i2X – LBNL Webinar Series

DER Interconnection Solutions for a Reliable and Secure Grid

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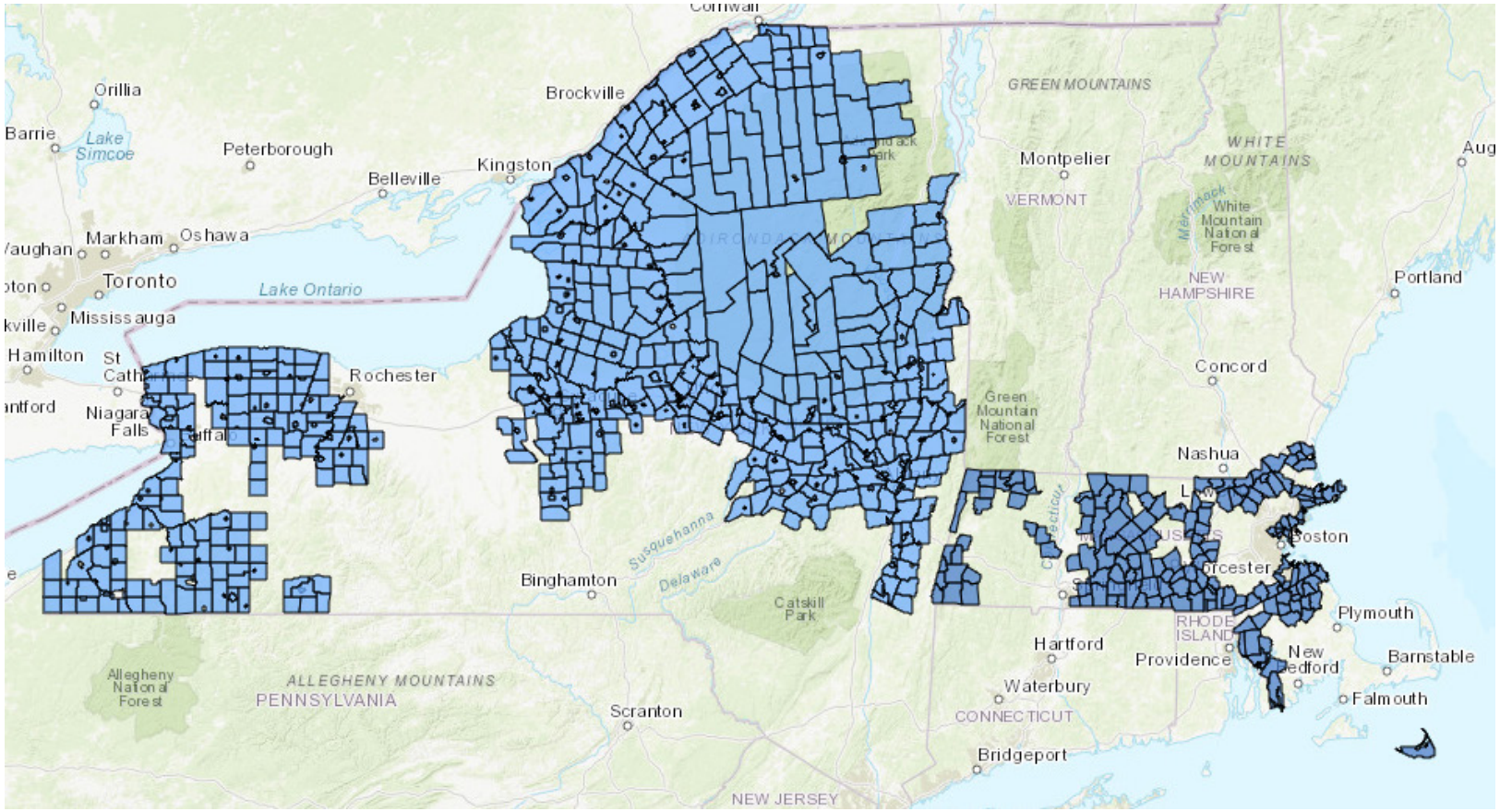
National Grid US

- **3M Electric Customers**
- **3,304 Distribution Circuits, Totaling 63,000 miles**



National Grid Massachusetts DER Stats (as of 07/15/25)

- **117,588 Total Connected**
- **DER ≥ 1,000 kW**
  - 456 Sites, Totaling 1,128 MW
  - 189 Feeders w/ >= 1,000 kW Site (This stat from 05/24)
- **20 ≤ DER < 1000 kW**
  - 1,792 Sites, Totaling 398 MW
- **DER < 25 kW**
  - 115,330 Sites, Totaling 788 MW

References

- **Massachusetts Tariff MDPU 1620, “Standards for Interconnection of Distributed Generation”**
  - Tariff Provisions | Bills, Meters & Rates | National Grid, https://www.nationalgridus.com/MA-Home/Rates/Tariff-Provisions
- **National Grid Electric Service Bulletin 756, “Requirements for Parallel Generation Connected to a National Grid owned EPS” (see Appendix 756C for Mass requirements)**
  - Electric Specifications, https://gridforce.my.site.com/electric/s/article/Electric-Specifications
- **IEEE 1547-2018, “Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Power Systems Interfaces”**
- **IEEE 1547.1-2020, “Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces”**

National Grid DG Application Process

The application process is dictated by MDPU 1620 and has three pathways. For specific definitions and process timelines, please see MDPU 1620, linked in the Reference slide.

