ISO Rules
Part 500 Facilities
Division 502 Technical Requirements
Section 502.8 SCADA Technical and Operating Requirements

Expedited Filing Draft

September 7, 2017

Applicability

1 Subject to subsections 2 and 3 below, section 502.8 applies to:

(a) the **legal owner** of a **generating unit** or an **aggregated generating facility** that has a **gross real power** capability equal to or greater than 5 MW and is:

(i) connected to the **interconnected electric system** or an electric system in the service area of the City of Medicine Hat, including by way of connection to an **electric distribution system**;

(ii) part of an industrial complex connected to the **transmission system**; or

(iii) providing, or part of a facility providing, **ancillary services**;

(b) the **legal owner** of a **transmission facility** connected to the **transmission system** or **transmission facilities** in the service area of the City of Medicine Hat;

(c) the **legal owner** of a load that is:

(i) connected to the **transmission system**;

(ii) connected to **transmission facilities** in the service area of the City of Medicine Hat;

(iii) part of an industrial complex; or

(iv) providing **ancillary services**; and

(d) the **ISO**.

2 The **legal owner** of a **generating unit**, **aggregated generating facility**, **transmission facility** or a load that is energized and commissioned on or after April 7, 2017 must ensure the facility meets the minimum supervisory control and data acquisition requirements of this section 502.8 and, where applicable, verify to the **ISO** that the facility meets those requirements during **commissioning** and energization.

3(1) Subject to subsection 3(3), the provisions of this section 502.8 do not apply to the **legal owner** of a **generating unit**, **aggregated generating facility**, **transmission facility**, or a load that was energized and commissioned prior to April 7, 2017 in accordance with a previous technical requirement, technical standard, **ISO rule** or functional specification, but the **legal owner** of such an existing **generating unit**, **aggregated generating facility**, **transmission facility**, or a load must remain compliant with all the standards and requirements set out in that previous technical requirement, technical standard, **ISO rule** or functional specification.

(2) Notwithstanding subsection 3(1), the **ISO** may require the **legal owner** of a **generating unit**, **aggregated generating facility**, **transmission facility**, or a load to comply with any specific provision or all of the provisions of this section 502.8, if the **ISO** determines that such compliance is necessary for the safe and reliable operation of the **interconnected electric system**.

(3) Notwithstanding subsection 3(1), the **legal owner** of a **generating unit**, **transmission facility**, **aggregated generating facility** or a load must comply with the provisions of this section 502.8 if:

(a) it modifies its facilities after April 7, 2017 to:

(i) increase its Rate DTS or Rate STS contract capacity; or

(ii) upgrade or alter the functionality of its supervisory control and data acquisition system; and

(b) the **ISO** determines that such compliance is necessary for safe and reliable operation of the **interconnected electric system**.

Functional Specification

4(1) The **ISO** may issue a written functional specification containing details, work requirements and specifications for the design, construction and operation of a supervisory control and data acquisition system for the facility.

(2) The functional specification referred to in subsection 4(1) must be generally consistent with the provisions of this section 502.8 but may contain material variances the **ISO** approves of based upon its discrete analysis of any one (1) or more of the technical, economic, safety, operational and **reliability** requirements related to the specific system or connection project.

Use of the Term Legal Owner

5(1) Unless specified otherwise, where the term "**legal owner**" is used below it includes the **legal owner** of a **generating unit**, an **aggregated generating facility**, a **transmission facility** or a load.

Supervisory Control and Data Acquisition Requirements

6(1) The **legal owner** of a synchronous **generating unit** must meet the supervisory control and data acquisition requirements set out in Appendix 1, *SCADA Requirements for Synchronous Generating Units*.

(2) The **legal owner** of a wind or solar **aggregated generating facility** must meet the supervisory control and data acquisition requirements set out in Appendix 2, *SCADA Requirements for Wind or Solar Aggregated Generating Facilities*.

(3) The **legal owner** of a **generating unit** that is part of an industrial complex and the **legal owner** of a load must meet the supervisory control and data acquisition requirements set out in Appendix 3, *SCADA Requirements for Industrial Complexes and Load*.

