

# Project Data Update Package – Instruction Manual (PDUP-IM)

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## Revision History

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Release of Revision 1 (R1) – Entire Document	2010-11-18
Release of Revision 2 (R2) – Entire Document Including: <ul style="list-style-type: none"> <li>• Revisions, additions, and deletions in <u>all</u> sections</li> <li>• Incorporation of formal &amp; informal feedback received from Stakeholders</li> <li>• Revision of Connection Project examples</li> <li>• Addition of Section 9 – PDUP Submissions for System Projects</li> <li>• Addition of System Project examples</li> <li>• Addition of Appendix B-2 – Staged Submittal Process – System Projects</li> </ul>	2011-07-28
Release of Revision 2.1 (R2.1) – Minor Revision <ul style="list-style-type: none"> <li>• Removal of EMS requirements which are now contained in Energization Package Deliverable Requirements document</li> <li>• Update of Supplemental Data Forms to reflect move of EMS requirements to Energization Package Deliverable Requirements document</li> <li>• Explicit inclusion of Phase Shifting Transformers (PST) in modeling requirements and adding example for PST</li> </ul>	2013-07-22
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## Executive Summary

The Project Data Update Package - Instruction Manual (“PDUP-IM”) is provided as a tool to improve the consistency, and subsequently the accuracy, of project data submissions to the Alberta Electric System Operator (AESO) during the Connection, Market Participant Choice, Behind-the-Fence, and System Processes. Consistency of data submissions will allow the AESO to improve the accuracy and the availability of project models posted to the AESO website for use in project studies.

It is understood by the AESO that submitting data in the manner described in the PDUP-IM may cause Stakeholders to alter their internal processes. The AESO recognizes this potential impact to Stakeholders, and appreciates Stakeholders’ efforts to assist with development of standardized data submission. The AESO views the standardization of project data submittal outlined in this instruction manual as a bridge toward a longer-term goal of web-based data submission.

The PDUP-IM documents a baseline understanding for the AESO, transmission facility owners, market participant/TFOs and consultants with respect to data submission requirements.

Ultimately, the end result of implementing the practice outlined in the PDUP-IM will increase accuracy, availability, and reliability of Operation, Planning and Study Base Cases.

## The Current AESO PDUP-IM Team

The following individuals provided core contribution to this version of the document:

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Appendix B: WECC Approved Dynamic Models



# 1 Background

The PDUP-IM describes the data requirements for gate completion in each stage of the connection, market participant choice, behind-the-fence, or system process. It also specifies the format of how the data is to be submitted. The objective of the PDUP-IM is to achieve adequate and accurate modelling of individual projects as they pass gates. The PDUP-IM must not be used, nor relied upon, by any party for any purpose other than that stated above.

The PDUP-IM includes:

- detailed information on project data submission content;
- a description of the increasing levels of project data accuracy required at each stage of submission; and
- a description of the roles and responsibilities of each participant in the project data submission.

The PDUP-IM does not include:

- ID #2010-001R *Facility Modeling Data* (the “Guideline”) which can be found on the [AESO website](#). *Appendix 1 - Electrical and Physical Parameters for Transmission System Model List* is a technical document that provides further information regarding the modelling data and records.
- PDF template forms for project data submission to the AESO
- example PDUP forms for various projects

## 2 Project Data Update Package Content

A Project Data Update Package (PDUP) is required for a connection project, market participant choice, behind-the-fence project or system project at designated stages of the process. The PDUP submission at later stages represents data accuracy updates to the submissions at earlier stages.

The PDUP must include:

- Before and after project Single Line Diagram (SLD) which is a visual modelling representation of what the project will build and decommission<sup>1</sup>.
- PSS/E input data files in text format (Power Flow RAW Data File, Sequence Data File, and/or Dynamic Data Files<sup>2</sup>) for the project.<sup>3</sup>, which are submitted separately.
- For stages 2, 3 and 5, asset level supplementary data for each equipment associated with the project<sup>4</sup>

The PDUP for each stage must be authenticated by a professional engineer registered with The Association of Professional Engineers and Geoscientists of Alberta (APEGA). Specifics on authentication requirements are detailed in Section 5 of the PDUP-IM..

Information on the process for submitting a PDUP is found in Section 6.

The detailed description of data requirements for the submission of a PDUP is outlined in Section 7 of the PDUP-IM.

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<sup>1</sup> For details see section 7.1.

<sup>2</sup> For details see section 7.2.

<sup>3</sup> For details see section 7.2.

<sup>4</sup> For details, see Section 7.3. For Stage 5 only, asset-level supplementary data includes additional supporting Engineering Documents required as outlined in subsection 7.3.1.

### 3 Connection and Market Participant Choice Processes – PDUP Data Quality Progression

On April 1, 2010, the AESO implemented a [Connection Process](#) and on March 1, 2014, the AESO implemented a [Market Participant Choice Process](#) that outlines the process for a market participant/TFO to connect to the Alberta interconnected electric system (AIES).

The connection and market participant choice processes are divided into stages 0 through 6 and follow a gated approach. In order to advance to the next stage in the process, projects must complete all required deliverables for the stage. See [ID #2018-018T Provision of System Access Service and the Connection Process](#) for more information.

A PDUP is one of the requirements outlined in stages 1, 2, 3 and 5 that must be met in order to pass through the corresponding gate. The PDUP submission represents increasing levels of data accuracy as the project progresses through each stage. The data to be submitted in the PDUP represents the preferred alternative for the project.

Data must be submitted for each project that involves changes in topology and equipment. Examples of changes are installation, salvaging, altering or reconnection of the following power system equipment, but not limited to:

- transmission line segments;
- transformers;
- capacitors;
- reactors;
- motors;
- generators/condenser;
- loads;
- battery.

#### 3.1 Stage 0: Application – No Project Data Update Package Required

A PDUP is not required in Stage 0.

#### 3.2 Stage 1: Scope – Project Data Update Package Representing Typical or Estimated Data

A Stage 1 PDUP must be submitted showing the market participant/TFOs' facilities as proposed that are in need of connection. It is submitted for review and acceptance in order to advance through Gate 1.

The quality and accuracy of the Stage 1 PDUP represents a typical or estimated level of technical data. Where market participant/TFO equipment is not yet ordered, the market participant/TFO estimates data representing their project to a level of accuracy adequate for the connection study. This level of data quality and accuracy at Stage 1 refers to equipment with the same rating and performance characteristics, but

sourced from different manufacturers. The technical data contained in the Stage 1 PDUP for each power system equipment associated with the project is provided by the market participant/TFO as generic, typical, or “best guess” examples of the connection facilities proposed as system development to connect the market participant/TFO’s project to the AIES.

Stage 1 PDUP consist of a preliminary, editable copy of the before and after project SLD and the PSS/E Input data files outlined in subsection 7.2, and is sent to AESO Project Manager for each studied alternative. The SLD and the PSS/E Input data files must be of sufficient quality to conduct the Stage 2 connection study. The market participant/TFO may suggest a substation name, topologicalNode (Busses) description and equipment IDs subject to the AESO’s approval at a later stage.

Please see subsection 7.1.2, Facility and Equipment for more information on facility codes, topologicalNodes names (Bus ID) and equipment IDs.

The market participant/TFO is responsible for a complete and accurate Stage 1 PDUP submission to the AESO.

### **3.3 Stage 2: Assessment - Project Data Update Package Representing Manufacturer’s Type Data**

In Stage 2, one of the requirements to get through Gate 2 is for a PDUP to be submitted to the AESO for acceptance. The Stage 2 PDUP will both update the market participant/TFO facilities submitted in the Stage 1 PDUP, and provide revised data for the proposed connection alternative

If a new line, substation or topologicalNode (Busses) is contemplated by a market participant/TFO, it is necessary that facility codes and topologicalNode name (Bus ID) and/or equipment IDs are assigned in Stage 2. TopologicalNodes (Busses) will be required for the study and associated documentation in Stage 2. Please refer to process outlined in Section 6 for details on procedure for facility code, topologicalNode name (Bus ID), and equipment ID assignment.

The Market participant/TFO must use the topologicalNodes (Busses) and Facility Code Request Forms for obtaining topologicalNodes names (Bus ID) and facility codes from the AESO. The AESO will assign topologicalNodes names (Bus ID) and facility codes by updating the submitted draft copy of the after modelling SLD along with these forms. The AESO may communicate with the market participant/TFO for coordination of facility codes or substation names upon request.

It is at the AESO’s discretion to accept a substation name change at later stages; as a general rule the AESO will not accept a substation name change due to the impact on bus names

At Stage 2, the AESO assigns the following:

1. Facility codes that are unique identifiers to distinguish individual substation and transmission lines; and
2. TopologicalNodes names (Bus ID) that is used in the Power System Simulation Model.

The market participant/TFO submits to the AESO, a Stage 2 PDUP having a manufacturers’ type level of technical data for the equipment of the project. This level of data quality and accuracy at Stage 2 refers to type data provided by the manufacturer for the model of equipment being ordered if available. The AESO requires data on specific impedances and losses for the equipment that will be used, or is most likely to be used, on the project. For equipment with dynamic characteristics such as machines, the Stage 2 PDUP submission includes specific dynamic data for dynamic studies, if applicable. This data is utilized to perform

Stage 2 connection studies. The Stage 2 connection studies are subject to further update within the Facility Application (FA) which may cause the Stage 2 studies to become obsolete. In the case of considerable updates between the Stage 2 PDUP and the Stage 3 PDUP, the studies may need to be updated or redone in Stage 3.

Stage 2 PDUP consist of editable copy of the before and after project SLD and the PSS/E Input data files outline in subsection 7.2, and is sent to AESO Project Manager **for the preferred alternative**.

Please see subsection 7.4.1, Facility and Equipment for more information on facility codes, topologicalNodes names (Bus ID) and equipment IDs.

The market participant/TFO is responsible for a complete and accurate Stage 2 PDUP submission to the AESO.

### **3.4 Stage 3: Regulatory Preparation - Project Data Update Package Representing Revised Manufacturers' Type Data**

One of the requirements to pass Gate 3 is a Stage 3 PDUP which must be submitted to the AESO for comments and acceptance. A Stage 3 PDUP is required to be submitted to document any data parameters that have changed from the Stage 2 submittal. The PDUP reflects both the market participants/TFO project and system developments as modelled in the NID study corresponding to AESO's Functional Specification, and the Facility Application (FA) developed by market participants/TFO in parallel based on the Service Proposal.

The market participant/TFO submits to the AESO, a Stage 3 PDUP having a revised manufacturers' type level of technical data for the equipment of the project. This level of data quality and accuracy at Stage 3 refers to type data provided by the manufacturer for the model of equipment being ordered; or actual line routes for transmission lines being built and actual locations of new substations. Revised manufacturers' type level data refers to data that must be provided for equipment that has been selected that was different than anticipated in Stage 2 or that has updated specifications available since the acceptance of the Stage 2 PDUP.

The market participant/TFO is responsible for a complete and accurate Stage 3 PDUP submission to the AESO. A revised Stage 3 PDUP may be requested by the AESO should the market participants change decision which could impact technical data being reported and accepted in the original Stage 3 PDUP.

### **3.5 Stage 4: AUC Applications – No Project Data Update Package Required**

No PDUP submission is required for Stage 4. In the event that the Alberta Utilities Commission (AUC) awards a permit and license with a scope change, another study may be deemed necessary. Therefore, in this situation a revised Stage 3 PDUP would be required.

### **3.6 Stage 5: Construction – Project Data Update Package Represents Test and Actual Equipment Data**

At the conclusion of Stage 5 the project is ready for energization.

A Stage 5 PDUP including additional supporting engineering documents for Power System Model Management (PSMM) must be submitted to the AESO for acceptance (see subsection 7.3.1). The AESO Energization Package Requirements requires that modelling data is received 100 days prior to the facility's energization.

The quality and accuracy of the Stage 5 PDUP represents actual as-built equipment and test data. The technical data contained in the Stage 5 PDUP for each power system element associated with the project is provided by the market participant/TFO as actual equipment and test data for the equipment connected to the AIES. Stage 5 machine data includes manufacturers' test and nameplate data, provided for each individual machine based on the machines' manufacturer, measurements and test results. Stage 5 transmission line data includes as-built data, including line impedances and summer, winter, and emergency thermal capacities based on actual engineering calculations of the precise lengths and spacing from the transmission line survey or structure list. The modelling data provided is consistent with actual measurements, tests or surveys of the physical equipment as-built, and is accompanied by the appropriate type test reports, nameplates, final drawings and engineering documents which are detailed in subsection 7.3.

The market participant/TFO is responsible for a complete and accurate Stage 5 PDUP submission to the AESO.

### **3.7 Stage 6: Close Out – No Project Data Update Package Required**

No PDUP submission is required for Stage 6. However, a Model Validation Report will be required for generator units. The Model Validation Report must comply with [ISO rule Section 502.6](#) *Generating Unit Operating Requirements* and associated Information Document #2017-013R *Model Validation and Reactive Power Report Guidance*.

## 4 Connection and Market Participant Choice Processes – Roles and Responsibilities

The AESO is subject to the requirements of the Alberta Reliability Standards. Relative to project data submission, the AESO's requirements are twofold.

The first requirement is to establish connection and performance requirements for facilities connecting to the AIES. The AESO meets this requirement by mandating the submission of a PDUP for connection projects. The relevant Alberta Reliability Standard (ARS) is documented at the following link:

<https://www.aeso.ca/rules-standards-and-tariff/alberta-reliability-standards/fac-001-facility-connection-requirements/>

The second requirement is to demonstrate that the proper evaluation of potential reliability impacts of new transmission facilities to be connected to the AIES has occurred. The AESO meets this requirement by performing due diligence modelling on proposed facilities to ensure reliability within the AIES is maintained. The relevant Alberta Reliability Standard is documented at the following link:

<https://www.aeso.ca/rules-standards-and-tariff/alberta-reliability-standards/fac-002-coordination-of-plans-for-new-facilities/>

Following these two requirements, Section 4 describes the responsibilities for coordinating project data submissions for roles within the AESO and roles outside of the AESO for market participants, consultants, and TFOs as follows:

- Industry Studies Engineer (market participant, consultant, TFO)
- AESO Studies Engineer
- AESO Project Manager
- AESO Modelling Engineer
- AESO Power System Model Management (PSMM) group

### 4.1 Role of the Industry Studies Engineer

An Industry Studies Engineer can be:

- a TFO engineer conducting connection studies for the market participant/TFO;
- a consultant engineer conducting connection studies for the market participant/TFO; or
- a market participant engineer conducting connection studies.

