2010-02-11

To: Market Participants and Interested Persons

Re: (Information Document # 2010-001R Summary Statement)

This document outlines what data Facility Owners must submit to the Alberta Electric System Operator in regard to Transmission System Modelling. These requirements provide guidance on the content and format of modelling data required by AESO rule OPP 1306.

The data requirements are premised on identifying the *FACILITIES* comprising the Alberta Electric System, and the *ELEMENTS* contained in those Facilities. These requirements apply to all transmission facilities and their constituent elements, regardless of whether those facilities are existing facilities, facilities being built or changed under direct assignment from the AESO, or facilities built or changed according to an operational decision made by the Facility Owner.

The actual timing of data submissions and the procedure for coordinating the data submission with construction or energization activities is not in scope of this document.

This document represents the generous contributions of the members of the Transmission Data Committee: Rasheek Rifaat P.Eng.; Michael Burke CET; Sami Abdulsalam Ph.D. P.Eng.; Jenny Wang P.Eng.; Tanya Tam P.Eng.; Lance Grainger Ph.D. P.Eng; Trent Loga P.Eng.

Sincerely

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Comments/Questions

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1. Purpose

This document outlines what data Facility Owners must submit to the Alberta Electric System Operator, in order to maintain accurate system models as defined by AESO rule OPP 1306.

This document is subject to revision periodically as the system grows and incorporates new types of equipment; as baseline data is developed allowing an increased focus on refining different aspects of the dataset; and as new industry standards for data management are developed. This revision of Transmission Modelling Data Requirements is in effect until the subsequent revision is published.

2. Background

The Alberta Electric System Operator maintains a Transmission System Object Model (TASMo); a state-estimator model component to the Energy Management System (EMS model); and a geographic transmission system mapping database (GIS Model). The electric utility industry is moving toward a standardized modelling format, the Common Information Model (CIM)[1]. Data is required in such a format as to allow the use of CIM data structures as they become adopted by various modelling applications.

2.1 The Transmission System Object Model

The Transmission System Object Model was populated in 1998 and 1999 from legacy data compiled from multiple sources. The sources from which the Transmission System Object Model was populated had varying degrees of authority and detail and may include various deficiencies. When a deficiency is identified in the representation of the electric grid, a "representation log item" is created. The Facility Owner can have a representation log item closed by resubmitting information for that facility or element in a form compliant with this document.

Since the last revision of *Transmission Modelling Data Requirements*, scrutiny and verification of the submitted data, and incremental data resubmissions have resulted in significant improvement to the dataset. It is the intent of *Transmission Modelling Data Requirements* that the data will continue to improve incrementally over time.

The Transmission System Object Model includes data which is adequate for transmission system studies using powerflow, short circuit and dynamics, when applied appropriately by a skilled power system engineer.

It also includes asset data which provides a general overview of types and locations of equipment and construction, but which is incomplete or simplified and shall not be relied on as a comprehensive set of asset data. These data include:

(1) missing or incomplete test data for a majority of transformers,

(2) inconsistently reported line lengths, structure-types and configurations, and conductor types,

1 IEC 61970-301 Energy Management System Application program interface (EMS_API) Part 301 Common Information Model (CIM) base, First edition 2003-11

(3) suspect switching strategy for shunt devices, in particular the voltage control bands.

2.2 The Energy Management System Model

The EMS includes the same impedance data as used in the Transmission System Object Model, with increased topology detail at transmission voltages including connectivity of individual circuit breakers. The EMS model is cross-referenced to SCADA signals that are recorded in the AESO's data accumulation tool (PI Historian). Increasingly, the topological details in the EMS model are also being cross-referenced with the objects in the Transmission System Object Model.

2.3 Geographic Data

The Alberta Electric System Operator also maintains a geographic database (GIS data) of the facilities comprised by the Alberta Transmission System. GIS data supports mapping of transmission facilities. The AESO maintains the geographic data by periodically exchanging geographic machine-readable data files ("shape files") with the Facility Owners; by periodically reviewing line routes and substation land locations; and by manually entering Project data.

3. Electrical and Physical Parameters for Transmission System Objects

Section 3 lists the data that must be submitted for each type of Transmission System object. Each section follows the following format:

(1) a very short definition of the data categories covering that equipment type (if necessary);

(2) check list of the required data indicated by check boxes;

(3) short paragraphs expanding on, or explaining, the check list where necessary, with detail where necessary indicated by bullet points.

Data submission forms referred to in this section are included as an appendix to this document.