Three Categories of Applications:

- **"Simplified Process" shall mean, as described in Section 3.1, process steps from initial application to final written authorization for certain inverter-based Facilities of limited scale and minimal apparent grid impact. In other words, up to 15 kW single phase, 25 kW three phase. Application goes through a screening procedure that verifies ESB 756C compliance.**
- **"Expedited Process" shall mean, as described in Section 3.3, process steps for Listed Facilities from initial application to final written authorization, using a set of technical screens to determine impact on the Company EPS. In other words, larger than Simplified and can pass MDPU 1620 Figure 1 Screens, application follows Simplified process. If application can NOT pass Figure 1 Screens, application goes to Standard Process, which can be limited in scope.**
- **"Standard Process" shall mean, as described in Section 3.4, process steps from initial application to final written authorization for Facilities that do not qualify for Simplified or Expedited treatment. In other words, all applications that do NOT qualify for Simplified or Expedited. This is where the System Impact Study (SIS) lives.**

We'll be focusing on the System Impact Study in this presentation.

National Grid System Impact Study Timeline

MDPU 1620 dictates a 55 Business Day Deadline for *single-application* SIS completion. We are allowed to put the timeline on HOLD for customer document revisions/decisions.

Timeline:

- **0-20 BD, Customer submittals reviewed for completion. Ngrid and Customer come to agreement as to exactly what is being studied.**
  - Facility Oneline (showing DER, interconnection transformer arrangement, protective devices, etc.)
  - Facility Site Plan
  - BESS Narrative (customer describes the intended operation of the facility; backup, solar-extending, wholesale markets, etc.)
- **21-50 BD, National Grid performs SIS and presents results (w/o estimates) to customer. Customer may have decisions to make at this time. Once decisions are finalized…**
- **51-55 BD, SIS Report is Finalized with estimates and presented to Customer.**
- **If this is a BESS application, we are allowed an additional 35 BD to perform 8760 thermal analysis.**

National Grid System Impact Study Technical Content

- **A System Impact Study is performed to quantify the Facility's *Impact to the Company EPS*. If those impacts are found to be negative to the EPS, as compared to various industry Standards, mitigations are proposed and estimated for the Customer.**
- **Thermal Analysis/Load Flow**
  - New applications are studied with respect to their Queue position, meaning if there are prior-in-queue projects, they will be considered *interconnected*.
  - Consideration towards substation assets (transformer, voltage regulators, etc), D-line assets (wire, fusing, etc). MDPU 1599 is a cost causation model, so the DER customer would be responsible for the cost of replacing over-loaded assets.
- **Power Quality Analysis**
  - Facilities shall not cause Rapid Voltage Change greater than 3%. Using Load Flow, lock controllable voltage regulating devices, run with facility ON and then OFF, note voltage difference at Point of Common Coupling. IEEE 1547 Enter Service requirements usually mitigate this issue.
  - Facilities shall not push the EPS voltage outside of ANSI C84.1 voltage bounds (+/-5%). Facilities that fail this analysis may need to replace small wire, utilize a non-unity power factor, etc.
  - Facilities shall comply with IEEE 1453 Flicker requirements. Anecdotally, cloud cover does not cause flicker with PV. BESS will usually require a Ramp to prevent instantaneous power flow changes.

National Grid System Impact Study Technical Content

- **Risk of Islanding Analysis**
  - National Grid uses SANDIA-2019 Screens
  - Inverter Based Resources (IBR) would trigger Reclose Blocking, where voltage supervision is added to the reclosing element. Older reclosers may need to be replaced to achieve this functionality.
  - DTT is reserved for rotating machines.
- **Protection Analysis**
  - Ensure Customer's protection coordinates with Ngrid protection. Ensure any rearrangement or addition of new Ngrid protective devices are coordinated.
  - National Grid requires an Effectively Grounded DER Interconnection, which means the Facility will contribute Zero Sequence fault current during a 1LG fault on the EPS. Customers are required to have their own 51N element (in coordination with Ngrid to prevent nuisance trips) to pickup and trip their Facility for that contribution.
  - When backfeed at the substation transformer reaches 67% of minimum load, Ngrid requires 3V0 protection at the high side of that transformer. This is to prevent fault contribution, from DER, to a transmission fault.

