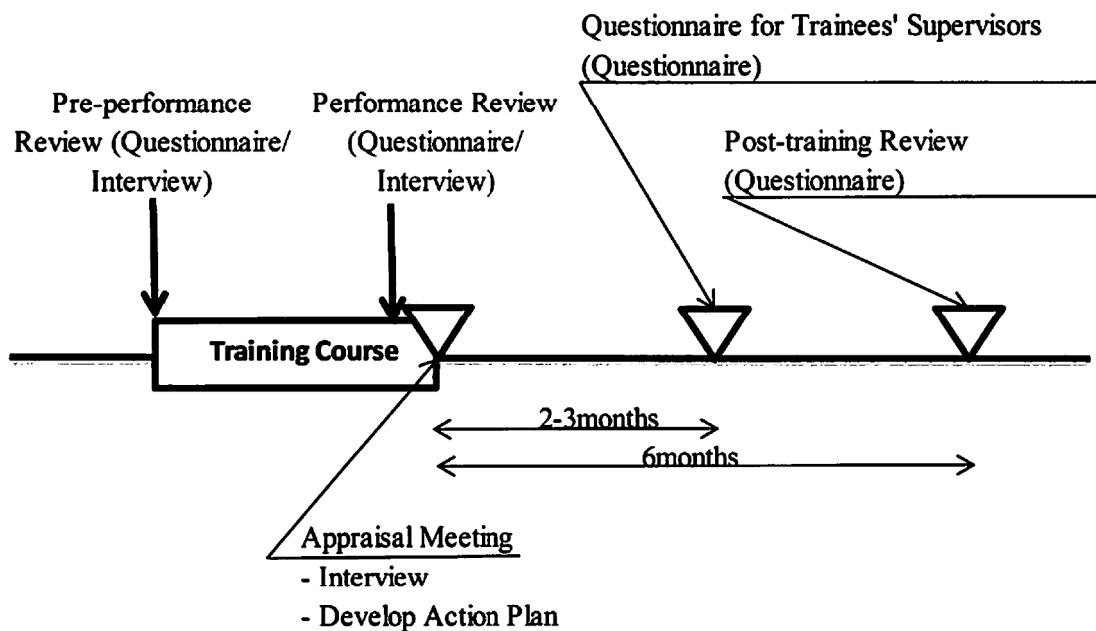


Fig.1 Flowchart of monitoring framework

2 . Monitoring Works for the Training Courses

Monitoring works will be implemented in the following training courses.

(1) First Year of the Project

① Training Course for Technicians of ECG

“Maintenance Techniques for Power Equipment and Implementation Procedure”

② Training Course for Technicians of Third Countries

“Maintenance Techniques for Power Equipment (Overhead Line)”

(2) Second Year of the Project

① Training Course for Engineers of ECG “System Protection and Control”

② Training Course for Engineers of ECG “Distribution Network Planning”

③ Training Course for Engineers of Third Countries

“System Protection and Control”

(3) Third Year Project

① Training Course for Engineers of ECG “Distribution Network Design”

Questionnaires for the monitoring (Monitoring Sheets) are attached at the last part of this report.

3 . Recommendations for Improving Training Courses

Implementation of training courses is related more closely to a plan of human resources development in the organization. Besides the opinions of division which is executing practical operations should be reflected to training courses.

Consultant Team will mainly support on activities of training course in the ECG Training Center, however, based on lessons learned and know-how from the project should feed back to the plan of human resources development in ECG.

Consultant Team is planning to make recommendations to the principal of ECG Training Center directly or related division of human resources development in headquarters of ECG.

Monitoring Sheets

(1) Training Course for Technicians of ECG

“Maintenance Techniques for Power Equipment and Implementation Procedure”

- Pre-training Questionnaires (P5~8)
- Post-Training Questionnaires (P9~12)

(2) Training Course for Technicians of Third Countries

“Maintenance Techniques for Power Equipment (Overhead Line)”

- Pre-training Questionnaires (P13~15)
- Post-Training Questionnaires (P16~20)

(3) The Questionnaire (Interview) to the Supervisor of the Trainee. (P21)

(4) The Questionnaire (Interview) about the Progress of the Action Plan (P22)

Pre-training Questionnaires

Course Name: _____

1. Background

| | | | | | |
|-----------------|--|-------------------------|--|-------------------------|--|
| Name | | Age | | Years after joining ECG | |
| Graduate school | | Speciality of education | | | |

Belonging section: _____

The work currently engaged _____

Job title _____

Work experience Mark relivant column ↓ ↓ Years of experience

| | | |
|-----------------------|--|--|
| Substation department | | |
| T&D department | | |
| Underground section | | |
| Overhead section | | |

Fill experience years →

| | | |
|--------------|-----------|-------------|
| Planning | Design | |
| | | |
| Construction | Operation | Maintenance |
| | | |

2. Knowledge possession situation regrding Power system technology and Job implementetion

I. Distribution Facilities

(1) Configuration of Distribution Facilities

| | | | | |
|------------------------|---|-----------------|---|------------------------------|
| knowing perfectly well | | knowing roughly | | Having very little knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(2) Configuration and function of the protection system of the distribution system

| | | | | |
|------------------------|---|-----------------|---|------------------------------|
| knowing perfectly well | | knowing roughly | | Having very little knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(3) Deterioration Aspects and Mechanism of Equipment

| | | | | |
|------------------------|--------------|-----------------|---|------------------------------|
| knowing perfectly well | Deterioratic | knowing roughly | | Having very little knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(4) Significance of preventive maintenance of distribution equipment

| | | | | |
|---------------------------|---|-----------------------|---|----------------------|
| understanding well enough | | understanding roughly | | understanding poorly |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line)

| | | | | |
|------------------------|---|-----------------|---|------------------------------|
| knowing perfectly well | | knowing roughly | | Having very little knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(6) Deterioration diagnosis method of cable(Underground Line)

| | | | | |
|------------------------|---|-----------------|---|------------------------------|
| knowing perfectly well | | knowing roughly | | Having very little knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

4. What do you expect in this training program ?

(1) Please fill in knowledge or technology you want to get in this training program.◦

-
-
-

(2) Please fill in Business knowledge you want to get in this training program.

-
-
-

That's all of our questionnaires. Thank you for your cooperation.

Post-training Questionnaires

Course Name : _____

| | | | |
|------|--|--------------------|--|
| Name | | Belonging section: | |
|------|--|--------------------|--|

● **The evaluation items and the scale**

(1) Novelty of the program contents

Q⇒ How much new knowledge for yourself were included in this chapter ?

| | | | | |
|---------------|-----------|-----------|-----------|---------------------------|
| more than 80% | about 70% | about 50% | about 30% | Very little new knowledge |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(2) Possibility of practical use of acquired knowledge

Q⇒ How much content that leads to improving the quality of your current work were acquired in this chapter ?

| | | | | |
|---------------|-----------|-----------|-----------|----------|
| more than 80% | about 70% | about 50% | about 30% | Very few |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(3) Usefulness in future

Q⇒ How much content that is not directly related to the charge of current operations but leads to improving technical capabilities for yourself were included in this chapter?

| | | | | |
|---------------|-----------|-----------|-----------|----------|
| more than 80% | about 70% | about 50% | about 30% | Very few |
| 5 | 4 | 3 | 2 | 1 |
| | | | | |

(4) Advanced level of the technical content

Q⇒ How sophisticated is the level of this chapter compared with your current technical level?

| | | |
|------------------------------|--------------------------|--------------------|
| fairly sophisticated content | comparable to your level | much lower content |
| 5 | 4 | 3 |
| 5 | 4 | 3 |
| | | |

(5) Intelligibility of the lectures

Q⇒ Was the explanation method of a text or a lecturer intelligible?

| | | |
|-------------------------|----------------------------|-------------------------|
| very easy to understand | Neither Agree Nor Disagree | difficult to understand |
| 5 | 4 | 3 |
| 5 | 4 | 3 |
| | | |

(6) Satisfaction (comprehensive evaluation)

Q⇒ Please fill in the evaluation when viewing above-listed evaluation items in a comprehensive manner.

| | | |
|----------------|----------------------------|---------------------|
| very satisfied | Neither Agree Nor Disagree | Rather dissatisfied |
| 5 | 4 | 3 |
| 5 | 4 | 3 |
| | | |

● **Fill out the evaluation**

Please fill in the following table evaluation regarding each evaluation items described above.

