GUIDELINES FOR GENERATOR INTERCONNECTION REQUESTS

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By SPP Generation Interconnection Department
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<tr>
<th>DATE OR VERSION NUMBER</th>
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<th>CHANGE DESCRIPTION</th>
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<tr>
<td>1/29/2018</td>
<td>S. Purdy</td>
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<td>Made GI Contact Changes</td>
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**GUIDELINES FOR GENERATOR INTERCONNECTION REQUESTS TO SPP’S TRANSMISSION SYSTEM**

NOTE: Effective 1 July 2019, under FERC Order the Revised SPP Tariff Attachment V, Generator Interconnection Procedures is approved and now incorporates the Three-Stage study process and several significant additions and deletions from the previous Attachment V, Generator Interconnection Procedures. Further, following FERC Order 845, the Revised SPP Tariff Attachment V, Generator Interconnection Procedures has a new effective date of 23 January 2020.

Key changes under Revised SPP Tariff Attachment V, Generator Interconnection Procedures:

- Feasibility Study and Preliminary Impact Studies are no longer conducted
- Application Deposit and Study Deposits are combined into one sole deposit
- Definitive Interconnection System Impact Study process is now divided into a Three-Stage progressive study methodology
- All initial Interconnection Request forms are combined into one set (*Appendix 3 and Attachment A, B and C*)
- Permitted Modifications to Generator Interconnection Requests
- Surplus Capacity Studies are now offered

This guideline is primarily based on Federal Energy Regulatory Commission (FERC) Tariff Attachment V Generator Interconnection Procedures (GIP) and current SPP business process and practices for the administration of Generator Interconnection Request Queue Studies. The Southwest Power Pool (SPP) Generator Interconnection Request (GIR) process has now been reduced to just a single application stage that encompasses both Validation and Study Acceptance.

Under the current SPP Tariff Attachment V, submitting a GIR requires full completion of Appendix 3, and Attachment A, B and C; along with all cash study deposits and required security deposits. Reasonable demonstration of Site Control must include a completed and signed Attestation for Demonstration of Site Control form. Additional information may be requested once the study request has been reviewed and validated.

Reference SPP Tariff Attachment V, Generator Interconnection Procedure, Section 8 “Definitive Planning Phase” for more detail.

Upon receipt of all requirements per Section 8 of the GIP, SPP will notify the Customer of the GI Study Queue Number (GEN-20YY-XXX) and it’s assignment to the DISIS Queue Cluster.

The following information is provided to better clarify the Generator Interconnection process.
1 GENERATOR INTERCONNECTION REQUEST

1.1 APPLICATION PROCESS
To initiate a Generation Interconnection Request under the current SPP Tariff Attachment V, submitting a GIR requires full completion of Generator Interconnection Study Agreement Appendix 3, and Attachments A, B and C; along with all cash Study Deposits and required Security Deposits. Reasonable demonstration of Site Control must include a completed and signed Attestation for Demonstration of Site Control form. Additional information may be requested once the study request has been reviewed and validated.

Required information for a valid request, as stated by the procedure, is listed below. Blank fields can delay the review and validation and possibly result in withdrawal of the submitted application. This summary does not replace any required information listed in the Generator Interconnection Study Agreement Appendix 3, and Attachment A, B or C; nor supersedes additional information that may be requested at any future date to complete the study.

Attachment A to Appendix 3 includes, but is not limited to:

- Type of Generating Facility for which the service is requested
- Type of Interconnection Service requested (ERIS or NRIS)
- Location of the Generating Facility site (address, GPS coordinates)
- Aggregate generator nameplate rated capacity (in MW) of the request, including Summer and Winter output ratings
- One-Line Diagram illustrating the POI, transmission lead(s), main project transformer(s), collector system cable(s), generator step-up transformer(s), and generating unit(s)
- Proposed Commercial Operation date of the request
- Contact information for the Interconnection Customer
- Geographical map indicating the proposed Point of Interconnection (POI) and Generating Facility
- Generating Facility Data (Attachment B to the Appendix 3) for each generator and transformer
- Primary frequency response operating range (energy storage resources only)
- Required cash Study Deposits and Security Deposits
  - Less than 2 MW - $25,000 cash Study Deposit
  - Greater than 2 MW but less than or equal to 20 MW - $35,000 cash Study Deposits
  - Greater than 20 MW but less than or equal to 75 MW - $50,000 cash Study Deposits
  - Greater than 75 MW - $90,000 cash Study Deposits
  - Security Deposit of $2,000 per MW (initial Financial Security One deposit cash or equivalent)
Evidence of ownership in or right to acquire the site of the proposed plant, referred to as Site Control. SPP is unable to accept Letters of Intent or Memorandums of Understanding for negotiation purposes. Demonstration of actual control over real property must be provided:

- Wind: For capacity of the Generating Facility for a wind-powered generating facility, the recommended minimum accepted site control is 30 acres/MW of wind generation or Manufacturers Specifications
- Solar: For a solar-powered generating facility, the recommended minimum accepted site control is 6 acres/MW of solar generation or Manufacturers Specifications
- Storage: For a storage generating facility, the recommended minimum accepted site control (without a detailed layout) is 1 acre/MW of generation or Manufacturers Specifications
- Conventional: For a conventional generating facility, the recommended minimum accepted site control (without a detailed layout) is 40 acres or site layout.

