

# Order Nos. 2023/2023-A – Improvements to Generator Interconnection Procedures and Agreements



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*Conforming Changes to ISO Planning Procedures and  
Model Acceptance Tests for Inverter-Based Resources*

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# Order Nos. 2023/2023-A - Conforming Changes to ISO Planning Procedures

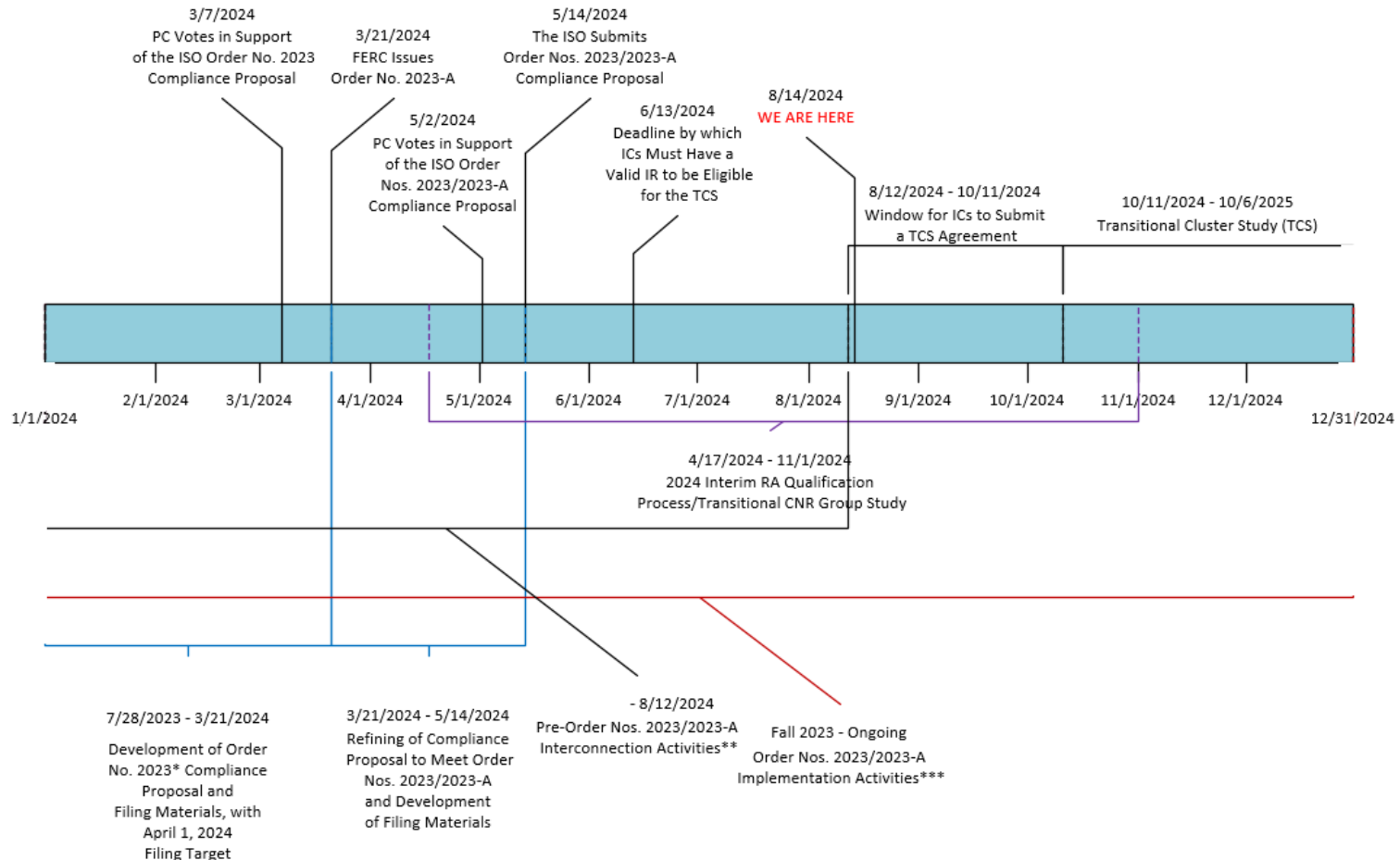
**Proposed Effective Date: September 2024 (for PP5-6)**