I. Distribution Facilities

| No. | Training Item | 1.Novelty of the contents | 2.Possibility of practical use | 3. Usefulness in future | 4.level of the technical content | 5.Intelligibility of lecture | 6.Satisfaction (total evaluation) | Entry of the improvements (For Q5 and Q6⇒If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the below column.) |
|-------|---|---------------------------|--------------------------------|-------------------------|----------------------------------|------------------------------|-----------------------------------|--|
| (1) | Configuration of Distribution Facilities | | | | | | | |
| (2) | Configuration & function of the protection system of the distribution system | | | | | | | |
| (3) | Deterioration Aspects and Mechanism of Equipment | | | | | | | |
| (4) | Significance of preventive maintenance of dist- equipment | | | | | | | |
| (5) | Points of Patrol & Inspection Technique and imlementation procedure (Overhead Line) | | | | | | | |
| (6) | Deterioration diagnosis method of cable (Underground Line) | | | | | | | |
| (7) | fault locating technique for underground cable (Underground Line) | | | | | | | |
| (8) | Significance of Management of Maintenance Data | | | | | | | |
| (9-1) | The voltage reguration standards of distribution line | | | | | | | |
| (9-2) | Currenrt (load) management technique of distribution line | | | | | | | |
| (10) | Earthing technology of distribution system (The purpose and necessary part of earthing) | | | | | | | |

II . Substation facilities

| No. | Training Item | 1.Novelty of the contents | 2.Possibility of practical use | 3. Usefulness in future | 4.level of the technical content | 5.Intelligibility of lecture | 6.Satisfaction (total evaluation) | Entry of the improvements (For Q5 and Q6⇒If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the below column.) |
|-------|---|---------------------------|--------------------------------|-------------------------|----------------------------------|------------------------------|------------------------------------|--|
| (1) | Configuration of Substation | | | | | | | |
| (2) | Transformer Deterioration Diagnosis Method (The technology of dissolved gas analysis) | | | | | | | |
| (3) | Points of Patrol & Inspection Technique and Implementation Procedure (Substation equipment) | | | | | | | |
| (4) | Points of Periodic Inspection and Implementation Procedure for Substation Equipment | | | | | | | |
| (5) | Significance of Management of Maintenance Data | | | | | | | |
| (6) | Significance of Failure analysis of substation equipment and implementation procedure | | | | | | | |
| (7-1) | Standard Information to be Monitored and Fault Restoration of Substation (1) Standard Information to be monitored for Main Equipment | | | | | | | |
| (7-2) | Standard Information to be monitored and Fault Restoration of Substation (2) Fault Restoration | | | | | | | |
| (8) | Human Factors relating Worker's Disaster | | | | | | | |
| (9) | Overload Operation Method of Oil-immersed Transformers | | | | | | | |
| (10) | Safety Work at Substation | | | | | | | |

●Other Questions

1. Have you been able to get the technology and knowledge you would like

.....

What kind of content have you gotten specifically? If so, please write €

.....

.....

2. In this training course, have you gotten clues to solve problems that you face in daily work ?

.....

What kind of content have you gotten specifically? If so, please write €

.....

.....

3. The opinion on the implementation of this training

If you have some items to be improved, please write suggestion from the point of view of the following. /the contents of training including to be added or to be omitted, / duration (time) for every curriculum item, / the

.....

.....

That's all of our questionnaires. Thank you for your cooperation.

Pre-training Questionnaires

Course Name: _____

1. Background

| | | | | | |
|-----------------|--|-------------------------|--|-----------------------------|--|
| Name | | Age | | Years after joining Company | |
| Graduate school | | Speciality of education | | | |

Belonging section: _____

The work currently engaged _____

Job title _____

Work experience Mark relevant column ↓ ↓ Years of experience

| | | |
|-----------------------|--|--|
| Substation department | | |
| T&D department | | |
| Underground section | | |
| Overhead section | | |

Fill experience years

| | | |
|--------------|-----------|-------------|
| Planning | Design | |
| | | |
| Construction | Operation | Maintenance |
| | | |

2. Knowledge possession situation regarding Power system technology and Job implementation

I. Distribution Facilities (The differences of system configuration among WAPP countries)

(1) Configuration of Distribution Facilities

| | | | | | | |
|------------------------|---|-----------------|---|---|------------------------------|---|
| knowing perfectly well | 4 | knowing roughly | 3 | 2 | Having very little knowledge | 1 |
| 5 | | | | | | |

(2) Configuration and function of the protection system of the distribution system

| | | | | | | |
|------------------------|---|-----------------|---|---|------------------------------|---|
| knowing perfectly well | 4 | knowing roughly | 3 | 2 | Having very little knowledge | 1 |
| 5 | | | | | | |

(3) Deterioration Aspects and Mechanism of Equipment

| | | | | | | | |
|------------------------|---|-------------|-----------------|---|---|------------------------------|---|
| knowing perfectly well | 4 | Deteriorati | knowing roughly | 3 | 2 | Having very little knowledge | 1 |
| 5 | | | | | | | |

(4-1) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line)

| | | | | | | |
|------------------------|---|-----------------|---|---|------------------------------|---|
| knowing perfectly well | 4 | knowing roughly | 3 | 2 | Having very little knowledge | 1 |
| 5 | | | | | | |

(4-2) Points of Patrol & Inspection Technique and implementation procedure (Overhead Equipment)

| | | | | | | |
|------------------------|---|-----------------|---|---|------------------------------|---|
| knowing perfectly well | 4 | knowing roughly | 3 | 2 | Having very little knowledge | 1 |
| 5 | | | | | | |

(5) Fault locating technique for underground cable (Underground Line)

| | | | | | | |
|----------------------------------|---|------------------------------------|---|---|---------------------------|---|
| enough experience & knowing well | 4 | some experience, but no confidence | 3 | 2 | no knowledge & experience | 1 |
| 5 | | | | | | |

(6) Significance of Management & Application of Maintenance Data

| | | | | | | |
|---------------------------|---|-----------------------|---|---|----------------------|---|
| understanding well enough | 4 | understanding roughly | 3 | 2 | understanding poorly | 1 |
| 5 | | | | | | |

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

(7-1) The voltage regulation standards of distribution line

| | | | |
|------------------------|---|-----------------|------------------------------|
| knowing perfectly well | | knowing roughly | Having very little knowledge |
| 5 | 4 | 3 | 2 1 |

(7-2) Current (load) management technique of distribution line

| | | | |
|---------------------------|---|-----------------------|----------------------|
| understanding well enough | | understanding roughly | understanding poorly |
| 5 | 4 | 3 | 2 1 |

(8) Earthing technology of distribution system (The purpose and necessary part of earthing)

| | | | |
|---------------------------|---|-----------------------|----------------------|
| understanding well enough | | understanding roughly | understanding poorly |
| 5 | 4 | 3 | 2 1 |

II. Maintenance skills of distribution facilities (practical training)

(1) Safety Skills & Procedure (Isolation to Allow Work) regarding safety standards of the company

| | | | |
|------------------------|---|-----------------|------------------------------|
| knowing perfectly well | | knowing roughly | Having very little knowledge |
| 5 | 4 | 3 | 2 1 |

(2) Safety Skills & Procedure (Earthing to Allow Work) regarding safety standards of the company

| | | | |
|------------------------|---|-----------------|------------------------------|
| knowing perfectly well | | knowing roughly | Having very little knowledge |
| 5 | 4 | 3 | 2 1 |

(3) Safety Skills & Procedure (Reconnection of Apparatus) regarding safety standards of the company

| | | | |
|------------------------|---|-----------------|------------------------------|
| knowing perfectly well | | knowing roughly | Having very little knowledge |
| 5 | 4 | 3 | 2 1 |

(4) Key point & Method of Patrol

| | | | |
|----------------------------------|---|-----------------|------------------------------|
| knowing key point perfectly well | | knowing roughly | Having very little knowledge |
| 5 | 4 | 3 | 2 1 |

(5) Practice of Remedy Work (Broken Tension Wire)

| | | | |
|--|---|------------------------|----------------------|
| very skilled(experience of many times) | | carrying out sometimes | Almost no experience |
| 5 | 4 | 3 | 2 1 |

