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

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 greater than or equal to 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 facility 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 facility 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 with the **ISO** that the facility meets the requirements during **commissioning** and before 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 facility 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 facility must remain compliant with all the standards and requirements set out in that previous technical requirement, technical standard, **ISO rule**, or functional specification.

(2) The **ISO** may, notwithstanding subsection 3(1), require the **legal owner** of a **generating unit**, **aggregated generating facility**, **transmission facility**, or a load facility 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) The **legal owner** of a **generating unit**, **transmission facility**, **aggregated generating facility**, or a load facility must, notwithstanding subsection 3(1), 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 The **ISO** must, in accordance and generally consistent with this Section 502.8, approve 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.

Supervisory Control and Data Acquisition Data Requirements

5(1) The **legal owner** of a synchronous **generating unit** must provide the supervisory control and data acquisition data requirements set out in Appendix 1, *Supervisory Control and Data Acquisition Data 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 data requirements set out in Appendix 2, *Supervisory Control and Data Acquisition Data 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 facility must meet the supervisory control and data acquisition data requirements set out in Appendix 3, *Supervisory Control and Data Acquisition Data Requirements for Industrial Complexes and Load Facilities*.

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

(a) the substation contains 2 or more buses operated at nominal voltage greater than 60 kV;

(b) the substation contains one or more buses operated at a nominal voltage greater than 200 kV;

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

(d) the substation connects 3 or more transmission lines operated at a nominal voltage greater than 60 kV;

(e) the substation supplies local site load, with normally energized site load equipment rated greater than or equal to 5 MVA 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 greater than or equal to 10 MVA;

(g) the substation supplies **supplemental reserve** load greater than or equal to 5 MVA; or

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

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

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

(i) Appendix 2, *Supervisory Control and Data Acquisition Data Requirements for Wind or Solar Aggregated Generating Facilities*; and

(ii) Appendix 5, *Supervisory Control and Data Acquisition Data Requirements for Ancillary Services*.

Separate Meters

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

Supervisory Control and Data Acquisition Data General Requirements

7(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.**

(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 "subordinate" device using the appropriate addressing the **ISO** assigns.

(4) The **legal owner** must configure the supervisory control and data acquisition data so that each data falls within the allowable deadbands for the measurement types specified in Table 1 when using report-by-exception polls with the **ISO**.

Table 1
Allowable Deadband Requirement by Measurement Type

Measurement Type	Equipment Normal Rating Range	Allowable Deadband
Real power	0 to 200 MW	0.5 MW
	Greater than 200 MW	1.0 MW
Reactive power	0 to 200 MVAr	0.5 MVAr
	Greater than 200 MVAr	1.0 MVAr
Voltage	0 to 20 kV	0.1 kV
	Greater than 20 kV	0.5 kV

(5) A **legal owner** must, if it is providing analog values to the **ISO**, provide those values with the following minimum accuracy and resolution as specified in Table 2.

Table 2
Accuracy and Resolution Requirements by Measurement Type

Measurement Type	Units	Accuracy	Resolution
All facilities			
All analog measurements not otherwise specified below		+/-2% of full scale	0.1
Frequency (between 55 Hz and 65 Hz only)	Hz	+/- 0.012 Hz	0.001 Hz
Transformer tap position	Position	Integer Value	1
Renewable **aggregated generating facilities**			
Ambient temperature (for solar facilities)	°C	+/-1 °C	1°C
Barometric pressure	hPa	6 hPa	1 hPa
Global horizontal irradiance (for solar facilities)	W/m^2	+/-25 W/m^2	1 W/m^2
Potential **real power** capability	MW	+/-10% of full scale	0.1
Wind direction from true north	Degrees	+/-5°	1°
Regulating reserve			
Regulating reserve measurements	MW	0.25% of Full Scale	0.25% of measurement

(6) A **legal owner** must ensure that the transducer is scaled such that the maximum, full scale, Table 2 values returned are between 120% and 200% of the **normal rating** of the equipment.