- The ISO identified the need for several conforming changes to Planning Procedure 5-6: Interconnection Planning Procedure for Generation and Elective Transmission Upgrades (PP5-6) and Planning Procedure 10: Planning Procedure to Support the Forward Capacity Market (PP10), as a result of Order Nos. 2023/2023-A
  - Order Nos. 2023/2023-A result in significant reforms to the interconnection process to move to a “first ready, first served” Cluster Study construct with clustered Interconnection Requests equally queued
- The ISO also discussed the need for enhanced model acceptance tests for inverter-based resources
- This is the fifth RC meeting that discusses proposed PP5-6 modifications
  - This presentation discusses updates to the Order Nos. 2023/2023-A related PP5-6 revisions presented at the [July 16, 2024 meeting](#) made in response to submitted stakeholder comments, including those provided through the July 25, 2024 meeting
    - A separate presentation addresses proposed PP5-6 updates on Affected System Operator (ASO) study coordination
  - Background on the rationale for the PP5-6 revisions was first discussed at the [March 19, 2024 meeting](#)

# ILLUSTRATION OF RECENT AND UPCOMING ORDER NOS. 2023/2023-A ACTIVITIES AND MILESTONES



# Summary of Recent and Upcoming Order Nos. 2023/2023-A Activities and Milestones



\* FERC Issued Order 2023 on July 28, 2023.

\*\* August 30 is the deadline for Interconnection Customers with late stage System Impact Studies (SISs) to accept the SIS results. The ISO will stop work related to late stage SISs after this deadline.

\*\*\* The ISO expects Order Nos. 2023/2023-A interconnection process improvements to occur over the years beyond 2025.

# OVERVIEW OF INCREMENTAL PP5-6 UPDATES



# Section 1.0 (Introduction)

- In this section:
  - Added mention of Regional Network Service and Through or Out Service
  - Added language describing that only net impacts are evaluated for Interconnection Requests related to a Material Modification to an existing or previously studied facility

Studies conducted in accordance with this procedure are also used to support applications made pursuant to Section I.3.9 (“Review of Market Participant’s Proposed Plans”) of the Tariff,<sup>1</sup> including studies of proposed distributed energy resources (DERs) that are processed under state interconnection procedures;<sup>2</sup> studies of requests for Regional Network Service (RNS) under Section II.19 of the Tariff, and studies of requests for Through or Out Service under Section II.34 of the Tariff.

This document (and the relevant documents referenced herein) describes the interconnection requirements and procedures for coordinated studies of new or materially modified ~~existing~~ Generating Facility and ETU interconnections and their impacts on affected system(s) as required by NERC FAC-001, Facility Interconnection Requirements. For an Interconnection Request for a Material Modification to an existing or previously studied Generating Facility or ETU, only the incremental impact of the net modification is studied. Those responsible for the reliability of affected system(s)<sup>3</sup> of new or materially modified existing interconnections are notified in accordance with the “coordination with affected systems” provisions of the interconnection procedures.

## Section 1.1.2 (CCIS)

- In this section:
  - Added clarity that, for studies performed according to the Capacity Capability Interconnection Standard (CCIS), facilities within the same Load Zone may not be reduced when the facility under study is introduced

compromised. Thus, when the new Generating Facility or ETU is added to the system models used in the study, capacity injections from other Generating Facilities, external transactions, other interface transfers or ETUs within the same Load Zone generally may not be reduced. This means that the proposed Generating Facility or ETU can operate without re-dispatch of other capacity resources. CCIS examines the deliverability of Generating Facilities or ETUs under study to their associated Load Zones.<sup>7</sup>



## Section 2.2 (System Configuration)

- In this section:
  - Added reference to relevant state-jurisdictional projects within on-going Affected System Operator (ASO) studies that are included in the system configuration used in a Cluster Study
  - Added footnote addressing when a Cluster Enabling Transmission Upgrade (CETU) is included in the system configuration used in a Cluster Study

