# APPENDIX C

Minimum Inspection Requirements

## C.1 DISTRIBUTION INSPECTION STANDARDS

### Inspection Cycles

A distributor should ensure that only persons qualified under the Occupation of Health and Safety Act are involved in inspection activities. Since some inspections can expose inspectors to energized lines or high voltage circuits and equipment, and may include inspection and repair, a qualified person should be assigned to this work. This assumes that they are both properly trained to protect both themselves and the public, and to respond to those emergencies, which may arise during inspections.

In developing the standards for facilities inspections, the patrol inspection is defined as follows:

> Patrol or simple visual inspections consists of walking, driving or flying by equipment to identify obvious structural problems and hazards such as leaning power poles, damaged equipment enclosures, and vandalism. In cases where a patrol notices that a problem exists or identifies a condition that warrants a more thorough or rigorous inspection, patrol may then include situations where structures are opened as necessary, and individual pieces of equipment carefully observed and their condition noted and recorded. The specifics of these inspections would be recorded, and a summary document prepared in the distributor's annual reports as part of their rates or licensing submissions.

In all cases, a distributor is responsible to ensure that appropriate follow up and corrective action is taken regarding problems identified during a patrol.

The Board or a Board-designated party reserves the right to conduct random audits of inspection reports to ensure that appropriate follow up and corrective action is taken regarding problems identified during a patrol.

It is expected that distributors will file both annual summary reports of detailed patrol inspection activities that have taken place during the previous year as well as an outline of inspection plans ("compliance plans") for the forthcoming year.

Inspection cycles are categorized by the following major distribution facilities:

Distribution Transformers
Stations
Switching and Protective Devices
Regulators
Capacitors
Conductors and Cables

Vegetation
Poles/Supports
Civil Infrastructure

For each of these facilities, the distributor shall further distinguish between overhead facilities, underground facilities. The distributor shall also separate according to the facilities' location and the relative population density in the locale.

C **Rural** means those areas that are less populous suburban areas and are outside of a standard metropolitan area. Generally, rural will be defined on a circuit or sub-circuit basis by each utility, as areas with a line density of less than 60 customers per kilometer of line. It is recognized that there may be circumstances where the utility might want to treat something as urban though it would otherwise be defined as 'rural' according to this definition.

C **Urban**, means areas with higher density and, by definition pose safety and reliability consequences to greater numbers of people.

The following description provides a list of the requirements to be expected from a typical distribution line patrol inspection in terms of the types of defects that may be detected visually. Clearly, the list will vary depending on the equipment specifics and locations, thus this should be viewed as a 'generic' patrol expectation.

*Transformers and switching kiosks:*
Paint condition and corrosion
Placement on pad or vault
Check for lock and penta bolt in place
Grading changes
Access changes (Shrubs, trees, etc.)
Phase indicators and unit numbers match operating map (where used)
Leaking oil
Flashed or cracked insulators
Pad mounted – lid damage, missing bolts, cabinet damage, public security lock damage

*Substation*- May consist of one or all types of equipment listed

*Switching/Protective Devices*
Overhead
Bent, broken bushings and cutouts,
Damaged lightning arresters, control boxes, current and potential transformers
Underground
Security and structural condition of enclosure
Pad mounted
Security and structural condition of enclosure

*Regulators*

- Condition of bushings
- Tank corrosion/leaks
- Damaged disconnect switches or lightning arresters

*Capacitors*

- Condition of bushings
- Tank corrosion/leaks
- Damaged cutouts, disconnects or control cabinet

*Conductors and Cables*

- Low conductor clearance
- Broken/frayed conductors or tie wires
- Tree conditions, exposed broken ground conductors
- Broken strands, bird caging, and excessive or inadequate sag.
- Insulation fraying on secondary especially open wire

*Poles/Supports*:

- Bent, cracked or broken poles
- Excessive surface wear or scaling
- Loose, cracked or broken cross arms and brackets
- Woodpecker or insect damage, bird nests
- Loose or unattached guy wires or stubs
- Guy strain insulators pulled apart or broken
- Guy guards out of position or missing
- Grading changes, or washouts
- Indications of burning

*Hardware and attachments:*

- Loose or missing hardware
- Insulators unattached from pins
- Conductor unattached from insulators
- Insulators flashed over or obviously contaminated (difficult to see)
- Tie wires unraveled
- Ground wire broken or removed
- Ground wire guards removed or broken

*Equipment Installations (includes transformers)*

- Contamination/discoloration of bushings
- Oil leaks
- Rust
- Ground lead attachments
- Ground wires on arrestors unattached
- Bird or animal nests
- Vines or brush growth interference

Evidence of bushing flashover
Accessibility compromised

*Vegetation and Right of Way:*

Leaning or broken “danger” trees
Growth into line of “climbing” trees
Unapproved/unsafe occupation or secondary use

*Civil Infrastructure* - For example, buildings that house the equipment may need attention (cracking, fire hazards, etc). In addition, cable chambers, underground vaults and tunnels crossing the rail track or water are also included in this category. These inspections would likely be conducted in the patrol of the equipment with which they are “associated.”