The role of the Industry Studies Engineer is to provide a PDUP at stages 1, 2, 3 and 5, and to authenticate the PDUP during data submission.

#### 4.1.1 Stage 1

The Industry Studies Engineer's provides the Stage 1 PDUP representing valid typical or estimated levels of technical data for the project as a starting point for connection studies.

### **4.1.2 Stage 2**

The Industry Studies Engineer provides a Stage 2 PDUP representing all facilities identified in the study scope and engineering study results. The study scope developed in Stage 1 will identify which projects must be included in the connection studies (all projects that have passed Gate 2). The market participant/TFO identifies if there are any other projects to be included (projects not passed Gate 2). The Industry Studies Engineer prepares the study case by incorporating project input data files to the applicable base cases.

Projects can be included into a base case by applying project input data files. Instruction to access the dependent input data files can be found on the [AESO website](#).

If the input data files are not available, the Industry Studies Engineer sends a request to the AESO Project Manager.

### **4.1.3 Stage 3**

The Industry Studies Engineer provides a PDUP representing all facilities identified in the NID Application.

### **4.1.4 Stage 5**

The Industry Studies Engineer provides a PDUP representing all facilities to be energized. The market participant/TFO's Industry Studies Engineer or Project Manager provides engineering source documents in support of the PDUP as outlined in subsection 7.3.1.

## **4.2 Role of the AESO Studies Engineer**

An AESO Studies Engineer, if conducting connection studies on behalf of the market participant/TFO, assumes all the project data submission roles of the Industry Studies Engineer described in subsection 4.1. This occurs if the market participant/TFO hires the AESO to perform their study. If the AESO Studies Engineer is acting solely on behalf of the AESO, he or she will assume the roles described below.

### **4.2.1 Stage 1**

The AESO Studies Engineer completes the connection study scope. They work with the market participant/TFO's representative (who will be the Industry Studies Engineer) to develop the connection study scope and provide support to the AESO Project Manager and AESO Modelling Engineer for PDUP submissions.

### **4.2.2 Stage 2**

The AESO Studies Engineer coordinates with the market participant/TFO's representative (who may be the Industry Studies Engineer) to perform studies, screen alternatives, recommend proposed solutions and provide support to the AESO Project Manager and Modelling Engineer for project data submissions can be included into a base case by applying project input data files. Instructions to access these files can be found on the [AESO website](#).

If the input data files are not available, the AESO Studies Engineer checks in the Power System Models Case Library – [Current Year] Planning Base Case Suites folder. If the files are not in this folder, the AESO



Studies Engineer requests that the Project Manager send an email to PSMM at the following email address; [psmm@aeso.ca](mailto:psmm@aeso.ca) to have the project input data files created.

Any project changes or issues identified through the connection studies must be relayed to the Modelling Engineer who will then relay them to PSMM.

### **4.2.3 Stage 3**

The Industry Studies Engineer provides a PDUP representing all facilities in the NID. The AESO Studies Engineer:

- responds to any relevant requests submitted to the AESO Project Manager by the Industry Studies Engineer;
- coordinates with the market participant/TFO's representative and provides support in completing the PDUP; and
- in the case of a combined filing, confirms full agreement between the PDUP and the FA, or agrees to delegate the PDUP to the Industry Studies Engineer.

### **4.2.4 Stage 5**

No involvement is required for the AESO Studies Engineer in this stage.

## **4.3 Role of the AESO Project Manager**

The AESO Project Manager ensures timely receipt of the authenticated PDUP in the stages where one is required and provides support to the project team. The PDUP is one of the requirements for gate completion; thus it has a significant impact on the project schedule. The AESO Project Manager will respond to requests from the Industry Studies Engineer.

### **4.3.1 Stage 0**

No PDUP involvement is required in this stage.

### **4.3.2 Stage 1**

At Stage 1, the Project Manager coordinates and communicates with the Industry Studies Engineer designated for the PDUP submission reflecting the specific project scope and requirements.

Upon receipt of the Stage 1 PDUP the Project Manager forwards the Stage 1 PDUP to the AESO Modelling Engineer for review and acceptance on recommendation by AESO Study Engineer.

### **4.3.3 Stage 2**

At Stage 2, the Project Manager to coordinates and communicates with the Industry Studies Engineer designated for the PDUP submission reflecting the specific project scope and requirements.

In Stage 2, the AESO Project Manager coordinates any requests regarding the facility code for substation and/or transmission line and topologicalNode name (Bus ID) assignments received from the Industry Studies Engineer. The AESO Project Manager obtains all facility codes from the AESO Modelling Engineer who will

only accept requests from Project Managers. Project Manager Over the course of the project the AESO Project Manager ensures that only one facility code is being assigned to each facility. The Industry Studies Engineer initiates the request and sends it to the AESO Project Manager who forwards it to the AESO Modelling Engineer. The request is sent along with supporting documents including:

- the after project SLD in PowerPoint or Visio format with the equipment labeled with the existing or newly named equipment IDs;
- the completed facility code request form; and the completed topologicalNodes name (Bus ID) request form.

Upon receipt of the Stage 2 PDUP the Project Manager forwards it to the AESO Modelling Engineer for review and acceptance.

If the Project Manager receives a request for project input data files from the Industry Studies Engineer, the Project Manager checks in the Power System Models Case Library – [Current Year] Planning Base Case Suites folder. If the files are not in this folder, the Project Manager sends an email to PSMM at [psmm@aeso.ca](mailto:psmm@aeso.ca) to have the project input data files created.

#### 4.3.4 Stage 3

Upon receipt of the Stage 3 PDUP, the Project Manager forwards the PDUP to the AESO Modelling Engineer for review and acceptance.

#### 4.3.5 Stage 5

Upon receipt of the Stage 5 PDUP, the Project Manager forwards the PDUP to the AESO Modelling Engineer for review and acceptance.

### 4.4 Role of the AESO Modelling Engineer

The AESO Modelling Engineer:

1. Issues facility codes as required by the Industry Studies Engineer via the AESO Project Coordinator;
2. Ensures the submitted PDUP meets APEGA standards as outlined in Section 5;
3. Reviews only the authenticated PDUP submitted by a market participant/TFO;
4. Reviews and accepts the PDUP prior to gate completion in stages 1, 2, 3 and 5;
5. Maintains PDUP records for stages 1, 2, 3 and 5;
6. Notifies PSMM to proceed with data modelling upon acceptance of the PDUP;
7. Notifies the AESO Studies Engineers that data has been accepted;
8. Authorizes entry of the project data into the Transmission Administration System Model (TASMo) database;
9. Reviews and authenticates all project data changes made into the TASMo database; and
10. Sends a request to PSMM for the topologicalNodes names (Bus IDs).

#### 4.4.1 Stage 0

No involvement is required in this stage.

#### **4.4.2 Stage 1**

The AESO Modelling Engineer advises and provides support to the Project Manager or Industry Studies Engineer regarding PDUP requirements and expectations.

#### **4.4.3 Stage 2**

The AESO Modelling Engineer collaborates with PSMM regarding any required project changes.

Upon receipt of the facility code request from the AESO Project Manager, the AESO Modelling Engineer assigns the facility code.

The AESO Modelling Engineer forwards the assigned facility code and the after project SLDs to PSMM for topologicalNode names (Bus IDs) assignment, if necessary.

#### **4.4.4 Stage 3**

The AESO Modelling Engineer collaborates with PSMM regarding project changes and will provide additional facility codes and topologicalNodes names (Bus IDs) if required for the NID Application.

#### **4.4.5 Stage 5**

The AESO Modelling Engineer reviews the supplementary engineering documents submitted and confirms completeness in order for the project to complete Gate 5.

Upon PDUP acceptance by the AESO Modelling Engineer, the AESO Modelling Engineer forwards the Stage 5 PDUP to the Project Manager with a copy to the AESO's Energy Management System (EMS) Group for input into the EMS modelling process.

### **4.5 Role of Power System Model Management (PSMM)**

At each stage, PSMM performs the following:

1. Incorporates the PDUP data into the TASM database;
2. Creates and updates the auxiliary data archives; and
3. Provides a monthly update on available topologicalNodes names (Bus IDs) to AESO Modelling Engineer.

## 5 Authentication (Stamping) Requirements

The process by which PDUP submissions are authenticated by those who submit them is very important to the AESO. Authentication ensures the AESO of accuracy of submissions and supports the AESO in the Alberta Reliability Standards requirement that proper evaluation of potential reliability impacts of new transmission facilities to be connected to the AIES has occurred.

Authentication of PDUP submissions indicates to the AESO by the submitter that a level of professional engineering oversight has verified the PDUP contents. PDUP submissions must be authenticated by an engineer licensed to practice in Alberta.<sup>5</sup>

The AESO recognizes that portions of the PDUP may contain information that was not “engineered” by the submitter. The index list referenced in subsection 5.2) and the authentication statement in subsection 5.3 may be used to address these situations.

### 5.1 Stamping of PDUP Component

The APEGA’s Practice Standard for Authenticating Professional Documents must be followed for the authentication of a PDUP for submission to the AESO.

The AESO has determined the stamping requirements for each of the PDUP submission components based on the APEGA standard as follows:

1. After project SLD, which is a visual modelling representation of what the project will build and decommission;
  - For plans, drawings and detailed drawings, each sheet in a set of drawings shall be authenticated.<sup>6</sup>
  - The AESO requires SLD submittals to be authenticated if they will not form part of a larger document.
  - If the SLD submittals will form part of a larger document, please see
  - subsection 5.2 below for alternatives to the stamping of every sheet in the PDUP.
  - The before project SLD does not require stamping as it illustrates what currently exists and there is no engineering work that needs to be authenticated.
2. PSS/E Input Data Files for the project, containing Power Flow RAW File, Sequence Data File and/or Dynamic Data File<sup>7</sup>; each file must be submitted separately and authenticated.
3. Asset-level supplementary data for each equipment associated with the project.
  - Specifications that are separate from related project documents should clearly refer to the related documents and shall be authenticated.<sup>8</sup>
  - The AESO requires asset-level supplementary data submittals to be authenticated.

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<sup>5</sup> APEGA allows for engineers from outside of the jurisdiction of Alberta to register to practice in Alberta for a nominal fee, provided the engineer meets APEGA qualifications.

<sup>6</sup> From APEGA – Practice Standard for Authenticating Professional Documents; V3.1, January 2013.

<sup>7</sup> For details, see Section 7.2.

<sup>8</sup> From APEGA – Practice Standard for Authenticating Professional Documents; V3.1, January 2013.

## 5.2 Authentication Alternatives

In accordance with the APEGA practice standard, the AESO will accept two alternatives for the authentication of the PDUP:

1. Authenticating every page of the component items of the PDUP; or
2. Authenticate the cover page of the PDUP with a legible and signed engineering stamp only if:
  - the PDUP component item requirements can be scanned into one cohesive document;
  - the title of the document can be contained within the header or footer on each page of the PDUP;
  - sequential page numbers (1 of 10, 2 of 10, etc.) can be used within the document to ensure inherent integrity the PDUP is one document; or
  - an index list is included after the cover page to indicate what is covered by the stamp; so that it is easily recognized that the component items of the PDUP are one document.

If it is not practical or possible to represent the PDUP as one document, it is acceptable to break the PDUP down into its component items and authenticate the component items accordingly. Component items that are more than one page that are being authenticated together must follow the cohesive document authentication guidelines outlined within this section.

## 5.3 Authentication Statement

The AESO has included, on the supplementary data submission forms, the following statement:

*Data submitted in this engineering document represents the electrical system components to a level adequate for powerflow, short-circuit, and dynamic modelling of an operational facility, or a project passing gate X<sup>9</sup> of the AESO project process, and is subject to change as the project design proceeds and as-built data becomes available. It is not to be relied upon for construction.*

The submitter of the PDUP may also use this statement elsewhere in the document if necessary.

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<sup>9</sup> Where X is the Stage for which the PDUP is being submitted. For Gate 5, the submitter must provide test reports, line surveys, station SLDs, and other supporting engineering documents.

## 6 PDUP Submission Procedure

Outlined below is a detailed description of the procedure for submitting PDUP requirements to the AESO. Note that a compliant, complete and accepted PDUP is required in order for a connection project to complete a gate. Failure to provide a PDUP in a timely manner will have an impact on connection process milestones, up to, and including delaying project in-service dates.

### 6.1 Staged Submittal Process

Please refer to Appendix A-1, *Project Data Update Package (PDUP) – Staged Submittal Process – Connection Projects*, including Market Participant Choice Projects, for supporting documentation of the process workflow. The numbered steps below correspond to the numbers within the process boxes on Appendix A-1. The submittal process is outlined according to the defined stages of the published connection process.

#### 6.1.1 Stage 0 – Application

##### **0.0 – No Stage 0 PDUP required.**

The AESO assigns a project number and a project name at Stage 0. The project number and project name are required for subsequent PDUP submissions.

#### 6.1.2 Stage 1 – Scope

##### **1.1 – Receipt PDUP**

The PDUP is submitted via email to the AESO Project Manager. The authenticated PDUP, or the separately authenticated components, are submitted in one communication. This prevents ambiguity or the loss of component detail that can occur with multiple email submissions over a period of time. Upon receipt, the AESO Project Manager facilitates the provision of the PDUP to the AESO Modelling Engineer and Study Engineer.

##### **1.2 – PDUP for Acceptance**

If deficiencies are found in the data as defined in the acceptance criteria (see Section 8), the AESO Modelling Engineer consults the submitter to seek clarification or correction by means of a revised PDUP submission. A revised PDUP is another authenticated document; which is distinguished from the original submission. Please note that a resubmission of the PDUP will have an impact on the length of time spent in the process stage.

**At this point of the process, from a PDUP requirement standpoint, the project is cleared to pass Gate 1.**

### **6.1.3 Stage 2 – Assessment**

#### **2.1 – Request facility code and supply preliminary after project SLD**

The market participant/TFO identifies the need for facility codes for the proposed connection. The market participant/TFO links to the facility code request template fillable PDF form<sup>10</sup> to request facility codes. The market participant/TFO also provides a preliminary after project SLD in order for the AESO to assign topologicalNodes (Busses). Normally the SLD will be delivered as a slide within a single PowerPoint file; however other electronic file formats will be accepted as long as they contain equivalent information and are capable of being opened and modified by the standard suite of office software such as Microsoft Word or Visio in use at the AESO. The market participant/TFO sends the form and the preliminary after project SLD via email to the AESO Project Manager.

