



# Load Interconnection Guide

**A T C**

ATC

# **Load Interconnection Guide**

---

Revision 14.0  
February 12, 2025

ATC  
W234 N2000 Ridgeview Pwky. Court  
Waukesha, WI 53188-1022

**A**TC plans, constructs, owns, operates and maintains the high-voltage electric transmission system (69 kV and above) to provide adequate and reliable transmission of electric power in portions of Wisconsin, Michigan, Minnesota and Illinois. ATC is a member of the Midcontinent Independent System Operator (MISO) regional transmission organization, and provides nondiscriminatory service to all customers, supporting effective competition in energy markets without favoring any market participant. ATC owns more than 10,081 miles of transmission lines and 582 substations. ATC presently maintains more than 700 load interconnections with municipalities, cooperatives, and investor-owned utilities (Customers). For more information about ATC, visit our Web site at [www.atcllc.com](http://www.atcllc.com).

In general, ATC accommodates a Customer's new or modified load interconnections according to the requirements of a Distribution – Transmission Interconnection Agreement (D-T IA) between ATC and the Customer.<sup>1</sup> ATC will collaborate with the Customer in the development and implementation of the appropriate interconnection solution in response to the Customer's requested need. It is important to note that ATC provides no retail services. The direct interconnection of retail customers to ATC's transmission facilities is governed in part by requirements of the local distribution company or Customer in whose service territory the interconnection is requested.

The Customer is directed to ATC's Web site (<https://www.atcllc.com/customer-engagement/>) for formal submittal of a load interconnection request for each of the following types of projects:

- 1 New load interconnections or,
- 2 Modifications to existing load interconnection facilities.

Any questions or requests for additional information concerning load interconnections to the ATC Transmission System should be directed to:

[T-DLIRFS@atcllc.com](mailto:T-DLIRFS@atcllc.com)  
ATC Interconnection Solutions

---

<sup>1</sup> It is important to note that the phrase "load interconnection" is synonymous to "distribution-transmission interconnection." Capitalized Terms not defined in this Load Interconnection Guide have the meaning set forth in Attachment FF-ATCLLC of the MISO Open Access Transmission, Energy and Operating Reserve Markets Tariff.

# Table of Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Purpose	5
1.2	Legal and Regulatory Requirements	5
<b>2</b>	<b>Load Interconnection Process</b>	<b>6</b>
2.1	Process Initiation	6
2.2	Project Development	13
2.3	Project Implementation	15
<b>3</b>	<b>Interconnection Facility Requirements</b>	<b>17</b>
3.1	Overview	17
3.2	ATC and Customer Responsibility	18
3.3	Procedures for Coordinated Joint Studies of New Facilities and Their Impacts on the Interconnected Transmission Systems	20
3.4	Procedures for Notification of New or Modified Facilities to Others (Those Responsible for the Reliability of the Interconnected Transmission Systems) as soon as Feasible	20
3.5	Design of Common Facilities	20
3.6	Interconnection Configuration	20
3.7	Voltage Level and MW and MVAR Capacity or Demand at the Point of Interconnection	24
3.8	Breaker Duty and Surge Protection	25
3.9	System Protection and Coordination	26
3.10	Metering and Telecommunications	30
3.11	Grounding and Safety	30
3.12	Insulation and Insulation Coordination (Basic Insulation Level)	31
3.13	Voltage, Reactive Power, and Power Factor Control	32
3.14	Power Quality Impacts	33

<b>3.15</b>	<b>Substation Equipment Ratings</b>	<b>33</b>
<b>3.16</b>	<b>Synchronizing of Facilities</b>	<b>35</b>
<b>3.17</b>	<b>Maintenance Coordination</b>	<b>35</b>
<b>3.18</b>	<b>Operational Issues (Abnormal Frequency and Voltages)</b>	<b>36</b>
<b>3.19</b>	<b>Inspection Requirements for Existing or New Facilities</b>	<b>36</b>
<b>3.20</b>	<b>Communications and Procedures During Normal and Emergency Operating Conditions</b>	<b>39</b>
<b>3.21</b>	<b>Transformers</b>	<b>40</b>
	Figure 1: Typical switch installation on a line with multiple radial taps	<b>42</b>
<b>3.22</b>	<b>Physical Design Guidelines</b>	<b>43</b>
<b>Revision History</b>		<b>49</b>
<b>Revision Information</b>		<b>49</b>

# 1 Introduction

## 1.1 Purpose

This Load Interconnection Guide is intended to be a single resource for a Customer working with ATC on a new or modified load interconnection. ATC is committed to working collaboratively with the Customer to effectively plan, develop and implement a safe and reliable new or modified load interconnection. This document provides ATC's minimum requirements and guidance to enable development and completion of load interconnections that consistently satisfy the needs of both ATC and its Customers. The minimum facility requirements described herein are consistent with the Facility Interconnection Requirements promulgated in Mandatory Reliability Standard FAC-001 Requirement R1 (as modified from time-to-time).

This guide generally applies to proposed new load interconnections. ATC will work with the Customer to apply this guide to modifications of an existing interconnection as appropriate, but also while respecting previous interconnection requirements, limitations, and other factors on a case-specific basis. This Guide may also apply to new load interconnections associated with the provision of auxiliary power to generation facilities when the auxiliary power interconnection facilities are a separate interconnection to the ATC Transmission System.

## 1.2 Legal and Regulatory Requirements

### 1.2.1 FERC

Throughout the interconnection process, ATC adheres to the FERC Standards of Conduct<sup>2</sup> as well as the rules relating to critical energy infrastructure information. If the LDC (Local Distribution Company) is a new customer of ATC's, a new Distribution – Transmission Interconnection Agreement (D-T IA) will need to be filed with FERC before the facility is energized. A Standards of Conduct Agreement (SOCA) will also be needed between the parties.

### 1.2.2 State

The states in which ATC operates have their own requirements for siting and construction. This guide is not intended to describe those requirements. The Customer will be responsible for compliance with the specific state requirements and processes. Further information regarding these requirements and processes is available from the pertinent state regulatory agency:

- Public Service Commission of Wisconsin - <http://www.psc.wi.gov/>
- Michigan Public Service Commission - <http://www.michigan.gov/mpsc/>
- Minnesota Public Utilities Commission - <http://www.mn.gov/puc//>
- Illinois Commerce Commission - <http://www.icc.illinois.gov/>

---

<sup>2</sup> Order No. 888, 61 FR 21540 (May 10, 1996)

### 1.2.3 NERC

ATC is registered as a Transmission Owner, Transmission Operator, and Transmission Planner with both the Midwest Reliability Organization (MRO) and ReliabilityFirst Corporation (RFC) under the requirements of the electric reliability organization, the North American Electric Reliability Corporation (NERC).

## 2 Load Interconnection Process

This section describes the process that ATC will follow in working with the Customer on a Load Interconnection or Distributed Energy Resource (DER) projects. See Appendix B for a high-level process overview diagram. ATC works with its Customers to accommodate all requests for load or DER interconnections utilizing the concept of Best Value Planning (BVP)<sup>3</sup>. The BVP process collaboratively establishes a consistent means of assessing an interconnection project that considers various project alternatives, including their costs, as well as issues relating to system performance, construction, maintenance, environmental impacts and regulatory requirements in relation to the requested in-service date. *See Also*, Attachment FF-ATCLLC of the Mid-continent Independent Transmission Operator (MISO) FERC Electric Tariff. Section 2.2 of this document further describes the Best Value Planning (BVP) process.

### 2.1 Process Initiation

As part of ATC's ongoing planning process, ATC maintains close working relationships with existing interconnected Customers for both parties to best understand both ATC and the Customer's present and future needs. ATC's planning processes and mechanisms are formally filed at FERC as part of the Midcontinent ISO tariff.<sup>4</sup>

ATC encourages Customers to share their knowledge of proposed interconnections and load forecasts as soon as possible and especially through regular interaction and meetings with ATC. However, ATC will formally develop a potential new or modified load or DER interconnection only after the Customer submits a Load Interconnection Request Form (LIRF) or DER Request Form (DERRF) to ATC. Upon submittal of a LIRF/DERRF, ATC will post updates on the status of the interconnection project on ATC's Distribution -Transmission (D-T) Interconnection Queue.<sup>5</sup>

Additionally, all existing ATC Customers are required to annually provide ATC with their respective 11-year load forecasts<sup>6</sup> that reflect expected load growth, modified and proposed new load interconnections to be used in the Ten-Year Assessment. ATC administers these potential modified or new interconnections reflected in the load forecasts via its D-T Interconnection Queue and includes all proposed interconnection projects that have completed the BVP

---

<sup>3</sup> See BVP definition in Appendix A.1

<sup>4</sup> See Attachment FF-ATCLLC of the MISO FERC Electric Tariff.

<sup>5</sup> See <http://www.atcllc.com/customer-engagement/>

<sup>6</sup> See <http://www.atc10yearplan.com/> for a complete description of the ATC Planning Ten Year Assessment.

process in ATC’s annual system planning used for the 10-Year Assessment. These projects are also then listed in the appropriate MISO Transmission Expansion Planning (MTEP) report that is published in December of each year.

**2.1.1 Load Interconnection Request**

The first step in working with ATC to develop a new or modified load interconnection to the ATC system requires the Customer to submit a completed Load Interconnection Request Form (LIRF) to ATC. An example of the LIRF template is included in Appendix D.

**2.1.1.1 Scenarios Requiring a LIRF Submittal**

The Customer should submit a LIRF to ATC for any additions or modifications to the distribution system that may be reasonably anticipated to have a potential impact on the Transmission System, including the scenarios shown in Table 1.

<b>Table 1: Scenarios Requiring LIRF Submittal</b>		
1	<b>New Distribution Interconnections</b>	New interconnections made via either a new or existing substation.
2	<b>Modifications to Existing Distribution Interconnections</b>	Modification of an existing load interconnection (e.g. replacement or addition of an interconnection transformer, capacitors).
3	<b>Un-forecasted Load</b>	The notable change of any load not included in the Customer’s last 10-year load forecast to ATC.
4	<b>Power Quality</b>	Addition or modification of any loads or equipment that may affect power quality.
5	<b>Reliability Needs – Customer Request to Improve Interconnection Performance</b>	Customer requests ATC review transmission service reliability at the Point of Interconnection.

**2.1.1.2 Distributed Energy Resource (DER) Request (DERRF)**

The first step in working with ATC to develop a new or modified DER interconnection to the ATC system requires the Customer to submit a completed DER Request Form (DERRF) to ATC. An example of the DERRF template is included in Appendix D.

The Customer should submit a DERRF to ATC when addition of, change to or removal of any generating capacity interconnected to a distribution system that’s part of an existing load interconnection where the resulting aggregate DER generating capacity is greater than or equal to 1 MW (including battery storage system(s)). A DERRF submittal is also recommended for each additional 500 KW (after the previous DER BVP assessment) and for any equipment



change that modifies an existing DER's ability to isolate for transmission faults. Refer to the ATC DER Planning Guide for more information on protection requirements for DERs.<sup>7</sup>

Effective October 2023, MISO will be managing a DER Affected System Study Process. The process includes an ATC screening to identify DER Net Injection of greater than 1 MW into the Transmission System. As outlined in MISO Business Practice BPM-015, the screening will compare the total nameplate DER capacity (existing and proposed) at a substation against the peak summer or shoulder load at the substation, with the load model depending on the DER fuel type. Upon deeming the DERRF complete and with LDC consent to proceed, if the screening indicates DER Net Injection greater than 1 MW, ATC will submit data to MISO as outlined in the MISO Business Practical Manual BPM-015. When the Net Injection to the Transmission System at the DER substation increases by 1 MW, it will trigger another DER Affected System screening by MISO.

The substation peak load amounts, sourced from ATC Load Forecast data, will be aligned with the anticipated DER project in-service date. If multiple DER interconnections are submitted at a single substation in the same MISO screening window, the earliest projected DER in-service date will be conservatively used for load amounts (i.e., less anticipated peak load amount).

The DER Affected System Studies will require Study Deposits, Study Agreements, Study Reports and when Transmission System Network Upgrades are identified, Facility Construction Agreements between MISO, ATC and the DER Developer. Additional details can be found in the [MISO Business Practice Manual BPM-015](#). If the MISO DER AFS process is triggered, but no other system upgrades are identified, surge arrester upgrades may still be necessary and will not be processed through the MISO DER AFS cost allocation process.

### **2.1.1.3 Timing of a LIRF/DERRF Submittal**

To enable ATC to meet the needs of the Customer, a LIRF/DERRF must be received sufficiently in advance of the Customer's requested in-service date for the new or modified load or DER interconnection. This will allow sufficient time for the following:

- Effective BVP,
- Satisfaction of any necessary regulatory requirements and/or permitting,
- Complete design of necessary facilities,
- Order of long-lead time materials, and
- Safe and effective construction.

However, ATC is also mindful of the possibility of being counterproductive if a LIRF/DERRF is submitted prematurely and before the Customer can commit [more] firmly to certain project details. Therefore, ATC provides the following guidance for the Customer to consider with respect to when to submit a LIRF/DERRF. Ultimately, as part of BVP, ATC and the Customer will develop a mutually agreeable schedule for meeting both parties' needs with respect to the project in-service date.

The following discussion represents typical schedule requirements of ATC's project development and implementation process. Ultimately the ATC and Customer implementation team will establish a project-specific schedule that may deviate from the timelines noted below based upon project-specific details.

#### **1. Best Value Planning (6-18 months):**

<sup>7</sup> See the footnote on page [47](#) for additional guidance.

## ATC

BVP between ATC and the Customer can typically take anywhere from 6 to 18 months, dependent upon extent of anticipated scope of work for both parties. At the outset of BVP, ATC and the Customer will agree on a specific development/BVP schedule.

### 2. Construction Lead Time (12-60 months):\*

\*Construction includes design and material procurement activities. Subject to change based on resource availability and supply chain constraints.

#### a. 12 – 18 months

Construction (after receipt of the appropriate project documentation<sup>8</sup>) will take 12 -18 months for DER interconnections (any voltage) requiring only transmission line arrester upgrades.

#### b. 18 - 30 months

Construction (after receipt of the appropriate project documentation) will take 18-30 months for load interconnections at all voltages with transmission line extensions of less than 1 mile.

#### c. 30 - 48 months

Construction (after receipt of the appropriate project documentation) will take 30-48 months for load interconnections requiring transmission line extensions greater than 1 mile at any transmission voltage.

#### d. 48 - 60 months

Construction (after receipt of the appropriate project documentation) will take 48-60 months for load interconnections that potentially involve transmission power transformers, gas-insulated substations, underground transmission, long lead time material, other major Transmission System reinforcements, or appropriate State Regulatory Approvals such as a Certificate of Authority (CA) or Certificate of Public Convenience and Necessity (CPCN). For projects that require a regulatory filing, efforts can be made to shorten project schedules if the LDC or end-use customer is willing to execute a Project Acceleration Agreement (PAA) that covers design and procurement of materials in advance of receiving regulatory approval.<sup>9</sup>

### 2.1.1.4 LIRF/DERRF Receipt Notice

Within 10 business days of the receipt of a LIRF/DERRF, ATC will acknowledge the receipt of the LIRF/DERRF with written communication back to the Customer (typically via e-mail) and indicate whether the LIRF/DERRF is complete or if additional information is required. If ATC indicates that the LIRF/DERRF is not complete, ATC still

---

<sup>8</sup> The appropriate project documentation may consist of any one of these documents, a signed Best Value Plan Report, a signed Capital Work Letter, a Minimal Capital Work Letter, a signed Project Commitment Agreement, or a signed Facility Construction Agreement. It is the responsibility of both ATC and the Customer to determine the appropriate documentation to use for communicating the agreed upon project documentation to both Parties involved in the Project.

<sup>9</sup> See the footnote on page 47 for additional guidance.

needs certain information from the Customer in order to effectively conduct its initial cross-functional evaluation and prepare for planning analyses.

ATC will typically respond to the Customer that a LIRF or DERRF is complete when the information provided in Table 2 or Table 3 has been received.

<b>Table 2: LIRF Information Required in order to be “Complete”</b>	
1	<b>Requestor Information</b> – contact information for the Customer
2	<b>Load Interconnection Information</b> – substation location (prospective geographic/physical location(s), especially for a new substation or expansion of an existing substation) and load characteristics (including transient or dynamic data if requested)
3	<b>10-Year Load Forecast</b> – supply a new load forecast if loads shifted or peak outside of typical summer peaking hours or indicate that the last forecast is still accurate
4	<b>One-line Diagram</b> – required for modified load interconnections, not necessarily required for new load interconnections
5	<b>Scope and Justification</b> – distribution scope of work and justification for the project

<b>Table 3: DERRF Information Required in order to be “Complete”</b>	
1	<b>Requestor Information</b> – contact information for the Customer
2	<b>DER Interconnection Information</b> – requested ATC point of interconnection. As available, Customer to provide DER generator information (including transient or dynamic data if requested), MISO Market participation, DER modeling information (including short circuit) and protective system/anti-islanding capabilities, including inverter IEEE requirements and UL certifications.
4	<b>One-line Diagram</b> – required for modified load interconnections, not necessarily required for new load interconnections (not required if substation interconnecting to ATC is not modified).
5	<b>Scope</b> – distribution scope of work for the DER project

ATC can only effectively coordinate with the Customer on a schedule to meet a requested in-service date after all information listed above has been included in a LIRF/DERRF. If all required information is not available at the time

the LIRF/DERRF is submitted, the Customer should contact ATC as soon as possible to jointly determine what developmental work can be performed until the missing information becomes available.

#### **2.1.1.5 Notification of Initial LIRF/DERRF Review**

Within 20 business days of the LIRF/DERRF being deemed complete, ATC will communicate to the Customer one of the following:

1. ATC's initial assessment indicates that there are minimal or no anticipated upgrades to ATC's network Transmission System or Interconnection Facilities necessary for ATC to accommodate the proposed new or modified load or DER interconnection.
2. ATC's initial assessment indicates that it is likely that significant upgrades to ATC's network Transmission System and/or Interconnection Facilities will be required to accommodate the proposed new or modified load or DER interconnection. ATC will also seek a collaborative scoping conversation with the Customer to determine a schedule for Best Value Planning (BVP).

#### **2.1.1.6 LIRF/DERRF Revisions**

If the Customer makes changes to the project that result in changes to LIRF/DERRF information (e.g. a delay in in-service date, scope of work revision, load forecast changes, etc.), ATC requests that the Customer submit a revised LIRF/DERRF to ATC to enable project development and/or implementation to continue. ATC will process the LIRF/DERRF in a manner similar to the original LIRF/DERRF submittal. If the only change is a change in in-service date, written communication, such as email or meeting notes, is adequate. Should the project change after the appropriate project documentation is issued, ATC and the Customer will work together to revise or amend the appropriate project documentation.

#### **2.1.2 Un-Forecasted Load Interconnection Requests**

In developing load interconnection requests related to un-forecasted load, ATC and the Customer will collaborate to assess the preliminary best value interconnection solution. This collaboration may include preliminary feasibility and/or system impact studies by ATC relating to the un-forecasted load interconnection request given that the proposed load interconnection request has not been accounted for in the annual 10-year load forecast. The preliminary feasibility and/or system impact studies help to determine if the addition of the un-forecasted load would have an adverse impact on the ATC Transmission System. Un-forecasted load interconnection requests may cause ATC and its Customer to consider additional issues such as aggressive in-service dates, significant transmission system upgrades outside of the load interconnection, regulatory timelines, and outage schedules while jointly developing a solution to satisfy the un-forecasted load interconnection request. Please refer to the ATC Economic Development Projects Guide GD-1801 for additional information. Contact ATC Interconnection Solutions for a copy of this Guide.

Once a LIRF or DERRF is submitted, ATC will typically perform formal studies related to a *single* preferred interconnection location (as mutually agreed to by ATC and the Customer). Should the Customer request the formal study of additional interconnection locations related to the same load or DER interconnection need, ATC reserves the right to charge the cost of such additional studies to the Customer in accordance with ATC's Elective

## **A T C**

Interconnection Facilities Business Practice. The Customer will be responsible to pay for the estimated cost of any additional studies prior to ATC beginning the additional study work.

In the event a Customer requests a high-level capacity study for multiple locations, ATC will enter into a study agreement for the requested studies. If a high-level capacity study is requested for a single location, the end-use customer or amount of forecasted load must be known. Otherwise, ATC will enter into a study agreement for the requested capacity studies.

In addition, ATC reserves the right to charge the Customer (via a study agreement) for atypical studies, those beyond steady-state thermal or voltage analysis, for example-

- dynamic and transient studies
- steady state voltage stability studies
- power quality studies
- special protection assessments

Please note, for ATC to accurately study and represent the load or DER interconnection, atypical studies may require customer transient or dynamic data on a case-by-case basis.

## 2.2 Project Development

ATC and the Customer will employ BVP in order to determine the most effective solution to meet the Customer's load interconnection request.