(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, Table 2 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) A **legal owner** must, notwithstanding subsection 7(8), report:

(a) **real power** and **reactive power** measurements from a **collector bus** as positive polarity;

(b) **reactive power** measurements from a capacitor as positive polarity; and.

(c) **reactive power** measurements from a reactor as negative 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 7 hours.

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

Supervisory Control and Data Acquisition Communications

8(1) A **legal owner** must implement the communication methods for supervisory control and data acquisition data between its facility and the **ISO** in accordance with Table 3.

Table 3Communication Requirements by Maximum Authorized Real Power for Generating Units, Aggregated Generating Facilities, and Load Facilities

Maximum Authorized Real Power	Communication Method Options	Data Latency	Data Availability	Mean Time to Repair
less than 50 MW	Internet or Dedicated	30 seconds	98.0%	48 hours
greater than or equal to 50 MW, and less than 300 MW	Dedicated	15 seconds	98.0%	48 hours
greater than or equal to 300 MW	Dedicated	4 seconds	99.8%	48 hours

(2) A **legal owner** providing **ancillary services** must implement the communication methods for supervisory control and data acquisition data between its facility and the **ISO** in accordance with Table 4 or Table 3 as applicable.

Table 4
Communication Requirements by Ancillary Service Type Provided

Ancillary Service Type	Communication Method Options	Data Latency	Data Availability	Mean Time to Repair
Regulating Reserve	Dedicated	2 seconds	99.8%	4 hours
Regulating reserve for high/low limits	Dedicated	10 seconds	99.8%	4 hours
Spinning reserve	Dedicated	10 seconds	99.8%	4 hours

(3) A **legal owner** of a **transmission facility** must implement the communication methods for supervisory control and data acquisition data between its facility and the **ISO** in accordance with Table 5.

Table 5
Communication Requirements for Transmission Facilities by Bus Operating Voltage

Bus Operating Voltage	Communication Method Options	Data Latency	Data Availability	Mean Time to Repair
Greater than or equal to 60 kV, and less than 200 kV	Dedicated	30 seconds	98.0%	48 hours
greater than or equal to 200 kV	Dedicated	15 seconds	98.0%	48 hours

(4) A **legal owner** that has been directed by the **ISO** to participate in a **remedial action scheme** must implement the communication methods for supervisory control and data acquisition data between the **legal owner**'s facility that participates in the **remedial action scheme** and the **ISO** in accordance with Table 6 below.

Table 6
Communication Requirements for Remedial Action Scheme Facilities by Bus Operating Voltage

Bus Operating Voltage	Communication Method Options	Data Latency	Data Availability	Mean Time to Repair
greater than or equal to 60 kV, and less than 200 kV	Dedicated	30 seconds	99.8%	4 hours
greater than or equal to 200 kV	Dedicated	15 seconds	99.8%	4 hours

(5) A **legal owner** with a **reactive power** resource must implement the communication methods for its **reactive power** resource between its facility and the **ISO** in accordance with Table 7.

Table 7
Communication Requirements for Reactive Power Resources by Type

Reactive Resource Type	Communication Method Options	Data Latency	Data Availability	Mean Time to Repair
Capacitor bank/ reactor	Dedicated	30 seconds	98.0%	48 hours
Static VAr compensator, synchronous condenser, or other similar device	Dedicated	15 seconds	98.0%	48 hours

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

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

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

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

(10) 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 **control centre**, with any variations, as appropriate.

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

Notification of Actual or Suspected Data Unavailability or Data Error

9(1) A **legal owner** must, if supervisory control and data acquisition data becomes, or is suspected of being unavailable or erroneous, notify the **ISO** as soon as practicable after becoming aware of this data unavailability or data error.

(2) The **ISO** may, following receipt of the notification pursuant to subsection 9(1), require the **legal owner** to discontinue the provision of **ancillary services**.

