TRANSMISSION CONTROL AGREEMENT

APPENDIX C

ISO MAINTENANCE STANDARDS

1. DEFINITIONS[1]

Availability - A measure of time a Transmission Facility under ISO Operational Control is capable of providing service, whether or not it actually is in service.

Availability Measures - The frequency and accumulated duration of Forced Outages(IMS) for each of the Transmission Line Circuits within a Voltage Class for a given calendar year.

*Availability Measure Target*s- The Availability performance goals established by the ISO.

Forced Outage(IMS) - A Forced Outage(IMS) occurs when a Transmission Facility is in an Outage(IMS) condition regardless of duration and: (1) there is no Scheduled Outage request in effect with respect to that period; or (2) the Transmission Facility is in an Outage(IMS) condition for a period that exceeds the period specified in the Scheduled Outage request, in which case a Forced Outage(IMS) is deemed to exist for the balance of the period, unless the PTO requests and is granted an extension to the approved Scheduled Outage request.

ISO Maintenance Guidelines - Criteria presented herein which are to be followed by each PTO in preparing its PTO Maintenance Practices.

ISO Maintenance Standards - Those maintenance standards which result from the

[1] A term followed by the superscript "(IMS)" denotes a term which has a special, unique definition in this

combination of each PTO's Maintenance Practices and their respective Availability Measures .

Maintenance - Maintenance as used herein, unless otherwise noted, encompasses inspection, assessment, maintenance, repair and replacement activities.

Maintenance Coordination Committee - A committee responsible for recommending to the ISO modifications to and implementation of the ISO Maintenance Standards. The committee shall be organized and operate in accordance with Section 7.0 of this document.

Outage$^{(IMS)}$ - Any interruption of the flow of power in a Transmission Line Circuit between any terminals under ISO Operational Control.

PTO - A Participating Transmission Owner as defined in Appendix D of the Transmission Control Agreement.

PTO Maintenance Practices - A description of methods used by a PTO for the Maintenance of each substantial type of Transmission Facility or component in its system which is under the Operational Control of the ISO. The PTO Maintenance Practices are to be prepared in accordance with the ISO Maintenance Guidelines.

Scheduled Outage - The removal from service of a Transmission Facility under ISO Operational Control to perform work on specific components in accordance with the requirements of the Transmission Control Agreement.

Section 348 Criteria - The criteria for maintenance standards established by Section 348 of the California Public Utilities Code, as in effect from time to time, to "provide for high quality, safe and reliable service", taking into consideration "cost, local geography and weather, applicable codes, national electric industry practices, sound engineering

judgment, and experience".

Stations - Facilities under the Operational Control of the ISO for purposes such as line termination, voltage transformation, voltage conversion, stabilization, or switching.

Transmission Facilities - All equipment and components transferred to the ISO for Operational Control, pursuant to the Transmission Control Agreement, such as overhead and underground transmission lines, Stations, and system protection equipment.

Transmission Line Circuit - The continuous set of transmission conductors located primarily outside of a Station, and apparatus terminating at interrupting devices which would be isolated from the transmission system following a fault on such equipment.

Voltage Class - The voltage to which operating, performance, and maintenance characteristics are referenced. Voltage Classes are defined as follows:

Voltage Class	**Range of Nominal Voltage**
69 kV	≤ 70 kV
115 kV	110 - 161 kV
230 kV	200 - 230 kV
345 kV	280 - 345 kV
500 kV	500 kV
HVDC	HVDC

2. INTRODUCTION

These standards were prepared by the ISO through a lengthy consensus building effort involving a diverse group of stakeholders (i.e., the ISO Maintenance Standards task force).

2.1. Objective

The Maintenance of Transmission Facilities has several objectives:

- Ensuring that the safety and Availability performance levels inherent to the Transmission Facilities are achieved,
- Restoring the safety and Availability to the levels inherent to the Transmission Facilities when degradation has occurred,
- Gathering information that can be of use as the basis for identifying improvements to those Transmission Facilities whose Availability performance is inadequate,
- Gathering information that can be used as the basis for optimizing and forecasting Maintenance for Transmission Facilities,
- Extending the useful life of the Transmission Facilities while maintaining their inherent levels of Availability, and
- Achieving the aforementioned objectives at a minimum total cost for Maintenance and Outages.

The ISO Maintenance Standards address the following topics:

- Transmission Facilities Covered by the ISO Maintenance Standards;
- Availability Measures ;
- Availability Measure Targets;
- ISO Maintenance Guidelines for PTO Maintenance practices;
- Qualifications of Maintenance Personnel;
- Maintenance Record Keeping and Reporting;
- Establishment of a Maintenance Coordination Committee;
- Process for the Revision of the ISO Maintenance Standards;
- Incentives and Penalties for PTO Availability Performance;
- Compliance with Laws and Regulations; and
- Dispute Resolution.

For certain aspects of Maintenance, these Standards delineate specific requirements

and responsibilities (e.g., requirements for PTO inspection and Maintenance records), for others they provide guidelines (e.g., contents of PTO Maintenance Practices documents), and for others they describe processes (e.g., review process for PTO Maintenance Practices documents) to be enacted to achieve the desired results.

Flexibility in establishing ISO Maintenance Standards is implicit in the goal of optimizing Maintenance across a system characterized by diverse environmental and climatic conditions, terrain, equipment, and design practices. To provide for flexibility while ensuring the reasonableness of each PTO's approach to Maintenance, the ISO Maintenance Standards are founded on two basic precepts: 1) the effectiveness of each PTO's Maintenance will be gauged through an Availability performance monitoring system, and 2) the adequacy of each PTO's Maintenance Practices will be assessed through ISO review. Each PTO's Maintenance Practices will serve as the ISO's Maintenance Standards for the Transmission Facilities covered therein. The PTO Maintenance Practices ensure a reasonable level of Maintenance during the short term while Availability is used to monitor long term performance.

It is the belief of the ISO Maintenance Standards task force that it is impractical for the ISO to develop and/or impose on the PTO's a single uniform set of detailed descriptions of practices delineating condition or time-based schedules for various Maintenance activities that account for the myriad equipment, operating conditions, and environmental conditions within the ISO grid. For this reason, the ISO Maintenance Standards provide ISO Maintenance Guidelines to be followed by each PTO in preparing PTO Maintenance Practices for its Transmission Facilities.

2.2. Availability

ISO grid reliability is a function of the Availability of Transmission Facilities owned and operated by its PTO's. The key to the effectiveness of the ISO Maintenance Standards is the establishment of a consistent measure of Transmission Facility Availability (Availability Measures) and the initial setting of the Availability Measure Targets as well as periodic revisions of those targets. By measuring Availability the ISO is able to monitor the effectiveness of Maintenance. While the ISO is concerned with grid reliability, reliability is a function of a complex set of variables including the accessibility of alternative load paths, speed and sophistication of protective equipment, and the Availability of Transmission Line Circuits, and therefore is indirectly related to Maintenance. Thus, Availability will be the principal determinant of each PTO's performance under the ISO Maintenance Standards.

When using Availability as a gauge of Maintenance adequacy, several things must be kept in mind to avoid misinterpreting performance. The most important consideration is that across the ISO grid, the vast majority of all Forced Outages$^{(IMS)}$ are due to random/chance events that cannot be controlled by Maintenance. It is important to recognize that only a small percentage of all Forced Outages$^{(IMS)}$ can be controlled through Maintenance (i.e. activities that do not change the basic configuration of Transmission Facilities). This principle assumes the PTO is performing a reasonable level of Maintenance consistent with Good Utility Practice. If an unreasonably low level of Maintenance is performed for a sufficient period of time, Availability will decline. However, if a level of Maintenance is being performed, consistent with Good Utility Practice, increasing Maintenance activities by a significant order will not result in a corresponding increase in Availability. Thus, while Maintenance is important to ensuring Availability, drastic increases in Maintenance will not lead to substantial improvements in Transmission Facility Availability and associated grid reliability.