BVP describes ATC and the Customer's collaborative development of the requested load interconnection project and determination of the best value solution. Steps within the BVP process include:

1. ATC and the Customer agree on the study schedule, study milestones, needs analysis, alternatives (both transmission and distribution) to consider, the forms of communication to be used while working together, and formal documentation.
2. ATC will coordinate with the customer to determine the appropriate project documentation.
3. The Customer documents needs/project justification and its part of a draft BVP matrix including alternatives considered; all in support of the Customer's analysis.
4. ATC documents needs/project justification and its part of a draft BVP matrix including alternatives considered; all in support of ATC's analysis.
5. ATC and the Customer complete a formal BVP report.
6. ATC and the Customer acquire management approvals as required before moving the project formally to implementation.

ATC and the Customer will formally document their BVP collaboration and conclusions in a BVP Project Scoping Report<sup>10</sup>.

BVP takes into account such factors as:

1. Customer justification or need drivers behind the requested load interconnection.
2. Distribution and transmission system performance assessment including; power flow impact (voltage and thermal limitations), dynamic and transient response to system faults, short circuit changes,

---

<sup>10</sup> The collaborative review / analysis and BVP documentation of an interconnection project is governed in part by NERC Standard FAC-002-3 requirements R1, Parts 1.1-1.4, and the requirements of ATC's Local Planning under Attachment FF-ATCLLC of the Midcontinent ISO Tariff. ATC and the Customer are required to retain the documentation of the reliability impact of the new facilities in accordance with NERC Standard FAC-002-3. Additionally, it is required that the Customer ensure that the load associated with the interconnection project is included within the metered boundaries of a Balancing Authority in accordance with NERC Standard FAC-001-3 requirement 3.3.

## **A T C**

protection/coordination concerns, operational concerns/limitations and asset management/maintenance concerns.

3. ATC stakeholder impact.
4. Construction as well as operating costs (for both transmission and distribution facilities),
5. Environmental issues,
6. Siting requirements, including land acquisition and permits, and
7. Ongoing operations and maintenance considerations, including reliability impacts on the transmission system.

To facilitate consistent analysis, review, documentation, and resource allocation for a given load interconnection project; Appendix C describes four different reporting levels of BVP activities and the responsibilities of both ATC and its Customer. The complexity of the assessment associated with the BVP Project Scoping Report is dependent on the size and cost of the proposed load interconnection project. Once ATC and its Customer determines the best value solution to meet ATC and the Customer's needs, ATC and the Customer prepare the BVP Project Scoping Report that sets forth the solution to meet the Customer's load interconnection request.

Once the BVP process is completed, the next implementation step is to develop the appropriate project documentation which may consist of a Best Value Plan Report, a Capital Work Letter (CWL), a Minimal Capital Work Letter, a No Capital Work Letter, a Project Commitment Agreement (PCA), or a Facilities Construction Agreement (FCA). The agreed upon project documentation sets forth for both parties the scope of construction activities and the proposed construction schedule<sup>11</sup> to construct the facilities necessary to interconnect the new load or modify the existing load interconnection facilities. For more information, the process included in BVP, please

---

<sup>11</sup> Only the BVP report, PCA and FCA contain proposed construction schedules.

## **A T C**

refer to the BVP white paper located at – <https://www.atcllc.com/customer-engagement/>. Please also refer to Attachment FF-ATCLLC of the MISO Tariff for additional information.

### **2.3 Project Implementation**

Once ATC and the Customer agree on the best value solution and formally publish a BVP Project Scoping Report, as appropriate, ATC will provide the Customer with the appropriate project documentation. A brief description of the project documentation documents are shown in the next section.

#### **2.3.1 Project Documentation**

At the conclusion of the Best Value Planning process, ATC will work with the Customer to develop the appropriate project documentation. This documentation may consist of any one of the documents described below:

At a minimum, the Best Value Plan Report will typically include:

- A review of the alternatives considered,
- Scope of work for both ATC & Customer,
- Anticipated ATC Cost,
- Schedule estimate.

The Capital Work Letter will typically include:

- Scope of work for both ATC & Customer,

The Minimal Capital Work Letter will typically include:

- Scope of work for both ATC & Customer,

The No Capital Work Letter will typically include:

- Scope of O&M work for both ATC & Customer,

At a minimum, the PCA will typically include the items in Table 3.



Table 3: Required PCA Contents		
1	<b>BVP Project Scoping Report</b>	Provides the justification that supports the decision for the facilities to be constructed.
2	<b>Non-Typical Planning Studies</b>	Indication of any remaining studies, aside from the typical planning studies. (Examples may include power quality studies, special protection assessments, etc.)
3	<b>Project Schedule</b>	An estimated project schedule, including a timeline for any necessary regulatory approvals and the expected completion date of the project.
4	<b>High-Level Scope of Work</b>	Including a one-line diagram, project location or map.
5	<b>Applicable Business Practices</b>	Indication of other applicable ATC Business Practices associated with the project.

At a minimum the Facility Construction Agreement will typically include:

- Scope of work for both ATC & Customer,
- Anticipated ATC Cost,
- Schedule estimate.

The determination of what type of project documentation is required for a given project is made based upon the BVP solution for the given project. ATC will work with the Customer to define which form of project documentation is appropriate for each Load Interconnection Project. Examples of the project documentation documents are available upon request<sup>12</sup> to the ATC Interconnection Solutions Group.

Additionally, an example of the PCA template can be seen at: <https://www.atcllc.com/customer-engagement/>.

**2.3.2 Distribution - Transmission Interconnection Agreement**

ATC requires execution of a Distribution – Transmission Interconnection Agreement (D-T IA) before ATC will commence any regulatory proceedings (if applicable) or otherwise begin design engineering on any project associated with a load interconnection request. If the request is from a Customer that has an existing D-T IA, the new interconnection substation will be included in the Entity Ownership Records (EOR) through the EOR Business Practice.

**2.3.3 Regulatory Approvals**

If the load interconnection request requires regulatory approvals or filings, ATC and the Customer shall cooperate in seeking any regulatory or other approvals by providing the necessary information and participating in any regulatory proceeding or process to demonstrate need for the project, if requested to do so by either ATC or the Customer.

---

<sup>12</sup> See the footnote on page 47 for additional guidance.

## ATC

Examples of regulatory approvals or filings include, but are not limited to:

State Public Service Commissions for<sup>13</sup>:

- Construction Authorization filings,
- Certificates of Public Convenience and Necessity filings,
- Affiliated Interest filings

Federal Energy Regulatory Commission for:

- D-T IA filings

NERC (together with Midwest Reliability Organization and ReliabilityFirst Corporation) for:

- Reliability filings / reports associated with interconnection facilities at voltages greater than or equal to 100 kV.

Please note; NERC compliance is the responsibility of both ATC and the Customer. Under NERC requirements, ATC is a registered:

- Transmission Owner,
- Transmission Operator,
- Transmission Planner, and a
- Distribution Provider

**IMPORTANT NOTE:** ATC does not assume any NERC reliability responsibilities aside from those listed above. The D-T IA between ATC and its Customers is not a delegation of, nor the transfer of either party's NERC functional responsibilities from one party to the other.

Additional requirements applicable to both parties' substations are set forth in state electrical and administrative codes. ATC should be consulted on matters relative to the guidelines and requirements contained in this guide, but Customers are advised to consult directly with appropriate code enforcement authorities for matters that pertain to requirements of other applicable governing codes and/or with the specific requirements set forth in contracts concluded with ATC. Likewise, the regulatory filings listed above are for ATC requirements only, the Customer may have regulatory filings that may also be needed as determined by the Customer.

### 2.3.4 ATC's relationship to the wholesale electric market

ATC owns, operates, maintains and plans the transmission system over which MISO provides transmission service in conjunction with its FERC Electric Tariff. ATC is not a Market Participant in the MISO Energy and Operating Reserve Markets.

## 3 Interconnection Facility Requirements

### 3.1 Overview

These design guidelines apply predominantly to new load interconnections and modifications to existing interconnections. ATC will work with the Customer to apply these guidelines as appropriate and feasible for modifications to existing load interconnections. Some proposed load interconnections may also require necessary network upgrades to ATC's Transmission System, beyond the interconnection facilities themselves. This guide does

---

<sup>13</sup> Note: Regulatory requirements vary from state to state and need to be coordinated between ATC and its Customer for a given project.

not govern those additional ATC Transmission System modifications that may be required. Any upgrades needed to the ATC transmission system will be identified within the BVP Project Scoping Report and used when assessing alternatives.

By following the process guidelines in the previous section of this document, ATC and its Customers work together to develop an interconnection project design in response to a Customer's interconnection request. This section of the document offers an overview of technical design guidelines to assist ATC and its Customers when developing a project solution for a load interconnection request.

It is important to note that ATC design standards apply to ATC Transmission System facilities and that the Customer's design standards apply to the Customer's facilities unless otherwise specifically noted in the following sections.

In the event that such ATC design guides, standards or specifications do not address a particular item or issue, ATC requires that the Customer and ATC agree on the use of nationally-recognized standards, guides or specifications to ensure that the Customer's Interconnection Facilities are designed in accordance with Good Utility Practice and any applicable Mandatory Reliability Standards (for example FAC-001). In the event that there is a conflict between any mandatory standard, guide or specification and ATC's design guides, standards and material/construction specifications, the more restrictive design guides, standards and specifications will apply.

### **3.2 ATC and Customer Responsibility**

The requirements in this guide are part of the requirements necessary to protect ATC's transmission facilities and to maintain transmission system reliability consistent with the NERC Mandatory Reliability Standards. The Customer is responsible for the reliability, availability and the protection of its own facilities. All facilities constructed to meet a Customer's load interconnection request will be designed, installed, operated and maintained in accordance with Good Utility Practice, the National Electrical Code (Article 90), National Electrical Safety Code, equipment manufacturer's requirements, approved North American Electric Reliability Corporation and Regional Entity

reliability standards, any applicable independent system operator or ATC planning criteria<sup>14</sup> and guidelines, and all other applicable laws, rules and regulations.

### **3.2.1 Customer Submittals Prior to Design Work**

The Customer shall submit the following information after the LIRF has been accepted and the planning analysis performed, including any BVP, and prior to ATC initiating design work:

- A substation three-line diagram that includes substation phasing,
- A general arrangement diagram,
- Proposed modifications to Common Facilities,
- The power transformer nameplate drawing and the manufacturer's performance specification or test report, if it's available,
- A detailed description of the protection scheme to be used on the Customer's power transformer(s), and
- An executed PCA (if applicable) or, as necessary, an executed Facilities Construction Agreement if ATC's Elective Interconnection Facilities Business Practice applies.<sup>15</sup>

Customer shall coordinate with ATC Legal to determine whether any FPA section 203 prior authorizations (acquisitions/dispositions of FERC-jurisdictional facilities) or FPA section 205 prior authorizations (for provision of services by a public utility) are required and, if so, cooperate in obtaining same.

### **3.2.2 Customer Submittals During Design Work**

The Customer shall also provide the information listed below to ATC for review and approval prior to completion of required design work. The information can be submitted electronically (.pdf format for example) or as printed copies of drawings, whichever is convenient. *Please allow three weeks for ATC's review of the submitted information and at least three weeks for the Customer's consideration of ATC comments or modifications prior to the start of project construction:*

- As available, current transformer ("CT") ratio correction curves and excitation curves for any CTs that may be used in ATC protection schemes.
- A Customer-owned line conductor terminal structure design.
- If the interconnection is to a substation bus protected by an ATC bus differential relay; the Customer must provide AC schematics showing proposed changes and additions to the current inputs to the ATC bus differential relay and DC schematics showing tripping and breaker failure functionality.
- If interconnection is to a substation bus tripped by an ATC bus lockout relay; the Customer must provide DC schematics showing Customer breaker failure relay trip outputs, test switches, and connection to the ATC protective devices.

### **3.2.3 Elective Facilities**

The Customer may request interconnection facilities beyond those facilities that ATC would normally determine as appropriate for a given interconnection request. The cost responsibilities for the incremental facilities will be

---

<sup>14</sup> See ATC planning criteria at <http://www.atc10yearplan.com/about/planning-criteria-and-tools/>

<sup>15</sup> For any Elective Facilities transaction  $\geq$  \$ 250,000 with an ATC affiliate please contact the ATC Legal Department for a determination of the appropriate regulatory actions.

determined during the BVP process. ATC may agree to provide such facilities provided that the following conditions are satisfied:

- The Customer agrees to finance and pay the construction cost difference (including any applicable taxes) between the Customer-requested facilities and those facilities ATC determines appropriate.
- The Customer-requested facilities meet all regulatory and reliability standards requirements and pose no additional risks or obligations for ATC's operations or maintenance of ATC's facilities.
- ATC can obtain all necessary permits and approvals.

Please consult ATC Business Practice, Elective Interconnection Facilities for additional information. See the ATC website: [www.atcllc.com/customer-engagement](http://www.atcllc.com/customer-engagement)

### **3.3 Procedures for Coordinated Joint Studies of New Facilities and Their Impacts on the Interconnected Transmission Systems**

Please refer to Sections 2.1 and 2.2 above for additional details on notifying ATC of an interconnection request and the assessment completed during BVP.

### **3.4 Procedures for Notification of New or Modified Facilities to Others (Those Responsible for the Reliability of the Interconnected Transmission Systems) as soon as Feasible**

Please refer to Section 2.1 above for additional details on notifying ATC of an interconnection request.

### **3.5 Design of Common Facilities**

Depending on the substation's ownership, ATC or the Customer may own facilities that are used by multiple parties at that substation. However, ATC will not share a joint substation or any common facilities with an end-use customer for load interconnections made directly from transmission facilities to an end-use customer's facilities.

For further information regarding Common Facilities, please consult ATC's Joint-use Substations -- Common Facilities Business Practice<sup>16</sup> for more details on how ATC and the Customer should coordinate the design, addition or modification of common facilities. All Common Facilities will be designed to meet ATC Design Criteria, all applicable national and state electrical and safety codes, and all applicable NERC, Federal, State, MRO (or ReliabilityFirst) and MISO standards and policies for Transmission Owner interconnection service to a Local Distribution Company. Any differences or conflicts between the Customer's standards and ATC standards will be addressed in the design of the Common Facilities. The Customer shall provide a common facilities design proposal for ATC review and comment prior to any construction.

### **3.6 Interconnection Configuration**

The configuration of interconnection facilities will consider both the immediate and future plans for the new or modified substation. Where economically advantageous, future requirements of the Customer and ATC will be incorporated into the immediate substation design associated with the load interconnection request. ATC strongly

---

<sup>16</sup> See ATC Business Practice "Joint Use Substations – Cost Responsibility For Common Facilities" <http://www.atcllc.com/customer-engagement>.

advocates three-phase interconnections with balanced load between all three phases. ATC may consider exceptions to this configuration on a case-by-case basis.

The interconnection facility configuration is considered by ATC to be a joint development effort. In addition to meeting the Customer's needs, ATC's design requirements are intended to facilitate ongoing maintenance and the required reliability of the transmission system, with minimal dependence on Customer load switching and/or load bridging<sup>17</sup>. ATC's facilities design will endeavor to include the most effective and least-cost design of both transmission and distribution facilities in order to minimize the frequency and duration of Customer interruptions. The jointly agreed to electric facilities design will be documented in the BVP Report. Examples of typical interconnection configurations can be found in Appendix F. It should be noted that Configurations H and I in Appendix F will be determined by a transmission network need. These are not typical configurations, nor driven by the Customer.

### **3.6.1 Line Topology, Line Sectionalizing**

ATC prefers to design its new facilities to sectionalize the affected transmission line's<sup>18</sup> load in a way that provides the greatest reliability for ATC's facilities as well as the Customer's. Sectionalizing the affected transmission lines may include load-break switches, remote-controlled motor-operated disconnect switches, auto-sectionalizers, or breakers. The consideration of the appropriate sectionalizing method and equipment choice will be made on a case-by-case basis subject to the approval of ATC Operations, Maintenance and Engineering groups. The following criteria may be used in designing and sectionalizing transmission lines, unless ATC and the Customer determine that other criteria should apply:

#### **3.6.1.1 Sectionalizing Guidelines - 30 MW**

When the new request affects a transmission line's load<sup>19</sup> to be greater than or equal to 30 MW, then ATC will split the load on the existing line by adding breakers per Section 3.21.3 at an appropriate location to maximize transmission line performance. When 30 MW is forecasted between breakers in the LDC load forecast at an existing substation without line breakers, two (2) line breakers will be installed. When a substation has two distribution transformers with 30 MW of load realized at the substation, a bus tie breaker will be installed.

#### **3.6.1.2 Sectionalizing Guidelines - 300 MW-miles**

Another factor to be considered is the product of line length (in miles) and the load (in MW) on the transmission line. If this product is equal to or greater than 300 MW-miles, then ATC in collaboration with the Customer will consider determining the most appropriate manner to sectionalize the affected transmission line.

#### **3.6.1.3 Reliability Considerations**

Some load interconnections may require consideration of other guidelines in those instances when it is anticipated that the transmission lines may not perform adequately or reliably because of the load interconnection. (See Sections 3.6.1.4 and 3.6.1.5 below). ATC may consider other criteria to sectionalize the affected transmission lines in a reasonable and reliable manner.

---

<sup>17</sup> Please refer to the ATC Business Practice Load Bridging for Transmission Related Work [http:// www.atcllc.com/customer-engagement](http://www.atcllc.com/customer-engagement).

<sup>18</sup> A transmission line is defined as a segment of the ATC Transmission System found between two circuit breakers.

<sup>19</sup> The term "load" as used here is the maximum forecast load as discussed in Section 2.1 of this Guide.

#### **3.6.1.4 ATC Reliability Performance Metrics**

ATC monitors transmission system reliability performance as related to load interconnection (delivery) points using a performance metric. The goal is to understand the ongoing performance of an integrated transmission and distribution system, but at very specific interconnection points. This performance metric is significantly affected by not only the transmission system performance, but also the design and performance of the interconnected distribution system. For example, a local distribution company's ability to bridge distribution loads (especially automatically) will have substantial impact on ATC's delivery point metric which in part measures the number of end-use customers impacted by outages.

When considering the line sectionalizing requirements for any load interconnection, ATC may consider the performance of the existing transmission line affected by the new load interconnection request relative to ATC's other lines' delivery point metrics performance. ATC may determine not to sectionalize an affected transmission line if doing so would decrease its performance reliability based upon the performance metrics measured by ATC.

#### **3.6.1.5 Distribution Change-Over**

Transmission line sectionalizing may not be necessary if the distribution facilities incorporate bridging capability.

#### **3.6.1.6 Number of Taps**

Multiple taps between breakers may; 1) affect Customer service reliability, 2) complicate load bridging and operations, and 3) increase response time to isolate disturbances. Therefore, the number of existing taps on the transmission line affected by the new load interconnection request is a factor that ATC will consider when determining the effective line sectionalizing design. However, in general for lines with three or more taps (new plus existing), ATC will consider the design of line sectionalizing as set forth in Section 3.21.4 and Appendix F below. At a minimum, a new interconnection will have load break switches if there is another distribution tap without load break switches on the transmission line.

**3.6.1.7 Number of End-Use Customers:** The number of end-use customers normally connected to the local distribution system could be a factor that should be considered when considering effective transmission line sectionalization. However, in general, for transmission lines that support more than 3,000 end-use customers ATC will design line sectionalizing as already provided for in Section 3.21.4.

#### **3.6.1.8 Underground Transmission Lines**

Substations served with underground transmission lines require additional consideration and will be handled on a case-by-case basis because of the risk of long-term outages resulting from underground cable failure. ATC Operations, Maintenance and Engineering groups may be required to participate in the facilities design with Planning.

#### **3.6.1.9 Sectionalizing Device Ratings/Capability**

Aside from the guidance derived from the line sectionalizing design guidelines discussed above, load break capability, line charging interruption and short circuit current interruption requirements of the transmission line under consideration may require installation of line sectionalizing devices that are designed to withstand high current applications. This will be accounted for in the Sectionalizing Device Flowchart seen in Appendix F.

When disconnect switches will be used for the sectionalizing device, picking up charging current is an acceptable application for the device and should not be accounted for within the Appendix F flowchart. The proper switch type for these substation applications will be determined during design with guidance provided by GDE-4500, the Substation Disconnect Switch design guide.

While these guidelines are specific, in some exceptional cases, the BVP study and analysis may need to be sensitive to case-specific considerations not otherwise addressed in these guidelines.

ATC and its Customers will coordinate the application and use of sectionalizing devices as part of the development of the interconnection project.

### **3.6.2 Line Topology – Radial versus Loop-through Connections**

ATC and its Customer will jointly decide on the optimum means of connecting a new substation to the ATC Transmission System. To encourage efficient land usage for load interconnections, ATC will provide a straight bus (loop feed) substation for any new load interconnection substation with an ultimate configuration of two or more transformers.

When modifying an existing load interconnection substation with one transformer that is radially fed where Customer load growth subsequently calls for two or more transformers, ATC and the Customer will utilize the BVP process to determine on a case-by-case basis if the substation should be converted to a loop-through substation instead of establishing a second radial feed into the substation. Land availability, substation proximity to the transmission line, the need for line breakers, load bridging capability of the distribution system and other related issues will be jointly considered. Additional information on determining the interconnection configuration is included in the Bus Configuration Flow Chart in Appendix F.