(3) A **legal owner** must, following or as part of the notification pursuant to subsection 9(1), provide the **ISO** with, as soon as practicable, in writing:

(a) the cause of any supervisory control and data acquisition data unavailability or data error;

(b) if there is an equipment failure that relates to subsection 9(3)(a), a plan that is acceptable to the **ISO** to repair the failed equipment;

(c) the expected date when the supervisory control and data acquisition data will be restored or repaired; and

(d) if, following the notification pursuant to subsection 9(1), the **legal owner** determines that there was no actual supervisory control and data acquisition data unavailability or data error, then the **legal owner** must notify the **ISO** of this determination.

(4) The **legal owner** must notify the **ISO,** as soon as practicable, in writing of any revisions necessary to the plan and the rationale for the revisions to the plan.

(5) The **legal owner** must notify the **ISO** once the supervisory control and data acquisition data is restored or repaired.

Exceptions

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

(a) that is being repaired or replaced in accordance with a plan accepted by the **ISO** pursuant to subsection 9; and

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

Appendices

Appendix 1 – *Supervisory Control and Data Acquisition Data Requirements for Synchronous Generating Units*

Appendix 2 – *Supervisory Control and Data Acquisition Data Requirements for Wind or Solar Aggregated Generating Facilities*

Appendix 3 – *Supervisory Control and Data Acquisition Data Requirements for Industrial Complexes and Load Facilities*

Appendix 4 – *Supervisory Control and Data Acquisition Data Requirements for Transmission Facilities*

Appendix 5 – *Supervisory Control and Data Acquisition Data Requirements for Ancillary Services*

Revision History

Date	Description
2021-02-18	Administrative amendments to align with ISO drafting principles, fix typographical errors, and remove and consolidate some provisions of Section 502.8 in order to improve clarity, reduce repetition, and reduce overall requirements.
2019-12-11	Removed duplication with new Section 103.14, *Waivers and Variances*; standardized functional specifications language; capitalized references to "Section".
2018-09-01	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 facility when providing spinning reserve.
2013-02-28	Initial release

Appendix 1 – Supervisory Control and Data Acquisition Data Requirements for Synchronous Generating Units

Facility/ Service Description	Signal Type	Description	Unit	
Legal owner data acquisition data requirements				
For each power plant	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating unit** to a **transmission facility control centre**, if applicable	0 = Normal	1= Alarm
		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	
		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	Hz	
		Net **real power** as measured on the high side terminal of the **transmission system** step up transformer	MW	
		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	
		Ambient temperature if the **generating unit** is a gas turbine **generating unit** (range of -50^{0}C and +50^{0}C)	^{0}C	
	Status	Breaker, circuit switchers, motor operated switches, or other devices that can remotely or automatically control the connection to the **interconnected electric system**; and does not include manually operated air breaks.	0 = Open	1= Closed

		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 status	0 = Off	1 = On
		Generating unit automatic voltage regulation in service and controlling voltage	0 = Off	1 = On
		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 distribution connected facility including distributed connected in the service area of the City of Medicine Hat. synchronous **generating unit**, or **aggregated generating facilities** consisting of synchronous **generating units**, where the **gross real power** capability is greater than or equal to 5 MW	Analog	**Gross real power** as measured at the stator winding terminal	MW	
		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, or other devices that can remotely control the connection to the **interconnected electric system**; and does not include manually operated air breaks.	0 = Open	1= Closed

Appendix 2 – Supervisory Control and Data Acquisition Data Requirements for Wind or Solar Aggregated Generating Facilities