(4) The **legal owner** of a **transmission facility** must meet the supervisory control and data acquisition requirements set out in Appendix 4, *SCADA Requirements for Transmission Facilities*, if at least one (1) of the following criteria is met:

(a) the substation contains two (2) or more buses operated above 60 kV nominal voltage;

(b) the substation contains one (1) or more buses operated above 200 kV nominal voltage;

(c) the substation contains a capacitor bank, reactor, static VAr compensator or synchronous condenser rated 5 MVAr or greater;

(d) the substation connects three (3) or more transmission lines above 60 kV;

(e) the substation supplies local site load, with normally energized site load equipment rated at 5 MVA or greater that are offered for **ancillary services** or are included in **remedial action schemes**;

(f) the substation supplies local site load with normally energized site load equipment rated at 10 MVA or greater;

(g) the substation supplies **supplemental reserve** load of 5 MVA or greater; or

(h) the substation supplies system load that is part of a **remedial action scheme**.

(5) The **legal owner** of a **generating unit**, the **legal owner** of an **aggregated generating facility** or the **legal owner** of a load must, if they provide **ancillary services**, meet the supervisory control and data acquisition requirements for **ancillary services** set out in Appendix 5, *SCADA Requirements for Ancillary Services*.

(6) The **ISO** must meet the supervisory control and data acquisition requirements set out in:

(i) Appendix 2, *SCADA Requirements for Wind or Solar Aggregated Generating Facilities*; and

(ii) Appendix 5, *SCADA Requirements for Ancillary Services*.

Separate Meters

7 A **legal owner** must gather supervisory control and data acquisition data using a device that is independent from a revenue meter.

Data Acquisition

8(1) The **ISO** must initiate all supervisory control and data acquisition communications with a **legal owner**'s equipment directly connected to the **ISO**'s equipment to acquire supervisory control and data acquisition data from a **legal owner** and must do so using the following means:

(a) periodic scans; or

(b) report-by-exception polls.

(2) The **ISO** must configure the **ISO**'s communications device to be the "master" device.

(3) A **legal owner** must configure its communication device to be the "slave" device using the appropriate addressing the **ISO** assigns.

(4) The **ISO** must, if it initiates communications with a **legal owner** using report-by-exception polls, configure and acquire the supervisory control and data acquisition data so that the data value falls within the allowable deadbands set out in Table 1 below:

Table 1

Value	Allowable Deadband
MW	0.5 MW from 0 to 200 MW, 1.0 MW above 200 MW
MVAr	0.5 MVAR from 0 to 200 MVAr, 1.0 MVAr above 200 MVAr
kV	0.1 kV from 0 to 20 kV, 0.5 kV above 20 kV

(5) A **legal owner** must, if it is providing analog values to the **ISO**, provide those values with at least one (1) decimal place accuracy unless otherwise specified in the attached appendices.

(6) A **legal owner** must ensure that the transducer is scaled such that the maximum, full scale, value returned is between 120% and 200% of the nominal equipment rating.

(7) The **legal owner** of a **generating unit** that uses a mode of operation of either a synchronous condenser or motor, must ensure that the minimum, full scale, values are between 120% and 200% of the lowest operating condition.

(8) A **legal owner** must report supervisory control and data acquisition data relating to power flows with the sign convention of positive power flow being out from a bus, except in situations where source measurements are positive polarity.

(9) Notwithstanding subsection 8(8), a **legal owner** must report:

(a) MVAr measurements from a reactor as negative polarity;

(b) MW and MVAr measurements from a **collector bus** as positive polarity; and

(c) MVAr measurements from a capacitor as positive polarity.

(10) A **legal owner** must, if installing a global positioning system clock as required in a functional specification, use the coordinated universal time as the base time where the base time is the universal time code minus seven (7) hours.

(11) A **legal owner** must ensure that its global positioning system clock functionality provides for one (1) millisecond time stamped event accuracy and can automatically adjust for seasonal changes to daylight savings time.

Supervisory Control and Data Acquisition Communications

9(1) A **legal owner** must implement one (1) of the following communication methods between its facility and the **ISO**:

(a) an internet connection, if the **legal owner** has a latency time requirement of thirty (30) seconds or greater; or

(b) a dedicated telecommunications link, if the **legal owner** has a latency time requirement of less than thirty (30) seconds.

(2) A **legal owner** must provide and maintain a connectivity point and data communication to both the **ISO**'s primary system coordination centre and the **ISO**'s backup system coordination centre.

(3) The **ISO** must provide and maintain a connectivity point to the **legal owner**'s facility at both the **ISO**'s primary system coordination centre and the **ISO**'s backup system coordination centre.

