

# PJM Manual 14E:

Upgrade and Transmission Interconnection  
Requests

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Prepared by  
Interconnection Projects Department

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**Approval**

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Jason Shoemaker, Manager  
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## Current Revision

### **Administrative Change (03/16/2021):**

- Updated document ownership from Jason Connell to Jason Shoemaker

### **Revision 08 (07/01/2020):**

The following administrative changes were identified as part of the periodic manual review:

- Section 1.1: Updated section header and manual titles in Exhibit 1.
- Section 1.3: Updated Exhibit 2: New Services Requests Swim Lane Diagram



## Introduction

Welcome to the PJM Manual for Upgrade and Transmission Interconnection Requests. In this section you will find:

- What you can expect from the PJM Manuals in general (see “*About PJM Manuals*”).
- What you can expect from this PJM Manual (see “*About This Manual*”).
- How to use this manual quickly and easily (see “*Using This Manual*”).

### About PJM Manuals

The PJM Manuals are the instructions, rules, procedures, and guidelines established by PJM for the operation, planning, and accounting requirements of PJM and the PJM Energy Market. The manuals are grouped under the following categories:

- Transmission
- PJM Energy Market
- Generation and Transmission Interconnection
- Reserve
- Accounting and Billing
- PJM administrative services

For a complete list of all PJM manuals, go to the Library section on PJM.com.

### About This Manual

The PJM Manual for ***Additional Information for Upgrade and Transmission Interconnection Projects*** is one of a family of PJM Procedure manuals. This manual focuses on the specific requirements for interconnecting Merchant Transmission Facilities, proposing capability increases to specific Transmission Owner Facilities, and making Upgrade Requests to obtain Incremental Auction Revenue Rights (IARRs) under PJM’s Regional Transmission Expansion Planning Process.

This manual describes the various rights available and agreements required to complete the Transmission Interconnection or Upgrade planning process.

This PJM Manual for Upgrade and Transmission Interconnection Projects consists of five sections. The sections are as follows:

- Section 1: Determining Your Customer Type
- Section 2: Queue Point Application Process
- Section 3: Transmission Interconnection Customers Proposing Merchant Transmission Facilities
- Section 4: Transmission Interconnection Customers Proposing Capability Increases to specific Transmission Owner Facilities

- Section 5: Upgrade Customers

**Note:**

While the PJM Manuals provide instructions and summaries of the various rules, procedures and guidelines for Generation and Transmission Interconnections, the PJM Open Access Transmission Tariff contains the authoritative provisions for the PJM New Services Queue process.

**Applicability**

This manual shall apply to apply to:

- (a) any New Service Request received prior to April 1, 2018; and
- (b) any New Service Request for which, as of the Transition Date (defined in Tariff, Part VII), the Interconnection Customer has received for execution an Interconnection Service Agreement or wholesale market participation agreement or has directed the PJM to file an Interconnection Service Agreement or wholesale market participation agreement unexecuted.

New Service Requests received on or after April 1, 2018 for which Interconnection Customers have not received for execution or directed to be filed unexecuted an Interconnection Service Agreement or wholesale market participation agreement will be subject to the Generation Interconnection Procedures set forth in PJM Manual M14 H, as applicable.

**Intended Audience**

The intended audiences for this PJM Manual for Additional Information for Upgrade and Transmission Interconnection Projects are:

- Transmission Interconnection Customers requesting to interconnect and own Merchant Transmission Facilities, which must complete Tariff form Attachment S to enter the New Services Queue; or
- Transmission Interconnection Customers requesting to upgrade existing Transmission Owner facilities, also known as a Merchant Network Upgrade, which must complete Tariff form Attachment EE to enter the New Services Queue; or
- Upgrade Customers which are seeking IARRs in accordance with Operating Agreement Section 7.8, which must complete Tariff for Attachment EE to enter the New Services Queue; and
- Transmission Owner's respective engineering staff
- PJM Members
- PJM Staff

An entity seeking rate of return per FERC Order 1000 should not enter the New Services Queue, but rather should contact PJM to propose the project via the Regional Transmission Expansion Plan. Refer to PJM Manual 14F for "The Competitive Planning Process"..

**References**

- There are other PJM documents that provide both background and detail on other topics.

- o Manual M-01: “Control Center Requirements”
- o Manual M-02: “Transmission Service Requests”
- o Manual M-03: “Transmission Operations”
- o Manual M-06: “Financial Transmission Rights”
- o Manual M-14A: “Generation and Transmission Interconnection Process Overview”
- o Manual M-14B: “Generation and Transmission Interconnection Planning”
- o Manual M-14C: “Generation and Transmission Interconnection Facility Construction”
- o Manual M-14D: “Generator Operational Requirements”
- o Manual M-14F: “The Competitive Planning Process”

- o Manual M-14G: “Generator Interconnection Requests”

## Using This Manual

We believe that explaining concepts is just as important as presenting procedures. This philosophy is reflected in the way we organize the material in this manual. We start each section with an overview. Then we present details, procedures or references to procedures found in other PJM manuals.

## What You Will Find In This Manual

- A table of contents.
- An approval page that lists the required approvals and the revision history.
- This introduction.
- Sections containing the identification of different customer types, the process for submitting a queue request, and specific details on each individual customer type including agreements, obligations, potential rights and technical and administrative requirements.

## Section 1: Overview and Determining Your Customer Type

Welcome to the Overview and Determining Your Customer Type section of the PJM Manual for **Upgrade and Transmission Interconnection Requests**. In this section you will find the following information.

- A description of PJM’s interconnection process as outlined in the PJM Manual 14 series.
- An overview of the different Upgrade and Transmission Interconnection project types identified in the PJM Tariff
- The customer type and applicable PJM Manual 14E section that corresponds to a particular project type

### 1.1 PJM’s Interconnection Process Overview

The PJM Regional Transmission Organization (RTO) has the responsibility for planning the expansion and enhancement of the PJM Transmission System on a regional basis. As the RTO, PJM administers the connection of generators and new transmission facilities to the PJM Transmission System through the New Services Requests process. In this role, PJM coordinates the planning process for connection of new generation and/or new transmission facilities (including upgrades to either), coordinates the reliability studies for the operation of new generation and/or new transmission facilities (including upgrades to either) and oversees the construction of the required Interconnection Facilities and any associated network upgrades.

Manual 14E is one in a series of PJM Planning Manuals which cover all aspects of Transmission Planning including customer interconnections and transmission expansion PJM recommends that New Service Customers first review the interconnection process as outlined in the Manual 14 series:

Manual	Title	Description
14A	New Services Requests Process	Guides New Service Customers through the general application, study and agreement process
14B	PJM Region Transmission Planning Process	Describes the process of planning baseline expansion facilities and base case development
14C	Generation and Transmission Interconnection Facility Construction	Covers the lifecycle of a project from agreement execution to commercial operation and also describes the process of tracking RTEP projects.
14D	Generator Operational Requirements	Identifies the markets and operations requirements for generators to connect to the PJM system.
14E	Upgrade and Transmission Interconnection Requests	Identifies the specific requirements, study/agreement overview, and rights for Upgrade Requests and Merchant Transmission Interconnection projects proposed on the PJM system.

14F	Competitive Planning Process	Outlines the process to conduct competitive proposal windows consistent with Order No. 1000.
14G	Generation Interconnection Requests	Identifies interconnection requirements, upgrade requirements, study/agreement overview, and rights for any generator customer.

### Summary of PJM Manual 14 Series

PJM Manual 14E augments PJM Manual 14A and describes additional requirements, rights and obligations applicable to Upgrade and Transmission Customers. A project that completes an executed Interconnection Service Agreement and Interconnection Construction Service Agreement or Upgrade Construction Service Agreement through PJM Manual 14E will then transfer to PJM Manual 14C for construction implementation.

## 1.2 Request Types Submitted by Transmission Interconnection Customers and Upgrade Customers

Use the following descriptions along with the diagrams shown in Exhibits 2 and 3 of Section 1.3 to further understand the types of Upgrade and Transmission Interconnection projects envisioned by the Tariff:

### 1.2.1 Transmission Interconnection Customers

If a New Service Customer intends on installing, owning, and maintaining Merchant Transmission Facilities, the New Services Customer should enter the New Services Queue with a Transmission Interconnection Request, submit Tariff Attachment S, and follow section 3 of this PJM Manual. All Attachment S customers are collectively designated Transmission Interconnection Customers. The following are examples of Merchant Transmission Facilities that can be proposed by Transmission Interconnection Customers:

- **Merchant D.C. Transmission Facilities**

Any Merchant D.C. (direct current) Transmission Facilities to interconnect to the Transmission System.

- **Controllable A.C. Merchant Transmission Facilities**

Any Controllable A.C. (alternating current) Merchant Transmission Facilities that employ technology that PJM reviews and verifies will permit control of the amount and / or direction of power flow on such facilities to such extent to effectively enable the controllable facilities to be operated as if they were direct current Transmission Facilities.

- **Merchant A.C. Transmission Facilities**

Any Merchant A.C. (alternating current) Transmission Facilities, other than those that are Controllable A.C. Merchant Transmission Facilities.

If a New Services Customer proposes to fund capability upgrades to existing Transmission Facilities owned by Transmission Owner(s), or fund advancement of proposed Regional

Transmission Expansion Plan upgrades, then the Tariff defines the New Services Customer as a Transmission Interconnection Customer proposing a Merchant Network Upgrade. The developer should enter the Queue with an Upgrade Request, submit Tariff Attachment EE, and follow section 4 of this PJM Manual.

### 1.2.2 Upgrade Customers

As specified in the Operating Agreement, Section 7.8 and Part VI of the Tariff, any party may elect to fully fund new Network Upgrades to obtain financial rights called Incremental Auction Revenue Rights (IARRs). If the New Services Customer proposes the preceding, then the Tariff defines the New Services Customer as an Upgrade Customer. To request IARRs, the party must submit Attachment EE from the PJM Tariff, specifying the Source and Sink for incremental financial rights as a MW amount in the request and follow section 5 of this PJM Manual. Allocation and general description of IARRs are documented in PJM Manual 6. This PJM Manual describes the study process required for these requests.