If the Customer submits a request for ATC to construct transmission facilities to connect a spare, de-energized transformer or other similar modification for load bridging, ATC will consider that scope elective facilities. However, if the Customer has specific distribution planning criteria that provides justification for the request, ATC's scope, through the BVP process, would be deemed standard facilities.

Please consult ATC Business Practice, Elective Interconnection Facilities for additional information. See the ATC website: [www.atcllc.com/customer-engagement](http://www.atcllc.com/customer-engagement)

### **3.6.3 Phase Rotation**

ATC phase rotation is ABC (counterclockwise). The Customer will exercise careful coordination with ATC to match this phase rotation to the Customer's specific phase designations. For new interconnections, the LDC typically specifies the phase rotation for the interconnection facility. When ATC was formed, it was recognized that the phase rotation configurations vary from contributor –to- contributor. Table 4 below highlights the phase rotation



**ATC**

conventions used by the various Balancing Authorities interconnecting to the ABC phasing of the ATC Transmission System.

<b>Table 4</b>				
Balancing Areas		Phase to Phase		
Wisconsin Public Service Corporation		C	A	B
Wisconsin Power and Light Company		A	B	C
Madison Gas and Electric		A	B	C
Wisconsin Electric Power Company		A	B	C
Upper Peninsula Power Company		A	B	C
Edison Sault Electric Light Company		A	B	C
Cloverland / Edison Sault (West)	(See Note 2)	A	B	C
Cloverland / Edison Sault (East)	(See Note 3)	C	A	B
General Notes:				
Note 1. All systems have A – B – C rotation				
Note 2. Cloverland / Edison Sault Substations; West of Hiawatha Substation				
Note 3. Cloverland / Edison Sault Substations; Hiawatha Substation and East				

### **3.7 Voltage Level and MW and MVAR Capacity or Demand at the Point of Interconnection**

#### **3.7.1 Voltage Level**

The design of the new interconnections must effectively address the voltage requirements of both this Section and in Section 3.13 (Voltage, Reactive Power & Power Factor). ATC operates transmission facilities predominantly at nominal system voltages of 69, 138, 345 kV, which is further detailed in ATC Design Criteria. For the purposes of this guide, any reference to 138kV voltage levels shall also encompass interconnections to ATC's 115 kV system.

ATC will discuss with the Customer on a case-by-case basis the requirements associated with interconnections to the 161, 230, and 345kV facilities owned and operated by ATC.

The service voltage will depend on 1) the location of Customer Facilities relative to ATC's existing facilities and 2) the present and future load the Customer intends to serve. The Customer shall consult with ATC on how these issues will affect service voltage selection.

### **3.7.2 MW and MVAR Capacity or Demand at the Point of Interconnection**

ATC and the Customer will work together in the design of the Interconnection Facilities to provide sufficient MW and MVAR capacity at the Point of Interconnection for both current and future needs of both parties as determined by the collaborative BVP process.

## **3.8 Breaker Duty and Surge Protection**

### **3.8.1 Fault Current**

Customer Interconnection Facilities connected to ATC's Transmission System can be subjected to fault levels that are largely the product of system characteristics and interconnection impedance. The design of the Customer's Interconnection Facilities must possess sufficient fault interrupting and momentary withstand ratings to meet the maximum expected fault current, with appropriate margin for future system growth (See also Section 3.15.4 Circuit Breakers).

### **3.8.2 Continuous Current Ratings**

ATC will endeavor to design facilities for the maximum continuous load that the Customer forecasts in the interconnection request or the next highest ATC standard rating for equipment beyond the maximum continuous rating of the Customer's transformer. The minimum continuous rating for new ATC substation facilities will be 2,000

A. The minimum continuous rating for new ATC transmission line tap switches will be 1,200 A. Any consideration of planned or emergency overloads are to be provided for in the LIRF.

**3.8.3 Transient and Fault Duty Ratings**

Customer facilities are to be designed to include sufficient fault interrupting and momentary withstand ratings to meet the maximum expected transmission system requirements, with appropriate margin for future system growth. Equipment fault ratings will be determined for each interconnection as part of the project development process.

**3.8.4 Shielding, Grounding & Surge Protection**

ATC’s requirements for substation shielding, grounding, and surge protection are addressed in *ATC Substation Site Design Criteria – CR-0060*. Surge protection for Customer-owned equipment shall be designed and incorporated to be independent of ATC’s surge protection for ATC’s equipment.

All Interconnection Facility equipment must be adequately designed to meet surge protection and shielding requirements. ATC and the Customer will coordinate with each other in a manner that will provide the necessary data at the request of either party.

**3.9 System Protection and Coordination**

**3.9.1 Protection and Control Guidelines**

To minimize disturbances to the ATC system and provide for customer ownership of their interconnection Protection Systems<sup>20</sup>, the Customer must design its interconnection facilities to protect its transformer with a Customer-owned protective scheme utilizing a circuit breaker, or circuit switcher as appropriate for the primary tripping device. ATC may contact the Customer to facilitate coordination of protection schemes between systems, including addition of current transformers (CTs) to accommodate bus differential scheme changes.

If a fuse is used for high-side protection of a distribution transformer (permissible on 69 kV interconnections only), the fuse must be able to operate for all transformer faults during an N-1 transmission event for the available fault current.

Examples of situations that may require additional review by the ATC System Protection Department include (but are not limited to):

- Any generation normally connected to the local distribution system where the distributed energy resource is  $\geq$  1/3 of the minimum load at the substation or transformer,
- Normally-closed distribution voltage bus tie breaker(s) between at least two separate transmission sources,
- Situations that include the use of distribution transfer trip or direct transfer trip protection schemes, and
- Load interconnections to end-use customers directly to the Transmission System.

**3.9.2 Control Circuit Practices**

The specifics of the protection requirements design will be dictated by several factors, such as available communication facilities, line length and construction, interconnection on a blackstart path, mutual coupling effects,

<sup>20</sup> “Protection System” is defined in the Glossary of Terms Used in NERC Reliability Standards (“NERC Glossary”) as: Protective relays which respond to electrical quantities; Communications systems necessary for correct operation of protective functions; Voltage and current sensing devices providing inputs to protective relays; Station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply); Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.

available fault currents, critical clearing times, circuit breaker characteristics, etc. However, in general the requirements in the following sub-sections will apply.

### 3.9.3 General Requirements

ATC's protective relay systems for transmission facilities are generally designed to provide some level of redundancy. ATC installs two relay protection schemes for line and bus protection. The schemes will use separate AC current and voltage sources, separate DC control circuits, and separate circuit breaker trip coils. Redundant batteries are generally not required.

ATC's preferred bus protection scheme design utilizes two (2) bus differentials, connected to two (2) separate sets of CTs. Determination of the required number of CTs, the location of the CTs, the CT ratio and accuracy class for both new interconnections and replacements of existing distribution transformers must be made in conjunction with ATC system protection on a project specific basis, considering both the existing configuration and future plans for the substation.

ATC requires engineering review of any modifications to its protective relay or control circuits. This review should take place during the engineering phase of the project.

When designing and installing protective relay systems, the Customer is encouraged to install equipment with replaceable indicating lamps or other obvious indicators that clearly show the operating status of the Customer's transformer protective device and ATC's equipment.

### 3.9.4 Instrument Transformers

ATC includes instrument transformers as part of its protective relay design.

### 3.9.5 Distributed Energy Resources

In those situations where there are distributed energy resource facilities associated with the Customer's distribution system, care must be taken to protect the ATC Transmission System from fault currents. The Customer's protective system design must include provisions for separating from ATC's system. The Customer shall provide the protective system design for ATC's review. ATC recommends that any generation without sufficient synchronizing capabilities be disconnected before reconnecting the Customer to ATC's transmission system. The Customer must have adequate protection to sense all transmission faults and disconnect from the transmission system in the event of a transmission fault. Consistent with the Distribution – Transmission Interconnection Agreement (D-T IA), it is the responsibility of the LDC to ensure that this protection is in place. Additional information about DER can be seen in the *ATC Distributed Energy Resource – Protection and Insulation Coordination* Guide GD-1701. Contact ATC Interconnection Solutions for a copy of the Guide.<sup>21</sup>

In addition to how the DER is assessed through the DERRF process, ATC also reviews how these units should be modeled and forecasted. Additional information on modeling and load forecast implication of distributed energy resources can be seen in the ATC Generator Modeling Decision Methodology found on: <https://www.atcllc.com/customer-engagement>

---

<sup>21</sup> See the footnote on page 47 for additional guidance..

### 3.9.5.1 Distributed Energy Resource Reliability and Safety Related Issues

Delta-wye transformer configurations are the preferred means of interconnecting load to the ATC Transmission System. When the nature of a load interconnection changes due to the addition of DER (for both changes to existing as well as new load interconnections) it is important for ATC to assess the potential for adverse impacts to the ATC Transmission System. This is especially true when the name plate rating of the accumulative DER is greater than or equal to ( $\geq$ ) 1/3 of the minimum load at the substation or transformer. The reliability and safety related design issues that need to be reviewed includes (but are not limited to):

- Transmission system network impact,
- System protection requirements to mitigate back-feed into a fault on the ATC transmission system,
- Insulation coordination of substation and line equipment (including arrestors and voltage transformers (VTs)). (See Sections 3.7.1.1 and 3.12 also)

It is requested that ATC be advised of all new and existing distributed energy resources at a load interconnection point with a cumulative capacity greater than 1 MW. The information may be submitted to ATC via a DERRF. It will then be assessed within ATC to determine the impact and if additional analysis and/or system upgrades are needed. A DERRF submittal is also recommended for each additional 500 KW (after the previous DER BVP assessment).

Typically, if VTs are required to support the Customer's protection systems to separate the distribution system from the ATC Transmission System, the VTs should be installed on the Customer side of the disconnecting device and owned by the Customer. If BVP and/or substation space limitations result in the VTs being installed on the ATC side of the Customer's disconnecting device, then it is appropriate for ATC to own and maintain the VTs consistent with the D-T IA. The addition of Voltage Transformers to the ATC side of the high-side breaker in these instances will be consistent with ATC design practices.

Determination of the appropriate voltage class for ATC-owned VTs will be determined as part of the design of the Interconnection Facilities.

### 3.9.5.2 Distributed Energy Resources Synchronizing Requirements

The Customer is responsible to ensure that the design of the Customer's distribution system provides for the synchronization of the Distributed Energy Resource Facility to the Customer's distribution system.

### 3.9.6 Reclosing

ATC's transmission line reclosing practice after a breaker has opened during an operation is to reclose the transmission line one or more seconds after a line breaker has tripped open. The Customer is responsible for designing its distribution system to isolate all sources of back-feed from the distribution line prior to any ATC reclose attempts.

## **A T C**

This includes any Customer-owned throw-over schemes. ATC will address timing considerations with its Customer on a project-specific basis.

### **3.9.7 Breaker Failure**

Scenario 1. - Customer equipment connected to an ATC transmission bus that has a conventional bus differential / lockout protection scheme.

In the event of a bus fault or breaker failure condition on the transmission system, ATC will send a trip signal to the Customer to trip their high-side interrupting device.

ATC's practice is to receive two (2) separate trip outputs from the Customer's high-side interrupting device breaker failure relay. One of these outputs will be wired to trip the interconnecting bus lockout and the other will trip the interconnecting bus relay which will direct trip the breakers on the interconnecting bus. If the Customer is unable to provide two (2) separate breaker failure trip output contacts, the single contact will be used to trip the interconnecting bus lockout.

Test switches should be installed in the same control house as the Customer's breaker failure relay. The required test switches will be placed such that they allow for operation of lockout relays, while preventing breaker failure operations and / or tripping of the Interconnection Facilities.

Scenario 2. - Customer equipment connected to an ATC transmission line, or a bus with no conventional bus differential that is protected by the line protection scheme.

If the Customer-owned equipment could be a source into a line fault (such as networked distribution), the Customer's protective scheme design shall be capable of recognizing a fault condition and isolating the source of the fault from the transmission line. For a radial connection, Customer-owned high side protective device failure presents a risk to both the Customer and ATC. Customer-owned equipment is at risk of catastrophic failure due to a sustained fault. The Customer is responsible for mitigating these high side protective device failure risks in the Customer's design of its protective systems.

#### **3.9.7.1 Test Switches**

Each Party's protective relay design shall incorporate the necessary test switches to perform the tests required for the pre- and post- in-service testing discussed in Section 3.19. The required test switches will be placed such that they

allow operation of lockout relays while preventing breaker failure operations and/or tripping of the Interconnection Facilities.

### **3.9.8 Substation Electrical Service**

The Customer will consult with appropriate ATC personnel for the design of substation AC and DC systems that will be connected to ATC equipment.

Additional information on control circuit practices can be discussed with ATC as part of the development of the interconnection project. (See also ATC Business Practice “Transmission Related Station Power Use at Substations” which can be found on the ATC website <http://www.atcllc.com/customer-engagement>

## **3.10 Metering and Telecommunications**

### **3.10.1 Communications**

ATC will install the communications facilities determined by ATC to be necessary at networked connected load interconnection substations. The communication facilities may be utilized for protection, control or metering applications as appropriate. ATC will design communication facilities for their use to match existing methods employed on the existing line. The communication methods may include, but are not limited to, telephone circuits, fiber optic networks, or other technologies as appropriate. ATC will identify for the Customer the space requirements necessary to accommodate ATC’s communication requirements in the Interconnection Facilities.

### **3.10.2 SCADA / RTU**

ATC encourages Customers to control distribution lines that are interconnected to ATC substations remotely via SCADA for potential emergencies including, but not limited to, system restoration activities following a blackout or reduction and/or control of loadings for other unanticipated events. ATC also requests Customers provide ICCP data (flow and voltage when applicable) to ATC for the load(s) that are being added.

### **3.10.3 Revenue Metering**

Since the Customer and ATC will both monitor metering data, they shall together determine the design requirements for interconnection revenue metering on a project-specific basis. Primary instrument transformers/devices will be revenue class, preferably wound-type current transformers, and voltage transformers that are accessible to the Customer and ATC.

### **3.10.4 Balancing Area Metering**

Consult ATC’s Coordination of Balancing Authority Business Practice for guidance on the design and installation of appropriate Balancing Authority Area (BAA) facilities for any load interconnection project that impacts a BAA boundary. In addition, the ATC Guide for LBA Transmission Load Interconnection is included in Appendix G. In general ATC does not install instrument transformers associated with any required BAA metering. For BAA metering at any existing load interconnection substations, the Customer will install, own, and maintain any cables necessary to connect to any ATC transmission-connected instrument transformers.

## **3.11 Grounding and Safety**

As set forth in the D-T IA, the Customer and ATC must agree to operate their respective facilities considering the ratings and capabilities of the facilities of the other party and shall not operate their system in a manner that would

result in exceeding the operating limits or equipment ratings of the other party. This includes the coordination and use of appropriately sized grounding equipment as part of the Interconnection Facilities’ design.

**3.11.1 Effective Grounding**

ATC maintains effective grounding on its transmission system facilities, as defined by the National Electrical Safety Code (NESC). All Customer facilities connected to the ATC Transmission System must be designed to be effectively grounded per the NESC requirement. The Customer must meet the effective grounded system criterion independent of the ATC Transmission System.

**3.11.2 Grounding System**

The Customer is responsible for the appropriate grounding of their equipment. At the Point of Interconnection, the Customer’s grounding equipment must be compatible with ATC’s grounding equipment. The Customer shall submit the grounding system study and design for ATC review prior to construction. The ground grid design must comply with IEEE 80 and properly address site extremes. Site tests should be completed to determine soil resistivity prior to ground grid design. Post-construction grid resistance testing should be performed to verify design assumptions and that the installation was completed per the ground grid design. ATC grounding standards are available upon request<sup>22</sup>.

**3.11.3 Safety Issues**

All personnel working on or in proximity to the Interconnection Facility as well as personnel performing switching on lines associated with the Interconnection Facility will comply with all safety policies, manuals and procedures of the Customer and ATC along with all applicable OSHA safety laws and federal, state, and local rules and regulations.

The Customer and ATC will agree to work together to develop appropriate switching procedures to be utilized at the Interconnection Facilities.

All Customer equipment must be designed physically and electrically to allow for the attachment of properly sized working grounds as specified in IEEE 1246, *Guide for Temporary Protective Grounding Systems Used in Substations*.

**3.12 Insulation and Insulation Coordination (Basic Insulation Level)**

The substation equipment and bus systems shall be designed for the voltage ratings shown below. Substations designed for 345kV, 230kV and 161kV shall be dealt with as an exception. New substations energized at 115kV shall be built to 138kV ratings in accordance with Table 5. Additions to existing substations energized at 115kV or 138kV, with 550kV BIL construction shall be continued similar to their original design and in all other cases consideration shall be given to the existing substation design.

Table 5: Equipment Voltage Ratings		
<b>Nominal Operating Voltage (phase-to-phase)</b>	<b>138 kV</b>	<b>69 kV</b>
Nominal Phase-to-Phase Voltage	138 kV	69 kV
Nominal Phase-to-Ground Voltage	80 kV	40 kV
Maximum Phase-to-Phase Voltage	145 kV	72.5 kV
Maximum Phase-to-Ground Voltage	84 kV	42 kV
Basic Insulation Level (BIL)	650 kV <sup>1</sup>	350 kV
1. In some remote locations and transformers a 550 kV BIL may be acceptable.		

<sup>22</sup> See the footnote on page 47 for additional guidance.



ATC and the Customer must ensure that all equipment is adequately protected from excessive system over-voltages. This includes selection of equipment Basic Insulation Level (BIL) and protective devices (e.g., surge arresters) to achieve proper insulation coordination across the distribution – transmission interconnection.

ATC designs its transmission facilities for the BILs shown in Table 5. Interconnections at 345kV, 230kV or 161kV will be reviewed on an exception basis. New substations energized at 115kV will be built to 138kV ratings in accordance with 138 kV standards. Additions to existing substations energized at 115kV or 138kV, with 550kV BIL construction will be continued similar to their original design. In all other cases consideration will be given to the existing substation design.

### **3.13 Voltage, Reactive Power, and Power Factor Control**

#### **3.13.1 Steady State Voltage Range**

The Customer should expect a normal transmission operating voltage range of +/- 5% from nominal. During system contingency or emergency operation, ATC permits operating voltages to vary up to +/- 10% from nominal. The Customer's equipment should be designed appropriately to operate and maintain adequate voltage under these conditions.

Refer to ATC's Planning Criteria (see current 10-Year Assessment, - About section under Planning Criteria, Practices and Tools - <https://www.atc10yearplan.com/>) for additional guidance related to voltage ratings.

#### **3.13.2 Transmission Line Reactive Capability**

All interconnections will be designed to be reactive compensated pursuant to Good Utility Practice to ensure proper operation of the interconnection. The Customer must provide their own reactive support for their Interconnection Facilities.

#### **3.13.3 Load Interconnection Power Factor Guidelines**

ATC's Customers should plan, design and maintain their load interconnection facilities in order to maintain a power factor at the low side of the load interconnection transformer that is greater than 95% lagging when the load is greater than 85% of maximum forecast load at that load interconnection.

Customer reactive resources should be designed with the ability to be switched off during light loading periods. This applies to any load interconnection where transmission system BVP indicates a need for transmission system power factor improvement at that load interconnection.

For cost allocation purposes, if the Customer load interconnection power factor derived from the Customer's most recent load forecast is below 95% lagging, the Customer will be responsible to bring the power factor up to the 95% level and ATC will be responsible to bring the power factor up to the level identified in the BVP. Costs will be allocated between ATC and the Customer based upon a ratio of the Customer capacitor banks installed. If the load interconnection power factor is already above the 95% lagging level and additional transmission system power factor improvement is identified in the BVP to address the transmission system need, then ATC will reimburse the

## **A T C**

Customer(s) for the additional Customer capacitor banks identified in the BVP consistent with its Capacitor Bank Business Practice<sup>23</sup>.

The Customer is responsible for maintaining the 95% (or greater) lagging power factor at the load interconnection regardless of previous capacitor bank contributions requested by ATC. If Customer capacitor banks are removed it is required that the Customer maintain a power factor according to these guidelines.

### **3.14 Power Quality Impacts**

#### **3.14.1 Voltage Flicker and Harmonics**

The energization and operation of any facilities on the Customer's side of the interconnection facilities must be consistent with ATC's Planning Criteria<sup>24</sup> and Operating Instructions (available upon request<sup>25</sup>) regarding permissible voltage deviations, harmonics, flicker and distortion.

#### **3.14.2 Frequency and Frequency Control**

The Customer should expect a normal transmission operating voltage range of +/- 5% from nominal. During system contingency or emergency operation, ATC permits operating voltages to vary up to +/- 10% from nominal. The Customer's equipment should be designed appropriately to operate and maintain adequate frequency under these conditions. For DER, energy delivered into the ATC Transmission System must be 60 Hz sinusoidal alternating current as a standard frequency. In accordance with Applicable Reliability Standards, the Customer will design and install both control and protective relaying equipment necessary to maintain proper transmission system frequency.