3.1 Load and Generation Measurement and Forecast

3.1.1 Measurement Point

☐ Unique MP_ID

The Measurement Point identifier (MP_ID) is defined by the Metering Services Provider. The Facility Owner must obtain the MP_ID from the Metering Services Provider and forward it to the AESO. The AESO may assign an interim, temporary MP_ID in consultation with the Facility Owner.

In the case of "Behind-the-Fence" loads (loads which are served by self-generation and which therefore represent power both generated and used at the same site without passing through a revenue meter) a unique MP_ID beginning with the letters "BTF_" will be assigned by the AESO.

3.1.2 Load Forecast

- ☐ MP_ID
- ☐ Year
- ☐ "Load" or "Generation"
- ☐ Peak Forecast MW
- ☐ Forecast MVAr at MW peak

Provide annual peak forecast for each MP_ID for each of the next ten years.

The Facility Owner may submit forecast metered volume data on form "Power System Modelling: Supplementary Data: Initial Submission Form – MPID"

3.2 Transmission Facilities

A "Transmission Facility" is a Substation or Transmission Line.

- ☐ Facility Code
- ☐ GIS location
- ☐ Owner

The "Facility Code" is the unique identifier assigned to each Transmission Facility. Facility Codes are assigned by the AESO. The identifier shall consist of up to twenty characters including only capital letters, the digits 0 through 9, period and hyphen. The Facility Owner may request a particular identifier. Preferred identifiers are a simple, pronounceable, unambiguous word; or a short number optionally combined with a letter or letters.

For Example: ROSSDALE
D05
14.83L

When Transmission Facilities are segmented or merged, the AESO will issue new Facility Codes as appropriate. The Facility Owner may consult with the AESO regarding the new Facility Codes.

Submit GIS data describing the detailed location of the Facility. GIS data may be submitted either as a shape file or as a 1:10,000 scale map showing the line route or substation polygon.

The "Owner" is the legal corporate name of the entity that holds title to the Facility.

The Facility Owner may submit Facility data on form "Power System Modelling: Supplementary Data: Initial Submission Form – Facility"

3.2.1 Substations

- ☐ Single Line Diagram
- ☐ Substation name

☐ Land location

Substation names are required only where the Facility Owner in fact assigns names to their substations. The AESO will, upon request, provide assistance in selecting a Substation name. Substation names may not include corporate names. Substation names may not include variations on geographical names that are already used for other substations.

Land locations shall be specified using the Dominion Land Survey designations specifying at minimum resolution the quarter-section, and preferably the Legal Sub-Division. Land locations shall conform rigorously to the following format: XX-XX-XX-XXWX.

3.2.2 Transmission Lines

A Transmission Line begins and ends with connection to a Substation bus or busses or at its connection to a Transmission Line of a different Facility Owner. A Transmission Line may have two or more terminals.

☐ Structure List or Line Survey

☐ Transmission Line Segment Summary

☐ Structure Drawings

A Transmission line comprises one or more line segments. When a transmission line comprises more than one line segment, provide a drawing or table showing how the segments connect.

Structure Drawings shall comprise dimensioned drawings of every Structure-type mentioned on the Structure List.

3.3 Busses

A “Bus” is a node that serves as a common connection for two or more circuits; equivalent to a “connectivityNodeGroup” in the IEC Common Information Model.[2]

☐ Unique bus ID

☐ Nominal bus voltage

☐ Area code

☐ Facility Code

New busses are identified by the AESO. The AESO shall assign Bus IDs consistent with the following:

2 IEC 61970-301 Energy Management System Application program interface (EMS_API) Part 301 Common Information Model (CIM) base, First edition 2003-11

Table 3.3-1 Standard Bus Ranges

BUSRANGE DESCRIPTION	BUSRANGE	
	From_	To _
General transmission busses	1	999
	1000	1999
Distribution busses	2000	4999
	15000	19999
	20001	29999
	30000	39999
	40000	49999
Transformer midpoint busses	5000	8999
	10000	14999
Temporary busses	9000	9999
Isolated system busses	50000	59999
Collector System busses	60000	69999
Resource Adequacy generation busses	70000	79999
Unassigned	80000	99999

New bus numbering will generally follow the pattern used by existing busses in the same area. Nominal bus voltage on the transmission system shall be one of 500kV, 240kV, 138kV, or 69kV; which may differ somewhat from the actual operating voltage of the transmission system at any location.

The AESO will assign an Area Code according to the planning needs of the Alberta Interconnected Electric System.

3.4 Elements

An Element is a current-carrying device that, by virtue of having inherent impedance, contributes to the admittance matrix of the power-flow model.