Analyses shall be performed with the existing system facilities and topology, with the addition of all Planned transmission projects (those with approved Proposed Plan Applications under Section I.3.9 of the Tariff), ~~and~~ with all relevant Generating Facilities and ETUs with active Interconnection Requests along with their associated upgrades in the Interconnection Queue ahead of the Generating ~~Facility or ETU under study~~ Facilities or ETUs under study in a Cluster.<sup>12</sup> and with all relevant state-jurisdictional projects within on-going Affected System Operator (ASO) study that are ready to receive Reliability Committee approval within 90 days of the start of the Transitional Cluster Study pursuant to Section 11.4.1.1 of this procedure or a Cluster Study pursuant to Section 11.4.2.1 of this procedure.<sup>13</sup> Analyses shall also consider the Generating Facilities and ETUs under study in a Cluster.<sup>14</sup>

<sup>13</sup> Cluster Enabling Transmission Upgrades (CETUs) are included in the Cluster Study Base Case when one or more CETU-eligible Interconnection Request is included in the Cluster under study.



## Section 3.3 (Steady-State Redispatch)

- In this section:
  - Added clarifying language to footnote on the use of Generating Facilities and ETUs in a Cluster Study for redispatch

Facility or ETU in-service under study dispatched (post-project case). The change to output of Generating Facilities and external controllable ETUs from the values in a pre-project case to the values in the post-project case is commonly referred as redispatch<sup>31</sup>.

<sup>31</sup> For a Cluster Study (including the Transitional Cluster Study), all Generating Facilities and ETUs in the cluster can be considered as available for stressing the pre-project case and, to the extent there is a system constraint that would provide the basis for a redispatch condition, for redispatch in the post-project case (in addition to all existing and earlier queued Generating Facilities and ETUs).

## Section 3.3 (Steady-State Redispatch) (cont'd)

- In this section (cont'd):
  - Added clarifying language to the CCIS redispatch description

<u>N-1 CCIS Redispatch Objective</u>	<u>There is no redispatch (i.e. reduction) in the output of other impactful generation with established CNRC or active Interconnection Requests for CNRIS seeking to establish CNRC in the same or previous Cluster, or the flows of impactful controllable External ETUs with established CNICIS or active Interconnection Requests for CNIIS seeking to establish CNIC in the same or previous Cluster, after the dispatch of the proposed Generating Facility or ETU.</u>
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## Section 3.5.1 (NCIS Steady-State Load Levels)

- In this section:
  - Added clarifying language on the facility output level used for steady-state Peak Load analyses

- Analysis shall be performed at Peak Load with the Generating Facility or ETU operating at full capability (i.e., its full requested summer or winter NRC as applicable):



## Section 3.5.2 (CCIS Steady-State Load Level)

- In this section:
  - Added clarifying language on the dispatch of applicable facilities for CCIS analysis

▪ A mid-day peak scenario, characterized by high load and resources providing expected capacity (i.e. resources dispatched up to established or requested, in the case of active Interconnection Requests, summer CNRC).



## Section 6.5 (Electromagnetic Transient Testing)

- In this section:
  - Added information on how to identify the need for Electromagnetic Transient models for non-inverter based facilities

Any inverter-based Generating Facility, including DER, an ETU that includes power electronics as part of the facility or a Generating Facility or ETU that includes power electronics as part of Interconnection Facilities or Network Upgrades shall provide an Electromagnetic Transient (EMT) model(s) useable in PSCAD, of that equipment. ~~The need for a EMT model will be discussed at the Scoping Meeting for non-inverter based technology.~~ For any other facility, an EMT model useable in PSCAD is required for any of the facility's equipment that is not available in the model library of the version of PSCAD or ETran that will be used for its study<sup>54</sup>. The EMT study shall examine N-1, N-1-1 and other potential contingent or operating conditions specified by the ISO. -Guidance regarding the requirements for PSCAD model submittals and for EMT testing is provided in Appendix C. <sup>55</sup>

<sup>54</sup> The ISO will list software and software versions used for studies on its website.

