# Alberta Reliability Standard
# Protection System, Automatic Reclosing and Sudden Pressure Relaying Maintenance
# PRC-005-~~AB1~~AB2-6

## 1. Purpose

The purpose of this **reliability standard** is to document and implement programs for the maintenance of all **protection systems**, automatic reclosing, and sudden pressure relaying affecting the reliability of the **transmission system** so that they are kept in working order.

## 2. Applicability

The entities identified in subsection 2.1 must apply the requirements of this **reliability standard** to the devices listed in subsection 2.2, unless exempted under subsection 2.3.

**2.1** This **reliability standard** applies to:

(a) the **legal owner** of a **transmission facility** that:

(i) is part of the **bulk electric system**, excluding any transformer with less than 2 terminals energized at 100 kV or higher;

(ii) is not part of the **bulk electric system**, and owns any of the following:

(A) the **protection systems** used for the **ISO**'s **underfrequency load shedding program**;

(B) the **protection systems** used for **undervoltage load shed systems** installed to prevent system voltage collapse or voltage instability for the **reliability** of the **interconnected electric system**;

(C) **protection systems** installed as a **remedial action scheme**, including automatic reclosing applied as an integral part of a **remedial action scheme**, for the **reliability** of the **interconnected electric system**; or

(iii) is material to this **reliability standard** and to the **reliability** of either the **interconnected electric system** or the City of Medicine Hat electric system, as the **ISO** determines and includes on a list published on the AESO website, which the **ISO** may amend from time to time in accordance with the process set out in Appendix 3.

(b) the **legal owner** of a **generating unit** that:

(i) has a **maximum authorized real power** rating greater than 18 MW and is either:

(A) directly connected to the **transmission system**,

(B) directly connected to **transmission facilities** within the City of Medicine Hat, or

(C) part of an industrial complex that is directly connected to the **transmission system** or to **transmission facilities** within the City of Medicine Hat;

(ii) is within a power plant that:

(A) is not part of an **aggregated generating facility**;

(B) is directly connected to the **transmission system** or to **transmission facilities** within the City of Medicine Hat; and

(C) has a combined **maximum authorized real power** rating greater than 67.5 MW;

(iii) is a **black start resource**; or

(iv) is material to this **reliability standard** and to the **reliability** of either the **interconnected electric system** or the City of Medicine Hat electric system, regardless of the **maximum authorized real power** rating of the **generating unit**, as the **ISO** determines and

includes on a list published on the AESO website, which the **ISO** may amend from time to time in accordance with the process set out in Appendix 3;

(c) the **legal owner** of an **aggregated generating facility** that:

(i) has a **maximum authorized real power** rating greater than 67.5 MW and is either:

(A) directly connected to the **transmission system**;

(B) directly connected to **transmission facilities** within the City of Medicine Hat; or

(C) part of an industrial complex that is directly connected to the **transmission system** or to **transmission facilities** within the City of Medicine Hat;

(ii) is a **black start resource**; or

(iii) is material to this **reliability standard** and to the **reliability** of either the **interconnected electric system** or the City of Medicine Hat electric system, regardless of the **maximum authorized real power** rating of the **aggregated generating facility**, as the **ISO** determines and includes on a list published on the AESO website, which the **ISO** may amend from time to time in accordance with the process set out in Appendix 3.

**2.2** This **reliability standard** applies to the following devices:

(a) **protection systems** and sudden pressure relaying that are installed for the purpose of detecting faults on **system elements** as identified in section 2.1;

(b) **protection systems** used for the **ISO**'s **underfrequency load shedding** program;

(c) **protection systems** used for **undervoltage load shed** systems installed to prevent system voltage collapse or voltage instability for the reliability of the **interconnected electric system**;

(d) **protection systems** installed as a **remedial action scheme** for the **reliability** of the **interconnected electric system**;

(e) **protection systems** and sudden pressure relaying for **generating units**, including:

(i) **protection systems** that act to trip the **generating unit** either directly or via lockout or auxiliary tripping relays;

(ii) **protection systems** and sudden pressure relaying for **generating unit** step-up transformers; and

(iii) **protection systems** and sudden pressure relaying for station service or excitation transformers connected to the **generating unit** bus, that act to trip the **generating unit** either directly or via lockout or tripping auxiliary relays;

(f) **protection systems** and sudden pressure relaying for **aggregated generating facilities** from and including the **collector bus** to a common point of connection at 100 kV or above;

(g) automatic reclosing~~, including~~ :

(i) ~~automatic reclosing~~ applied on all transmission lines connected to a bus operated at a voltage level of 100 kV or higher located at generating plant substations where the combined **maximum authorized real power** is greater than 500 MW;

(ii) ~~automatic reclosing~~ applied on all transmission line terminals operated at a voltage level of 100 kV or higher at substations one bus away from generating plants specified in Section 2.2 (g)(i) when the substation is less than 10 circuit-miles from the generating plant substation; and

(iii) ~~automatic reclosing~~ applied as an integral part of a **remedial action scheme** specified in subsection (d) above.