### **3.15 Substation Equipment Ratings**

The Customer and ATC must agree on the applicable substation/transmission/protection design guides, standards, and specifications to be used, for the design of and procurement for the interconnection of the Customer's facility (or facilities). Both Parties will be afforded the opportunity to confirm the overall Interconnection Facility capabilities and identify the limiting transmission element within the Interconnection Facility.

As set forth in the D-T IA, the Customer and ATC will be obligated to operate their respective facilities considering the ratings and capabilities of the facilities of the other party and shall not operate their respective systems in a manner

---

<sup>23</sup> See ATC Business Practice 0302 entitled "Capacitor Bank Installations on Distribution Systems for Transmission Benefit" which can be found at: <https://www.atcllc.com/customer-engagement>

<sup>24</sup> See ATC planning criteria at <https://www.atc10yearplan.com/about/planning-criteria-and-tools-2/>

<sup>25</sup> See the footnote on page 47 for additional guidance.

that would result in exceeding the operating limits or equipment ratings of the other party. This includes the coordination of the topics discussed in Sections 3.15.1 through 3.15.6 below.

### **3.15.1 Voltage and BIL Levels**

See Section 3.12 above.

### **3.15.2 Current Ratings**

ATC and the Customer shall coordinate Interconnection Facility equipment current ratings with each other during the design of the Interconnection Facilities.

### **3.15.3 Bus Spacing and Clearances**

ATC substation and bus systems shall be designed to match existing layouts when applicable, but at a minimum, new equipment shall maintain clearances and spacing consistent with the current ATC design standards, available upon request. ATC and the Customer shall coordinate substation and bus clearances and spacing with each other during the design of the Interconnection Facilities.

### **3.15.4 Circuit Breakers**

ATC and its Customers will coordinate the application and use of dead-tank circuit breakers as part of the development of the interconnection project. It is understood that when ATC installs line breakers at 100 kV and above on greenfield sites, it is expected that the LDC also will install breakers to protect their transformers. The LDC-owned breakers should meet all project requirements and be equipped with LDC required accessories.

The ATC power circuit breakers at the substations are expected to be SF<sub>6</sub> gas-insulated, dead-tank type that conform to applicable ANSI-C37 standards. ATC will provide expected short circuit currents to the Customer to assist them in selecting the appropriate circuit breaker ratings during the design of the Interconnection Facilities.

CTs should fit the specific project requirements and be designed and tested to the most recent revision of IEEE C57.13. A fault study can be requested by the LDC during the scoping of the project. If a high impedance differential is installed on a bus, all CTs should be connected at the same, full ratio. A good reference is ATC's own breaker application guide, GDE-4000. A current copy can be found on the ATC standards website.

### **3.15.5 Disconnect Switches**

ATC disconnect switches are expected to be three-phase, gang operated, horizontal-mounted, with station post insulators that conform to ANSI-29.9 as outlined in ATC's substation switch design guide GDE-4500. ATC and the Customer shall coordinate the application of disconnect switches with each other during the design of the Interconnection Facilities.

### **3.15.6 Voltage Transformers (VTs & CCVTs)**

Wound voltage transformers (VTs) are preferred for all 138 kV and lower bus voltage sensing and non-power line carrier applications on ATC Transmission System facilities. Voltage transformers will conform to IEEE C57.13. Coupled Capacitor Voltage Transformers (CCVTs) will conform with ANSI C93.1. ATC and the Customer shall

coordinate the application of these VTs and CCVTs with each other during the design of the Interconnection Facilities.

### **3.16 Synchronizing of Facilities**

#### **3.16.1 Synchronism**

The Customer is responsible to ensure that the design of the Customer's distribution system provides for the synchronization of the Distributed Energy Resource Facility to the Customer's distribution system.

ATC and the Customer shall coordinate the application of these devices during the design of the Interconnection Facilities.

#### **3.16.2 Phase Rotation**

The ATC Transmission System phase rotation is ABC counter-clockwise. The Customer should verify phase rotation with ATC before purchasing any equipment and proceeding with the Interconnection Facility construction. See Section 3.7.2 of this guide for additional information.

### **3.17 Maintenance Coordination**

#### **3.17.1 Maintenance Notification**

The Customer must notify ATC or Midcontinent ISO as provided for in the applicable Midcontinent ISO ASM Tariff and the D-T IA of any unusual conditions including, but not limited to the following:

1. Partial operating capability due to equipment limitations.
2. Scheduled outage periods and return to service expectations. Return to service notification must be updated daily to reflect the recent progress or the lack of progress.

#### **3.17.2 Maintenance**

Interconnection equipment owned by the Customer should be maintained and inspected according to manufacturer recommendations, NERC, and/or industry standards. Procedures must be established for visual and operational inspections. Provisions should be established for equipment maintenance and testing as part of the Interconnection Facilities design.

ATC maintains the right to review the maintenance, calibration, and operation data of all protective equipment for protecting ATC facilities, ATC Customers, and other Interconnected Parties. The Customer is responsible for providing the necessary test accessories (such as relay test plugs, instruction manuals, wiring diagrams, etc.) required

to test these protective devices. Verification testing may include the tripping of the interconnection breaker, as appropriate.

If ATC performs work on the premises of the Customer, ATC operating personnel may inspect the work area. If ATC personnel deem working conditions to be hazardous, the Customer must correct the unsafe conditions before ATC personnel will perform their work.

### **3.18 Operational Issues (Abnormal Frequency and Voltages)**

#### **3.18.1 Abnormal Frequency and Voltages**

As part of the Interconnection Facilities design, ATC and the Customer will work together to establish appropriate procedures, protocols and operating guides (if necessary) to account for and manage abnormal frequency, voltages or other operating limits on either party's system in accordance with all appropriate industry standards, Mandatory Reliability Standards, and Good Utility Practice.

#### **3.18.2 Power System Restoration Design Considerations**

ATC is required to maintain a power system restoration plan in accordance with NERC Standard EOP-005, including provisions for supplying cranking power to target facilities and off-site power to nuclear plants. If the proposed Customer interconnection impacts the ATC restoration plan, as determined by ATC, additional design requirements may be identified, such as, requiring interconnection to a different transmission facility, where available. If the ATC restoration plan will be impacted, the Customer will be required to install and maintain SCADA control of the Customer owned high side disconnecting devices. Alternatively, ATC will install a ring bus interconnection configuration to ensure appropriate clearing of distribution equipment in a timely manner.

### **3.19 Inspection Requirements for Existing or New Facilities**

#### **3.19.1 Acceptance Testing, Inspection and Commissioning**

ATC requires all Customers proposing to interconnect to the ATC Transmission System comply with the applicable testing and/or performance requirements as part of the Interconnection Facilities design.

#### **3.19.2 General**

Prior to energizing the interconnection equipment with the ATC Transmission System, the Customer and ATC will work together to ensure that all pertinent contracts (such as the D-T IA) are signed and that all equipment modifications have been completed. The Customer is required to demonstrate the correct operation of all interface protective and control devices to ATC. ATC shall define and witness but is not responsible for performing this demonstration.

The Customer must provide detailed information on the protective relaying, metering, and control (including sync-check) equipment that will interface with the ATC Transmission System.

Scheduling of demonstration testing should be coordinated through ATC with a minimum of fifteen business days notice. Any outage of ATC protection equipment must be requested and approved in accordance with ATC's System

## **A T C**

Operation Approval Procedure for System Protection Equipment and Communication Channel Outages. This procedure is available upon request<sup>26</sup>.

ATC commissioning specifications and documentation requirements are available upon request<sup>27</sup> and provide the specific criteria that ATC uses for ensuring its electrical equipment is properly tested and checked out. Inspection and approval by ATC does not constitute a warranty or relieve the Customer of responsibility for the operating condition or installation of the equipment and may not be relied upon by the Customer for that purpose. Once interconnected, ATC will retain the right to inspect the Interconnection Facilities at ATC's discretion.

### **3.19.3 Demonstration**

The Customer and ATC shall adhere to the following steps in assuring that the Interconnection Facilities have been adequately tested both prior to and after energization and interconnection to the ATC Transmission System:

- Construction testing documentation review,
- Demonstration tests,
- Post in-service tests.

Details on the specific testing requirements are to be coordinated between ATC and the Customer as part of the commissioning process.

### **3.19.4 Future Changes In Requirements**

From time-to-time new requirements for testing, reporting, equipment and/or performance are established by NERC or Regional Entity for interconnections. The Customer should take the appropriate actions, so it is notified of any requirement changes by the applicable entity.

### **3.19.5 Performance of Tests**

The Customer must test all wire, cable, electrical equipment, and systems installed by the Customer or connected by the Customer to assure proper installation, adjustment, setting, connection, and functioning. Details on the

---

<sup>26</sup> See the footnote on page [47](#) for additional guidance.

<sup>27</sup> See the footnote on page [47](#) for additional guidance.

## **A T C**

performance of specific testing requirements are to be coordinated between ATC and the Customer as part of the commissioning process.

### **3.19.6 Test Equipment**

The Customer must provide all equipment necessary to perform the tests required by ATC. Details on the specific testing equipment requirements are to be coordinated between ATC and the Customer prior to performing tests.

### **3.19.7 ATC Supplied Equipment**

Any ATC supplied equipment that is factory calibrated (transducers, pressure switches, tuners, etc.) shall be tested to verify calibration consistent with ATC testing practices. The use of ATC supplied equipment shall be coordinated with the appropriate ATC personnel prior to performing tests.

### **3.19.8 Final Design / Final “Draft” As-Built Documents**

The Customer must at the time of demonstration testing have a complete set of construction drawings and documentation available. ATC and the Customer will coordinate together what information is required prior to demonstration testing. ATC shall be provided a duplicate copy of this documentation at least fifteen business days

prior to demonstration testing. A coordination meeting with ATC should be held to clarify any questions on documentation or testing requirements at least one week before demonstration testing begins.

### **3.20 Communications and Procedures During Normal and Emergency Operating Conditions**

ATC and the Customer will design the Interconnection Facilities to function properly under both Normal and Emergency Operating Conditions. General guidelines will be stated below, but any specific guidelines will be defined in the D-T IA between ATC and the Customer.

The Customer shall operate within the applicable guidelines of this document and any other specific requirements as stated in the D-T IA, if applicable.

#### **3.20.1 Normal Conditions**

The Customer must have twenty-four-hour support available and operate according to the instructions and approval given by the ATC system control center personnel:

#### **3.20.2 Abnormal Conditions**

ATC reserves the right to open the interconnection disconnecting device for any of the following reasons:

1. ATC line maintenance work on ATC Transmission System.
2. ATC Transmission System emergency.
3. Inspection of a Customer's substation equipment and protective equipment reveals a hazardous condition.
4. Failure of the Customer to provide maintenance and testing reports when required.
5. Customer's Interconnection Facilities interfere with other ATC customers, other Interconnection Parties, or with the operation of the ATC Transmission System.
6. Customer has modified the Interconnection Facilities that affects ATC equipment without the knowledge and approval of ATC or has not installed ATC required protective devices.
7. Personnel or public safety are threatened.
8. Customer fails to comply with applicable OSHA Safety Tagging and Lockout requirements or ATC Hold Card Procedures.

Changes to the ATC Transmission System or the addition of other ATC Customer Interconnection Party's facilities, loads, or generators in the vicinity of the Customer's Interconnection Facilities may require modifications to the



Customer's and ATC's interconnection protective devices. If such changes are required, the Customer may be subject to future charges for these modifications as described in the D-T IA.

## 3.21 Transformers

### 3.21.1 Transformer Connections

The Customer shall clearly designate the proposed transformer connection scheme and provide drawings and test reports submitted to ATC. ATC prefers delta-grounded wye for the Customer's transformer connection scheme. ATC shall review other transformer configurations on a project specific basis depending on the circumstances.

### 3.21.2 Transformer Protection

The Customer shall install, own and maintain transformer protective equipment<sup>28</sup>, including surge protection devices on the Customer side of the Point of Interconnection. For straight bus applications, the Customer may design transformer protection using one of four options. The Customer will determine the most appropriate option by considering the transmission connection, available fault current<sup>29</sup> and the Customer's standard practices. These options are:

- Option 1. - A circuit breaker in series with a source-side disconnect switch installed at the load interconnection substation,
- Option 2. - A circuit switcher or transrupter with an integral visible air-break switch can be utilized in existing substations where space is constrained. This configuration is not recommended for new interconnections, (see Section 3.21.4 for additional information on disconnect switches)
- Option 3. - A circuit switcher or transrupter **without** an integral visible air-break switch and an air-break switch in series with the circuit switcher or transrupter,
- Option 4. - Fuses in series with an air-break switch (with the switch must have the capability to break Customer transformer magnetizing current and the fuse must interrupt for all transformer faults). Fuses can only be used on 69 kV interconnections.

Additional design considerations include:

- The Customer's interrupting device shall not be designed to depend upon AC power, including capacitive trip devices, for tripping.
- ATC will provide expected short circuit currents for a specific location upon request<sup>30</sup>.
- For options 1-4, the Customer's interconnection will contain current transformers sufficient for supporting an ATC bus differential protection scheme if necessary. All interconnections to breakered substations must meet this requirement. ATC has specific CT requirements for differential protection. See Section 3.9.3 for specific CT requirements.

ATC and its Customers will coordinate the application and use of transformer protection as part of the development and design of the interconnection project. As discussed in Sections 3.2.1 & 3.2.2 the Customer must submit the

---

<sup>28</sup> Note: All of the interconnection configuration drawings in Appendix F use a breaker symbol (with interrupting device "i.d." designation) to represent the general requirement of a customer-owned protective device per this section. ATC prefers utilizing a breaker in this application, however a circuit switcher or a fuse may be a viable alternative. Consult previous sections in this guide for recommended devices. The demarcation point (change of ownership point) is at the source-side terminal of the customer-owned disconnecting device.

<sup>29</sup> Note: The high voltage device must be capable of interrupting the worst-case fault current (from ATC) and not rely on bus tie breakers or line circuit breakers as low-cost method for protecting for high current faults.

<sup>30</sup> See the footnote on page [47](#) for additional guidance.

## **A T C**

transformer manufacturer's test report prior to ATC initiating the design work and the CT ratio curves to ATC as a part of the engineering review package, specified in section 3.9.3 of this guide.

ATC and its Customers will coordinate the application and use of circuit breakers as part of the development of the interconnection project. It is understood that when ATC installs line breakers at 100 kV and above on greenfield sites, it is expected that the LDC also installs circuit breakers to protect their transformers.

For existing substations with transformer additions and/or replacements it is expected that the LDC installs circuit breakers as transformer protection if any one of the following situations is true:

- A bus outage that the LDC transformer is located on violate an Interconnection Reliability Operating Limit.
- There are concerns with NERC TPL-001 P2-P7 contingencies.
- There is 30 MWs or more of non-consequential load loss. Substations with multiple transformers will be addressed in the following way:
  - In a substation with transmission bus-tie breaker – load served by failed equipment is not counted
  - In a substation without transmission bus-tie breaker – load served by failed equipment is counted
  - Assumes multiple transformer substations have capacity for transformer failure
- There are more than three transmission network elements (ATC transformers are included; capacitor banks are not included unless if the outage of the capacitor bank or banks behind a single breaker results in a limitation of ATC's Planning Criteria).

### **3.21.3 Circuit Breakers**

If transmission circuit breakers are required in the Interconnection Facilities design (typically when 30 MW of load is forecasted within the 10-year planning horizon, or the sectionalizing guidelines are applied), ATC will install a breaker on each of the line terminals at a straight bus load interconnection substation. The application of a bus-tie breaker will be considered when 30 MW of substation load is achieved. ATC may also elect to install breakers in any position

deemed appropriate for reliable design when the subject interconnection substation includes more than two transmission line elements and/or a generation interconnection(s).

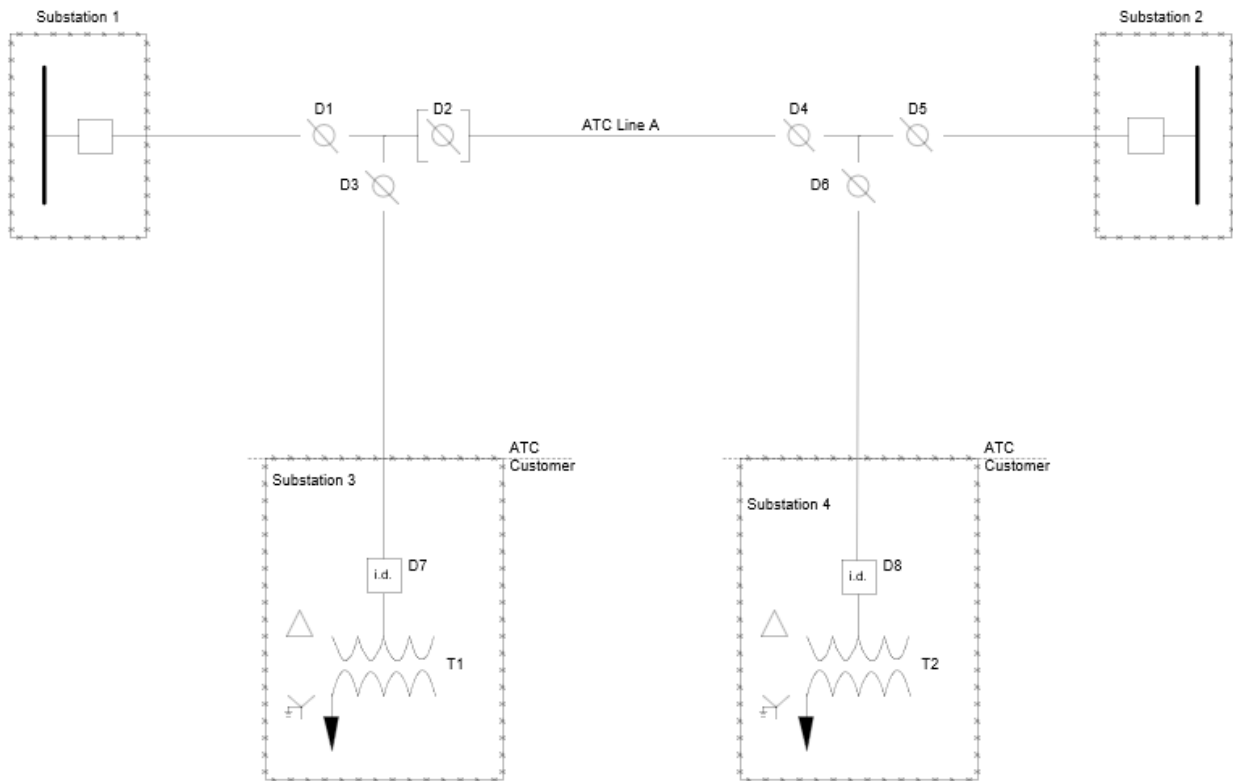
If a Customer-owned circuit breaker is installed, CT requirements for ATC bus differential protection should be evaluated as needed. See Section 3.9.3 for specific CT requirements.

**3.21.4 Disconnect Switches**

Load interconnection facilities shall include disconnect switches located in appropriate places which are summarized here.

All line disconnect switches shall be installed on steel structures. Installation on wood structures is not acceptable (unless installation is temporary, i.e. scheduled to be removed within two years).

Since the configuration drawings in Appendix F provide details for any single load interconnection, Figure 1 is provided to show the minimum installation of mainline switches for a typical line with multiple radial load interconnections.



\* ATC and its Customer will work together to determine if a radial connection is the most appropriate design for any single interconnection.

Figure 1: Typical switch installation on a line with multiple radial taps<sup>31</sup>

ATC will apply switches with load-break, and/or line-charging current break capability as necessary, after considering the proper current breaking capability of all proposed and existing disconnect switches on the transmission line(s) affected by the proposed interconnection.

Motor-operators and RTUs are elective facilities for the convenience of the Customer and are paid for by the Customer. The exception to this statement is when the use of this equipment is determined to be appropriate per Section 3.6.1 of this Guide. ATC reserves the right to approve the design and equipment to be installed for these purposes since these devices directly impact the reliability of the switch installation.

For load interconnection requests that are on 69 kV lines, ATC will use phase-over-phase switch installations. In addition, ATC may install a 3-way switch to facilitate construction and coordinate outages most effectively.<sup>32</sup> For load interconnection requests that are on 138 kV lines, ATC will use horizontal mounted switches.

## 3.22 Physical Design Guidelines

### 3.22.1 Site Selection

One of the most critical factors in the design of a substation is its location. It is important that the site selected have sufficient space to accommodate the present and future Customer and/or ATC's use. The Customer should review all potential substation sites with ATC prior to purchasing property.

The preparation of the site should follow ATC Design Criteria. The Customer shall submit soil borings and resistivity reports to ATC for review and use in the design of ATC's transmission facilities.

The Customer should consider the following factors when siting a load interconnection substation:

- Environmental considerations, including previous site usage or possible permitting issues,
- Sufficient size to accommodate the ultimate interconnection configuration requirements,
- Ingress/egress, including proximity to all-weather roads and/or railroad siding for (heavy) equipment installation and removal,
- Proximity to existing transmission lines and other utilities,
- The availability of suitable right-of-way and access to the substation site for transmission lines,
- Proximity to potential contaminants (such as highway salt),
- Site maintenance requirements including repair, landscaping, and storage, and
- The ATC communication methods presently employed on the existing line to be tapped, including the availability or feasibility of other methods (microwave, fiber, power line carrier, leased phone-lines, and point-to-point radio). If a substation requires underground interconnection, the cost for an underground load interconnection will be borne by the Customer, unless the interconnection is to be made to an existing ATC underground transmission line. The Customer should consult with ATC for design details regarding the feasibility of underground transmission facilities with respect to the location siting decision. Consult ATC Business Practice, Elective Undergrounding for additional details.