## 1.3 Customer Classifications

The PJM Tariff classifies a party wishing to perform the following on the PJM Transmission System as a Transmission Interconnection Customer:

- interconnecting or adding Merchant Transmission Facilities to the Transmission System;
- increasing the capability of existing Merchant Transmission Facilities interconnected with the Transmission System;
- proposing to increase the capability of existing Transmission Owner facilities, or
- advancing the construction of any transmission enhancement or expansion other than Merchant Transmission Facilities that is included in the Regional Transmission Expansion Plan prepared pursuant to Schedule 6 of the Operating Agreement.

The PJM Tariff requires that a party wishing to perform the following on the PJM Transmission System be considered an Upgrade Customer:

- request Incremental Auction Revenue Rights pursuant to Section 7.8 of the Operating Agreement

Transmission and Upgrade Customers will submit either an Attachment S Agreement or an Attachment EE Request form. The New Service Customer must submit the proper Attachment based on the type of service being requested. The New Services Requests Swim Lane Diagram in Exhibit 2 below depicts the various types of New Service Customer Requests, the associated customer names, the applicable PJM Manual sections, the required Attachment for queue entry, and the study process flow through final agreements. The 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> columns are specific to Upgrade and Transmission Interconnection Customers.

Project Type Requested	Customer Owned Generation Request (20 MW or less)	Customer Owned Generation Request (Over 20 MW)	Customer owned Merchant Transmission Facilities Request	Customer Funded Upgrade to Transmission Facilities Request	Incremental Auction Revenue Rights Request	Transmission Service into, out of or through PJM
Customer Type	Generation Interconnection Customer	Generation Interconnection Customer	Transmission Interconnection Customer	Transmission Interconnection Customer	Upgrade Customer	Eligible Customer
Applicable Manual Reference	Manual 14G	Manual 14G	Manual 14E	Manual 14E	Manual 14E	Manual 2
Interconnection Queue Entry	OATT Attachment N, Y, BB	OATT Attachment N	OATT Attachment S	OATT Attachment EE	OATT Attachment EE	OATT Attachment FF
Interconnection Studies	Feasibility, System Impact, Facilities or Combined Feasibility/System Impact	Feasibility, System Impact, Facilities	Feasibility, System Impact, Facilities	System Impact, Facilities	Market Requirements, Feasibility, System Impact, Facilities	Feasibility, System Impact, Facilities
Agreements	ISA IISA ICSA WMPA	ISA IISA ICSA WMPA	ISA, ICSA, UCSA	UCSA	UCSA	UCSA (for construction), TSA (for point-to-point), NITSA (for Network Integrated)

Agreement	Description
ISA	Interconnection Service Agreement
IISA	Interim Interconnection Service Agreement
ICSA	Interconnection Construction Service Agreement
NITSA	Network Integration Transmission Service Agreement
TSA	Transmission Service Agreement
WMPA	Wholesale Market Participation Agreement

### New Services Requests Swim Lane Diagram

Exhibit 3 below highlights the Transmission Interconnection and Upgrade Requests specifically including the Manual 14E sections which detail each request type.



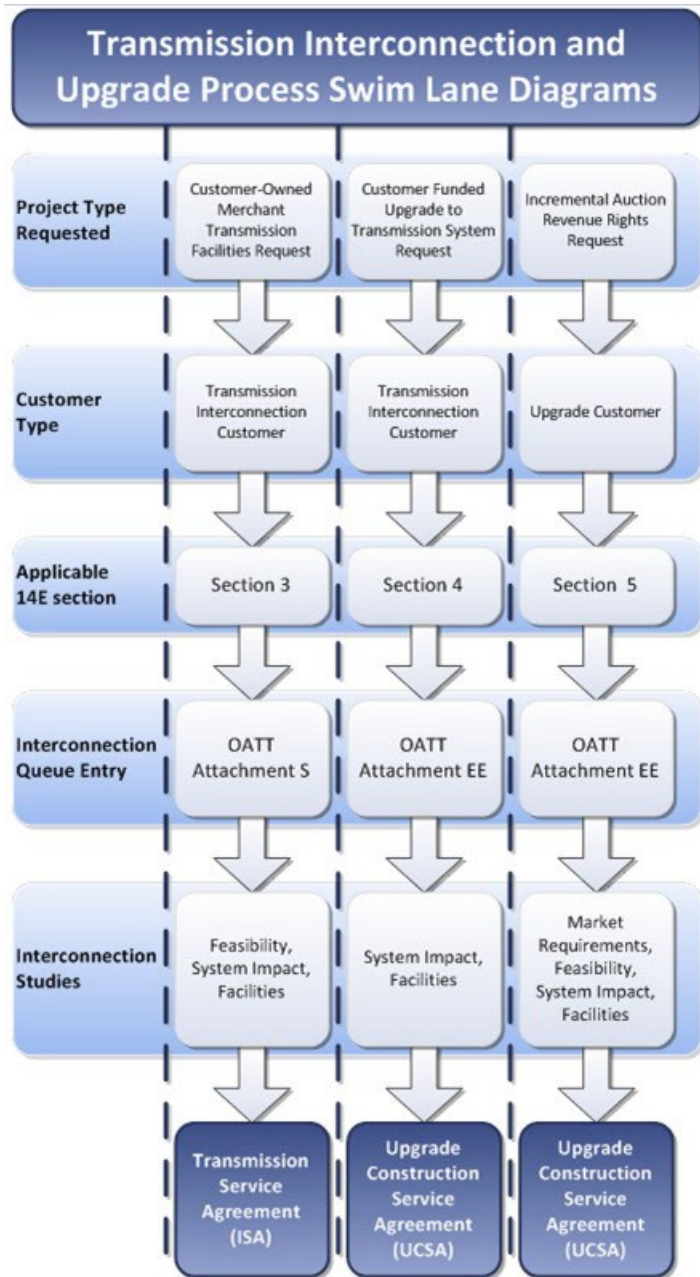


Exhibit 1: Transmission Interconnection and Upgrade Request Process Flow

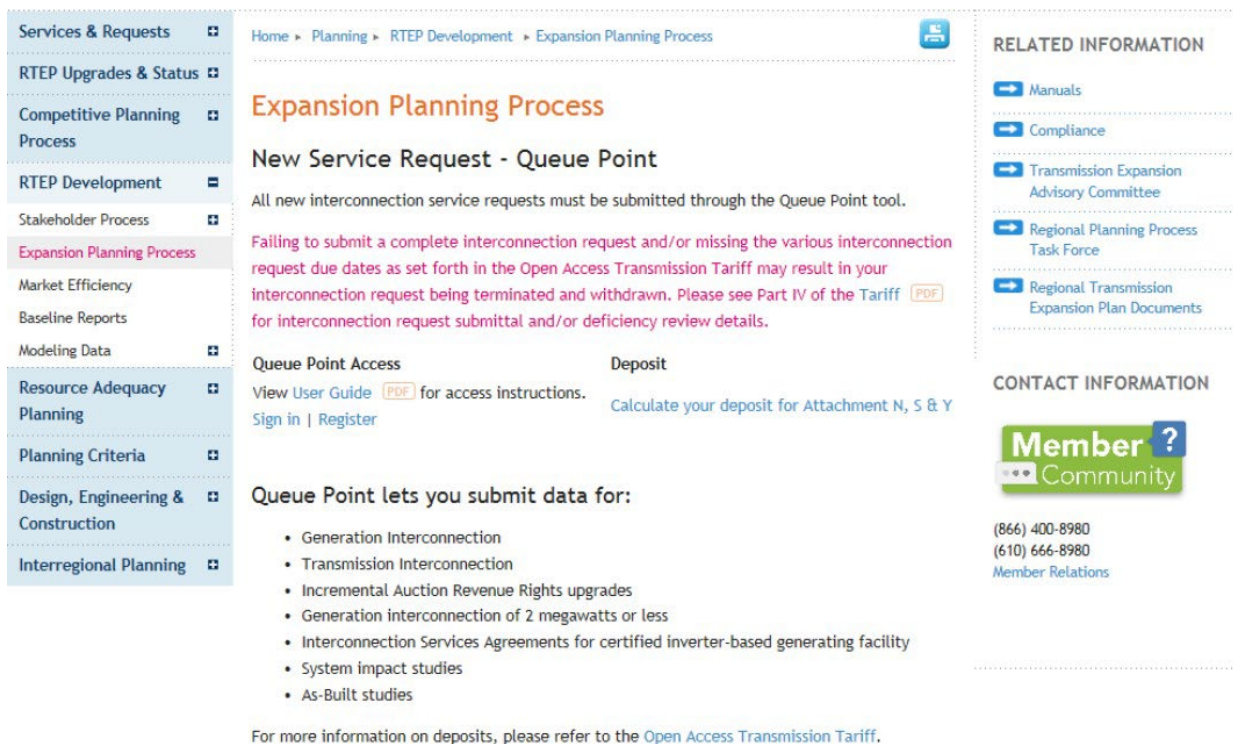
## Section 2: Queue Point Application Process

Welcome to the Queue Point Application Process section of the PJM Manual for Upgrade and Transmission Interconnection Requests. In this section you will identify with the Queue Point tool that is needed in order to submit a New Services Request. You will also learn how to determine which Attachment is required to submit your New Services Request.

### 2.1 Queue Point Tool

In order for the Upgrade or Transmission Customer to initiate a New Services Request, they must follow the “Queue Point Application Process” discussed in Manual 14A, Sections 2.1 and 2.2. The Queue Point tool is available on the PJM Website along with a User Guide at the following link, a view of which can be seen in Exhibit 4 below:

<http://pjm.com/planning/rtep-development/expansion-plan-process.aspx>



Home > Planning > RTEP Development > Expansion Planning Process

### Expansion Planning Process

#### New Service Request - Queue Point

All new interconnection service requests must be submitted through the Queue Point tool.

Failing to submit a complete interconnection request and/or missing the various interconnection request due dates as set forth in the Open Access Transmission Tariff may result in your interconnection request being terminated and withdrawn. Please see Part IV of the Tariff [PDF](#) for interconnection request submittal and/or deficiency review details.