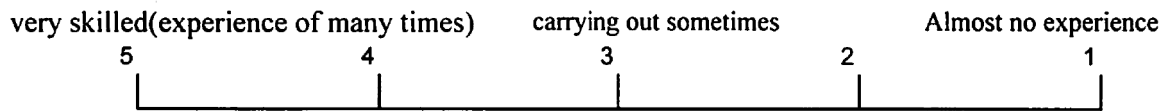
(6) Practice of Remedy Work (Broken Jumper)

| | | | |
|--|---|------------------------|----------------------|
| very skilled(experience of many times) | | carrying out sometimes | Almost no experience |
| 5 | 4 | 3 | 2 1 |

(7) Practice of Remedy Work (Replacing Transformer)

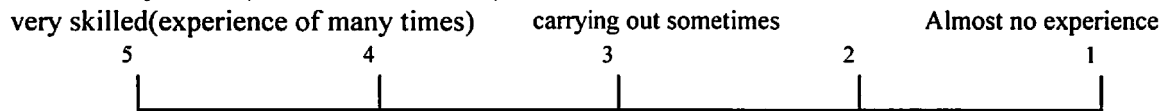
| | | | |
|--|---|------------------------|----------------------|
| very skilled(experience of many times) | | carrying out sometimes | Almost no experience |
| 5 | 4 | 3 | 2 1 |

(8) Practice of Remedy Work (Replacing Arrester)

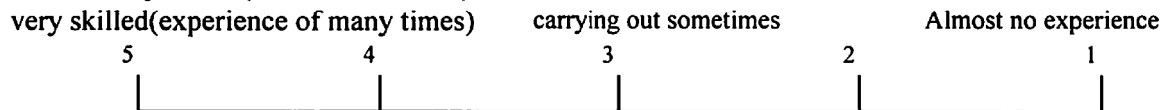


(9) Practice of Remedy Work (Replacing Insulator)

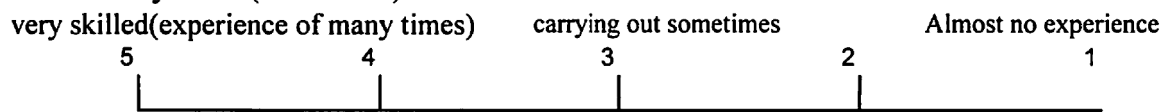
①Practice of Remedy Work (Pin & Post Insulator)



②Practice of Remedy Work (Tension Insulator)



(10) Practice of Remedy Work (Titled Pole)



3. Please enumerate problems and hindrances that you recognise during your daily work.

•

•

•

4. What do you expect in this training program ?

(1) Please fill in knowledge or technology you want to get in this training program. .

•

•

•

(2) Please fill in Business knowledge you want to get in this training program.

•

•

•

That's all of our questionnaires. Thank you for your cooperation.

Post-training Questionnaires

Course Name : _____

| | | |
|------|--|--------------------|
| Name | | Belonging section: |
|------|--|--------------------|

| | |
|---------|--|
| Country | |
|---------|--|

● **I . The evaluation items and the scale for the lecture on Distribution technology**

(1) Novelty of the program contents

Q⇒ How much new knowledge for yourself were included in this chapter ?

more than 80% about 70% about 50% about 30% Very little new knowledge

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

(2) Possibility of practical use of acquired knowledge

Q⇒ How much content that leads to improving the quality of your current work were acquired in this chapter ?

more than 80% about 70% about 50% about 30% Very few

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

(3) Usefulness in future

Q⇒ How much content that is not directly related to the charge of current operations but leads to improving technical capabilities for yourself were included in this chapter?

more than 80% about 70% about 50% about 30% Very few

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

(4) Advanced level of the technical content

Q⇒ How sophisticated is the level of this chapter compared with your current technical level?

fairly sophisticated content comparable to your level much lower content

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

(5) Intelligibility of the lectures

Q⇒ Was the explanation method of a text or a lecturer intelligible?

very easy to understand Neither Agree Nor Disagree difficult to understand

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

(6) Satisfaction (comprehensive evaluation)---

Q⇒ Please fill in the evaluation when viewing above-listed evaluation items in a comprehensive manner.

very satisfied Neither Agree Nor Disagree Rather dissatisfied

| | | | | |
|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|

● **Fill out the evaluation**

Please fill in the following table evaluation regarding each evaluation items described above.

I . Distribution facilities

| No. | Training Item | 1.Novelty of the contents | 2.Possibility of practical use | 3. Usefulness in future | 4.level of the technical content | 5.Intelligibility of lecture | 6.Satisfaction (total evaluation) | Entry of the improvements (For Q5 and Q6⇒If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the below column.) |
|-----|--|---------------------------|--------------------------------|-------------------------|----------------------------------|------------------------------|-----------------------------------|---|
| (1) | Configuration of Distribution Facilities | | | | | | | |

| | | | | | | | | |
|-------|--|--|--|--|--|--|--|--|
| (2) | Configuration & function of the protection system of the distribution system | | | | | | | |
| (3) | Deterioration Aspects and Mechanism of Equipment | | | | | | | |
| (4) | Points of Patrol & Inspection Technique and imlementation procedure (Overhead Line) | | | | | | | |
| (5) | Points of Patrol & Inspection Technique and imlementation procedure (Overhead Equipment) | | | | | | | |
| (6) | Fault locating technique for underground cable (Underground Line) | | | | | | | |
| (7) | Significance of Management of Maintenance Data | | | | | | | |
| (8-1) | The voltage reguration standards of distribution line | | | | | | | |
| (8-2) | Currenrt (load) management technique of distribution line | | | | | | | |
| (9) | Earthing technology of distribution system (The purpose and necessary part of earthing) | | | | | | | |

II . The evaluation items and the scale for the lecture on Distribution tachnology

(1) Safety Skills & Procedure (Isolation to Allow Work regarding safety standards of the comoany

skills were improved to Improvement basic procedure Absence of
 significantly improved some extent was found was mastered. usefulness
 5 4 3 2 1

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Entry of the improvements

(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

| |
|--|
| |
|--|

(2) Safety Skills & Procedure (Earthing to Allow Work regarding safety standards of the comoany

skills were improved to Improvement basic procedure Absence of
 significantly improved some extent was found was mastered. usefulness
 5 4 3 2 1

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Entry of the improvements

(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement

| |
|--|
| |
|--|

opinion in the right column.)

(3) Safety Skills & Procedure (Reconnection of Apparatus regarding safety standards of the company)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(4) Key point & Method of Patrol

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(5) Practice of Remedy Work (Broken Tension Wire)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(6) Practice of Remedy Work (Broken Jumper)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(7) Practice of Remedy Work (Replacing Transformer)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(8) Practice of Remedy Work (Replacing Arrester)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(9) Practice of Remedy Work (Replacing Insulator)

① Practice of Remedy Work (Pin & Post Insulator)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

② Practice of Remedy Work (Tension Insulator)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

(10) Practice of Remedy Work (Titled Pole)

| skills were significantly improved | improved to some extent | Improvement was found | basic procedure was mastered. | Absence of usefulness |
|------------------------------------|-------------------------|-----------------------|-------------------------------|-----------------------|
| 5 | 4 | 3 | 2 | 1 |

Entry of the improvements
(If you turned on the evaluation points 1 and 2, please fill out the reason and improvement opinion in the right column.)

● Other Questions

1. Have you been able to get the technology and knowledge you would like to get in this training?

.....

What kind of content have you gotten specifically? If so, please write examples.

.....

.....

2. In this training course, have you gotten clues to solve problems that you face in daily work ?

.....

What kind of content have you gotten specifically? If so, please write examples.

.....

.....

3. The opinion on the implementation of this training

If you have some items to be improved, please write suggestion from the point of view of the following. /the contents of training including to be added or to be omitted, / duration (time) for every curriculum item, / the

.....

.....

.....

That's all of our questionnaires. Thank you for your cooperation.

The Questionnaire (Interview) to the Supervisor of the Trainee
(Around three months after the training course)

Name: _____ **Title:** _____

Name of the Trainee: _____

Name of the Training Course at ECG:

Training Course for Technicians of ECG

“Maintenance Techniques for Power Equipment and Implementation Procedure “

(1) Can you find some improvement in the trainee’s job after receiving the training course?