**Underground Systems:**

With respect to underground systems, riser poles should be checked as with an overhead patrol, with a visual check of cable, cable guards, terminators and arrestors. While it is not possible to inspect underground cable directly, the system may be checked for exposed cable and or grade changes that may indicate that the cable has been brought too close to the surface. Patrol inspection of cable chambers is not required since a visual inspection will not reveal faults because the failure mechanism for underground cable (e.g. voids, water trees) is not visually detectable.

Cable is hard to check, but the system can be checked for exposed cable and/or grading changes that may have brought cable or wire too close to the surface.

## TABLE C-1
## Electric Utility System Inspection Cycles
## (Maximum Intervals in Years)

| Major or Substantial Distribution Facility* | Patrol | Patrol |
|---|---|---|
| | | |
| **Distribution Transformers** | **Urban** | **Rural** |
| Overhead | 3 | 6 |
| Submersible | 3 | 6 |
| Vault | 3 | 6 |
| Pad Mounted | 3 | 6 |

| Stations (see note below) | Outdoor Open | Outdoor Enclosed | Indoor Enclosed | Outdoor Open | Outdoor Enclosed | Indoor Enclosed |
|---|---|---|---|---|---|---|
| Transformer Station | 1 month | 1 | 1 | 6 month | 1 | 1 |
| Distribution Station | 1 month | 1 | 1 | 6 month | 1 | 1 |
| Customer Specific Substation | 1 | 3 | 3 | 1 | 3 | 3 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Lines and Associated Equipment** | | | | | | |
| | | | | | | |
| Regulators | | 3 | | | 6 | |
| | | | | | | |
| Switching and Protective Devices | | 3 | | | 6 | |
| | | | | | | |
| Capacitors | | 3 | | | 6 | |
| | | | | | | |
| Conductors and Cables | | | | | | |
| Overhead | | 3 | | | 6 | |
| Underground | | 3 | | | 6 | |
| Submarine | | 3 | | | 6 | |
| | | | | | | |
| Vegetation (see note below) | | 3 | | | 6 | |
| | | | | | | |
| Poles | | 3 | | | 6 | |
| | | | | | | |
| Civil Infrastructure | | 3 | | | 6 | |

**Notes to Table C-1:**

1. The above distribution system patrol cycles form part of the regulatory framework and are minimum inspection requirements for each major or substantial distribution component and related hardware.

2. A distributor may determine that more frequent inspections may be required due to local conditions such as geographic location, climate, environmental conditions such as air pollution or highway salt spray, technologies available to perform the inspection, type and vintage of distribution technology in place, manufacturer specifications, system design, or relative importance to overall system reliability of a particular piece of equipment or portion of the distributor's distribution system.

   The burden of proof is on the distributor to demonstrate that it should not have to comply with these the inspection schedules or requirement in Table C-I. To demonstrate that it should not have to comply with these inspection schedules, the distributor would have to present a comprehensive and detailed case establishing:

   Revised inspection cycles may be allowed when justified by:
   - C Documented historical good utility maintenance and inspection practices, including a program to manage reliability.
   - C Alternative or additional maintenance activities that are practiced by the utility and can be demonstrated as being practiced.
   - C Achieved reliability performance. The utility will be required to submit both the current and historic reliability statistics over five years. These statistics must be verifiable. This will be measured by the following:
     - Once the data is available over the course of Generation 1 and 2 of the PBR regime, the reliability indices that are better than the average of distributors which are comparable in size and type. The reliability indices to be used are those that are defined over time in the PBR regime, including initially SAIDI, CAIDI and SAIFI averaged over the previous three year period, and;
     - The reliability indices over time for the individual utility that are at least as good, if not better, than the average of the indices over the previous five year period. Again, the reliability indices to be used are those that are defined over time in the PBR regime, including initially SAIDI, CAIDI and SAIFI averaged over the previous five-year period.

3. The method by which inspection cycles are structured and the work carried out is at the discretion of the distributor. The above table is organized according to major classification of equipment, however distributors may choose to conduct and record the inspections on some other basis such as:
   - Circuit or feeder basis
   - Overhead & underground
   - System voltage
   - Dividing its service area into geographical areas
   - Other

   It is intended that if the inspections are organized by one of the above approaches, all major equipment categories identified in the table and related hardware along the line or within the area will be inspected. It is intended that the utility would perform the inspection on a minimum of approximately 1/3 (urban) or 1/6 (rural) of their system in each year, such that at the end of the first term of the PBR framework, a utility would have performed an inspection of their entire system in urban areas and approximately half of rural systems. If, in any one year of the PBR framework, a utility has performed the inspection on less or more than the 1/3 (urban) or 1/6 (rural) of their system, the utility would provide an explanation of this deviation in their annual submission. For clarity, the plant will be inspected on a cyclical basis, and the cyclical interval is specific to a particular region or portion of plant, and not on the system as a whole.