### 3.22.2 Space Requirements

When reasonably possible, the Customer will provide sufficient physical space to accommodate not only ATC and the Customer's present but also anticipated future use of the substation (see Appendix F for typical space requirements of each substation configuration). Such additional ATC requirements, beyond those outlined in the ATC Design Guide, may include transmission capacitor banks and/or additional ATC-owned elements (e.g. lines). Space required for an ATC capacitor bank is detailed in ATC Guide. The Customer should also consider its

---

<sup>32</sup> Phase-over phase switch installation is only acceptable for 69 kV applications or where physical space in an existing right-of-way does not accommodate a horizontal mount installation. Hydraulic motor-operators are not permitted for phase-over-phase switch installations, since experience has demonstrated insufficient hydraulic pressure often results in switch contact not closing properly.

## **A T C**

requirements for connection of a mobile substation as a means for load bridging under emergency outage circumstances.

The Customer shall also provide sufficient clearance from energized equipment to satisfy the NESC and ATC Design Criteria. To facilitate maintenance access, ATC prefers to maintain a horizontal clearance between the substation fence and bus support structures or equipment consistent with the Safety Clearance Zone specifications consistent with the NESC Section 110.A.2. Please refer to the ATC Design Criteria CR-0060 entitled “*Substation Site Design*”, Section 4.3. The Customer shall discuss exceptions with ATC as part of the design review process.

### **3.22.3 Ownership Demarcation**

The Point of Interconnection will be where the Customer interconnection facilities connect to the ATC Transmission System.

#### **3.22.3.1 Radial Connections**

The point of interconnection between ATC and Customer-owned high-voltage facilities will be at the Customer end of the jumper connected to the ATC-owned line insulator connection at the Customer’s dead-end structure. For an overhead ATC-owned transmission tap conductor terminated at a Customer-owned dead-end structure, the Customer will include provisions on that structure to accommodate the installation of surge arresters by either party, if necessary. Through the project team, ATC and its Customer will select an appropriate connector and coordinate responsibility for furnishing and installing the connectors as well as completing the final connection to the Customer-owned facilities. Note: Jumpers between the transmission line (overhead conductor or rigid bus conductor) and the LDC disconnect switch will be owned by the LDC in both situations described above.

#### **3.22.3.2 Network Connections**

The Customer’s connection at the high-voltage bus side terminal of the Customer-owned disconnecting device will be the physical point of transmission facilities ownership demarcation between ATC and Customer-owned facilities. Through the project team, ATC and its Customer will select an appropriate connector and coordinate responsibility for furnishing and installing the connectors as well as completing the final connection of the jumpers to the Customer-owned facilities.

The default Point Of Interconnection for interconnected bus differential relaying is located at the terminal of the Customer-owned CTs on the Customer-owned breaker or transformer. ATC owns all of the cables up to the Customer-owned CTs on the Customer-owned breaker or transformer.

### **3.22.4 Land Rights**

#### **3.22.4.1 Customer-Owned or Leased Substation Lands**

The Customer shall furnish at no cost to ATC any necessary access, easements, licenses, and/or rights-of-way upon, over, under, and across lands owned by the Customer and/or its affiliated interests for the construction, operation and maintenance of necessary lines, substations, and other equipment to accomplish the requested interconnection. ATC will be responsible for obtaining land rights from third parties. The Customer will be responsible for obtaining all of the appropriate permits for the substation.

#### **3.22.4.2 ATC-Owned Substation Lands**

ATC will furnish at no cost to the Customer any necessary access, easements, licenses, and/or rights of way upon, over, under, and across lands owned by ATC and/or its affiliated interests for the construction, operation and

maintenance of the Customer's facilities. The Customer will be responsible for obtaining any land rights from third parties. ATC will be responsible for obtaining all of the appropriate permits for the substation.

### **3.22.5 Clearances**

Clearances to ATC substation facilities shall satisfy ATC Design Criteria.

### **3.22.6 Line Termination Structures**

The Customer and ATC shall carefully coordinate the substation design of the last span of wire between the last ATC transmission tower and the substation overhead line terminal structure(s). ATC and the Customer together will arrange the orientation of the substation in relation to ATC's incoming transmission line(s) to minimize line angles, turning towers, and crossings.

ATC will typically design the last full-tension tap span to terminate into an ATC-owned structure outside the Customer's radially fed load interconnection substation. However, where physical constraints dictate, and ATC-owned transmission lines terminate at a Customer-owned terminal (dead-end) structure, the Customer will design the structure to support the loads identified for ATC's equipment provided by ATC's Design Engineering Department and those outlined in ATC Design Criteria.

#### **3.22.6.1 Site Preparation**

Examples of the common facilities requirements that are applicable to Customer-owned substations containing ATC equipment can be found in the ATC Business Practice BP 0403 entitled Joint-Use Substation Cost Responsibility for Common Facilities.

##### **3.22.6.1.1 Greenfield Interconnection Substation**

The Customer is responsible for providing a suitable site for the load interconnection substation. When appropriate, the Customer will be required to convey to ATC all necessary easements, in a form acceptable to ATC, over all property owned, leased or otherwise controlled by the Customer, including easements for ingress and egress to permit ATC access to all of the ATC Interconnection Facilities and Network Upgrades, which are on the property of the Customer. Additionally, the site that the Customer provides to ATC must be sufficiently large enough to accommodate the present and future uses of ATC and meet the rough grading requirements of ATC for the substation pad. ATC design expectations and review of rough grading are listed in ATC Construction Standard Specification Manual – section 31.10.10., available upon request<sup>33</sup> The specific real estate requirements will be determined during the detailed design.

The Customer will be responsible for obtaining all necessary zoning, building, and environmental, permits or approvals required for the load interconnection substation. This includes permits for impacts to waterways, wetlands, floodplains, or endangered resources and any compensatory mitigation associated with such permits. The specific permits required will depend on the characteristics of the site and the local jurisdiction. When appropriate, copies of all environmental permits obtained shall be provided to ATC in order to ensure that ATC's construction of the substation meets all permit requirements.

The Customer is responsible to design, obtain permits and install all storm water management facilities for the load interconnection substation and the overall Customer property. The Customer will be responsible for establishing final grade, revegetation, and any necessary landscaping of the portion of their property. When appropriate, the Customer's

---

<sup>33</sup> See the footnote on page [47](#) for additional guidance.

## **A T C**

storm water management permit shall allow for ATC's construction activities to build the substation and bring it to final grade. Long-term maintenance and inspections of all storm water management facilities are the responsibility of the Customer. If ATC's construction activities disturb areas where the Customer has completed final grading and re-vegetation, ATC will repair the disturbance in a timely manner.

### **3.22.6.1.2 Existing Interconnection Substation**

If the Customer chooses to modify or expand an existing load interconnection substation that results in the need for environmental permits/approvals, ATC and the Customer (and landowner if other than ATC or Customer) will coordinate to determine which entities will be responsible for obtaining the necessary permits/approvals.

### **3.22.6.2 Control Enclosures**

The Customer will design control enclosures (buildings) that contain ATC relaying with sufficient space for convenient access to control panels - with at least 36 inches of clear space behind the panels and unobstructed access

## **A T C**

to substation batteries. Please review ATC Design Guide or refer to the latest version of the NESC for additional guidance.

### **3.22.6.3 Security / Access**

The Customer will design, install, own, and maintain the substation fence.

The Customer will make provisions at both the substation gate and the control enclosure for an ATC lock, thereby enabling ATC access by an ATC-owned key or other electronic means.

The Customer will design the substation outdoor lighting system to provide adequate illumination for security, emergency ingress/egress, and position indication of disconnect switchblades. ATC does not require lighting for nighttime maintenance operations.

Substations interconnected to the ATC transmission system above 100 kV may need additional security and access included in the design. This will be determined by the design team during the project.

### **3.22.6.4 Conduit / Raceway**

The Customer will install, own, and maintain substation cable conduit and/or raceway systems.

### **3.22.6.5 Signs and identification**

The following requirements apply to all substations containing ATC equipment.

- For maximum effectiveness, the Customer will place security and identification signs at eye level (less than six feet and more than four feet above grade or floor level).
- On Customer-owned dead-end and/or switch structures, the Customer will provide phase identification signs on A, B, and C phases to indicate ATC standard phase rotation next to the termination device for each interconnection point.

### **3.22.6.6 References**

The following documents<sup>34</sup> provide additional guidance for use in the development of load interconnection facilities between ATC and its Customers:

- ATC Business Practice, Coordination of Local Balancing Authority Metering Boundary Modifications (See the ATC website <https://www.atcllc.com/customer-engagement>).
- ATC Business Practice, Capacitor Bank Installations on Distribution Systems for Transmission Benefit (See the ATC website <https://www.atcllc.com/customer-engagement>).
- ATC Business Practice, Elective Interconnection Facilities for additional information (See the ATC website <https://www.atcllc.com/customer-engagement>).
- ATC Business Practice; Elective Undergrounding (See the ATC website <https://www.atcllc.com/customer-engagement>).

---

<sup>34</sup> Internal ATC references/documentation are available upon request to existing customers and entities with a signed non-disclosure agreement with ATC. Please contact ATC Interconnection Solutions ([T-DL.IRES@atcllc.com](mailto:T-DL.IRES@atcllc.com)) for additional information and guidance.



**A T C**

- ATC Business Practice, Joint-use Substations -- Common Facilities (See the ATC website <https://www.atcllc.com/customer-engagement> ).
- ATC Business Practice; Load Bridging for Transmission Related Work (<https://www.atcllc.com/customer-engagement> ).
- ATC Business Practice, Project Acceleration (<https://www.atcllc.com/customer-engagement> ).
- ATC Construction Standard Specification Manual (Available upon request).
- ATC Criteria CRT-0060, Substation Site Design (Available upon request).
- ATC Guide GDE-8000; Substation Capacitor Bank (Available upon request).
- ATC Guide GD-2300; Substation Control House (Available upon request).
- ATC Guide GDE-4500, Substation Disconnect Switch (Available upon request).
- ATC Distributed Energy Resource Guide GD-1701 (Available upon request).
- ATC Best Value Planning White Paper (See the ATC website: <http://www.atcllc.com/customer-engagement> ).
- ATC Planning Criteria (See the ATC website: <https://www.atc10yearplan.com/about/planning-criteria-and-tools-2/> )
- Midcontinent ISO Tariff - Open Access Transmission, Energy and Operating Reserve Markets Tariff (ASM Tariff) - Midcontinent ISO FERC Electric Tariff, First Revised Vol. No. 1.
- National Electrical Code.
- National Electrical Safety Code.
- IEEE Standard 1246 “Guide for Temporary Protective Grounding systems used in Substations”
- IEEE Standard 1547 “IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power System Interfaces”
- NERC Reliability Standard FAC-002-3
- NERC Reliability Standard FAC-001-3.3

Effective Date: 02/12/25		<b>Revision: 14.0</b>
<b>TITLE:</b> Trevor Stiles, Director of Customer and Corporate Affairs	Load Interconnection Guide Approved by: <i>TD Stiles</i>	<b>Page 48 of 75</b>

**A T C**

## **Revision History**

### **Revision Information**

**A T C**

Revision	Author	Date	Section	Description
14.0	Kaylin Schueler	2/12/25	Various	<ul style="list-style-type: none"> <li>• Addition of PAA as option for projects with regulatory filings.</li> <li>• Radial Connections section – edit to ensure it is represented that the customer owns the jumpers and switches at the end of a radial line.</li> <li>• Appendix F – Removal of Sectionalizing Matrix and publishing new Sectionalizing Device Flowchart to atelc.com.</li> </ul>
13.0	Kaylin Schueler	2/21/24	Various	<ul style="list-style-type: none"> <li>• Addition of MISO DER AFS Process</li> <li>• Refresh of construction lead times based on current environment.</li> <li>• Un-Forecasted Load Interconnection Requests- guidance and language related to additional studies and when ATC charges the customer for a study</li> <li>• Updates to Appendix C &amp; F</li> </ul>
12.0	Kaylin Schueler	1/11/23	Various	<ul style="list-style-type: none"> <li>• Section 3.6.2 Line Topology – Radial versus Loop-through Connections</li> <li>• Updates to links and functional area names</li> <li>• Updates to Appendix B and C</li> </ul>
11.0	Kaylin Schueler	12/10/21	Various	<ul style="list-style-type: none"> <li>• Added reference to DER Request Form</li> <li>• Removal of all language and diagrams related to 2 way switches</li> <li>• Updates to LIG diagrams – Appendix B</li> <li>• Updates to Load Interconnection Configurations – Appendix F</li> </ul>
10.0	Kaylin Schueler	12/18/20	Various	<ul style="list-style-type: none"> <li>• DCG terminology/definition updated to DER</li> <li>• Additions of MCW, NCW and CW definitions</li> <li>• Added Site Preparation language</li> <li>• Removal of MCW \$ threshold</li> <li>• Update to Interconnection Configuration Diagrams &amp; Figure 1 Disconnect Switches</li> </ul>
9.0	John Raisler	12/20/19	3.9.5.1	<ul style="list-style-type: none"> <li>• Clarified that the installation of VTs will be to ATC design specifications.</li> </ul>
8.0	John Raisler	12/20/18	Various	<ul style="list-style-type: none"> <li>• Updated various links and document references</li> <li>• Added Battery Storage to DCG definition</li> <li>• Added appropriate project documentation definition and description to reflect updated project commitment practice.</li> <li>• Replaced circuit switcher symbol with breaker symbol to represent interrupting device (i.d.) in all Appendix F substation configuration diagrams and Figures in the document.</li> <li>• Clarified language in various sections for readability.</li> </ul>
7.0	John Raisler	12/15/2017	3	<ul style="list-style-type: none"> <li>• Clarified language in the two breaker failure scenarios.</li> </ul>
6.0	Heather Andrew	12/21/2016	Various	<ul style="list-style-type: none"> <li>• Updated reference to FAC-001</li> <li>• Updated one-lines</li> <li>• Added SOCA reference</li> <li>• Updated BA Metering reference</li> </ul>
5.0	Heather Andrew	12/16/2015	Various	<ul style="list-style-type: none"> <li>• Updated Appendix F,</li> <li>• Added Appendix G,</li> <li>• Removed Planning Coordinator role</li> <li>• Updated transformer protection section</li> <li>• Updated power factor section</li> <li>• Removed Index</li> <li>• Removed copies of LIRF and PCA</li> </ul>
4.01	Heather Andrew	10/09/2014	Appendix F	<ul style="list-style-type: none"> <li>• Updated the Flowchart</li> </ul>

**A T C**

4.0	Heather Andrew	6/16/2014	All	<ul style="list-style-type: none"> <li>• Changed MISO’s name to Midcontinent Independent System Operator</li> <li>• Section 2.1.2 – Last Paragraph, changed “will be responsible to pay...” to “may be responsible to pay...”</li> <li>• Updated Sections 3.3 and 3.4 with the correct reference sections.</li> <li>• Section 3.6 – added a statement clarifying when a ring bus would be implemented.</li> <li>• Section 3.6.1.1 – updated to reflect what load level drives line breakers and a bus tie breaker.</li> <li>• Section 3.6.3 – corrected the phasing table for Cloverland/Edison Sault</li> <li>• Section 3.9.1 – removed fuses for an option for new substation and the footnote. Added a statement about fuses at existing locations.</li> <li>• Section 3.9.5 – added a reference to the new Planning Guideline for distribution connected generation.</li> <li>• Section 3.15.4 – added a statement about when circuit breakers are recommended for LDC transformer protection. Also added a paragraph as to the CT requirements.</li> <li>• Section 3.21.2 – added a statement about integral circuit breaker/switch configurations for existing and new interconnections</li> <li>• Section 3.21.3 – added two clarifying statements about when breakers are considered</li> <li>• Appendix B – Updated the CA threshold reference in the box on lower right corner</li> <li>• Appendix C – Updated the BVP process map</li> <li>• Appendix C – updated the table to reflect the new BVP Assessment Types per the new Queue layout.</li> <li>• Appendix F – Added a bus configuration decision tree</li> <li>• Appendix F – Configurations J and K became I and J because there was no I previously</li> </ul>
3.0	John Raisler	1/21/2013	All	
2.0	John Raisler	08-24-11	All	<p>Rearranged &amp; added sections to align with FAC-001 requirements ordering of topics.</p> <p>Added</p> <p>Expanded Distribution Connected Generation discussion in 3.10.5</p> <p>Added BVP Process Flow Diagram Appendix B</p> <p>Updated BVP Responsibilities Matrix Appendix C</p> <p>Updated LIRF example</p> <p>Added Revision History</p>
1.0	John Raisler	10-09-09	All	<p>New - Includes review by: System Protection, Operations, Commissioning, Safety, Substation Services, Environmental, Maintenance, Metering, Planning, Legal and Interconnection Services.</p>

## Appendix A.1 – Glossary of Terms

Any capitalized terms not defined herein will have the meanings set forth in the Midcontinent ISO Tariff.

**ATC Design Criteria, ATC Guide:** are terms used to reference a series of design criteria documents and guides used internally at ATC to document specifications for various transmission facilities. (See Section 3.4 references) The documents are available upon request.

**ATC Transmission System:** the facilities owned by ATC subject to the administration of the Midcontinent ISO that are used to provide energy market, transmission, energy, and ancillary reserves market, interconnection services or Wholesale Distribution Service under the Midcontinent ISO ASM Tariff.

**Balancing Authority:** an entity responsible for managing an electric system area (a Balancing Authority Area) bounded by interconnection metering and telemetry; and capable of controlling generation to maintain its interchange schedule with other Balancing Authority Areas and contributing to frequency regulation and which has received certification by NERC or a Regional Reliability Council of NERC.

**Best Value Planning (BVP):** means the consideration of, or evaluation of, one or more alternatives to the proposed construction of new, or the modification of existing, transmission facilities which have been identified in a planning process to determine whether an alternative or alternatives exists that may include the construction of new, or the modification of the existing, distribution facilities or transmission facilities owned by others that is/are less costly or which may provide greater enhancement to the reliability, capability or integrity of ATC's transmission facilities and such interconnected transmission or distribution facilities when compared to the estimated cost of the construction and capability of the proposed new, or the proposed modification of, ATC's transmission facilities, while taking into account the environmental considerations, regulatory approvals and the ability to construct the proposed distribution or transmission facilities in a timely and appropriate manner.

**Best Value Planning Project Scoping Report:** the report jointly developed by ATC and its Customer that documents the decisions leading to the recommended project solution for a given load interconnection request. Once this report signed by both ATC and the Customer, it is then used to document the commitment to proceed with the project, support project approvals, project schedules, project budgets and regulatory requirements.

**Capital Work (CW) :** A D-T project in which ATC's scope drives the need for a full project team and the associated spend is considered capital. Examples may include but

not limited to a new substation, adding a transformer and installing sectionalizing device(s).

**Capital Work Letter:** A signed Capital Work Letter summarizes and commits ATC and the Customer to the agreed upon scope of work.

**Common Facilities:** those facilities, installed at a joint-use substation, which are substantially used and useful to more than one entity at such substation.

**Customer<sup>35</sup>:** any authorized distribution utility that proposes a new or modified load interconnection with ATC’s Transmission System at a nominal voltage level of  $\geq 50$  kV. For purposes of this Guide, Customers that serve load are Local Distribution Companies (LDCs) that include Investor-Owned Utilities, Municipal Utilities and Rural Electric Cooperatives. The LDCs may or may not be functionally NERC registered as Distribution Providers (DPs).

**Customer’s Interconnection Facilities:** all facilities and equipment, as identified in the D-T IA, that are located between customer load(s) and the Point of Change of Ownership, including any modification, addition, or upgrades to such facilities and equipment necessary to physically and electrically interconnect the load to the Transmission System.

**Distributed Energy Resources (DER):** is defined as “any resource located on the distribution system, any subsystem thereof or behind a customer meter.” These resources may include, but are not limited to, resources that are in front of and behind the customer meter, electric storage resources, intermittent generation, distributed generation, demand response, energy efficiency, thermal storage, and electric vehicles and their supply equipment – as long as such a resource is “located on the distribution system, any subsystem thereof or behind a customer meter.”<sup>36</sup>

**Distribution – Transmission Interconnection Agreement (D-T IA):** the form of the interconnection agreement. ATC utilizes an ATC developed Distribution –

---

<sup>35</sup> Any references to “customer(s)” are intended to include either the distribution utility, their end-use customer that is directly-connected to the transmission system, or both in the sense that the end-use customer’s relationship with ATC must be coordinated through the responsible distribution utility.

<sup>36</sup> DER as defined in FERC 18 CFR Part 35 – Docket No RM18-9-000; Order No. 2222 (pg. 91). Issued September 17, 2020 - [https://www.ferc.gov/sites/default/files/2020-09/E-1\\_0.pdf](https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf)

Transmission Interconnection Agreement template which is files at FERC and made part of the Midcontinent ISO ASM Tariff once it is fully executed.