- ☐ Element Code
- ☐ Element Type (L, X, M, C, S, D, F)
- ☐ Facility Code
- ☐ Owner
- ☐ Element normal status
- ☐ Element commissioning timing
- ☐ Element de-commissioning timing (if known)

The Element Code is the unique identifier assigned to each Element. The identifier shall consist of up to twenty characters including only capital letters, the digits 0 through 9, period and hyphen. The AESO will, upon request, provide assistance in selecting a unique identifier. Preferred identifiers are a simple, pronounceable, unambiguous word; or a short number optionally combined with a letter or letters.

Element Types are line-segments (L), transformers(X), machines (M - includes both motors and generators), FACTS devices (F), Series Compensation (D), Loads (S - includes non-rotating sources and sinks) and shunts (C - includes both capacitors and reactors). Each Element Type requires different detailed additional data, as defined in sections 3.4.1 through 3.4.8.

The "Owner" is the legal corporate name of the entity that holds title to the Element.

The "Facility Code" is required for clarity in identifying which Facility contains the Element. The Facility Code shall be the exact ASCII string previously assigned by the AESO.

"Normal Status" is set to "normally in service=TRUE" if the element is normally energized and able to carry current; and is set to "normally in service=FALSE" if the element is normally on standby or de-energized.

The timelines for commissioning or decommissioning an element are defined either by a fixed date (in the case of maintenance change-outs) or by a project schedule during the course of which the dates may change.

If the element commissioning or decommissioning is associated with maintenance change-out, submit the date on which the change-out takes effect.

If the element commissioning or decommissioning is associated with a project the AESO will assign a project-number. A project may comprise elements that are commissioned or decommissioned three months or more apart. Such elements must be associated with "sub-project" numbers so that the timeline may be traced.
The Facility Owner may submit Element data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Facility"*

3.4.1.1 Element-to-Measurement Point Mapping

- ☐ MP_ID
- ☐ Element Code(s)
- ☐ Portion of MP_ID delivered to or from each element.

Every MP_ID serves one or more elements (either machines or loads).

The portions of the MP_ID summed over all the elements that serve that MP_ID, must sum to 100%.

The Facility Owner may submit element -to-measurement -point data on form *"Power System Modelling: Supplementary Data: Initial Submission Form –Element- MPID"*

3.4.1.2 Dynamic Control Systems

A Dynamic Control System is an automated system that operates within a 0.01s to 10.0s timeframe, to achieve prescribed relationships between selected system variables by comparing functions of these variables to effect control of an identified Element[3].

- ☐ Element Code
- ☐ Control System Type
- ☐ Manufacturer
- ☐ Make
- ☐ Model

Control System Type shall be one of those listed in Table 3.4-1:

Table 3.4-1 Standard Control System Types

CONTROL_SYS	Applies to
Compensator	Machines
Exciter	Machines
Exciter Limiter	Machines
Generator	Machines
Stabilizer	Machines
TurbineGovernor	Machines
Remedial Action Scheme	All Element Types
Load	Loads
Power electronics	Shunts, Loads
Converter controls	DC Converter
FACTS devices	All Element Types

The Facility Owner may submit Control System data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Control Systems"*

3.4.1.3 PSS/E and PSLF Model Data

- ☐ Element Code
- ☐ Model Name
- ☐ Description of Model
- ☐ Model Block Diagram
- ☐ Parameter Names
- ☐ Parameter Values
- ☐ Source-code or compiled object

3 IEEE Std 100-1996 The IEEE Standard Dictionary of Electrical and Electronic Terms

A User-written model may be submitted for detailed study of any dynamic control system.

A standard library model shall be submitted for every dynamic control system, regardless of whether a user-written model is submitted.

Models shall be submitted for both PSS/E software and PSLF software. IEEE models may be submitted in addition to the PSS/E and PSLF models.

A description shall accompany each model, providing a high-level assessment of the model's accuracy and the scenarios under which it is applicable.

A Block Diagram shall be submitted for all user-written models but can be waived for standard library models.

Parameter names shall be the same as specified for the model in the relevant software documentation.

All parameter values shall be provided.

Model source-code or compiled object shall be submitted for all user-written models but can be waived for standard library models.

The Facility Owner may submit software-specific dynamic data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – PS-Models"*

3.4.1.4 Protection Types and Application

The AESO will request that settings will be provided, on a situational basis.

3.4.2 Transformers

- ☐ Transformer nameplate
- ☐ Test report.

Transformers have significant scope for variation from one transformer to the next. The data is requested in a standard format that can accommodate both common transformers and their variations; and more unusual transformers.

Phase-connected grounding transformers and regulators shall be submitted separately; and not as part of any other transformer model.