## Section 10.4 (Phase 3: Calculate Cost Allocations for Required Upgrades)

- In this section:
  - Added a footnote clarifying that cost allocation for CETUs is separate from cost allocation for Cluster Studies

During this phase, the ISO calculates allocated costs for the identified set of upgrades to address all identified violations in a Cluster Study (or a restudy thereof)<sup>59</sup>.

<sup>59</sup> This section does not describe the cost allocation for CETUs. Cost allocation for CETUs is pursuant to Schedule 11 of the Open Access Transmission Tariff.



## Section 10.4.1 (Upgrade Classifications)

- In this section:
  - Added language to clarify that cost allocation for Substation Network Upgrades considers the number of interconnection facilities
  - Added a footnote clarifying that System Network Upgrades can be identified at substations

2. Substation Network Upgrades: As defined in Schedules 22, 23 and 25 of the Tariff, Substation Network Upgrades are substation related equipment required at Generating Facilities' Points of Interconnection. Pursuant to Schedule 11 of the Tariff, the costs for these upgrades are allocated by voltage level and on a per capita basis according to the number of interconnection facilities connecting to the substation to each Generating Facility or ETU interconnecting at the related voltage level.
3. System Network Upgrade: As defined in Schedules 22, 23 and 25 of the Tariff, System Network Upgrades are upgrades required beyond the substation at the Point of Interconnection<sup>60</sup>. Pursuant to Section 11 of the Tariff, the costs of these upgrades are allocated based on the proportional impact of each individual Generating Facility or ETU in a Cluster on the need for the upgrades.

<sup>60</sup> System Network Upgrades may be required at substations where projects propose to interconnect to address system performance related violations (e.g. the addition of a voltage support device to address a voltage and/or stability violation, or the addition of a transformer to address thermal and/or voltage violation).

## Section 10.4.2 (Cost Allocation Calculation Details for System Network Upgrades)

- In this section:
  - Added a footnote describing that only net impacts are evaluated for Interconnection Requests related to a Material Modification to an existing for previously studied facility for the purposes of cost allocation

- consider a project's impact on all elements with a violation that require a System Network Upgrade<sup>61</sup>

<sup>61</sup> Where a request has been made to materially change a Generating Facility, materially change an Eligible External ETU, or to increase the capability of a Generating Facility or Eligible External ETU, the project's impact considered in the cost allocation calculation is the impact of the requested incremental changes to the Generating Facility or Eligible External ETU, and not the entire facility.



## Section 10.4.2 (Cost Allocation Calculation Details for System Network Upgrades) (cont'd)

- In this section (cont'd):
  - Added clarifying language that Through or Out Service is included in cost allocation calculations

Projects requesting Regional Network Service (RNS) or Through or Out Service are included in cost allocation calculations.



## Section 10.4.5 (Impact Calculations to Address Steady-State Voltage Violations)

- In this section:
  - Revised language to the voltage impact methodology for identifying the critical bus

- The critical bus is the bus with the largest lowest observed voltage deviation for the worst case voltage violation associated with the project, and



## Section 10.4.6 (Impact Calculations to Address Stability Violations)

- In this section:
  - Added a footnote which provides more details on how projects are associated with a stability violation

The impact calculation for a project associated with a stability violation<sup>63</sup> is:

<sup>63</sup> Not all projects in a Cluster will automatically be associated with a stability violation should a stability violation be identified in a Cluster Study. The Cluster Study Report (or Cluster Restudy Report) will provide justification on why a project is associated with a stability violation that requires upgrades to resolve.

# Appendix B (Requirements of PSS/E Models)

- In this section:
  - Added a footnote describing that the ISO will list software and software versions used for studies on its website

All power flow and dynamic models must be made available for use in the version of PSS/E that is in use by ISO New England<sup>71</sup> and must accurately model all of the relevant control modes and characteristics of the equipment, such as:

<sup>71</sup> The ISO will list software and software versions used for studies on its website.