**Queue Point Access**      **Deposit**

View [User Guide PDF](#) for access instructions.      Calculate your deposit for Attachment N, S & Y

[Sign in](#) | [Register](#)

**Queue Point lets you submit data for:**

- Generation Interconnection
- Transmission Interconnection
- Incremental Auction Revenue Rights upgrades
- Generation interconnection of 2 megawatts or less
- Interconnection Services Agreements for certified inverter-based generating facility
- System impact studies
- As-Built studies

For more information on deposits, please refer to the [Open Access Transmission Tariff](#).

**RELATED INFORMATION**

- ➔ Manuals
- ➔ Compliance
- ➔ Transmission Expansion Advisory Committee
- ➔ Regional Planning Process Task Force
- ➔ Regional Transmission Expansion Plan Documents

**CONTACT INFORMATION**

**Member ?**  
Community

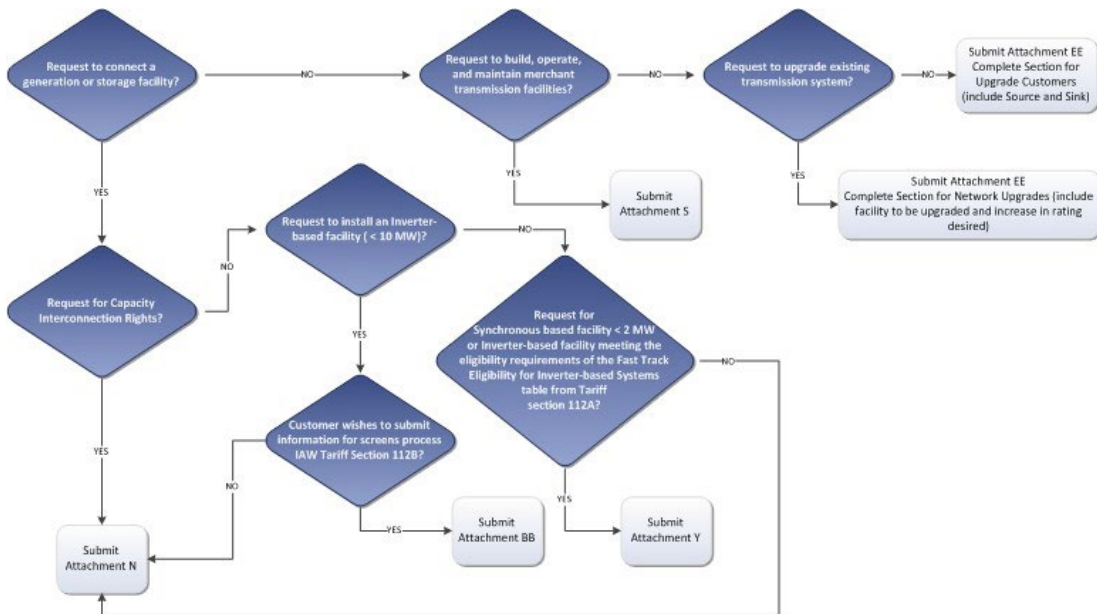
(866) 400-8980  
(610) 666-8980  
Member Relations

*Exhibit 2: Pjm.com New Services Request – Queue Point Page*

Completed Attachments, including the submittal of all required data, must be accompanied by the appropriate fees as detailed in Manual 14A, in order to reserve a place in PJM’s New Services Queue.

## 2.2 Determining New Services Request Tariff Attachment

The Queue Point wizard will help guide to determining the proper Attachment form for your New Services Request. You can also reference the Decision Tree in Exhibit 5 below. Sections 3.1.1, 4.1.1 and 5.1 of this Manual identify what information PJM requires on each Attachment depending on their request type.



*Exhibit 3: Decision Tree to Determine New Service Request Tariff Attachment*

## Section 3: Transmission Interconnection Customers Proposing Merchant Transmission Facilities

Welcome to the Transmission Interconnection Customers Proposing Merchant Transmission Facilities section of the PJM Manual for **Upgrade and Transmission Interconnection Requests**. In this section you will find an overview of Merchant Transmission Facilities projects.

- Requirements to enter the New Services Queue
- Agreements applicable to Merchant Transmission Facilities projects
- An overview of rights, obligations and technical requirements

### 3.1 Entering the New Services Queue

Merchant Transmission Facilities are additions to the Transmission System that upon interconnection with the Transmission System are owned, operated and maintained by the developer.

#### 3.1.1 General Requirements

The following information must be provided for all Transmission Interconnection Customer requests proposing Merchant Transmission Facilities, under Attachment S, section 3:

- location of proposed facilities;
- substation(s);
- voltage and increase in system capability in MW;
- equipment description;
- in-service date; and
- the type of Merchant Transmission Facility being proposed.

As indicated above, each request must identify an increase in power transfer capability in MW. The refundable and non-refundable deposits follow the same formula as those for Generation projects greater than 20 MW described in PJM Manual 14A, regardless of the size of a Transmission Interconnection Request.

#### 3.1.2 Controllable A.C. Merchant Transmission Facilities Specific Requirements

For a Controllable A.C. Merchant Transmission Facilities project, in addition to the above general requirements for the Attachment S, the requestor must:

- complete Attachment S, 3.f.i;
- agree with Attachment S, 3.f.ii.; and
- provide additional information about the project in Attachment S, 3.f.iv as needed. Additional information can include applicable prior queue requests related to the project, additional proposals as how the New Services Customer envisions the interconnection with the system, additional technical information on the proposed facilities and any other information that the New Services Customer thinks would aid in the understanding and study of the facility.

### **3.1.3 Merchant D.C. Transmission Facilities Specific Requirements**

For a Merchant D.C. Transmission Facilities project, in addition to the above general requirements for the Attachment S, the requestor must:

- complete Attachment S, 3.f.i; and
- provide additional information about the project in Attachment S, 3.f.iv as needed. Additional information can include applicable prior queue requests related to the project, additional proposals as how the New Services Customer envisions the interconnection with the system, additional technical information on the proposed facilities and any other information that the New Services Customer thinks would aid in the understanding and study of the facility.

### **3.1.4 Merchant A.C. Transmission Facilities Specific Requirements**

For a Merchant A.C. Transmission Facilities project, in addition to the above general requirements for the Attachment S, the requestor must:

- identify the location for Incremental Deliverability Rights in Attachment S, 3.f.iii; and
- provide additional information about the project in Attachment S, 3.f.iv as needed. Additional information can include applicable prior queue requests related to the project, additional proposals as how the New Services Customer envisions the interconnection with the system, additional technical information on the proposed facilities and any other information that the New Services Customer thinks would aid in the understanding and study of the facility.

## **3.2 Agreements**

Applicable study attachments and service agreements are described in PJM Manual 14A. The following attachments, from PJM's Transmission Tariff, are applicable to Merchant Transmission Provider projects:

- Attachment S: Feasibility Study Agreement;
- Attachment N-1: System Impact Study Agreement;
- Attachment N-2: Facilities Study Agreement;
- Attachment N-3: Optional Interconnection Study Agreement;
- Attachment O: Interconnection Service Agreement;
- Attachment O-1: Interim Interconnection Service Agreement; and
- Attachment P: Interconnection Construction Service Agreement.

The following study and agreement information is unique to Transmission Interconnection Customers proposing Merchant Transmission Facilities:

### **3.2.1 HVDC Projects - Additional Studies required as part of the Facilities Study Agreement or Interconnection Service Agreement**

In addition to the studies normally required during the Facilities Study phase for interconnection and integration of a project in PJM, several additional studies are required among PJM, Interconnected Transmission Owner(s), and the Transmission Interconnection Customer to



facilitate the proper design of an HVDC facility. PJM and member Interconnected Transmission Owners require verification of the expected performance of the facilities being interconnected. The studies described in Attachment A to this manual will be coordinated with the Transmission Interconnection Customer for proper design of the HVDC facilities.

### **3.2.2 Interconnection Service Agreement (ISA)**

ISAs are issued at the completion of the study process for projects where the New Services Customer will own, operate and maintain its Interconnection Facilities. Since Merchant Transmission Facilities will be owned by the Transmission Interconnection Customer upon commercial operation, an ISA must be issued at the end of the study process. Any applicable Upgrade Related Rights, Transmission Injection Rights, or Transmission Withdrawal Rights available to the Merchant Transmission Facilities will be determined pursuant to the applicable specifications in the ISA.

### **3.2.3 Incremental Deliverability Rights (IDR) Transfer Agreement**

A Transmission Interconnection Customer may obtain Incremental Deliverability Rights (IDR) associated with its Network Upgrades necessary to interconnect their Merchant Transmission Facilities. IDRs are further described, including their transfer, in this manual in Attachment E. An IDR transfer agreement is a two-party agreement developed between the two New Services Customers. The requirements of the agreement are described in PJM Tariff section 237.

## **3.3 Rights**

As specified in the PJM Tariff and Schedule 6 of the Operating Agreement, the owners of Merchant Transmission Facilities that interconnect with the PJM Transmission System may be entitled to select from a choice of Upgrade-Related Rights, Transmission Injection Rights, and Transmission Withdrawal Rights if they are created by the addition of the Merchant Transmission Facilities:

### **3.3.1 Transmission Injection Rights and Transmission Withdrawal Rights (TIRs & TWRs)**

These rights are described in this manual in Attachment B.

### **3.3.2 Incremental Available Transfer Capability Revenue Rights (IATCRRs)**

These rights are described in this manual in Attachment C.

### **3.3.3 Incremental Auction Revenue Rights (IARRs)**

These rights are described in this manual in Attachment D.

### **3.3.4 Incremental Deliverability Rights (IDRs)**

These rights are described in this manual in Attachment E.

### **3.3.5 Incremental Capacity Transfer Rights (ICTRs)**

These rights are described in this manual in Attachment F.

## 3.4 Obligations

### 3.4.1 Signatory to PJM Consolidated Transmission Owners Agreement

In order to obtain the rights associated with Merchant Transmission Facilities, prior to the commencement of Interconnection Service associated with such facilities; the Transmission Interconnection Customer that interconnects or adds Merchant Transmission Facilities to the Transmission System must become and remain a signatory to the applicable PJM Consolidated Transmission Owners Agreement per the PJM Tariff.

