Periodic Safety Inspection System on Electrical Installation in Republic of Korea

Kwangsu Kim (James)
Korea Electrical Safety Corporation
Republic of Korea
Reviewed the international experiences for Developing Electrical Safety System

Contents

1. ABOUT KESCO
2. ELECTRICAL SAFETY MANAGER
3. PERIODIC INSPECTION SYSTEM
4. ENGINEERING SERVICE
Reviewing the international experiences for Developing Electrical Safety System

Leader in Electrical Safety

Seek to be a key electrical safety agency whose electrical safety criteria become global standards and construct a new electrical safety system leading innovation into the future.

Happy Customers

Ensure customer satisfaction by forming "Safe and Convenient Living" conditions with perfect performance in preventing electrical accidents.

Exhilarating Workplace

Create an organizational culture that encourages workers to display their full potential by establishing a fair performance reward system that values individual ability and performance.

ABOUT KESCO
History

- Jun. 1974: Established as a Juridical Foundation
- Apr. 1975: Name Changed to the Korea Electrical Safety Corporation
- Jul. 1990: Designated as a Disaster Management Agency
- Jul. 1995: Opened Electrical Safety Research Institute
- Mar. 2000: Opened Electrical Safety Technical Education Institute
- Jun. 2007: Lunched 24-hour Emergency Reaction Service
- Jun. 2010: Opened the Middle East Office in Dubai, UAE
- Dec. 2013: Awarded a Presidential citation for 2013 Disaster Safety Management
- Feb. 2014: Opened the South-East Asian Office in Hanoi, Vietnam
- Jun. 2014: Opened a new building Sae Wool Lim in Jeonbuk Innovation City
Mission & Vision

Mission

Protecting life and property from electrical disasters

Vision

KESCO, an electrical safety leading organization, will make the future of electrical safety brighter, so that each of the Korean people can be satisfied.
Organization

CEO

Director of Planning Headquarters
Office of Planning & Coordination
Office of Management Assistance
Office of Human Resources Development
Affiliated Institutions

Director of Safety Headquarters
Office of Safety Management
Office of Safety Panning

Director of Technology Headquarters
Office of Technology Business
Office of Growth Engines
Office of Electrical Power Facility Inspection

Office of Public Relations

Executive Auditor
Office of Audit

Human Resources

District & Branch Offices

• 13 Regional Head Offices
• 47 Branch Offices
• 2 Overseas Branch Offices
• Dubai, UAE office
• Hanoi, Vietnam office

Human Resources

• 2,363 Engineers
• 365 Office Clerks
ورشة عمل استعراض التجارب الدولية لتطوير منظومة السلامة الكهربائية

Reviewing the international experiences for Developing Electrical Safety System
Electric Utility Act

**Purpose**

The purpose of this Act is to promote the sound development of the electric utility and protect the interest of the consumers of electricity by establishing the basic system, and by promoting the competitiveness, of the electric utility and thereby to contribute to the progress of the national economy

**Article 98 (Delegation or Entrustment of Authority)**

The Minister of Trade, Industry and Energy may, under the conditions as prescribed by the Presidential Decree, delegate a part of his authority to his dependent agency, the mayor governor.

Of the functions of the Minister of Trade, Industry and Energy, the Mayor or governor as provided by this Act, such affairs as set forth in the following subparagraphs may partially be entrusted to the Korea Electrical Safety Corporation (hereinafter “KESCO”) under the conditions as prescribed by the Presidential Decree.

**Article 73 (Appointment of Electrical Safety Manager )**

An operator of the electric utility or an owner or occupant of electric installations for private use shall, under the conditions as prescribed by the Ordinance of the Ministry of Trade, Industry and Energy, appoint an electric safety control person by each field from among those who have, under the National Technical Qualifications Act, obtained qualifications for technician in the fields of electricity, machine, and engineering in order to charge him with the performance of safety control service in connection with the works, maintenance, and operation of the electric installations.
General Status of Electrical Facility

**Electrical Facility**

- **for Electrical Businesses**
  - Power Plant, Substation, Transmission line, etc.
  - Pre-use Inspection
  - Periodic Inspection

- **for Private Use**
  - Building or Factory (Exceed 600V or over 75kW)
  - Pre-use Inspection
  - Periodic Inspection

- **for General Use**
  - Building, Factory, Dwellings (600V or lower & under 75kW)
  - Pre-use Inspection
  - Periodic Inspection