# Appendix E (Procedures for Material Modification Determinations)

- In this section:
  - Revised proposed language and removed existing language to clarify that, after the completion of a Cluster Study or Cluster Restudy, a decrease in electrical output of a proposed project, where the project remains responsible for its previously determined allocated upgrade costs, is not deemed material

- The following may be deemed material and require a new Interconnection Request:

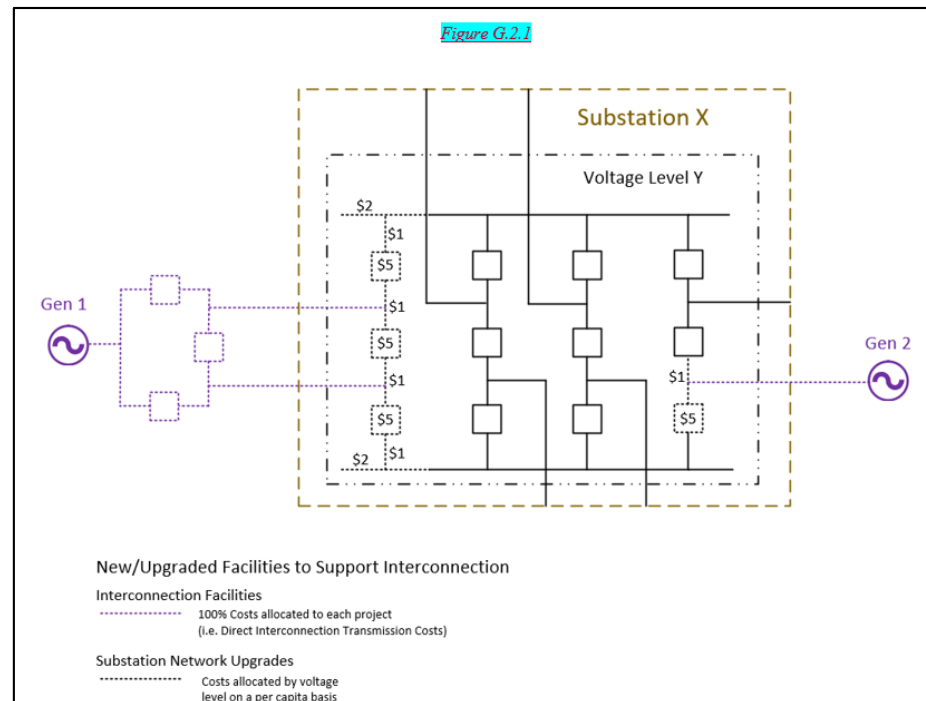
A decrease of the electrical output (MW) of the proposed project where the decrease would not result in the transfer of an upgrade obligation to one or more projects in the same or a later Cluster

- The following will not be deemed material and will not require a new Interconnection Request

- Upon achieving Commercial Operation, After the completion of a Cluster Study or Cluster Restudy, a decrease of the electrical output (MW) of the proposed project, but where the project remains responsible for its allocated costs for all Interconnection Facilities, Substation Network Upgrades and System Network Upgrades the project is responsible for, as identified in its Interconnection Studies prior to the decrease in electrical output, have been built.

# Appendix G (Cost Allocation Methodology Examples)

- In this section:
  - Added a new example which provides additional clarity on how interconnection facilities are considered in the cost allocation calculation for Substation Network Upgrades
    - Edits also made to example numbering and to the Substation Network Upgrade tables in Example 1 to align with the added example