### 3.4.2 Maintenance of Merchant Transmission Facilities

An owner of Merchant Transmission Facilities shall maintain, or shall cause the maintenance of, its facilities in a safe and reliable manner in accord with Applicable Standards, applicable laws, regulations, rules, procedures, and protocols set forth in the PJM Tariff and the Operating Agreement that may be amended from time to time.

### 3.4.3 Additions to or Upgrades of Merchant A.C. Transmission Facilities

In the event that PJM determines in accordance with the Regional Transmission Expansion Planning Protocol of Schedule 6 of the Operating Agreement that a future addition or upgrade to Merchant A.C. Transmission Facilities is necessary, the owner of such Merchant A.C. Transmission Facilities shall undertake such addition or upgrade and shall operate and maintain all facilities so constructed or installed in accordance with Good Utility Practice and with applicable terms of the Operating Agreement and the Consolidated Transmission Owners Agreement. See Attachment A to PJM Manual 14B for a description of PJM cost allocation methodologies.

## 3.5 Technical Design Requirements

### 3.5.1 Reactive Power Design Criteria

The significant amount of power flow over Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities result in (1) the capability to inject electrical energy into the PJM Transmission System at the defined Point(s) of Interconnection between the Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities and the PJM Transmission System and (2) the capability to withdraw electrical energy from the PJM Transmission System at that same defined Point(s) of Interconnection between the Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities and the PJM Transmission system. This capability to inject energy at a defined Point(s) of Interconnection with the PJM Transmission System is directly comparable to the capability of Generation facilities to inject energy into the PJM Transmission System. Similarly, the capability to withdraw energy at a defined Point(s) of Interconnection with the PJM Transmission System is directly comparable to the capability of load to withdraw energy from the PJM Transmission System.

Injections and withdrawals of a significant amount of energy at various points on the PJM Transmission System affect the scheduled voltage profile necessary for reliable operation of the PJM Transmission System. The reactive power losses needed to support the power flows across the PJM Transmission System due to the injections/withdrawals at the terminals of Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities have a significant impact on the PJM Transmission System voltage profile. The effect

on the PJM Transmission System voltage profile due to such injections and withdrawals of energy at the terminals of Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities are best mitigated by compensating for the reactive power losses and the reactive requirements of the Merchant facility near their point of occurrence. Thus, a Transmission Interconnection Customer interconnecting Merchant D.C. Transmission Facilities and/ or Controllable A.C. Merchant Transmission Facilities shall design its Customer Facility to maintain a power factor at the Point of Interconnection of at least 0.95 leading and 0.95 lagging, when the Customer Facility is operating at any level within its approved operating range.

### **3.5.2 Voltage Operating Criteria**

Effective and reliable operation of the electric Transmission System requires scheduling a voltage profile for the system that must be followed within a narrow bandwidth. Maintaining a voltage profile across the Transmission System requires the capability to control voltage schedules at specific points on the Transmission System by implementing adjustments to voltage schedules at those locations. The Point of Interconnection of Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities are among the locations where appropriate voltage schedules and/or reactive power schedules must be controlled as specified by PJM or the Interconnected Transmission Owner's control center (acting on behalf of or at the direction of PJM) or that is consistent with Good Utility Practice.

### **3.5.3 Payment for Reactive Power**

Any payments to the Transmission Interconnection Customer for reactive power shall be in accordance with Schedule 2 of the Tariff. Schedule 2 of the Tariff provides for payment for Reactive Supply and Voltage Control from Generation Sources Service. Merchant Transmission facilities are not eligible to receive payment for reactive power under the provisions of Schedule 2.

### **3.5.4 Construction Requirements**

#### **3.5.4.1 Cost Responsibility**

The Interconnection Service Agreement defines the obligation of the Transmission Interconnection Customer regarding cost responsibility for any required Transmission System upgrades.

#### **Note:**

Further information on all terms and conditions to be incorporated and made part of the Interconnection Service Agreement may be found in PJM Manuals M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### **3.5.4.2 Interconnection Construction Service Agreement**

The construction of any Interconnection Facilities required to interconnect Merchant Transmission Facilities with the PJM Transmission System shall be performed in accordance with the Standard Terms and Conditions as specified in an Interconnection Construction Service Agreement to be executed among the Transmission Interconnection Customer, the Transmission Provider and the affected Interconnection Transmission Owner(s). The form of an Interconnection Construction Service Agreement may be found in the PJM Open Access Transmission Tariff as Attachment P.



**Note:**

Further information on all terms and conditions to be incorporated and made part of an Interconnection Construction Service Agreement may be found in PJM Manual M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

### 3.5.4.3 Construction Standards

The facilities of the PJM Transmission System, while operated by PJM, are comprised of the physical facilities owned by the various Interconnected Transmission Owners (“ITOs”). While the facilities of the various ITOs are operated by PJM as a fully integrated transmission network, the physical facilities of each individual ITO are designed to the particular construction standards of that ITO. While particular construction standards may vary among the various ITOs, all such standards are derived from those generally accepted industry standards developed by the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) and the National Electric Safety Code.

The ITOs have selected their various construction standards to facilitate operation, maintenance and repair or replacement of the various components utilized on their portion of the overall PJM Transmission System. Thus, it is essential that any additions, upgrades or other changes to the transmission facilities of any particular ITO must be designed and installed to the construction standards of that ITO. PJM, as the Transmission Provider, will ensure that any Constructing Entities authorized to perform construction activities under the Option to Build provisions of the PJM Tariff to interconnect with the facilities of an ITO or to install or upgrade facilities within the transmission system of an ITO has access to the established construction standards of that ITO. All such construction standards shall be referenced in an appendix to the Interconnection Construction Service Agreement.

PJM will also ensure that the Transmission Interconnection Customer has access to the applicable technical requirements of the ITO for parallel operation with the ITO’s system and other matters generally included in Good Utility Practice. PJM makes documents containing Applicable Technical Requirements and Standards for each Transmission Owner available through its website.

**Note:**

Further information about Construction Standards and Technical Requirements applicable to transmission interconnection projects may be found in PJM Manual M-14-C, Section 4.

### 3.5.4.4 Option to Build

The Transmission Interconnection Customer shall have the option to assume the responsibility for the design, procurement and construction of Transmission Owner Interconnection Facilities that are Direct Connection Network Upgrades (“Option to Build”).

**Note:**

Further information on all terms and conditions to be incorporated under the Option to Build provision may be found in PJM Manual M-14A and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

### **3.5.5 Project Controls**

PJM believes that the effective use of project controls is essential to maintaining and monitoring cost and schedules during the construction phase of Merchant Transmission Facilities.

Thus, PJM has established project controls, concepts and tools to facilitate coordination of interconnection construction activities.

**Note:**

Further information about interconnection coordination project controls may be found in PJM Manual M-14C.

### **3.5.6 Operation across Control Area Boundaries**

Operations of Transmission Facilities that span from one Control Area to another control area require installation of interchange metering points. For additional details regarding operations that span Control Areas, see PJM Manual M-01 and PJM Manual M-03.

### **3.5.7 Operational and Maintenance Requirements**

Each Interconnected Entity shall operate and maintain, or shall cause the operation and maintenance of, its facilities in a safe and reliable manner in accord with (i) the terms of the PJM Tariff (ii) Applicable Standards; (iii) applicable rules, procedures and protocols set forth in the Tariff and the Operating Agreement, as any or all may be amended from time to time; (iv) Applicable laws and Regulations, and (v) Good Utility Practice.

### **3.5.8 Metering and Communication**

All Merchant Transmission Facilities must install metering and communication equipment as outlined in PJM Manual 01.

## Section 4: Transmission Interconnection Customers Proposing Capability Increases to specific Transmission Owner Facilities

Welcome to the Transmission Interconnection Customers Proposing Capability Increases to specific Transmission Owner Facilities section of the PJM Manual for **Upgrade and Transmission Interconnection Requests**. In this section you will find an overview of Merchant Network Upgrade projects.

- Requirements to enter the New Services Queue
- Agreements applicable to Merchant Network Upgrade projects
- An overview of rights, technical requirements, and operation and maintenance requirements

### 4.1 Entering the New Services Queue

Merchant Network Upgrades are Transmission Interconnection Customer funded upgrades to existing Transmission Owner(s) Transmission Facilities or advancements of approved Regional Transmission Expansion Plan projects that upon completion will be fully owned and controlled by the Transmission Owner(s).

#### 4.1.1 General Requirements

The following information must be provided for all Transmission Interconnection Customer requests proposing capability increases to specific Transmission Owner Facilities, under Attachment EE:

- location of proposed facilities to upgrade;
- substation(s);
- equipment description;
- voltage;
- increase in system capability in MW or MVA;
- in-service date; or
- if advancing the construction of an RTEP project, provide the number and the requested in-service date the project should be advanced to

As indicated above with the exception of RTEP project advancements, each request must identify an increase in power transfer capability in MW or MVA. A refundable deposit of \$50,000 is required with each request.

### 4.2 Agreements

The following attachments are applicable to Merchant Network Upgrade projects:

- Attachment EE: Upgrade Request;
- Attachment N-1: System Impact Study Agreement;
- Attachment N-2: Facilities Study Agreement; and

- Attachment GG: Upgrade Construction Service Agreement.

These attachments are described in PJM Manual 14A. The following agreements are specific to Transmission Interconnection Customers proposing capability increases to specific Transmission Owner Facilities:

#### **4.2.1 Upgrade Construction Service Agreement (UCSA)**

Transmission Interconnection Customers proposing capability increases to specific Transmission Owner Facilities finance Merchant Network Upgrade which upgrade Transmission Facilities or advance RTEP projects that are or will be owned by Transmission Owner(s). Since these customers will not own the Transmission Facilities that they are funding, the agreement that they receive identifies and causes construction of the upgrade(s) to the system, obligates them to pay, identifies the applicable rights and establishes the term for those rights.

Rights shall become effective pursuant to the applicable UCSA and upon commencement of service. The term of rights is for the advancement period (for an advancement project), or the lesser of 30 years or the life of the upgrade (for all other Merchant Network Upgrades). If there are no rights or if rights terminate, the UCSA also terminates.

#### **4.2.2 IDR Transfer Agreement**

A Transmission Interconnection Customer proposing a Merchant Network Upgrade may obtain Incremental Deliverability Rights (IDR) associated with its Network Upgrades. IDRs are further described, including their transfer, in this manual in Attachment E.