**2.3** Automatic reclosing addressed in subsections 2.2(g)(i) and 2.2(g)(ii) may be excluded if the equipment owner can demonstrate to the **ISO** that a close-in three-phase fault present for twice the normal clearing time (capturing a minimum trip-close-trip time delay) does not result in a total loss of gross generation in either the **interconnected electric system** or the City of Medicine Hat electric system exceeding the gross capacity of the largest **generating unit** where the automatic reclosing is applied.

## 3. Requirements

**R1** Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** must establish a **protection system** maintenance program for its **protection systems**, automatic reclosing, and sudden pressure relaying.

The **protection system** maintenance program must:

**R1.1** identify which maintenance method (a time-based method, the performance-based method per Appendix 2, or a combination of these maintenance methods) is used to address each **protection system**, automatic reclosing, and sudden pressure relaying component type (as identified in Appendix 1). All batteries associated with the station dc supply component type of a **protection system** must be included in a time-based program as described in Table 1-4 and Table 3 of Appendix 1.

**R1.2** include the applicable monitored component attributes applied to each **protection system**, automatic reclosing, and sudden pressure relaying component type consistent with the maintenance intervals specified in Tables 1-1 through 1-5, Table 2, Table 3, Tables 4-1 through 4-3, and Table 5 of Appendix 1, where monitoring is used to extend the maintenance intervals beyond those specified for unmonitored **protection system**, automatic reclosing, and sudden pressure relaying components.

**R2** Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** that uses performance-based maintenance intervals in its **protection system** maintenance program must follow the procedure established in Appendix 2 to establish and maintain its performance-based intervals.

**R3** Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** that uses time-based maintenance program(s) must maintain its **protection system**, automatic reclosing, and sudden pressure relaying components that are included within the time-based maintenance program in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, Table 3, Tables 4-1 through 4-3, and Table 5 of Appendix 1.

**R4** Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** that uses performance-based maintenance program(s) in accordance with requirement R2 must implement and follow its **protection system** maintenance program for its **protection system**, automatic reclosing, and sudden pressure relaying components that are included within the performance-based program(s).

**R5** Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** must demonstrate efforts to correct identified unresolved maintenance issues.

## 4. Measures

The following measures correspond to the requirements identified in section 3 of this **reliability standard**. For example, MR1 is the measure for requirement R1.

**MR1** Evidence of having a documented **protection system** maintenance program in accordance with requirement R1 exists. Evidence may include, but is not limited to a documented **protection system** maintenance program that may include supporting information such as manufacturer's specifications or engineering drawings or other equivalent evidence.

**MR2** Evidence of following the procedure for performance-based maintenance intervals as required in requirement R2 exists. Evidence may include, but is not limited to, component lists, dated maintenance records and dated analysis records and results or other equivalent evidence.

**MR3** Evidence of maintaining **protection system**, automatic reclosing, and sudden pressure relaying components in accordance with the minimum maintenance activities and maximum maintenance intervals as required in requirement R3 exists. Evidence may include, but is not limited to, dated maintenance records, dated maintenance summaries, dated check-off lists, dated inspection records, or dated work orders or other equivalent evidence.

**MR4** Evidence of following the **protection system** maintenance program for performance-based maintenance program(s) as required in requirement R4 exists. Evidence may include, but is not limited to, dated maintenance records, dated maintenance summaries, dated check-off lists, dated inspection records, or dated work orders or other equivalent evidence.

**MR5** Evidence of demonstrating efforts to correct identified unresolved maintenance issues as required in requirement R5 exists. Evidence may include, but is not limited to, work orders, replacement component orders, invoices, project schedules with completed milestones, return material authorizations or purchase orders or other equivalent evidence.

## 5. Implementation Plan

Each **legal owner** of a **transmission facility**, **legal owner** of a **generating unit**, and **legal owner** of an **aggregated generating facility** must implement requirements R1 through R5 in accordance with the implementation plan in Appendix 5.

## 6. Appendices

Appendix 1 – *Tables describing protection system, automatic reclosing, and sudden pressure relaying component types, maintenance activities and intervals*:

| | |
|---|---|
| Table 1-1 | Maintenance Activities and Intervals for Protection Systems for Protective Relay Excluding distributed UFLS and distributed UVLS |
| Table 1-2 | Maintenance Activities and Intervals for Protection Systems for Communications Systems Excluding distributed UFLS and distributed UVLS |
| Table 1-3 | Maintenance Activities and Intervals for Protection Systems for Voltage and Current Sensing Devices Providing Inputs to Protective Relays Excluding distributed UFLS and distributed UVLS |
| Table 1-4(a) | Maintenance Activities and Intervals for Protection Systems for Protection System Station dc Supply Using Vented Lead-Acid (VLA) Batteries Excluding distributed UFLS and distributed UVLS |
| Table 1-4(b) | Maintenance Activities and Intervals for Protection Systems for Protection System Station dc Supply Using Valve-Regulated Lead-Acid (VRLA) Batteries Excluding distributed UFLS and distributed UVLS |