If yes, please describe his (or her) improvement.

(2) If you find some additional issues to the training course above, please describe.

(3) If you have any requests to the training course above, please describe.

Thank you very much for your Cooperation.

(Follow-up survey of the Action Plan)

**The Questionnaire (Interview) to the Trainee about the Progress of the Action Plan
(Around six months after the training course)**

Name of the Trainee: _____

Name of the Training Course at ECG:

Training Course for Technicians of ECG

“Maintenance Techniques for Power Equipment and Implementation Procedure “

(1) How about the progress of your Action Plan?

Please describe.

(2) How long does it take additionally to achieve your Action Plan?

(3) If you face the difficulty to achieve your Action Plan, please describe the reason.

(4) If you find some additional issues to the training course , please describe.

(5) If you find some contents to improve or revise the training course , please describe.

Thank you very much for your cooperation.

2)Monitoring Report on Training Course for Technicians of ECG“Maintenance Techniques for Power Equipment and Implementation Procedure” (July 2014)

Monitoring Report on the Training Course for Technicians of ECG
“Maintenance Techniques for Power Equipment and Implementation Procedure”

1. Outline for the Training Course

(1) Purpose

To learn basic concept and basic knowledge of power distribution maintenance work and related equipment

(2) Targets of the Training and number of trainee

Junior Technician less than 3 years' experience in relevant field, Ten (10)

(3) Duration of the Training

23 June ~ 27 June 2014 (5 days)

2. Implementation of the Training Course

(1) Program of the Training

Program of the training is shown in Table-1.

(2) Participants

Participants of the Training are shown in Table-2.

3. Monitoring of the Training Course

(1) Pre-Questionnaires

Technological level including job experience of the trainee has been grasped through the Pre-Questionnaires in the recruitment of the Training Course.

The results of the Technical level and job experiences of the trainees are shown in Table-3 taking self-evaluation of their own technologies into consideration.

In Table-3, the adequacy as the trainee of this Training Course is investigated by comparing with the nominee qualifications of the training course.

As the result of this investigation, the participants P-1, P-2, P-5, P-7 and P-8 are considered appropriate as the trainees judging from their technological level and job experiences. Other participants are a little bit higher than the target of the training course.

From this result, we considered that the trainees should be divided into two groups when analyzing the Post-Questionnaires.

Two groups are A group (Junior Technicians) and B group (Experienced Technicians). Result of the Pre-Questionnaires is shown in Table-4.

(2) Post-Questionnaires

At the time of the end of Training Course, Post-Questionnaires were carried out

for measuring the training effects.

Post-Questionnaires are prepared from the following view points ①Novelty of the program contents,②Possibility of practical use of acquired knowledge③Usefulness in future④Advanced level of technical contents⑤Intelligibility of the lectures⑥Satisfaction(comprehensive evaluation).

From the results of the comparison between Pre-Questionnaire and ① of Post-Questionnaires, the degree of each individual's technical improvement level is measured and the effect of a training course can be judged from the degree of improvement from the whole average value.

The possibility of the practical use of the knowledge and technology acquired in this training course can be known from the average value of ②and③ of each individual.

If the average value is higher than 3.0, it will be regarded as effective.

From the average value of ④ and ⑤of each individual, the appropriateness of methods of operation for training course can be evaluated.

If the average value is less than 3.0, it can be considered that it is necessary to improve the methods of operation, a textbook, etc. of a training course.

From the average value of ⑥, the synthetic degree of satisfaction to a training course can be judged.

If the average value is higher than 3.0, it can be considered that the training course was satisfactory contents.

(3) Results of the Post-Questionnaires

1) Novelty of the program contents

The result of the question on "Novelty of the program contents" in Post-Questionnaire is shown in Table-5.

It can be confirmed that the average values of the individual of A and B group are improved from those of Pre-Questionnaires as follows.

(3.0 is an average and new knowledge can be mastered more as closer to 5.0.

To the contrary, new knowledge cannot be mastered as closer to 1.0.)

| (Distribution Facilities) | | Pre-Q | Post-Q | |
|-----------------------------|-------|-------|--------|------------|
| A (Junior Technicians) | Group | : 3.3 | —> | 4.4 (+1.1) |
| B (Experienced Technicians) | Group | : 3.3 | —> | 4.2 (+0.9) |
| (Substation Facilities) | | | | |
| A | Group | : 2.5 | —> | 4.6 (+2.1) |
| B | Group | : 2.6 | —> | 4.5 (+1.9) |

From these results, we can observe the following.

i) New knowledge can be offered to both groups.

Effectiveness of the training (Improvement of knowledge and technologies) is judged very high, as the figures of the Post-Questionnaires is far exceeding the average.

ii) Effectiveness of the training of A (Junior Technicians) group is bigger than that of B (Experienced Technicians) group, because less knowledge and experience are considered to give bigger impact to the effectiveness of the training.

iii) It is common that both A group and B group technicians are engaged in the field of the power distribution, therefore they don't have enough knowledge and experience in the field of substations.

Through this training course, knowledge and technology in the field of substations of both group technicians has been judged to be improved very much.

2) Possibility of practical use of acquired knowledge and technology

The result of the question on "Possibility of practical use of acquired knowledge and technology" in Post-Questionnaire is shown in Table-6. The average figure of each group is as follows.

(Distribution Facilities)

A (Junior Technicians) Group : 4.1

B (Experienced Technicians) Group : 4.2

(Substation Facilities)

A Group : 4.5

B Group : 4.8

From these results, we can observe the following.

i) Both groups felt that the knowledge and technology acquired in this training course could be utilized in their own jobs and quality of their jobs would be improved very much.

ii) As for the distribution facilities, there is not big difference between A group and B group. Both groups recognized the possibility of practical use of acquired knowledge in this training course.

iii) As for the substation facilities, both groups recognized the possibility of practical use of acquired knowledge. But group B seemed to feel a bit stronger than group A.

3) Usefulness in future

The result of the question on "Usefulness in future" in Post-Questionnaire is

shown in Table-7. The questions are about the knowledge which is not directly related to their current jobs, but will link to the improvement of their own technology in the future. The average figure of each group is as follows.

(Distribution Facilities)

A (Junior Technicians) Group : 4.3

B (Experienced Technicians) Group : 4.3

(Substation Facilities)

A Group : 4.6

B Group : 4.8

From these results, we can observe the following.

- i) Both groups felt that the knowledge and technology acquired in this training course would not be related to their current jobs directly but contained a lot of useful technology in the future.
- ii) As for the distribution facilities, both groups recognized strongly the usefulness of acquired knowledge in this training course.
- iii) As for the substation facilities, group B seemed to feel a bit stronger than group A just as same as the former result of 2).

It is observed that the group B could understand more deeply the value of the technology provided in this training course because group B had more knowledge and experience than group A.

4) Advanced level of technical contents

Technical level comparison between each individual and training course is asked in this item. If the technical level is the same, the value is set to 3.0

If the contents of training are felt to be quite advanced, the value is set to 5.0 and to the contrary if quite low, the value is set to 1.0. The average figure of each group is as follows.

(Distribution Facilities)

A (Junior Technicians) Group : 4.2

B (Experienced Technicians) Group : 4.4

(Substation Facilities)

A Group : 4.5

B Group : 4.9

- i) Prior to the training it was assumed that the adequate training level would be from 4.0 to 4.5. Judging from above results, almost of the lectures was set to be adequate level.

On the other hand, some part of lectures seemed to be a bit difficult for the trainees.

The lectures which exceed 4.5 in each individual's average value are as follows.

I . Distribution Facilities

(5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line)

II . Substation Facilities

(3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities)

(8) Human factors relating worker's disaster

(10) Safety work at substation

ii) As for the substation facilities, technicians in both group doesn't have enough experience in this field. Therefore it was considered that they felt it difficult because of the shortage of related knowledge.

5) Intelligibility of the lecture

The result of the question on "Intelligibility of the lecture" in Post-Questionnaire is shown in Table-9. The average figure of each group is as follows.

(Distribution Facilities)

A (Junior Technicians) Group : 4.3

B (Experienced Technicians) Group : 4.5

(Substation Facilities)

A Group : 4.7

B Group : 5.0

i) Prior to the training it was assumed that the adequate value would be from 4.0 to 4.5. Judging from above results, we could get the better results than our expectation.