### **4.3 Rights**

As specified in the UCSA, Transmission Interconnection Customers proposing capability increases to specific Transmission Owner Facilities funding incremental increases in capability to the PJM Transmission System may be entitled to Upgrade-Related Rights if they are created by the incremental capability.

#### **4.3.1 Incremental Available Transfer Capability Revenue Rights (IATCRRs)**

These rights are described in this manual in Attachment C.

#### **4.3.2 Incremental Auction Revenue Rights (IARRs)**

These rights are described in this manual in Attachment D.

#### **4.3.3 Incremental Deliverability Rights (IDRs)**

These rights are described in this manual in Attachment E.

#### **4.3.4 Incremental Capacity Transfer Rights (ICTRs)**

These rights are described in this manual in Attachment F.

## 4.4 Technical Design Requirements

### 4.4.1 Construction Requirements

#### 4.4.1.1 Cost Responsibility

The UCSA defines the obligation of the Transmission Interconnection Customer regarding cost responsibility for the required Merchant Network upgrades. The costs associated with advancing existing RTEP projects are defined in PJM Tariff section 217.

**Note:**

Further information on all terms and conditions to be incorporated and made part of the Upgrade Construction Service Agreement may be found in PJM Manuals M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### 4.4.1.2 Terms and Conditions

The construction of any Merchant Network Upgrade on the PJM Transmission System shall be performed in accordance with the Standard Terms and Conditions as specified in an Upgrade Construction Service Agreement to be executed among the Transmission Interconnection Customer, the Transmission Provider and the affected Interconnection Transmission Owner(s). The form of an Upgrade Construction Service Agreement may be found in the PJM Open Access Transmission Tariff as Attachment GG.

**Note:**

Further information on all terms and conditions to be incorporated and made part of an Upgrade Construction Service Agreement may be found in PJM Manual M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### 4.4.1.3 Option to Build

The Transmission Interconnection Customer shall have the option to assume the responsibility for the design, procurement and construction of Transmission Owner Interconnection Facilities that are Direct Connection Network Upgrades (“Option to Build”).

**Note:**

Further information on all terms and conditions to be incorporated under the Option to Build provision may be found in PJM Manual M-14A and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### 4.4.1.4 Construction Standards (If Option to Build is Exercised)

The facilities of the PJM Transmission System, while operated by PJM, are comprised of the physical facilities owned by the various Interconnected Transmission Owners (“ITOs”). While the facilities of the various ITOs are operated by PJM as a fully integrated transmission network, the physical facilities of each individual ITO are designed to the particular construction standards of that ITO. While particular construction standards may vary among the various ITOs, all such standards are derived from those generally accepted industry standards developed by the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) and the National Electric Safety Code.

The ITOs have selected their various construction standards to facilitate operation, maintenance and repair or replacement of the various components utilized on their portion of the overall PJM Transmission System. Thus, it is essential that any additions, upgrades or other changes to the transmission facilities of any particular ITO must be designed and installed to the construction standards of that ITO. PJM, as the Transmission Provider, will ensure that any Constructing Entities authorized to perform construction activities under the Option to Build provisions of the PJM OATT to interconnect with the facilities of an ITO or to install or upgrade facilities within the transmission system of an ITO has access to the established construction standards of that ITO. All such construction standards shall be referenced in an appendix to the Upgrade Construction Service Agreement.

PJM will also ensure that the Transmission Interconnection Customer has access to the applicable technical requirements of the ITO for parallel operation with the ITO's system and other matters generally included in Good Utility Practice. PJM makes documents containing Applicable Technical Requirements and Standards for each Transmission Owner available through its website.

**Note:**

Further information about Construction Standards and Technical Requirements applicable to Merchant Network Upgrade projects may be found in PJM Manual M-14-C, Section 3.

#### **4.4.2 Project Controls**

PJM believes that the effective use of project controls is essential to maintaining and monitoring cost and schedules during the construction phase of Merchant Network Upgrades. Thus, PJM has established project controls, concepts and tools to facilitate coordination of interconnection construction activities.

**Note:**

Further information about interconnection coordination project controls may be found in PJM Manual M-14C.

#### **4.4.3 Operational and Maintenance Requirements**

As set forth in the Upgrade Construction Service Agreement, the Interconnected Transmission Owner that owns the Transmission System facilities to which any Merchant Network Upgrades are connected shall operate and maintain such Merchant Network Upgrades (a) on behalf of and at the expense of the Transmission Interconnection Customer that constructed or caused construction of the pertinent Merchant Network Upgrades and (b) in accordance with the terms of the PJM Tariff and the UCSA regarding such operation and maintenance.

## Section 5: Upgrade Customers

Welcome to the *Upgrade Customers* section of the PJM Manual for ***Upgrade and Transmission Interconnection Requests***. In this section you will find an overview of Upgrade projects.

- Requirements to enter the New Services Queue
- Agreements applicable to Upgrade Customers
- An overview of rights, technical requirements, and operation and maintenance requirements

### 5.1 Entering the New Services Queue

PJM Manual 6 identifies that the interconnection planning process for an elective upgrade to obtain financial rights known as Incremental Auction Revenue Rights (IARRs) is triggered by the Upgrade Customer executing an Upgrade Request, or Tariff Attachment EE, and submitting the required study deposit of \$20,000. This deposit will be applied towards the Upgrade Customer's cost responsibility in the Upgrade Feasibility Study.

For IARR requests with specific financial transfer capability requested, the request itself constitutes the initial estimate of IARRs. The rights associated with the initial request, or estimate, are subject to a final binding determination of IARRs. The Tariff governs this analysis, and requires that the final assignment occur no less than 45 days prior to the in-service date of the associated Network Upgrades.

The reason for this process is that the financial viability of the rights is supported by the capability of the Transmission System, which can change subsequent to initial IARR estimates. Assigning the final determination of IARRs 45 days prior to the in-service date protects Auction Revenue Rights and Financial Transmission Rights holders from underfunding that may result from changes to the Transmission System that occur between the initial IARR estimate and the in-service date for the underlying upgrades. Financial Transmission Rights holders are the group that would be at the risk of underfunding.

Entities have a non-binding expectation of a certain amount of IARRs. To mitigate the potential for significant disparities between initial IARR requests, or estimates, and final determinations, an entity will receive a minimum of 80% and a maximum of 100% of the initial estimate of IARRs requested.

### 5.2 Agreements

The following attachments are applicable to Upgrade Customers:

- Attachment EE: Upgrade Request;
- Attachment N-1: System Impact Study Agreement;
- Attachment N-2: Facilities Study Agreement; and
- Attachment GG: Upgrade Construction Service Agreement.



The study attachments are described in PJM Manual 14A. The following agreements are specific to Upgrade Requests:

### **5.2.1 Upgrade Construction Service Agreement (UCSA)**

Upgrade Customers finance the upgrading of Transmission Facilities that are or will be owned by Transmission Owner(s). Since these customers will not own the Transmission Facilities that they are funding, the agreement that they receive identifies and causes construction of the upgrade(s) to the system, obligates them to pay, identifies the applicable rights and establishes the term for those rights.

Rights shall become effective pursuant to the applicable UCSA and upon commencement of service. The term of rights is for the advancement period or 30 years, whichever is shorter. If there are no rights or if rights terminate, the UCSA also terminates.

### **5.2.2 IDR Transfer Agreement**

An Upgrade Customer may obtain Incremental Deliverability Rights (IDR) associated with its Network Upgrades. IDRs are further described, including their transfer, in this manual in Attachment E.

## **5.3 Rights**

As specified in the UCSA, Upgrade Customers funding incremental increases in capability to the PJM Transmission System may be entitled to select from a choice of Upgrade-Related Rights if they are created by the incremental capability.

### **5.3.1 Incremental Available Transfer Capability Revenue Rights (IATCRRs)**

These rights are described in this manual in Attachment C.

### **5.3.2 Incremental Auction Revenue Rights (IARRs)**

These rights are described in this manual in Attachment D.

### **5.3.3 Incremental Deliverability Rights (IDRs)**

These rights are described in this manual in Attachment E.

### **5.3.4 Incremental Capacity Transfer Rights (ICTRs)**

These rights are described in this manual in Attachment F.

## **5.4 Technical Design Requirements**

### **5.4.1 Construction Requirements**

#### **5.4.1.1 Cost Responsibility**

The UCSA defines the obligation of the Upgrade Customer regarding cost responsibility for the required Network upgrades.



**Note:**

Further information on all terms and conditions to be incorporated and made part of the Upgrade Construction Service Agreement may be found in PJM Manuals M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### 5.4.1.2 Terms and Conditions

The construction of any Network Upgrade on the PJM Transmission System shall be performed in accordance with the Standard Terms and Conditions as specified in an Upgrade Construction Service Agreement to be executed among the Upgrade Customer, the Transmission Provider and the affected Interconnection Transmission Owner(s). The form of an Upgrade Construction Service Agreement may be found in the PJM Open Access Transmission Tariff as Attachment GG.

**Note:**

Further information on all terms and conditions to be incorporated and made part of an Upgrade Construction Service Agreement may be found in PJM Manual M-14A and M-14-C and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### 5.4.1.3 Construction Standards

The facilities of the PJM Transmission System, while operated by PJM, are comprised of the physical facilities owned by the various Interconnected Transmission Owners (“ITOs”). While the facilities of the various ITOs are operated by PJM as a fully integrated transmission network, the physical facilities of each individual ITO are designed to the particular construction standards of that ITO. While particular construction standards may vary among the various ITOs, all such standards are derived from those generally accepted industry standards developed by the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) and the National Electric Safety Code.

The ITOs have selected their various construction standards to facilitate operation, maintenance and repair or replacement of the various components utilized on their portion of the overall PJM Transmission System. Thus, it is essential that any additions, upgrades or other changes to the transmission facilities of any particular ITO must be designed and installed to the construction standards of that ITO. PJM, as the Transmission Provider, will ensure that any Constructing Entities authorized to perform construction activities under the Option to Build provisions of the PJM OATT to interconnect with the facilities of an ITO or to install or upgrade facilities within the transmission system of an ITO has access to the established construction standards of that ITO. All such construction standards shall be referenced in an appendix to the Upgrade Construction Service Agreement.