Facility / Service Description	Signal Type	Description	Unit	
Legal owner data acquisition data requirements				
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, and where the **gross real power** capability is greater than or equal to 5 MW.	Analog	**Real power** of each collector system feeder	MW	
		Reactive power of each collector system feeder	MVAr	
		Voltage for each **collector bus**	kV	
		Real power of station service greater than 0.5 MW	MW	
		Reactive power of station service greater than 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	
		Net **real power** at the **point of connection**	MW	
		Net **reactive power** at the **point of connection**	MVAr	
		Frequency at the **point of connection**	Hz	
		Voltage at the **point of connection**	kV	
		Voltage regulation system setpoint	kV	
		Potential **real power** capability, where potential **real power** capability is 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	
		Real power limit used in the power limiting control system at the **aggregated generating facilities**	MW	
		Wind speed at hub height as collected at the meteorological tower, (for wind facilities)	m/s	
		Wind direction from the true north as collected at the meteorological tower, (for wind facilities)	Degrees	
		Barometric pressure (for wind facilities)	hPa	
		Ambient temperature (for wind facilities)	^{o}C	
		Wind Speed at between 2 to 10 m above ground (for solar facilities)	m/s	
		Wind direction from the true north at between 2 to 10 m above ground (for solar facilities)	Degrees	
		Ambient Temperature (for solar facilities)	^{0}C	
		Global Horizontal Irradiance (for solar facilities)	W/m^2	
	Status	Communications failure alarm from remote terminal unit acting as a data concentrator for one or more **generating units** to the **control centre** of a **transmission facility**, if applicable	0 = Normal	1= Alarm
		Communications failure indication between an intelligent electronic device and any remote terminal unit acting as a data concentrator	0 = Normal	1= Alarm
		Each collector system feeder breaker	0 = Open	1 = Closed
		Each **reactive power** resource feeder breaker	0 = Open	1 = Closed
		Power limiting control system	0 = Off	1 = On

Facility / Service Description	Signal Type	Description	Unit	
		Voltage regulation system status	0 = Manual	1 = Automatic
		Breaker, circuit switchers, motor operated switches, or other devices that can remotely or automatically control the connection to the **interconnected electric system**; 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
ISO supervisory control data requirements				
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, and where the **gross real power** capability is greater than or equal to 5 MW.	Analog	Facility limit	MW	
		Reason for facility limit	1 = Transmission, 2= Ramp, 3 = No limit	
Legal owner data acquisition data requirements				
For each wind or solar **aggregated generating facility**, where the **gross real power** capability 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	
		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	
		Net **reactive power** at the **point of connection**	MVAr	
		Frequency at the **point of connection**	Hz	
		Potential **real power** capability, where potential **real power** capability is 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	
		Real power limit used in the power limiting control system at the **aggregated generating facilities**	MW	
		Wind speed at hub height as collected at the meteorological tower, (for wind facilities)	m/s	
		Wind direction from the true north as collected at the meteorological tower, (for wind facilities)	Degrees	
		Barometric pressure with precision for instantaneous measurements (for wind facilities)	HPa	

Facility / Service Description	Signal Type	Description	Unit	
		Ambient temperature (for wind facilities)	°C	
		Wind Speed at between 2 and 10 m above ground (for solar facilities)	m/s	
		Wind direction from the true north at between 2 and 10 m above ground (for solar facilities)	Degrees	
		Ambient Temperature (for solar facilities)	^{0}C	
		Global Horizontal Irradiance (for solar facilities)	W/m²	
	Status	Breaker, circuit switchers, motor operated switches, or other devices that can remotely or automatically control the connection to the **interconnected electric system**; and does not include manually operated air breaks.	0 = Open	1= Closed
ISO supervisory control data requirements				
For each wind or solar **aggregated generating facility**, where the **gross real power** capability 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	Facility limit	MW	
		Reason for facility limit	1 = Transmission, 2= Ramp, 3 = No limit	

Appendix 3 – Supervisory Control and Data Acquisition Data Requirements for Industrial Complexes and Load Facilities

Facility / Service Description	Signal Type	Description	Unit	
Legal owner data acquisition data requirements				
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
		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	
		Reactive power at the **point of connection**	MVAr	
		Voltage at the **point of connection**	kV	
	Status	Breaker, circuit switchers, motor operated switches, or other devices that can remotely or automatically control the connection to the **interconnected electric system**; and does not include manually operated air breaks.	0 = Open	1 = Closed
A **market participant** with a **remedial action scheme** on its load facility or industrial complex	Analog	Total **remedial action scheme** load available	MW	
		Amount of load armed	MW	
	Status	**Remedial action scheme** circuit breaker, circuit switcher, or other controllable isolating devices	0 = Open	1 = Closed
		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 – Supervisory Control and Data Acquisition Data Requirements for Transmission Facilities