3.4.2.1 Transformer Windings

- ☐ Winding identifier
- ☐ Connection (delta/wye)
- ☐ Neutral Grounding status
- ☐ Grounding impedance
- ☐ Ratings

A winding identifier is required simply as a cross-reference with which the ratings and terminations can be associated. A "winding" can have

- one “termination” (for example, the “H” termination on the primary winding of a two-winding transformer);
- multiple terminations (for example, the “H” and “X” terminations on the primary winding of an autotransformer); or
- zero terminations (for example, a buried tertiary winding).

The windings’ ratings may be

- identical (for example, in a two-winding transformer, primary and secondary windings are equally rated);
- related (for example, the two secondaries of a split-secondary are each half the rating of the primary);
- arbitrary (for example, the windings of a three-winding transformer may all be differently rated.)

For each winding submit the winding connection as either Y or Δ. For other connections, please contact the Alberta Electric System Operator.

For each winding, Neutral Grounding Status is “TRUE” if the winding is grounded and “FALSE” if the winding is ungrounded. The grounding impedance shall be resistance and reactance values expressed in ohms. Indicate solidly grounded windings by a grounding impedance of zero.

Each winding may have one or more ratings, expressed in MVA. Provide all ratings for each winding, including provisional ratings. For each rating, indicate the condition under which the rating is valid. Clearly indicate which ratings are available and which are provisional. If the transformer capacity is limited by separate equipment in addition provide the limiting condition and its rating.

The Facility Owner may submit Winding data on form *“Power System Modelling: Supplementary Data: Initial Submission Form – Transformer Windings”*

3.4.2.2 Transformer Terminations and Tapchangers

- ☐ Termination identifier (H,X,Y,Z)
- ☐ The winding associated with the termination
- ☐ Termination rated voltage
- ☐ Identification of the bus to which termination connects
- ☐ Tap changing on the termination
- ☐ Tap points
- ☐ Tap-changing strategy (manual, automatic)
- ☐ On-load tap changing (True/False)

☐ Control band

☐ Actual Tap

For each termination, indicate which winding the termination is on: for example, on an autotransformer both the H and X terminations are on the Primary winding.

For each termination, provide the bus to which the termination is connected. If it is not connected, the bus may be left blank.

Provide the rated voltage of that termination. Note that in some cases this may be different from the nominal voltage of the bus to which the termination connects; for example in Alberta 145kV transformer terminations are routinely connected to the nominally 138kV system .

Terminations may be associated with tap-changers. For each tap-changer on a termination, provide all of the following information:

Provide the voltage rating of each tap (for a voltage controlling tapchanger), or the phase shift for each tap (for a phase-shifting transformer), or indicate that no tap-changer exists for this termination.

Provide the tap-changing strategy, one of:

Table 3.4-2 Standard Tap-changing Strategies

TAP_CHANGING_CODE	TAP_CHANGING_DESCR
OFF	Off-load tap changing (having external controls on the transformer tank but requiring de-energization)
OLTC-M	On-load tap changing (manual-local)
OLTC-S	On-load tap changing (supervisory, i.e. manual-remote)
OLTC-A	On-load tap changing (automatic, i.e. under voltage regulation)
FIXED	Fixed taps (having no external control)
PHASE-P	Phase shifting, controlling MW
PHASE-Q	Phase shifting, controlling MVAr

Indicate which transformer termination is intended to be controlled by the tapchanging action -- usually the "X" bushing of a distribution load transformer. If a remote bus is intended to be controlled, enter the bus number. Provide the voltage range for tap-changer control, in per-unit of the system nominal voltage.

For a voltage controlling tap-changer, specify the control band as the maximum and minimum allowed voltage at the controlled bus. For a phase-shifting tap changer specify the control band as the power flow into the termination.

The Facility Owner may submit termination (bushing) data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Transformer Windings".*

3.4.2.3 Transformer Impedances

☐ Transformer equivalent circuit

☐ Positive and zero-sequence real and reactive impedances

- ☐ Positive and zero-sequence real and reactive shunt admittances
- ☐ Short Circuit Impedances and Copper Losses
- ☐ Open Circuit Excitation Currents and Core Losses

Test data is defined in IEEE standard C57-12-00.

Refer to the AESO's *Guideline for Creating Transformer Models from Test Data*[4] for derivation of the Transformer equivalent circuit. The equivalent circuit shall include positive and zero sequence resistance and reactance for every series branch in the equivalent circuit. The equivalent circuit shall include conductance and susceptance to ground for every shunt branch in the equivalent circuit.

The equivalent circuit impedances shall be expressed in per-unit on 100MVA base and the system nominal voltage of the bus connected to the un-tapped (or least responsively tapped) winding.