#### **2.2 – Provide Facility code and TopologicalNode Name (Bus ID)**

The AESO Project Manager facilitates the provision of the facility code request template and preliminary after project SLD to the AESO Modelling Engineer. The AESO Modelling Engineer assigns the facility code and PSMM assigns the topologicalNodes name (Bus ID). The AESO Project Manager will provide this information back to the market participant/TFO. Turnaround time for a facility code and topologicalNode name (Bus ID) request is five working days.

#### **2.3 – Submit PDUP to AESO**

The market participant/TFOs submits the Stage 2 PDUP. Stage 2 PDUP consists of an editable copy of the before and after project SLD and the PSS/E Input data files. PSS/E Input data files include Power Flow RAW Data File, Sequence Data File, and/or Dynamic Data Files in text format. Stage 2 PDUP is sent to AESO Project Manager for the preferred alternative. Refer to subsection 7.2 of this manual for more details about the PSS/E format data files.

Connection and market participant choice projects involve multiple stakeholders. It is the AESO's preference that a market participant and TFO, or their designated consultants, coordinate the submission of a single consolidated PDUP. In cases where multiple energizations are required on a project, a PDUP is required for each energization instance.

#### **2.4 – Reception of PDUP**

Refer to step 1.1 of the subsection 6.1 for details.

#### **2.5 – PDUP for Acceptance**

Refer to step 1.2 of the subsection 6.1 for details.

**At this point of the process, from a PDUP requirement standpoint, the project is cleared to pass Gate 2.**

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<sup>10</sup> These can be found on the [AESO website](#).

## **6.1.4 Stage 3 – Regulatory Preparation**

### **3.1 – Submit PDUP to AESO Using Fillable PDF Forms**

The project data submissions in Stage 3 PDUP must be submitted via the fillable PDF forms.

A download of each required form<sup>11</sup> is filled out. They are then combined with the other elements of the PDUP (see Section 2) and authenticated to the APEGA standard (see Section 5). To maintain consistency in project data submission, supplementary data at Stage 3 will only be accepted on the additional fillable PDF forms. The two SLDs must be delivered in both PDF and editable format. The PSS/E input data files must be included with Power Flow RAW Data File, Sequence Data File, and/or Dynamic Data Files in text format. Refer to subsection 7.2 of this manual for more details about the PSS/E-format data files.

### **3.2 – Reception of PDUP**

Refer to step 1.1 of the subsection 6.1 for details.

### **3.3 – PDUP for Acceptance**

Refer to step 1.2 of the subsection 6.1 for details.

**At this point of the process, from a PDUP requirement standpoint, the project is cleared to pass Gate 3.**

## **6.1.5 Stage 4 – AUC Applications**

### **4.0 – No Stage 4 PDUP required.**

## **6.1.6 Stage 5 – Construction**

### **5.1 – Submit PDUP to AESO Using Fillable PDF Forms**

The project data submissions in Stage 5 PDUP must be submitted via the fillable PDF forms. A download of each required form<sup>12</sup> is filled out. They are then combined with the other components of the PDUP (see Section 2) and authenticated to the APEGA standard (see Section 5). To maintain consistency in project data submission, supplementary data at Stage 5 will only be accepted on the additional fillable PDF forms. The two SLDs must be delivered in both PDF and editable format. The PSS/E input data files must be included with Power Flow RAW Data File, Sequence Data File, and/or Dynamic Data Files in text format. Refer to subsection 7.2 of this manual for more details about the PSS/E-format data files.

**Note:** If a project proposes multiple energizations, a PDUP is required for each energization occurrence. The timeline that the AESO applies to this requirement is six weeks between energizations. Energizations beyond six weeks apart require multiple PDUP submissions. If timeline is less than six weeks between energization, then the AESO considers this one energization with the requirement to submit one PDUP. In both cases, a project energizations plan is required.

### **5.2 – Reception of PDUP**

Refer to step 1.1 of the subsection 6.1 for details.

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<sup>11</sup> These can be found on the [AESO website](#).

<sup>12</sup> These can be found on the [AESO website](#).



### **5.3 – PDUP for Acceptance**

Refer to step 1.2 of the subsection 6.1 for details.

### **5.4 – Authorize PDUP Entry in the TASM<sub>o</sub> Database**

The AESO Modelling Engineer authorizes entry of the accepted PDUP. The PDUP is passed on to PSMM for entry into the TASM<sub>o</sub> database. Supplementary data is input, and then a query is performed in the TASM<sub>o</sub> database to output Power Flow RAW Data File, Sequence Data File and/or Dynamic Data Files. The PSMM group compares the generated data files to the data files submitted by the market participant/TFO in the PDUP and ensures a match.

### **5.5 – Generate Facility Report (FR)**

At this step, PSMM generates a Stage 5 FR from the TASM<sub>o</sub> database.

**At this point of the process, from a PDUP requirement standpoint, the project is cleared to pass Gate 5.**

## **6.1.7 Stage 6 – Close Out**

### **6.1 – Email FR to Market Participant/TFO**

The FR is generated by PSMM and made available to the AESO Project Manager who then makes it available to the market participant/TFO.

### **6.2 – Submit Model Validation Report**

The market participant/TFO is required to submit a Model Validation Report to the AESO to comply with the WECC and the AESO requirements (see subsection 3.7).

## 7 Details

### 7.1 Before and After Project SLDs

A visual representation of the project changes accompanies all PDUP submissions. It includes a set of two SLDs, a before project SLD and an after project SLD, which include the smallest subset of the AIES that still accurately depicts the changes being made by the project.

The before project SLD shows what currently exists and captures facilities that will be altered by the project changes; the after project SLD depicts the new facilities and modifications on the facilities altered by the project changes.

A preliminary draft of the after project SLD, in editable form, is submitted to the AESO Project Manager in Stage 1 for facility code and topologicalNode name (Bus ID) assignments. Normally the before and after project SLDs are delivered as two slides within a single PowerPoint file; however, other electronic file formats are acceptable as long as they contain equivalent information and are capable of being opened and modified by the standard suite of office software such as Microsoft Word or Visio in use at the AESO.

For the PDUP submission, the two SLDs are delivered in both PDF and editable format.

**Examples of Equipment (Elements) that may be included in the SLDs are as follows:**

- machines (generators/motors/Condenser);
- line segments;
- transformers;
- capacitor/reactors;
- loads;
- battery;
- topologicalNode (Busses) connecting the electrical equipment; and
- other electrical equipment (i.e. SVC, FACTS, etc.).

**Substation demarcation:**

- Enclose all the topologicalNode (Busses) and equipment of a facility in a box with dashed line pattern to indicate that they all belong to one substation. The demarcation is to be labeled with the facility code and substation name.

**Labelling to include in the SLDs:**

- facility code for both substations and transmission lines<sup>13</sup>;
- topologicalNode name (Bus ID) and its nominal kV (i.e., 500/240/138/69/34.5/25 kV)<sup>14</sup>; and
- equipment (element) and its ratings.

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<sup>13</sup> Substation name is optional.

<sup>14</sup> ATCO can continue to present their SLDs with their system nominal voltage of 144 kV.

**Colour coding for the SLDs:**

- Draw and label equipment additions in red (red solid lines for line segment addition).
- Draw and label equipment to be decommissioned in green (green dashed lines for line segment decommissioned).
- Draw and label equipment without changes in black.

**Electrical equipment symbols (typical; other styles acceptable):**

Generator



Transformer



Capacitor



Reactor



Loads



Battery Energy Storage System



Photovoltaics (PV)

### 7.1.1 The Before Project SLD

A before project SLD showing the system as it exists prior to the initiation of the project is submitted as part of the PDUP. With some preliminary connection information, the AESO can provide information in the preparation of the before project SLD if necessary.

If the system is going to be altered first by another project or other projects, then the before project SLD must carry an annotation stating which projects must be completed to bring about the depicted before configuration. Stamping of the before project SLD is not necessary.

See Figure 7.1.1-1 below for an example of a before project SLD.

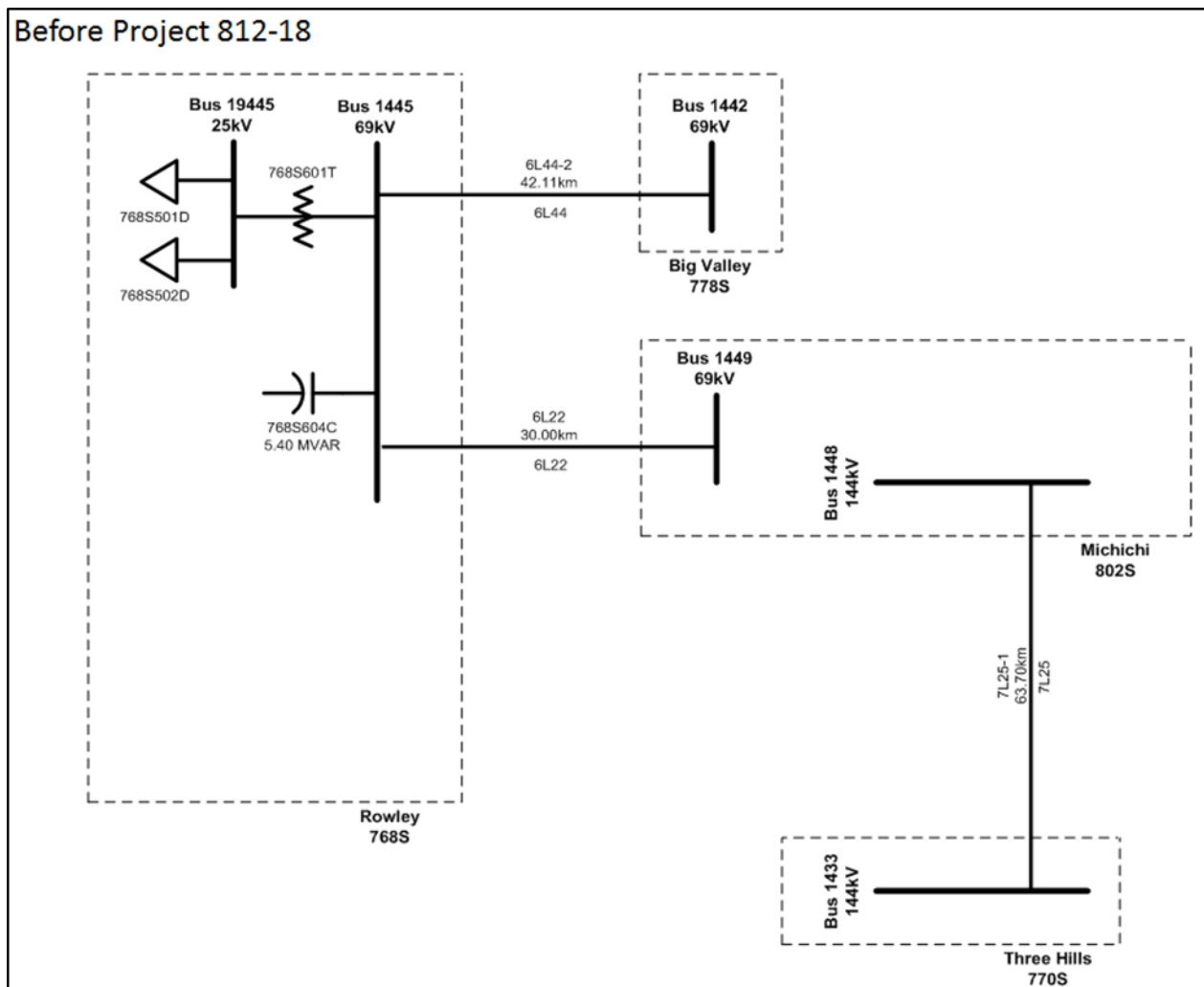


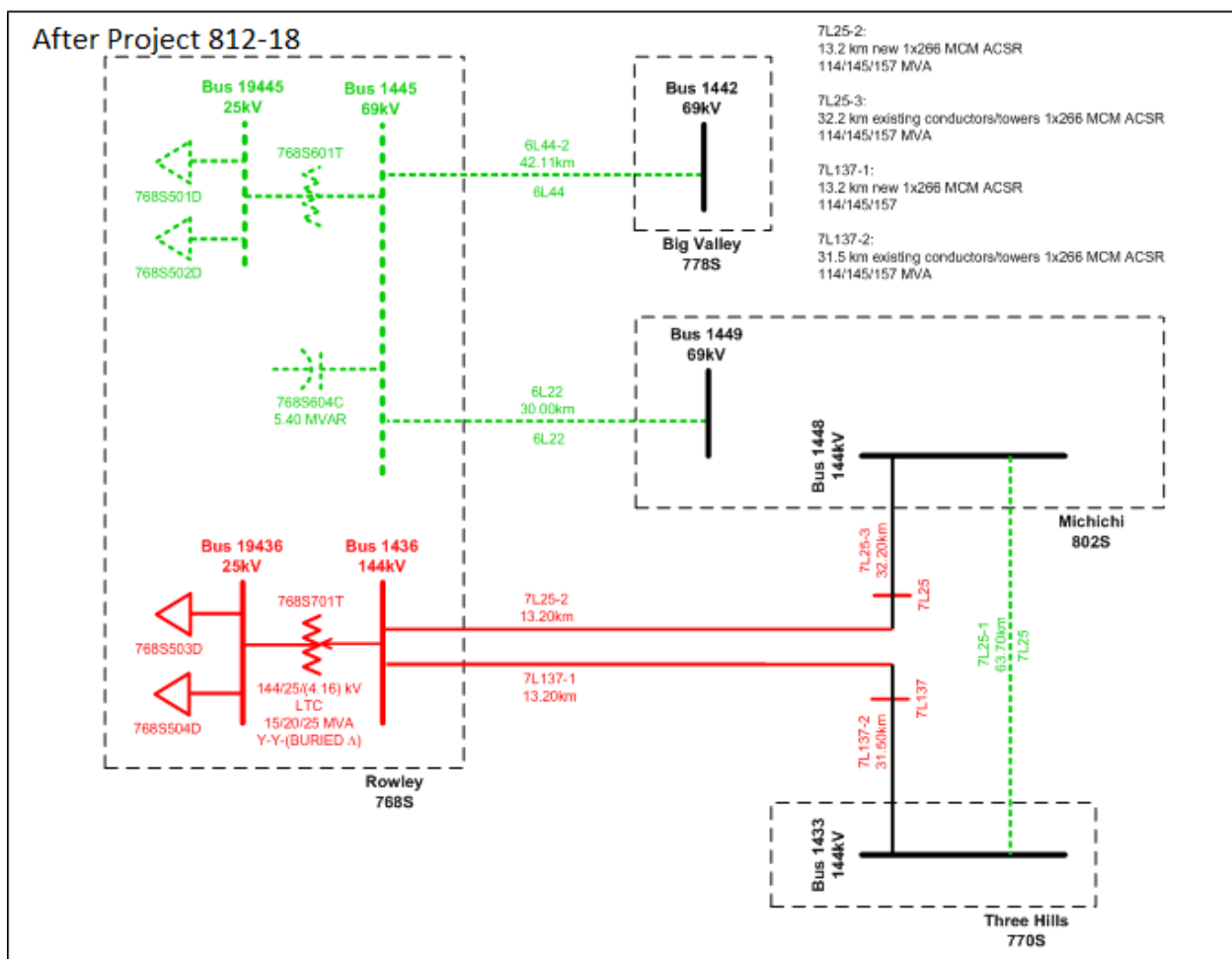
Figure 7.1.1-1 Before Project SLD Example

### 7.1.2 The After Project SLD

An after project SLD showing the system as it will exist when the project is complete is submitted as part of the PDUP. The after project SLD must show:

1. all existing facilities or equipment that remain unchanged in black;
2. any facilities or equipment to be added in red, shown as solid lines; and
3. any facilities or equipment to be decommissioned in green, shown as dashed lines.