National Grid System Impact Study Technical Content

- **Customer Equipment Analysis**
  - Metering arrangement review. Various state programs may require different arrangements (see customer submittals)
  - Interconnection Transformer review. Winding arrangement impacts effective grounding, fault detection, etc.
  - Effective Grounding review. Size and arrangement of ground banks, etc.
  - Manual Generator Disconnect. Required by NEC, ensure it's in an appropriate location in the wiring and site plan. Shall be 24/7 accessible to utility.
  - Protective Device review. Ratings of interruptible devices are appropriate for interconnection type. PT/CTs are rated appropriately. Relays shall be "utility grade" (IEEE C37.90 series). Ensure correct 27/59/81 elements, in the DER and any Relays, as required be IEEE 1547. Relay power supply supplied from appropriate location. Relay failure detection is appropriate (if the Customer relay fails, facility shall trip)

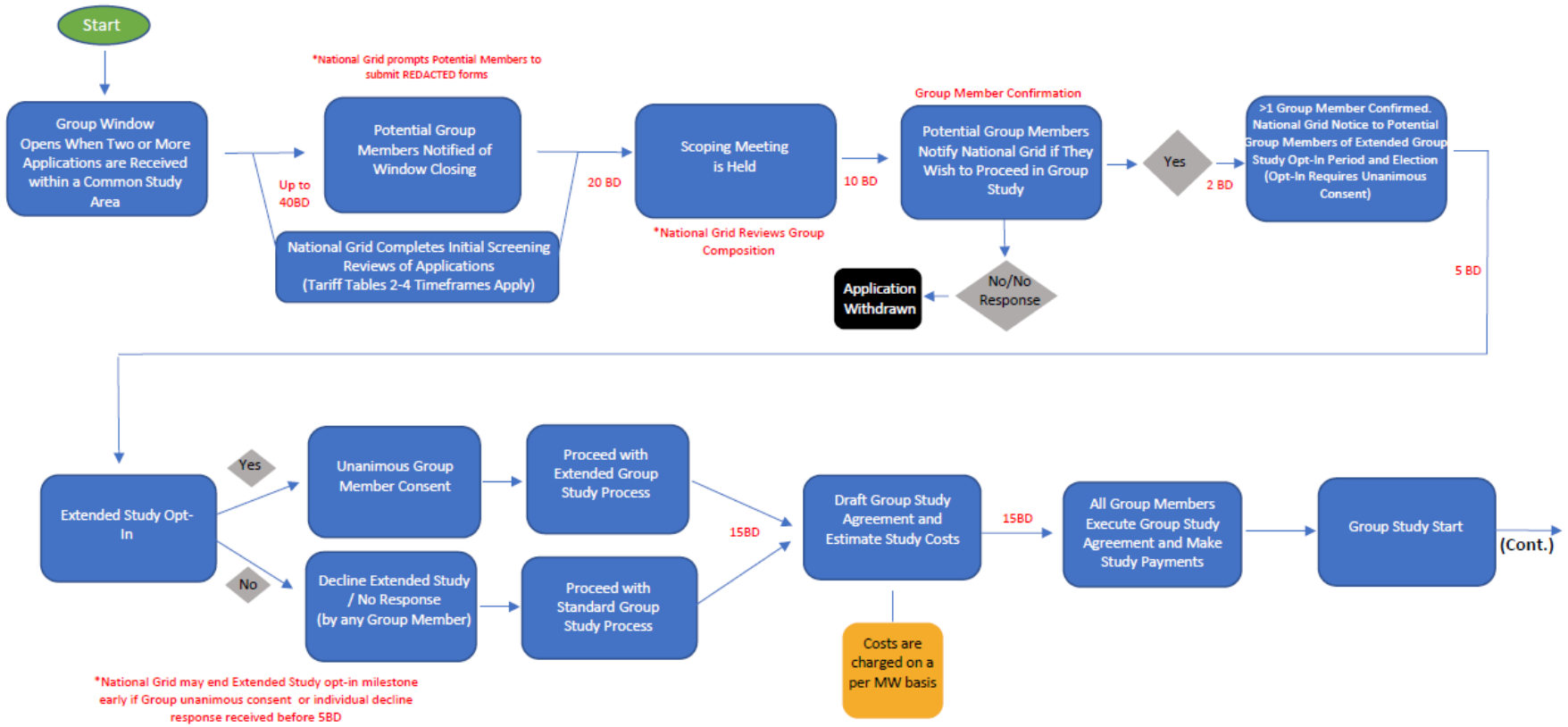
National Grid System Impact Study Technical Content