A variety of techniques can be used to monitor performance, however techniques that do not account for random variations in processes have severe limitations in that they may yield inconsistent and/or erroneous assessments of performance. To account for random/chance variations while enabling monitoring for shifts and trends in performance, control charts have been widely accepted as an effective means for monitoring performance. Control charts are statistically-based graphs which illustrate both an expected range of performance for a particular process based on historical data, and discrete measures of recent performance. The relative positions of these discrete measures of recent performance and their relationship to the expected range of performance are used to gauge the adequacy of performance. Availability is affected by several factors only one of which is Maintenance. In fact, for most Transmission Line Circuits only a small fraction of Forced Outages(IMS) can be attributed to phenomenon that could be controlled or avoided through Maintenance. Many more Forced Outages(IMS) are attributable to random/chance events than Maintenance-related items. Therefore, while monitoring Availability as a gauge of Maintenance adequacy is useful for evaluating long term trends, care must be taken to avoid reading too much into the correlation of Availability to Maintenance since so many additional variables also impact Availability.

The fundamental performance measures selected as the basis for developing an Availability performance monitoring system are the annual accumulated duration and frequency of certain types of Outages for each Transmission Line Circuit under the ISO's Operational Control. To enhance the Availability performance monitoring system's use as a gauge of Maintenance adequacy, it was necessary to exclude certain Outage(IMS) types from the determination of the performance measures. Those excluded Outages are:

- Scheduled Outages;
- Outages caused by events originating outside the PTO's system; and
- Outages demonstrated to have been caused by earthquakes.

Additionally, the Forced Outage(IMS) duration has been capped at 72 hours so that excessively long Forced Outages(IMS) do not skew the data as to detract from the meaningfulness and interpretation of the control charts for accumulated Forced Outage(IMS) duration. This is not to say that an excessively long Forced Outage(IMS) is not a concern. Rather, such Forced Outages(IMS) should be investigated to assess the reasons for their extended duration.

The performance monitoring system requires use of separate control charts for each Voltage Class and PTO. Existing Forced Outage(IMS) data contains significant differences in the Availability performance between Voltage Classes and between PTOs. These differences may be attributable to factors such as the uniqueness of operating environments, Transmission Facility designs, and PTO operating policies. However, regardless of the cause of the differences, review of the Forced Outage(IMS) data makes it eminently apparent that the performance differences are such that no single set of control chart parameters for a particular Voltage Class could be applied to all PTOs.

Three types of control charts will be constructed to provide a complete representation of historical Availability performance, and to provide a benchmark against which future performance can be gauged. The three types of control charts for each PTO and Voltage Class are:

- The annual average Forced Outage(IMS) frequency for all Transmission Line Circuits;
- The annual average accumulated Forced Outage(IMS) duration for those Transmission Line Circuits which experience Forced Outages(IMS); and
- The annual proportion of Transmission Line Circuits that experienced no Forced Outages(IMS).

These three control charts will assist the ISO and PTO's in assessing the performance

of Voltage Classes over time. To accommodate this process on a cumulative basis data are made available to the ISO by each PTO at the beginning of a new year to assess the performance of the past years.

2.3. ISO Maintenance Guidelines

Two specific requirements regarding Maintenance documentation have been incorporated into the ISO Maintenance Standards. First, these standards require that each PTO develop and submit a description of its Maintenance practices (PTO Maintenance Practices) to the ISO. Second, these standards require that each PTO maintain Maintenance records and make those records available to the ISO in order to demonstrate compliance with each element of its PTO Maintenance Practices.

To outline the fundamental requirements for, and to promote consistency in the PTO Maintenance Practices, these standards provide guidelines for the preparation and maintenance of the PTO Maintenance Practices. These ISO Maintenance Guidelines provide for flexibility in approach to Maintenance, but also require the description of certain specific Maintenance practices. The guidelines require that the PTO's provide descriptions of the various Maintenance activities, schedules and condition triggers for performing the Maintenance, and samples of any checklists, forms, or reports used for Maintenance activities.

2.4. Data Standards

To facilitate processing of Outage$^{(IMS)}$ data for the Availability performance monitoring system, and to enable consistent and equitable interpretation of PTO Maintenance records by the ISO, these standards address the need for data recording and reporting. The ISO and PTO's have committed to developing standardized formats for transmitting Outage$^{(IMS)}$ data to the ISO for the Availability performance monitoring system. These

standard formats are to be finalized within the first 60 days of 1998. Additionally, the ISO and PTO's have agreed to develop and implement a standard Maintenance reporting system by the end of the third year of operation of the ISO. This system will provide for consistent gathering of information that can be used as the basis for optimizing and forecasting maintenance of Transmission Facilities. The development of such a Maintenance reporting system is consistent with fostering the spirit of cooperation among the ISO and the PTO's as it may eventually aid in the resolution of performance problems, and provide the basis for research on an ISO grid-wide basis to identify opportunities to enhance Transmission Facility Maintenance.

2.5. Applicability of Incentives and Penalties

Cooperation and collaboration among the PTOs responsible for ensuring the Availability of the Transmission Facilities comprising the ISO grid are needed to ensure the most reliable grid possible. Therefore, the ISO Maintenance Standards task force believes that a formal program of incentives and penalties tied purely to PTO Maintenance may hinder needed cooperation among PTOs. As a result, the ISO Maintenance Standards task force recommends that no such program be instituted initially by the ISO.

Further, the task force recognizes the need for the ISO to enforce reasonable Maintenance to ensure Availability in the case that: 1) a PTO exhibits degradation in Availability performance due to Maintenance, 2) a PTO does not comply with its PTO Maintenance Practices, or 3) a PTO is grossly or willfully negligent with regards to Maintenance. Therefore, it is the position of the ISO Maintenance Standards task force that it is reasonable for the ISO to establish penalties for such conditions. In the absence of a formal program of incentives and penalties, the task force acknowledges the ISO's right to pursue sanctions for cause on a case by case basis.

Availability is a useful and tractable means for monitoring performance, however, the

electric utility industry as a whole has little experience in using Availability to gauge the adequacy of Maintenance. Further, because the industry in general has not carefully managed historical Outage(IMS) data to the degree that is necessary to make them useful for performance monitoring, there are varying limitations with regards to the accessibility and reliability of Outage(IMS) data among PTOs. Also, the impact on Availability when a new entity, namely the ISO, assumes Operational Control of the grid is unknown. Thus, it is the position of the ISO Maintenance Standards task force that the Availability performance monitoring system will be implemented and used to gauge Availability performance beginning on the ISO Operations Date. However, the system needs to be used and updated during a five year phase in period to be considered for use in a program of incentives and penalties for Availability performance.

Availability is a function of several variables including Transmission Facility Maintenance, capital improvements, and improvements in restoration practices. If a PTO is exercising a reasonable level of Maintenance, yet the Availability performance of a Voltage Class or individual Transmission Line Circuit is inadequate for the purposes of the ISO grid, then capital improvements or improvements in restoration practices may lead to greater Availability improvements than increased Maintenance. Therefore, assessing incentives and penalties on the basis of Availability as influenced by all of these variables may be a reasonable approach for influencing PTO's to improve the Availability of their Transmission Facilities where such improvements can be justified.

3. TRANSMISSION FACILITIES COVERED BY THE ISO MAINTENANCE STANDARDS

All Transmission Facilities transferred to the ISO, pursuant to the Transmission Control Agreement, shall be maintained in accordance with the ISO Maintenance Standards.