**Definition of Voltage**

- **Low Voltage (LV)**
  - DC: Lower than 750V
  - AC: Lower than 600V

- **High Voltage (HV)**
  - DC: Exceed 750V ~ 7kV
  - AC: Exceed 600V ~ 7kV

- **Special-High Voltage (SHV)**
  - Exceed 7kV
Diagram of Electrical Facility

- Electrical facilities for business use:
  - Power plant
  - Substation
    - 154 kV
    - Substation for power distribution
    - 22.9 kV
    - Pole transformer
      - 380V/220V

- Electrical facilities for general use:
  - 600 V or lower under 75 kW

- Electrical facilities for private use:
  - Self power generation
    - Power plant
  - Large factories
  - Factories, buildings, etc.
    - 600 V or higher 75 kW or higher

- Under 10 kW: power generation facilities
- Under 20 kW: public & dangerous workplace

Reviewing the international experiences for Developing Electrical Safety System
General Status of Electric Facility

- **Electrical Facility for Electrical business**
  - Power Plant: 353 unit, 82,335 MW
  - Substation: 782 sites, 279,145 MVA

- **Electrical Facility for Private Use**
  - Facility of Receiving electricity with LV (over 75kW): 92,415 unit
  - Facility of Receiving electricity with HV (SHV): 210,657 unit
  - Facility of Power Generation: 85,295 unit / (emergency: 67,036 unit)

- **Electrical Facility for General Use (less than 75kW)**
  - Dwelling, small factory & building, etc: 22,830,000 unit
Legal Basis of Electrical Safety Manager

Electrical Facilities

- for Electrical Businesses (Mandatory - Residence)
- for Private Use (Exceed 600V, or over 75kW)
- for General Use (600V or lower & under 75kW)

- Electrical safety manager (Mandatory - Residence)
- Electrical safety manager (Mandatory - agent or non-residence)
- Owner/Occupant's Self-Management (Safety manager is not mandatory)
KESCO provides agency service to company which has small and medium-scale of electrical facilities requiring to hire an electrical safety manager in accordance with Article 73 of the Electric Utility Act as following:

- Inspection on maintenance status of electrical facilities (1~4 times per month)
- Maintaining the electrical facilities of customer with optimum condition
- Technical education of electrical safety
- First aid & troubleshooting for electrical problem
- Supervision for installation or modification of electrical facility

<table>
<thead>
<tr>
<th>Facility</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Facility</td>
<td>Lower than 1,000 kW</td>
</tr>
<tr>
<td>Power Generation Facility</td>
<td>Lower than 300 kW</td>
</tr>
<tr>
<td>(lower than 500 kW of emergency generation)</td>
<td></td>
</tr>
<tr>
<td>Photovoltaic Power Generation Facility</td>
<td>Lower than 1,000 kW</td>
</tr>
<tr>
<td>Renewable Energy Facility</td>
<td>Lower than 300 kW</td>
</tr>
<tr>
<td>(Wind Power, Fuel Cell, etc)</td>
<td></td>
</tr>
</tbody>
</table>
Reviewing the international experiences for Developing Electrical Safety System
Definition and Scope of Electric Facilities for Private Use

**Definition**

- Facilities that receive electricity with a low voltage and over 75kW of capacity or High Voltage

**Scope**

- Electric facilities which are receiving over HV
- Electric facilities which are receiving low voltage and electrical capacity is over 75kW
  - Electric facilities with a capacity of over 20kW of dangerous facilities
  - Electric facilities with a capacity of over 20kW of public facilities
- Power generators with a capacity over 10kW
- Electrical facilities installed in the same premises which is installed electric facilities for private use
Definition and Scope of Periodic Inspection

**Definition of Term**

- The term “Facility of accommodating electricity” means Facility of Receiving electricity + Facility of distribution on premises
  - A < 1000kW: Facility of Receiving electricity
  - B ≥ 1000kW: Facility of Receiving electricity + Facility of distribution on premises

Facility omitted

- Facility of receiving electricity in case of transforming SHV or HV to LV
- Facility of receiving electricity in case of transforming SH to HV