See Figure 7.1.2-1 below for an example of an after project SLD.<sup>15</sup>



**Figure 7.1.2-1 After Project SLD Example**

<sup>15</sup> Ratings and distances are shown in the “after” project SLD example; however, ratings and distances are not required on the “after” project SLD. They are captured as part of the Supplementary Data.

For Stage 1 PDUPs, as bus numbers and facility codes have yet to be assigned, temporary bus numbers in the range of 990001 to 999001 are to be used for new buses and project facility codes for new facilities as shown in Figure 7.1.2-2. New buses for each alternative must start with 990001.

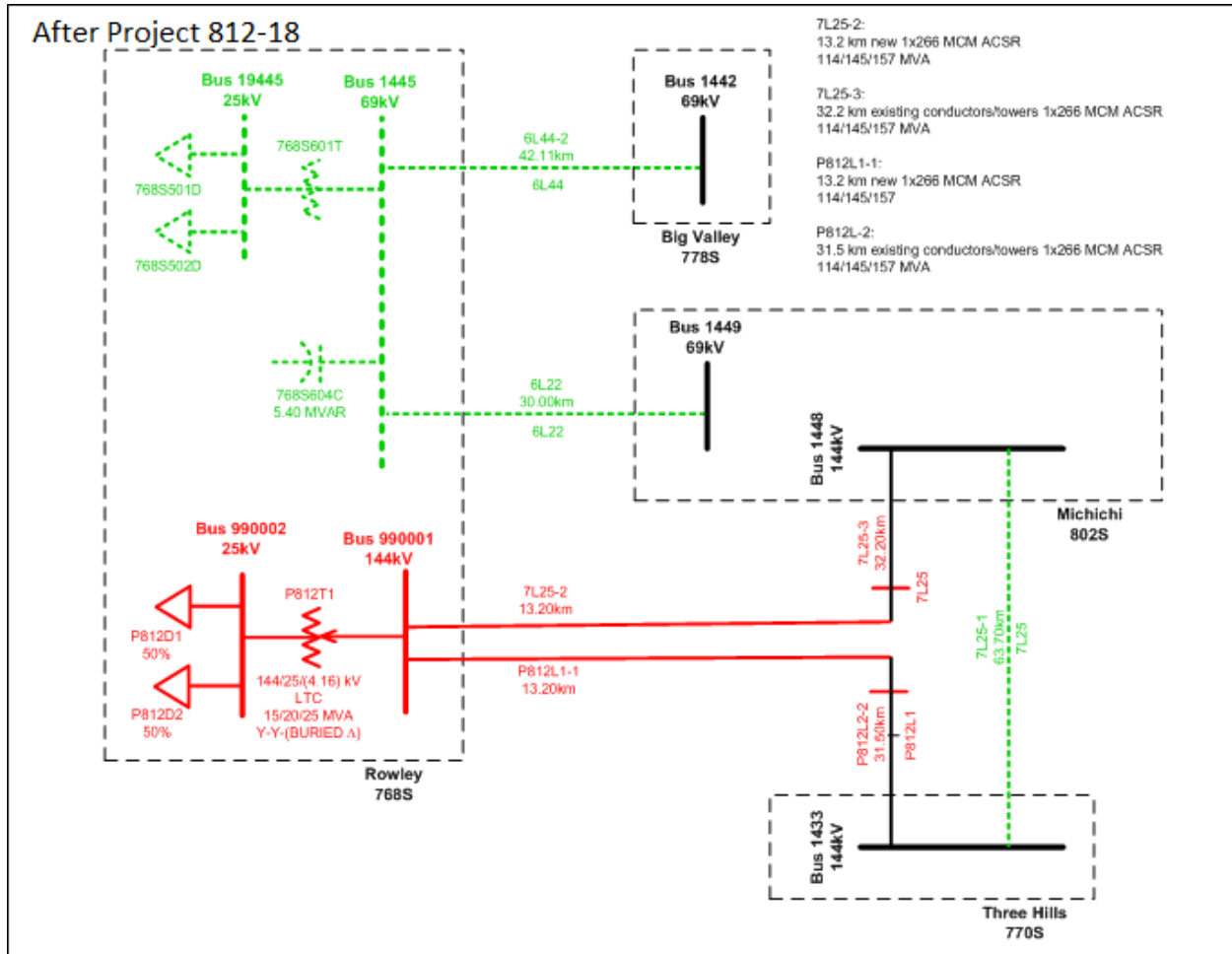


Figure 7.1.2-2 After Project SLD Example for Stage 1 PDUP

## 7.2 PSS/E Input Data Files

PSS/E Version 34 input files are requested as Power Flow RAW Data File, Sequence Data File and/or Dynamic Data File. Market participants submit to the AESO the soft copies (text files) of PSS/E input data files. These data files can be exported from most power system analysis software that is broadly in use. PSS/E format data is exported to the most current PSS/E version the software being used can produce.

The data files are modeled to the prevailing standard as practiced in the planning base cases provided by AESO.

All topologicalNode names (Bus IDs) used in the data files are assigned by the AESO and recorded in the AESO modelling database.

For Stage 1 PDUPs, as bus numbers and facility codes have yet to be assigned, temporary bus numbers in the range of 990001 to 999001 are to be used for new buses. New buses for each alternative must start with 990001.

All project-related changes included in PSS/E-format data files implicitly include assumptions about the physical assets that will be built. These assumptions must be compatible with data submitted elsewhere in the PDUP. For example:

1. branch data in a Power Flow RAW Data File implies assumptions about line length, line impedances, tower configuration, and conductor type and size;
2. transformer data in a Power Flow RAW Data File implies assumptions about transformer rating and impedances, and transformer winding connection; and
3. machine data in a Power Flow RAW Data File implies assumptions about machine ratings.

### 7.2.1 Power Flow RAW Data File

This input data file should be recognized and read in by PSS/E RDCH activity command. The file must be capable of automatically entering positive sequence impedance data to the latest AESO Operations Planning base cases for the changes shown in the after project modelling SLD. If the data file is dependent on other projects, it should be prefaced with comment lines annotating the projects on which it depends.

For all input data file, use 100 MVA System base for lines and transformers.

To generate a data file containing positive sequence raw data, please follow AESO's standardized format as described below:

- Use the RDCH command, with formatted ASCII data input, to add or alter existing data but not delete data.
- Preface the data file with BATPURG\_\* commands for equipment to be deleted by indicating bus and associated CKT/ID, e.g., Line 1, Load 1, or Gen 1etc.
- Start comment lines with "@!" or 'TEXT'. Avoid characters such as \, #, etc. which all cause an 'INVALID ACTIVITY' when read into PSS/E.
- Include only those equipment that are modified or new with the project.
- Include the impedance correction table for Phase Shifting Transformers (PST).

- Include transformer impedances as calculated on system MVA and system kV. For a list of accepted system kV values, refer to the [Guideline](#).
- Use the following commands to indicate a bus deletion. Note that these commands will only remove an islanded bus that has no elements connected to it:

```
BAT_BSYSINIT, 1
BAT_BSYSO, 1, BUSNUMB
ER BAT_EXTR, 1, 0, 0, 0
```

- Indicate the PSS/E version to which the Power Flow RAW data conforms.
- Save the file with '.raw' extension.

An example of an acceptable Power Flow Raw Data File can be found on the [AESO website](#).

### 7.2.2 Sequence Data File

This input data file should be recognized and read in by PSS/E RESQ activity command. To generate a sequence data file containing negative and zero sequence data, please follow AESO's standardized format as described below:

- Use the RESQ command, with formatted ASCII data input, to provide sequence data for all elements added or changed by the project.
- Start comment lines with "@" or 'TEXT'. Avoid characters such as \, #, etc. which all cause an 'INVALID ACTIVITY' when read into PSS/E.
- Include only those equipment that are new or modified with the project.
- Indicate the PSS/E version to which the sequence data conforms.
- Save the file with the 'seq' extension.

An example of an acceptable Sequence Data File containing sequence data can be found on the [AESO website](#).

### 7.2.3 Dynamic Data File

If any equipment is added by the project that includes a dynamic control system that is intended to be modelled in the AESO Planning Base Case suite, then the input data file should be recognized and read in by PSS/E DYRE activity command.

The dynamic model submitted must be a WECC approved standard library model and not user defined models.

An example of an acceptable Dynamic Data File can be found on the [AESO website](#).

## 7.3 Supplementary Data

The third component of a PDUP is the asset level supplementary data for each equipment associated with the project. As a project progresses through Stage 3, it is understood that market participants/TFOs may not know what their tower type, conductor type and size, and impedances are going to be. For the PDUP,



the AESO requires current assumptions used to come up with the impedances. If the as-built conductor or tower choice is radically different from what was initially assumed, the AESO will check that the impedances and mutual line couplings were re-calculated consistently with the change to the original assumptions. The assumptions pertaining to the physical and electrical characteristics of project assets are documented and support the PSS/E input data files if requested.

Supplementary data is submitted using data forms. If data for new equipment is required as the project progresses through stages, new supplemental data form are to be used.

Please refer to Section 6 for a detailed description on how to submit supplemental data for the PDUP.

### **Data Forms**

Data forms are usually used when a new facility or equipment is proposed. Detailed instructions on filling out each individual field in the Supplementary Data forms are outlined in subsection 7.4.

Note: Supplementary Data received in a format other than the above mentioned data forms will not be accepted.

The process for submitting forms is outlined in Section 6.

### **7.3.1 Stage 5 Additional Information**

For Stage 5 PDUP, additional supporting engineering documents are submitted for projects that involve construction, installation or modification of the following facilities and/or equipment. Each additional engineering document is submitted in its own separate file.

#### **Substations**

- Authenticated substation SLD - This includes the AC control, protection and control, or switching SLD.

#### **Transmission Lines**

- Structure list or staking order - No authentication required. It is acceptable in tabulated or Excel format.
- Typical tower drawing - No authentication required. It is acceptable in PDF format.
- Substation SLDs for substations affected by installed transmission lines - Authentication required. The SLDs represent the substations that are affected by the lines. This could be the AC control or protection and control SLD.

#### **Transformers**

- Nameplates - Either a manufacturer's drawing or a picture of the nameplate is acceptable. No authentication required.
- Factory test reports - This report provides data such as No Load Loss & Exciting Current Measurements, Measurement of Load Loss & Impedance Voltage and Zero Sequence Impedance Measurements.
- Substation single line.

#### **Voltage Regulator**

- Nameplate - Both manufacturer's drawing and picture are acceptable. No authentication required.
- Substation single line.

### **Machines**

- Nameplate - Both manufacturer's drawing and picture are acceptable. No authentication required.
- Manufacturer's datasheet.
- Model Validation Test Report after energization.
- Substation single line.

### **Shunts**

- Nameplate - Both manufacturer's drawing and picture are acceptable. No authentication required.
- Dynamic Model for SVS - Standard library model is required.
- Factory test report applicable to SVS as available.
- Substation single line

## **7.4 Data Form Descriptions**

Data forms are available on the [AESO website](#) in fillable PDF format for facilities and different equipment types. The following sections provide information for the various fields that need to be completed. Examples of various PDUP submissions utilizing completed data forms can also be found on the [AESO website](#).

### **7.4.1 Facility and Equipment (Elements)**

A transmission facility is a substation or transmission line. Each substation or transmission line is assigned a facility code. Refer to the [Guideline](#) for precise definition of what facility data is to be provided.

One facility code is assigned for back-to-back substation. A back-to-back substation exists when the following apply:

- The back-to-back substation is fenced overall with a shared fence between the two sides, and
- The two sides of the substation have shared grounding work, and
- Facility connections between the two sides do not extend out of substation fence

Facility and equipment data is submitted using the B.1 - Facilities Equipment Data Form. The following table provides details of the form.

Field	Required Stage	Description
Facility Code	3	<p>Unique identifier supplied by the AESO. It consists of up to twenty characters including only capital letters, the digits 0 through 9, period and hyphen.</p> <p>Examples of acceptable identifiers are:</p> <ul style="list-style-type: none"> <li>• 700S</li> <li>• ROSSDALE</li> <li>• D05</li> <li>• 704L</li> <li>• 14.83L</li> </ul>
Substation Name	3	<p>Required only where Facility owner assigns names to their substation. Acceptable substation name shall:</p> <ul style="list-style-type: none"> <li>• be a pronounceable text strings of 50 characters of less;</li> <li>• use only the ASCII characters A-Z, a-z, 0-9, space, and hyphen;</li> <li>• use a shorter form in preference to a longer form;</li> <li>• not include corporate name;</li> <li>• not include variations on geographical names that are already used; and</li> <li>• not use modifiers like “south” or “northwest”.</li> </ul>
Operated By	3	The legal corporate name of the entity that holds title to the Facility or Equipment. Within one Facility, equipment may belong to separate owners.
Land Location	3	<p>Expressed using the Dominion Land Survey designations<sup>16</sup> at minimum resolution to the quarter-section, and preferably the legal sub-division. Land locations shall conform rigorously to the following format: LL-SS-TT-RRWP where:</p> <ul style="list-style-type: none"> <li>• LL is the legal subdivision or quarter-section (NE, NW, SE, SW);</li> <li>• SS is the section number;</li> <li>• TT is the township;</li> <li>• RR is the range; and</li> <li>• P is the parallel.</li> </ul>
Project-Energization or Date	3	These are project and energization numbers assigned by the AESO to associate with the energization date.