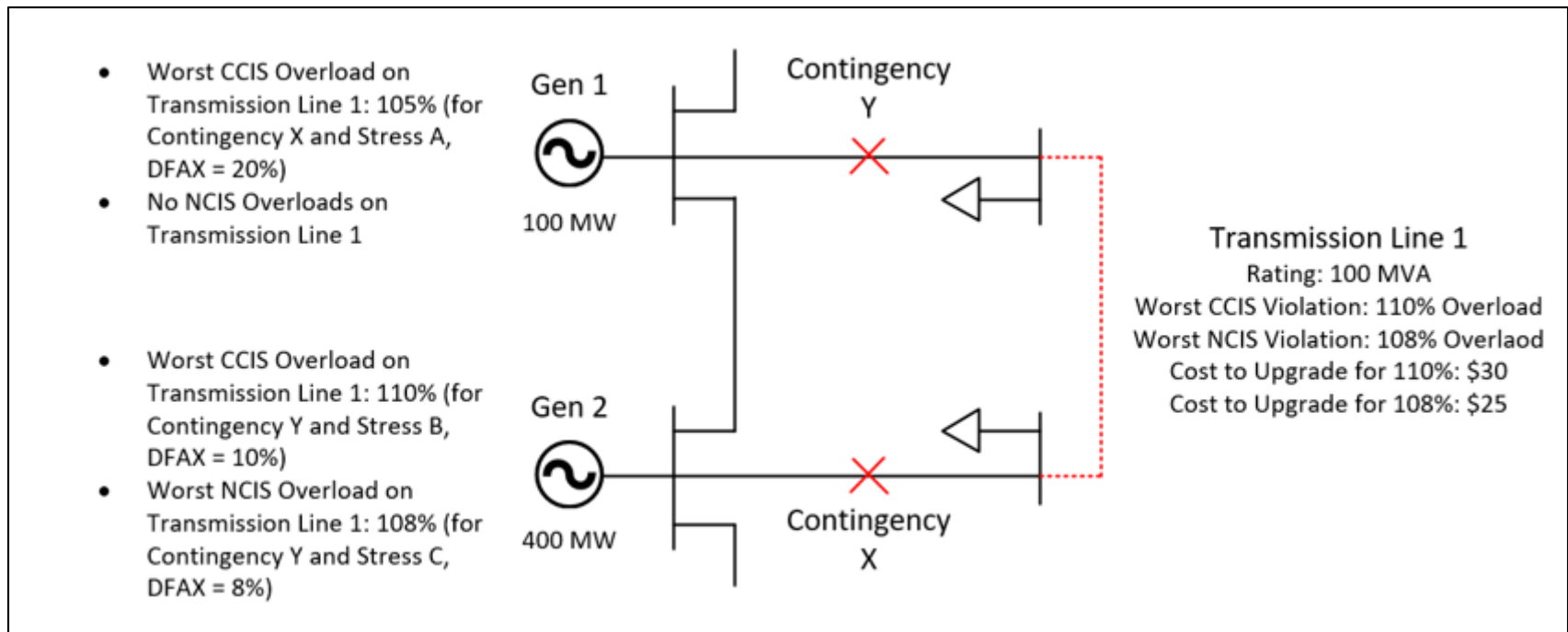
# Appendix G (Cost Allocation Methodology Examples) (cont'd)

- In this section (cont'd):
  - Added a new example, which provides additional clarity on how interconnection facilities are considered in the cost allocation calculation for Substation Network Upgrades (cont'd)

Project	Substation Network Upgrades @ Y kV					
Gen 1	Upgrade	A) Number of Applicable Upgrades	B) Cost per Upgrade	C) Total Number of Applicable Connections for All Projects	D) Number of Applicable Connections for the Project	E) Total Costs per Upgrade = $\frac{[(A \times B)]}{C} \times D$
	Breakers	4	\$5.00	3	2	\$13.33
	Inter-Breaker Bus Segments	5	\$1.00	3	2	\$3.33
	Main Bus Segments	2	\$2.00	3	2	\$1.33
	Total Substation Network Upgrades @ Y kV Cost (sum of column D): \$17.99					
Gen 2	Upgrade	A) Number of Applicable Upgrades	B) Cost per Upgrade	C) Total Number of Applicable Connections for All Projects	D) Number of Applicable Connections for the Project	E) Total Costs per Upgrade = $\frac{[(A \times B)]}{C} \times D$
	Breakers	4	\$5.00	3	1	\$6.67
	Inter-Breaker Bus Segments	5	\$1.00	3	1	\$1.67
	Main Bus Segments	2	\$2.00	3	1	\$0.67
	Total Substation Network Upgrades @ Y kV Cost (sum of column D): \$9.01					