It was proved that ECG instructors had very high teaching technology.

ii) As for the training items I-5, II -3,8,10 which were pointed out to be difficult to understand, almost of the trainees answered that those lectures were very intelligible. The average value of "Intelligibility of the lecture" shows above 4.5.

It means that the high level of technical contents were able to be taught plainly.

6) Satisfaction(comprehensive evaluation)

The result of the question on “Satisfaction (Comprehensive Evaluation)” in Post-Questionnaire is shown in Table-10. The average figure of each group is as follows.

(Distribution Facilities)

A (Junior Technicians) Group : 4.4

B (Experienced Technicians) Group : 4.4

(Substation Facilities)

A Group : 4.7

B Group : 4.9

- i) Prior to the training it was assumed that the adequate value would be from 4.0 to 4.5. Judging from above results, we could get the good results as we expected.
- ii) As for the substation facilities, technicians in both group doesn't have enough experience in this field. Therefore the contents in this field became stimulative and fresh for them and this caused the higher value of satisfaction.

(6) Results of the monitoring by Pre- and Post-Questionnaires

From the results of the Pre- and Post-Questionnaires, the training course is evaluated as follows.

- 1) This training course could provide the big technical improvement for ECG technicians. In other words this training course was implemented very successfully and effectively.
- 2) We can expect that the knowledge and technology acquired in this training course will be utilized very much and contribute to enhance the quality of their jobs.
And we can also expect the usefulness of the technology in the future.
- 3) The degree of satisfaction to this training is very high.(All the trainees evaluated this training very high.)
- 4) We can say that we could obtain the expected outcome from this training course and this training course was implemented successfully.

4. Some comments (impression) from lecture observation

We would like to point out some comments from the observation of lectures besides

the questionnaires.

(1) Basic rule for the lecture

- 1) Lectures should be more punctual. (Starting time and rest time should be clearer.)
- 2) Mobile phones should be prohibited to use during the lecture.
- 3) Some measures should be taken for concentrating the lecture.
(Some trainees go out the class room freely for the toilet and the mobile.)
- 4) Trainees don't have notebooks. They write memo in a piece of paper.
We may consider providing the notebooks and ballpoint pen to trainees.

(2) Teaching method of the instructor

- 1) As for the explanation of the instructors, generally speaking an introduction is long and detail is short. Allocation of time should be considered more to the detail.
- 2) Power point by the instructors should link more clearly to the textbooks of the trainees.
- 3) Instructors should use a textbook more effectively in order to assist the trainees understanding.

(3) Atmosphere of the lecture

- 1) Attitude of the trainee is very good.
- 2) The way to proceed the lectures with exchanging views between instructor and trainees is very good.
- 3) However in such atmosphere, there are more senior's opinions than young people. It seemed that young people were hesitating to express their opinions.
- 4) It seemed that the senior brought the position of the job into the training course.

(4) Others

- 1) We should put more photographs of facilities and equipment on the textbook so as to enhance the effectiveness of the lectures.
- 2) As for the daily inspection and safety education, more photographs should be used in the lectures for example in accordance with the inspection order.

5. Recommendation to the next training courses

(1) Nominee Qualifications

If ECG would like to continue the training course for the junior engineers, we recommend ECG to odd the age limit to the Nominee Qualifications.

Revised Nominee Qualifications are as follows.

- Junior Technician less than 3 years' experience in the relevant field
- Under the age of 40 is favorable.

(2) Revise of the Textbook

It may be necessary to revise the textbook in order to enhance the trainees' comprehension of lectures.

(3) Some challenges in the future

We can recognize that this training course was effective not only for the junior technicians but also for the experienced technicians.

We can say the followings.

- 1) By using same syllabus and curriculum, ECG can provide the refreshing training course for experienced technicians.
- 2) By using same syllabus and curriculum, ECG can provide the training course for instructors in regional office.
- 3) ECG can dispatch their instructors to the regional office to provide this training course for regional instructors and experienced technicians.
- 4) If this training course divided into two such as technicians for distribution facilities and substation facilities, ECG can provide more short term (2-3 days) training courses and produce larger number of trained technicians based on the needs of the human resource development of ECG. In this case the same syllabus, curriculum and textbooks can be utilized for these short term training courses.

Table-1. Program of the Training

| DAYS | 8:30am – 9:00am | 9:00am – 10:00am | 10:00am-10:15am | 10:15am –12noon | 12noon –1pm | 1pm – 3:30pm |
|-------|--|--|----------------------------|---|----------------------------|---|
| Day 1 | Registration and Opening Ceremony | 1. Orientation 2. Outline of power distribution facilities Samuel Andoh | S n a c k B r e a k | Deterioration mechanism of power distribution Samuel Andoh | L u n c h B r e a k | |
| Day 2 | Overhead line and underground cable Bless Agbi | | | 1. Management and application of maintenance date 2. Distribution line fault and investigation Peter Asare | | 1. Inspection and preventive maintenance of distribution line (type and method) 2. Inspection on transformer Bless Agbi 1. Procedure of cable fault location Peter Asare 2. Operation and management of power distribution system a. management of voltage and current b. measurement of earth resistance Samuel Andoh |
| Day 3 | Outline of substation equipment Kingsford Amoako | | S n a c k B r e a k | Outline of distribution equipment Kingsford Amoako | | Outline of distribution equipment Kingsford Amoako |
| Day 4 | Substation patrol/periodic inspection Isaac Nukpezah | | | Substation patrol/periodic inspection Isaac Nukpezah | | 1. Data management of substation equipment 2. Statistic and analysis of fault Isaac Nukpezah |
| Day 5 | 1. Procedure of fault restoration 2. Overload operation of transformer Kingsford Amoako | | | Prevention of Human error and safety Isaac Nukpezah | | Prevention of Human error and safety Isaac Nukpezah Evaluation |

Note: Name in bold means a name of Instructor

Table-2. List of the Participants

Course Title: Maintenance Technicians for Overhead Line

| No. | Name | Age | Region | Designation |
|------|------------------------|-----|-------------|----------------------|
| P-1 | Samuel Acquah | 32 | Central c/c | Senior Artisan |
| P-2 | Gershon K. Asiedu | 33 | Accra | Tradesman |
| P-3 | Paul Kumah | 48 | Eastern | Foreman |
| P-4 | Prince Oduro Anim | 40 | ASH West | Foreman |
| P-5 | Effal Mensceh Emuanuel | 33 | ASH-East | Senior Artisan |
| P-6 | Kenneth Assan | 48 | Tema | Works SUPT |
| P-7 | Moro Haruna | 27 | Accra-East | Senior Artisan |
| P-8 | Deffor Atsu Edem | 31 | VOLTA | Senior Artisan |
| P-9 | Seth C. Marley | 56 | Sub-T | Senior Technician |
| P-10 | Matthew Yaw Aboagye | 45 | West | Works SUPT |