**Revision History**

| Date | Description |
|---|---|
| 2020-xx-xx | Revised Applicability section 2.2(g) to clearly identify the reclosers that this reliability standard applies to. |
| 2019-10-01 | Revised:<br>- the Applicability section to clearly apply the reliability standard to protection systems associated with underfrequency load shedding, under voltage load shedding, and remedial action schemes that are not part of the bulk electric system, add clarity regarding the reference to the bulk electric system and the exclusion of certain types of transformers, and to add a provision enabling the ISO to add transmission facilities it determines are material to this reliability standard;<br>- the Implementation Plan to add references to Tables 4 and 5 in subsection 5.5 in Appendix 5; and<br>- reliability standard to correct various typos, update references, and replace the descriptions of compliance dates in Appendix 5 with the actual calendar dates. |
| 2019-10-01 | Initial release. |

**Appendix 1 – Protection system, automatic reclosing, and sudden pressure relaying component types, maintenance activities and intervals**

| Table 1-1<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Protective Relay Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any unmonitored protective relay not having all the monitoring attributes of a category below. | 6 calendar years | For all unmonitored relays:<br>• Verify that settings are as specified.<br>For non-microprocessor relays:<br>• Test and, if necessary, calibrate.<br>For microprocessor relays:<br>• Verify operation of the relay inputs and outputs that are essential to proper functioning of the **protection system**; and<br>• Verify acceptable measurement of power system input values. |

| Table 1-1<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Protective Relay Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Monitored microprocessor protective relay with the following:<br>• Internal self-diagnosis and alarming (see Table 2);<br>• Voltage and/or current waveform sampling three or more times per power cycle, and conversion of samples to numeric values for measurement calculations by microprocessor electronics; and<br>• Alarming for power supply failure (see Table 2). | 12 calendar years | Verify:<br>• Settings are as specified;<br>• Operation of the relay inputs and outputs that are essential to proper functioning of the **protection system**; and<br>• Acceptable measurement of power system input values. |

| Table 1-1<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Protective Relay Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Monitored microprocessor protective relay with preceding row attributes and the following:<br>• Ac measurements are continuously verified by comparison to an independent ac measurement source, with alarming for excessive error (See Table 2);<br>• Some or all inputs and outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure (See Table 2); and<br>• Alarming for change of settings (See Table 2). | 12 calendar years | Verify only the unmonitored relay inputs and outputs that are essential to proper functioning of the **protection system**. |

| Table 1-2<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Communications Systems Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any unmonitored communications system necessary for correct operation of protective functions, and not having all the monitoring attributes of a category below. | 4 **months** | Verify that the communications system is functional. |
| | 6 calendar years | Verify that the communications system meets performance criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate).<br>Verify operation of communications system inputs and outputs that are essential to proper functioning of the **protection system**. |
| Any communications system necessary for correct operation of protective functions with continuous monitoring or periodic automated testing for the presence of the channel function, and alarming for loss of function (See Table 2). | 12 calendar years | Verify that the communications system meets performance criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate).<br>Verify operation of communications system inputs and outputs that are essential to proper functioning of the **protection system**. |

| Table 1-2<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Communications Systems Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any communications system with all of the following:<br>• Continuous monitoring or periodic automated testing for the performance of the channel using criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate, and alarming for excessive performance degradation); (See Table 2); and<br>• Some or all inputs and outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure (See Table 2). | 12 calendar years | Verify only the unmonitored communications system inputs and outputs that are essential to proper functioning of the **protection system** |

| Table 1-3<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Voltage and Current Sensing Devices Providing Inputs to Protective Relays Excluding distributed UFLS and distributed UVLS (see Table 3) | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any voltage and current sensing devices not having monitoring attributes of the category below. | 12 calendar years | Verify that current and voltage signal values are provided to the protective relays. |
| Voltage and current sensing devices connected to microprocessor relays with ac measurements that are continuously verified by comparison of sensing input value, as measured by the microprocessor relay, to an independent ac measurement source, with alarming for unacceptable error or failure (see Table 2). | No periodic maintenance specified | None. |

| Table 1-4(a)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Vented Lead-Acid (VLA) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| **Protection system** station dc supply using Vented Lead-Acid (VLA) batteries not having monitoring attributes of Table 1-4(f). | 4 **months** unless a variance is granted by the AESO | Verify:<br>□ Station dc supply voltage<br>Inspect:<br>□ Electrolyte level; and<br>□ For unintentional grounds |
| | 18 **months** | Verify:<br>□ Float voltage of battery charger<br>□ Battery continuity<br>□ Battery terminal connection resistance<br>□ Battery intercell or unit-to-unit connection resistance |