# Appendix G (Cost Allocation Methodology Examples) (cont'd)

- In this section:
  - Revised example showing automatic downgrade to NRIS to reflect that automatic downgrade to NRIS only occurs when all overloads seen in CCIS analyses are also seen in NCIS analyses





# Appendix G (Cost Allocation Methodology Examples) (cont'd)

- In this section (cont'd):
  - Revised example showing automatic downgrade to NRIS to reflect that automatic downgrade to NRIS only occurs when all overloads seen in CCIS analyses are also seen in NCIS analyses

Case 1 – No projects chose “downgradable CNRIS”

Project	Project Impact (DFAX*MW Rating)	Project Impact/Σ of All Project Impacts	Project Cost Allocation
Gen 1	$0.20 \times 100 = 20 \text{ MW}$	$20 / (20 + 40) = 33.33\%$	$0.3333 \times \$30 = \$10$
Gen 2	$0.10 \times 400 = 40 \text{ MW}$	$40 / (20 + 40) = 66.67\%$	$0.6667 \times \$30 = \$20$

Case 2 – Gen 1 chose “downgradable CNRIS”, but Gen 2 did not.

Project	Project Impact (DFAX*MW Rating)	Project Impact/Σ of All Project Impacts	Project Cost Allocation
Gen 1	N/A	N/A	N/A
Gen 2	$0.10 \times 400 = 40 \text{ MW}$	$40 / (40) = 100.00\%$	$1.00 \times \$30 = \$30$

Case 3 – Gen 2 chose “downgradable CNRIS”, but Gen 1 did not.

Project	Project Impact (DFAX*MW Rating)	Project Impact/Σ of All Project Impacts	Project Cost Allocation
Gen 1	$0.20 \times 100 = 20 \text{ MW}$	$20 / (20 + 3240) = 38.4633.33\%$	$0.3846333 \times \$2530 = \$9,6210$
Gen 2**	$0.0810 \times 400 = 3240 \text{ MW}$	$3240 / (20 + 3240) = 61.5466.67\%$	$0.6154667 \times \$2530 = \$15,3820$

Case 4 – Gen 1 and Gen 2 chose “downgradable CNRIS”

Project	Project Impact (DFAX*MW Rating)	Project Impact/Σ of All Project Impacts	Project Cost Allocation
Gen 1	N/A	N/A	N/A
Gen 2**	$0.1008 \times 400 = 3240 \text{ MW}$	$3240 / (3240) = 100.00\%$	$1.00 \times \$2530 = \$2530$

\*Gen 1 is automatically downgraded to NRIS because overloads were only seen for CCIS analysis.

\*\*Gen 2 is not automatically downgraded to NRIS because all overloads seen in CCIS analyses were also seen in NCIS analyses.

# Appendix H (Acreage Requirements)

- In this section:
  - Revised the provided example to align with values in Table H.1
  - Revised the proposed footnote to provide additional clarity on the project values applicable to Table H.1

The minimum expected acreage requirement for Interconnection Requests representing a proposed co-located Generating Facility are calculated by summing the minimum expected acreage requirement for each technology component. For example, an Interconnection Request for a 20 MW co-located Generating Facility, where 15 MW is based on PV and 5 MW is based on 20MWh of electric energy storage, the expected minimum acreage requirement calculations are:

- Step 1: Minimum expected acreage requirement for the PV =  $15 \text{ MW} \times 5 \text{ acres/MW} = 75 \text{ acres}$
- Step 2: Minimum expected acreage requirement for the electrical energy storage =  $5 \text{ MW} \times 0.1 \text{ acres/MW} = 0.5 \text{ acres}$
- Step 3: Minimum expected acreage requirement for the total co-located Generating Facility = PV minimum expected acreage requirement + electrical energy storage minimum expected acreage requirement =  $75 \text{ acres} + 0.5 \text{ acres} = 75.5 \text{ acres}$ .

If the acreage associated with an Interconnection Request's Site Control is below the minimum expected acreage requirements listed in Table H.1, or if the Interconnection Request uses a technology not listed in Table H.1, then the Interconnection Customer must provide documentation with the Interconnection Request's Site Control explaining why the Interconnection Request has sufficient acreage. If provision of such documentation is required, the ISO will review any such documentation and determine if the documentation is complete and if the acreage associated with the Interconnection Request's Site Control is appropriate-sufficient for the proposed project facilities.