Table-3. Technical level and job experiences of the trainees

| Number | Age | Experience(Years) | Academic background | Job experience | Self-evaluation(Distribution) | Self-evaluation(Substation) | Observation | Adequacy as the trainee |
|--------|-----|--------------------|-------------------------------|---|-------------------------------|-----------------------------|---|---|
| P-1 | 32 | 3 | Poli Tech(2 years) | Substation :2years, Distribution 1year | 26 | 31 | 1. Having wide basic Knowledge but short of experience 2. Desiring new knowledge | Target of the Training Course |
| P-2 | 33 | 4 | Vocational Training Institute | Operation of Distribution | 33 | 22 | 1. Having basic knowledge in Distribution 2. None knowledge on Substation | Target of the Training Course |
| P-3 | 40 | 9 | Training Center | Construction and Maintenance of the Distribution 9years each | 29 | 15 | 1. Having enough experience but unbalance knowledge 2. Necessary to complement an unbalanced field | Out of the target considering age and job experience |
| P-4 | 40 | 14 | Poli Tech (3years) | Long experience from Construction to Maintenance of the Distribution | 31 | 26 | 1. Having enough experience but unbalance knowledge 2. Necessary to complement an unbalanced field 3. Desiring to solve the shortage of the knowledge | Out of the target considering age and job experience |
| P-5 | 33 | 9 | Poli Tech (3years) | Long experience mainly in Operation of the Distribution | 30 | 14 | 1. Having experience in Distribution but no experience in Substation 2. Desiring the new knowledge in Substation | 1. Necessary to complement an unbalanced field 2. Target of the Training Course considering his age |
| P-6 | 48 | 25 | ECG/Training Center | Long experience from Construction to Maintenance of the Distribution | 40 | 26 | 1. Having enough experience but unbalance knowledge 2. Necessary to complement an unbalanced field | Out of the target considering age and job experience |
| P-7 | 27 | 5 | Poli Tech | Experience in Maintenance of the Distribution | 43 | 37 | 1. High score in spite of the short experience 2. Having basic knowledge | 1. Necessary to complement an unbalanced field 2. Target of the Training Course considering his age |
| P-8 | 31 | 1 | Poli Tech (2years) | Experience only in Maintenance of the Distribution | 32 | 23 | 1. High score in spite of the short experience 2. Having basic knowledge 3. Shortage of experience | Target of the Training Course |
| P-9 | 56 | 36 | ? | Long experience in Distribution and Substation | 39 | 42 | 1. Having long experience in Distribution and Substation 2. Desiring to understand the basic theory | Out of the target considering age and job experience |
| P-10 | 45 | 25 | Poli Tech | Long experience mainly from Construction to Maintenance of the Distribution | 23 | 21 | Low score in spite of his long job experience | Out of the target considering age and job experience |

A: Junior Technicians group B: Experienced Technicians group:

Table-4 Result of the Pre- Questionnaire

Course Name:

Technique and Procedure for Maintenance of Power Equipment

Knowledge possession situation regarding Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facilities | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 3 |
| (2) Configuration and function of the protection system of the distribution | 3 | 3 | 1 | 1 | 2 | 4 | 4 | 3 | 5 | 2 |
| (3) Deterioration Aspects and Mechanism of Equipment | 3 | 3 | 3 | 4 | 2 | 4 | 4 | 3 | 4 | 2 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 3 | 4 | 4 | 3 | 4 | 5 | 5 | 5 | 3 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 3 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 3 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 2 | 3 | 2 | 3 | 3 | 4 | 4 | 5 | 3 | 2 |
| (7) Fault locating technique for underground cable (Underground Line) | 2 | 3 | 2 | 2 | 2 | 4 | 4 | 5 | 3 | 2 |
| (8) Significance of Management & Application of Maintenance Data | 2 | 3 | 3 | 2 | 3 | 4 | 5 | 1 | 3 | 2 |
| (9-1) The voltage regulation standards of distribution line | 1 | 3 | 3 | 4 | 4 | 4 | 4 | 1 | 4 | 3 |
| (9-2) Current (load) management technique of distribution line | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 1 | 4 | 2 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 2 |
| Total of Personal score | 26 | 33 | 29 | 31 | 30 | 40 | 43 | 32 | 39 | 23 |
| Average of Personal score | 2.73 | 3.18 | 3.00 | 3.18 | 3.09 | 4.00 | 4.27 | 3.18 | 4.00 | 2.36 |
| Deviation of Personal score | 0.96 | 0.72 | 0.95 | 1.03 | 0.79 | 0.00 | 0.45 | 1.59 | 0.74 | 0.48 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 4 | 2 | 1 | 4 | 2 | 4 | 4 | 1 | 4 | 2 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 3 | 2 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 1 | 4 | 2 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 4 | 2 |
| Substation Equipment | | | | | | | | | | |
| (5) Significance of Management & Application of Maintenance Data | 4 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 2 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 1 | 3 | 2 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 1 | 4 | 2 |
| ① Standard Information items to be | | | | | | | | | | |
| (7) ②The relationship aspect of failure and warning of main equipment | 3 | 2 | 1 | 3 | 1 | 4 | 4 | 3 | 5 | 2 |
| (8) Human factors relating worker's disaster | 2 | 4 | 2 | 3 | 2 | 2 | 4 | 3 | 3 | 1 |
| (9) Overload Operation method of Oil-immersed Transformers | 2 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 4 | 1 |
| (10) Safety work at substation | 3 | 3 | 1 | 4 | 2 | 2 | 4 | 5 | 5 | 3 |
| Total of Personal score | 31 | 22 | 15 | 26 | 14 | 26 | 37 | 23 | 42 | 21 |
| Average of Personal score | 2.82 | 2.00 | 1.36 | 2.36 | 1.27 | 2.36 | 3.36 | 2.09 | 3.82 | 1.91 |
| Deviation of Personal score | 0.72 | 1.04 | 0.48 | 0.98 | 0.45 | 0.77 | 0.48 | 1.31 | 0.72 | 0.51 |

Table-5 Novelty of the program contents

Course Name: Technique and Procedure for Maintenance of Power Equipment

Differential evaluation caused by tra ⇒ (1) Novelty of the program contents
 Q⇒ How much new knowledge for yourself were included in this chapter ?

2Knowledge possession situation regdring Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facili | 3 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 3 |
| (2) Configuration and function of the protection system of the distribution | 3 | 4 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 3 |
| (3) Deterioration Aspects and Mechanism of Equipment | 4 | 3 | 5 | 5 | 4 | 4 | 3 | 4 | 5 | 4 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 3 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 4 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 3 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 3 | 5 | 4 | 4 | 5 | 4 | 5 | 3 | 5 | 3 |
| (7) Fault locating technique for underground cable (Underground Line) | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 3 |
| (8) Significance of Management & Application of Maintenance Data | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 3 |
| (9-1) The voltage reguration standards of distribution line | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 3 |
| (9-2) Currenrt (load) management technique of distribution line | 3 | 5 | 5 | 4 | 5 | 2 | 5 | 3 | 5 | 3 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 3 |
| Total of Personal score | 38 | 42 | 47 | 45 | 49 | 38 | 48 | 41 | 47 | 32 |
| Average of Personal score | 3.73 | 4.18 | 4.73 | 4.45 | 4.91 | 3.82 | 4.82 | 4.09 | 4.73 | 3.18 |
| Deviation of Personal score | 0.62 | 0.72 | 0.45 | 0.50 | 0.29 | 0.57 | 0.57 | 0.67 | 0.45 | 0.39 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 4 | 3 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 3 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 5 | 5 | 3 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 5 | 4 | 5 | 4 | 5 | 3 | 5 | 3 | 5 | 3 |
| (4) Points of Periodic Inspectionand imlementation procedure for substation equipment Substation Equipment | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 3 | 5 | 3 |
| (5) Significance of Management & Application of Maintenance Data | 5 | 5 | 5 | 4 | 5 | 3 | 5 | 4 | 4 | 3 |
| (6) Significance of Failure anaalysis of main substation equipment and imlementation procedure | 5 | 3 | 5 | 4 | 4 | 4 | 5 | 3 | 5 | 3 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 0 | 4 | 3 |
| ① Standard Information items to be | | | | | | | | | | |
| (7) ②The relationship aspect of failure and warning of main equipment | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 0 | 4 | 3 |
| (8) Human factors relating worker's disaster | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 3 | 5 | 4 |
| (9) Overload Operation method of Oil-immersed Transformers | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 3 |
| (10) Safety work at substation | 5 | 5 | 5 | 4 | 0 | 4 | 5 | 4 | 5 | 3 |
| Total of Personal score | 51 | 45 | 51 | 49 | 48 | 42 | 55 | 33 | 50 | 34 |
| Average of Personal score | 4.64 | 4.09 | 4.64 | 4.45 | 4.36 | 3.82 | 5.00 | 3.00 | 4.55 | 3.09 |
| Deviation of Personal score | 0.48 | 0.67 | 0.48 | 0.50 | 1.43 | 0.39 | 0.00 | 1.54 | 0.50 | 0.29 |

Table—6 Possibility of practical use of acquired knowledge

Course Name: Technique and Procedure for Maintenance of Power Equipment

Effectiveness evaluation caused by this course ⇔

Q⇒ How much content that leads to improving the quality of your current work were acquired in this chapter ?