4. AVAILABILITY STANDARD

4.1. Introduction

The ISO shall monitor and measure each PTO's Availability for the Transmission Line Circuits under ISO Operational Control. The ISO shall use an Availability measurement system which consists of two primary components: 1) measures of the annual performance of each Voltage Class based on the performance of each of the Transmission Line Circuits comprising the Voltage Class, i.e. the Availability Measures; and 2) a set of threshold performance criteria for each Voltage Class, i.e. Availability Measure Targets. The Availability Measure Targets will be used to gauge the adequacy of the PTO's annual performance for each Voltage Class. Each PTO shall make an annual report to the ISO within 90 days from the end of each calendar year that describes its compliance with the Availability Measure Targets. In its report to the ISO, supporting data based on Outage$^{(IMS)}$ records shall be included, justifying the Availability Measures reported for each Voltage Class.

4.2. Availability Measures

4.2.1. Calculation of Availability Measures for Individual Transmission Line Circuits

The calculation of the Availability Measures will be performed utilizing Outage$^{(IMS)}$ data through December 31 of each year. Separate Forced Outage$^{(IMS)}$ frequency and accumulated Forced Outage$^{(IMS)}$ duration Availability Measures shall be calculated as follows for each Transmission Line Circuit under ISO Operational Control within each

Voltage Class. The calculations shall be performed annually for each of the Transmission Line Circuits utilizing all appropriate Outage data for the calendar year in question.

Forced Outage$^{(IMS)}$ Frequency:

The Forced Outage$^{(IMS)}$ frequency (f_{ik}) of the ith Transmission Line Circuit shall equal the total number of Forced Outages$^{(IMS)}$ that occurred on the ith Transmission Line Circuit during the calendar year k. See Notes 1 and 2.

NOTES:

1. Multiple momentary Forced Outages$^{(IMS)}$ on the same Transmission Line Circuit in the span of a single minute shall be treated as a single Forced Outage$^{(IMS)}$ with a duration of one minute. When the operation of a Transmission Line Circuit is restored following a Forced Outage$^{(IMS)}$ and the Transmission Line Circuit remains operational for a period exceeding one minute, i.e. 61 seconds or more, followed by another Forced Outage$^{(IMS)}$, then these should be counted as two Forced Outages$^{(IMS)}$. Multiple Forced Outages$^{(IMS)}$ occurring as a result of a single event should be handled as multiple Forced Outages$^{(IMS)}$ only if subsequent operation of the Transmission Line Circuit between events exceeds one minute. Otherwise they shall be considered one continuous Forced Outage$^{(IMS)}$.

2. If a Transmission Line Circuit, e.g. a new Transmission Line Circuit, is only in service for a portion of a year, the Forced Outage$^{(IMS)}$ frequency and accumulated duration data shall be treated as if the Transmission Line Circuit had been in service for the entire year, i.e. the Outage$^{(IMS)}$ data for that Transmission Line Circuit shall be handled the same as those for any other Transmission Line Circuit.

Accumulated Forced Outage$^{(IMS)}$ Duration:

The accumulated Forced Outage$^{(IMS)}$ duration in minutes shall be calculated as follows for each of the Transmission Line Circuits having a Forced Outage$^{(IMS)}$ frequency (f_{ik}) greater than zero for the calendar year k:

$$d_{ik} = \sum_{j=1}^{f_{ik}} o_{ijk}$$

where

d_{ik} = accumulated duration of Forced Outages$^{(IMS)}$ (total number of Forced Outage$^{(IMS)}$ minutes) for the ith Transmission Line Circuit having a Forced

Outage(IMS) frequency (f_{ik}) greater than zero for the calendar year k.

f_{ik} = Forced Outage(IMS) frequency as defined above for calendar year k.

o_{ijk} = duration in minutes of the j^{th} Forced Outage(IMS) which occurred during the k^{th} calendar year for the i^{th} Transmission Line Circuit. See Notes 1 and 2.

The durations of extended Forced Outages(IMS) shall be capped as described in Section 4.2.2. "Capping of Forced Outage(IMS) Duration" for the purposes of calculating the Availability Measures . In addition, certain types of events/Outages shall be excluded from the calculations of the Availability Measures as described in Section 4.2.3 "Excluded Events".

If a PTO makes changes to its Transmission Line Circuit identification, configuration, or Outage(IMS) data reporting schemes, the PTO shall notify the ISO at the time of the change. In its annual report to the ISO the PTO shall provide recommendations regarding how the Availability Measures and Availability Measure Targets should be modified to ensure they remain consistent with the modified Transmission Line Circuit identification or Outage(IMS) data reporting scheme, and that they provide an appropriate gauge of performance.

4.2.2. Capping of Forced Outage(IMS) Durations

The durations of individual Forced Outages(IMS) which exceed 72 hours (4320 minutes) shall each be capped at 4320 minutes for the purpose of calculating the accumulated Forced Outage(IMS) duration.

4.2.3. Excluded Events

The following types of events/Outages shall be excluded from the calculation of the Availability Measures and the Availability Measure Targets:

- Scheduled Outages which are scheduled, reviewed and approved by the ISO in accordance with the Transmission Control Agreement, and

- Forced Outages(IMS) which: 1) were caused by events outside the PTO's system including those Outages which originate in other TO systems, other electric utility systems, or customer equipment, and 2) those Forced Outages(IMS) which can be demonstrated to have been caused by earthquakes.

4.3. Targets for Availability Performance

The Availability Measure Targets described herein shall be phased in over a period of five years beginning on the ISO Operations Date. The adequacy of each PTO's Availability performance shall be monitored through the use of charts on which are plotted indices reflecting annual Availability performance. These charts, called control charts as shown in Figure 4.3.1, are defined by a horizontal axis with a scale of years and a vertical axis with a scale describing the expected range of magnitudes of the index in question. Annual performance indices shall be plotted on these charts and a series of tests may then be performed to assess the stability of annual performance, shifts in performance and longer term performance trends.

Control charts for each of the following indices shall be developed and utilized to monitor Availability performance for each Voltage Class within each PTO's system:

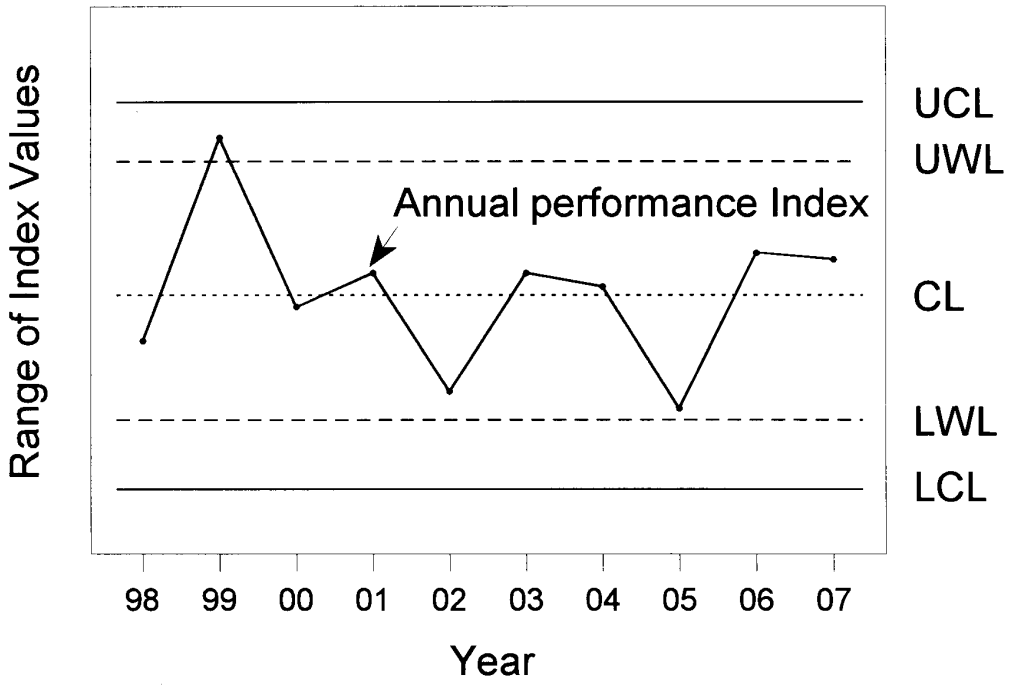

Figure 4.3.1 Sample Control Chart

- Index 1: Annual Average Forced Outage(IMS) Frequency for All Transmission Line Circuits.
- Index 2: Annual Average Accumulated Forced Outage(IMS) Duration for those Transmission Line Circuits with Forced Outages(IMS).
- Index 3: Annual Proportion of Transmission Line Circuits with No Forced Outages(IMS).