| Table 1-4(a)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Vented Lead-Acid (VLA) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| | | Inspect:<br>□ Cell condition of all individual battery cells where cells are visible – or measure battery cell/unit internal ohmic values where the cells are not visible; and<br>□ Physical condition of battery rack. |
| | 18 **months**<br>-or-<br>6 calendar years | Verify that the station battery can perform as manufactured by evaluating cell/unit measurements indicative of battery performance (e.g. internal ohmic values or float current) against the station battery baseline.<br>-or-<br>Verify that the station battery can perform as manufactured by conducting a performance or modified performance capacity test of the entire battery bank. |

| Table 1-4(b)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Valve-Regulated Lead-Acid (VRLA) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| **Protection system** station dc supply with Valve Regulated Lead-Acid (VRLA) batteries not having monitoring attributes of Table 1-4(f). | 4 **months** unless a variance is granted by the AESO | Verify:<br>□ Station dc supply voltage<br>Inspect:<br>□ For unintentional grounds |
| | 6 **months** | Inspect:<br>□ Condition of all individual units by measuring battery cell/unit internal ohmic values. |
| | 18 **months** | Verify:<br>□ Float voltage of battery charger;<br>□ Battery continuity; |

| Table 1-4(b)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Valve-Regulated Lead-Acid (VRLA) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| | | Battery terminal connection resistance; and<br>Battery intercell or unit-to-unit connection resistance.<br>Inspect:<br>Physical condition of battery rack. |
| | 6 **months**<br>-or-<br>3 calendar years | Verify that the station battery can perform as manufactured by evaluating cell/unit measurements indicative of battery performance (e.g. internal ohmic values or float current) against the station battery baseline.<br>-or-<br>Verify that the station battery can perform as manufactured by conducting a performance or modified performance capacity test of the entire battery bank. |

| Table 1-4(c)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Nickel-Cadmium (NiCad) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS system, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| **Protection system** station dc supply Nickel-Cadmium (NiCad) batteries not having monitoring attributes of Table 1-4(f). | 4 **months** unless a variance is granted by the AESO | Verify:<br>□ Station dc supply voltage.<br>Inspect:<br>□ Electrolyte level; and<br>□ For unintentional grounds. |
| | 18 **months** | Verify:<br>□ Float voltage of battery charger;<br>□ Battery continuity;<br>□ Battery terminal connection resistance; and<br>□ Battery intercell or unit-to-unit connection resistance. |

| Table 1-4(c)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Nickel-Cadmium (NiCad) Batteries Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS system, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| | | Inspect:<br>□ Cell condition of all individual battery cells; and<br>□ Physical condition of battery rack. |
| | 6 calendar years | Verify that the station battery can perform as manufactured by conducting a performance or modified performance capacity test of the entire battery bank. |

| Table 1-4(d)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply Using Non Battery Based Energy Storage Excluding distributed UFLS and distributed UVLS (see Table 3)<br>Protection System Station dc supply used only for non-bulk electric system interrupting devices for RAS, non-distributed UFLS system, or non-distributed UVLS systems is excluded (see Table 1-4(e)). | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any **protection system** station dc supply not using a battery and not having monitoring attributes of Table 1-4(f). | 4 **months** | Verify:<br>□ Station dc supply voltage<br>Inspect:<br>□ For unintentional grounds |
| | 18 **months** | Inspect:<br>Condition of non-battery based dc supply |
| | 6 calendar years | Verify that the dc supply can perform as manufactured when ac power is not present. |

| Table 1-4(e)<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type – Protection System Station dc Supply for non-bulk electric system Interrupting Devices for RAS, non-distributed UFLS, and non-distributed UVLS systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any **protection system** dc supply used for tripping only non- **bulk electric system** interrupting devices as part of a **remedial action scheme**, non-distributed UFLS, or non-distributed UVLS system and not having monitoring attributes of Table 1-4(f). | When control circuits are verified (See Table 1-5) | Verify station dc supply voltage. |

| Table 1-4(f)<br>Exclusions for Protection System Station dc Supply Monitoring Devices and Systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any station dc supply with high and low voltage monitoring and alarming of the battery charger voltage to detect charger overvoltage and charger failure (See Table 2). | No periodic maintenance specified | No periodic verification of station dc supply voltage is required. |
| Any battery based station dc supply with electrolyte level monitoring and alarming in every cell (See Table 2). | | No periodic inspection of the electrolyte level for each cell is required. |
| Any station dc supply with unintentional dc ground monitoring and alarming (See Table 2). | | No periodic inspection of unintentional dc grounds is required. |
| Any station dc supply with charger float voltage monitoring and alarming to ensure correct float voltage is being applied on the station dc supply (See Table 2). | | No periodic verification of float voltage of battery charger is required. |
| Any battery based station dc supply with monitoring and alarming of battery string continuity (See Table 2). | | No periodic verification of the battery continuity is required. |