<sup>16</sup> Refer to the Government of Alberta website for details on Dominion Land Survey designations:  
<http://www.srd.alberta.ca/MapsFormsPublications/AirPhotoDistribution/LegalLandDescriptions.aspx>

Field	Required Stage	Description
Equipment	3	<p>Unique identifier assigned to each piece of equipment. It consists of up to twenty characters including only capital letters, the digits 0 through 9, period and hyphen. In the event that the market participant/TFO does not provide the identifier, the AESO will assign it based on the stated guidelines.</p> <p>The identifier referenced here should be consistent with that used in the before and after project SLD.</p> <p>Examples of acceptable identifiers:</p> <ul style="list-style-type: none"> <li>• 700S701T (transformer)</li> <li>• 811S701C (shunt)</li> <li>• GHOST1 (generator)</li> <li>• 7L22-1, 7L22-2 (line segments)</li> </ul>
Normally In-Service	3	Check if the equipment is normally energized; otherwise leave it unchecked.
In/Out	3	<p>In: To indicate the equipment comes into service.</p> <p>Out: To indicate the equipment to be taken out of service or to be decommissioned.</p>

A sample Facilities Equipment form can be found on the [AESO website](#).

#### 7.4.2 Topological Nodes

A Topological Node is a node that serves as a common connection for two or more circuits. \_Topological Node data is submitted using the B.5 – Topological Nodes Data Form. The following table provides details of the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Project Number and Facility Code are assigned by the AESO's Project Manager and Modeling Engineer respectively. However, Energization is assigned by AESO's Project Manager after consultation with the Market Participant/TFO
Bus Number	3	AIES Buscode in numeric form, see the <a href="#">Guideline</a> for detail
Bus Name	3	Bus name, a maximum of 8 Characters
energized	3	Existing and Energised bus
voltage (kV)	3	Operating voltage express in kV (i.e., 72 kV, 144 kV)
nominal Voltage (kV)	3	System base voltage (i.e., 69 kV, 13 8kV, 240 kV, 500 kV) express in kV

A sample Topological Nodes form can be found on the [AESO website](#).

### 7.4.3 Line Segments

Line segments are a portion of a transmission line that has consistent physical attributes of conductor and cross-section throughout the length of the segment. Refer to the [Guideline](#) for precise definitions of what line segments data are to be provided. Line segments data is submitted by using the B.11. – ACLineSegments Data Form. The following table provides details of the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Project number and facility code are assigned by the AESO's Project Manager and Modelling Engineer, respectively. However, energization is assigned by AESO's Project Manager after consultation with the market participant/TFO.
name	3	The name for line segments, generally, contains the line designation followed by number(s) and/or a combination of number(s) and a letter. Examples of acceptable identifiers: <ul style="list-style-type: none"> <li>• 7L22-1, 7L22-2</li> <li>• 923-10A, 923-10B</li> </ul>
conductorType_name	3	Refer to the <a href="#">Guideline</a> for a list of conductor names.
Conductors/bundle	5	Express number of conductors per bundle
Bundle spacing(m)	5	Express in meters
length (m)	3	Express in meters.
height (m)	5	Express the height of the tower structure from the ground to the lowest conductor in meters. A height of zero is used for cables.
r and r0 x and x0 bch and b0ch gch and g0ch	3	Express positive-sequence and zero-sequence line segment real and reactive impedance in ohms. The positive-sequence and zero-sequence susceptances are expressed in micro siemens. The positive-sequence and zero-sequence terminal shunt admittance are expressed in mhos.
operationalLimitType	3	Summer/ SummerEmergency (10 min)/ Winter/ Winter Emergency (10 min) with the limiting factor. Refer to the <a href="#">Guideline</a> for the list of limiting factors.
apparentPowerLimit	3	Enter MVA ratings based on operationalLimitType.
currentLimit	3	The ampere ratings of the line segment in kA.
NominalVoltage	3	Express voltage in kV.

A sample AC Line Segments form can be found on the [AESO website](#).

#### 7.4.4 Branches

A branch is made up of one or more line segments connected in series or a transformer unit. Branches show the connectivity of a line segment and its association with a project or projects. All line segments affected by a project are captured on the branch form B.17. – Branches Data Form. The following table provides details of the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
name	3	The name for line segments.
fromTopologicalNode (Bus) toTopologicalNode (Bus)	3	Each branch begins and ends with connection to a substation bus or a tap bus. The “fromTopologicalNode” and “toTopologicalNode” are the TopologicaNode names (Bus IDs) at the two terminals. The “fromTopologicalNode” is always the lower ordered number. All line segments that are part of the same branch must have the same “fromTopologicalNode” and “toTopologicalNode”.
circuit	3	Circuit is a two-character identifier of the line segment, usually adopting the last two digits of the line designation.  For example: ‘04’ in 704-1, ‘24’ in 7L224-1. All line segments that are part of the same branch must have the same “Circuit”.
orderNumber	3	The ordering of the line segment branches starting from 1 is created and entered by PSMM in the TASM database.
conductor_name	3	Refer to the <a href="#">Guideline</a> for a list of conductor names.

A sample Branches form can be found on the [AESO website](#).

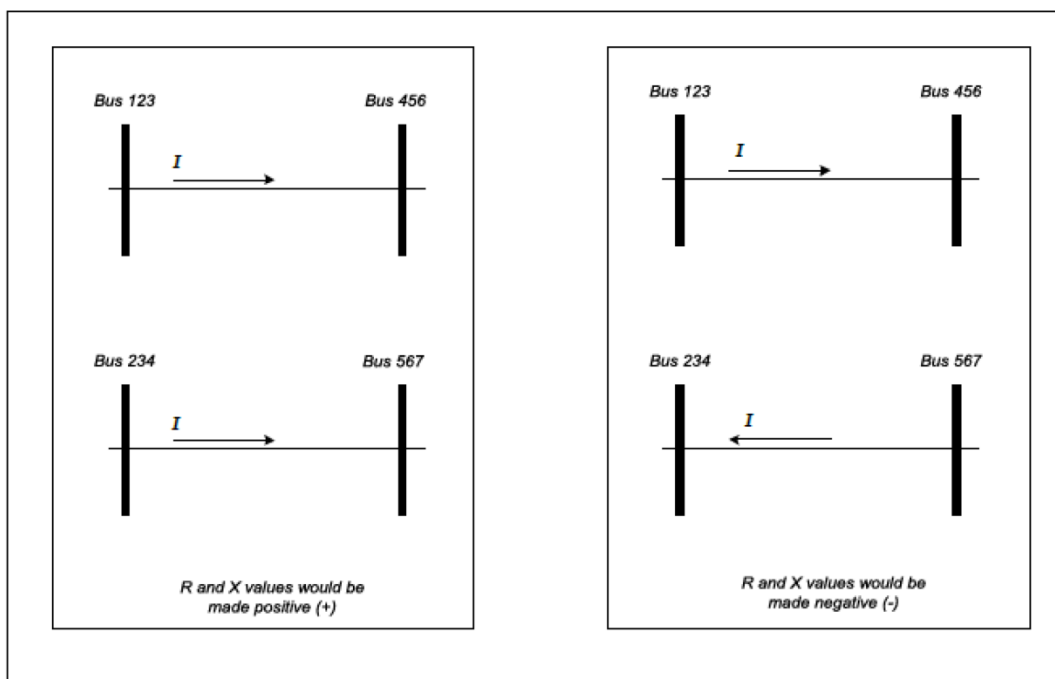
#### 7.4.5 Mutual Coupling

Mutual coupling exists between pairs of line segments that lie parallel one another for all or part of their length. Refer to the [Guideline](#) for precise definition of what mutual coupling data is to be provided. Mutual couplings data is submitted using the B.18. - Mutual Coupling Data Form. The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	5	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
name	5	The name for line segments.
fromTopologicalNode	5	fromTopologicalNode is a bus from which current is presumed to be flowing into the line segments and it should be confirmed from input data file.

Start parallel (m)	5	The distance in meters from the “fromTopologicalNode” end of the line segment to the point at which the parallel begins.
End parallel (m)	5	The distance in meters from the “fromTopologicalNode” end of the line segment to the point at which the parallel ends.
R0m X0m	5	Real and reactive zero sequence mutual impedances expressed in ohms.

The assumed direction of flow may be specified as “+” or “-” with the impedance R and reactance X values. AESO modelling assumes the direction of power flow is from the lower ordered bus to the higher ordered bus. If the power flow on two lines is in the same direction, the R and X values are positive; if the power flow is opposite, the values are negative. An illustration is shown below:



A sample Mutual Coupling form can be found on the [AESO website](#).

### 7.4.6 Transformers (one from each winding)

Transformer refers to a voltage transformer, phase-shifting transformer, voltage regulator or grounding transformer. The data is requested in a standard format that can accommodate both common transformers and their variations, and more unusual transformers. Refer to the [Guideline](#) for precise definition of what transformer data is to be provided.

Transformer data is submitted using the B.9. – Transformers Data Form. The following table provides details for the form.

A Phase Shifting Transformer should be modelled as a two-winding transformer. Two-winding Transformer with buried tertiary should be modelled as two-winding transformer.

Field	Required Stage	Description
Project Number and Energization or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
Transformer Name	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
Local Name	3	Two-character circuit identifier of the transformer. For example, 'T1' in transformer element code 19ST1 and '1T' as in element 700S701T.
Cooling Type	3	Appropriate cooling system/method to achieve the highest MVA ratings. For example, fill in OFAF2 for a transformer equipped with ONAN/OFAF/OFAF2 cooling methods.
Winding Base	3	Winding base in MVA from which the per-unit impedance data are calculated.
Base Voltage	3	Winding base voltage in kV from which the per-unit impedance data are calculated.
Winding	3	Required winding identifier to cross-reference with which the ratings and terminations can be associated. It can be one of the following: <ul style="list-style-type: none"> <li>• P – primary winding</li> <li>• S – secondary winding</li> <li>• T – tertiary winding</li> <li>• Q – quaternary</li> <li>• A – Autotransformer</li> </ul>
Connection	3	A winding connection can either be Y (Wye) or D (Delta). For other connections, please contact the AESO.
r and r0 x and x0	3	Positive and zero sequence impedance (resistance and reactance) in per-unit on winding base and winding bus base voltage.
g and gfrom/to b and bfrom/to	3	Positive and zero sequence magnetizing conductance and susceptance in per-unit on winding base and winding bus base voltage. From and To values should correspond to the From Bus and To Bus
Grounded? Rground Xground	3	"Fill" the button if the neutral grounding status of the winding is TRUE. Express the grounding resistance and reactance values in ohms. Indicate solidly grounded winding by a grounding impedance of zero.



Field	Required Stage	Description
high Step	3	The highest tap with respect to the neutral tap position.
neutral Step	3	The neutral tap for this winding.
Low Step	3	The lowest tap with respect to the neutral tap position.
normal Step	3	The tap position during “normal” operation. Indicate the current physical tap position for “Fixed” tap changer.
Step Phase Shift Increment	3	Tap increment in degrees.
step Voltage	3	Tap increment in percent of nominal voltage for each tap position.
initial Delay	3	For an LTC, the delay (in seconds) for initial tap changer operation.
neutral U	3	The voltage at which the winding operates at the neutral tap.
subsequent Delay	3	For an LTC, the delay (in seconds) for subsequent tap changer operation.
Regulating bus	3	Indicates the transformer termination that is intended to be controlled by the tap changing action. If a remote bus is intended to be controlled, enter the topological node.
Control Mode	3	The transformer control mode can be one of the followings: <ul style="list-style-type: none"> <li>Off, Local, Volt, Active, Reactive, Supervisory.</li> </ul>
tap-Changer Kind	3	It can be one of the followings: <ul style="list-style-type: none"> <li>Fixed, Voltage, Phase, Voltage and Phase.</li> </ul>

Field	Required Stage	Description
Vmax	3	Specify the maximum allowable voltage at the control bus in PU
Vmin	3	Specify the minimum allowable voltage at the control bus in PU
operationLimitType	3	The transformer summer and winter season ratings. Some are: <ul style="list-style-type: none"> <li>• Summer Normal and Winter Normal</li> <li>• Summer 4 hours and Winter 4 hours</li> <li>• Summer 30 min and Winter 30 min</li> </ul>
ApparentPowerLimit	3	The MVA rating as per the operationalLimitType.
NominalVoltage	3	The base voltage of the winding in kV.
No Load Losses	5	The losses associated with the transformer without load in kW and I% in winding base and base voltage.
Load Losses	5	The losses associated with the transformer with load in kW and Z% in winding base and base voltage.

Sample Transformer forms for high side and low side can be found on the [AESO website](#).

### 7.4.7 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 generator representing the farm. Machines are classified into the following categories:

1. Large Individual Machines
2. Aggregated Generating Facilities
3. Battery Energy Storage Facility
4. Industrial Complex Aggregated Machines
5. Distribution Generators

Refer to the [Guideline](#) for precise definition of what machines data are to be provided. Generator data is submitted by using the B.12 - Energy Sources (Generators) Data Form.

The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
name	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
activePower (MARF)	3	For large individual machine, the maximum gross real power in MW that the generating unit is authorized to deliver to its generator terminal. For collector-system generators, the maximum gross real power in MW that the generating units is authorized to deliver to its collector bus.
nominalVoltage (Vbase)	3	The rated voltage in kV of the machine.
Bus ID	3	ConnectivityNodeName (Bus ID) where this machine is connected.
Machine ID	3	Machine ID in two-character format.

A sample Energy Sources (Generator) form can be found on the [AESO website](#).

The mandatory generator data under large individual machine will be submitted by using the B.20. - Generator Control Data Form. The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection, 7.4.3, <i>Line Segments</i> of this manual for details.
Conducting Equipment	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
Control System	N/A	It is prefilled as “Generator”.
In-Service	3	Check if the machine is normally energized; otherwise leave it uncheck.