PJM will also ensure that the Upgrade Customer has access to the applicable technical requirements of the ITO for parallel operation with the ITO’s system and other matters generally included in Good Utility Practice. PJM makes documents containing Applicable Technical Requirements and Standards for each Transmission Owner available through its website.

**Note:**

Further information about Construction Standards and Technical Requirements applicable to Upgrade Customer projects may be found in PJM Manual M-14-C, Section 3.

#### **5.4.1.4 Option to Build**

The Upgrade Customer shall have the right to assume the responsibility for the design, procurement and construction of the Transmission Owner Interconnection Facilities that are Direct Connection Network Upgrades (“Option to Build”).

**Note:**

Further information on all terms and conditions to be incorporated under the Option to Build provision may be found in PJM Manual M-14A and in Part VI of the PJM Open Access Transmission Tariff available on the PJM website.

#### **5.4.2 Project Controls**

PJM believes that the effective use of project controls is essential to maintaining and monitoring cost and schedules during the construction phase of Network Upgrades. Thus, PJM has established project controls, concepts and tools to facilitate coordination of interconnection construction activities.

**Note:**

Further information about interconnection coordination project controls may be found in PJM Manual M-14C.

#### **5.4.3 Operational and Maintenance Requirements**

The Transmission Owner shall operate and maintain, or shall cause the operation and maintenance of, its facilities in a safe and reliable manner in accord with (i) the terms of the PJM Tariff (ii) Applicable Standards; (iii) applicable rules, procedures and protocols set forth in the Tariff and the Operating Agreement, as any or all may be amended from time to time; (iv) Applicable laws and Regulations, and (v) Good Utility Practice.

## Attachment A: HVDC Additional Study Requirements

In addition to the studies normally required interconnection during the Facilities Study phase by PJM and the Interconnected Transmission Owner, several other studies are required among PJM, Interconnected Transmission Owner, and the Transmission Interconnection Customer to facilitate proper design of the HVDC facility. Though many of the studies listed below will be required by the project developer for proper design of the HVDC facilities, PJM and member Interconnected Transmission Owners require verification of the expected performance of the facilities being interconnected.

### A1. Proposed Merchant D.C. Transmission Facilities and Their Dynamic Characteristics

The Transmission Interconnection Customer needs to provide to PJM proposed operating performance specifications, dynamics characteristics and models of the HVDC facilities as they become available, but no later than when the customer returns the System Impact Study Agreement. This would include but not limited to

- Proposed control modes (e.g. power control, power factor control)
- Proposed power modulation controls
- Expected recovery times after AC or DC side faults
- Proposed reactive compensation

### A2. Dynamic Performance Analysis

This study assesses the dynamic performance of an HVDC project to disturbances on both the DC and AC system. It is typically performed using various simulation tools like PSS/E, EMTDC, EMTP, HYPERSIM, MATLAB/SimPower, etc. The dynamic performance is demonstrated by time domain analysis for a list of system disturbance cases generally based on applicable NERC, Regional, PJM and Interconnected Transmission Owner criteria that will include, but not limited to;

- DC side faults
- Energization of the Merchant D.C. Transmission Facilities
- DC facility step response
- Blocking and De-Blocking of the Merchant D.C. Transmission Facilities
- AC side faults (Temporary or Permanent, single phase or multi-phase) considering reclosing, breaker failure, delayed clearing, and loss and recovery performance of DC tie for faults near converter or inverter terminal.
- Tripping of generation or Switching of large loads in the proximity of DC terminal

Assessment of the dynamic performance will also include analysis of possible dynamic overvoltages/undervoltages on the AC network. In addition to the above listed phenomena, additional events to be studied, but not limited to

- Switching of HVDC facility's AC filters, bus voltage control devices

- Switching of nearby transformers, reactors, capacitor banks etc.

### **A3. Sub-synchronous Torsional Analysis**

Torsional perturbations in a turbine-generator could cause modulations of the generator's rotor speed, which in turn could cause variations in the generator's terminal voltage. If an HVDC converter terminal is in the electrical proximity, this could cause variations in the DC side voltages and currents. Regulators within the DC terminal could respond to these changes, which in turn could cause changes in the machine's electrical torque. If this change in torque is out of phase with the change in speed, it could provide negative damping to the torsional vibrations amplifying their effects, which could damage the turbine-generator shaft.

The possibilities of torsional interactions between HVDC converter and the generator would depend on relative coupling between the two, their relative sizes, and the phase lag from perturbation in generator speed to the perturbation in generator electrical torque including the actions of the HVDC controls.

A screening study is performed to determine if there is any risk of torsional interactions over the entire range of expected operating conditions. If a risk of torsional interactions is identified, more detailed studies would be required to help design HVDC controls to minimize such a risk, and if necessary to design Torsional Protection for the generator at risk.

### **A4. AC System Harmonic Analysis**

This study is to assess the impact of an HVDC project on the power quality of the local AC electrical system and to validate the suitability of the design of AC filters associated with the DC terminals over the range of operation of the facility. The study is performed to demonstrate that there will be no unacceptable harmonic impact of the AC system, and that the facility will meet performance criteria and standards on power quality. If necessary, mitigation solutions would be identified. IEEE Std. 519 will be used if no local utility standard is available.

### **A5. Studies required by Interconnected Transmission Owner's FERC-715 report**

PJM and the affected Interconnected Transmission Owner will require verification of design and/or expected performance of the proposed HVDC facilities to meet requirements as listed in the ITO's FERC-715 filing.

### **A6. A.C. Ferro-Resonance Study**

PJM and/or the Interconnected Transmission Owner will evaluate the results of the ferro-resonance study to be performed by the Transmission Interconnection Customer.

### **A7. Power Line Carrier Filter Performance Verification**

PJM and/or the Interconnected Transmission Owner will evaluate the results of the power line carrier blocking filter design study to be performed by the Transmission Interconnection Customer.

## A8. Field Investigation of Existing A.C. System Harmonic Content

This study will measure and analyze the existing harmonics and negative phase sequence content at the Point of Interconnection between the Interconnected Transmission Owner and the Transmission Interconnection Customer's project.

## A9. Stability Analyses

PJM and/or the Interconnected Transmission Owner will provide data listed in the table below to the Transmission Interconnection Customer. Information included in the table indicates the A.C. power system characteristics at the Point of Interconnection to be used in design of the project. Each converter terminal's Point of Interconnection shall be provided.

AC Network Parameter	Substation No.1	Substation No. 2
Nominal AC Line Voltage	kV	kV
Base AC Voltage	kV	kV
Normal Operating Line Voltage (range)	kV	kV
Maximum Steady State Line Voltage	kV	kV
Minimum Steady State Line Voltage	kV	kV
Negative Sequence Voltage During Normal Operation	%	%
Nominal System Frequency	Hz	Hz
Steady State Maximum Frequency	Hz	Hz
Steady State Minimum Frequency	Hz	Hz
Frequent Disturbance Frequency Deviation	±Hz	±Hz
Infrequent Disturbance Frequency Deviation - 10 - 12 % Load Shedding	_% Load Shedding ±Hz	_% Load Shedding ± Hz
Infrequent Disturbance Frequency Deviation - 50% Load Shedding	≥Hz	≥Hz
Maximum Phase Current Unbalance	%	%
Maximum Short Circuit	___MVA, 3-PH ___MVA, 1-PH	___MVA, 3-PH ___MVA, 1-PH
Ultimate Maximum Short Circuit	___MVA, 3-PH	___MVA, 3-PH
Minimum Short Circuit	___MVA, 3-PH ___MVA, 1-PH	___MVA, 3-PH ___MVA, 1-PH

AC Network Parameter	Substation No.1	Substation No. 2
Maximum Positive Sequence System Impedance (100 MVA base)	___+j ___PU	___+j ___PU
Maximum Zero Sequence System Impedance (100 MVA base)	___+j ___PU	___+j ___PU
Minimum Positive Sequence System Impedance (100 MVA base)	___+j ___PU	___+j ___PU
Minimum Zero Sequence System Impedance (100 MVA base)	___+j ___PU	___+j ___PU
AC System Fault Clearing Time Normal	cycles	cycles
AC System Fault Clearing Time – Breaker Failure	cycles	cycles
Automatic Reclosing Time(1-PHASE)	cycles	cycles
(3-PHASE) Instantaneous	cycles	cycles
Delayed	cycles	cycles
Switchyard Equipment BIL (LIWL)	kV	kV
Switchyard Equipment SIL (SIWL)	kV	kV

Table 1 - AC Power System Characteristics at the Point of Interconnection

## Attachment B: Transmission Injection Rights and Transmission Withdrawal Rights

### B1. Summary of Transmission Injection Rights (TIRs) and Transmission Withdrawal Rights (TWRs)

The assignment of TIRs and TWRs associated with new Merchant D.C. Transmission Facilities or Controllable A.C. Transmission Facilities will be made in accordance with the PJM Tariff and may depend upon the capabilities of the facilities and upgrades necessary to accommodate other New Service Requests. TIRs and TWRs are defined in PJM Tariff section 232.

The holder of TIRs is entitled to schedule capacity and/or energy on the associated Merchant D.C. Transmission Facilities or Controllable A.C. Transmission Facilities for injection into the PJM Transmission System at the defined Point of Interconnection between the Merchant D.C. Transmission Facilities or Controllable A.C. Transmission Facilities and the PJM Transmission System. TWRs entitle the holder to schedule energy on the associated Merchant Transmission Facilities to be withdrawn from the PJM Transmission System at the defined Point of Interconnection between the Merchant D.C. Transmission Facilities or Controllable A.C. Transmission Facilities and the PJM Transmission System. This capability to inject capacity/energy at a defined Point of Interconnection with the PJM Transmission System is directly comparable to the capability of generation facilities to inject capacity/energy into the PJM Transmission System. Similarly, the capability to withdraw capacity/energy at a defined Point of Interconnection with the PJM Transmission System is directly comparable to the capability of load to withdraw capacity/energy from the PJM Transmission System.