The control charts incorporate a center line (CL), upper and lower control limits (UCL and LCL, respectively), and upper and lower warning limits (UWL and LWL, respectively). The CL represents the average annual historical performance for a period prior to the current year. The UCL and LCL define a range of expected performance extending above and below the CL. For the annual proportion of Transmission Line Circuits with no Forced Outages(IMS), the limits are based on standard control chart techniques for binomial proportion data. For the other two

indices, bootstrap resampling techniques are used to determine empirical UCL and LCL at 99.75% and 0.25% percentile values, respectively, for means from the historical data. The bootstrap procedure is described in Section 4.3.2. Similarly, the UWL and LWL define a range of performance intending to cover the percentiles from 2.5% to 97.5%. The bootstrap algorithm is also used to determine these values. Thus, the UCL and LCL will contain about 99.5% of resampling means from the Voltage Class of interest. UWL and LWL will contain about 95% of the resampling means. These limits coincide with the usual choices for control charts when the means are approximately normal. Bootstrap estimation procedures are used here since the sampling means do not follow the Normal distribution model. The bootstrap estimation procedures ensure consistent control chart limits by using a starting base number("seed") for it's random number generator. Accuracy or reduced variances in the control chart limits are attained by using the average control chart limits generated from applying ten repetitions or cycles of the bootstrap sampling method. Collectively, the CL, UCL, LCL, UWL and LWL provide reference values for use in evaluating performance as described in Section 4.3.3.

For the special case where there is a Voltage Class with only one Transmission Line Circuit, individual and moving range control charts should be used for Index 1 and 2. The method used herein for calculating Index 3 is not applicable for those Voltage Classes containing less than six Transmission Line Circuits. Maintenance procedures recommended by the MCC and approved by the ISO Governing Board will be used by the PTOs to calculate Index 1, 2, or 3 where the methods provided herein do not apply. More information on the individual and moving range control charts can be found in the user manuals of the statistical software recommended by the MCC and approved by the ISO Governing Board for use in creating the control charts .

4.3.1. Calculations of Annual Availability Performance Indices for Individual Voltage Classes

Separate annual Availability performance indices shall be calculated for each Voltage Class and PTO as described below utilizing the Availability Measures discussed in Section 4.2.

Annual Average Forced Outage(IMS) Frequency for All Transmission Line Circuits (Index 1):

$$F_{vc,k} = \frac{1}{N_k} \sum_{i=1}^{N_k} f_{ik}$$

where

$F_{vc,k}$ = frequency index for the Voltage Class, vc, (units = Forced Outages(IMS) /Transmission Line Circuit). The frequency index equals the average (mean) number of Forced Outages(IMS) for all Transmission Line Circuits within a Voltage Class for the calendar year k.

N_k = number of Transmission Line Circuits in Voltage Class in calendar year k. See Note 2, Section 4.2.1.

f_{ik} = frequency of Forced Outages(IMS) for the ith Transmission Line Circuit as calculated in accordance with Section 4.2.1 for calendar year k.

Annual Average Accumulated Forced Outage(IMS) Duration for those Transmission Line Circuits with Forced Outages(IMS) (Index 2):

$$D_{vc,k} = \frac{1}{N_{o,k}} \sum_{i=1}^{N_{o,k}} d_{ik}$$

where

$D_{vc,k}$ = duration index for the Voltage Class (units = minutes/Transmission Line Circuit). The duration index equals the average accumulated duration of Forced Outages(IMS) for all Transmission Line Circuits within a Voltage Class which experienced Forced Outages(IMS) during the calendar year k.

$N_{o,k}$ = number of Transmission Line Circuits in the Voltage Class for which the Forced Outage(IMS) frequency Availability Measure (f_{ik}) as calculated in accordance with Section 4.2.1 is greater than zero for the calendar year k. See Note 2, Section 4.2.1.

d_{ik} = accumulated duration of Forced Outages(IMS) for the ith Transmission Line

Circuit having a Forced Outage(IMS) frequency Availability Measure (f_{ik}) greater than zero for calendar year k as calculated in accordance with Section 4.2.1.

Annual Proportion of Transmission Line Circuits with No Forced Outages(IMS) (Index 3):

$$P_{vc,k} = \frac{N_k - N_{o,k}}{N_k}$$

where

$P_{vc,k}$ = index for the proportion of Transmission Line Circuits for the Voltage Class with no Forced Outages(IMS) for the calendar year k.

N_k = number of Transmission Line Circuits in Voltage Class for calendar year k. See Note 2, Section 4.2.1.

$N_{o,k}$ = number of Transmission Line Circuits in the Voltage Class for which the Forced Outage(IMS) frequency Availability Measure (f_{ik}) as calculated in accordance with Section 4.2.1 is greater than zero for the calendar year k. See Note 2, Section 4.2.1.

4.3.2. Development of Limits for Performance Control Charts

The CL, UCL, LCL, UWL and LWL for the three control charts (Annual Average Forced Outage(IMS) Frequency for All Transmission Line Circuits, Annual Average Accumulated Forced Outage(IMS) Duration for Transmission Line Circuits with Forced Outages(IMS), and Annual Proportion of Transmission Line Circuits with No Forced Outages(IMS)) on which the annual Availability performance indices are to be plotted shall be calculated as described below. The CL, UCL, LCL, UWL and LWL for each of the three control charts shall be determined using continuously recorded Outage(IMS) data for the ten year period immediately preceding the ISO Operations Date, or immediately preceding the date a TO becomes a PTO. In the event that a PTO does not have reliable, continuously recorded Outage(IMS) data for this 10 year period, the PTO may determine the control chart limits using data for a shorter period. However, if data for a shorter period are to be used, the PTO shall prepare a brief report to the ISO providing

reasonable justification for this modification. This report shall be submitted to the ISO prior to February 1, 1998, or within 30 days after a TO becomes a PTO. The ISO shall periodically review the control chart limits and appropriately modify them when necessary in accordance with Section 8.0, "Revision of ISO Maintenance Standards," of this document.

4.3.2.1. CLs

The calculation of the CLs for each of the three control charts is similar to the calculation of the annual Availability performance indices described in Section 4.3.1 except that the period for which data are to be included in the calculations is expanded from a single calendar year to the ten years, unless a shorter period is justified by the PTO, for the period immediately preceding the ISO Operations Date, or immediately preceding the date a TO becomes a PTO. To account for this change a count of Transmission Line Circuit years is included in the equations as shown below to enable derivation of CLs which represent average performance during a multi-year period.

CL for Annual Transmission Line Circuit Forced Outage(IMS) Frequency

$$CL_{fvc} = \sum_{k=1}^{Y} \sum_{i=1}^{N_k} f_{ik} \; / \; (\sum_{k=1}^{Y} N_k \;)$$

where

CL_{fvc} = center control line value for the Forced Outage(IMS) frequencies for each of the Transmission Line Circuits in the Voltage Class for Y years prior to the ISO Operations Date, or the date a TO becomes a PTO.

Y = number of years prior to the ISO Operations Date (or the date a TO becomes a PTO) for which the PTO has reliable, continuously recorded Outage(IMS) data. Y=10 is preferred.