| Table 1-4(f)<br>Exclusions for Protection System Station dc Supply Monitoring Devices and Systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any battery based station dc supply with monitoring and alarming of the intercell and/or terminal connection detail resistance of the entire battery (See Table 2). | | No periodic verification of the intercell and terminal connection resistance is required. |
| Any Valve Regulated Lead-Acid (VRLA) or Vented Lead-Acid (VLA) station battery with internal ohmic value or float current monitoring and alarming, and evaluating present values relative to baseline internal ohmic values for every cell/unit (See Table 2). | | No periodic evaluation relative to baseline of battery cell/unit measurements indicative of battery performance is required to verify the station battery can perform as manufactured. |
| Any Valve Regulated Lead-Acid (VRLA) or Vented Lead-Acid (VLA) station battery with monitoring and alarming of each cell/unit internal ohmic value (See Table 2). | | No periodic inspection of the condition of all individual units by measuring battery cell/unit internal ohmic values of a station VRLA or Vented Lead-Acid (VLA) battery is required. |

| Table 1-5<br>Maintenance Activities and Intervals for Protection Systems<br>Component Type - Control Circuitry Associated With Protective Functions Excluding distributed UFLS and distributed UVLS (see Table 3), Automatic Reclosing (see Table 4), and Sudden Pressure Relaying (see Table 5)<br>Note: Table requirements apply to all Control Circuitry Components of Protection Systems, and RAS except as noted. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Trip coils or actuators of circuit breakers, interrupting devices, or mitigating devices (regardless of any monitoring of the control circuitry). As long as there is monitoring on the mitigating devices for high-voltage direct current/ flexible alternating current transmission system (HVDC/FACTS) devices no maintenance is required. | 6 calendar years | Verify that each trip coil is able to operate the circuit breaker, interrupting device, or mitigating device. |
| Electromechanical lockout devices which are directly in a trip path from the protective relay to the interrupting device trip coil (regardless of any monitoring of the control circuitry). | 6 calendar years | Verify electrical operation of electromechanical lockout devices. |
| Unmonitored control circuitry associated with RAS. (See Table 4-2(b) for RAS which include automatic reclosing.) | 12 calendar years | Verify all paths of the control circuits essential for proper operation of the RAS. |

| | | |
|---|---|---|
| Unmonitored control circuitry associated with protective functions inclusive of all auxiliary relays. | 12 calendar years | Verify all paths of the trip circuits inclusive of all auxiliary relays through the trip coil(s) of the circuit breakers or other interrupting devices. |
| Control circuitry associated with protective functions and/or RAS whose integrity is monitored and alarmed (See Table 2). | No periodic maintenance specified | None. |

| Table 2 – Alarming Paths and Monitoring<br><br>In Tables 1-1 through 1-5, Table 3, Tables 4-1 through 4-3, and Table 5 alarm attributes used to justify extended maximum maintenance intervals and/or reduced maintenance activities are subject to the following maintenance requirements | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any alarm path through which alarms in Tables 1-1 through 1-5, Table 3, Tables 4-1 through 4-3, and Table 5 are conveyed from the alarm origin to the location where corrective action can be initiated, and not having all the attributes of the "Alarm Path with monitoring" category below.<br><br>Alarms are reported within 24 hours of detection to location where corrective action can be initiated. | 12 calendar years | Verify that the alarm path conveys alarm signals to a location where corrective action can be initiated. |
| Alarm Path with monitoring:<br><br>The location where corrective action is taken receives an alarm within 24 hours for failure of any portion of the alarming path from the alarm origin to the location where corrective action can be initiated. | No periodic maintenance specified | None. |

| Table 3<br>Maintenance Activities and Intervals for distributed UFLS and distributed UVLS Systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any unmonitored protective relay not having all the monitoring attributes of a category below. | 6 calendar years | Verify that settings are as specified.<br>For non-microprocessor relays:<br>□ Test and, if necessary calibrate.<br>For microprocessor relays:<br>□ Verify operation of the relay inputs and outputs that are essential to proper functioning of the **protection system**; and<br>□ Verify acceptable measurement of power system input values. |
| Monitored microprocessor protective relay with the following:<br>□ Internal self-diagnosis and alarming (See Table 2); and<br>□ Voltage and/or current waveform sampling three or more times per power cycle, and conversion of samples to numeric values for measurement calculations by microprocessor electronics.<br>Alarming for power supply failure (See Table 2). | 12 calendar years | Verify:<br>□ Settings are as specified;<br>□ Operation of the relay inputs and outputs that are essential to proper functioning of the **protection system**; and<br>□ Acceptable measurement of power system input values. |