![Diagram of electrical facilities](image)
# Cycle of Periodic Inspection

<table>
<thead>
<tr>
<th>Division</th>
<th>Targets</th>
<th>Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Power Generation Facilities</td>
<td>(1) Steam turbine and internal combustion engine systems (including power generator systems)</td>
<td>4 years</td>
</tr>
<tr>
<td>(Excluding stand-by emergency generation facilities)</td>
<td>(2) Gas turbine (including power generator systems)/boiler/heat exchanger</td>
<td>2 years</td>
</tr>
<tr>
<td></td>
<td>(3) Hydraulic power generator systems</td>
<td>4 years</td>
</tr>
<tr>
<td></td>
<td>(4) Fan-driven power generator systems</td>
<td>4 years</td>
</tr>
<tr>
<td>2. Electric receiving facilities and stand-by emergency generation facilities</td>
<td>(1) Power-receiving facilities and 75 kW or higher stand-by emergency generation facilities installed in medical centers/concert halls/hotels/large stores/wedding halls/designated cultural properties/karaoke/bars/bath houses/singing practice rooms</td>
<td>2 years</td>
</tr>
<tr>
<td></td>
<td>(2) Receiving facilities of manufacturers or manufacturing-related service providers for which the designation of electric safety manager is exempted pursuant to Article 40, Clause 1</td>
<td>2 years</td>
</tr>
<tr>
<td></td>
<td>(3) Over high voltage power-receiving facilities and 75 kW or higher stand-by emergency generation facilities installed in customer except those in (1), (2) and (4)</td>
<td>3 years</td>
</tr>
<tr>
<td></td>
<td>(4) Over high voltage power-receiving facilities and 75 kW or higher stand-by emergency generation facilities of those who submit or keep a process safety report or a safety improvement plan.</td>
<td>4 years</td>
</tr>
</tbody>
</table>

※ Note: The inspection for power generation facilities shall be carried out during the suspension period of the facilities.
<table>
<thead>
<tr>
<th>Division</th>
<th>Capacity</th>
<th>Safety Manager</th>
<th>Pre-use Inspection</th>
<th>Periodic Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dangerous facilities &amp; Public facilities</td>
<td>Over 20 kW</td>
<td>○</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>Manufacturing Facilities</td>
<td>Over 100 kW ~ Lower than 200 kW</td>
<td>×</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Over 200 kW</td>
<td>○</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>Manufacturing-related service facilities</td>
<td>Over 75 kW ~ Lower than 200 kW</td>
<td>×</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Over 200 kW</td>
<td>○</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>Night-time Power Facilities</td>
<td>Over 100 kW ~ Lower than 200 kW</td>
<td>×</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>Over 200 kW</td>
<td>○</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>Other facility</td>
<td>Over 75 kW</td>
<td>○</td>
<td>○</td>
<td>×</td>
</tr>
</tbody>
</table>
When there are both power-receiving facilities and emergency power generation facilities

- If generator is 10 kW or lower: Identical to the case where there are only facility of receiving electricity
- If the generator is over 10 kW

<table>
<thead>
<tr>
<th>Division</th>
<th>Capacity</th>
<th>Safety Manager</th>
<th>Pre-use Inspection</th>
<th>Periodic Inspection</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility of accommodating electricity</td>
<td>No limitations</td>
<td>○</td>
<td>○</td>
<td>×</td>
<td>Note 1</td>
</tr>
<tr>
<td>Emergency Power Generation Facilities</td>
<td>Over 10 kW - Lower than 75 kW</td>
<td>○</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 75 kW</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

*Note 1: [Enforcement Regulations Article 3, Clause 2, No. 1]*
The general electrical facilities installed in the premises as the installation site of an electrical facility for private use shall be regarded as a part of the electrical facility for private use.
Application of Periodic Inspection

- **Application time**
  - Apply no later than 7 days before the desired inspection day with a written application attached the required documents.

- **Required document**
  - Single line diagram, Certificate for business registration, application form.

- **Method of application**
  - Personal visit, mail, or website.

- **Reception**
  - Regional head offices or branches of KESCO
    - Electrical facilities for private use
    - Stand-by emergency generation facilities and internal combustion generation facilities with an output under 500 kW

- **Change of inspection schedule**
  - Inspection schedule may be changed if there is an unavoidable reason such as the applicant’s affairs.