CL for Annual Accumulated Forced Outage(IMS) Duration for those Transmission Line Circuits with Forced Outages(IMS)

$$CL_{dvc} = \sum_{k=1}^{Y} \sum_{i=1}^{N_{o,k}} d_{ik} / (\sum_{k=1}^{Y} N_{o,k})$$

where

CL_{dvc} = center control line value for accumulated Forced Outage(IMS) duration for each of the Transmission Line Circuits in the Voltage Class for *Y* years prior to the ISO Operations Date (or the date a TO becomes a PTO) in which the Forced Outage(IMS) frequency (f_{ik}) was greater than zero.

CL for Annual Proportion of Transmission Line Circuits with No Forced Outages(IMS)

$$CL_{Pvc} = \frac{\sum_{k=1}^{Y} (N_k - N_{o,k})}{\sum_{k=1}^{Y} N_k}$$

where

CL_{Pvc} = center control line value for the proportion of Transmission Line Circuits in the Voltage Class with no Forced Outages(IMS) for *Y* years prior to the ISO Operations Date, or the date a TO becomes a PTO.

4.3.2.2. UCLs, LCLs, UWLs and LWLs

UCLs, LCLs, UWLs and LWLs for Index 1 and 2 for Voltage Classes Containing Four or More Transmission Line Circuits with Forced Outages(IMS) for Five or More Years

The UCLs , UWLs, LWLs, and LCLs for the control charts for each Voltage Class containing four or more Transmission Line Circuits with Forced Outages(IMS) shall be determined by bootstrap resampling methods as follows: The available historical data for Index 1 and 2 will each be entered into columns. A "seed" is then selected prior to beginning the sampling process. The ISO assigns a number for the "seed" prior to each years development of the control charts. The "seed" allows the user to start the

sampling in the same place and get the same results provided the data order hasn't changed. For Index 1, sampling with replacement will occur for the median number of lines per year in a Voltage Class for the time period being evaluated. A sample, the size of which is the median number of all Transmission Line Circuits for the period being evaluated, is taken from the column of actual frequency values for all Transmission Line Circuits. A mean is calculated from this sample and the resulting number will be stored in a separate column. This process, will be repeated 10,000 times in order to create a column of sampling means from the historical data base. The column of sampling means is then ordered from the smallest to largest means. From this column percentiles are determined for a UCL(99.75), a LCL(0.25) a UWL(97.5), and a LWL(2.5). Thus, for one cycle, the limits are determined by resampling from the historical data base, calculating statistics of interest, in this case means, and then estimating appropriate limits from the resampling means. Ten cycles of this same process are necessary to get 10 values each of UCLs, LCLs, UWLs, and LWLs. The average for the ten values of each limit is taken to provide the UCL, LCL, UWL, and LWL values used in analyzing annual performance. The procedure is repeated for Index 2 forming means for the median number of lines with Forced Outages$^{(IMS)}$ in this Voltage Class for the time period being evaluated. See **Bootstrapping - A Nonparametric Approach to Statistical Inference** (1993) by Christopher Z. Mooney and Robert D. Duval, Sage Publications with ISBN 0-8039-5381-X, and **An Introduction to the Bootstrap** (1993) by Bradley Efron and Robert J. Tibshirani, Chapman and Hall Publishing with ISBN 0-412-04231-2 for further information.

Consider an example to illustrate how the Bootstrap procedure works for one cycle of the ten required. Assume that a Voltage Class has approximately 20 Transmission Line Circuits per year with a history of ten years. Furthermore, assume that about 15 Transmission Line Circuits per year experience Forced Outages. Therefore, there are 10 x 15 = 150 Forced Outage$^{(IMS)}$ durations available for bootstrap sampling. Place these 150 Forced Outage$^{(IMS)}$ durations in a column, say "outdur"... in a specified order . The order is automatically provided in the bootstrap algorithm developed by the ISO

and made available to the PTO. The bootstrap algorithm will sample 15 rows from "outdur" with replacement. That is, any row may, by chance, be sampled more than once. From these 15 values determine the sample mean and place this in another column, say "boot". Repeat this sampling process 10,000 times adding the new means to "boot". The column "boot" now has 10,000 means from samples of size 15 from the original Forced Outage(IMS) duration data for this Voltage Class. The next step is to locate the appropriate percentiles from these means for use in determining the control chart limits for one cycle. This is accomplished by ordering the column "boot" from smallest to largest mean and restoring these ordered means in "boot". The percentiles which are needed are 99.75% (UCL), 97.50% (UWL), 2.50% (LWL) and 0.25% (LCL). These are easily estimated from the sorted means by finding the associated rows in the column "boot". For example, LWL will be estimated as the average of the 250th and 251st rows in column "boot". Likewise the other limits will be determined. Of course, the CL is the actual mean average for 15 lines over the ten years using the formulas in Section 4.3.2.1. This example is for one cycle. Nine more cycles of this process will establish the more accurate control and warning limits necessary to evaluate a PTO's annual performance.

UCLs, LCLs, UWLs and LWLs for Index 1 and 2 for All Other Voltage Classes

When data for less than four Transmission Line Circuits with Forced Outages(IMS) are available per year in a Voltage Class for fewer than five years, an exhaustive enumeration of all possible selections with replacement may need to be performed. This is because the number of possible samples for bootstrap resampling will be less than the aforementioned 10,000 resampling frequency used for Voltage Classes containing four or more Transmission Line Circuits with Forced Outages(IMS) for five or more years. For example, if a Voltage Class has only two Transmission Line Circuits per year for five years, the data base will consist of 2*5 = 10 accumulated Forced Outage(IMS) durations assuming both Transmission Line Circuits experience a Forced Outage(IMS) or more per year. Resampling two values from the column of 10 yields only

10**2 = 100 possible means. Thus, bootstrap resampling of 10,000 would over-sample the original data 10,000/100 = 100 times.

For the general case, let M = the number of accumulated Forced Outage$^{(IMS)}$ durations (or Forced Outage$^{(IMS)}$ frequencies) from the historical data base. If n is the median number of Transmission Line Circuits per year, there are M**n = U possible enumerated means for this Voltage Class. The procedure to determine the appropriate limits for a Voltage Class is to order the column containing U enumerated means from smallest to largest means. Then, the UCL, LCL, UWL, and LWL are determined from this vector as described above (i.e. at the 99.75, 0.25, 97. 5 and 2. 5 percentiles, respectively).

UCLs, LCLs, UWLs and LWLs for Index 3 When Number of Lines is > 125

According to standard procedures for proportion control charts for voltage classes where the median number of lines in service is greater than 125 for any given year, the upper and lower control chart limits (UCL, LCL, UWL, and LWL) for the kth year are determined using the normal approximation to the binomial distribution. The formulas are:

$$UCL = CL_{Pvc} + 3S_{Pvc,k} \qquad LCL = CL_{Pvc} - 3S_{Pvc,k}$$

UWL and LWL are calculated by replacing the “3” above with a “2”.

and

$$S_{Pvc,k} = \sqrt{CL_{Pvc}(1 - CL_{Pvc}) / N_k}$$

where

$S_{Pvc,k}$ = standard deviation for the annual proportion of Transmission Line Circuits in the Voltage Class with no Forced Outages$^{(IMS)}$ for each (kth) year of the *Y*

years prior to the ISO Operations Date, or the date a TO becomes a PTO. If LCL or LWL is less than zero, they should be set to zero by default.

UCLs, LCLs, UWLs and LWLs for Index 3 when Number of Lines is less than or equal to 125 and greater than or equal to six.

The UCLs, LCLs, UWLs, and LWLs for the control charts for each voltage class shall be based on exact binomial probabilities for those voltage classes having equal to or more than six but less than or equal to 125 median transmission lines per year.

A customized macro and a statistical software package approved by the ISO creates the proportion control charts. The macro determines the control limits and use of the exact binomial or the normal approximation to the binomial for computing the control chart limits. This macro ensures the UCL and LCL contains about 99.5% and the UWL and LWL contains about 95% of the binomial distribution. The percentile values of the UCL, UWL, LWL, and LCL are respectively 99.75%, 97.5%, 2.5%, and 0.25%.