**Existing Substation:** any substation other than the new interconnection substation at which any single new load interconnection is proposed.

**Facility Construction Agreement:** A signed FCA establishes a commitment by both ATC and the Customer to support the Project. An FCA is typically used to document elective facilities chosen by the Customer in support of the project.

**FERC:** the Federal Energy Regulatory Commission or its successor.

**Good Utility Practice:** any of the practices, methods and acts engaged in or approved by a significant portion of the electric industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region, including those practices required by Federal Power Act Section 215(a)(4). Good Utility Practice includes compliance with Mandatory Reliability Standards.

**Guide:** this ATC published document entitled “Load Interconnection Guide.”

**Interconnection Facilities:** the physical plant and equipment required to facilitate the transfer of electric energy between two or more entities; including communication equipment, substations and transmission lines.

**Joint-use Substations:** substations in which both the Customer and ATC own facilities.

**Load:** a customer’s projected normal peak demand load forecast (in both MW & MVAR) for a minimum 10 years, used by ATC for sizing interconnection facilities.

**Load Interconnection:** the interconnection service provided by ATC at a voltage level  $\geq 50$  kV to a Customer for transformation and/or utilization.

**D-T Interconnection Queue:** ATC maintains a listing of load and DER interconnection requests from its Customers for the benefit of both ATC and its Customers. The D-T Interconnection Queue is available on the ATC Web site at <http://www.atcllc.com/customer-engagement/> look for the link to the ATC queue towards the bottom of the webpage.

**Mandatory Reliability Standards:** those standards promulgated and approved by NERC as the Electric Reliability Organization (ERO), or any Regional Entity authorized

to do so, as ratified and approved by the FERC that are applicable to ATC and the Customer.

**Minimal Capital Work (MCW)** : a D-T project that results in minimal ATC scope and capital spend for minor equipment replacements and/or interconnection modifications. Examples may include work to support a mobile sub, high side protection upgrades & upgrades to surge arresters.

**MISO**: the Midcontinent Independent Transmission System Operator, Inc., the Regional Transmission Organization that administers the tariff and provides transmission and energy market services over the transmission facilities of its transmission-owning members in interstate commerce.

**MISO Tariff**: the MISO FERC Electric Tariff under the terms of which open access transmission, energy and operating reserves market and interconnection services are offered, as filed with the FERC, and as amended or supplemented from time to time, or any successor tariff. Used interchangeably with Tariff.

**NERC**: the North American Electric Reliability Corporation or its successor organization.

**Network Connection**: an interconnection configured with multiple transmission connections into the load interconnection substation. In addition to the Customer's load, transmission network power may flow through the interconnection facility.

**New Interconnection Substation**: any existing or new substation at which a new load interconnection is proposed.

**No Capital Work (NCW)** : a D-T project in which the ATC scope and costs are considered O&M. There are two types of NCW projects: **LDC support & LDC only**. If an LDC scope drives the need for system protection to review and update drawings and/or if there is commissioning work to support the project, the project is considered LDC support. If the LDC scope does not result in any ATC support work, but may require the LDC to submit updated documentation, like a transformer test report, it is considered LDC only.

**Planning Authority**: MISO is the responsible entity that coordinates and integrates transmission facility and service plans, resource plans and protection systems associated with the ATC Transmission System.

**Point of Change of Ownership (PCO)**: the point, as set forth in Appendix A to the D-T Interconnection Agreement, where the Customer's Interconnection Facilities connect to the ATC Interconnection Facilities.

**Project Commitment Agreement (PCA)**: the Project Commitment Agreement establishes the commitments by ATC and the Customer when significant resources are



required to site, engineer, design, permit, procure, and build the planned interconnection facilities. The PCA will also include any remaining study requirements, the timeline for any necessary regulatory approvals, cost estimates and the preliminary construction schedule.

**Radial Tap Connection:** an interconnection configured with a single transmission connection into the load interconnection substation.

**Tariff:** the MISO Tariff through which open access transmission service and interconnection service are offered, as filed with the FERC, and as amended or supplemented from time to time, or any successor tariff. Used interchangeably with MISO Tariff.

**Transmission Facilities:** for the purpose of this Guide, means electric lines and related facilities that are operated at 50 kV and above.

**Transmission Operator:** ATC is the entity responsible for the reliability of the ATC Transmission System. ATC is also the entity that operates or directs the operations of the ATC Transmission System.

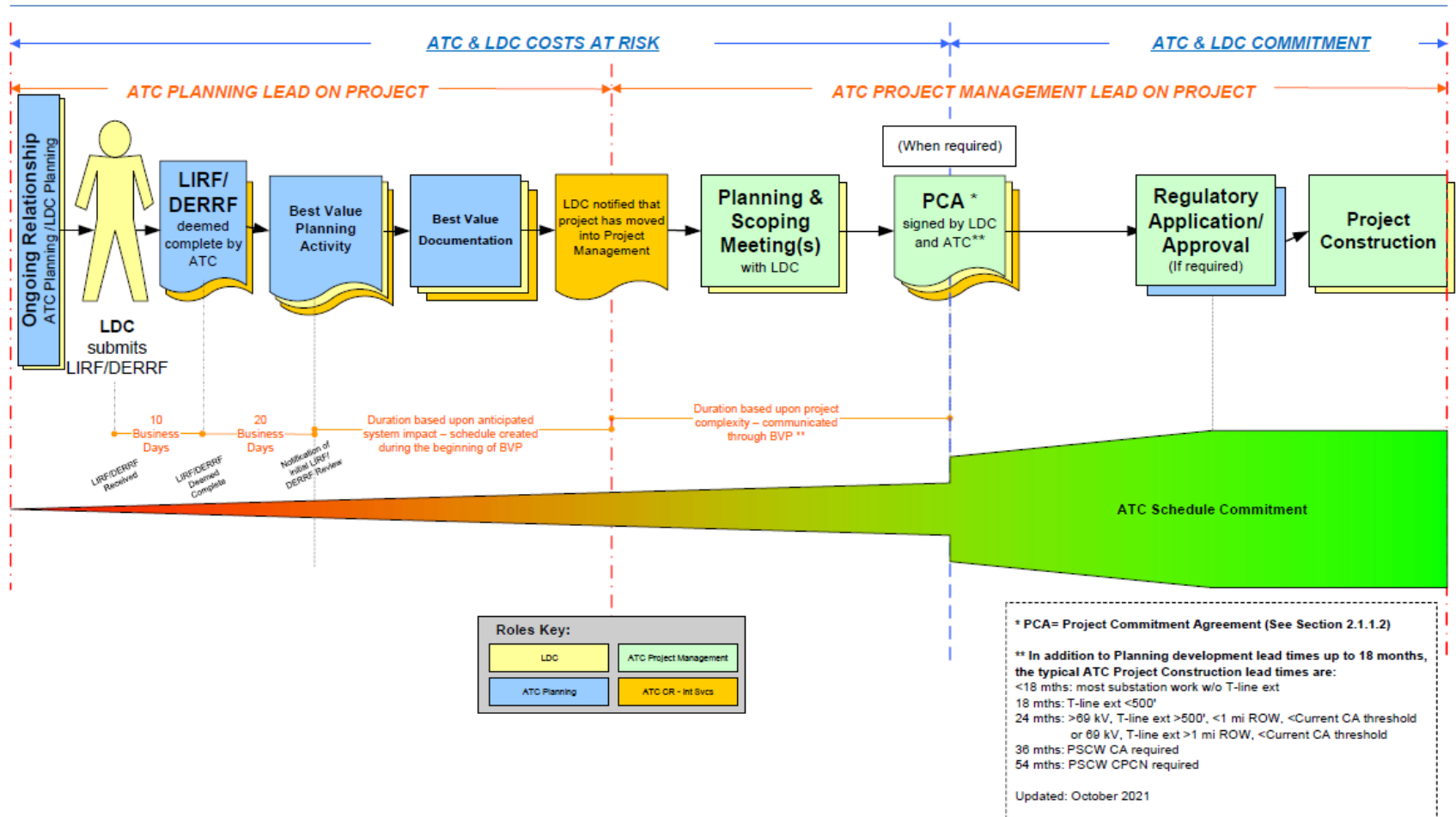
**Transmission Owner:** ATC is the entity that owns and maintains the ATC-owned Transmission Facilities.

**Transmission Planner:** ATC is the entity that develops a long-term (generally one year & beyond) plan for the reliability (adequacy) of the interconnected bulk electric transmission systems within its portion of the Planning Authority Area.

**Transmission System:** the facilities owned by ATC subject to the administration of the Midcontinent ISO that are used to provide energy market, transmission service or wholesale distribution service under the Tariff.

# Appendix B – Load Interconnection Process Overview

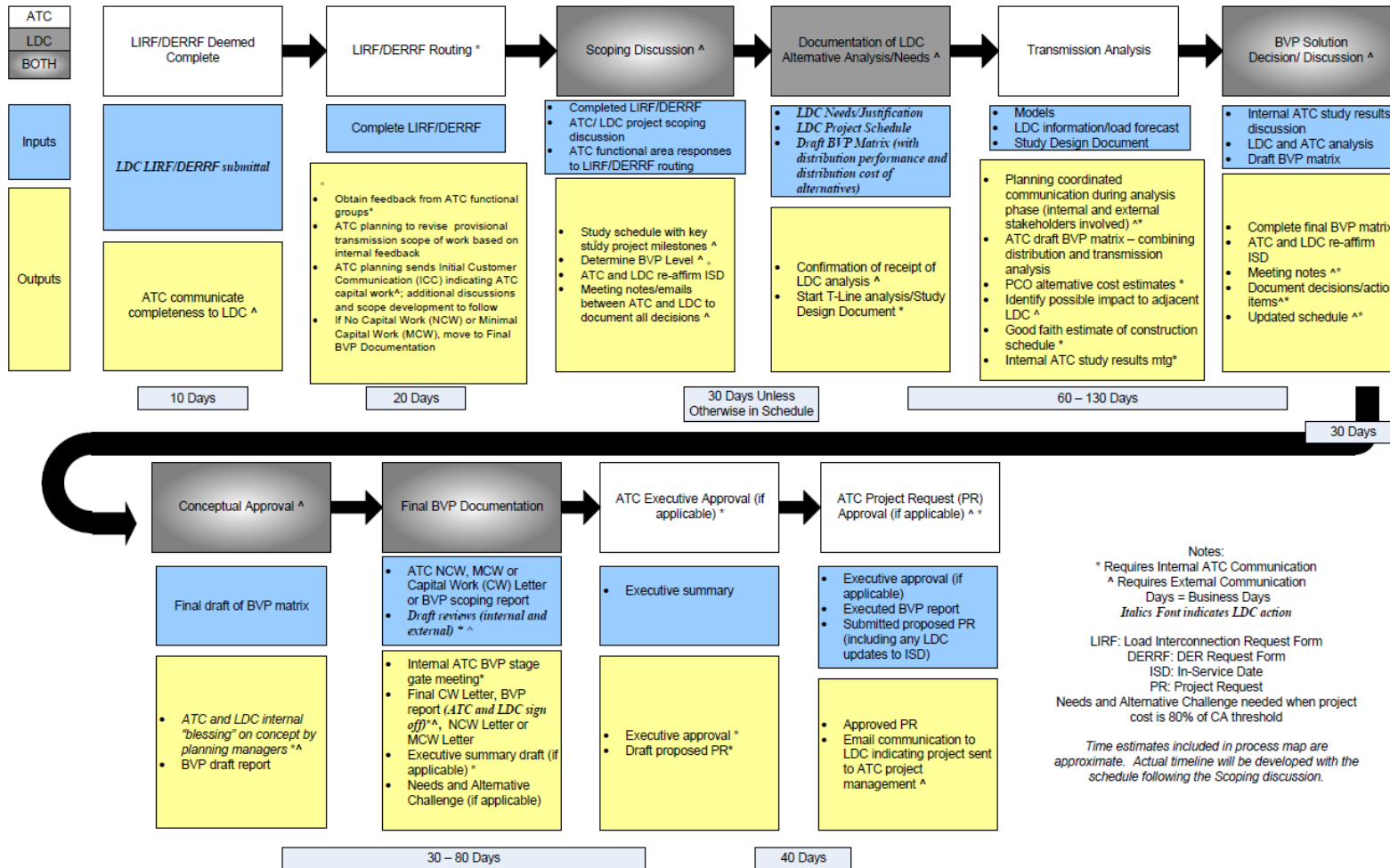
## SUMMARY - LDC & ATC LOAD INTERCONNECTION PROJECT COMPONENTS



# Appendix B – Load Interconnection Process Overview *(continued)* -Additional detail showing Best

## Value Planning Process Map

Best Value Planning Process Map Updated 11/2022



## Appendix C - Best Value Plan Documentation Descriptions

### Best Value Planning Assessment Type

BVP Assessment Type*	Explanation**	LDC Information (minimum)	Transmission Analysis	ATC Documentation
NCW	No ATC Capital Work and no transmission analysis	Completed LIRF/DERRF	No planning analysis – internal ATC routing only	NCW letter stating assessment completed
MCW	Minimal ATC Capital Work and no transmission analysis	Completed LIRF/DERRF	No planning analysis – internal ATC routing only	MCW letter stating assessment completed
Alternative Assessment	May include a transmission alternative interconnecting load to the transmission line currently serving the local load or assessment of multiple substation configurations	Completed LIRF/DERRF and LDC distribution assessment (as listed in guidelines in Appendix B)	Potential for planning analysis of alternatives including a difference analysis (compared to the base case model) including a selective list of NERC TPL contingencies and possibly different transmission system network and load configurations – amount determined by engineering judgment and team meetings	Letter stating assessment completed or BVP Scoping Report – describing the pertinent assumptions and assessment that was performed
System Study	ATC Executive approval needed or ATC Needs and Alternatives stage gate is needed (ATC project cost of 80% of the CA threshold) or multiple transmission alternatives. If applicable –ATC to file a Certificate of Authority (CA) or Certificate of Public Convenience and Necessity (CPCN) with the PSCW (CPCN) with the PSCW	Completed LIRF/DERRF and LDC distribution assessment (as listed in guidelines in Appendix B) with at least one viable distribution alternative (see Project Alternatives in Appendix B)	Modeling analysis for at least two alternatives including a difference analysis (compared to the base case model) including the complete list of NERC TPL contingencies with different transmission system network and load configurations. Modeling will encompass at least a 10-year planning horizon	BVP Scoping Report and if applicable - support for CPCN or CA filing documentation

\*BVP assessment type and high-level schedule will be developed after Scoping Meeting with Customer as seen in Appendix B

\*\*These are typical explanations of BVP types however any given project may change during BVP if the scope of work changes

## **Appendix D – Example Load Interconnection Request Form & Distributed Energy Resource Request Form**

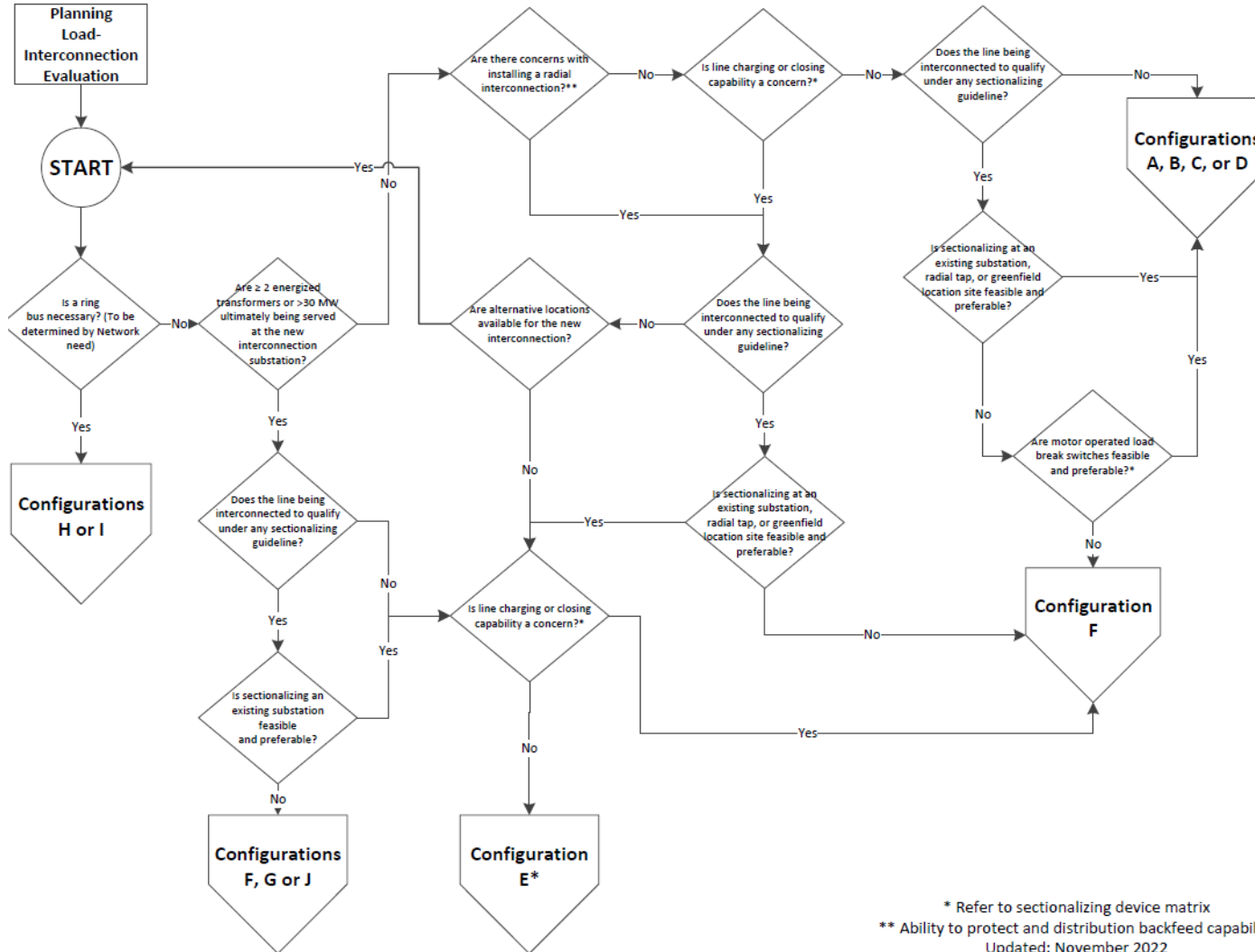
The LIRF and DERRF can be found at:  
<https://www.atcllc.com/customer-engagement/>

## Appendix E – Example Project Commitment Agreement

Please contact [T-DLIRFS@atcllc.com](mailto:T-DLIRFS@atcllc.com) for the current Project Commitment Agreement template.

# Appendix F – Interconnection Configurations

Figure 2 Bus Configuration Decision Flow Chart



\* Refer to sectionalizing device matrix  
 \*\* Ability to protect and distribution backfeed capability  
 Updated: November 2022

Note: When the proposed substation has two transformers and the load is < 30 MW, it is acceptable to not include line breakers in the original substation design.