4. "Civil Infrastructure": Refers to facilities and structures such as tunnels, ducts suspended from or attached to bridges, underground chambers and hand holes, towers supporting distribution plant, communication towers, buildings that house substation equipment. It is intended that civil infrastructure will be inspected as part of the patrol of the distribution system or in the course of doing normal, routine utility work. It is recognized that there may be instances where it will be extremely difficult to perform a visual inspection (e.g. where access is restricted due to energized equipment in cable chambers), and therefore the civil infrastructure associated with this would be inspected in the course of doing normal utility work which would require entrance to the chamber, which would require the utility to de-energize the equipment. In other words, the equipment should not be de-energized simply to comply with this scheduled inspection routine.

5. "Patrol": Visual inspection of major distribution system components to identify problems and hazards such as leaning poles, damaged equipment enclosures, and vandalism. This will include an inspection of all related peripheral equipment, hardware, connections, all supports and attachments (e.g. cross arms, braces, guys and anchors). This would also include an assessment of vegetation encroachment on right-of-ways.

   The patrol may highlight that a problem exists or may identify conditions that warrant a more thorough or rigorous inspection or the need for specific maintenance. The specific follow up or corrective action shall be according to the best judgment of the distributor considering best industry practices. To further clarify the nature of problems detected during the inspection, the distributor may choose to utilize diagnostic tools such as infrared thermography, ultrasonic testing or other technologies that may emerge. Several technologies are also available for wood pole testing. Distributors may choose, (as post inspection follow up or ongoing maintenance), to conduct tests of major distribution system components on a sample basis. Issues such as the age, equipment design, exposure to adverse conditions, manufacturer specifications, and relative impact on overall system reliability may influence a distributor's decisions regarding corrective action and application of these diagnostic technologies following a patrol. In all cases, a distributor is responsible to ensure that appropriate follow up and corrective action is taken regarding problems identified during a patrol. This may entail upgrade or replacement of specific components or equipment.

   Maintenance activities and schedules are not specified in the above table and are left to the discretion of the distributor. It is not practical to attempt to establish a regulatory regime for literally hundreds of maintenance activities that range from insulator washing, cable replacement, $CO_2$ cleaning of switchgear, to gas-in-oil testing of station transformers, etc. The absence of more detailed inspection or maintenance criteria in the above table in no way reduces the distributor's obligation to maintain the distribution system in a safe and serviceable condition.

   The Board or a Board- designated party reserves the right to conduct random audits of inspection reports to ensure that appropriate follow up and corrective action is taken regarding problems identified during a patrol.

7. "Rural": Generally will be defined on a circuit or sub-circuit basis by each distributor, as areas with a customer density of less than 60 customers per kilometer of line. It is recognized that there may be circumstances where the distributor may choose to treat some parts of its distribution system as urban though it is "rural" according to this definition.

   "Urban": Each distributor will define "Urban", or more populated areas, on a circuit or sub-circuit basis, as areas with higher density and, by definition pose safety and reliability consequences to greater numbers of people.

8. "Stations": The terms "substations", "distribution /municipal stations", etc. Are frequently interpreted and applied differently by various distributors. In some jurisdictions the term "substation" refers to a large 125 MVA station directly connected to the 115 or 230 kV

transmission system while in other jurisdictions "substation" refers to a customer specific station that provides transformation from a distribution voltage to a utilization voltage of 600V for example.

The impact on overall distribution system reliability of any particular station varies considerably according to the nature of the station and local system design. Specific station design features such as indoor versus outdoor may warrant different inspection cycles according to the relative exposure to unauthorized access and associated public safety concerns.

The following definitions are provided to assist with interpretation of the above table such that the resulting inspection cycles are appropriate for the nature of the station.

8.1 "Transformer Station" (TS): A transformation facility with the primary connected to the 115/ 230 kV or higher transmission system and the secondary operating at 50 kV or less.

8.2 "Distribution Station" (DS): Also known as "municipal Station (MS), a transformation facility with the primary operating at a sub transmission or distribution voltage and the secondary operating at lower distribution voltage. The upstream transformation facility will typically be a Transformer Station. A Distribution Station supplies main feeders for wide area distribution.

8.3 "Customer-Specific Substation": A transformation facility supplying a specific industrial/commercial customer. The primary operates at a distribution or sub transmission voltage and the secondary typically operates at 600V. The upstream station could be either of the stations identified in 8.1 or 8.2. Typically these facilities are on the customer's private property and include customer-owned equipment in addition to a Distributor-owned transformer.