(4) The **legal owner** of a **generating unit**, an **aggregated generating facility**, or a load must, if it owns a facility with the capability of combined load and generation greater than 1000 MW, provide two (2) communication circuits to each of the **ISO**'s primary system coordination centre and the **ISO**'s backup system coordination centre and to each of the **legal owner**'s primary and backup communication centres.

(5) A **legal owner** of a **generating unit**, an **aggregated generating facility**, or a load must, when providing **ancillary services**, send supervisory control and data acquisition data to each of the **ISO**'s primary system coordination centre and the **ISO**'s backup system coordination centre.

(6) A **legal owner** must, based on the **ISO**'s generic communication block diagrams and prior to connecting facilities to the **interconnected electric system** or an electric system in the service area of the City of Medicine Hat, indicate to the **ISO** the generic communication block diagram that depicts the communication protocols between the **legal owner**'s facility and the **ISO**'s system coordination centre, with any variations as appropriate.

(7) A **legal owner** must, if it changes the communication protocols used between itself and the **ISO**, communicate these changes to the **ISO** in writing ninety (90) **business days** prior to changing the protocols.

Notification of Unplanned Availability

10(1) A **legal owner** must, if any component in the communication circuit becomes unavailable due to an unplanned event, notify the **ISO** as soon as practicable, in writing, after determining such unavailability due to equipment failure.

(2) The **ISO** may, following receipt of the notification in 10(1), require the **legal owner** to discontinue the provision of **ancillary services**.

(3) A **legal owner** must provide the **ISO** as soon as practicable, in writing:

(a) the cause of any unavailability reported pursuant to subsection 10(1);

(b) in the event of an equipment failure, a plan, acceptable to the **ISO**, to repair the failed equipment, including testing; and

(c) the expected date when the equipment will be repaired and the required measurements will be restored.

(4) The **legal owner** must, if the equipment is not repaired and required measurements are not restored by the expected date, notify the **ISO** as soon as practicable, in writing, with the revised date and the reason why the communication system was not repaired.

(5) The **legal owner** must notify the **ISO** once the equipment is repaired and the required measurements are restored.

Suspected Failure or Erroneous Data of a Remote Terminal Unit

11(1) A **legal owner** must, if it suspects that a remote terminal unit has failed or is providing erroneous data, notify the **ISO** as soon as practicable, in writing, after identifying the failure or data error.

(2) The **ISO** must, if it suspects that a remote terminal unit has failed or is providing erroneous data, notify the **legal owner** as soon as practicable, after identifying the failure or data error.

(3) The **legal owner** must provide the **ISO** as soon as practicable, in writing, with the date it expects to test the remote terminal unit.

(4) The **legal owner** must, if it is unable to test the remote terminal unit on the expected date provided under subsection 11(3), provide the **ISO** as soon as practicable, in writing, with the revised date.

(5) The **legal owner** must, after testing the remote terminal unit, confirm if there is a problem with the remote terminal unit or not and notify the **ISO** as soon as practicable, in writing, with the results of the test.

(6) The **legal owner** must, if the results of the test indicated that the remote terminal unit has actually failed, provide the **ISO** as soon as practicable, in writing, with a plan acceptable to the **ISO** to repair the failed remote terminal unit and the date by which that the **legal owner** expects to repair or replace the remote terminal unit.

(7) The **legal owner** must, if the remote terminal unit is not repaired or replaced by the date provided under subsection 11(6), notify the **ISO** as soon as practicable, in writing, with the revised date.

(8) The **legal owner** must notify the **ISO** as soon as practicable, in writing, once the remote terminal is repaired or replaced.

Exceptions

12 A **legal owner** is not required to comply with the specific supervisory control and data acquisition submission requirements of this section 502.8 applicable to a particular device:

(a) that is being repaired or replaced in accordance with a plan acceptable to the **ISO** under subsections 10 or 11; and

(b) the **legal owner** is using reasonable efforts to complete such repair or replacement in accordance with that plan.