- If the Customer provides a reasonable site layout demonstrating it can site the generating facility on less acreage, SPP may accept such demonstration as acceptable site control, per Section 8.2.a in the GIP.
- All site control submitted must be accompanied by an Attestation for Demonstration of Site Control form. This form must be completed by the Interconnection Customer. You can find the document here: [http://opsportal.spp.org/documents/studies/AttestationStatementForSiteControl.pdf](http://opsportal.spp.org/documents/studies/AttestationStatementForSiteControl.pdf)

Attachment B to Appendix B includes, but is not limited to:

- Study Assumptions involving specific location of the Point of Interconnection
- Geographic Coordination’s of the proposed Point of Interconnection
- Generating Facility Data, including generator Unit Ratings; Combined Turbine-Generator-Exciter Inertia Data; Reactance Data (PU – rated KVA); Field Time Constant Data; Armature Time Constant Data
- MW Capability and Plant Configuration Generating Facility Data, including Armature Winding Resistance Data (PU); performance Curves; Generator Step-Up Transformer Data and Ratings; Main Generator Step-Up Transformer Data Ratings; Excitation System Data; Governor System Data; Multiple-Unit Generating Facilities; Induction Generators

Attachment C to Appendix B includes, but is not limited to:

- Interconnection Facilities Study Data, including location plan and simplified one-line diagram; metering configuration; Auxiliary Power; Transfer Bus information: Control System Scheme and Protocol; Bus and Line Length; Site Map, Towers, Easement; and key project commencement dates

When submitting the generator interconnection application and technical data for any new request, the application must be complete, whole, and independent of any previous GIR. SPP is unable to complete any documentation for the Interconnection Customer. Failure to submit complete
information could result in the application request not being validated in time for the study window. At no time will SPP rebuild application or data requirements from previous GIRs on record.

Once received, SPP will review the completed application during the thirty (30) Calendar Day DISIS Review Period. Please note – “validation” of the application does not constitute a “compatible” model set for the performance of studies. All modeling files provided pursuant to any generator interconnection application is subject to a “compatibility” test with PSS®E version 33, 34.2, and 34.4 power flow software. Failure to provide a compatible model will result in a Cure Deficiency notification. Failure to resolve the deficiency will result in the GIR’s withdrawal from the queue and loss of queue position.

1.2 GENERATOR INTERCONNECTION STUDY AGREEMENT

1.2.1 DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY QUEUE (DISIS)

Following validation and study acceptance of your Generation Interconnection Request, the Definitive Interconnection System Impact Study will be conducted in two phases, as per Section 8.4 of Attachment V.

- DISIS Phase One – consists of a power flow analysis and calculation of the short-circuit ratio.
- DISIS Phase Two – consists of a short circuit analysis, stability analysis, taking into accounting any requests withdrawn after the above DISIS Phase One.
- DISIS Study results will provide list of required facilities using non-binding good faith estimates of cost (+/- 30%)
- The DISIS Study will identify Limited Operation potential
- Preliminary Facilities Analysis will be included, during the DISIS Phase One

All study deposit payments may be in the form of check or wire transfers and must be submitted concurrent with any required application or agreement. For a security payment, cash via check or wire transfer is acceptable, or a Letter of Credit that meets the SPP Credit Policy in Attachment X of the Tariff may also be submitted. Additionally, all GIRs must include both a current and completed IRS W-9 Form and an SPP Study Deposit Refund and Disposition Form. Links may be found below in Section 16. SPP bank wiring instructions can be provided upon request.

Generator Interconnection Customers that wish to obtain transmission service must request transmission service in accordance with the terms of SPP’s Open Access Transmission Tariff (OATT).

SPP’s Generator Interconnection Study Agreement and the Interconnection Procedure may be downloaded by visiting www.spp.org and navigating at the tool bar to “Engineering” > “Generation Interconnection” > and then selecting the specific hyperlinks to the Generator Interconnection Procedures (GIP) or other sections. Any questions regarding GIRs can be addressed to:
SPP Contacts For Generation Interconnection Studies Process

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Engineering Finance and Administration
1.3 OVERVIEW OF STUDY DEPOSIT AND SECURITY REQUIREMENTS

All initial applications for Generator Interconnection Requests are required to submit cash Study Deposit and an initial Security Deposit (cash or Letter of Credit(LOC)), along with the forms from Appendix 3 and Attachment A, B and C to Appendix 3.

<table>
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<th>Payment Requirement</th>
<th>Payment Form</th>
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<tr>
<td>GIR Application and DISIS Cluster Study Deposit (with Appendix 3) to enter into DISIS Phase One Study</td>
<td>$25,000</td>
<td>For generation less than or equal to 2MW</td>
<td>Check or Wire</td>
</tr>
<tr>
<td></td>
<td>$35,000</td>
<td>For generation greater than 2 MW and less than or equal to 20 MW</td>
<td>Check or Wire</td>
</tr>
<tr>
<td></td>
<td>$50,000</td>
<td>For generation greater than 20 MW and less than 75 MW</td>
<td>Check or Wire</td>
</tr>
<tr>
<td></td>
<td>$90,000</td>
<td>For generation greater than or equal to 75 MW</td>
<td>Check or Wire</td>
</tr>
<tr>
<td><strong>AND</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISIS Financial Security One</td>
<td>$2,000 per MW</td>
<td>Security Deposit equal to $2,000 per generation nameplate capacity of the plant</td>
<td>Check, Wire, or Letter of Credit</td>
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<td><strong>DP2 (Decision Point 2) - TO PROCEED INTO DISIS PHASE TWO, AFTER DECISION POINT ONE HAS ENDED</strong></td>
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<tr>
<td>DISIS Financial Security Two</td>
<td>10% or $2,000 per MW</td>
<td>Equal to the greater of a) Ten percent (10%) of the Financial Security Two Cost Factor**, less the amount of Financial Security One that was provided to enter DISIS Phase One, or b) $2,000 per MW of the requested capacity advancing to DISIS Phase Two.</td>
<td>Check, Wire, or Letter of Credit</td>
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<tr>
<td>DISIS Financial Security Three</td>
<td>20% Less Previous Securities</td>
<td>Equal to twenty percent (20%) of the total upgrade costs**, less the amount of Financial Security One and Financial Security Two that was provided to enter DISIS Phase One and DISIS Phase Two</td>
<td>Check, Wire, or Letter of Credit</td>
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<td><strong>DP3 - INTERCONNECTION FACILITIES STUDY QUEUE, AFTER DECISION POINT TWO HAS ENDED</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Facilities Study Deposits</td>
<td>--</td>
<td>No additional cash Study Deposits are required to enter into the Facilities Study, other than satisfying requirements under Section 8.5.2 and providing the DISIS Financial Security Three (above). However, Transmission Owners may invoice SPP (and Interconnection Customer) for study costs. These costs may be received even after an Interconnection Request has received deposit refunds. Interconnection Customer is responsible for all study costs.</td>
<td>Cash via check or wire</td>
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*Security Deposits may be utilized to fund initial Network Upgrades and/or Shared-Network Upgrades. Any remaining cash deposits will be refundable after Commercial Operation; or if Interconnection Request is withdrawn or terminated prior to execution of the Facilities Study Agreement, as soon as all related study costs have been concluded. ** Upgrade Costs used in security deposit calculations exclude Affected Systems mitigation.
Visual Timeline of SPP’s Revised GIP Three Stage Process (for information only)