Knowledge possession situation regarding Power system technology and Job implementation

I. Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facilities | 4 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 3 |
| (2) Configuration and function of the protection system of the distribution system | 3 | 3 | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 3 |
| (3) Deterioration Aspects and Mechanism of Equipment | 3 | 2 | 5 | 5 | 5 | 2 | 3 | 5 | 4 | 4 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 5 | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 4 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 4 | 5 | 5 | 4 | 5 | 2 | 3 | 4 | 5 | 3 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 3 | 3 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 3 |
| (7) Fault locating technique for underground cable (Underground Line) | 3 | 3 | 5 | 4 | 3 | 3 | 5 | 5 | 4 | 4 |
| (8) Significance of Management & Application of Maintenance Data | 3 | 5 | 5 | 4 | 4 | 5 | 3 | 3 | 5 | 3 |
| (9-1) The voltage regulation standards of distribution line | 3 | 3 | 5 | 3 | 5 | 5 | 5 | 4 | 4 | 4 |
| (9-2) Current (load) management technique of distribution line | 3 | 6 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 4 |
| Total of Personal score | 34 | 39 | 48 | 43 | 46 | 36 | 44 | 43 | 47 | 36 |
| Average of Personal score | 3.45 | 4.00 | 4.82 | 4.36 | 4.55 | 3.64 | 4.36 | 4.27 | 4.73 | 3.55 |
| Deviation of Personal score | 0.66 | 1.21 | 0.39 | 0.64 | 0.66 | 1.15 | 0.88 | 0.62 | 0.45 | 0.50 |

II. Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 3 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 4 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 3 | 4 | 5 | 4 | 5 | 4 | 5 | 3 | 5 | 4 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 5 | 4 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment Substation Equipment | 4 | 3 | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 |
| (5) Significance of Management & Application of Maintenance Data | 4 | 4 | 4 | 3 | 5 | 3 | 5 | 4 | 5 | 3 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 3 | 5 | 4 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation ① Standard Information items to be monitored for main equipment | 5 | 3 | 5 | 5 | 5 | 4 | 5 | 0 | 5 | 4 |
| (7) ② The relationship aspect of failure and warning of main equipment | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 0 | 5 | 4 |
| (8) Human factors relating worker's disaster | 5 | 5 | 5 | 4 | 5 | 3 | 5 | 4 | 5 | 3 |
| (9) Overload Operation method of Oil-immersed Transformers | 3 | 3 | 4 | 5 | 5 | 3 | 5 | 5 | 5 | 4 |
| (10) Safety work at substation | 5 | 5 | 5 | 5 | 0 | 4 | 5 | 5 | 5 | 4 |
| Total of Personal score | 45 | 44 | 52 | 49 | 50 | 42 | 53 | 35 | 54 | 43 |
| Average of Personal score | 4.09 | 4.00 | 4.73 | 4.45 | 4.55 | 3.82 | 4.82 | 3.18 | 4.91 | 3.91 |
| Deviation of Personal score | 0.79 | 0.74 | 0.45 | 0.66 | 1.44 | 0.57 | 0.39 | 1.64 | 0.29 | 0.51 |

Table—7 Usefulness in future

Course Name: Technique and Procedure for Maintenance of Power Equipment

Effectiveness evaluation caused by training

How much content that is not directly related to the charge of
 Q⇒ current operations but leads to improving technical
 capabilities for yourself were included in this chapter?

Knowledge possession situation regarding Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facilities | 4 | 4 | 5 | 3 | 5 | 3 | 5 | 5 | 5 | 5 |
| (2) Configuration and function of the protection system of the distribution system | 4 | 3 | 5 | 4 | 5 | 3 | 5 | 3 | 5 | 5 |
| (3) Deterioration Aspects and Mechanism of Equipment | 3 | 4 | 5 | 4 | 5 | 3 | 5 | 5 | 4 | 5 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 3 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 4 | 3 | 5 | 3 | 5 | 4 | 5 | 5 | 5 | 5 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 3 | 3 | 4 | 3 | 5 | 4 | 5 | 4 | 5 | 5 |
| (7) Fault locating technique for underground cable (Underground Line) | 3 | 4 | 5 | 3 | 4 | 2 | 5 | 5 | 5 | 5 |
| (8) Significance of Management & Application of Maintenance Data | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 4 |
| (9-1) The voltage regulation standards of distribution line | 4 | 4 | 5 | 3 | 5 | 4 | 5 | 3 | 5 | 4 |
| (9-2) Current (load) management technique of distribution line | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 5 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 5 | 3 | 5 | 3 | 5 | 3 | 5 | 4 | 5 | 5 |
| Total of Personal score | 38 | 35 | 49 | 36 | 49 | 35 | 50 | 43 | 49 | 48 |
| Average of Personal score | 3.82 | 3.55 | 4.91 | 3.55 | 4.91 | 3.45 | 5.00 | 4.36 | 4.91 | 4.82 |
| Deviation of Personal score | 0.57 | 0.50 | 0.29 | 0.66 | 0.29 | 0.66 | 0.00 | 0.77 | 0.29 | 0.39 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 3 | 4 | 5 | 3 | 5 | 4 | 5 | 5 | 5 | 5 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 3 | 3 | 5 | 3 | 5 | 4 | 5 | 4 | 5 | 4 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 5 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment Substation Equipment | 4 | 4 | 5 | 4 | 5 | 3 | 5 | 4 | 5 | 5 |
| (5) Significance of Management & Application of Maintenance Data | 4 | 4 | 5 | 3 | 5 | 4 | 5 | 4 | 4 | 4 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 3 | 5 | 5 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 5 | 3 | 5 | 4 | 5 | 4 | 5 | 0 | 5 | 4 |
| ① Standard Information items to be monitored for main equipment | | | | | | | | | | |
| (7) ②The relationship aspect of failure and warning of main equipment | 4 | 3 | 5 | 3 | 5 | 4 | 5 | 0 | 5 | 4 |
| (8) Human factors relating worker's disaster | 5 | 4 | 5 | 3 | 5 | 4 | 5 | 4 | 5 | 3 |
| (9) Overload Operation method of Oil-immersed Transformers | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 5 |
| (10) Safety work at substation | 5 | 5 | 5 | 4 | 0 | 4 | 5 | 5 | 5 | 5 |
| Total of Personal score | 45 | 43 | 54 | 39 | 49 | 43 | 55 | 38 | 54 | 49 |
| Average of Personal score | 4.09 | 3.91 | 4.91 | 3.55 | 4.45 | 3.91 | 5.00 | 3.45 | 4.91 | 4.45 |
| Deviation of Personal score | 0.67 | 0.67 | 0.29 | 0.50 | 1.44 | 0.29 | 0.00 | 1.72 | 0.29 | 0.66 |

Table—8 Advanced level of the technical content

Course Name: Technique and Procedure for Maintenance of Power Equipment

Effectiveness evaluation caused by t ⇒ (4) Advanced level of the technical content

Q⇒ How sophisticated is the level of this chapter compared with your current technical level?

Knowledge possession situation regarding Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facilities | 3 | 5 | 4 | 5 | 4 | 4 | 3 | 3 | 4 | 3 |
| (2) Configuration and function of the protection system of the distribution | 3 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| (3) Deterioration Aspects and Mechanism of Equipment | 3 | 5 | 5 | 5 | 5 | 4 | 3 | 5 | 5 | 3 |
| (4) Significance of preventive maintenance of distribution equipment | 3 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 3 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 5 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 4 | 4 | 5 | 5 | 4 | 4 | 5 | 3 | 5 | 5 |
| (7) Fault locating technique for underground cable (Underground Line) | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 |
| (8) Significance of Management & Application of Maintenance Data | 4 | 4 | 4 | 5 | 5 | 3 | 0 | 4 | 4 | 4 |
| (9-1) The voltage regulation standards of distribution line | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 5 |
| (9-2) Current (load) management technique of distribution line | 3 | 4 | 5 | 5 | 4 | 3 | 5 | 4 | 5 | 5 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 4 | 4 | 5 | 3 | 5 | 4 | 5 | 4 | 5 | 5 |
| Total of Personal score | 36 | 44 | 46 | 45 | 47 | 38 | 43 | 40 | 48 | 43 |
| Average of Personal score | 3.55 | 4.45 | 4.55 | 4.55 | 4.64 | 3.82 | 4.18 | 3.91 | 4.73 | 4.18 |
| Deviation of Personal score | 0.50 | 0.50 | 0.50 | 0.66 | 0.48 | 0.39 | 1.53 | 0.51 | 0.45 | 0.83 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 3 | 3 | 5 | 4 | 5 | 5 | 5 | 3 | 5 | 4 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 3 | 5 | 4 | 5 | 5 | 5 | 5 | 3 | 5 | 5 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 5 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment | 4 | 5 | 4 | 5 | 5 | 4 | 5 | 3 | 5 | 4 |
| Substation Equipment | | | | | | | | | | |
| (5) Significance of Management & Application of Maintenance Data | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 5 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 0 | 5 | 5 |
| ① Standard Information items to be | | | | | | | | | | |
| (7) ②The relationship aspect of failure and warning of main equipment | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 0 | 5 | 5 |
| (8) Human factors relating worker's disaster | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 3 | 0 | 5 |
| (9) Overload Operation method of Oil-immersed Transformers | 4 | 3 | 4 | 5 | 5 | 4 | 5 | 5 | 5 | 4 |
| (10) Safety work at substation | 5 | 4 | 5 | 5 | 0 | 4 | 5 | 4 | 5 | 4 |
| Total of Personal score | 44 | 46 | 49 | 51 | 49 | 47 | 55 | 33 | 49 | 50 |
| Average of Personal score | 4.00 | 4.18 | 4.45 | 4.64 | 4.45 | 4.27 | 5.00 | 3.00 | 4.45 | 4.55 |
| Deviation of Personal score | 0.60 | 0.72 | 0.50 | 0.48 | 1.44 | 0.45 | 0.00 | 1.54 | 1.44 | 0.50 |