Field	Required Stage	Description
Manufacturer	3	The machine manufacturer.
Model	3	The machine model number.
Mbase	3	Rated capacity expressed in MVA.
Vbase	3	Rated RMS voltage in kV.
Fuel	3	Examples: gas, biomass, wind, hydro, etc.
P_MAX	3	Maximum authorized real power in MW.
P_MIN	3	The minimum continuous real power output in MW.
H	3	Inertia constant.
R1	3	Positive-sequence resistance in per-unit on machine base.
T'	3	Applicable transient time constant. In the example form the AESO assumed it is direct axis.
T''	3	Applicable sub-transient time constant. In the example form the AESO assumed it is direct axis.
X	3	Positive-sequence unsaturated synchronous reactance on machine base.
X'	3	Positive-sequence unsaturated transient reactance on machine base.
X''	3	Positive-sequence unsaturated sub-transient reactance on machine base.
X(sat)	3	Positive-sequence saturated synchronous reactance on machine base.
X'(sat)	3	Positive-sequence saturated transient reactance on machine base.
X''(sat)	3	Positive-sequence saturated sub-transient reactance on machine base.
R2	3	Negative-sequence resistance in per-unit on machine base.
X2	3	Negative-sequence reactance in per-unit on machine base.

Field	Required Stage	Description
R0	3	Zero-sequence resistance in per-unit on machine base.
X0	3	Zero-sequence reactance in per-unit on machine base.
StationService	3	MW at zero generation.
UnitService	3	Incremental MW per MW of generation.

A sample Generator Control form can be found on the [AESO website](#).

### 7.4.8 Control Systems

The associated control data is submitted by using the B.7. - Control System Form. One control data form is used for each control system. The following table provides details of the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
Conducting Equipment	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
Control System	3	Appropriate control system installed. Examples are: Generator, Exciter, Governor, Stabilizer, Load (motor) and SVC. Refer to previous section regarding the mandatory generator data under large individual machine.
In-Service	3	Check if the control system is normally energized; otherwise leave it uncheck.
Manufacturer	3	The control system manufacturer.
Model	3	The control system model number.
Data	3	Market participant provide related data in the form, see example below.

A sample Control System form can be found on the [AESO website](#).

### 7.4.9 Power System Simulation

Dynamic models of generators and associated controls shall be submitted to represent the dynamic behavior for realistic simulation of the power system equipment. The AESO recommends the dynamic model library that appears on the WECC list of accepted standard PSS/E and PSLF library models. Dynamic models are submitted using the B.8. – Dynamic Simulation Models. The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
Equipment	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
Control System	3	Appropriate control system. Refer to subsection 7.4.7, <i>Machines</i> of this manual for details.
Programme	3	PSS/E or PSLF.
MODEL	3	The name of the standard library model. For example, REGCAU1 is the Wind type 3 or 4 generator/converted model in PSS/E while it is named as regc_a in PSLF.
Description	3	Description providing high level assessment of the model's accuracy and scenarios as appropriate.
Array # Value Description	3	Specified parameter names, indexes, values, and description as in the PSS/E or PSLF documentation.

A sample Dynamic Simulation Models form can be found on the [AESO website](#).

### 7.4.10 Energy Consumer (Loads)

A “Load” is a non-rotating sink or source of MW. Motors and generators smaller than 5 MVA can be represented as non-rotating loads. Loads shall be aggregated to the first non-transmission voltage bus or generator bus upstream of the physical loads.

Refer to the [Guideline](#) for precise definition of what load data is to be provided. Load data is submitted using the B.13. - Transmission Modelling Data Form - Energy Consumers (Loads). The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
name	3	The name for the load equipment following the naming convention as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual.
PI / QI PZ / QZ P-MVA-Q-MVA	3	Required when NAICS code is 99. Indicate the constant power, constant impedance, and constant current in percent for both real and reactive components. They should add up to 100 percent. Default is 100 percent constant power.
NAICS <sup>19</sup> Code	3	Load is characterized by some industrial type, or group of industries, as identified in the North American Industrial Classification System (NAICS). See table below for a list of NAICS codes. If using a different NAICS code, submit the supporting reference material from NAFTA <sup>17</sup>
Customer Count	3	Number of market participants represented by this load.
Bus ID	3	TopologicalNodeName (Bus ID) where the load is connected.
Load ID	3	Two-character Load ID.

**Table 7.4.10-1 List of NAICS Industry Description Codes**

NAICS Code	Industry Description
11	Agriculture (except forestry, logging, hunting, fishing, and trapping)
21	Mining
22	Utilities
23	Construction
29	Planning Load
31	Light Manufacturing
32	Manufacturing – general
33	Heavy Manufacturing
34	Captive Load (i.e. Self-served or behind-the-fence)
35	Generation
36	House Load
37	Behind-the-fence (ISD) load
40	Commercial and Services (except Pipelines and Private Households)
42	Wholesale Trade
44	Retail Trade
45	Retail Trade

<sup>17</sup> North American Free Trade Agreement.

48	Transportation
49	Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Renting and Leasing
54	Professional, Scientific and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation
61	Educational Services
62	Health and Social Services
71	Arts, Entertainment and Recreation
72	Accommodation and Food Services
81	Other Services
91	Public Administration - Canada
99	Nonclassifiable Establishments
112	Fishing, Hunting and Trapping
113	Forestry and Logging
211	Oil And Gas Extraction
212	Mining (except Oil And Gas)
486	Pipelines
814	Private Households
22131	Farming - Irrigation
221111	Hydroelectric Power Generation
221112	Fossil Fuel Power Generation
221113	Nuclear Power Generation
221114	Wind Power Generation
221115	Biomass Power Generation
221116	SolarPower Generation
221119	Other Electric Power Generation

A sample Energy Consumers (Loads) form can be found on the [AESO website](#).

#### 7.4.11 Element-to-Measurement Point Mapping

Each measurement point is cross-referenced to elements that either sink or supply the metered power. Refer to the [Guideline](#) for details. The information is submitted using the B.3. - Transmission Modelling Data Form - Element-to-MP.

The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.



MP_ID	3	Unique identified assigned by the Metering Services Provider. The facility owner obtains the MP_ID from the Metering Service Provider and provide it here. The AESO may assign a temporary MP_ID in consultation with the facility owner.
conductingEquipment name (Load Name)	3	The name for the equipment following the naming convention as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual.
% of MP	3	A single element can be mapped to a percentage of a single MP_ID. The sum of all elements that serve the same MP_ID should be equal to 100 per cent.

A sample Element-to-MP form can be found on the [AESO website](#).

### 7.4.12 Shunts

Static VAr Compensators, reactor and capacitor banks data are submitted using the B.10. - Transmission Modelling Data Form - Shunt Compensators. The following table provides details for the form.

Field	Required Stage	Description
Project Number and Energization; or Facility Code	3	Refer to subsection 7.4.3, <i>Line Segments</i> of this manual for details.
ShuntCompensatorName Regulating Control Name	3	Same as equipment name (unique identifier as stated per subsection 7.4.1, <i>Facility and Equipment (Elements)</i> of this manual).
nominal Q	3	The MVAR rating at the bank rated voltage. Positive value indicates the shunt as capacitor while negative value indicates the shunt device as reactor.
nominal Voltage	3	The bank nominal voltage in kV.
MVAR Per Section	3	MVAR rating for the related section.
G0 / B0 Per section	3	Zero sequence shunt conductance and susceptance per section.
maximumSections	3	The maximum number of sections that may be switched in.
normalSections	3	The normal number of sections switched in.
ControlBus	3	The topological node(bus) at which the voltage is monitored for the purpose of controlling this shunt device.

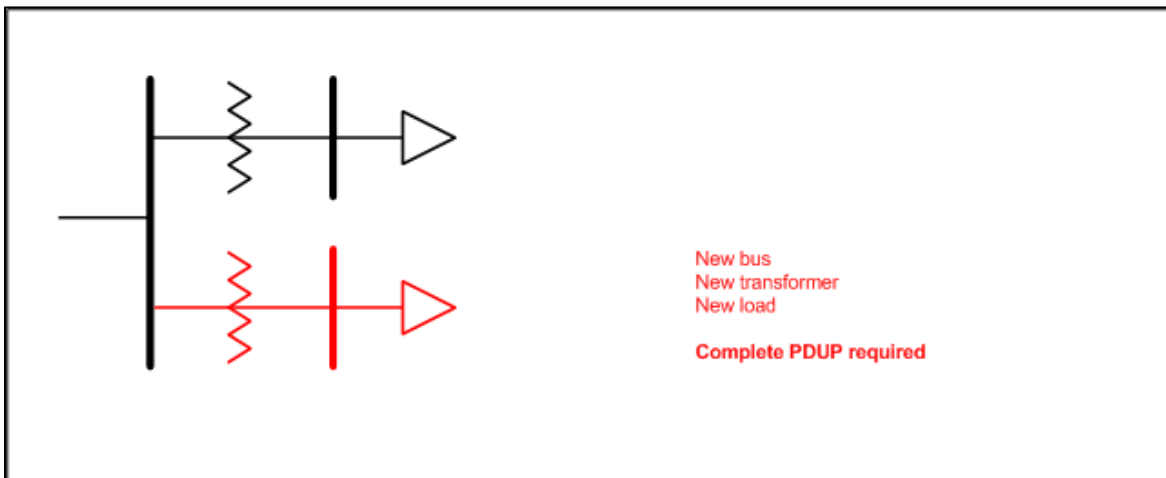
maxU / minU	3	The maximum and minimum voltages of the control shunt and shall be expressed in per unit of the system nominal kV at the ControlBus.
Regulating Control Mode	3	0 – Locked 1 – Discreet 2 – Continuous

A sample Shunt Compensators form can be found on the [AESO website](#).

### 7.4.13 Other Equipment

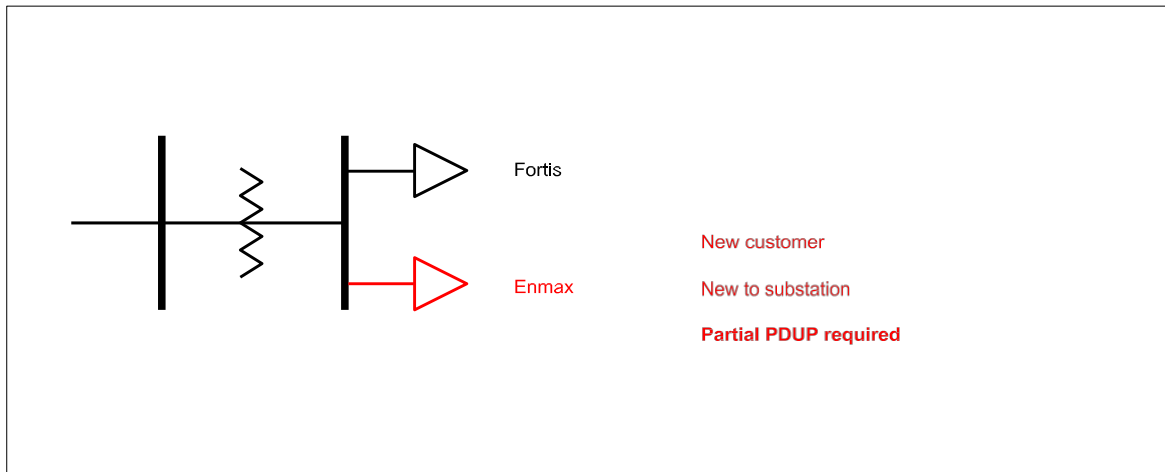
When a project involves the addition of a circuit breaker or circuit breakers, a partial PDUP may be required. The criteria for when a partial PDUP may be required are explained below.

If a new load is connected to a new bus, as a result of a transformer addition for example, then a complete PDUP including transformer and load data (plus data for other facilities or equipment) is submitted. See Figure 7.4.14-1.



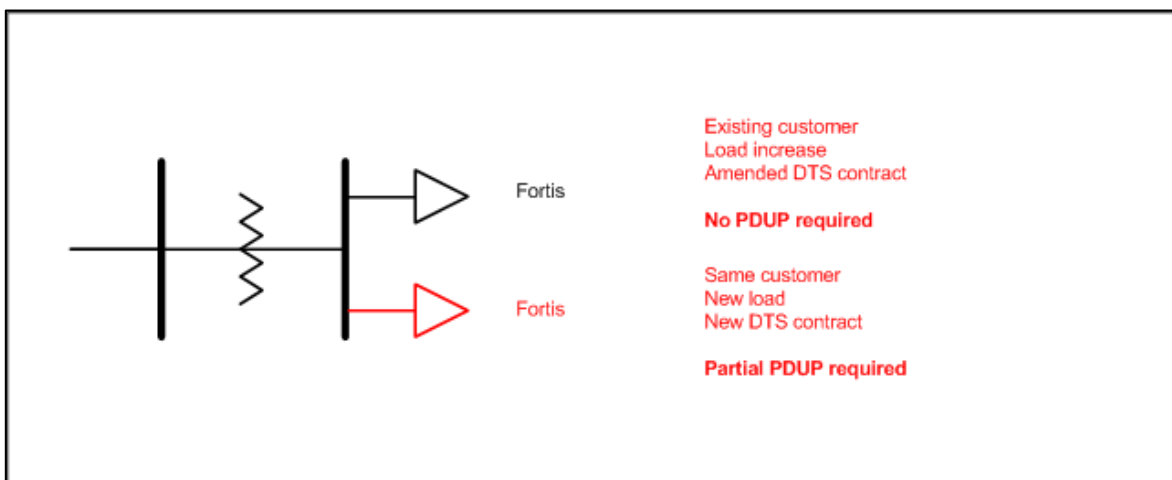
**Figure 7.4.14-1 New Load Connected to a New Bus**

If a new load is connected to an existing bus, and the owner of the new load is new to the substation, therefore requiring a new DTS contract, then a partial PDUP is required. See Figure 7.4.14-2.



**Figure 7.4.14-2 New Load Owner with New DTS Contract Connected to an Existing Bus**

If there is an increase in load connected to an existing bus, therefore requiring an amended DTS contract, no PDUP is required. If the new load is the same owner as the existing load(s) and a new DTS contract is required, a partial PDUP is required. See Figure 7.4.14-3.