To complete the entire GIP, the Interconnection Customer must, at a minimum, complete the Application, Validation and Acceptance of the GIR into study; complete the DISIS Study Cluster stages Phase One (90 Calendar Days after close of DISIS Review Period) and Phase Two (120 Calendar Days after end of Decision Point 1 (DP1)); complete a Facilities Study conducted by the TO; and execute a GIA.

2 QUEUE PRIORITY

All Interconnection Requests within the same DISIS Queue Cluster Window shall have equal priority.

After satisfying the all the requirements of Section 8.9 of the GIP to enter into the Interconnection Facilities Study, an Interconnection Facilities Study Queue (IFS) position will be assigned based on date and time those requirements are met.

2.1 INITIAL QUEUE POSITION

When a GIR is submitted and validated and accepted into the DISIS Study Queue, the request is given an Initial Queue Position. The Initial Queue Position is an identifier for the GIR but does not assign any priority to the request. This Initial Queue Position will be identified as GEN-20YY-XXX, where

- YY is the year the GIR was accepted
- XXX identifies the specific request within the year of submission
The GIR will keep its Initial Queue Position number throughout the DISIS phases of the GIP and beyond into the GIA stage.

2.2 INTERCONNECTION FACILITIES STUDY (IFS) QUEUE POSITION

When all GIR requirements to enter the IFS queue have been completed, the request will receive an Interconnection Queue Position. The Interconnection Queue Position assigns a queue priority of the GIR relative to all other requests in the IFS queue. The Interconnection Queue Position has a higher priority than any request within the DISIS Queues.

This IFS Queue Position will be identified as IFS-20YY-00X-ZZZ, where

- YY-00X is the year and DISIS study in which the GIR was studied prior to entering the IFS Queue
- ZZZ identifies the specific request within the DISIS study

3 DISIS OPEN SEASONS

Prior to the Effective Date, 1 July 2019, of the currently Revised Generator Interconnection Procedure (GIP) tariff, SPP GI Studies Engineering conducted two cycles of the larger DISIS Cluster Studies. However, under the Revised GIP and the stated transition plan in Section 5.1, that schedule has been modified to address the backlog of generation interconnection requests and to accommodate a multi-stage transition into the new Three-Stage GI Study process. Until all current DISIS Clusters have transitioned into the Revised GIP, SPP GI Studies Engineering will hold an eleven (11) Month + one (1) Month cycle. SPP GI Studies Engineering will receive Generator Interconnection Requests for a period of eleven (11) months, followed by a one (1) month DISIS Review Period.

The current DISIS Cluster Window for DISIS-2020-001 will CLOSE 30 April 2020, followed by a DISIS Review Period from 1 May 2020 until 31 May 2020. Then, the DISIS-2021-001 will OPEN with a CLOSE date of 30 April 2021. See SPP Tariff Attachment V, Section 5.1 for transition details.

Interconnection Requests received prior to the close of the DISIS Cluster Window will be processed for Validation and Acceptance, and provisions will be made to cure any deficiencies within fifteen (15) Business Days. SPP reserves the option to request and clarify technical information during the DISIS Review Period, and beyond, that follows the close of the DISIS Cluster Window.

For information on projected Cluster Study completion dates, you may refer to this web page located at: [http://opsportal.spp.org/documents/studies/sppgistudyupdate_weekly.pdf](http://opsportal.spp.org/documents/studies/sppgistudyupdate_weekly.pdf)
4 TYPES OF INTERCONNECTION SERVICE

4.1 ENERGY RESOURCE INTERCONNECTION SERVICE (ERIS)
As defined in Section 1 of the GIP, Energy Resource Interconnection Service shall mean an Interconnection Service that allows the Interconnection Customer to connect its Generating Facility to the Transmission System to be eligible to deliver the Generating Facility’s electric output using the existing firm or nonfirm capacity of the Transmission System on an as available basis. Energy Resource Interconnection Service in and of itself does not convey transmission service.

When choosing ERIS, consider that the analysis for this service will identify all significantly affected facilities identified as impacting the i) short-circuit/fault duty, ii) under- or over-voltage violations, iii) dynamic stability angular deviations, and/or iv) having a 20% or higher distribution factor on thermally overloaded transmission facilities under contingency or having a 3% or higher distribution factor on thermally overloaded transmission facilities for system intact conditions. This is discussed further in Section 7.2.

4.2 NETWORK RESOURCE INTERCONNECTION SERVICE (NRIS)
As defined in Section 1 of the GIP, Network Resource Interconnection Service shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Generating Facility with the Transmission System in a manner comparable to that in which the Transmission Owner integrates its generating facilities to serve Native Load Customers as a Network Resource. Network Resource Interconnection Service in and of itself does not convey transmission service.

When choosing NRIS, consider that the analysis for this service will identify all significantly affected facilities identified as impacting the i) short-circuit/fault duty, ii) under- or over-voltage violations, iii) dynamic stability angular deviations, and/or iv) having a 3.0% or higher distribution factor on thermally overloaded transmission facilities under a base case and/or contingency. Although NRIS may be requested, all ERIS upgrades are a subset of requirements for any NRIS request. This is discussed further in Section 7.2.

5 DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY (DISIS)

Under the newly Revised Attachment V, the SPP Generation Interconnection Study process has eliminated the Feasibility and the Preliminary Interconnection System Impact Study (PISIS) Clusters. SPP GI Engineering now conducts only the collective Definitive Interconnection System Impact Study (DISIS) Cluster Study.