Phase angle shift shall be submitted if it is non-standard.

The AESO will assign an arbitrary two-character circuit identifier for each impedance branch in the equivalent circuit.

The Facility Owner may submit Transformer impedance data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Transformer Impedance"*

3.4.3 Reactor and Capacitor Banks

- ☐ Bank nameplate
- ☐ MVAR rating
- ☐ Rated voltage
- ☐ Control strategy
- ☐ Control Bus
- ☐ Maximum control-band voltage
- ☐ Minimum control-band voltage
- ☐ Connection (Δ/Y)
- ☐ Neutral Grounding status
- ☐ Grounding impedance

MVAR rating should be expressed at the bank rated voltage.

The Control Strategy shall be one of

4 To be published; please contact the AESO

Table 3.4-3 Standard Shunt-switching Strategies

Strategy
Manual
Supervisory
Automatic
Fixed

"Control Bus" is the bus at which the voltage is monitored for the purpose of controlling this shunt device. Refer to the bus by the BUS_CODE assigned to the bus by the AESO.

Maximum and minimum voltages of the control band shall be expressed in per-unit of the system nominal kV at the Control Bus.

Grounding impedance shall comprise resistance and reactance expressed in ohms, with zero indicating a solidly grounded bank.

The Facility Owner may submit Shunt data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Shunts"*

3.4.4 Line Segments

3.4.4.1 Line Segments Construction

A "Line Segment" is a portion of a Transmission line that has consistent physical attributes of conductor and cross-section throughout the length of the segment.

- ☐ Line Segment length (km)
- ☐ Conductor type
- ☐ # of conductors per bundle
- ☐ Bundle spacing (m)
- ☐ Average sag (m)
- ☐ Typical tangent structure
- ☐ Typical structure height (m)
- ☐ Positive and zero-sequence real and reactive impedances and susceptances
- ☐ Positive and zero-sequence real and reactive shunt admittance

A tap off a line that enters a substation, no matter how short, shall be designated as a separate Line Segment.

If a Line Segment is

- less than 500 meters and less than 20% of the line's total length, or
- less than 50 meters,

it can be considered part of the adjacent line segment; otherwise it shall be considered a separate segment.

Conductor type shall be defined by name as shown in Table 3.4-4. If using a different conductor type, the conductor data sheet shall be submitted.

Table 3.4-4 Conductors

CONDUCTOR_NAME
CHICKADEE
COCHIN
COREOPSIS
COSMOS
CROWSNEST
CURLEW
DOVE
DRAKE
HADDOCK
HAWK
HORNBILL
IBIS
LINNET
MERLIN
OSPREY
PARTRIDGE
PELICAN
PENGUIN
PIGEON
RAVEN
SPARROW
TRILLIUM
WAXWING

The tangent structure shall be designated with a reference to the relevant Structure drawing submitted under section 3.2.2.

Express the structure height measured from the ground to the lowest conductor.

Submit line-segment impedance, susceptance, and terminal-shunt admittance in per-unit on 100MVA base and the nominal kV of the busses at which the line terminates. Nominal kV is discussed in section 3.3 of this document. The submission must state the assumed ground resistivity (ohm-m) and the base kV on which the values are calculated.

3.4.4.2 Line Segment Ratings

- ☐ Conditions
- ☐ Ratings (MVA)
- ☐ Limiting Factors
- ☐ Rating kV

Submit the MVA ratings of the line-segment for each of Summer Normal, Summer Emergency, Winter Normal and Winter Emergency conditions.

For each condition, identify the Line Segment rating as limited by the unconstrained line conductor thermal rating. If the Line Segment has a more limiting rating, identify also the most

limiting factor that limits the rating of the Line Segment, Submit the rating corresponding to that limiting factor for each condition. Describe limiting factor(s) as one of:

Table 3.4-5 Capacity-limiting Conditions

CONDITION_DESCR
Circuit Breaker
Current Transformer
Line conductor Thermal rating
Sag
SLAPAC dampers
Underbuild
Disconnect Switch
Jumpers
Buswork
Protection setting

If some other factor limits the capacity of the line-segment, please describe the factor in detail in a letter to the AESO.

The Facility Owner may submit Line-Segment construction and ratings data on section form *"Power System Modelling: Supplementary Data: Initial Submission Form – Line Segments"*

3.4.4.3 Line Mutuals

- ☐ Element Codes of the two Line Segments
- ☐ Real and reactive mutual impedances
- ☐ Assumed direction of flow for the mutual calculation

Where two Line Segments form any part of a parallel between two transmission lines where

- The length of the parallel is greater than 5% of the length from bus to bus, and
- The separation of the parallel is less than 500 m.

the Mutual Impedances should be submitted.