- **Telemetry review**
  - Any Facility greater than or equal to 500 kW shall have some form of telemetry, so the Ngrid Control Room has visibility and control of the DER. For Independent Power Producers (DER only, no load), a company owned recloser at the PCC is required. Where there is onsite DER and Load, a Remote Telemetry Unit (RTU) is required to be integrated into the Facility.
- **Cost Estimate for System Modifications identified by SIS analysis.**

Group Study / Affected System Operator (ASO) Studies

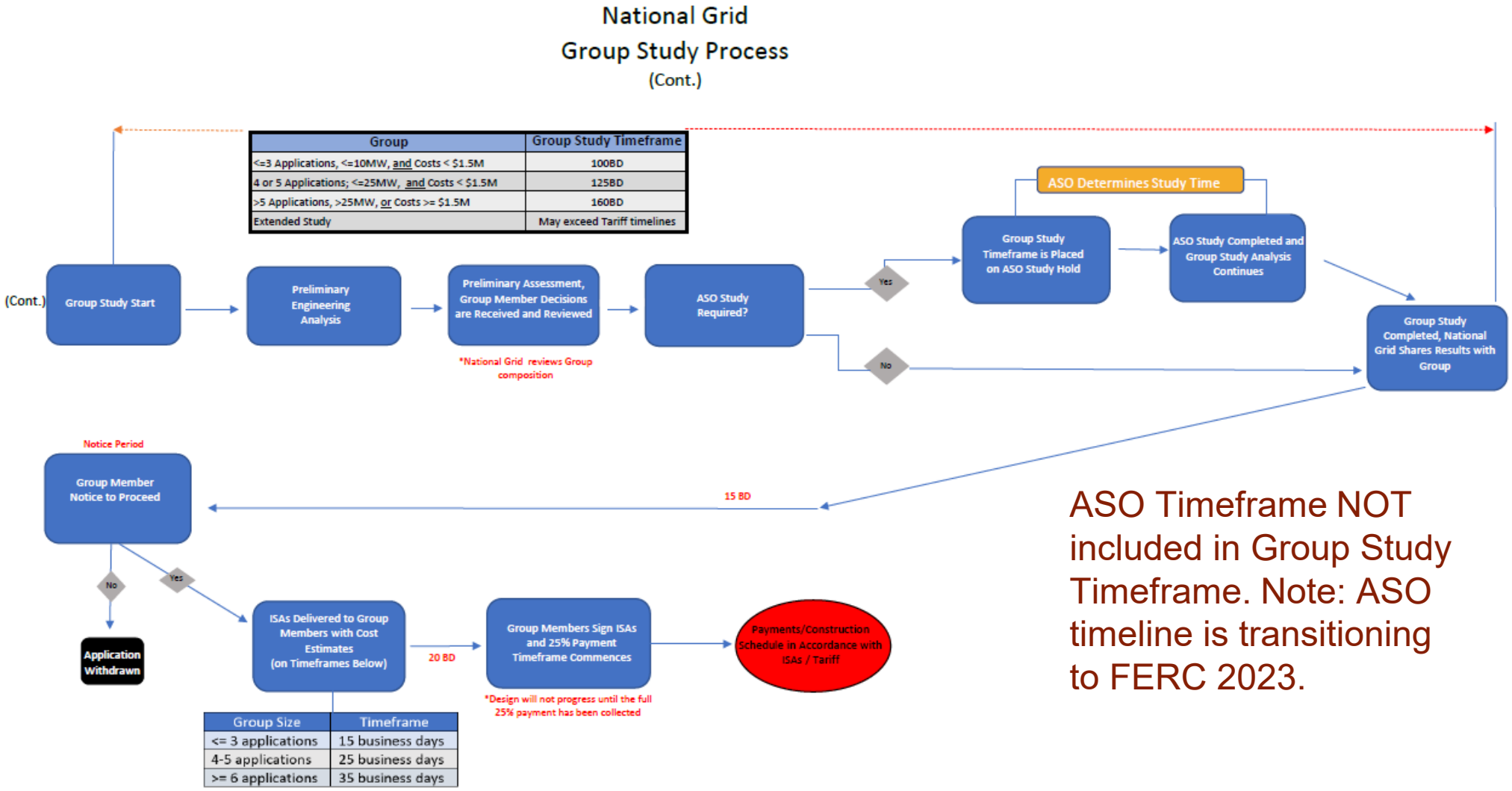
National Grid
Group Study Process*
(Interconnection Tariff, Section 3.4.1)

For more information on Group Studies, see MDPU 1620 3.4(b)



This Group Study process flow-chart is a visual aid intended for convenience only and National Grid makes no representation as to its completeness or accuracy. Please refer to National Grid's Standards for Interconnection of Distributed Generation Tariff M.D.P.U. 1468, as may be amended.

Group Study / Affected System Operator (ASO) Studies



ASO Timeframe NOT included in Group Study Timeframe. Note: ASO timeline is transitioning to FERC 2023.

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