To initiate the Generation Interconnection Request, the Interconnection Customer must satisfy the requirements of Attachment V, Section 8.2 of the GIP. The Generation Interconnection Request will not be considered valid until all items in Section 8.2 of the GIP are received. If the Interconnection Customer fails to meet all the requirements of the GIP, unless a Dispute under Section 13.5 is
requested, SPP will deem the request to be withdrawn and will provide notification of the withdrawal and reason. This will result in the loss of the Interconnection Customers Initial Queue Position.

The current DISIS Cluster Window for DISIS-2020-001 will CLOSE 30 April 2020, followed by a DISIS Review Period from 1 May 2020 until 31 May 2020. Then, the DISIS-2021-001 will OPEN with a CLOSE date of 30 April 2021. See SPP Tariff Attachment V, Section 5.1 for transition details.

Following the transition period described in Section 5.1.3 of the GIP, after DISIS-2019-001 is transitioned, then each DISIS Queue Cluster Window will be five (5) Calendar Months in duration. Following the close of the DISIS Queue Cluster Window will be a one (1) Calendar Month DISIS Review Period to resolve any deficiencies of the Interconnection Request.

Per Section 8.5 of the GIP, SPP will use Reasonable Efforts to complete DISIS Phase One no later than ninety (90) Calendar Days after the close of the DISIS Review Period and no later than one hundred twenty (120) Calendar Days after the end of DP1 to complete DISIS Phase Two.

After this study is completed, SPP will post the results of the Impact Study on the public SPP OASIS study page. Since this is a public site, the Customer’s identity will be kept confidential.

Interconnection Requests received prior to the close of the DISIS Cluster Window will be processed for Validation and Acceptance, and provisions will be made to cure any deficiencies within fifteen (15) Business Days. SPP reserves the option to request and clarify technical information during the DISIS Review Period, and beyond, that follows the close of the DISIS Cluster Window.

5.1 **SYSTEM IMPACT STUDY DATA REQUIREMENTS**

The following data will be required to begin the detailed Interconnection Study:

1) Definitive POI
2) Definitive plant size (MW) (cannot be changed)
3) One-line diagram showing the POI, transmission lead(s), main project transformer(s), collector system cable(s), generator step-up transformer(s), and generating unit(s)
4) Facility data including line impedance & charging, transformer impedance & rating, and generating unit quantity, ratings, impedances, curves, & manufacturer model name, number, and version.
5) PSS®E models (if not standard for all versions) and facility specific parameters compatible with versions 33, 34.2 & 34.4*
6) Data required in Appendix 7 of the GIP (if wind turbine)

*All modeling data must be compatible with PSS®E version 33, 34.2, and 34.4. It is incumbent upon the Interconnection Customer to ensure that all modeling files are compatible as a stand-alone model and the collective product models combined. Failure to provide compatible models will result in a Cure Deficiency and may require SPP to withdraw the request from the queue.
5.2 DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY METHODOLOGY
A power flow and transient stability analysis is conducted under two scenarios: 1) Cluster Scenario – with all requests in the DISIS queue that were requested in the previous open season window and all higher queued GIRs; and 2) Stand Alone Scenario – with only GIRs that have advanced to the IFS.

The results of load flow analysis include power flow magnitudes and voltage levels under probable contingency conditions. The results of the load flow study will be used to identify equipment overloads. If an equipment overload is determined to be impacted by the GIR, a cost allocation of the mitigation will be assigned to the GIR that will be shared by other requests in the study that also impact the facility. The study shall be conducted using both PSS®MUST and the ACCC function of PSS®E.

A transient stability analysis will be performed to determine generator unit response due to a fault on the system and unit outages. The stability analysis will include new transmission reinforcements that were determined to be necessary by the power flow analysis. The transient stability analysis will determine:

1) Unit stability during faults
2) Voltage levels, frequency levels, and frequency deviation at the POI
3) Synchronous generator rotor oscillations and real and reactive power outputs

This information will be collected before the disturbance, at the time of the disturbance, at discrete time intervals during the disturbance, and after the removal of the disturbance from the system.

6 MODELING

6.1 REGIONAL GROUPINGS
The GIRs in each DISIS are aggregated into regional groups based on similar geographical and electrical impacts as shown in Figure 1.
To determine interconnection impacts, regional generation dispatch scenarios as described below are developed to accommodate the regional groupings.

6.2 DEVELOPMENT OF BASE STUDY MODELS

Models are developed for each study based on the specific needs and requirements of a particular study product. Feasibility studies include steady-state power flow and short-circuit analysis. PISIS and DISIS studies also include dynamic stability analysis.

6.2.1 POWER FLOW

The SPP Integrated Transmission Plan (ITP) power flow models serve as the starting point for all interconnection studies requiring steady-state power flow analysis. These models typically include:

- Year 1 or 2 Spring, Summer and Winter Peak
- Year 5 Light Load, Summer and Winter Peak
- Year 10 Summer Peak
6.2.2 **DYNAMIC STABILITY**
The SPP Model Development Working Group (MDWG) dynamic stability models serve as the starting point for all studies requiring dynamic analysis. These models typically include:

- Year 1 Winter Peak
- Year 2 Summer Peak
- Year 5 Summer and Winter Peak
- Year 10 Summer Peak

6.2.3 **SHORT CIRCUIT**
The Year 2 and Year 10 dynamic stability summer peak models are also used for short-circuit analysis.

6.2.4 **BASE CASE UPGRADES**
Facilities that are part of the current SPP Transmission Expansion Plan, the Balanced Portfolio, and recently approved Priority Projects, that have an approved Notification to Construct (NTC) or are in construction stages are assumed to be in-service and are added to the base case models if they are not already included in model.

6.2.5 **PREVIOUSLY QUEUED INTERCONNECTION REQUESTS**
In addition to the Base Case Upgrades, prior-queued interconnection requests and their associated upgrades are added to the Base Case models. These prior-queued interconnection requests are dispatched as Energy Resource Interconnection Service (ERIS) resources that sink into each zone in the SPP footprint in proportion to the zone's load. Prior-queued requests for Network Resource Interconnection Service (NRIS) are also dispatched in separate NRIS scenarios sinking into the same zone.