**Figure 7.4.14-3 Same Load Owner Connected to an Existing Bus**

### 1. Partial PDUP Requirements

For the specific breaker addition situations described above, it is acceptable to submit a partial PDUP. A partial PDUP includes:

- Before and after project SLD; and
- Supplementary data forms as listed below:
  - Facility and Equipment;

- Energy Consumers (Load);
- Element-to-MP; and

A partial PDUP is submitted in Stage 1 and Stage 5 only. Should a breaker addition project have a significant scope change after Stage 1, then a full PDUP may be required as part of the usual PDUP process.

## **2. Voltage Regulator**

Model the voltage regulator together with the Transformer (Please refer to subsection 7.4.6, Transformers). Generally, the impedance of the voltage regulator is significantly smaller than the transformer, therefore, the voltage regulator impedance can be ignored. The regulating tap of the voltage regulator is modelled as on-load tap position on the winding where the voltage regulator is connected to, generally the load side.

The off-load tap range of the transformer does not need to be represented.

## **3. Flexible AC Transmission System (FACTS) Devices**

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

## 8 PDUP Acceptance Criteria

The PDUP acceptance criteria is the means by which the AESO officially accepts or returns the submitted packages from a market participant, TFO or contractor based on data completeness and the quality of the data. A clear set of acceptance criteria for use as a baseline ensures all participants are aligned on PDUP submittal requirements.

### 8.1 AESO Role

Setting defined acceptance criteria ensures compliance to the Alberta Reliability Standards that require the AESO demonstrate proper evaluation of potential reliability impacts of new transmission facilities to be connected to the AES has occurred. The performance of PDUP acceptance is performed by the AESO Modelling Engineer that has been designated as part of the project team for which the PDUP is being provided.

### 8.2 Acceptance Criteria - Completeness

The first criteria by which a PDUP will be assessed for acceptance will be completeness. The following measures are met in order for the PDUP submission to be accepted for completeness:

1. Inclusion of a before and after project SLD;
2. Inclusion of asset-level supplementary data for each element associated with the project.  
All equipment added or changed by the project must have an associated data form submitted as part of the PDUP for stages 3 and 5; and
3. Inclusion of PSS/E input data files as Power Flow RAW Data File, Sequence Data File and/or Dynamic Data File. Each file should be submitted separately.

In the event that the above measures are not met, the PDUP deliverable will be returned. Per Section 6, PDUP Submission Procedure this feedback is provided by the AESO Modelling Engineer.

### 8.3 Acceptance Criteria - Accuracy

The second criteria by which a PDUP will be assessed for acceptance will be accuracy. The following parameters are met in order for the PDUP submission to be accepted for accuracy:

1. PDUP submitted using sound engineering judgement;
2. PDUP data consistent with established practice used on manufacturers data sheets; and
3. PDUP data suitable for powerflow, fault calculation and dynamics.

AESO Modelling Engineers contact the submitting engineer to discuss data submissions which appear not to meet the parameters defined above and, depending on the outcome of those discussions, the submission may be returned.

As the Transmission Data Committee refines modelling standards and requirements these accuracy parameters may be restated.

## **8.4 Acceptance Criteria – Authentication (Stamping)**

The third criteria by which a PDUP is assessed for acceptance is whether authentication requirements have been met. The PDUP meets all criteria outlined in Section 5 above in order for the submission to be accepted against the authentication criteria.

## 9 PDUP Submissions for Behind-the-Fence Projects

This section documents the process for submitting a PDUP for a behind-the-fence (BTF) project. Excluding the exceptions documented in this section, the requirements for submitting a PDUP for a BTF project are identical to the requirements for submitting a PDUP for a connection project.

BTF projects are projects that involve work to an existing industrial load or generation site currently connected to the AIES. There is no physical change to the Alberta Transmission System. Sites usually are, but are not limited to, those which have obtained an industrial site designation.

The Behind the Fence Equipment Change Reporting Guidelines explain what the BTF project is and specify when data submission is required.

Facilities and equipment of interest are lines, transformers, generators, shunts and loads. Activities that may change their capacities, ratings settings or impedances include the following:

a) Lines:

- CT ratio changes at either end of the line;
- replacement of conductor;
- terminal equipment changes affecting line ratings;
- relay changes;
- additional transmission lines; or
- voltage regulators – addition, replacement, repair, etc.

b) Transformers:

- replacement of transformer;
- addition of cooling fans;
- off-load tap positions of transformers; or
- change-out of lubrication oil resulting in increased output.

c) Generators:

- any changes in power flow or dynamic data;
- AVR control system replacement;
- governor replacement;
- static excitation system replacement/addition;
- stabilizer replacement/addition; or
- turbine changes.

d) Motors:

- any changes to machine model; or
- excitation system replacement.

e) Shunts:

- shunt replacement/addition. f) Loads
- load increase or decrease; or
- change in UFLS or UVLS settings.

Any repair, maintenance, upgrade or addition activities performed that result in equipment data changes is reported to the AESO. Equipment additions or updates follow the AESO's BTF Process which is the focus of the remainder of this section.

If a BTF project requirement variation is not documented in this section, then that requirement is identical to the connection PDUP requirement as defined in all other sections of the PDUP-IM. In such cases, please refer to the corresponding section in the PDUP-IM.

Each subsection below corresponds to the sequence of sections in the first eight sections of the PDUP-IM.

## 9.1 Background

There is no variation to this section for BTF projects.

## 9.2 Project Data Update Package Content

The following Table 9.2-1 identifies the stages of the BTF process; a PDUP is required for the submission to the AESO for review and approval.

**Table 9.2-1: BTF PDUP Submissions**

Stage	Stage Name	PDUP Required
1	Scope	Yes
2	Assessment	Determined by the AESO
3/4	Technical and Contract	No
5	Construction	Yes

## 9.3 BTF Process – PDUP Data Quality Progression

Key activities take place in each stage of the BTF process and projects must meet all of the requirements within each stage in order to pass the gate and move onto the next stage. A PDUP is one of the requirements outlined in stages 1, 2 and 5 that must be met in order to pass through the corresponding gate. The PDUP submission must represent increasing levels of available data accuracy as the project progresses through each stage.

There is no variation to this section for BTF project other than Stage 3 PDUP is not required. See Section 3 for details.



## 9.4 Roles in the BTF Process

This section describes the differences in responsibilities for BTF project PDUP submissions versus connection project PDUP submissions. For BTF projects, roles within the AESO and roles outside of the AESO are defined as follows:

- Industry Studies Engineer (market participant/TFO, consultant);
- AESO Project Manager;
- AESO Modelling Engineer; and
- AESO Power System Model Management group.
- The following role as defined for connection project PDUP submissions is not defined for BTF project PDUP submissions:
  - AESO/TFO Studies Engineer.

### 9.4.1 Role of the Industry Studies Engineer

There is no variation to this section for BTF projects other than that a Stage 3 PDUP is not required. See subsection 4.1 for details.

### 9.4.2 Role of the AESO Project Manager

There is no variation to this section for BTF projects other than that a Stage 3 PDUP is not required. See subsection 4.3 for details.

### 9.4.3 Role of the AESO Modelling Engineer

There is no variation to this section for BTF projects other than that a Stage 3 PDUP is not required. See subsection 4.4 for details.

### 9.4.4 Role of Power System Model Management (PSMM)

PSMM responsibilities are the same for BTF projects as they are for connection projects.

## 9.5 Authentication (Stamping) Requirements

There is no variation in the PDUP authentication requirements between BTF projects and connection projects.

## 9.6 PDUP Submission Procedure

Outlined below is a detailed description of the procedure for submitting BTF project PDUP requirements to the AESO. Note that a compliant, complete and accepted PDUP is required in order for a BTF project to complete a gate.

### **9.6.1 Staged Submittal Process**

There is no variation to this section for BTF projects other than that a Stage 3 PDUP is not required. See subsection 6.1 for details.

Please refer to Appendix A-2, Project Data Update Package (PDUP) – Staged Submittal Process – BTF Projects for supporting documentation of the process workflow.

## **9.7 Details**

There is no variation in the parameters for detailed PDUP submission requirements between BTF projects and connection projects.

## **9.8 PDUP Acceptance Criteria**

There is no variation in the requirements for PDUP acceptance between BTF projects and connection projects.

## 10 PDUP Submissions for System Projects

This section documents the differences in submitting a PDUP for a system project versus a connection project. Excluding the exceptions documented in this section, the requirements for submitting a PDUP for a system project are identical to the requirements for submitting a PDUP for a connection project.

If a system project requirement variation is not documented in this section, then that requirement is identical to the connection PDUP requirement as defined in all other sections of the PDUP-IM. In such cases, please refer to the corresponding section in the PDUP-IM.

Each subsection below corresponds to the sequence of sections in the first eight sections of the PDUP-IM.

### 10.1 Background

There is no variation to this section for system projects.

### 10.2 Project Data Update Package Content

The following Table 10.2-1 identifies the stage of the system process a PDUP is required and the organization responsible for the submission to the AESO for review and approval.

**Table 10.2-1: System Project PDUP Submissions**

Stage	Stage Name	PDUP Required	Responsible Organization
1	NID Initiation	No	N/A
2	PIP Notification	No	N/A
3	NID Filing and Approval	Yes	AESO
4	FA Filing and Approval	Yes	TFO
5	Construct and Energize	Yes	TFO
6	Project Closure	No	N/A

### 10.3 System Process – PDUP Data Quality Progression

Key activities take place in each stage of the system process and projects must meet all of the requirements within each stage in order to pass the gate and move onto the next stage. A

PDUP is one of the requirements outlined in stages 3, 4 and 5 that must be met in order to pass through the corresponding gate. The PDUP submission must represent increasing levels of available data accuracy as the project progresses through each stage. Please refer to subsections 10.3.1 through 10.3.5 for details. The data to be submitted in the PDUP must represent the preferred alternative for the project.

### **10.3.1 Stage 3 – NID Filing and Approval: Alternative Evaluation and Recommendation – Project Data Update Package Representing “Conceptual” Typical or Estimated Data**

At this stage in the system project, the AESO is responsible for creating, submitting and approving the PDUP. A PDUP must be submitted showing the system facilities as proposed. The submission and approval of a PDUP is one of the requirements to move through this stage of the system process.

The quality and accuracy of the PDUP at this stage of the project must represent a typical or estimated level of technical data. Where system equipment is not yet ordered, the AESO must estimate data representing the project to a level of accuracy adequate for the preparation of the Alternative Evaluation and Recommendation. This level of data quality and accuracy refers to equipment with the same rating and performance characteristics but sourced from different manufacturers. The technical data contained in the PDUP for each power system element associated with the project must be provided by the AESO as generic, typical or “best guess” examples of the facilities proposed for the system development on the AES. In all cases the data submitted should be at the highest level of accuracy available at that time.

The PDUP must consist of a preliminary, editable copy of the before and after project SLD and the PSS/E Input data files outline in subsection 7.2 for only the preferred alternative.

If a new line, substation or bus is contemplated, it is required that facility codes and topologicalNode names (Bus IDs) and/or equipment IDs are assigned in the PDUP. TopologicalNode names (Bus IDs) are also required to be included in the study and any associated documentation. Please refer to the process outlined in Section 6 for details on procedures for facility code, topologicalNode names (Bus IDs) and equipment ID assignment.

A request accompanied with a preliminary, editable copy of the before and after project SLD must also be included in the PDUP submission. If new equipment is associated with the project, the AESO Studies Engineer should assign an equipment ID and the SLD should be labelled accordingly.

The AESO Studies Engineer must use the request form for obtaining facility codes from the AESO Modelling Engineer. The AESO Modelling Engineer will assign facility codes and topologicalNode names (Bus IDs) by updating the submitted draft copy of the after-modelling SLD. The AESO may communicate with the AESO Studies Engineer for coordination of facility codes or substation names upon ownership of the facilities. It is at the AESO’s discretion to accept a substation name change at later stages. As a general rule the AESO will not accept a substation name change due to the impact on topologicalNode names (Bus IDs).

At this stage of the system project the AESO assigns the following:

- facility codes that are unique identifiers to distinguish individual lines, substations, etc.
- topologicalNode names (Bus IDs) that are used in the Power System Simulation Model; and
- equipment IDs that are unique identifiers assigned to each equipment.

The AESO Studies Engineer may suggest a substation name, topologicalNode names (Bus IDs) and equipment IDs subject to the AESO’s approval.

Please see subsection 7.4.1, Facility and Equipment (Elements) for more information on facility codes, topologicalNode names (Bus IDs) and equipment IDs.

The PDUP must be a quality transmission modelling product representing typical or estimated level accuracy, on which the present project can be accurately represented and other market participant/TFO projects and system projects can rely on to conduct their studies. The AESO Studies Engineer is responsible for a complete and accurate PDUP submission.

### ***10.3.2 Stage 4 - FA Filing and Approval: Finalize NID – Project Data Update Package Representing Manufacturers Type Data***

At this stage in the system project, the TFO is responsible for creating and submitting the PDUP to the AESO for review and approval. The submitted PDUP must show all proposed facilities that are a part of the system development on the AIES. The submission and approval of a PDUP is one of the requirements to move through this stage of the system process.

The PDUP will update the system facilities submitted in the Stage 3 PDUP and provide new data for the proposed development. If a different alternative is selected from what was submitted in the Stage 3 PDUP, the Stage 4 PDUP will completely replace the Stage 3 PDUP data.

The Stage 4 PDUP shall be a quality transmission modelling product representing a manufacturers' type level accuracy, on which other market participant/TFO projects and system projects can rely on to conduct their studies. This level of data quality and accuracy refers to type data provided by the manufacturer for the model of equipment being ordered; or actual line routes for transmission being built and actual locations of new substations. The AESO requires data on specific impedances and losses for the equipment that will be used, or is most likely to be used, on the project. The technical data for each power system element associated with the project must be provided by the TFO as manufactures' type data for the equipment proposed as system development on the AIES. For equipment with dynamic characteristics such as machines, the submission shall include specific dynamic data for dynamic studies, if applicable.

If the facility codes assigned at Stage 3 for the substation(s), line(s) or topologicalNode names (Buss IDs) associated with the project need to be updated once the system studies have been completed. A request, accompanied by a preliminary editable copy of the updated after project SLD, must be supplied to the AESO Project Manager.

The TFO/Industry Studies Engineer must use the request form for obtaining facility codes from the AESO. The AESO will review and update facility codes and topologicalNode names (Bus IDs) by marking up the draft copy of the after project SLD.

### ***10.3.3 Stage 5 - Construct & Energize: Project Data Update Package Represents Test and Actual Equipment Data***

Stage 5 concludes at the energization of the system project.