Appendices

Appendix 1 – *SCADA Requirements for Generating Units*

Appendix 2 - *SCADA Requirements for Wind or Solar Aggregated Generating Facilities*

Appendix 3 - *SCADA Requirements for Industrial Complexes and Load*

Appendix 4 - *SCADA Requirements for Transmission Facilities*

Appendix 5 - *SCADA Requirements for Ancillary Services*

Revision History

Date	Description
xxxx-xx-xx	Revised applicability section; clarified which requirements are applicable to synchronous generating units; added requirements for a distribution connected aggregated generating facility; added additional SCADA requirements for wind aggregated generating facilities to Appendix 2; and added SCADA requirements for solar aggregated generating facilities to Appendix 2.
2015-03-27	Replaced “effective date” with the initial release date in sections 2 and 3; and replaced the word “Effective” in the Revision History to “Date”.
2014-12-23	Appendix 1 amended by combining the two lines concerning generating unit automatic voltage regulation into one line. Appendix 5 amended reflect that the regulating reserve set point signal is sent by ISO every 4 seconds, not every 2 seconds. Appendix 5 amended to include the measurement point for load when providing spinning reserve.
2013-02-28	Initial Release

Appendix 1 – SCADA Requirements for Synchronous Generating Units

Facility/ Service Description	Signal Type	Point Description	Parameter		Accuracy Level	Resolution	Latency and Availability Requirements Based on Maximum Authorized Real Power					
							Maximum authorized real power less than 50 MW		Maximum authorized real power equal to or greater than 50 MW and less than 300 MW		Maximum authorized real power equal to or greater than 300 MW	
							Latency	Availability (%)	Latency	Availability (%)	Latency	Availability (%)
For each power plant	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating units** to a **transmission facility control centre** (if applicable)	0 = Normal	1= Alarm	N/A		30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Communications failure indication between an intelligent electronic device and any remote terminal unit acting as a data concentrator	0 = Normal	1= Alarm								
For each synchronous **generating unit** directly connected to the **transmission system** or **transmission facilities** in the service area of Medicine Hat.	Analog	**Gross real power** as measured at the stator winding terminal	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is to 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Gross **reactive power** as measured at the stator winding terminal	MVAr									
		Generating unit voltage at the generator stator winding terminal or equivalent bus voltage	kV									
		Unit frequency as measured at the stator winding terminal or equivalent bus frequency	Hertz		+/- 0.012 Hz	0.001 Hz						
		Net **real power** as measured on the high side terminal of the **transmission system** step up transformer	MW		+/- 2% of full scale	0.5% of the point being monitored						
		Net **real power** of summated generation of a facility with multiple **generating units** offering as a single **market participant**	MW									
		Net **reactive power** as measured on the high side terminal of the **transmission system** step up transformer	MVAr									
		Net **reactive power** of summated generation of a facility with multiple **generating units** offering as a single **market participant**	MVAr									
		Unit service load measured on the high side of the unit service transformer if the capacity is greater than 0.5 MW	MW									
		Unit service load measured on the high side of the unit service transformer if the capacity is greater than 0.5 MW	MVAr									
		Station service load **real power** if the capacity is greater than 0.5 MW, or if the station service load is for multiple units then the combined load for those units, measured on the high side of the station service transformer	MW									
		Station service load **reactive power** if the capacity is greater than 0.5 MW, or if the station service load is for multiple units then the combined load for those units, measured on the high side of the station service transformer	MVAr									
		Excitation system **real power** if the capacity is greater than 0.5 MW, measured on the high side of the excitation system transformer	MW									
		Excitation system **reactive power** if the capacity is greater than 0.5 MW, measured on the high side of the excitation system transformer	MVAr									
		Voltage at the **point of connection** to the **transmission system**	kV									
		Automatic voltage regulation setpoint	kV									
		Transmission system step-up transformer tap position if the step up transformer has a load tap changer	Tap position		Integer Value	1						
		Ambient temperature if the **generating unit** is a gas turbine **generating unit** (range of minus 50 degrees to plus 50 degrees Celsius)	degrees Celsius		+/- 2% of full scale	1 degree						
	Status	Breaker, circuit switchers, motor operated switches and other devices that can remotely or automatically control the connection to the AIES; and does not include manually operated air breaks.	0 = Open	1= Closed	N/A		30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Transmission system step up transformer voltage regulator if the **transmission system** step up transformer has a load tap changer	0 = Manual	1= Auto								
		Generating unit power system stabilizer (PSS) status	0 = Off	1 = On								
		Generating unit automatic voltage regulation (AVR) in service and controlling voltage	0 = Off	1 = On								
		Remedial action scheme armed status, if applicable	0 =	1= Armed			latency is 15 seconds				4 seconds	99.8%