<sup>79</sup> All MW or MWh values shown in table H.1 are AC at the POI, and reflect the maximum nameplate rating. Values provided according to table H.1 must be based on physical nameplate ratings (i.e. the net MW capability at the Point of Interconnection, which may be higher than the requested levels of Interconnection Service). For PV, onshore wind and offshore wind, MW values are AC and reflect the maximum nameplate rating that can be delivered to the project's Point of Interconnection. For Electrical Energy Storage, MWh values are useable AC energy, which considers all losses associated with delivering power to the Point of Interconnection.

# OVERVIEW OF INCREMENTAL APPENDIX C-2 UPDATES



## Section 2.1.6.1 (Infinite bus source load flow representation in PSSE)

- In this section:
  - Added additional clarity on the infinite bus voltage set point adjustments when setting up model acceptance tests

The source connected to the infinite bus is modeled as a generator with a machine base of 10,000 MVA with an impedance of  $R = 0$  and  $X = 0.01$  per unit. The infinite bus generator voltage set point is set to a default value of 1.0 p.u., and may be adjusted to achieve the required reactive power at the POI for the model acceptance tests.



# FUTURE UPDATES TO PLANNING PROCEDURES AND OTHER DOCUMENTS



# Future Updates to Planning Procedures and Other Documents

- PP10 will require updates to remove language associated with milestones and studies needed to achieve a capacity interconnection (revisions will be separately brought to stakeholders, starting in Q4, 2024)
  - This language needs to remain in PP10 until the 2024 interim reconfiguration auction qualification process is completed (*i.e.*, November 1, 2024)
- Other documents will require revisions to remove references to FSs, SISs, and overlapping interconnection impacts analyses (revisions will be separately brought to stakeholders, starting in Q4, 2024):
  - Transmission Planning Technical Guide
  - PP5-5 (Requirements and Guidelines for Application on Remedial Action Schemes and Automatic Control Schemes)

# Future Updates to Planning Procedures and Other Documents (cont'd)

- Future Order Nos. 2023/2023-A enhancements are expected for PP5-6
  - Additional possible enhancements considered to date are not needed until the initial Cluster Study, or until the late stages of the Transitional Cluster Study
  - Other possible enhancements likely to be identified through future Order Nos. 2023/2023-A implementation and as the region gets more experience with the cluster study approach
  - The ISO expects to bring future Order Nos. 2023/2023-A PP5-6 enhancements through the stakeholder process, starting in Q4 2024/Q1 2025



# CONCLUSION





# Conclusion

- Modifications to PP5-6 are required to support an Order Nos. 2023/2023-A compliant interconnection process
  - Modifications to PP5-6 are also required to provide additional guidance on model acceptance testing and document coordination of ASO studies with ISO performed Cluster Studies
- The ISO is targeting a September 2024 effective date for the proposed PP5-6 changes
  - The expected effective date will be soon after the September 5, 2024 Participants Committee (*i.e.*, sometime the week of September 9, 2024)
- The ISO will:
  - Bring other Planning Procedures and documents through the stakeholder process, starting in Q4 2024
  - Bring future Order Nos. 2023/2023-A PP5-6 enhancements through the stakeholder process, starting in Q4 2024/Q1 2025

# Stakeholder Schedule

Stakeholder Committee and Date	Scheduled Project Milestone
Reliability Committee March 19, 2024	Initial Presentation
Reliability Committee June 18th, 2024	Present PP5-6 Redlines
Reliability Committee July 16, 2024	Review PP5-6 Redlines
Reliability Committee July 25, 2024	Additional meeting to continue discussion on PP5-6 redlines from the July 16, 2024 RC and introduce any related amendments.
Reliability Committee August 13-14, 2024	Review PP5-6 Redlines; Vote
Participants Committee September 5, 2024	Vote

\*The schedule applies to PP5-6 changes; other document revisions will be presented to the RC starting in Q4 2024

# Questions