Impedances shall be expressed in per unit on 100MVA and bus nominal voltage, and shall be calculated on a Line Segment-by-Line Segment basis. Nominal kV is discussed in section 3.3 of this document.

Assumed direction of flow shall be specified in either tabular form or by submission of a map or diagram.

Facility Owners may submit mutual data on form *"Power System Modelling: Supplementary Data: Initial Submission Form – Mutuals"*

3.4.5 Machines

A "Machine" is a rotating generator or motor. In the case of a collector-based generating "farm" such as wind, or mini-hydro; "machine" means the aggregated equivalent machine representing the farm. [5]

- ☐ Nameplate
- ☐ Manufacturer's datasheet
- ☐ "G" for "generator or "M" for "Motor"
- ☐ The bus to which machine connects
- ☐ Model Validation test report

Nameplate and manufacturers data shall include at a minimum:

- Rated MVA
- Rated kV
- Maximum continuous rating (MW)
- Minimum stable generation (MW)
- Reactive Power capability curve
- Inertia constant
- Positive-sequence saturated and unsaturated subtransient reactance
- Positive-sequence saturated and unsaturated subsynchronous reactance
- Positive-sequence saturated and unsaturated synchronous reactance
- Transient time constant
- Subtransient time constant
- Negative sequence resistance
- Negative sequence synchronous reactance
- Zero-sequence resistance
- Zero-sequence synchronous reactance
- Station Service load (MW at zero generation)
- Unit Service load (incremental MW per MW of generation)
- Saturation

Express Inertia Constant for the combination of the Generator and Driver (or for the motor and the connected load)

Express machine impedances in per-unit on machine MVA rating and machine kV rating.

For synchronous machines, submit both direct-axis and quadrature-axis impedances and time constants.

Express saturation either as saturation factors or as a saturation curve.

[5] These requirements do not specify how to aggregate a farm into a single equivalent machine, which may be subject to other requirements.

The Facility Owner may submit machine data on form "*Power System Modelling: Supplementary Data: Initial Submission Form – Machines"*

3.4.6 FACTS Devices

- ☐ Nameplate
- ☐ Component Single-Line Diagram
- ☐ Manufacturer's Test report
- ☐ Manufacturer's Data Sheet

Provide a text description of the operation of the FACTS installation, to a level of detail to be discussed with AESO.

Submit separately the data for any Transformers, Line Segments, capacitor banks, reactor banks, or dynamic control systems associated with the FACTS device.

3.4.6.1 Dynamic Reactive Power Compensation:

- ☐ Control Bus
- ☐ Maximum MVAr capability
- ☐ Minimum MVAr capability

3.4.6.2 HVDC Converter Terminals:

- ☐ Monopole and bi-pole capacity

3.4.7 Series Compensation

- ☐ Nameplate
- ☐ MVAR rating
- ☐ Rated voltage
- ☐ Rated current
- ☐ Control strategy

Discuss the control strategy with the AESO to identify what details should be submitted.

3.4.8 Load

A "Load" is a non-rotating sink or source of MW

- ☐ The bus to which load connects
- ☐ NAICS code
- ☐ Load response characteristic

Loads shall be aggregated to the first non-transmission bus or generation bus upstream of the physical loads.

"Unmetered Volumes" (also called "Behind the Fence" loads) shall be submitted in the same way as any other load.

Every Load is characterized by some industrial type, or group of industries, as identified in the North American Industrial Classification System.

NAICS Code shall be normally one of the codes listed in Table 3.4-6. If using a different NAICS code, submit the supporting reference material from NAFTA.

Table 3.4-6 Standard Industry Types

NAICS CODE	Industry
11	Agriculture
32	Manufacturing - general
33	Heavy Manufacturing
40	Commercial and Services
71	Arts, Entertainment and Recreation
113	Forestry and Logging
211	Oil And Gas Extraction
486	Pipelines
814	Private Households
22131	Farming – Irrigation
99	Unspecified Industry

Specify a separate Element Code for each different industry to be represented.

If submitting a NAICS code of "99" then specify the load response characteristic as a breakdown of constant power, constant impedance, and constant current, in percent for both real and reactive component, to a total of 100%, with a default value of 100% constant power if no other information is available.