			Disarmed					
		Remedial action scheme operated status on communications failure, if applicable	0 = Normal	1 = Alarm		availability is 98% mean time to repair is 48 hours		mean time to repair is 4 hours
		Remedial action scheme operated status on runback, if applicable	0 = Normal	1 = Alarm				
		Remedial action scheme operated status on trip, if applicable	0 = Normal	1 = Alarm				
For each distribution connected synchronous **generating unit**, or **aggregated generating facilities** consisting of synchronous **generating units**, where the total turbine nameplate rating is greater than or equal to 5 MW	Analog	**Gross real power** as measured at the stator winding terminal	MW		+/- 2% of full scale	0.5% of the point being monitored	Latency is 30 seconds; Availability is 98%; Mean time to repair is 48 hours	
		Gross **reactive power** as measured at the stator winding terminal	MVAr					
		Generating unit voltage at the generator stator winding terminal or equivalent bus voltage	kV					
	Status	Breaker, circuit switchers, motor operated air brakes and other devices that can remotely control the connection to the AIES; and does not include manually operated air breaks.	0 = Open	1= Closed	N/A			

Appendix 2 – SCADA Requirements for Wind or Solar Aggregated Generating Facilities

Facility / Service Description	Signal Type	Point Description	Parameter		Accuracy Level	Resolution	Latency and Availability Requirements Based on Maximum Authorized Real Power					
							Maximum authorized real power less than 50 MW		Maximum authorized real power equal to or greater than 50 MW and less than 300 MW		Maximum authorized real power equal to or greater than 300 MW	
							Latency	Availability (%)	Latency	Availability (%)	Latency	Availability (%)
For each wind or solar **aggregated generating facility** directly connected to the **transmission system** or **transmission facilities** in the service area of the City of Medicine Hat,	Analog	**Real power** of each collector system feeder	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Reactive power of each collector system feeder	MVAr									
		Voltage for each **collector bus**	kV									
		Real power of station service over 0.5 MW	MW									
		Reactive power of station service over 0.5 MW	MVAr									
		Reactive power of each **reactive power** resource (other than **generating units**)	MVAr									
		Real power at the low side of **transmission system** step up transformer	MW									
		Reactive power at the low side of **transmission system** step up transformer	MVAr									
		Transmission system step-up transformer tap position if the step up transformer has a load tap changer	Tap position		Integer Value	1						
		Net **real power** at the **point of connection**	MW		+/- 2% of full scale	0.5% of the point being monitored						
		Net **reactive power** at the **point of connection**	MVAr									
		Frequency at the **point of connection**	Hertz		+/- 0.012 Hz	0.001 Hz						
		Voltage at the **point of connection**	kV		+/- 2% of full scale	0.5% of the point being monitored						
		Voltage regulation system set point	kV									
		Potential **real power** capability, being the **real power** that would have been produced at the **point of connection** without **aggregated generating facilities** curtailment and based on **real time** meteorological conditions	MW		+/-10% of full scale							
		Real power limit used in the power limiting control system at the aggregated generating facilities	MW		+/- 2% of full scale							
		Wind speed at hub height as collected at the meterological tower, (for wind facilities)	Meters per second		+/- 2% of anemometer maximum							
		Wind direction from the true north as collected at the meterological tower, (for wind facilities)	Degrees		+/- 5 degrees	1 degree						
		Barometric pressure with precision for instantaneous measurements to the nearest 6 HPA (for wind facilities)	HPa		Nearest 6 HPA	1HPA						
		Ambient temperature (for wind facilities)	^{0}C		+/- 1 degrees	1 deg c						
		Wind Speed at 2-10m above ground (for solar facilities)	m/s		+/- 2% of anemometer maximum	0.5% of the point being monitored						
		Wind direction from the true north at 2-10m above ground (for solar facilities)	Degrees		+/- 5 degrees	1 degree						
		Ambient Temperature (for solar facilities)	^{0}C		+/- 1 degrees	1 deg C						
		Global Horizontal Irradiance (for solar facilities)	W/m²		± 25 W/m²	1 W/m2						
		(FROM ISO) Facility limit	MW		N/A	0.1 MW	Signal sent by **ISO**					
		(FROM ISO) Reason for facility limit	1 = Transmission, 2= Ramp, 3 = No limit		N/A		Signal sent by **ISO**					
	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating units** to a **transmission facility control centre** (if applicable)	0 = Normal	1= Alarm	N/A		30 seconds	98.0% mean time to	15 seconds	98.0% mean time to	4 seconds	99.8% mean time to repair is 4 hours