6.3 **DEVELOPMENT OF ANALYSIS CASES**

6.3.1 **POWER FLOW**
In order to simulate and analyze the variety of generation and service types included in a study cluster, three dispatch scenarios are created:

**High-Variable Energy Resource (HVER).** This scenario is used to analyze the impact of renewable variable energy resources (VERs) such as solar and wind when they are available at maximum capability. This scenario assumes that VERs within each regional group are at maximum output and that conventional resources are not dispatched. The VERs in the remote groups are dispatched at 20% of maximum capability in the spring, summer peak, and winter peak models. In the light load models VERs in the remote groups are dispatched at 10% of maximum capability. The output of these requests is distributed across the SPP footprint by offsetting existing generation in proportion to the load in each zone.
Low-Variable Energy Resource (LVER). This scenario is used to analyze the impact of conventional resources such as combustion turbines or combined cycle units during peak periods when those resources may be dispatched at maximum capability. This scenario assumes that VERs are at minimal output and conventional resources are at maximum output. Peaking units are not dispatched in the spring case, nor in the HVER summer and winter peak cases. To study peaking units’ impacts, the winter and summer peak models are developed with peaking units dispatched at 100% of maximum capability and VERs at 20% of maximum capability. The output of these requests is distributed across the SPP footprint by offsetting existing generation in proportion to the load in each zone.

Network Resource (NR). This scenario is used to analyze the impact of those requests seeking the higher level of system integration afforded by NRIS. All generators (VER and peaking) that request NRIS are dispatched in an additional analysis into the interconnecting Transmission Owner’s zone at maximum capability. ERIS-only requests are at 80% of maximum. This method allows for identification of network constraints that are common between regional groupings to have affecting requests share the mitigating upgrade costs throughout the cluster.

The various assumptions used for each case are summarized in Table 1.

*Table 1: Generation Dispatch in the Power Flow Models*

<table>
<thead>
<tr>
<th>Dispatch Scenario</th>
<th>Seasons</th>
<th>Code</th>
<th>Number</th>
<th>Requested Service Type</th>
<th>In Group</th>
<th>Out Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVER</td>
<td>Winter, Summer, Spring, Light</td>
<td>01, 02, 03...18</td>
<td>112</td>
<td>Both</td>
<td>100%</td>
<td>n/a</td>
</tr>
<tr>
<td>LVER</td>
<td>Winter and Summer</td>
<td>00</td>
<td>5</td>
<td>Both</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>NR</td>
<td>Spring and Light Load</td>
<td>01NR, 02NR, 03NR...18NR</td>
<td>32</td>
<td>ERIS</td>
<td>80%</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Winter and Summer</td>
<td>00NR</td>
<td>5</td>
<td>ERIS</td>
<td>20%*</td>
<td>80%</td>
</tr>
</tbody>
</table>

*Solar 80% in Summer Peak  
**10% in Light Load
Each Generating Facility is represented in the power flow models as an equivalent generator dispatched at the applicable percentage of the requested service amount with 0.95 power factor capability. The facility modeling includes explicit representation of equivalent Generator Step-Up (GSU) and main project transformer(s) with impedance data provided in the interconnection request. Collector system(s) and transmission lead line(s) shorter than 20 miles are represented as zero-impedance branches. Longer lead lines are explicitly represented.

6.3.2 Dynamic Stability

For each regional group, all interconnection requests are dispatched at 100% of maximum capability while the remote groups are dispatched at 20% output for VERs and 100% output for conventional resources. The output of these requests is distributed across the SPP footprint by offsetting existing generation in proportion to the load in each zone. Specific adjustments may be made in order to assess stability limits or specific scenarios.

Each Generating Facility is represented in the dynamic stability models as an equivalent generator dispatched at the applicable percentage of the requested service amount with 0.95 power factor capability. The facility modeling includes explicit representation of equivalent Generator Step-up (GSU) and main project transformer(s), with impedance data provided in the interconnection request. Equivalent collector system(s) and transmission lead line(s) impedances are also explicitly modeled for dynamic stability analysis.

7 Power Flow Analysis

For all power flow models developed, the ACCC function of PSS®E is used to simulate single-element, breaker-to-breaker, and multi-element outages in all power flow areas of the SPP footprint, as well as other power flow areas external to SPP. The standard SPP contingency and monitored files are used to determine which outages to simulate. Constraints are then identified as stated in Section 11.

8 Dynamic Stability Analysis

For all stability models developed, a transient stability analysis will be performed to determine generator unit response due to a fault on the system and unit outages. The stability analysis will include new transmission reinforcements that were determined to be necessary by the power flow analysis.

The following types of outages will be simulated in the dynamic stability analysis:

- Single-phase and three-phase transmission line faults with and without reclosure.
- Single-phase and three-phase transformer faults without reclosure.
- Single-phase faults with breaker failure and delayed clearing.
- Prior outages – With one transmission element near the Point of Interconnection out of service, faults will be simulated to determine if generator curtailment is required.
The transient stability analysis will determine:

- Unit stability during faults
- Voltage levels, frequency levels, and frequency deviation at the POI
- Synchronous generator rotor oscillations, damping, and real and reactive power outputs
- For wind generators, a low voltage ride through analysis (LVRT) will be performed in accordance with FERC Order #661A
- This information will be collected before the disturbance, at the time of the disturbance, at discrete time intervals during the disturbance, and after the removal of the disturbance from the system

9 CONSTRAINT IDENTIFICATION

An impact analysis is performed using PSS®MUST to determine the distribution factor (DF) of each of the GIRs upon the constraint (overload). For ERIS, constraints are screened to determine which of the GIRs had at least a 20% DF upon the constraint for outage-based constraints and 3% DF for constraints for system-intact conditions. Constraints that measured these criteria from at least one GIR are considered for transmission reinforcement under ERIS. In addition, stability issues are considered for transmission reinforcement under ERIS. GIRs that have requested NRIS are additionally studied in the NRIS analysis to determine if any constraint measured at least a 3% DF. If so, these constraints are also considered for mitigation under NRIS.