The Facility Owner may submit Load data on form "*Power System Modelling: Supplementary Data: Initial Submission Form – Static Load and Generation"*

4. Appendices

4.1 Data Checklist

Measurement Point

- ☐ Unique MP_ID

Load Forecast

- ☐ MP_ID
- ☐ Year
- ☐ "Load" or "Generation"
- ☐ Peak Forecast MW
- ☐ Forecast MVAr at MW peak

Transmission Facilities

- ☐ Facility Code
- ☐ GIS location
- ☐ Owner

Substations

- ☐ Single Line Diagram
- ☐ Substation name
- ☐ Land location

Transmission Lines

- ☐ Structure List or Line Survey
- ☐ Transmission Line Segment Summary
- ☐ Structure Drawings

Busses

- ☐ Unique bus ID
- ☐ Nominal bus voltage
- ☐ Area code
- ☐ Facility Code
- ☐ Element Code
- ☐ Element Type (L, X, M, C, S, D)
- ☐ Facility Code
- ☐ Owner
- ☐ Element normal status
- ☐ Element commissioning timing
- ☐ Element de-commissioning timing (if known)
- ☐ MP_ID
- ☐ Element Code(s)
- ☐ Portion of MP_ID delivered to or from each element.

Dynamic Control Systems

- ☐ Element Code
- ☐ Control System Type
- ☐ Manufacturer
- ☐ Make
- ☐ Model

PSS/E and PSLF Model Data

- ☐ Element Code
- ☐ Model Name
- ☐ Description of Model
- ☐ Model Block Diagram
- ☐ Parameter Names
- ☐ Parameter Values
- ☐ Source-code or compiled object

Transformers

- ☐ Transformer nameplate
- ☐ Test report.

Transformer Windings

- ☐ Winding identifier
- ☐ Connection (delta/wye)
- ☐ Neutral Grounding status
- ☐ Grounding impedance
- ☐ Ratings

Transformer Terminations and Tapchangers

- ☐ Termination identifier (H,X,Y,Z)
- ☐ The winding associated with the termination
- ☐ Termination rated voltage
- ☐ Identification of the bus to which termination connects
- ☐ Tap changing on the termination
- ☐ Tap points
- ☐ Tap-changing strategy (manual, automatic)
- ☐ On-load tap changing (True/False)
- ☐ Control band
- ☐ Actual Tap

Transformer Impedances

- ☐ Transformer equivalent circuit
- ☐ Positive and zero-sequence real and reactive impedances
- ☐ Positive and zero-sequence real and reactive shunt admittances
- ☐ Short Circuit Impedances and Copper Losses
- ☐ Open Circuit Excitation Currents and Core Losses

Reactor and Capacitor Banks

- ☐ Bank nameplate
- ☐ MVAR rating
- ☐ Rated voltage
- ☐ Control strategy
- ☐ Control Bus
- ☐ Maximum control-band voltage
- ☐ Minimum control-band voltage
- ☐ Connection (Δ/Y)
- ☐ Neutral Grounding Status
- ☐ Grounding impedance

Line Segments Construction

- ☐ Line Segment length (km)
- ☐ Conductor type
- ☐ # of conductors per bundle
- ☐ Bundle spacing (m)
- ☐ Average sag (m)
- ☐ Typical tangent structure
- ☐ Typical structure height (m)
- ☐ Positive and zero-sequence real and reactive impedances and susceptances
- ☐ Positive and zero-sequence real and reactive shunt admittance

Line Segment Ratings

- ☐ Conditions
- ☐ Ratings (MVA)
- ☐ Limiting Factors
- ☐ Rating kV

Line Mutuals

- ☐ Element Codes of the two Line Segments
- ☐ Real and reactive mutual impedances
- ☐ Assumed direction of flow for the mutual calculation

Machines

- ☐ Nameplate
- ☐ Manufacturer's datasheet
- ☐ "G" for "generator or "M" for "Motor"
- ☐ The bus to which machine connects
- ☐ Model Validation test report

FACTS Devices

- ☐ Nameplate
- ☐ Component Single-Line Diagram
- ☐ FACTS strategy
- ☐ Manufacturer's Test report
- ☐ Manufacturer's Data Sheet

Dynamic Reactive Power Compensation:

- ☐ Control Bus
- ☐ Maximum MVAr capability
- ☐ Minimum MVAr capability

HVDC Converter Terminals:

- ☐ Monopole and bi-pole capacity

Series Compensation

- ☐ Nameplate
- ☐ MVAR rating
- ☐ Rated voltage
- ☐ Rated current
- ☐ Control strategy
- ☐ Control bus

Load

- ☐ The bus to which load connects
- ☐ NAICS code

4.2 Data Forms

These data forms accommodate all the data required for full representation of a completed Facility. If used for proposed or planned facilities, the proposal will follow the AESO's project process described elsewhere; and some portions of the forms may need to be left blank pending later stages of the project.