		Communications failure indication between an intelligent electronic device and any remote terminal unit acting as a data concentrator	0 = Normal	1= Alarm				repair is 48 hours		repair is 48 hours	
		Each collector system feeder breaker	0 = Open	1 = Closed							
		Each reactive resource feeder breaker	0 = Open	1 = Closed							
		power limiting control system	0 = Off	1 = On							
		Voltage regulation system status	0 = Manual	1 = Automatic							
		Breaker, circuit switchers, motor operated switches and other devices that can remotely or automatically control the connection to the AIES; and does not include manually operated air breaks.	0 = Open	1 = Closed							
		Generating unit step up transformer voltage regulator if the **transmission system** step up transformer has a load tap changer	0 = Manual	1 = Automatic							
		Remedial action scheme armed status, if applicable	0 = Disarmed	1= Armed							
		Remedial action scheme operated status on communications failure, if applicable	0 = Normal	1 = Alarm							
		Remedial action scheme operated status on runback, if applicable	0 = Normal	1 = Alarm							
		Remedial action scheme operated status on trip, if applicable	0 = Normal	1 = Alarm							
For each wind or solar **aggregated generating facility**, where the total nameplate rating is greater than or equal to 5 MW and is connected to an **electric distribution system** including distribution facilities in the service area of the City of Medicine Hat**.**	Analog	**Gross real power** as measured at the **collector bus**	MW		+/- 2% of full scale	0.5% of the point being monitored	latency is 30 seconds availability is 98% mean time to repair is 48 hours				
		Gross **reactive power** as measured at the **collector bus**	MVAr								
		Generating unit voltage at the **collector bus**	kV								
		Net **real power** at the **point of connection**	MW		+/- 2% of full scale	0.5% of the point being monitored					
		Net **reactive power** at the **point of connection**	MVAr		+/- 2% of full scale	0.5% of the point being monitored					
		Frequency at the **point of connection**	Hertz		+/- 0.012 Hz	0.001 Hz					
		Potential **real power** capability, being the **real power** that would have been produced at the **point of connection** without **aggregated generating facilities** curtailment and based on **real time** meteorological conditions	MW		+/-10% of full scale	0.5% of the point being monitored					
		Real power limit used in the power limiting control system at the aggregated generating facilities	MW		+/- 2% of full scale	0.5% of the point being monitored					
		Wind speed at hub height as collected at the meterological tower, (for wind facilities)	Meters per second		+/- 2% of anemometer maximum	0.5% of the point being monitored					
		Wind direction from the true north as collected at the meterological tower, (for wind facilities)	Degrees		+/- 5 degrees	1 degree					
		Barometric pressure with precision for instantaneous measurements to the nearest 6 HPA (for wind facilities)	HPa		Nearest 6 HPA	1HPA					
		Ambient temperature (for wind facilities)	^{o}C		+/- 1 degrees	1 deg C					
		Wind Speed at 2-10m above ground (for solar facilities)	m/s			0.5% of the point being monitored					
		Wind direction from the true north at 2-10m above ground (for solar facilities)	Degrees		+/- 5 degrees	1 degree					
		Ambient Temperature (for solar facilities)	^{0}C		+/- 1 degrees	1 deg C					
		Global Horizontal Irradiance (for solar facilities)	W/m²		± 25 W/m²	1 W/m2					
		(FROM ISO) Facility limit	MW		N/A	0.1 MW	Signal sent by **ISO**				
		(FROM ISO) Reason for facility limit	1 = Transmission, 2= Ramp, 3 = No limit		N/A		Signal sent by **ISO**				
	Status	Breaker, circuit switchers, motor operated switches and other devices that can remotely or automatically control the connection to the AIES; and does not include manually operated air breaks.	0 = Open	1= Closed	N/A		Latency is 30 seconds; Availability is 98%; Mean time to repair is 48 hours				