8.4 "Outdoor Open": Typically refers to a station surrounded by a locked security fence. Within the station fence bare energized components operating at distribution voltage levels or higher are readily accessible. More frequent inspections are required for public safety considerations and to ensure integrity of the station fence.

8.5 "Outdoor Enclosed": Similar to 8.4 above however all bare live components are enclosed in locked metal enclosures. Due to reduced accessibility to energized components less frequent inspections are appropriate.

8.6 "Indoor": Typically refers to a station located within a secure building. Access by the public to bare energized components within the station is prevented by the building enclosure. Due to reduced exposure to unauthorized public access less frequent inspections are appropriate.

9. "Conductors and Cables: Underground": It is not possible to inspect underground cable directly, however, the system can be checked for exposed cable and or grade changes that may indicate that the cable has been brought too close to the surface. Patrol inspection of cable chambers is not required since a visual inspection will not reveal faults because the failure mechanism for underground cable (e.g. voids, water trees) is not visually detectable.

10. "Vegetation": Refers to encroachment of vegetation upon distribution lines on any right-of-way; either public road allowance or private property. It is intended that vegetation will be inspected as part of the regular patrol of distribution equipment.

## C.2 DISTRIBUTION INSPECTION REPORTING

## TABLE C-2
## Sample Annual Inspection Summary Report

| | | | | | | |
|---|---|---|---|---|---|---|
| **Distributor** | | | | | | |
| **Reviewed by** | **Name:** | | **Position/Title:** | | | |
| **Date:** | **Signature:** | | | | | |
| **DESCRIPTION**<br><br>**Part 1 - Lines** | | **Percentage of Distribution System Scheduled for Patrol (%)** | **Percentage of Distribution System Actually Patrolled (%)** | **Reason Patrol was not Completed** | **Date Patrol will be Completed** | |
| **Overhead Plant**<br>Transformers<br>Switching & Protective Devices<br>Regulators<br>Capacitors<br>Conductor<br>Vegetation<br>Poles<br>Civil Infrastructure | **Urban** | | | | | |
| | **Rural** | | | | | |
| **Underground Plant**<br>Transformers<br>Switching & Protective Devices<br>Regulators<br>Capacitors<br>Cable<br>Civil Infrastructure | **Urban** | | | | | |
| | **Rural** | | | | | |

| **Part 2 – Substations** | **Number of Substations in Distribution System** | **No. of Substation Patrols Scheduled** | **No. of Scheduled Patrols not completed** | **Reason Patrols were not Completed** | **No. of Substations not Patrolled During Reporting Period** | **Date Substation Patrol Schedule will be Resumed** |
|---|---|---|---|---|---|---|
| **Transformer Station** | | | | | | |
| **Distribution Station** | | | | | | |
| **Customer Specific Substation** | | | | | | |

**Notes to Table C-2:**

## APPENDIX C - MINIMUM INSPECTION REQUIREMENTS

1. This report provides a summary of the patrols scheduled and carried out during the year as well as the target dates for completion of patrols which were not completed as planned.

2. This format is a sample of a summary report for patrols carried out on a geographical, system characteristic (overheard or underground) basis.

3. Major equipment categories need not be reported separately however, all categories of equipment within the particular area or circuits shall be inspected.

4. Civil infrastructure is intended to be inspected as part of patrol of the distribution system or in the course of doing normal routine utility work.

5. This report is to be submitted to the OEB on an annual basis.

## TABLE C-3
## Sample Patrol Deficiency Record

**Area/District** _____ **Date** _____

**Circuit** _____ **Patrolled by** _____

**Grid** _____ **Page** _____ **of** _____

| Location | Equipment Id. No. | Equipment Classification | Repair Required/ Problem | Corrective Action Priority | | Assigned to or Work Order No. | Date Repair Completed or Scheduled |
|---|---|---|---|---|---|---|---|
| | | | | Grade 1 | Grade 2 | | |
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| Number of Deficiencies for the Circuit/Area | | | | | | | |

**Notes to Table C-3:**

1. The format of this record is to be determined by the distributor based on their own system data input forms. This format is a sample for inspections done on a geographical or circuit basis and indicates the information that is expected to be collected.

2. Deficiencies and corrective action for all major equipment classifications for the area or circuit would be recorded.

3. Distributors are required to retain this information and make it available to the Board upon request.

4. Corrective Action Grade 1 is defined as a condition requiring urgent and immediate response and continued action until the condition is repaired or no longer presents a potential hazard.

5. Corrective Action Grade 2 is defined as a condition requiring timely corrective action to mitigate an existing condition which, at the time of identification, does not present an immediate hazard to the public, Distributor employees, or property.