- **Payment of fees**
  - The applicant shall pay an inspection fee approved by the Minister of Trade, Industry, and Energy.
Procedure of Inspection

Guide to inspection
- In case of Periodic Inspection, KESCO shall send a guide for inspection application method, inspection fee, and other information required for inspection to the target customers according to the annual inspection plan.
  - Informing: About 2 months before inspection-scheduled month
  - Expiration: Send a written notification for inspection which states the administrative measure to the customers who have passed the legal term for periodic inspection or re-inspection.
- Guide to send official request document for “Open switch of limited point for responsibility” to KEPCO
  ※KEPCO: Korea Electric Power Corporation

Preparation for inspection
- The inspector informs the following to the applicant for smooth inspection.
  - The electric safety manager shall be joined for witness.
- Reviewing the drawing and check Technical standard related in electrical installation.
Procedure of Inspection

- **Meeting before inspection**
  - Inspectors shall follow the safe work rules to guarantee the safety of human lives including themselves and facilities.
  - Inspector shall discuss with the applicant to adjust the sequence and method of inspection according to the situation of the site, and review the technical documents related to the inspection submitted by the applicant.
  - Check the required safety management information and perform safety education.

- **Performing inspection**
  - The inspector explain details of the objectives and contents of the inspection for electric facilities to the applicant.
  - The inspector perform inspection based on the inspection items and standards.
  - The inspector judge result of inspection in accordance with the following criteria:
    - Conform to the technical standards. (if necessary for public safety and smooth power supply, international standards or national standards which are equivalent to or higher than the technical standards may be applied)
    - Conform to the standards such as the inspection items for electrical facilities for private use.
Procedure of Inspection

❖ Meeting after inspection

- Inspector shall explain the inspection results to the applicant and guide as follow
  - Explain how to improve the nonconforming items
  - Give an advice on technical matters

❖ Follow-up measures according to the inspection result

- Measures on the site after inspection: Issue a certificate of performing inspection
- Notify the inspection results
  - In case of “Pass”, issue a certificate of periodic inspection to the applicant within 5 days after the inspection completed
  - In case of “Rejection”, send an official notice of the content, reason, correction method, and correction term.
Guide to periodic inspection
(2 months before inspection scheduled month)

Request periodic inspection
(7 days before inspection)

Inspection
Pass
Rejection

Send reminder for application
In case of no request

Request
No request

Issue a confirmation document of executing inspection

Notify inspection results & issue a certificate(within 5 days)

Guide to re-inspection within 3 months

Issue a confirmation document of executing inspection

Fail to request re-inspection within 3 months

Report to the relevant administrative office

Order to conform to technical standards (Imposing a penalty)

Order to receive inspection (Imposing a penalty)

Pass
Rejection

Request re-inspection within 3 months

Re-inspection
Pass
Rejection

Report to the relevant administrative office
Form of Official Document

- **Confirmation Document of Executing Inspection**

- **Certificate of Periodic Inspection**
**Inspection Items**

<table>
<thead>
<tr>
<th>Inspection Items</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual Inspection</strong></td>
<td>Size, strength separation and height, of electric wire, Span and dip of support structure</td>
</tr>
<tr>
<td></td>
<td>Inspection of insulator string, Condition of wire connection</td>
</tr>
<tr>
<td></td>
<td>Joint and terminal of underground line, Status of grounding system</td>
</tr>
<tr>
<td></td>
<td>Separation of arc organization, Separation and protection of charging part</td>
</tr>
<tr>
<td></td>
<td>Open and close operation of switch and circuit breaker</td>
</tr>
<tr>
<td></td>
<td>Alarm device or ground fault circuit breaker</td>
</tr>
<tr>
<td></td>
<td>Aging, deformation and operation of machine and device</td>
</tr>
<tr>
<td></td>
<td>Condition of measuring equipment and air compressor</td>
</tr>
<tr>
<td></td>
<td>Lighting for monitoring and operation, Prevention facility for outpouring of insulation oil</td>
</tr>
<tr>
<td></td>
<td>Capacity and condition of power fuse, Phase display of HV line</td>
</tr>
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## Inspection Items

<table>
<thead>
<tr>
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</table>
| **Grounding Resistance Inspection** | Measuring value of grounding resistance  
Check maintenance of underground wiring  
Other’s conformity of technical standard  |
| **Insulation Resistance Inspection** | Bus, distribution line, line & device  
Transformer, generator  
Cable  
(Measuring Partial Discharge)  
(Measuring temperature)  
(Measuring UV Corona)  
(Measuring leakage current of arrester)  
(Measuring moisture, purity & SO2 of SF6 gas)  
(Measuring leakage of SF6 gas) |