Appendix 3 – SCADA Requirements for Industrial Complexes and Loads

Facility / Service Description	Signal Type	Point Description	Parameter		Accuracy Level	Resolution	Latency and Availability Requirements Based on Maximum Authorized Real Power					
							Maximum authorized real power less than 50 MW		Maximum authorized real power equal to or greater than 50 MW and less than 300 MW		Maximum authorized real power equal to or greater than 300 MW	
							Latency	Availability (%)	Latency	Availability (%)	Latency	Availability (%)
For each facility	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating units** to a **transmission facility control centre** (if applicable)	0 = Normal	1= Alarm	N/A		30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Communications failure indication between an intelligent electronic device and any remote terminal unit acting as a data concentrator	0 = Normal	1= Alarm								
For each load facility or industrial complex	Analog	**Real power** at the **point of connection**	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
		Reactive power at the **point of connection**	MVAr									
		Voltage at the **point of connection**	kV									
	Status	Breaker, circuit switchers, motor operated switches and other devices that can remotely or automatically control the connection to the AIES; and does not include manually operated air breaks.	0 = Open	1 = Closed	N/A							
A **market participant** with a **Remedial action scheme** on its load facility or industrial complex	Analog	Total **Remedial action scheme** load available	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	99.8% mean time to repair is 4 hours	15 seconds	99.8% mean time to repair is 4 hours	4 seconds	99.8% mean time to repair is 4 hours
		Amount of load armed	MW									
	Status	**Remedial action scheme** circuit breaker, circuit switcher or other controllable isolating devices	0 = Open	1 = Closed	N/A							
		Arming status of the **Remedial action scheme**	0 = Disarmed	1 = Armed								
		Remedial action scheme operated status on communications failure, if applicable	0 = Normal	1 = Alarm								
		Remedial action scheme operated status on runback, if applicable	0 = Normal	1 = Alarm								
		Remedial action scheme operated status on trip, if applicable	0 = Normal	1 = Alarm								

Appendix 4 – SCADA Requirements for Transmission Facilities

Facility / Service Description	Signal Type	Point Description	Parameter		Accuracy Level	Resolution	Latency and Availability Requirements Based on Transmission Voltage			
							Any one bus operated at 60 kV or above, but less than or equal to 200 kV		Any one bus operated above 200 kV	
							Latency	Availability (%)	Latency	Availability (%)
For each substation	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating units** to a **transmission facility control centre** (if applicable)	0 = Normal	1= Alarm	N/A		30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours
		Communications failure indication between an intelligent electronic device and each remote terminal unit acting as a data concentrator	0 = Normal	1= Alarm						
Bus	Analog	Bus voltage line-to-line. Ring or split busses require a minimum of two voltage sources	kV		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours
	Status	Breakers, circuit switchers, motor operated switches, or other remotely or automatically controllable isolating device status	0 = Open	1= Closed	N/A					
Transformer winding greater than 60 kV	Analog	**Real power** as measured on the high side terminal of the transformer	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours
		Reactive power as measured on the high side terminal of the transformer	MVAr							
		Transformer voltage regulation setpoint if the transformer has a load tap changer	kV							
		Transformer tap position if the step up transformer has a load tap changer	Tap position		Integer Value	1				
	Status	Load tap changer	0 = Manual	1 = Automatic	N/A					
Reactive Resources	Analog	**Reactive power** of switchable **reactive power** resource - capacitor bank (positive polarity) or reactor (negative polarity)	MVAR		+/- 2% of full scale	0.5% of the point being monitored	latency is 30 seconds; availability is 98%; mean time to repair is 48 hours			
		Reactive power of dynamic **reactive power** resource - SVC, synchronous condenser, or other similar device					latency is 15 seconds; availability is 98%; mean time to repair is 48 hours			
		Voltage setpoint of dynamic **reactive power** resource - SVC, synchronous condenser, or other similar device	kV				latency is 15 seconds; availability is 98%; mean time to repair is 48 hours			
	Status	**Reactive power** resource control device - capacitor bank or reactor	0 = Off	1 = On	N/A		latency is 30 seconds; availability is 98%; mean time to repair is 48 hours			
		Reactive power resource control device - SVC, synchronous condenser, or other similar device	0 = Off	1 = On			latency is 15 seconds; availability is 98%; mean time to repair is 48 hours			
		Automatic voltage regulation status for dynamic **reactive power** resource - SVC, synchronous condenser, or other similar device	0 = Off	1 = On			latency is 15 seconds; availability is 98%; mean time to repair is 48 hours			
Remedial Action Scheme	Status	**Remedial action scheme** circuit breaker, circuit switcher or other controllable isolating devices	0 = Open	1 = Closed	N/A		30 Seconds	99.8% mean time to repair is 4 hours	latency is 15 seconds availability is 99.8% mean time to repair is 4 hours	
		Remedial action scheme armed status, if applicable	0 = Disarmed	1= Armed						
		Remedial action scheme operated status on communications failure, if applicable	0 = Normal	1 = Alarm						
		Remedial action scheme operated on equipment overload, if applicable	0 = Normal	1 = Alarm						
		Remedial action scheme operated status on trip, if applicable	0 = Normal	1 = Alarm						
Transmission line where the nominal voltage is greater than or equal to 60 kV and less than 200 kV	Analog	**Real power**	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98% mean time to repair is 48 hours	N/A	
		Reactive power	MVAr							
	Status	Breakers, circuit switchers, motor operated switches, or other remotely or automatically controllable isolating device status	0 = Open	1= Closed	N/A					
Transmission line where the nominal voltage is equal to or greater than 200 kV	Analog	**Real power**	MW		+/- 2% of full scale	0.5% of the point being monitored	N/A		15 seconds	98% mean time to repair is 48 hours
		Reactive power	MVAr							
		Line side voltage	kV							
	Status	Breakers, circuit switchers, motor operated switches, or other remotely or automatically controllable isolating device status	0 = Open	1= Closed	N/A					