The UCL, UWL, LWL, and LCL are calculated using the following formulas:

$$UCL = (X_1 + (P_2 - P_1)/(P_3 - P_1))/ n$$

$$UWL = (X_1 + (P_2 - P_1)/(P_3 - P_1))/ n$$

$$LWL = (X_1 + (P_2 - P_1)/(P_3 - P_1))/ n$$

$$LCL = (X_1 + (P_2 - P_1)/(P_3 - P_1))/ n$$

Where

P_2 = A cumulative binomial probability equal to the 0.9975, 0.9750, 0.025, and 0.0025 values used respectively in the UCL, UWL, LWL, and LCL above formulas(i.e. P_2 = 0.9975 in the UCL formula and =0.025 in the LWL formula)

P_1 = A cumulative binomial probability that if not representing the percentile value is representing the percentile value that is less than and closest to the 99.75, 97.50, 2.5, and 0.25 percentile values used respectively in the UCL, UWL, LWL, and LCL formulas(e.g. if P_1 = 0.74 and is closest to the 99.75 percentile value and represents the 99 percentile then P_1 = 0.74 should be used in the UCL formula).

P_3 = A cumulative binomial probability that if not representing the percentile value is representing the percentile value that is greater than and closest to the 99.75, 97.50, 2.5, and 0.25 percentile values used respectively in the UCL, UWL, LWL, and LCL formulas(e.g. if P_3 = 0.82 and is closest to the 99.75 percentile value and represents the 99.85 percentile then P_3 = 0.82 should be used in the UCL formula).

X_1 = The number of lines with no outages associated with the P_1 cumulative binomial probability values used respectively in the UCL, UWL, LWL, and LCL formulas.(e.g. If P_1 = 0.74 and represents the 99^{th} percentile for the case where 78 lines didn't have any outages then X_1 = 78 should be used in the UCL formula).

n = The median number of lines that are in service in a given year. This number remains the same in each of the UCL, UWL, LWL, and LCL formulas

More information on the calculations of the proportion control chart limits is in the current ISO Transmission Facility Availability Performance Monitoring System Handbook.

4.3.3. Evaluation of Availability Performance

The control charts shall be reviewed annually in order to evaluate Availability performance. The annual performance evaluation shall consist of an examination of each of the control charts to determine if one or more of the following four tests indicate

a change in performance. The four tests have been selected to enable identification of exceptional performance in an individual year, shifts in longer term performance, and trends in longer term performance.

Tests

- **Test 1:** The index value for the current year falls outside the UCL or LCL.
- **Test 2:** At least v1 consecutive annual index values fall above the CL or v2 consecutive annual index values fall below the CL. The actual values of v1 and v2 will be output from the bootstrap resampling procedures. The choices for v1 and v2 are designed to keep the probability of these events less than one percent.

Table 1. Values of v1 and v2 for Percentiles of the CL in Specified Ranges

Percentile	v1	v2
35 - 39	10	5
40	10	6
41 - 43	9	6
44 - 46	8	6
47 - 48	8	7
49 - 51	7	7
52 - 53	7	8
54 - 56	6	8
57 - 59	6	9
60	6	10
61 - 65	5	10

Thus, for example, if for a particular Voltage Class the percentile of the historical CL is 55%, this says that the CL is located at the 55 percentile of all bootstrap means in the “boot” column. From Table 1, v1=6, and v2=8.

- **Test 3:** At least two out of three consecutive annual index values fall outside the UWL or LWL on the same side of the CL.
- **Test 4:** Six or more values are consecutively increasing or consecutively decreasing.

Therefore, Test 1 is designed to detect a short term change or jump in the average level. Tests 2 and 4 are looking for long term changes. Test 2 will detect a shift up in averages or a shift to a lower level. Test 4 is designed to detect either a trend of continuous increase in the average values or continuous decrease. Test 3 is designed to assess changes in performance during an intermediate period of three years. If Test 3 is satisfied, the evidence is of a decline (or increase) in Availability over a three year period. Together the four tests allow the ISO to monitor the availability performance of a Voltage Class for a PTO.

If none of these tests indicates that a change has occurred, performance shall be considered to be stable and consistent with past performance. If one or more of these tests indicates a change then Availability performance shall be considered as having improved or degraded relative to the performance defined by the control chart. Table 4.3.1 provides a summary of the performance indications provided by the tests. The control chart limits may be updated annually if the last year's Availability performance indices did not trigger any of the four tests. If none of the four tests are triggered, the new limits will be constructed including the last year's data.

The control chart limits may be modified each year to reflect the number of Transmission Line Circuits in service during that year if necessary. However, it is suggested that unless the number of lines changes by more than 30% from the previous year, the use of the median number of lines should continue. Consider an example. Suppose after the control chart has been prepared for a Voltage Class, next year's data arrive with the number of lines 30% higher than the median used in the past. New limits will be generated in order to assess the Availability performance for that year.

For the special case where only one Transmission Line Circuit has a Forced Outage$^{(IMS)}$ in a Voltage Class during a year, the assessment process for Index 2 is as follows. If Index 2 for this Transmission Line Circuit does not trigger any of the four tests, no

further action is necessary. If, however, one or more of the tests are triggered, then limits for this Transmission Line Circuit for that year should be recalculated based on the historical data for this Transmission Line Circuit alone using an individual and moving range control chart. The only test warranted here is Test 1. More information on the individual and moving range control charts can be found in the user manuals of the statistical software approved by the ISO for use in creating the control charts

If the ISO deems that the Availability Measure Targets should be modified, they shall be modified in accordance with Section 8.0, “Revision of ISO Maintenance Standards,” of this document.

Table 4.3.1 Performance Indications Provided by Control Chart Tests

Control Chart Type	Test		Performance Status Indicated by Test Results	
	Number	Results	Improvement	Degradation
Annual Average Forced Outage(IMS) Frequency	1	value is above the UCL		✔
		value is below the LCL when LCL>0	✔	
	2	v1 or more consecutive values above the CL		✔
		v2 or more consecutive values below the CL	✔	
	3	2 out of 3 values above the UWL		✔
		2 out of 3 values below the LWL	✔	
	4	6 consecutive values increasing		✔
		6 consecutive values decreasing	✔	
Annual Average Accumulated Forced Outage Duration	1	value is above the UCL		✔
		value is below the LCL when LCL>0	✔	
	2	v1 or more consecutive values above the CL		✔
		v2 or more consecutive values below the CL	✔	
	3	2 out of 3 values above the UWL		✔
		2 out of 3 values below the LWL	✔	
	4	6 consecutive values increasing		✔
		6 consecutive values decreasing	✔	
Annual Proportion of Transmission Line Circuits with No Forced Outages	1	value is above the UCL	✔	
		value is below the LCL when LCL>0		✔
	2	v1 or more consecutive values above the CL	✔	
		v2 or more consecutive values below the CL		✔
	3	2 out of 3 values above the UWL	✔	
		2 out of 3 values below the LWL		✔
	4	6 consecutively increasing values	✔	
		6 consecutively decreasing values		✔

4.4. Outage(IMS) Data Reporting

All Outages which interrupt the flow of power on PTO Transmission Facilities under the ISO's Operational Control shall be reported by the PTO to the ISO. Outage(IMS) reports shall include the date, start time, end time, affected Transmission Facility, and the probable cause of the Outage(IMS) if known.

5. ISO MAINTENANCE GUIDELINES AND PTO MAINTENANCE PRACTICES

5.1. Introduction

The ISO with due consideration for the recommendations of the Maintenance Coordination Committee shall establish, revise as needed, and maintain guidelines for Transmission Facilities Maintenance as described in Section 5.2 of this document. These ISO Maintenance Guidelines shall be followed by each PTO in preparing a written description of, and updating as necessary, its PTO Maintenance Practices which may be performance-based, time-based, or both, as may be appropriate for each Transmission Facility under the ISO's Operational Control. The PTO Maintenance Practices will provide for consideration of the criteria referenced in Section 14.1 of the TCA, including technological innovations and facility importance.