Reviewing the international experiences for Developing Electrical Safety System
<table>
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</table>
| **Dielectric Withstand Inspection** | Transformer, Generator, etc  
Cable  
Bus and relating switch, breaker  
(Measuring Partial Discharge)  
(Measuring temperature)  
(Measuring UV Corona)  
(Measuring leakage current of arrester)  
(Measuring moisture, purity & SO2 of SF6 gas)  
(Measuring leakage of SF6 gas) |
| **Insulation oil test Inspection** | Breakdown voltage  
Acidity  
(Analysis of insulation oil) |
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<tr>
<td><strong>Protection equipment Inspection</strong></td>
<td>Break equipment for over current</td>
</tr>
<tr>
<td></td>
<td>Break equipment for ground fault</td>
</tr>
<tr>
<td></td>
<td>Protective equipment for transformer</td>
</tr>
<tr>
<td></td>
<td>- breaker &amp; alarm device</td>
</tr>
<tr>
<td></td>
<td>- measuring device</td>
</tr>
<tr>
<td></td>
<td>Air compressor equipment</td>
</tr>
<tr>
<td></td>
<td>- capacity &amp; operation, Safety valve</td>
</tr>
<tr>
<td></td>
<td>- Restoration equipment of air tank pressure</td>
</tr>
<tr>
<td></td>
<td>Power condenser or Shunt reactor</td>
</tr>
<tr>
<td></td>
<td>- breaker &amp; alarm device</td>
</tr>
<tr>
<td></td>
<td>Characteristic test for protective equipment</td>
</tr>
<tr>
<td></td>
<td>- minimum working test, moment characteristic test, interlock test</td>
</tr>
</tbody>
</table>
Power on Inspection (POI)

Definition

- Power On Inspection means inspection of electrical facility which is over 10,000 kW capacity without power cut

Introduction Background

- Request of customer like semiconductor, petrochemical and steel industries who are difficult with power cut
- Improve company’s productivity with POI
## Power on Inspection (POI)

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<td>Details</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
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</table>
| **Grounding Resistance**      | Measuring value of grounding resistance  
 Check maintenance of underground wiring  
 Other’s conformity of technical standard |
| **Insulation Resistance**     | Bus, distribution line, line & device  
 Transformer, generator  
 Cable  
  
 **Inspection**  
 (Measuring Partial Discharge)  
 (Measuring temperature)  
 (Measuring UV Corona)  
 (Measuring leakage current of arrester)  
 (Measuring moisture, purity & SO2 of SF6 gas)  
 (Measuring leakage of SF6 gas) |
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<table>
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<tr>
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<tbody>
<tr>
<td><strong>Dielectric Strength</strong></td>
<td>Transformer, Generator, etc</td>
</tr>
<tr>
<td><strong>Inspection</strong></td>
<td>Cable</td>
</tr>
<tr>
<td></td>
<td>Bus and relating switch, breaker</td>
</tr>
<tr>
<td>(Measuring Partial Discharge)</td>
<td></td>
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<td>(Measuring temperature)</td>
<td>(Measuring UV Corona)</td>
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<td>(Measuring leakage current of arrester)</td>
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<tr>
<td><strong>Insulation oil test</strong></td>
<td>Breakdown voltage</td>
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<td>Acidity</td>
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</tbody>
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</table>
## Power on Inspection (POI)

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Target of Inspection</th>
<th>Related Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partial Discharge</strong></td>
<td>Cable, Transformer, GIS with HV (SHV)</td>
<td>KS C IEC 60270, KS C IEC 60694, KECS 1201-2011</td>
</tr>
<tr>
<td><strong>Leakage of SF6</strong></td>
<td>Insulating installation with SF6 like GIS, GCB, etc</td>
<td>KS C IEC 60694, IEC 60480, IEC 60376</td>
</tr>
<tr>
<td><strong>(Sulfur Hexafluoride)</strong></td>
<td></td>
<td>IEC 60376, IEC 60480</td>
</tr>
<tr>
<td><strong>Analysis of SF6</strong></td>
<td>Insulating installation with SF6 like GIS, GCB, etc</td>
<td>IEC 60567, IEC 60567</td>
</tr>
<tr>
<td><strong>Analysis of Insulation oil</strong></td>
<td>Electrical installation with insulation oil like oil immersed transformer, oil immersed switch, etc</td>
<td>IEC 60599, IEC 60567, KECS 1201-2011</td>
</tr>
<tr>
<td><strong>Ultraviolet ray Corona</strong></td>
<td>Line: cable, wire, bus-bar, pylon, etc</td>
<td>IEC 60270, KECS 1201-2011</td>
</tr>
<tr>
<td></td>
<td>Installation: transformer, breaker, switch, generator, motor, etc</td>
<td></td>
</tr>
</tbody>
</table>
## Power on Inspection (POI)