Appendix 5 – SCADA Requirements for Ancillary Services

Facility / Service Description	Signal Type	Point Description	Parameter		Accuracy Level	Resolution	Latency and Availability Requirements Based on Maximum Authorized Real Power					
							Maximum authorized real power less than 50 MW		Maximum authorized real power equal to or greater than 50 MW and less than 300 MW		Maximum authorized real power equal to or greater than 300 MW	
							Latency	Availability (%)	Latency	Availability (%)	Latency	Availability (%)
For each resource providing black start services	Analog	Bus frequency in hertz with a range of at least 57 to 63Hz	Hertz		+/- 0.012 Hz	0.001 Hz	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
For each resource providing **regulating reserves**	Analog	**Gross real power** as measured at the stator winding terminal	MW		0.25% of full scale	0.25% of the point being monitored	latency is 2 seconds availability is 99.8% mean time to repair is 4 hours					
		Net **real power** as measured on the high side terminal of the step up transformer	MW									
		Gross real power set point from the **regulating reserve** resource control system	MW									
		High limit of the regulation range	MW				latency is 10 seconds availability is 99.8% mean time to repair is 4 hours					
		Low limit of the regulation range	MW									
		(FROM ISO) Set point. Note if multiple resources are used to provide the full resource commitment, the **ISO** will send a totalized expected MW output signal.	MW		N/A	0.1 MW	Signal sent by **ISO** every 4 seconds					
	Status	**Regulating reserve** resource circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed	N/A		latency is 2 seconds availability is 99.8% mean time to repair is 4 hours					
		Regulating reserveresource control status	0 = Disabled	1= Enabled								
		(FROM ISO) ISO has control of the **regulating reserve** resource	0 = Disarmed	1= Armed	N/A		Signal sent by **ISO** when **regulating reserves** are in effect (on or off)					
For each resource providing **spinning reserves**	Analog	**Gross real power** as measured at: a) For generating **pool assets**, the stator winding terminal or b) For load **pool assets** the closest circuit breaker or disconnection device to each load.	MW		+/- 2% of full scale	0.5% of the point being monitored	latency is 10 seconds availability is 99.8%, mean time to repair is 4 hours					
	Status	Spinning reserve resource circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed	N/A							
For each resource providing **supplemental reserves** either load or generation	Analog	**Gross real power**	MW		+/- 2% of full scale	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	4 seconds	99.8% mean time to repair is 4 hours
	Status	**Supplemental reserve** resource circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed	N/A							
For each resource providing **load shed service** for imports	Analog	Actual Volume, being the **real power** consumed at the **point of connection**	MW		+/- 2% of dispatched signal	0.5% of the point being monitored	30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours	N/A	
		Offered Volume, being the participant's **real power** offer to the **ISO**	MW									
		Armed Volume, being the **real power** commitment of the LSSI resource	MW									
		(From **ISO**) dispatched volume	MW		N/A		Signal sent by **ISO** when LSSI **dispatched** on or off					
	Status	LSSI provider status indication	0 = Disarmed	1 = Armed	N/A		30 seconds	98.0% mean time to repair is 48 hours	15 seconds	98.0% mean time to repair is 48 hours		
		(From **ISO**) **load shed service** for imports **dispatch** status	0 = Disarmed	1 = Armed	N/A		Signal sent by **ISO** when the **load shed service** for imports is **dispatched** on or off					