Constraints that required transmission reinforcement are generally listed in each DISIS report in Appendix G for power flow upgrades. For stability upgrades, the reinforcements are discussed in the stability section of the DISIS report.

10 DETERMINATION OF COST ALLOCATION FOR NETWORK UPGRADES

Cost allocation of Network Upgrades for wind GIRs are determined using the spring model. Cost allocation of Network Upgrades of peaking units was determined using the summer peak model. A PSS®MUST sensitivity analysis is performed to determine the DF, a distribution factor with no contingency that each GIR had on each new upgrade. The impact each GIR had on each upgrade project was weighted by the size of each request. Finally the costs due by each request for a particular project are then determined by allocating the portion of each request’s impact over the impact of all affecting requests.

For example, assume there are three GIRs: X, Y, and Z, that are responsible for the costs of Upgrade Project 1. Given that their respective power transfer distribution factors (PTDF) for the project have been determined, the cost allocation for GIR X for Upgrade Project 1 is found by the following set of steps and formulas:

1. Determine an Impact Factor on a given project for all responsible GI requests:
Request X Impact Factor on Upgrade Project 1 = PTDF (X) * MW(X) = X1
Request Y Impact Factor on Upgrade Project 1 = PTDF (Y) * MW(Y) = Y1
Request Z Impact Factor on Upgrade Project 1 = PTDF (Z) * MW(Z) = Z1

2. Determine each request’s Allocation of Cost for that particular project:

\[
\text{Request X's Project 1 Cost Allocation} = \frac{\text{Network Upgrade Project 1 Cost} \times X1}{X1 + Y1 + Z1}
\]

3. Repeat previous for each responsible GIR for each Project.

The cost allocation of each needed Network Upgrade is determined by the size of each request and its impact on the given project. This allows for the most efficient and reasonable mechanism for sharing the costs of upgrades. Costs assigned to each GIR are generally listed in Appendix E of each DISIS report.

10.1 FACILITIES ANALYSIS

During the DISIS Phase One, SPP shall specify and estimate the cost of transmission facilities at the Point of Interconnection in order to physically and electrically connect the Generating Facility to the Transmission System. Estimated cost of any Transmission Owner’s Interconnection Facilities and Network Upgrades necessary will also be provided. This information will be utilized as part of the Interconnection Facilities Study that follows DISIS Phase Two and Decision Point 2 (DP2).

11 INTERCONNECTION FACILITIES STUDY (IFS)

Prior to the end of DP2, per Section 8.5.2 of the GIP, the Interconnection Customer must provide written intent to either withdraw the request or proceed to the Interconnection Facilities Study (IFS). The Interconnection Customer is required to provide additional financial security deposit (“Financial Security Three”) equal to twenty percent (20%) of the total upgrade costs allocated, less previously provided Financial Security One and Financial Security Two.

SPP will assign an Interconnection Facilities Study Queue Position based on date and time Interconnection Customer satisfies all of the requirements of Section 8.9. The of the Interconnection Queue Position of each Interconnection Request, as determined in Section 4.1.3 of the GIP, will be used to determine the order of performing the Interconnection Facilities Studies and determination of cost responsibility.

In addition to signifying interest in proceeding with the Interconnection Facilities Study, the following may be considered:

- Opportunity to reduce requested capacity per Section 4.4.1 of the GIP
- Provide notification, if needed, to extend Commercial Operation Date
- Pursue Limited Operation, if necessary, per Section 8.7
SPP will coordinate with the Transmission Owner for information and study results to complete the Interconnection Facilities Study within ninety (90) Calendar Days of receiving the request. SPP will use Reasonable Effort to issue a draft Interconnection Facilities Study report to the Interconnection Customer no later than one hundred thirty-five (135) Calendar Days after the end of DP2, with a +/- 20% cost estimate in the report. Should it be determined that the required time frame for completing the Interconnection Facilities Study, SPP will notify the Interconnection Customer of an estimated completion date and explanation of why additional time is needed.

Refer to Section 8.11 Interconnection Facilities Study Procedures, of the GIP, for more detailed information.

The IFS consists of two parts, a facility analysis and a short circuit analysis. The facility analysis consists of SPP or TO specifying and estimating the cost of equipment, engineering, procurement and construction cost needed to implement the Interconnection to the transmission system. These facilities will have detailed cost estimates.

A short circuit (i.e., fault current) analysis will be performed to determine the effect that the new generation will have on the system fault currents. The new fault current levels will be used to evaluate the impact of the new generation on the fault duty (i.e., fault current interrupting capability or rating) of existing equipment, such as circuit breakers and switches. The results of this analysis may identify which equipment would have to be replaced as a result of the new generation.

Under the Revised Tariff Attachment V, Effective 1 July 2019, the Generator Interconnection Procedure is a Three-Stage process. Decision Point 3 (DP3) commences the following Business Day after SPP posts the draft Interconnection Facilities Study and will be fifteen (15) Business Days in duration. SPP will post the results of the study on the public SPP OASIS study page. Since this is a public site, the Customer’s identity will be kept confidential. The fifteen (15) Business Days will allow the Interconnection Customer opportunity to review the results, make inquiries to the content, and make decision to withdraw or proceed to the Generation Interconnection Agreement. Within fifteen (15) Business Days of receiving the Interconnection Customers comments or intent to make no comments, SPP will issue the Final Interconnection Facilities Study Report.

Per Section 11.1 of the GIP, SPP will issue a Draft Generator Interconnection Agreement to the Interconnection Customer which will commence the sixty (60) Calendar Day negotiation period.

12 RE-STUDY

If a re-study of the Interconnection Customer’s request for interconnection is required due to a higher queued project dropping out of the queue or a modification of a higher queued project, or more than one GIR moving forward into the IFS phase, SPP shall notify the Customer in writing. SPP shall make reasonable efforts to complete the re-study within 60 calendar days from the notice. Any cost of re-study shall be borne by the Interconnection Customer. The Customer shall be responsible for prepaying the cost of the re-study.
13 GENERATOR INTERCONNECTION AGREEMENT (GIA)

Upon completion of the IFS, SPP shall send the Customer, simultaneously with the posting of the Final Interconnection Facilities Study, a draft Generator Interconnection Agreement (GIA) to be executed by the Customer, SPP, and the TO. The agreement allows a physical interconnection of the generator to the SPP transmission grid. Other documents may also be required depending on individual circumstances.