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Target of Inspection</th>
<th>Related Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrared Thermography</strong></td>
<td>Line: cable, wire, bus-bar, pylon, etc, Installation: transformer, breaker, switch, generator, motor, etc</td>
<td>IEC 60076-11, KS C IEC 60726</td>
</tr>
<tr>
<td><strong>Analysis of Power Quality</strong></td>
<td>Transformer, motor, protection relay, etc</td>
<td>IEC 61000, IEEE 1159-1995</td>
</tr>
<tr>
<td><strong>Leakage of Arrester</strong></td>
<td>Arrester</td>
<td>ES 5920-0100, KS C IEC 60099</td>
</tr>
<tr>
<td><strong>Analysis of Storage Battery</strong></td>
<td>Storage battery</td>
<td>IEEE 1188-1996, IEEE 450/484-1996</td>
</tr>
<tr>
<td><strong>Scope telescope</strong></td>
<td>Pylon, wire, clamp, insulator, etc</td>
<td>Technical Standard</td>
</tr>
<tr>
<td><strong>Ground Resistance of live line</strong></td>
<td>Arrester, surge absorber, installation enclosure</td>
<td>Technical Standard</td>
</tr>
</tbody>
</table>
ورشة عمل استعراض التجارب الدولية لتطوير منظومة السلامة الكهربائية

Reviewing the international experiences for Developing Electrical Safety System
Diagnosis of Electrical Facility

Upon a customer’s request, KESCO diagnose present condition or operation status of electrical facilities and their compliance with technical standards for removing factors causing accidents in advance to ensure electrical safety using state-of-the-art equipments.

Main Customer

- Customer of huge electricity consumer (oil, chemical, steel, gas, power generation, transformation of electrical energy, electrical & electronics, etc.)
- Buildings, Shopping Center, Factory, etc.
Scope of Work

Object of Diagnosis

Power Transformer, CT, VT, Circuit Breaker, Cable, Protection Relay, GIS system, etc

1. Partial Discharge Analysis
2. Infrared Thermograph Analysis
3. Transformer Oil Gas Analysis
4. UV Corona Detection
5. SF6 Gas Measurement
6. Motor Precise Test
7. Earth Resistance Test
8. Power Quality Analysis

1. Protection Relay Test
2. AC Insulation Analysis
3. DC Insulation Resistance Test
4. Circuit Breaker Analysis
5. Micro-ohm Measurement
6. SFR Analysis
7. Winding Resistance Test
8. Transformer Turns Ratio Test

Energized

De-Energized
<table>
<thead>
<tr>
<th>Object</th>
<th>Test Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawing Review</td>
<td>Function, Meter, I/O, Alarm Indication, Transducer</td>
</tr>
<tr>
<td>LV/MV/GIS SWGR</td>
<td>Protection Relay Function, Meter, I/O, Alarm Indication, Transducer</td>
</tr>
<tr>
<td></td>
<td>CT / VT Primary Injection Testing, Ratio, Polarity, IR, Excitation curve, Burden</td>
</tr>
<tr>
<td></td>
<td>CB / BUS-BAR Function, Timing, Mechanical interlock, Low Resistance, AC Hi-Pot, IR</td>
</tr>
<tr>
<td></td>
<td>Function Test Inter-Lock/Trip test, Inter-Wiring, outgoing Wire Check</td>
</tr>
<tr>
<td></td>
<td>Power Cable Hi-Pot test, IR, PD(Partial Discharge) test</td>
</tr>
<tr>
<td>TR</td>
<td>Function test, IR, Ratio, Polarity, Rotation, Impedance</td>
</tr>
<tr>
<td>GENERATOR</td>
<td>GPP(Protection Panel) Function, Meter, I/O, Alarm Indication</td>
</tr>
<tr>
<td></td>
<td>AC,DC Sequence Check Outgoing/going Cable</td>
</tr>
<tr>
<td>Inter-Lock/Tripping, Stability test</td>
<td>Internal &amp; Inspection</td>
</tr>
<tr>
<td>Back-Energizing</td>
<td>Insulation Resistance</td>
</tr>
<tr>
<td>Commissioning</td>
<td>Motor Running, Trouble Shooting</td>
</tr>
</tbody>
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