Facility / Service Description	Signal Type	Description	Unit	
Legal owner data acquisition data requirements				
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
		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 buses require a minimum of two voltage sources	kV	
	Status	Breakers, circuit switchers, motor operated switches, or other remotely or automatically controllable isolating device status	0 = Open	1= Closed
Transformer winding greater than 60 kV	Analog	**Real power** as measured on the high side terminal of the transformer	MW	
		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	
	Status	Load tap changer	0 = Manual	1 = Automatic
Reactive Power Resources	Analog	**Reactive power** of switchable **reactive power** resource - capacitor bank (positive polarity) or reactor (negative polarity)	MVAr	
		Reactive power of dynamic **reactive power** resource – static VAr compensator, synchronous condenser, or other similar device	MVAr	
		Voltage setpoint of dynamic **reactive power** resource – static VAr compensator, synchronous condenser, or other similar device	kV	
	Status	**Reactive power** resource control device - capacitor bank or reactor	0 = Off	1 = On
		Reactive power resource control device – static VAr compensator, synchronous condenser, or other similar device	0 = Off	1 = On
		Automatic voltage regulation status for dynamic **reactive power** resource – static VAr compensator, synchronous condenser, or other similar device	0 = Off	1 = On
Remedial Action Scheme	Status	**Remedial action scheme** circuit breaker, circuit switcher or other controllable isolating devices	0 = Open	1 = Closed
		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	
		Reactive power	MVAr	
	Status	Breakers, circuit switchers, motor operated switches, or other remotely or automatically controllable isolating device status	0 = Open	1= Closed
Transmission line where the nominal voltage is greater than or equal to 200 kV	Analog	**Real power**	MW	
		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

Appendix 5 – Supervisory Control and Data Acquisition Data Requirements for Ancillary Services

Facility / Service Description	Signal Type	Description	Unit	
Legal owner data acquisition data requirements				
For each blackstart **resource**	Analog	Bus frequency	Hz	
Legal owner data acquisition data requirements				
For each **regulating reserve resource**	Analog	**Gross real power** as measured at the stator winding terminal	MW	
		Net **real power** as measured on the high side terminal of the step up transformer	MW	
		Gross real power setpoint from the **regulating reserve resource** control system	MW	
		High limit of the **regulating reserve** range	MW	
		Low limit of the **regulating reserve** range	MW	
	Status	**Regulating reserve resource** circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed
		Regulating reserve resource control status	0 = Disabled	1= Enabled
ISO supervisory control data requirements				
For each **regulating reserve resource**	Analog	Setpoint every 4 seconds. Note if multiple resources are used to provide the full resource commitment, the **ISO** will send a totalized expected MW output signal	MW	
	Status	**ISO** has control of the **regulating reserve resource**	0 = Disarmed	1= Armed
Legal owner data acquisition data requirements				
For each **spinning reserves resource**	Analog	**Gross real power** as measured at: a) For **source assets**, the stator winding terminal or b) For **sink assets** the closest circuit breaker or disconnection device to each load facility.	MW	
	Status	**Spinning reserve resource** circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed
Legal owner data acquisition data requirements				
For each **supplemental reserve resource** either load facility or generation	Analog	**Gross real power**	MW	
	Status	**Supplemental reserve resource** circuit breaker status (required for all circuit breakers composing the resource)	0 = Open	1= Closed
Legal owner data acquisition data requirements				
For each resource providing **load shed service**	Analog	Actual Volume of **real power** consumed at the **point of connection**	MW	
		Offered Volume of **real power**	MW	
		Armed Volume of **real power** commitment	MW	
	Status	**Load shed service** provider status indication	0 = Disarmed	1 = Armed
ISO supervisory control data requirements				
For each resource providing **load shed service**	Analog	**Real power** dispatched	MW	
	Status	**Dispatch** status for **load shed service**	0 = Disarmed	1 = Armed