TIRs and TWRs are available to developers of Merchant D.C. Transmission Facilities or Controllable A.C. Transmission Facilities only if the Transmission Interconnection Customer has elected, pursuant to the PJM Tariff, to receive Transmission Injection Rights and Transmission Withdrawal Rights in lieu of Incremental Deliverability Rights, Incremental Auction Revenue Rights, and Incremental Available Transfer Capability Revenue Rights. The holder of TIRs and TWRs for Merchant D.C. Transmission Facilities and/or Controllable A.C. Transmission Facilities that interconnect with the PJM Transmission System and with a control area outside the combined PJM Region shall be entitled to receive Transmission Injection Rights and/or Transmission Withdrawal Rights at each terminal where such Merchant D.C. Transmission Facilities and/or Controllable A.C. Transmission Facilities interconnect with the PJM Transmission System. The MW value of TIRs requested and/or held at one terminal of Merchant D.C. Transmission Facilities or Controllable Merchant A.C. Transmission facilities shall be the net of all losses on the facility. The value of TWRs requested and/or held shall be the actual MW value to be withdrawn.

A Transmission Interconnection Customer may hold TIRs and TWRs simultaneously at the same terminal on the PJM Transmission System, subject to PJM evaluation and approval. However, neither the aggregate TIRs nor the aggregate TWRs held at a terminal may exceed the Nominal Rated Capability (as defined in the PJM Tariff) of the interconnected Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities, as stated in the associated Interconnection Service Agreement.



Subject to the terms of the PJM Tariff, TIRs and/or TWRs received by a party shall be effective for the life of the associated Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities.

No TIRs or TWRs shall be received by a party with respect to transmission investment that is included in the rate base of a public utility and on which a regulated return is earned.

TIRs and/or TWRs may be sold or otherwise transferred subject to compliance with such procedures as PJM may establish regarding such transfer and required notice to PJM of use of such rights after the transfer. The transfer of TIRs or of TWRs shall not itself extend the time periods set forth in the PJM Tariff regarding loss of such rights.

## **B2. Procedure to Determine Transmission Injection Rights (TIRs) and Transmission Withdrawal Rights (TWRs)**

Transmission Injection Rights (TIRs) are the rights to inject capacity and/or energy into the Transmission System at a Point of Interconnection of a Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities with the Transmission System. TIRs are determined through the use of industry power flow software and analytical techniques to be the amount of capacity and/or energy that can be reliably accommodated for injection into the Transmission System at the Point of Interconnection. The studies to determine Capacity (Firm) TIRs are conducted under the same reliability criteria as studies for projects requesting Capacity Interconnection Rights and RTEP baseline studies. Studies to determine Energy (Non-Firm) TIRs are conducted under the same reliability criteria as studies for projects requesting only Energy Resource Status and RTEP baseline studies.

Transmission Withdrawal Rights (TWRs) are the rights to withdraw capacity and/or energy from the Transmission System at a Point of Interconnection of a Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities with the Transmission System. TWRs are determined through the use of industry power flow software and analytical techniques to be the amount of capacity and/or energy that can be reliably accommodated for withdrawal from the Transmission System at the Point of Interconnection. The studies to determine Firm and Non-Firm TWRs are conducted under the same reliability criteria as applied in the RTEP baseline studies.

PJM shall include in the System Impact Study an evaluation of the feasibility of the Transmission Injection Rights and the Transmission Withdrawal Rights (including the quantity of each type of such rights) requested by the Transmission Interconnection Customer at the terminal(s) where the pertinent Merchant D.C. Transmission Facilities and/or Controllable A.C. Merchant Transmission Facilities interconnect with the PJM Transmission System. Such rights shall become available to the Transmission Interconnection Customer pursuant to the Interconnection Service Agreement and upon commencement of Interconnection Service thereunder.

## **B3. Transmission Service Rate for TWR**

There are two components to transmission service requirements to deliver transactions out of PJM over Merchant D.C. Transmission Facilities.

- Subscription for transmission service over Merchant D.C. Transmission Facilities.



Assuming that the HVDC facility has elected TIRs and TWRs instead of possible incremental rights, 'transmission service' over the facility would be obtained and scheduled according to the subscription for service over the HVDC facility, regardless of which RTO retains operational control of the Merchant D.C. Transmission Facilities.

- Transmission service from the source(s) in PJM to the HVDC terminal in PJM.

The Transmission Interconnection Customer can choose either Point-To-Point Transmission Service or Network Integration Transmission Service, depending on their respective circumstances. Only Point-To-Point Transmission Service is available for service to non-designated loads. The only exception that provides for use of Network Integration Transmission Service is for a Network Customer that requests transmission service for load outside of PJM and elects to include its entire load as Network Load for all purposes.

## Attachment C: Incremental Available Transfer Capability Revenue Rights

### C1. Incremental Available Transfer Capability Revenue Rights

Available Transfer Capability (ATC) represents the amount of energy above “base case” conditions that can be transferred reliably from one Control Area to another over all transmission facilities without violating any pre- or post-contingency criteria for the facilities in the PJM Region under the specified system conditions. ATC of a particular path is an approximate indication of the anticipated transmission transfer capability remaining on the transmission network that could be scheduled for further energy transfers relative to the designated path under the conditions studied. PJM posts firm and non-firm ATC projections on its OASIS for interfaces between the PJM Region – including all PJM TOA and PJM West TOA signatories – and neighboring Control Areas.

The addition of Merchant Transmission Facilities (and the additional transmission enhancements that may be required to accommodate the Merchant Transmission Facilities), Merchant Network Upgrades, or Network Upgrades may create additional, incremental ATC. Incremental Available Transfer Capability Revenue Rights are the rights to revenues that are derived from incremental Available Transfer Capability created by the addition of a Merchant Transmission Facilities or a new transmission facility or upgrade resulting from the accommodation of an Interconnection Request(s) or Upgrade Request pursuant to Part IV and Part VI of the PJM Tariff. IATCRRs are defined in PJM Tariff Section 233. A Transmission Interconnection Customer proposing Merchant Transmission Facilities may elect to receive Incremental Available Transfer Capability Revenue Rights as part of the set of rights available in lieu of TIRs and TWRs.

A New Services Customer may request PJM to provide a non-binding estimate in the Facilities Study of the Incremental Available Transfer Capability Revenue Rights associated with the Merchant Transmission Facilities or with the required facilities or upgrades for which the New Services Customer has cost responsibility. The ultimate assignment of Incremental Available Transfer Capability Revenue Rights associated with the Merchant Transmission Facilities or with the required facilities or upgrades for which the New Services Customer has cost responsibility will be made pursuant to the process set forth in the PJM Tariff.

Incremental Available Transfer Capability Revenue Rights received by a New Services Customer shall be effective for thirty (30) years from commencement of Interconnection Service for such customer/developer or the life of the pertinent facility or upgrade, whichever is shorter, subject to any subsequent pro-rata reallocations of all Available Transfer Capability Revenue rights (including Incremental Available Transfer Capability Revenue Rights).

No Incremental Available Transfer Capability Revenue Rights shall be received by a New Services Customer with respect to transmission investment that is included in the rate base of a public utility and on which a regulated return is earned.

## **C2. Procedure to Determine Incremental Available Transfer Capability Revenue Rights (IATCRRs)**

Available Transfer Capability Revenue Rights (ATCRRs) are the rights of a Transmission Owner to the revenues for Available Transfer Capability made possible by the Transmission Facilities installed by the Transmission Owner. Incremental ATCRRs are those additional ATCRRs, not previously feasible, created by the addition of Merchant Transmission Facilities, or a new transmission facility or upgrade resulting from the accommodation of a New Service Request. The incremental ATCRRs are determined to be the difference between the ATCRRs that are available after the installation of the additional Merchant Transmission Facilities, Merchant Network Upgrades, or Network Upgrades and the ATCRRs that were available immediately prior to the installation of the additional transmission facilities. The incremental ATC created by the addition of these new facilities are determined through the use of industry power flow software and analytical techniques. The studies to determine the incremental ATC are conducted under the same reliability criteria as applied in the RTEP baseline studies.

## Attachment D: Incremental Auction Revenue Rights

### D1. Incremental Auction Revenue Rights

Incremental Auction Revenue Rights are the additional Auction Revenue Rights, not previously feasible, created by the addition of Merchant Transmission Facilities, Merchant Network Upgrade, or a new Network Upgrade resulting from the accommodation of a New Service Request pursuant to Part IV or Part VI of the PJM Tariff. IARRs are defined in PJM Tariff section 231.

No Incremental Auction Revenue Rights shall be received by New Service Customer with respect to transmission investment that is included in the rate base of a public utility and on which a regulated return is earned.

#### D1.1. Interconnection Customers

The Interconnection Customer may request PJM to provide a non-binding estimate in the Facilities Study of the Incremental Auction Revenue Rights associated with the Merchant Transmission Facilities, Merchant Network Upgrades, or new Network Upgrades for which the Interconnection Customer has cost responsibility on up to three (3) pairs of point-to-point combinations. The ultimate assignment of Incremental Auction Revenue rights associated with the new Merchant Transmission Facilities, Merchant Network Upgrades, or with the Network Upgrades for which the Interconnection Customer has cost responsibility will be made pursuant to the allocation process set forth in the PJM Tariff and may depend upon the point-to-point combination requests and cost responsibilities of other Interconnection Customers requesting interconnection under Part IV of the PJM Tariff.

Incremental Auction Revenue Rights are available to developers of Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities only if the developer has elected, pursuant to the PJM Tariff, to receive Incremental Auction Revenue Rights, Incremental Deliverability Rights and Incremental Available Transfer Capability Revenue Rights in lieu of Transmission Injection Rights and/or Transmission Withdrawal Rights.

#### D1.2. Upgrade Customers

Incremental Auction Revenue Rights are the additional Auction Revenue Rights, not previously feasible. An Upgrade Customer requesting IARRs per Section 7.8 of the Appendix to Tariff Attachment K requests PJM to determine the upgrades necessary to create the requested incremental ARR financial rights requested. As described in section 4 of this manual, the maximum level to be awarded of the IARRs is 100% of requested amount, and the minimum level to be awarded is 80% of the IARRs requested. Additional information can be found on the PJM website at <http://www.pjm.com/~media/planning/pjm-iarr-analysis.ashx>.