A Stage 5 PDUP including additional supporting engineering documents for PSMM must be submitted to AESO by the TFO for review and acceptance (see Subsection 7.3.1). The Stage 5 PDUP must be received 100 days prior to energization.

The quality and accuracy of the Stage 5 PDUP must represent actual as-built equipment and test data. The technical data for each power system element associated with the system project must be provided by the TFO as actual equipment and test data for the equipment connected to AIES. Machine data must include manufacturers' test and nameplate data, provided for each individual machine based on the machines' manufacture, measurements and test results. Transmission line data must include as-built data, including

line impedances summer, winter and emergency thermal capacities based on actual engineering calculations of the precise lengths and spacing from the transmission line survey or structure list. The modelling data provided must be consistent with actual measurements, tests or surveys of the physical equipment as-built and must be accompanied by the appropriate test reports, nameplates, final drawings and engineering documents which are detailed in subsection 7.3.

## 10.4 Roles in the System Process

This section describes the differences in responsibilities for system project PDUP submissions versus connection project PDUP submissions. For system projects, roles within the AESO and roles outside of the AESO are defined as follows:

- AESO/Industry Studies Engineer
- AESO Project Manager
- AESO Modelling Engineer
- AESO Power System Model Management group

### 10.4.1 Role of the AESO Studies Engineer

The role of the AESO Studies Engineer, responsible for conducting the studies, is to provide a PDUP at the appropriate stages of a system project. It is the AESO/Industry Studies Engineer's responsibility to authenticate the PDUP with an APEGA stamp the data submission.

#### 10.4.1.1 Stage 3 – NID Filing and Approval

The AESO Studies Engineer responsible for conducting the studies required to provide a PDUP that meets the specification details as defined in Section 7 and the system process as defined in subsection 10.3.2.

It is the responsibility of the AESO Studies Engineer to prepare the study case by incorporating project input data files to the applicable base cases.

Projects can be included into a base case by applying project input data files. Instructions on how to access the dependent input data files can be found on the [AESO website](#).

If the input data files are not available on the AESO website, the AESO Studies Engineer must send a request to the AESO Project Manager.

#### 10.4.1.2 Stage 4 - FA Filing and Approval

The Industry Studies Engineer responsible for conducting the studies is required to provide a PDUP that meets the specification details as defined in Section 7 and the system process as defined in subsection 10.3.3.

#### 10.4.1.3 Stage 5 - Construct & Energize

The Stage 5 PDUP is always provided by the Industry Studies Engineer. The Industry Studies Engineer role is to provide a Stage 5 PDUP that meets the specification details as defined in Section 7 and the system process as defined in subsection 10.3.4. It is the responsibility of the Industry Studies Engineer to provide engineering source documents in support of the PDUP as outlined in subsection 7.3.1.

### **10.4.2 Role of the AESO Project Manager<sup>18</sup>**

The AESO Project Manager is accountable for the timely receipt of the PDUP at the appropriate stages of a system project. The PDUP is one of the requirements for gate completion; thus it has a significant impact on the project schedule. The AESO Project Manager will respond to requests from the AESO/Industry Studies Engineer.

#### **10.4.2.1 Stage 3 – NID Filing and Approval**

Upon receipt of the Stage 3 PDUP, it is the Project Manager's responsibility to forward it to the AESO Modelling Engineer for review and acceptance.

The AESO Project Manager is required to coordinate any requests regarding the facility code and topologicalNode name (Bus ID) assignments received from the AESO/Industry Studies Engineer with the AESO Modelling Engineer. As the AESO Project Manager oversees the project, it is their responsibility to make sure that only one facility code is being assigned to each facility. The AESO/Industry Studies Engineer initiates the request which must be coordinated by the AESO Project Manager who will forward it to the AESO Modelling Engineer. The request must include the following supporting documents:

- the editable after project SLD in PowerPoint or Visio format with the equipment labeled with the existing or newly named equipment IDs; and
- the completed facility code request form.

#### **10.4.2.2 Stage 4 - FA Filing and Approval**

Upon receipt of the Stage 4 PDUP, it is the Project Manager's responsibility to forward it to the AESO Modelling Engineer for review and acceptance.

#### **10.4.2.3 Stage 5 - Construction & Energization**

Upon receipt of the Stage 5 PDUP, it is the Project Manager's responsibility to forward the PDUP to the AESO Modelling Engineer for review and acceptance.

Upon acceptance by the Modelling Engineer, it is the AESO Modelling Engineer's responsibility to forward the Stage 5 PDUP to the Project Manager with a copy to the EMS Group for input into the EMS process.

### **10.4.3 Role of the AESO Modelling Engineer**

The AESO Modelling Engineer's responsibilities are the same for system projects as they are for connection projects, with the exception that no PDUP is required at Stage 1 and Stage 2 for system projects. Additionally, facility code assignment for system projects, for which the AESO Modelling Engineer is responsible, occurs at Stage 3.

### **10.4.4 Role of Power System Model Management (PSMM)**

PSMM responsibilities are the same for system projects as they are for connection projects, with the exception that no PDUP involvement is required at Stage 1 and Stage 2, for system projects.

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<sup>18</sup> Should a System Project be initiated from AESO Long Term Planning, the AESO Project Manager will have involvement in the System Project beginning at Stage 2. Should a System Project be initiated by AESO Transmission Project Delivery, the AESO Project Manager will have involvement in the System Project beginning at Stage 0.

## 10.5 Authentication (Stamping) Requirements

There is no variation in the PDUP authentication requirements between system projects and connection projects.

## 10.6 PDUP Submission Procedure

Outlined below is a detailed description of the procedure for submitting system project PDUP requirements to the AESO. Note that a compliant, complete and accepted PDUP is required in order for a system project to complete a gate.

### 10.6.1 Staged Submittal Process

There is no variation to this section for system projects other than:

- Stage 1 and Stage 2 PDUP are not required; and
- the role of Industry Study Engineer is filled by AESO/TFO Studies Engineer. See subsection 6.1 for details.

## 10.7 Details

The only variation in the parameters for detailed PDUP submission requirements between system projects and connection projects, as documented in Section 7, is that system projects will never include generators unless the system project identifies the need for a synchronous condenser. Any reference to generators or generator requirements in Section 7 should be disregarded for system projects.

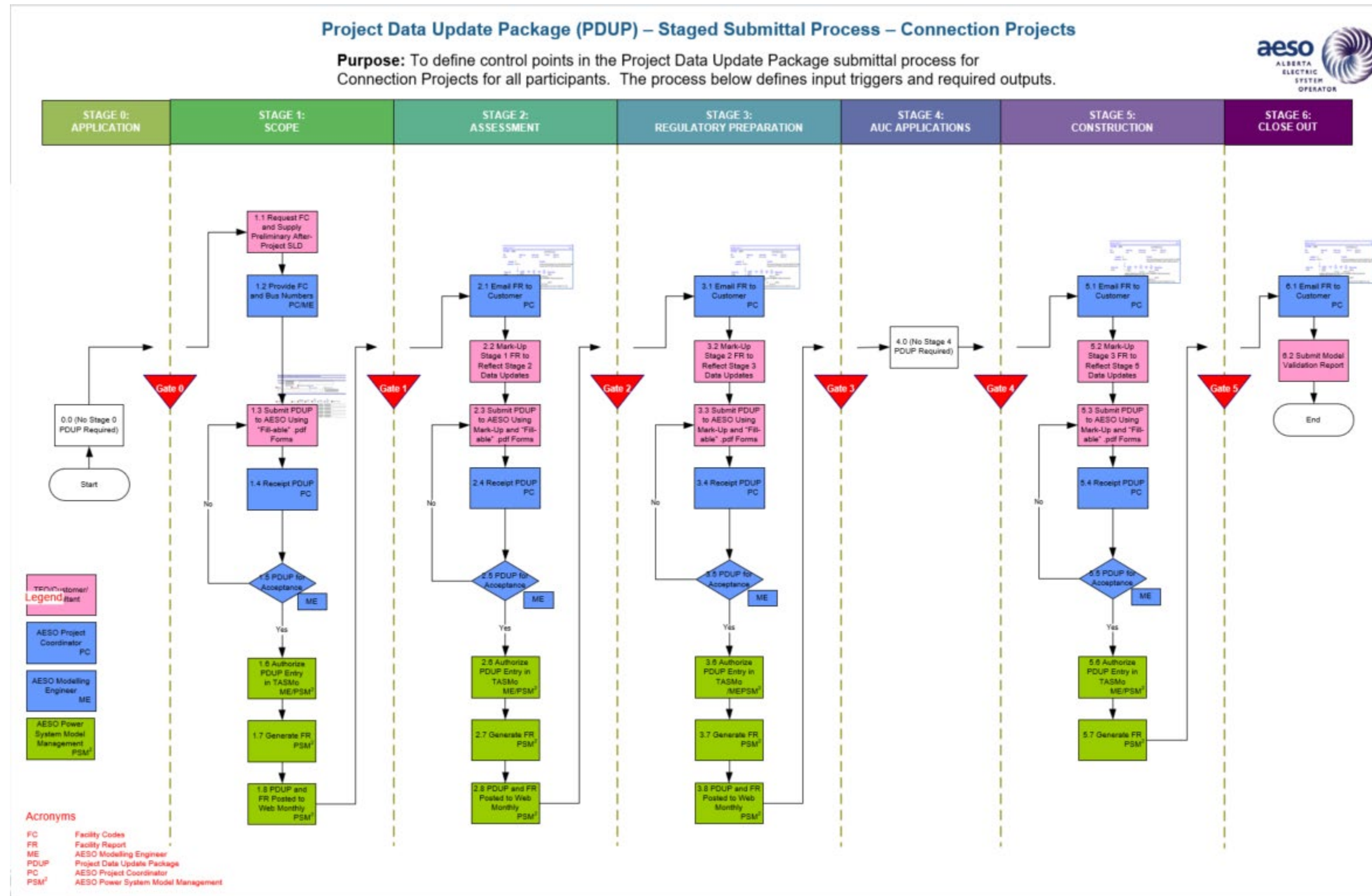
## 10.8 PDUP Acceptance Criteria

There is no variation in the requirements for PDUP acceptance between system projects and connection projects.

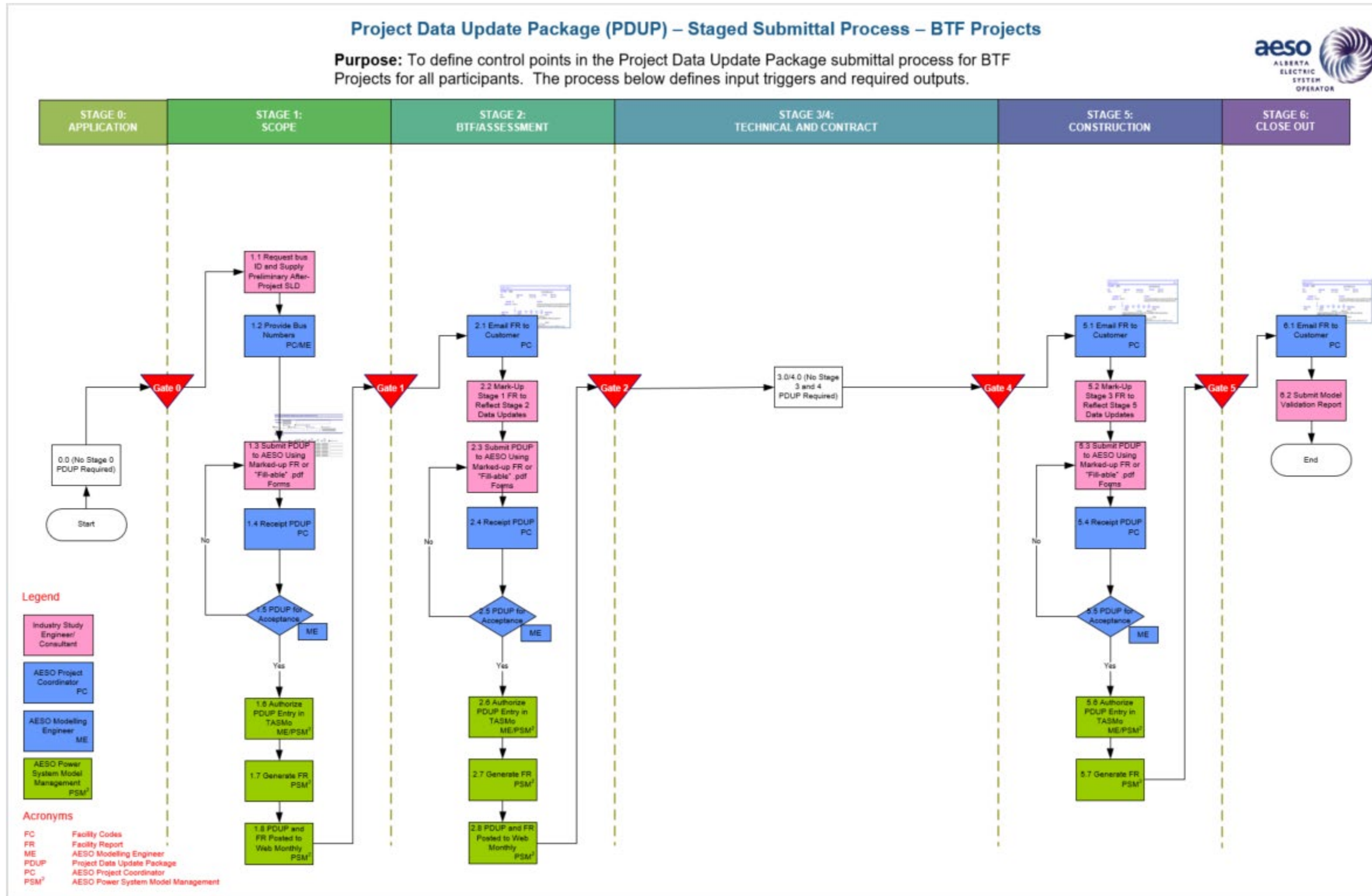


## Appendix A: PDUP Staged Submittal Process – Connection, Market Participant Choice, and BTF Projects

### Appendix A-1: PDUP – Staged Submittal Process – Connection/Market Participant Projects



## Appendix A-2: PDUP – Staged Submittal Process – Behind the Fence Projects





## Appendix B: WECC Approved Dynamic Models

The WECC Approved Dynamic Model Library is maintained and updated by WECC. Refer to the WECC website for the latest approved dynamic model library.