Table—9 (5) Intelligibility of the lectures

Course Name : Technique and Procedure for Maintenance of Power Equipment

Effectiveness evaluation caused by training

Q⇒ Was the explanation method of a text or a lecturer intelligible?

Knowledge possession situation regarding Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facilities | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| (2) Configuration and function of the protection system of the distribution | 4 | 4 | 5 | 5 | 4 | 4 | 5 | 5 | 5 | 3 |
| (3) Deterioration Aspects and Mechanism of Equipment | 4 | 3 | 5 | 4 | 4 | 4 | 3 | 4 | 5 | 4 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 5 | 3 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 4 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 4 | 4 | 5 | 5 | 3 | 4 | 5 | 4 | 4 | 4 |
| (7) Fault locating technique for underground cable (Underground Line) | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 4 |
| (8) Significance of Management & Application of Maintenance Data | 4 | 3 | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 4 |
| (9-1) The voltage regulation standards of distribution line | 4 | 3 | 5 | 4 | 5 | 4 | 5 | 3 | 5 | 4 |
| (9-2) Current (load) management technique of distribution line | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 4 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 4 |
| Total of Personal score | 43 | 36 | 50 | 46 | 45 | 41 | 48 | 44 | 47 | 39 |
| Average of Personal score | 4.36 | 3.73 | 5.00 | 4.64 | 4.55 | 4.18 | 4.82 | 4.45 | 4.73 | 3.91 |
| Deviation of Personal score | 0.48 | 0.96 | 0.00 | 0.48 | 0.66 | 0.39 | 0.57 | 0.66 | 0.45 | 0.29 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 5 | 2 | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 4 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 4 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 5 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment | 4 | 5 | 5 | 4 | 5 | 5 | 5 | 3 | 5 | 5 |
| Substation Equipment | | | | | | | | | | |
| (5) Significance of Management & Application of Maintenance Data | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 3 | 5 | 4 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 0 | 5 | 4 |
| ① Standard Information items to be | | | | | | | | | | |
| (7) ② The relationship aspect of failure and warning of main equipment | 4 | 3 | 5 | 5 | 4 | 4 | 5 | 0 | 5 | 4 |
| (8) Human factors relating worker's disaster | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 4 | 0 | 4 |
| (9) Overload Operation method of Oil-immersed Transformers | 5 | 4 | 5 | 5 | 4 | 4 | 5 | 5 | 5 | 4 |
| (10) Safety work at substation | 4 | 4 | 5 | 5 | 0 | 4 | 5 | 4 | 5 | 5 |
| Total of Personal score | 51 | 46 | 55 | 51 | 46 | 45 | 55 | 35 | 50 | 47 |
| Average of Personal score | 4.64 | 4.18 | 5.00 | 4.64 | 4.18 | 4.09 | 5.00 | 3.18 | 4.55 | 4.27 |
| Deviation of Personal score | 0.48 | 0.94 | 0.00 | 0.48 | 1.40 | 0.29 | 0.00 | 1.59 | 1.44 | 0.45 |

Table – 10 Satisfaction (Comprehensive Evaluation)

Course Name: Technique and Procedure for Maintenance of Power Equipment

Total Evaluation ⇔

Knowledge possession situation regarding Power system technology and Job implementation

I . Distribution Facilities

| Person → | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|--|------|------|------|------|------|------|------|------|------|------|
| Question ↓ | | | | | | | | | | |
| (1) Configuration of Distribution Facility | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 0 | 5 |
| (2) Configuration and function of the protection system of the distribution | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 0 | 3 |
| (3) Deterioration Aspects and Mechanism of Equipment | 3 | 4 | 4 | 5 | 5 | 4 | 3 | 5 | 0 | 5 |
| (4) Significance of preventive maintenance of distribution equipment | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 5 | 0 | 4 |
| (5) Points of Patrol & Inspection Technique and implementation procedure (Overhead Line) | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 0 | 4 |
| (6) Deterioration diagnosis method of cable (Underground Line) | 3 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 0 | 5 |
| (7) Fault locating technique for underground cable (Underground Line) | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 0 | 5 |
| (8) Significance of Management & Application of Maintenance Data | 4 | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 0 | 4 |
| (9-1) The voltage regulation standards of distribution line | 4 | 3 | 4 | 5 | 4 | 2 | 5 | 4 | 0 | 4 |
| (9-2) Current (load) management technique of distribution line | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 5 | 0 | 5 |
| (10) Earthing technology of distribution system (The purpose and necessary part of earthing) | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 0 | 5 |
| Total of Personal score | 39 | 43 | 45 | 48 | 46 | 39 | 48 | 44 | 0 | 44 |
| Average of Personal score | 3.91 | 4.27 | 4.45 | 4.82 | 4.55 | 3.91 | 4.82 | 4.45 | 0.00 | 4.45 |
| Deviation of Personal score | 0.51 | 0.62 | 0.50 | 0.39 | 0.50 | 0.67 | 0.57 | 0.50 | 0.00 | 0.66 |

II . Substation Facilities

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| (1) Configuration of substation | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 4 | 0 | 4 |
| (2) Transformer deterioration diagnosis method (the technology of dissolved gas analysis in insulation oil) | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 3 | 0 | 4 |
| (3) Points of Patrol & Inspection Technique and implementation procedure (Substation facilities) | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 3 | 0 | 5 |
| (4) Points of Periodic Inspection and implementation procedure for substation equipment Substation Equipment | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 0 | 5 |
| (5) Significance of Management & Application of Maintenance Data | 4 | 5 | 4 | 5 | 5 | 5 | 5 | 4 | 0 | 4 |
| (6) Significance of Failure analysis of main substation equipment and implementation procedure | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 3 | 0 | 4 |
| (7) Standard Information to be monitored and Fault Finding/Restoration of Substation | 5 | 4 | 4 | 5 | 5 | 3 | 5 | 0 | 0 | 4 |
| ① Standard Information items to be | | | | | | | | | | |
| (7) ②The relationship aspect of failure and warning of main equipment | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 4 |
| (8) Human factors relating worker's disaster | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 3 | 0 | 4 |
| (9) Overload Operation method of Oil-immersed Transformers | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 0 | 4 |
| (10) Safety work at substation | 5 | 4 | 5 | 5 | 0 | 4 | 5 | 4 | 0 | 5 |
| Total of Personal score | 51 | 49 | 51 | 52 | 49 | 47 | 55 | 33 | 0 | 47 |
| Average of Personal score | 4.64 | 4.45 | 4.64 | 4.73 | 4.45 | 4.27 | 5.00 | 3.00 | 0.00 | 4.27 |
| Deviation of Personal score | 0.48 | 0.50 | 0.48 | 0.45 | 1.44 | 0.62 | 0.00 | 1.54 | 0.00 | 0.45 |