MPID | | ***"LOD" or "GEN*** | |

Load Forecast

Year	*MW*	***MVAR***

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Facility

Facility Code*	Substation Name (if Applicable)

*Owner**	*Land Location**	*Facility InServic Date:*	*Facility OutService Date:*

Elements

ELEMENTCODE	*X/L/M*	*Normally InService*	*Energized as part of Project/Subproject:*	*salvaged as part of Project/Subproject*	*ELEMENT OWNER**

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Busses *Buscodes to be issued by AESO Modeller*

AIES Buscode	*WECC Buscode*	*BusName*	*kV*	*Area*	*Facility*	*Initial Voltage*	*Initial Angle*

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Load Element mapping

Element Code	*MP_ID*	*% of MPID on this Element*

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Control Systems

ELEMENTCODE	***Control System***

Dataname	*Datum*

Dataname	*Datum*

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PS Models

Model Name	*Dynamic Programme*

ELEMENTCODE	***Control System***

Parameter Array Index	*Parameter Value*	***Description***

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Transformer Windings (on System Voltage and 100MVA Base)

Element Code	Number of Windings	Number of Terminals

Winding	D/Y	Grounded? (Y/N)	Grounding R (Ohm)	X(Ohm)

Rating Condition	Rating (MVA)	Installed? (Y/N)

Terminal ("Bushing")	Bus	rating (kV)	Max Tap (pu)	Min Tap (pu)	N Taps	Actual Tap (pu)	Tap Changing Strategy	Regulated Bus	Control Bushing	VMAX (pu)	VMIN (pu)	

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Transformer Impedances (on System Voltage and 100MVA Base)

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Element Code	*From Terminal*	*To Terminal*	*Circuit Identifier*	*Base MVA*

	R	*X*	*GFrom*	*BFrom*	*GTo*	*BTo*	*Short Circuit*	*Copper Loss*	*Open Circuit*	*Core Loss*
Positive Sequence										
Zero Sequence										

Element Code	*From Terminal*	*To Terminal*	*Circuit Identifier*	*Base MVA*

	R	*X*	*GFrom*	*BFrom*	*GTo*	*BTo*	*Short Circuit*	*Copper Loss*	*Open Circuit*	*Core Loss*
Positive Sequence										
Zero Sequence										

Element Code	*From Terminal*	*To Terminal*	*Circuit Identifier*	*Base MVA*

	R	*X*	*GFrom*	*BFrom*	*GTo*	*BTo*	*Short Circuit*	*Copper Loss*	*Open Circuit*	*Core Loss*
Positive Sequence										
Zero Sequence										

Shunts

ELEMENTCODE	*Bus*	*rated KV*	*MVAR*	*MVAR0*	*Strategy*	*Bus*	*Control VMAX*	*VMIN*

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Line Segments (on System Voltage and 100MVA base)

Element Code	*Conductor*	*Conductors /Bundle*	*Bundle Spacing (m)*	*Tower*	*Height (m)*	*Length (km)*

	R:	*X:*	*B:*	*GFrom*	*BFrom*	*GTo*	*BTo*
Positive Sequence:							
Zero Sequence:							

Date	*Condition*	*Capacity (MVA)*	*Rated kV*	*Limited By:*

Element Code	*Conductor*	*Conductors /Bundle*	*Bundle Spacing (m)*	*Tower*	*Height (m)*	*Length (km)*

	R:	*X:*	*B:*	*GFrom*	*BFrom*	*GTo*	*BTo*
Positive Sequence:							
Zero Sequence:							

Date	*Condition*	*Capacity (MVA)*	*Rated kV*	*Limited By:*

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Branches

ELEMENTCODE	*From Bus*	*To Bus*	*Circuit*	*Connection is part of Project/Subproject*	*Disconnectionias part of Project/Subproject*

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Line Mutuals

ELEMENTCODE 1	*ELEMENTCODE 2*	***R0 Mutual***	***X0 Mutual***

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Machines

Element Code	*Buscode*	*Bus ID*	*M/G*

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Static Loads and Generation

Element Code	*Buscode*	*Bus ID*	*NAICS Code*

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Project IDEV:

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Pre-Project SLD:

Power System prior to Project (assumes the following projects are complete: _____)

Project or Facility SLD

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5. Revision History

Version	Effective Date	Description of Changes
Revision 0	2003	
Revision 1	2010-02-15	Removed reference to timing and process; updated to reflect new industry structure; regularized structure; applied Information Document template; added requirements for Loads, FACTS and Series compensation; added checklist appendix; updated forms.

Comments/Questions

If you have any comments or questions about the information in this document please contact:

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