5.2. ISO Maintenance Guidelines for Preparation of PTO Maintenance Practices

5.2.1. Transmission Line Maintenance

The PTO's Maintenance Practices shall, at a minimum, address the following transmission line Maintenance activities:

a) Patrol/Inspection

- Routine
- Detailed
- Emergency

b) Vegetation Management/Right-of-Way Maintenance

As may be appropriate for the specific facilities and equipment under the ISO's Operational Control, the PTO's Maintenance Practices shall further detail Maintenance activities for various attributes of the transmission lines including, but not limited to:

- Structures: wood pole, lattice steel, tubular steel, and concrete pole
- Guys/Anchors
- Foundations
- Insulators
- Conductor and Shield Wire
- Conductor and Shield Wire Clearances
- Hardware and Fittings
- Disconnects/Pole-top Switches
-
- Encroachments/Unauthorized Attachments
- Underground Transmission Components

5.2.2. Station Maintenance

The PTO's Maintenance Practices shall, at a minimum, address the Maintenance of the following equipment and attributes of Stations:

- Circuit Breakers
- Insulators/Bushings/Arrestors
- Transformers
- Regulator
- Disconnect Switches
- Metering
- Battery Systems

- Reactive Devices
- Relaying
- Communication Facilities
- Station Auxiliary Equipment
- Direct Current Transmission Components
- Structures/Foundations

As may be appropriate for the specific equipment in and configurations of the PTO's Stations under the ISO's Operational Control, the PTO's Maintenance Practices shall further detail various Maintenance activities for the attributes and potential conditions of the Stations including, but not limited to:

- Visual Inspection of/for: fences and grounds, vegetation, clearances, tracking, abnormal heating, cracks/chips, noise, leaks, blown fuses, and bulging of equipment cases
- Oil Containment
- Insulation Mediums
- Equipment Contacts
- Mechanical Timing
- Contamination Control
- Testing and Calibration
- Cooling Systems
- Measuring Devices
- Lubrication and Overhaul of Moving Parts

5.2.3. Descriptions of PTO Maintenance Practices

Each PTO's Maintenance Practices shall include a schedule for any time-based Maintenance activities and a description of conditions that will initiate any performance-based activities. The PTO's Maintenance Practices shall describe the Maintenance

methods for each substantial type of component and shall provide any checklists/report forms which may be required for the activity. Where appropriate, the PTO's Maintenance Practices shall provide criteria to be used to assess the condition of a Transmission Facility or component. Where appropriate, the PTO's Maintenance Practices shall specify condition assessment criteria and the requisite response to each condition as may be appropriate for each specific type of component or feature of the Transmission Facilities.

5.3. Review and Adoption of PTO Maintenance Practices

5.3.1. Initial Adoption of PTO Maintenance Practices

5.3.1.1. Submittal of Information by the Prospective PTOs to the ISO

Each prospective PTO shall provide the ISO with information concerning its PTO Maintenance Practices pursuant to Section 5.2 of this Appendix C. This information shall be prepared so as to be easily interpreted by the ISO and shall provide sufficient detail to assess the adequacy and reasonableness of the PTO Maintenance Practices, using the criteria referenced in Section 14.1 of the Transmission Control Agreement.

5.3.1.2. Review of the PTO Maintenance Practices by the ISO

The ISO shall review the information provided pursuant to Section 5.3.1.1 of this Appendix C and may provide to a PTO a recommendation for an amendment to the PTO Maintenance Practices in question by means of a notice delivered in accordance with Section 26.1 of the Transmission Control Agreement. The disposition of any such recommendation shall be in accordance with Section 5.3.3 of this Appendix C. To the extent there are no recommendations, the PTO Maintenance Practices will be adopted by the ISO, pursuant to California Public Utilities Code Section 348, as the PTO Maintenance Practices for that PTO.

Any agreement, in respect of PTO Maintenance Practices, reached between the ISO and a prospective PTO prior to the ISO Operations Date shall be adopted by the ISO for purposes of this Section 5.3.1.

5.3.2. Proposals for Amendments to the PTO Maintenance Practices

5.3.2.1. Amendments Proposed by the ISO

The ISO shall periodically review each PTO's Maintenance Practices having regard to the ISO Maintenance Standards, as amended and revised from time to time pursuant to Sections 7 and 8 of this Appendix C. Following such a review, and after considering the Section 348 Criteria, the ISO may recommend an amendment of PTO Maintenance Practices, by means of a notice delivered in accordance with Section 26.1 of the Transmission Control Agreement. The disposition of any such recommendation shall be in accordance with 5.3.3 of this Appendix C. Except as provided in Section 5.3.3.4 of this Appendix, the effective date shall be no earlier than 30 days from the date of such notice.

5.3.2.2. Amendments Proposed by a PTO

A PTO may provide to the ISO its own recommendation for an amendment to its PTO Maintenance Practices, by means of a notice delivered in accordance with Section 26.1 of the Transmission Control Agreement. The disposition of any such recommendation shall be in accordance with Section 5.3.3 of this Appendix C. The effective date shall be no earlier than 30 days from the date of such notice.

5.3.3. Disposition of Recommendations

5.3.3.1. If the ISO or a PTO makes a recommendation to amend the PTO Maintenance Practices of a PTO, as contemplated in Sections 5.3.1 or 5.3.2 of this Appendix C, the other Party shall have 30 days to provide a notice to the recommending party, pursuant to Section 26.1 of the Transmission Control Agreement, that it does not agree with the recommended amendment. If it fails to provide such

notice of disagreement, the recommended amendment shall be deemed adopted by the ISO, pursuant to California Public Utilities Code Section 348, as the PTO Maintenance Practices for that PTO, effective as of the date specified in the notice of the recommended amendment, which date shall be no earlier than 30 days from the date of issuance of such notice of amendment.

5.3.3.2. If a PTO makes a recommendation to amend its PTO Maintenance Practices, and if the ISO provides notice within the 30 days specified in the first paragraph of this Section 5.3.3, pursuant to Section 26.1 of the Transmission Control Agreement, that the ISO, having regard for the Section 348 Criteria, does not agree with the recommended amendment, the PTO and the ISO shall make good faith efforts to reach a resolution relating to the recommended amendment. If, after such efforts, the PTO and the ISO cannot reach a resolution, the pre-existing PTO Maintenance Practices shall be retained. Either Party may, however, seek further redress through appropriate processes, including the Maintenance Coordination Committee, the ISO Governing Board, and/or the dispute resolution mechanism specified in Section 15 of the Transmission Control Agreement. Following the conclusion of the redress processes, the PTO's Maintenance Practices, as altered, if at all, by these processes, shall be deemed adopted by the ISO, pursuant to California Public Utilities Code Section 348, as the PTO Maintenance Practices for that PTO.

5.3.3.3. If the ISO makes a recommendation to amend the PTO Maintenance Practices of a PTO, the PTO Maintenance Practices, as amended pursuant to the ISO recommendation, shall be deemed adopted by the ISO, pursuant to California Public Utilities Code Section 348, as the PTO Maintenance Practices for that PTO, effective as of the date specified by the ISO in its notice of recommended amendment. If the PTO gives notice of a disagreement within the 30 days specified in the first paragraph of this Section 5.3.3, the PTO and the ISO shall make good faith efforts to reach a resolution relating to the recommended amendment. If a resolution is not reached, either Party may seek further redress through appropriate processes, including the Maintenance Coordination Committee, the ISO Governing Board, and/or the dispute

resolution mechanism specified in Section 15 of the Transmission Control Agreement. The PTO may also request, during the initial attempts at resolution and at any stage of the redress processes, a deferral of the ISO recommended amendment, and the ISO shall not unreasonably withhold its consent to such a request, having regard to the Section 348 Criteria. Following the conclusion of the redress processes, the PTO's Maintenance Practices, as altered, if at all, by these processes, shall be deemed adopted by the ISO, pursuant to California Public Utilities Code Section 348, as the PTO Maintenance Practices for that PTO.