## Sectionalizing Device Flowchart

The flowchart can be found at:

<https://www.atcllc.com/customer-engagement/>



















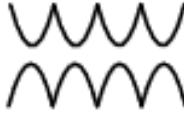

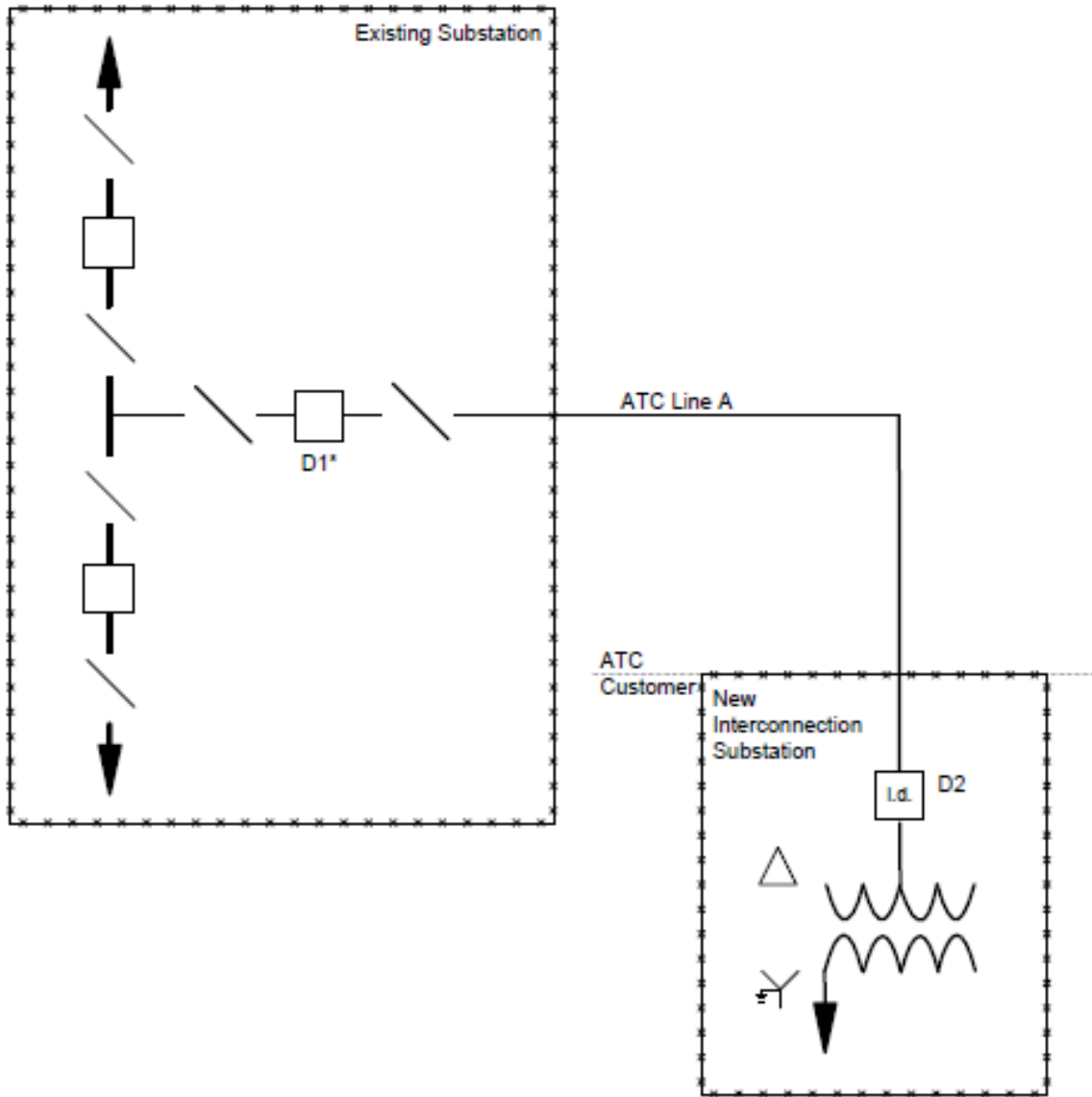
	Existing	Proposed for present or ultimate installation	Space for future (>10 yrs) installation
Circuit breaker			
Disconnect switch (switch with horns typical).			
Disconnecting device with sufficient capability to break line charging current (switch with whips typical).			
Disconnect switch with sufficient capability for loop-splitting on network lines or load-breaking on radial lines (switch with interrupter typical).			
Interrupting device sufficient for power transformer protection <sup>1</sup> .			
Power transformer			

Figure 3 Load Interconnection Configurations Symbology Key

<sup>1</sup>. ATC recommends customers utilize breakers for the interrupting device, however it is recognized that the ultimate decision on the interrupting device remains with the customer. See Section 3.21.2 of this Guide for additional information. For 69 kV applications, if the interrupting device is a fuse, a series switch capable of breaking transformer magnetizing current is needed and low voltage device(s) is(are) needed for breaking load. Fuses must be capable of clearing all transformer faults. For additional discussion on transformer protection issues please see Section 3.2.1.2.

# Appendix F – Interconnection Configurations (Continued)

## Configuration A

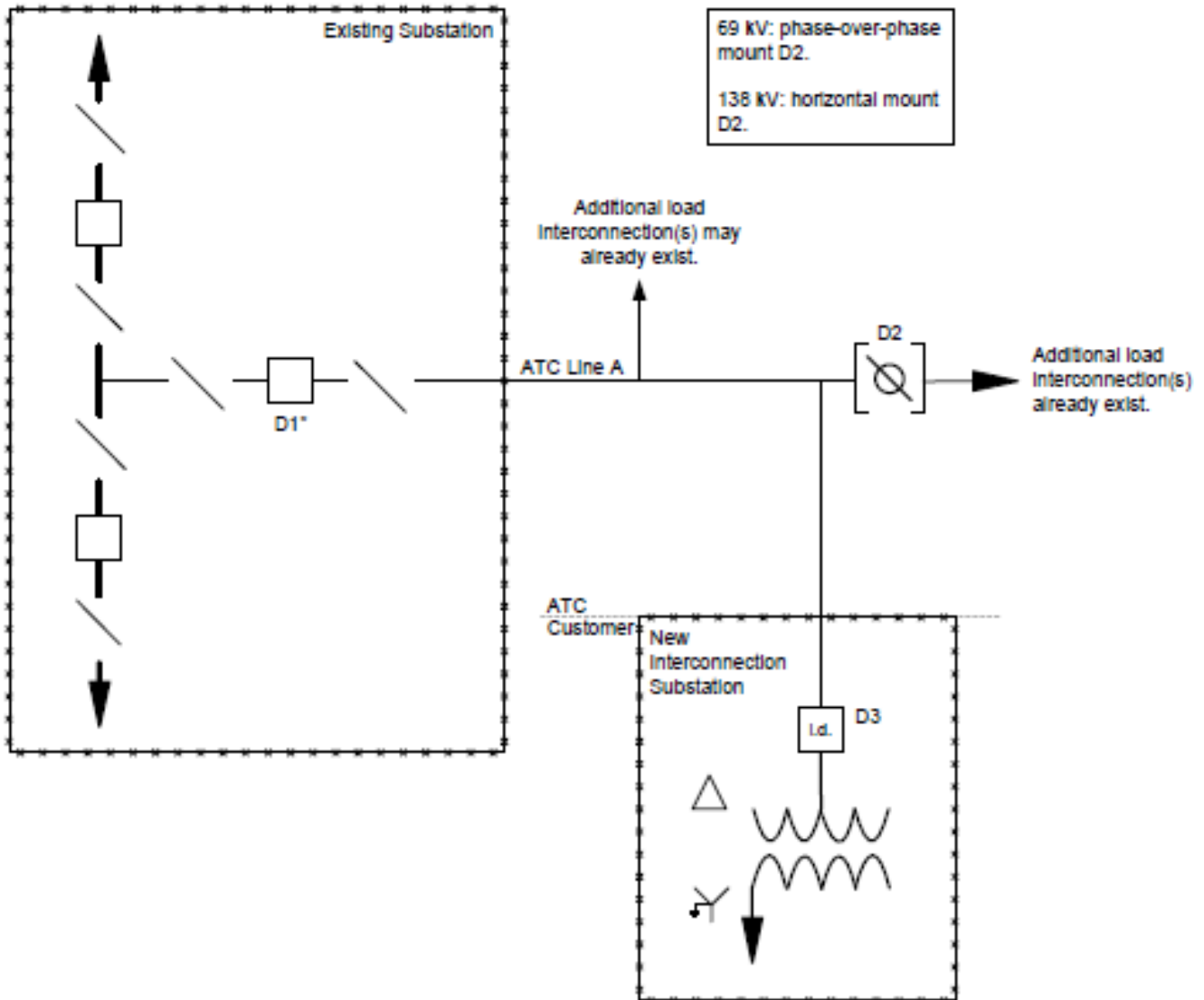


\* This line terminal breaker is not necessarily required if either of the following is true:  
 1) The radial line is terminated into a ring bus or breaker-and-a-half configuration.  
 2) The length of the tap from the mainline to the load interconnection substation is short enough that transmission exposure is minimal and the Customer's transformer protective device is sufficient by itself.

Figure F.4: Load Interconnection Configuration A

# Appendix F – Interconnection Configurations (Continued)

## Configuration B

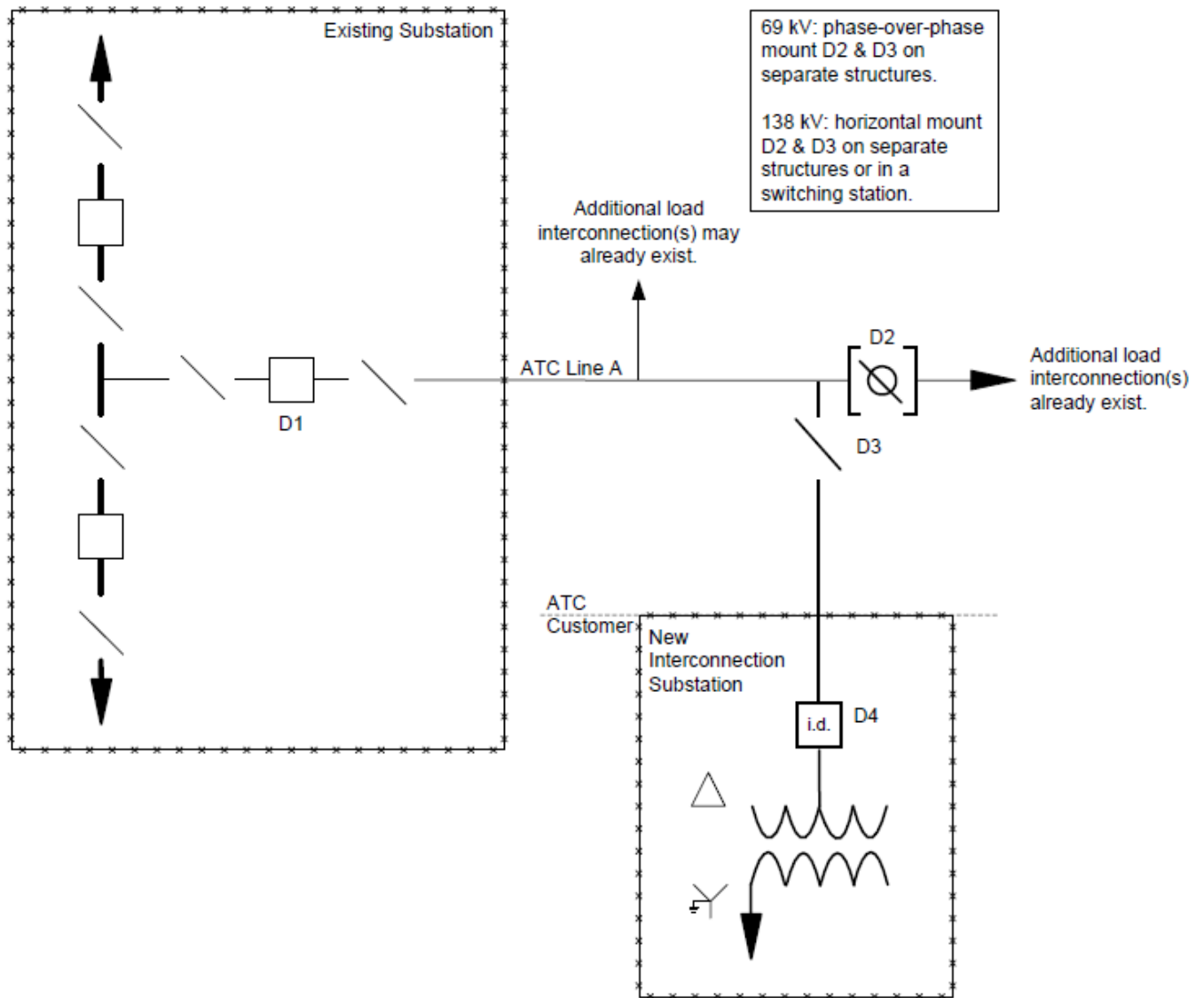


\* This line terminal breaker is not necessarily required if the radial line is terminated into a ring bus or breaker-and-a-half configuration.  
 Note: Switch D2 is needed only if it is greater than 1 mile to the next substation. Customer disconnect switch (D3) must be visible from the tap.

Figure F.5: Load Interconnection Configuration B

# Appendix F – Interconnection Configurations (Continued)

## Configuration C



\* This line terminal breaker is not necessarily required if the radial line is terminated into a ring bus or breaker-and-a-half configuration.

Figure F.6: Load Interconnection Configuration C

# Appendix F – Interconnection Configurations (Continued)

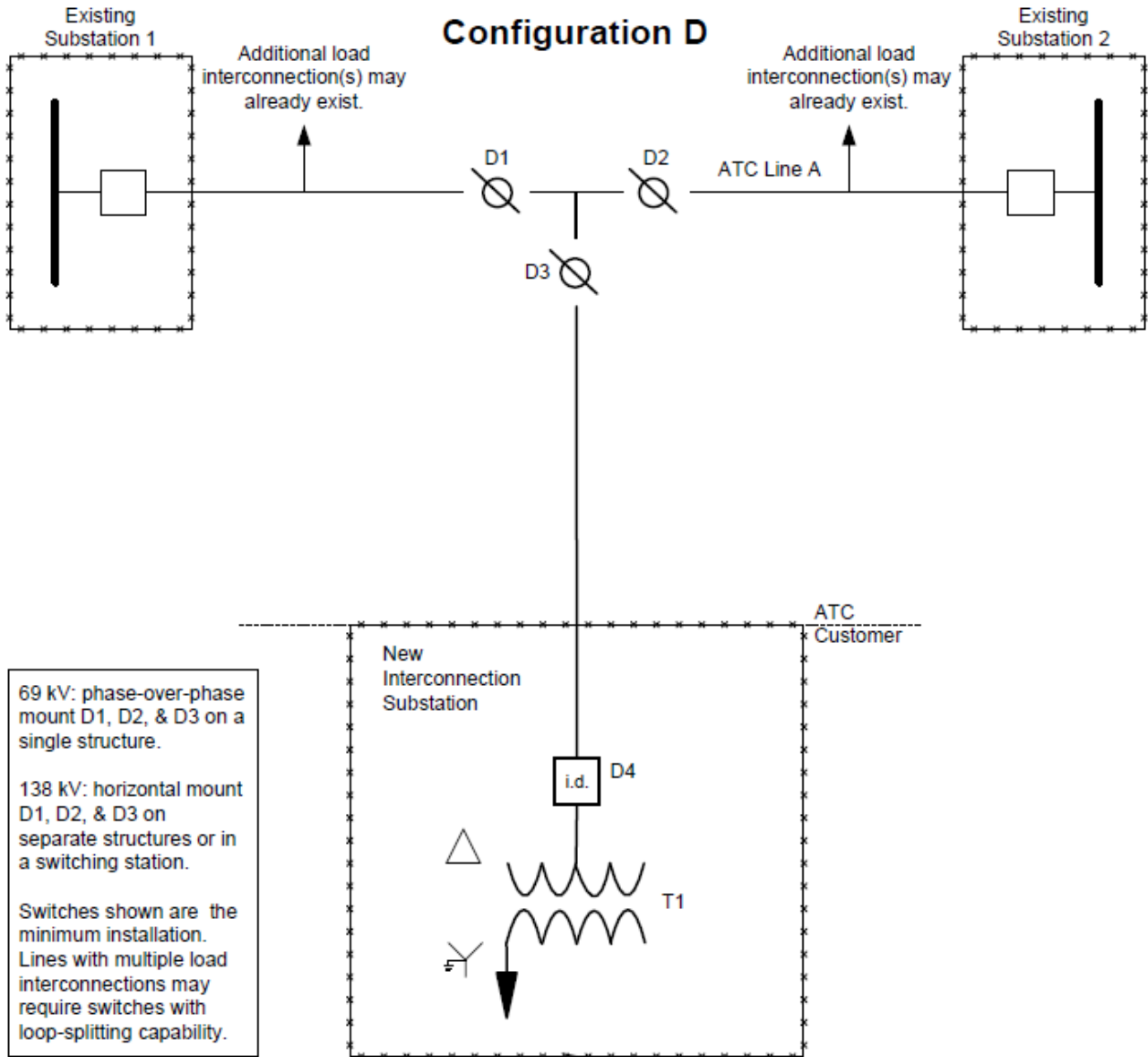


Figure F.7: Load Interconnection Configuration D

# Appendix F – Interconnection Configurations (Continued)

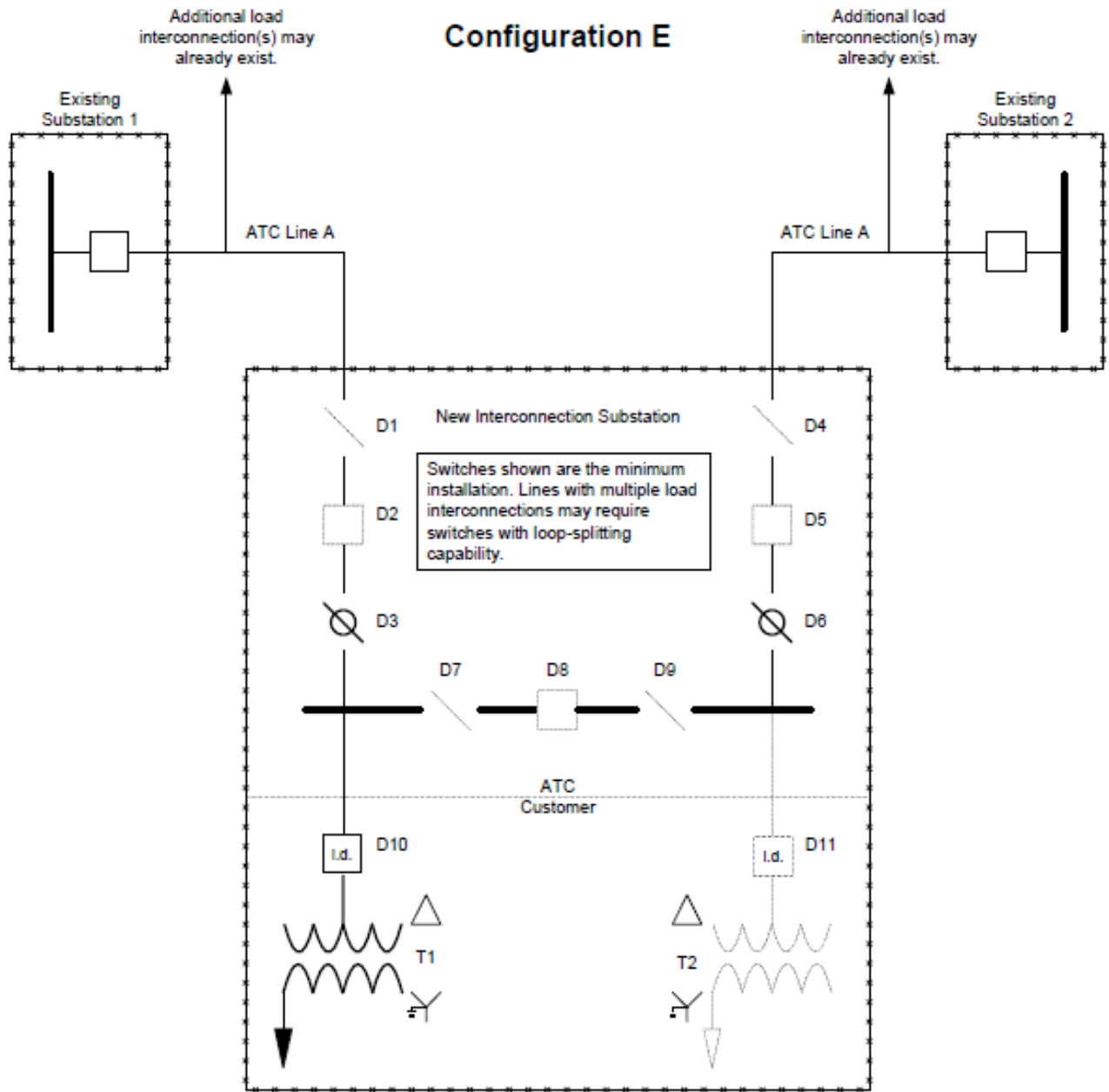


Figure F.8: Load Interconnection Configuration E

Note: For Switches D1 and D4, if only one D-T interconnection is on the line segment, sectionalizing could be done with remote circuit breakers.  
 Note: If total substation load is less than 30 MW, it is acceptable to not install breakers D2 and D5 until such time the substation load is  $\geq 30$  MW. If both T1 and T2 are installed, then also install switches D7 and D9.