| Table 3<br>Maintenance Activities and Intervals for distributed UFLS and distributed UVLS Systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Monitored microprocessor protective relay with preceding row attributes and the following:<br>• Ac measurements are continuously verified by comparison to an independent ac measurement source, with alarming for excessive error (See Table 2); and<br>• Some or all inputs and outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure (See Table 2).<br>Alarming for change of settings (See Table 2). | 12 calendar years | Verify only the unmonitored relay inputs and outputs that are essential to proper functioning of the **protection system**. |
| Voltage and/or current sensing devices associated with UFLS or UVLS systems. | 12 calendar years | Verify that current and/or voltage signal values are provided to the protective relays. |
| **Protection system** dc supply for tripping non-**bulk electric system** interrupting devices used only for a UFLS or UVLS system. | 12 calendar years | Verify **protection system** dc supply voltage. |

| Table 3<br>Maintenance Activities and Intervals for distributed UFLS and distributed UVLS Systems | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Control circuitry between the UFLS or UVLS relays and electromechanical lockout and/or tripping auxiliary devices (excludes non-**bulk electric system** interrupting device trip coils). | 12 calendar years | Verify the path from the relay to the lockout and/or tripping auxiliary relay (including essential supervisory logic). |
| Electromechanical lockout and/or tripping auxiliary devices associated only with UFLS or UVLS systems (excludes non-**bulk electric system** interrupting device trip coils). | 12 calendar years | Verify electrical operation of electromechanical lockout and/or tripping auxiliary devices. |
| Control circuitry between the electromechanical lockout and/or tripping auxiliary devices and the non-**bulk electric system** interrupting devices in UFLS or UVLS systems, or between UFLS or UVLS relays (with no interposing electromechanical lockout or auxiliary device) and the non-**bulk electric system** interrupting devices (excludes non-**bulk electric system** interrupting device trip coils). | No periodic maintenance specified | None. |
| Trip coils of non-**bulk electric system** interrupting devices in UFLS or UVLS systems. | No periodic maintenance specified | None. |

| Table 4-1<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Reclosing and Supervisory Relay<br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-1 through 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any unmonitored reclosing relay or supervisory relay not having all the monitoring attributes of a category below. | 6 calendar years | Verify that settings are as specified.<br>For non-microprocessor reclosing or supervisory relays:<br>• Test and, if necessary calibrate<br>For microprocessor reclosing or supervisory relays:<br>• Verify operation of the relay inputs and outputs that are essential to proper functioning of the Automatic Reclosing.<br>For microprocessor supervisory relays:<br>• Verify acceptable measurement of power system input values. |

| Table 4-1<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Reclosing and Supervisory Relay<br><br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-1 through 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Monitored microprocessor reclosing relay or supervisory relay with the following: Internal self-diagnosis and alarming (See Table 2).<br><br>Alarming for power supply failure (See Table 2).<br><br>For supervisory relay:<br><br>Voltage waveform sampling three or more times per power cycle, and conversion of samples to numeric values for measurement calculations by microprocessor electronics. | 12 calendar years | Verify:<br><br>Settings are as specified.<br><br>Operation of the relay inputs and outputs that are essential to proper functioning of the Automatic Reclosing.<br><br>For supervisory relays:<br><br>Verify acceptable measurement of power system input values. |

| Table 4-1<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Reclosing and Supervisory Relay<br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-1 through 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Monitored microprocessor reclosing relay or supervisory relay with preceding row attributes and the following:<br>• Some or all inputs and outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure (See Table 2).<br>• Alarming for change of settings (See Table 2).<br>For supervisory relay:<br>• Ac measurements are continuously verified by comparison to an independent ac measurement source, with alarming for excessive error (See Table 2). | 12 calendar years | Verify only the unmonitored relay inputs and outputs that are essential to proper functioning of the automatic reclosing. |

| Table 4-2(a)<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Control Circuitry Associated with Reclosing and Supervisory Relays that are NOT an Integral Part of RAS<br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Unmonitored control circuitry associated with automatic reclosing that is not an integral part of an RAS. | 12 calendar years | Verify that automatic reclosing, upon initiation, does not issue a premature closing command to the close circuitry. |
| Control circuitry associated with automatic reclosing that is not part of an RAS and is monitored and alarmed for conditions that would result in a premature closing command. (See Table 2) | No periodic maintenance specified | None. |

| Table 4-2(b)<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Control Circuitry Associated with Reclosing and Supervisory Relays that are an Integral Part of RAS<br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Close coils or actuators of circuit breakers or similar devices that are used in conjunction with automatic reclosing as part of an RAS (regardless of any monitoring of the control circuitry). | 6 calendar years | Verify that each close coil or actuator is able to operate the circuit breaker or mitigating device. |
| Unmonitored close control circuitry associated with automatic reclosing used as an integral part of an RAS. | 12 calendar years | Verify all paths of the control circuits associated with automatic reclosing that are essential for proper operation of the RAS. |
| Control circuitry associated with automatic reclosing that is an integral part of an RAS whose integrity is monitored and alarmed (See Table 2). | No periodic maintenance specified | None. |