### D2. Procedure to Determine Incremental Auction Revenue Rights (IARRs)

Auction Revenue Rights (ARRs) are the rights of an ARR holder to an appropriate portion of the revenues from the annual FTR Auction. Incremental ARRs are those additional ARRs, not previously simultaneously feasible, created by the addition of Merchant Transmission Facilities, Merchant Network Upgrades, or new Network Upgrades resulting from the accommodation of a New Service Request. The Incremental ARRs are determined to be the difference

between the ARR available after the installation of the additional transmission facilities and the ARR available immediately prior to the installation of the additional transmission facilities. The Incremental ARRs created by the addition of Merchant Transmission Facilities, Merchant Network Upgrades, or Network Upgrades are determined through the use of industry power flow software and analytical techniques. The studies to determine the Incremental ARRs are conducted under the same reliability criteria as Energy Resources and baselines.

**Note:**

Further information about the request and allocation process for FTRs and ARRs may be found in PJM Manual M-06 “Financial Transmission Rights” available on the PJM website.

## Attachment E: Incremental Deliverability Rights

### E1. Incremental Deliverability Rights

Incremental Deliverability Rights are the rights to the incremental ability, resulting from the addition of a Merchant Transmission Facilities or Merchant Network Upgrades, to inject capacity and energy at a point on the Transmission System, such that the injection satisfies the deliverability<sup>1</sup> requirements of a Capacity Resource. IDRs are defined in PJM Tariff section 235.

A Transmission Interconnection Customer shall be entitled to receive the Incremental Deliverability Rights associated with its Merchant Transmission Facilities or Merchant Network Upgrades as determined in accordance with the PJM Tariff, provided, however, that a Transmission Interconnection Customer that proposes to interconnect Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities that connect the Transmission System with another control area outside the PJM Region shall be entitled to Incremental Deliverability Rights associated with such Merchant D.C. Transmission Facilities and/or Controllable Merchant A.C. Transmission Facilities only if the Transmission Interconnection Customer has elected to receive Incremental Deliverability Rights, Incremental Auction Revenue Rights and Incremental Available Transfer Capability Revenue Rights in lieu of Transmission Injection Rights and/or Transmission Withdrawal Rights.

Incremental Deliverability Rights assigned to a Transmission Interconnection Customer shall be effective until one year after the commencement of Interconnection Service.

No Incremental Deliverability Rights shall be received by a Transmission Interconnection Customer with respect to transmission investment that is included in the rate base of a public utility and on which a regulated rate of return is earned.

### E2. Procedure to Determine Incremental Deliverability Rights (IDRs)

Deliverability Rights are the rights to inject capacity and energy at a point on the Transmission System, such that the injection satisfies the deliverability requirements of a Capacity Resource. Incremental Deliverability Rights (IDRs) are the additional reliable injection capability at that same point on the Transmission System created by the addition of Merchant Transmission Facilities or Merchant Network Upgrades. IDRs represent the additional Deliverability Capability created by the addition of Merchant Transmission Facilities or Merchant Network Upgrades resulting from the accommodation of the Transmission Interconnection Request or Upgrade Request. The IDRs are determined to be the difference between the Deliverability Capability available at that point after the installation of the additional transmission facilities and the Deliverability Capability available at that point immediately prior to the installation of the additional transmission facilities.

PJM shall include in the System Impact Study a determination of the IDRs associated with the Transmission Interconnection Customer's Merchant Transmission Facilities or Merchant

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<sup>1</sup> Deliverability is the determination that the aggregate of regional capacity resources can be utilized to deliver energy to the aggregate of regional load consistent with the requirements of the Reliability Principles and Standards of the applicable regional reliability council.

Network Upgrades. PJM shall post on its OASIS the IDRs that it assigns to the Transmission Interconnection Customer. The IDRs created by the addition of Merchant Transmission Facilities or Merchant Network Upgrades are determined through the use of industry power flow software and analytical techniques. The studies to determine the IDRs are conducted under the same reliability criteria as studies for projects requesting Capacity Status and RTEP baseline studies.

**Note:**

Refer to Manual 14-B for a full description of the deliverability testing methodology.

## Attachment F: Incremental Capacity Transfer Rights and Qualified Transmission Upgrades

### F1. General ICTR Information

Incremental Capacity Transfer Rights (ICTRs) are allocated to a New Service Customer obligated to fund a transmission facility or upgrade through a rate or charge specific to such facility or upgrade, to the extent such upgrade or facility increases the import capability into an LDA. ICTRs are described in PJM Tariff section 234. Such Incremental Capacity Transfer Rights allocation is based on the incremental increase in import capability across a Locational Constraint that is caused by the transmission facility upgrade. Incremental Capacity Transfer Rights will be effective for thirty years or the life of the facility, upgrade or advancement, whichever is less. Under conditions when the internal resources cleared in the LDA are high, the total amount of Capacity Transfer Rights is limited. The Incremental Capacity Transfer Rights will be limited to the total amount of Capacity Transfer Rights. If a customer funds advancement of a network transmission upgrade, the customer will receive Incremental CTRs for the years the upgrade is advanced based on the incremental CETL into a constrained LDA as certified by PJM.

A Qualified Transmission Upgrade (QTU) is a proposed project in the queue that if constructed would produce ICTRs. A QTU allows for a New Service Customer to determine in the BRA if the proposed project will provide a revenue stream prior to committing to construct the upgrade. Once constructed and placed into service, the QTU will be awarded ICTRs.

### F2. Procedure to Determine ICTRs

A New Service Customer wishing to request ICTRs must provide PJM with three Load Deliverability Areas to determine the rights. Once submitted, PJM will provide the amount of rights that will be received in the System Impact Study.

Participants must request PJM to certify the Incremental CTRs into the constrained LDAs modeled in RPM at least 90 days prior to the Base Residual Auction. PJM will certify the Incremental CTRs into the constrained LDA at least 45 days prior to the Base Residual Auction. For LDAs in which the RPM Auctions for such Delivery Year result in a positive average weighted Locational Price Adder with respect to the immediate higher level LDA, the holder of a Participant-Funded ICTR into such LDA shall receive a payment equal to (i) average weighted Locational Price Adder for the LDA into which the associated facility or upgrade increased import capability, multiplied by (ii) MW amount of ICTRs allocated to holder. No payment will be issued to the holder when a zero or negative average weighted Locational Price Adder with respect to the immediate higher level LDA is calculated as a result of the RPM Auctions for such Delivery Year. Participant-Funded ICTRs may be traded similar to CTRs.



## Revision History

### Revision 07 (04/01/2020):

Manual 14E changes to incorporate FERC Order 845 and 845-A Tariff changes.

The following sections were updated:

- Updated Section 3.5.4.4 Option to Build
- Updated Section 4.4.1.3 Option to Build
- Updated Section 5.4.1.4 Option to Build

### Revision 06 (12/20/2018):

- Updated manual ownership from David Egan to Jason Connell
- Cover to Cover Periodic Review
- Manual renamed to “Upgrade and Transmission Interconnection Requests”.
- Updated Section 1 for the overview to be consistent with other manuals in the 14 Series regarding New Services Requests.
- Added a new Exhibit in Section 1.1 describing all manuals in the 14 Series including the new Manual 14G for Generator Interconnection Requests.
- Added new Exhibits in Section 1.3 identifying Customer Classifications including customer types, request type, required attachments for queue entry, and applicable studies and agreements for each request type.
- Added new Section 2 “Queue Point Application Process” to describe the Queue Point tool and to assist the New Services Customer in determining the proper Tariff Attachment required depending on the type of request.
- With the addition of new Section 2 for “Queue Point Application Process” moved the previous Sections 2, 3, and 4 to Sections 3, 4, and 5, respectively.
- Corrections to Attachment S references made in old Section 2.1.2 (new Section 3.1.2).
- References to “developer” changed to “New Services Customer”, “Transmission Interconnection Customer”, or “Upgrade Customer” depending on context.

### Revision 05 (04/01/2018):

- Updated Upgrade Customer process for customers making an application under Attachment EE of the Tariff to obtain Incremental Auction Revenue Rights to add the additional study processes require to complete an Upgrade Feasibility Study prior to completing a System Impact Study.

### Administrative Change (11/14/2016):

- Removed Exhibit 1 – List of PJM Manuals as this is no longer current and inconsistent with the overall PJM manual format; revised exhibit numbering and table of contents accordingly.

**Revision 04 (05/26/2016):**

- Manual renamed to “Additional Information for Upgrade and Transmission Interconnection Projects”
- Revised Introduction to reflect new changes made to the manual prompted by the changes to the Merchant Network Upgrade process
- Moved the previous Sections 1, 2 & 3 to the Attachments portion of the manual and made updates to reflect the current PJM Tariff structure
- Added a new Section 1 to explain the different Transmission and Upgrade project and customer types
- Added a new Section 2 to provide an overview of Transmission Interconnection Customers that are proposing Merchant Transmission Facilities
- Added a new Section 3 to provide an overview of Transmission Interconnection Customers that are proposing capability increases to specific Transmission Owner Facilities
- Added a new Section 4 to provide an overview of Upgrade projects
- Cover to Cover Periodic Review

**Revision 03 (02/28/2013):**

- Administrative Change: update all references of “eSchedules” to “InSchedules”

**Revision 02 (07/05/05)**

- This document has been reviewed per PJM procedures.
- Updated Exhibit 1 to include new PJM Manuals.

**Revision 01 (08/17/04)**

- Revision includes the addition of study requirements for HVDC Projects at the end of Manual Section 2 and the addition of transmission service requirements for transactions over a merchant transmission HVDC facility in Manual Section 3.

**Revision 00 (10/31/03)**

- This document is the initial release of the PJM Manual for ***Merchant Transmission Specific Requirements (M-14E)***.
- Manual M-14, Revision 01 (03/03/01) has been restructured to create five new manuals:
  - o M-14A: “Generation and Transmission Interconnection Process Overview”
  - o M-14B: “Generation and Transmission Interconnection Transmission Planning”
  - o M-14C: “Generation and Transmission Interconnection Facility Construction”
  - o M-14D: “Generation Operational Requirements”
  - o M-14E: “Merchant Transmission Specific Requirements”