SPP, the TO, and the Interconnection Customer shall negotiate concerning any disputed provisions of the Appendices to the draft GIA for not more than 60 calendar days after tender of the draft GIA. If the Customer determines that negotiations are at an impasse, it may request termination of negotiations at any time after tender of the GIA and request submission of the unexecuted GIA to FERC or initiate Dispute Resolution procedures. If the Customer requests termination of the negotiations, but within the 60 calendar days thereafter fails to request either the filing of the unexecuted GIA or initiate Dispute Resolution, it is deemed to have withdrawn its GIR. If the Customer has not executed the GIA, requested filing of an unexecuted GIA or initiated Dispute Resolution procedures within sixty (60) calendar days of tender of completed draft of the GIA Appendices, it shall be deemed to have withdrawn its GIR, unless otherwise agreed by the Parties. The SPP shall provide to the Customer a final GIA within fifteen (15) business days after the completion of the negotiation process.

Within fifteen (15) business days after receipt of the final GIA, the Customer shall provide SPP reasonable evidence of continued site control or post a $250,000, non-refundable additional security which shall be applied toward future construction costs.

At the same time, the Customer shall provide reasonable evidence that one or more of the following milestones in the development of the facility, at the Customer’s election, has been achieved:

- Execution of a contract for the supply or transportation of fuel to the facility;
- Execution of a contract for the supply of cooling water to the facility;
- Execution of a contract for the engineering for, procurement of major equipment for, or construction of the facility;
- Execution of a contract for the sale of electric energy or capacity from the facility;
- Statement signed by an officer or authorized agent of the Interconnection Customer attesting the generating facility is included in an applicable state resource plan;
- Other information that the Transmission Provider deems to be reasonable evidence that the generating facility will qualify as a Designated Resource; or
- Application for an air, water, or land use permit.
Within 30 days after the Effective Date of the GIA, the Customer is required to make an Initial Payment to the Transmission Provider in the amount of the greater of a) 20% of the cost of Network Upgrades and Interconnection Facilities or b) $4,000/MW of the size of the GIR.

Transmission service must be arranged for separately under the terms and conditions of SPP’s OATT.

For information pertaining to Generator Interconnection Agreements, contact HweePing Won at hwon@spp.org.

14 STUDY DEPOSIT DISPOSITION

It is the intended business practice of SPP to commence study deposit reconciliations no sooner than 90 days after it reaches a terminal point in the GIR. A terminal point is either reaching Commercial Operation, having been Withdrawn or Terminated. This includes cluster studies, re-study iterations of cluster studies, individual re-studies, interim studies, and facilities studies.

If a GIR within a clustered study drops out, resulting in a restudy of any other GIR, the reconciliation will not commence until 90 days after the subsequent re-study results have been posted.

Refer to SPP Attachment V (GIP), Section 4.2.2 for further tariff guidance on study cost allocation methodology.

SPP will provide refund payment via ACH transaction to the authorized project owner that submitted the Generator Interconnection application, unless an assignment of the project has been made between parties. It is the responsibility of the Interconnection Customer to keep SPP informed of study deposit refund information, including changes in address, contacts, project ownership, banking, and routing information.

The submittal of a current and completed IRS W-9 Form, along with the completed SPP Study Deposit Refund and Disposition Form in your GIR application set, is required. Failure to provide SPP with an IRS W-9 Form associated with the project deposits and the SPP Study Deposit Refund and Disposition Form could result in delays in setting up security accounts as well as issuance of any refunds.

To wire Study Deposits or Security Deposits to SPP, the SPP banking information form will be provided upon request. Be sure to mark any wire transaction with project name or detail so that we can differentiate the funds from other projects.

For questions regarding study deposits, security deposits, refunds or remaining balances, contact Mitch Jackson, Sr. Engineering Analyst – Engineering Finance & Administration. Email: m.jackson@spp.org or call (501) 614-3542.
15  GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>DF</td>
<td>Distribution Factor</td>
</tr>
<tr>
<td>DISIS</td>
<td>Definitive Interconnection System Impact Study</td>
</tr>
<tr>
<td>ERIS</td>
<td>Energy Resource Interconnection Service</td>
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<tr>
<td>ESR</td>
<td>Energy Storage Resource</td>
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<tr>
<td>FCS</td>
<td>Feasibility Cluster Study</td>
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<tr>
<td>FERC</td>
<td>Federal Energy Regulatory Commission</td>
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<tr>
<td>GIA</td>
<td>Generator Interconnection Agreement</td>
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<tr>
<td>GIP</td>
<td>Generator Interconnection Procedures</td>
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<tr>
<td>GIR</td>
<td>Generator Interconnection Request</td>
</tr>
<tr>
<td>IFS</td>
<td>Interconnection Facilities Study</td>
</tr>
<tr>
<td>IR</td>
<td>Interconnection Request</td>
</tr>
<tr>
<td>NRIS</td>
<td>Network Resource Interconnection Service</td>
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<tr>
<td>OATT</td>
<td>Open Access Transmission Tariff</td>
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<tr>
<td>PISIS</td>
<td>Preliminary Interconnection System Impact Study</td>
</tr>
<tr>
<td>POD</td>
<td>Point of Delivery</td>
</tr>
<tr>
<td>POI</td>
<td>Point of Interconnection</td>
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<tr>
<td>PTDF</td>
<td>Power Transfer Distribution Factor</td>
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<tr>
<td>SPP</td>
<td>Southwest Power Pool</td>
</tr>
<tr>
<td>TO</td>
<td>Transmission Owner</td>
</tr>
</tbody>
</table>

16  REFERENCE DOCUMENTS

- SPP Open Access Transmission Tariff
  - Generator Interconnection Procedures (Attachment V)
- SPP Business Practices
  - 7250 Generator Interconnection Service
  - 7300 Guideline for Clarifying Application of the SPP Generator Interconnection Procedures
- SPP Planning Criteria
- Seams Agreements
  - AECI
  - ERCOT
  - MISO
  - Peak
  - Saskatchewan Power
  - SWPA
  - TVA
- SPP-MISO GI Coordination Document
17 REQUESTING A STUDY MODEL

Interconnection customers may obtain SPP models in which they have an interconnection request by submitting a request through the SPP Request Management System (RMS) (https://spprms.issuetrak.com/login.asp) and selecting the Quick Pick "Map/Model Orders, Submit NDA". Information about setting up an RMS account is available on the SPP website (http://www.spp.org/stakeholder-center/customer-relations/request-management-system/).