| Table 4-3<br>Maintenance Activities and Intervals for Automatic Reclosing Components<br>Component Type – Voltage Sensing Devices Associated with Supervisory Relays<br>Note: In cases where Components of Automatic Reclosing are common to Components listed in Table 1-3, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any voltage sensing devices not having monitoring attributes of the category below. | 12 calendar years | Verify that voltage signal values are provided to the supervisory relays. |
| Voltage sensing devices that are connected to microprocessor supervisory relays with ac measurements that are continuously verified by comparison of sensing input value, as measured by the microprocessor relay, to an independent ac measurement source, with alarming for unacceptable error or failure. (See Table 2) | No periodic maintenance specified | None. |

| Table 5-1<br>Maintenance Activities and Intervals for Sudden Pressure Relaying<br>Component Type – Fault Pressure Relay<br>Note: In cases where Components of Sudden Pressure Relaying are common to Components listed in Table 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Any fault pressure relay. | 6 calendar years unless a variance is granted by the AESO | Verify the pressure or flow sensing mechanism is operable. |

| Table 5-2<br>Maintenance Activities and Intervals for Sudden Pressure Relaying<br>Component Type – Control Circuitry Associated with a Fault Pressure Relay<br>Note: In cases where Components of Sudden Pressure Relaying are common to Components listed in Table 1-5, the Components only need to be tested once during a distinct maintenance interval. | | |
|---|---|---|
| **Component Attributes** | **Maximum Maintenance Interval** | **Maintenance Activities** |
| Electromechanical lockout devices which are directly in a trip path from the fault pressure relay to the interrupting device trip coil (regardless of any monitoring of the control circuitry). | 6 calendar years unless a variance is granted by the AESO | Verify electrical operation of electromechanical lockout devices. |
| Unmonitored control circuitry associated with sudden pressure relaying. | 12 calendar years | Verify all paths of the trip circuits inclusive of all auxiliary relays through the trip coil(s) of the circuit breakers or other interrupting devices. |
| Control circuitry associated with sudden pressure relaying whose integrity is monitored and alarmed (See Table 2). | No periodic maintenance specified | None. |

**Appendix 2 – Performance-Based Protection System Maintenance Program**

**Purpose:**

1. To establish a technical basis for initial and continued use of a performance-based **protection system** maintenance program.
2. To establish the technical justification for the initial use of a performance-based **protection system** maintenance program:
   - ~~a.~~(a) Develop a list with a description of components included in each designated segment, with a minimum segment population of 60 components;
   - ~~b.~~(b) Maintain the components in each segment according to the time-based maximum allowable intervals established in Tables 1-1 through 1-5, Table 3, Tables 4-1 through 4-2, and Table 5 until results of maintenance activities for the segment are available for a minimum of 30 individual components of the segment;
   - ~~c.~~(c) Document the maintenance program activities and results for each segment, including maintenance dates and countable events for each included component;
   - ~~d.~~(d) Analyze the maintenance program activities and results for each segment to determine the overall performance of the segment and develop maintenance intervals; and
   - ~~e.~~(e) Determine the maximum allowable maintenance interval for each segment such that the segment experiences countable events on no more than 4% of the components within the segment, for the greater of either the last 30 components maintained or all components maintained in the previous year.
3. To maintain the technical justification for the ongoing use of a performance-based **protection system** maintenance program:
   - ~~a.~~(a) At least annually, update the list of components and segments, and/or description if any changes occur within the segment;
   - ~~b.~~(b) Perform maintenance on the greater of 5% of the components (addressed in the performance based **protection system** maintenance program) in each segment or 3 individual components within the segment in each year;
   - ~~c.~~(c) For the prior year, analyze the maintenance program activities and results for each segment to determine the overall performance of the segment; and
   - ~~d.~~(d) Using the prior year's data, determine the maximum allowable maintenance interval for each segment such that the segment experiences countable events on no more than 4% of the components within the segment, for the greater of either the last 30 components maintained or all components maintained in the previous year.

If the components in a segment maintained through a performance-based **protection system** maintenance program experience 4% or more countable events, develop, document and implement an action plan to reduce the countable events to less than 4% of the segment population within 3 years.

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**Appendix 3 – Amending Process for List of Facilities**

In order to amend any list referenced in subsections 2.1(a)(iii), 2.1(b)(iv) and 2.1(c)(iii), of section 2, *Applicability* of this **reliability standard**, the **ISO** must:

(a) upon determining that a **transmission facility**, **generating unit** or **aggregated generating facility** is to be added, notify the **legal owner** in writing and determine when the **legal owner** is to be compliant with the requirements of this **reliability standard**, which from the date of notice must be at a minimum the maximum maintenance interval identified in Tables 1 to 5 plus six (6) full **months**;

(b) upon determining that a **transmission facility**, **generating unit** or **aggregated generating facility** is to be deleted, notify the **legal owner** in writing and determine an effective date for the **legal owner** to no longer be required to meet the applicable requirements; and

(c) publish the amended list with effective dates on the AESO website.