# Appendix F – Interconnection Configurations (Continued)

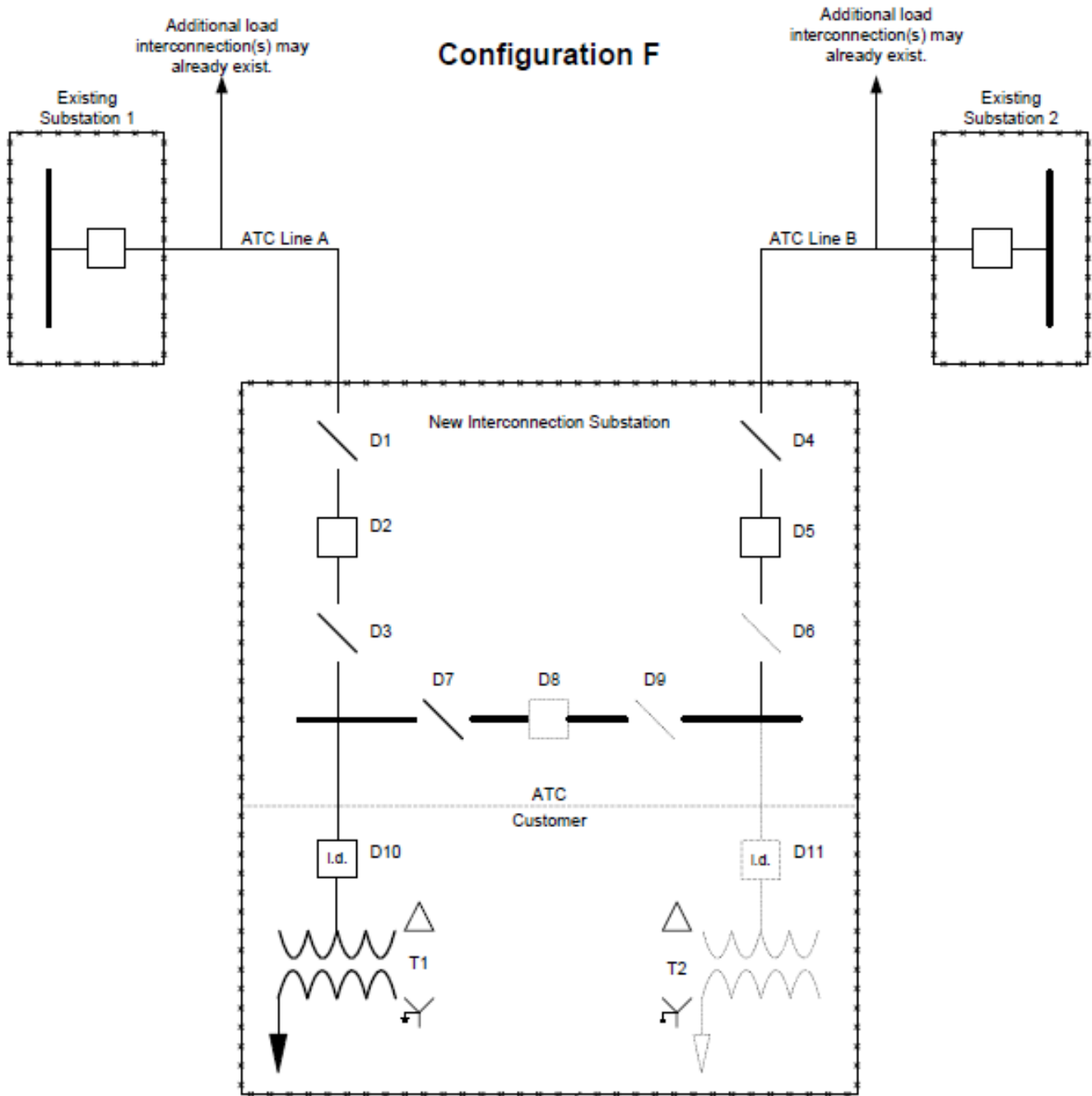
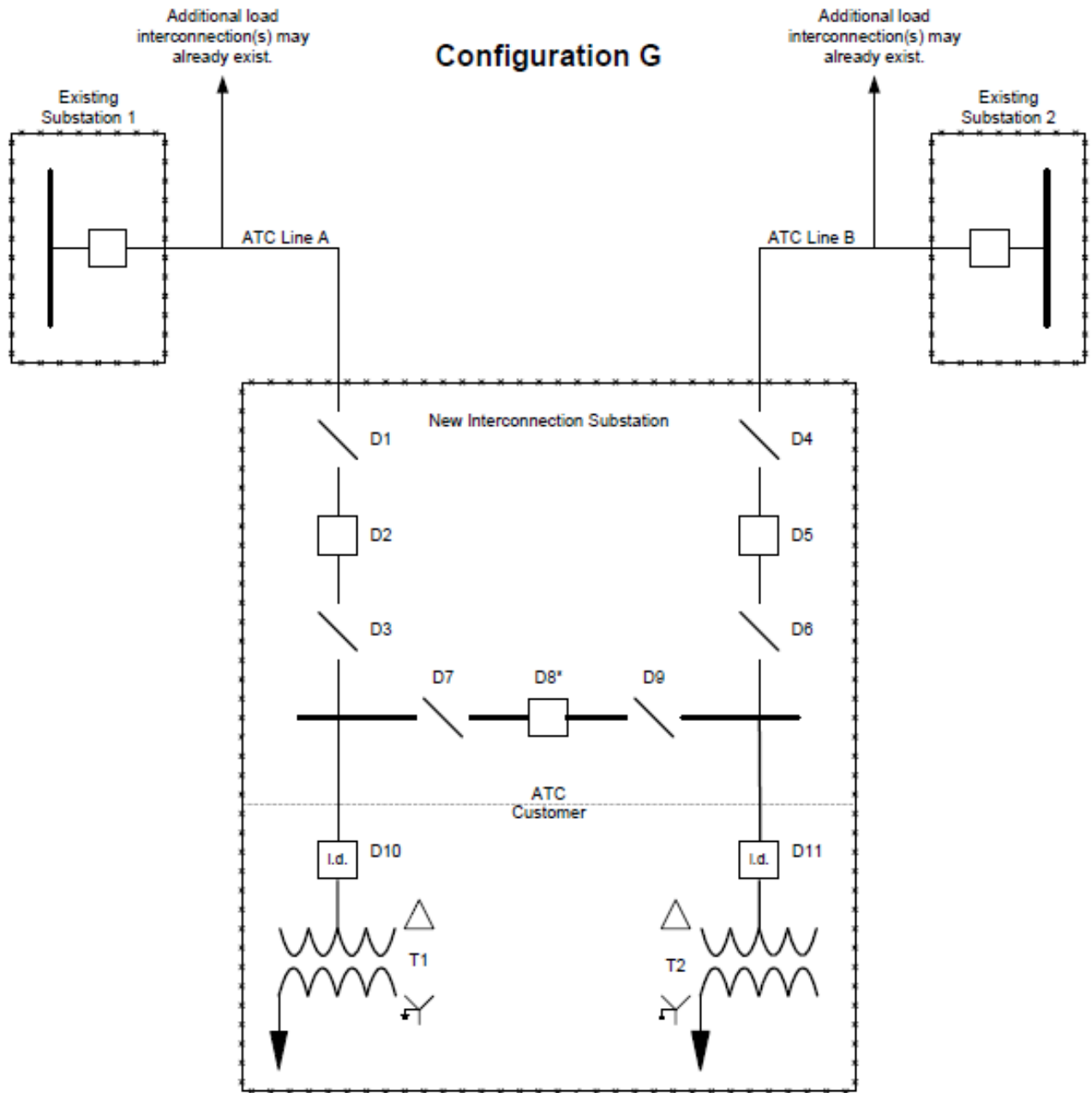


Figure F.9: Load Interconnection Configuration F

Note: For Switches D7 and D9, two switches are to be installed between transformers unless the customer can demonstrate load bridging capability in order to maintain a single switch with both transformers out of service.

# Appendix F – Interconnection Configurations (Continued)



\* If multiple transformers are part of the ultimate design, but only one will be installed presently, the bus-tie breaker (D8) may be installed at the time an additional transformer is installed. Both maintenance switches (D7 and D9) associated with the bus-tie breaker will be installed as part of the present design.

Figure F.10: Load Interconnection Configuration G



# Appendix F – Interconnection Configurations (Continued)

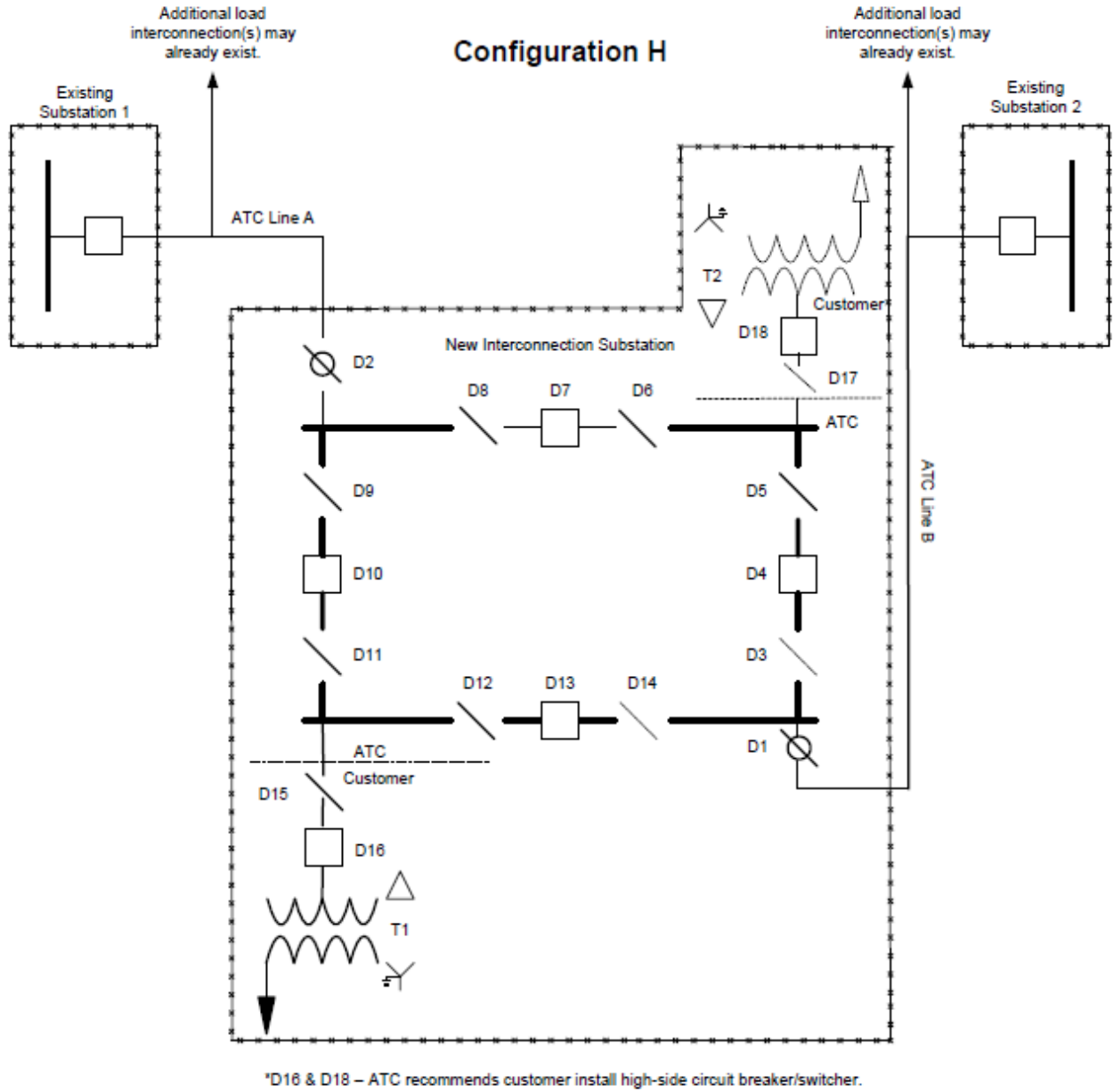


Figure F.11: Load Interconnection Configuration H

# Appendix F – Interconnection Configurations (Continued)

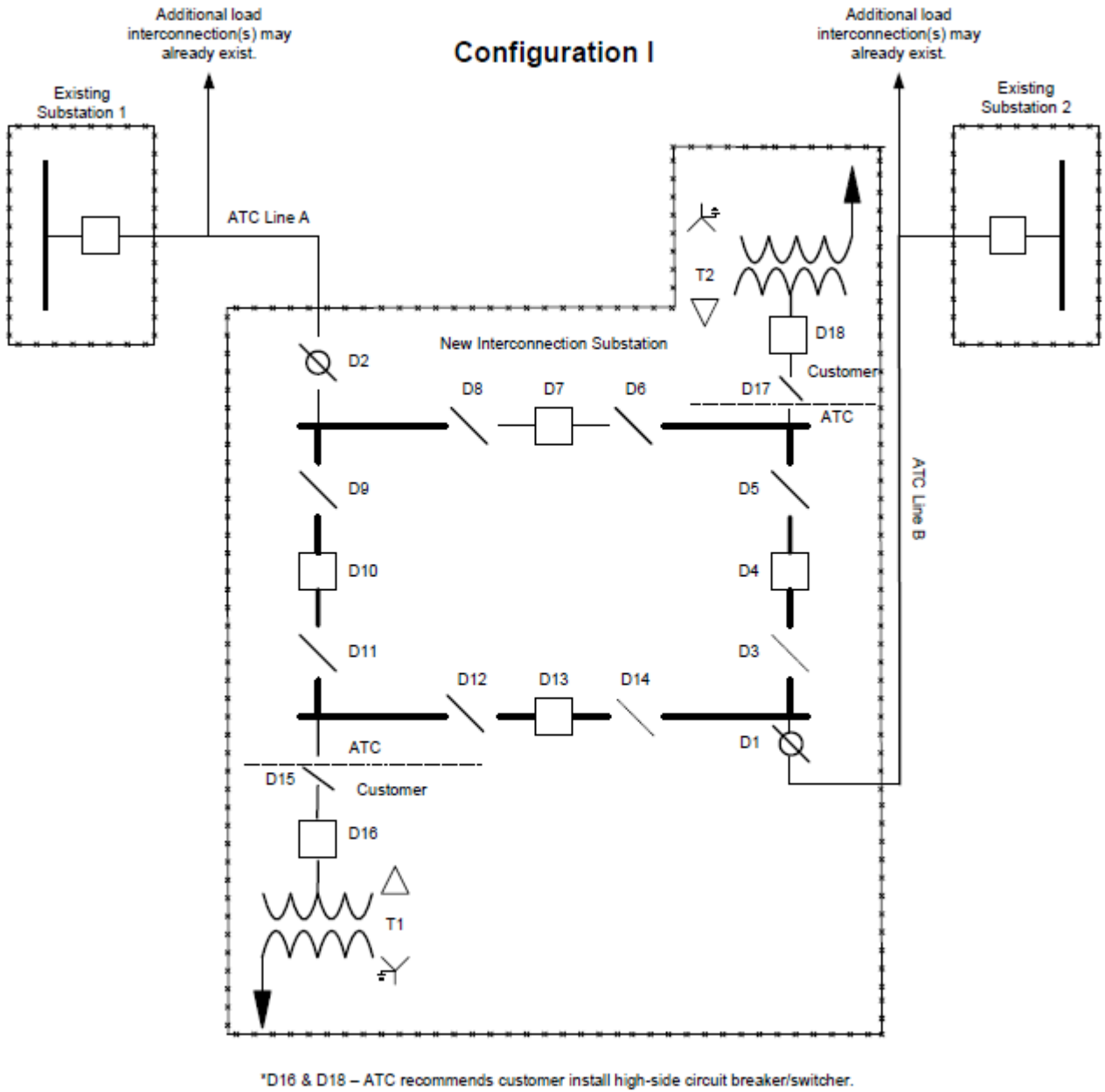
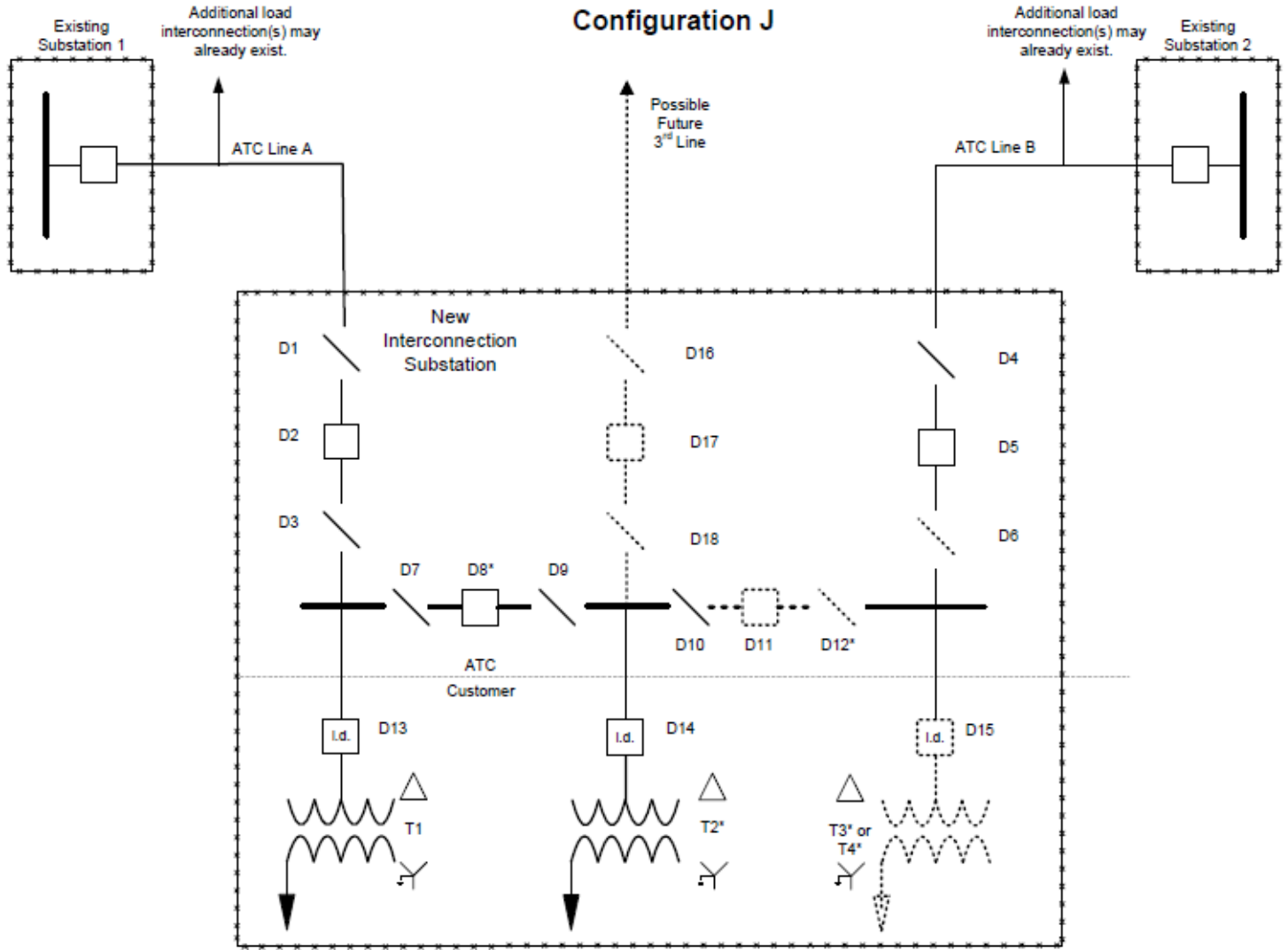


Figure F.12: Load Interconnection Configuration I

# Appendix F – Interconnection Configurations (Continued)



\* A third line source is recommended. For a three transformer substation, the BVP will determine the ultimate substation configuration. It is incumbent upon both ATC and the LDC to fully vet this substation configuration for optimal design and system resiliency.

Figure F.13: Load Interconnection Configuration J

Note: The BVP will determine the ultimate substation configuration. It is incumbent upon both ATC and the Customer to fully vet this substation configuration for optimal design and resiliency.

## Appendix G— ATC Guide for LBA Transmission Load Interconnections

Purpose: When a new load interconnection is requested or there is a change in LBA, the Interconnected Entity shall contact ATC, through the appropriate Regional Manager. The Regional Manager shall then follow the steps below. For projects that involve capital work, please refer to the Coordination of LBA Metering Boundary Modifications Business Practice (found at: <https://www.atcllc.com/customer-engagement/>) The intent of this document is to provide the same structure for non-construction projects.

1. ATC Regional Account Manager shall contact the LBA as soon as possible and schedule a meeting with all parties to discuss the metering needs, costs and schedule; to ensure everyone is working together with the same plan and timelines.
  - For existing interconnection locations with no ATC Capital Work, notification to the LBA should be accomplished no later than six (6) prior to the intended LBA Area Metering Boundary change.
  - For new interconnections or modifications to existing interconnection facilities, ATC will establish a Project Team to define the ATC scope of Work and coordinate with the LBA via the Project team,
2. The LBA Project Team will consist of representatives from ATC Customer Engagement and Subject Matter Experts (SME) (as appropriate), the affected Local Balancing Authority (LBA), Interconnected Entity (IE) and/or any known affected entity.
3. ATC, the IE and the LBA will review the ATC System one-line drawings to see if existing Intertie and/or LBA metering is being affected by the project. ATC, the IE and LBA will also review the project scope to see if new LBA metering or new Intertie metering is required.
4. The IE shall enter into appropriate agreements with the affected LBA.
5. The LBAs are responsible for providing LBA metering and RTU specifications and will be coordinated with ATC if applicable.
6. The IE and the LBA is responsible for providing ATC and each other notice when the metering and RTU equipment is ready to be energized. Any changes to the energization schedule by any party should be communicated to the Project Team in a timely fashion.
7. ATC will coordinate with MISO, as well as the affected LBA, any modeling issues and/or updates that may result from system modifications.
8. Responsibility for any cost incurred for the design, purchase, installation, and/or relocation of the LBA metering equipment associated with an Interconnection project is outlined in Section 2.4 of the Scope and Applicability Section of the Coordination of LBA Metering Boundary Modifications Business Practice.
9. It is the responsibility of the Project Team ATC member to ensure the ATC System one-line drawings are updated to include any changes to the LBA and/or Intertie metering information that was made due to the project.