SPP models contain Critical Energy Infrastructure Information (CEII) and resource-specific data and are only available to entities that execute a Non-Competitive Duty Non-Disclosure Agreement. A customer may designate a consultant or other non-competitive agent to obtain models on their behalf.
18 ENERGY STORAGE RESOURCES

18.1 APPLICABILITY
A request to interconnect an Energy Storage Resource (ESR) to the SPP Transmission System shall be treated as an Interconnection Request under the GIP.

A request to add an ESR to an existing Generating Facility may be made as a new request for Interconnection Service or, subsequent to the acceptance of SPP's compliance filing under FERC Order 845, as a new request for Surplus Interconnection Service.

18.2 PROCESS
ESRs will be evaluated for reliability impacts to the SPP Transmission System in both discharging mode (as a generator) and charging mode (as a load). The evaluation of both modes of operation will be conducted as part of the applicable Interconnection Study under the GIP. The application will require the provision of information necessary to fully evaluate interconnection of ESR facilities.

18.2.1 DISCHARGE MODE
When evaluating the interconnection of an ESR as a generator, the ESR will be dispatched in the GI cluster study models in the following ways:

Steady-State Power Flow Analysis
- As an Energy Resource in the high variable energy resource (HVER) cases
- When Network Resource Interconnection Service (NRIS) is requested, in the NR cases.
- In all seasons at 100% of requested capacity.

Dynamic Simulation
- In the same way as other non-storage resources.

Short-Circuit Analysis
- As a source with characteristic impedance of the device.

18.2.2 CHARGE MODE
Evaluation of the ESR in charging mode will be conducted as follows:

- The load will be modeled in the latest ITPNT Base Reliability model set, and a contingency scan will be performed. Thermal and voltage impacts will be identified in accordance with NERC TPL requirements.
- Seasons evaluated will include Year 1 or 2 system peak and off-peak, Year 5 system peak and off-peak, and Year 10 system peak.
- The additional load will be supplied following the rules for generation shortfall specified in the MDWG manual. The charging capacity may be specified less than the nameplate capacity.
The evaluation of the impact of the ESR in charging mode may be waived if the application meets these requirements:

- The application for interconnection service stipulates that the Generating Facility will never take energy from the Transmission System when operating in charging mode, by either Self-Dispatch or at the direction of SPP.
- The application for interconnection service includes a description of the monitoring and control equipment that will be used to ensure that the Generating Facility never takes energy from the Transmission System when operating in charging mode.

Normal auxiliary load required solely for the operation of the ESR is exempted from this requirement.

18.2.3 ADDITIONAL INFORMATION TO BE INCLUDED WITH AN APPLICATION FOR AN ENERGY STORAGE RESOURCE

The GIR will list the following:

- Battery manufacturer
- Technology (Li-ion, Lead Acid, Flow Battery, Pumped Hydro, Flywheel, etc.)
- Stand-alone, co-located with wind or co-located with solar (co-located means at the same POI)
- Battery Power (MW) and Energy (MWh) Ratings
- The maximum rate of charge (MW) of the Generating Facility or monitoring and control equipment that will be used to ensure that the Generating Facility never takes energy from the Transmission System when operating in charging mode
19  AFFECTED SYSTEM STUDIES

In accordance with Section 3.5 of the GIP and SPP Business Practice 7300, interconnection requests on non-SPP facilities that have been determined to have potential impacts on the SPP transmission system may be required to undergo an SPP affected system impact study. Interconnection requests to a facility under another provider's OATT are studied outside the SPP queue process with an estimated study completion of 60 days once prior study dependencies are met. Interconnection requests to a facility not under another provider's OATT are studied within the SPP Definitive Interconnection System Impact Study with an estimated completion of 120 days following commencement of the study. Queue priority is determined by the date of execution of the host transmission provider’s system impact study agreement or, if applicable, the cluster request window closing date.

In order to alleviate impacts on the SPP transmission system, all SPP identified Network Upgrades are required to be placed into service prior to full interconnection service on the host transmission provider being available. Additional Limited Operation Impact Studies (LOIS) are available upon request. Requests with SPP identified Network Upgrades require that an SPP Facilities Study be performed and the subsequent execution of an SPP Facilities Construction Agreement.

Requirements for Affected System Study requests are:

1. Affected system study deposit of $15,000 per request (please reference request name and/or number on wire transaction details)
2. Affected System Study Agreement (including Attachment A)
3. Parameters of Generators (Nameplate kVA, power factor, maximum inverter power, etc.)
4. Parameters of the pad mount transformers for the inverters (MVA rating, impedance, and X/R ratio)
5. Parameters of the substation main transformer (Minimum MVA rating/Maximum MVA rating, impedance on the self-cooled MVA rating, X/R ratio)
6. Collector system information in excel format
7. Parameters of the transmission lead from the generation facility to the Point of Interconnection (impedance of the lead in PU on 100 MVA system base, B (line charging) in PU, and the length of the transmission lead)
8. PSS/E dynamic model (and user guide) for the inverters compatible with both PSS/E version 33 and PSS/E version 34.2 and 34.4

Requirements for Affected System Facilities Study requests are:

1. Affected system study deposit of $15,000 per request (please reference request name and/or number on wire transaction details)
2. Affected System Interconnection Facilities Study Agreement (including Attachment A and B)

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1 Per SPP-AECI and SPP-MISO JOAs, affected system studies for requests in the AECI and MISO queues are coordinated with SPP and do not require a separate application or study deposits with SPP.