**Appendix 4 – Amending Process for List of Devices**

If devices are added or removed as described in subsections 2.2(b), 2.2(c) and 2.2(d) of section 2, *Applicability* of this **reliability standard** the **ISO** must:

(a) upon determining that a **protection system** that is to be used for **underfrequency load shedding**, **under voltage load shed** or that is to be installed as a **remedial action scheme** is to be added, notify the **legal owner** in writing and determine when the **legal owner** is to be compliant with the requirements of this **reliability standard**, which from the date of notice must be at a minimum the maximum maintenance interval identified in Tables 1 to 5 plus 6 full months;

(b) upon determining that a **protection system** that is used for **underfrequency load shedding**, **under voltage load shed** or that is installed as a **remedial action scheme** is to be removed, notify the **legal owner** in writing and determine an effective date for the **legal owner** to no longer be required to meet the applicable requirements.

**Appendix 5 – Implementation Plan**

## 1. Purpose

The purpose of this appendix is to set the effective dates and the implementation timelines for Alberta reliability standard PRC-005-~~AB1-6~~AB, *Protection System, Automatic Reclosing and Sudden Pressure Relaying Maintenance* ("PRC-005-~~AB1-6~~AB").

## 2. Compliance with Reliability Standards

The entities identified in section 2 of this **reliability standard** must comply with the requirements of PRC-005-~~AB1-6~~AB in accordance with the implementation schedule.

## 3. Effective Date

PRC-005-~~AB1-6~~AB will become effective on October 1, 2019. Entities must follow the phased implementation plan set out in sections 4 and 5 below.

## 4. Implementation Plan for Requirements R1, R2 and R5

Entities must be compliant with requirements R1, R2 and R5 of PRC-005-~~AB1-6~~AB on October 1, 2019.

## 5. Implementation Plan for Requirements R3 and R4

1. For **protection system**, automatic reclosing, and sudden pressure relaying component maintenance activities with maximum allowable intervals of less than 1 calendar year, as established in Tables 1-1 through 1-5, the entity must be compliant with PRC-005-~~AB1-6~~AB by April 1, 2020.
2. For **protection system**, automatic reclosing, and sudden pressure relaying component maintenance activities with maximum allowable intervals 1 calendar year or more, but 2 calendar years or less, as established in Tables 1-1 through 1-5, the entity must be compliant with PRC-005-~~AB1-6~~AB by October 1, 2021.
3. For **protection system**, automatic reclosing, and sudden pressure relaying component maintenance activities with maximum allowable intervals of 3 calendar years, as established in Tables 1-1 through 1-5, maintenance must be completed in accordance with the following:
   - The entity must complete maintenance on 30% of identified components in accordance with their **protection system** maintenance program by October 1, 2020 or, for generating plants with scheduled outage intervals exceeding 2 years, at the conclusion of the first succeeding maintenance outage;
   - The entity must complete maintenance on 60% of the identified components in accordance with their **protection system** maintenance program by October 1, 2021.
   - The entity must complete maintenance on 100% of the identified components in accordance with their **protection system** maintenance program by October 1, 2022.
4. For **protection system**, automatic reclosing, and sudden pressure relaying component maintenance activities with maximum allowable intervals of 6 calendar years, as established in Tables 1-1 through 1-5, Table 3, Table 4-1, Table 4-2b, Table 5-1, and Table 5-2 maintenance must be completed in accordance with the following:
   - The entity must complete maintenance on 30% of the identified components in accordance with their **protection system** maintenance program by October 1, 2021 or,

for generating plants with scheduled outage intervals exceeding 3 years, at the conclusion of the first succeeding maintenance outage.

- The entity must complete maintenance on 60% of the identified components in accordance with their **protection system** maintenance program by October 1, 2023.
- The entity must complete maintenance on 100% of the identified components in accordance with their **protection system** maintenance program by October 1, 2025.

5. For **protection system**, automatic reclosing, and sudden pressure relaying component maintenance activities with maximum allowable intervals of 12 calendar years, as established in Tables 1-1 through 1-5, Table 2, Table 3, Tables 4-1 through 4-3, and Table 5-2 maintenance must be completed in accordance with the following:
   - The entity must complete maintenance on 30% of the identified components in accordance with their **protection system** maintenance program by October 1, 2023.
   - The entity must complete maintenance on 60% of the identified components in accordance with their **protection system** maintenance program by October 1, 2027.
   - The entity must complete maintenance on 100% of the identified components in accordance with their **protection system** maintenance program by October 1, 2031.