5.3.3.4. If the ISO determines in its judgment, after considering the Section 348 Criteria, that prompt action is required to avoid a substantial risk to safety or reliability, it may direct a PTO to implement certain temporary maintenance activities in a period of less than 30 days, by issuing an advisory to the PTO to that effect, by way of a notice delivered in accordance with Section 26.1 of the Transmission Control Agreement. Any such maintenance practice advisories shall specify why implementation solely under Section 5.3.3.3 is not sufficient to avoid a substantial risk to safety or reliability including, where a substantial risk is not imminent or clearly imminent, why prompt action is nevertheless required. If time permits, the ISO shall consult with the relevant PTO before issuing a maintenance practice advisory. Upon receiving such an advisory, a PTO shall implement the temporary maintenance activities in question, as of the date specified by the ISO in its advisory, unless the PTO provides a notice to the ISO, in accordance with Section 26.1 of the Transmission Control Agreement, that the PTO is unable to implement the temporary maintenance activities as specified. Even if the PTO provides such a notice, the PTO shall use its best efforts to implement the temporary maintenance activities as fully as possible. All such maintenance practice advisories shall cease to have effect in 90 days after issuance or such earlier period as the ISO provides in its notice. Renewal or extension of such temporary maintenance requirements beyond 90 days shall require a

recommendation process pursuant to Section 5.3.3.2 or Section 5.3.3.3 of this Appendix.

5.3.3.5. Nothing in this Transmission Control Agreement shall be construed to limit the ISO's authority under Public Utilities Code Section 348 to adopt inspection, maintenance, repair, and replacement standards for the transmission facilities under ISO control.

5.4. Qualifications of Personnel

All Maintenance of Transmission Facilities under the ISO's Operational Control shall be performed by persons who, by reason of training, experience and instruction, are qualified to perform the task.

6. MAINTENANCE RECORD KEEPING AND REPORTING

The four elements of the ISO's requirements for Maintenance record keeping and reporting are as follows:

a) The PTO will maintain records of its Maintenance activities, as set forth in Section 6.1.
b) The PTO will provide certain Maintenance records to the ISO, as set forth in Section 6.2.
c) The PTO will allow the ISO to visit Transmission Facilities, as set forth in Section 6.3.
d) The PTO will make records for Maintenance activities available to the ISO, as set forth in Section 6.4.

In addition, the Maintenance Coordination Committee shall annually review the requirements of this section of the ISO Maintenance Standards and shall seek to

standardize reasonable record keeping, reporting and information-sharing requirements sufficient to support ISO regulatory reporting needs.

6.1. The PTO Will Maintain Records of its Maintenance Activities

The PTO shall maintain records demonstrating compliance with each element of the PTO Maintenance Practices. The PTO's Maintenance records shall be maintained for five years, or for one year after specific corrective Maintenance activities identified by the PTO are completed, whichever is longer.

Each PTO's inspection records shall, at a minimum, identify the inspector, the Transmission Facility inspected, the inspection date(s), the findings of the inspection, recommended Maintenance activities, and the priority of the Maintenance recommendations.

Each PTO's Maintenance records shall, at a minimum, identify the person responsible for performing the Maintenance, the date of the Maintenance, the Transmission Facility maintained, and a description of the Maintenance that was performed.

6.2. The PTO Will Provide Certain Maintenance Records to the ISO

By the end of the third year of operation of the ISO, the ISO and PTO's shall develop and implement a standard Maintenance reporting system based on the recommendations of the Maintenance Coordination Committee. Until the standard Maintenance reporting system is implemented, the PTO shall provide the ISO, on an annual basis, records for substantial Maintenance as limited by the following list:

a) Transmission Line Maintenance

- Patrol/Inspection
- Vegetation Management/Right-of-way Maintenance
- Structures: Wood pole, lattice steel, tubular steel, concrete pole

- Insulators (Contamination Control)

b) Station Maintenance

- Circuit Breakers
- Transformers
- Insulators/Bushings/Arrestors (Contamination Control)
- Regulators
- Relaying

If the PTO maintains records in a manner that includes additional information, such records may be submitted in that manner.

6.3. The PTO Will Allow the ISO to Visit Transmission Facilities

The ISO may visit Transmission Facilities in accordance with Section 18.3 of the Transmission Control Agreement.

6.4. The PTO Will Make Records for Maintenance Activities Available to the ISO

The PTO shall make all Maintenance records for a Voltage Class available to the ISO upon the request of the ISO if the annual evaluation of performance per Section 4.3.3 demonstrates degradation in the PTO's Availability performance. Upon identification of degradation, the PTO's reporting of Maintenance data to the ISO shall continue until a subsequent year's annual performance returns to a non-degraded level.

If a review of available records by the ISO indicates inconsistencies from the PTO Maintenance Practices relating to a specific activity, then the ISO may request that the PTO provide further documentation and explanation related to those Maintenance activities.

7. MAINTENANCE COORDINATION COMMITTEE

7.1. Maintenance Coordination Committee Functions

The ISO shall seek to establish and then appropriately convene a Maintenance Coordination Committee for the purposes of periodically conveying information, seeking input from other PTOs and interested stakeholders regarding ISO Maintenance Standards as well as making recommendations with respect to proposed amendments and revisions of the ISO Maintenance Standards.

7.2. Consensus

Although the role of the Maintenance Coordination Committee is advisory in nature, the ISO will strive to achieve a consensus among committee members, and promulgate practices, standards and protocols consistent with relevant laws and regulations.

8. REVISION OF ISO MAINTENANCE STANDARDS

The ISO, PTO's, or any interested stakeholder may submit proposals to amend or revise the ISO Maintenance Standards. Any change proposal shall be submitted to the Maintenance Coordination Committee for consideration in accordance with Section 7.0, "Maintenance Coordination Committee," of this document. Recommendations for revisions of the ISO Maintenance Standards shall be submitted by the Maintenance Coordination Committee to the ISO for approval.

9. INCENTIVES AND PENALTIES

Any incentives and penalties relating to this Appendix shall be established in accordance with the Transmission Control Agreement, the ISO Tariff and ISO Protocols after consultation between the PTO and the ISO, and approval by the FERC. No incentives, penalties or sanctions may be imposed relating to this Appendix unless a

Schedule providing for such incentives, penalties or sanctions has first been filed with and made effective by the FERC. Nothing in this Appendix shall be construed as waiving the rights of the PTO to oppose or protest any incentive, penalty or sanction proposed by the ISO to the FERC or the specific imposition by the ISO of any FERC-approved penalty on the PTO.

10. COMPLIANCE WITH OTHER REGULATIONS/LAWS

Each PTO shall maintain its Transmission Facilities that are under the Operational Control of the ISO in accordance with Good Utility Practice, sound engineering judgment, the guidelines as outlined in the Transmission Control Agreement, and all other applicable protocols, laws, and regulations, in order to achieve the Availability Measure Targets set by the ISO.

10.1 SAFETY

It is of paramount importance that the PTO ensure the safety of personnel, and the public in performing these Maintenance duties and that the ISO operate the system in a manner which is compatible with the priority of ensuring safety. The PTO shall ensure the safety of personnel and the public in accordance with jurisdictional agency regulations and ensure the reliability of the system in accordance with CAISO Maintenance Standards. In the event there is conflict between the safety and reliability, the jurisdictional agency regulations for safety shall take precedence.

11. DISPUTE RESOLUTION

Any disputes between the ISO and PTO regarding issues related to the Maintenance, and Availability of Transmission Facilities under the Operational Control of the ISO shall be resolved in accordance with the Section 15 of the Transmission Control

Agreement.