UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Interconnection of Large Loads to the Interstate Transmission System	**Docket No. RM26-4-000**

AFFIDAVIT OF ANDREW LEVITT, ANIRUDDH MOHAN, RYAN QUINT, AND SIRISHA TANNEERU

ON BEHALF OF
EOLIAN ENERGY, INC.

November 21, 2025

I. QUALIFICATIONS

Our names are Andrew Levitt, Aniruddh Mohan, Ryan Quint, and Sirisha Tanneeru. Mr. Levitt is a Senior Consultant and Dr. Mohan is an Energy Associate at The Brattle Group (Brattle). Dr. Quint is the President and Chief Executive Officer and Ms. Tanneeru is Lead Engineer at Elevate Energy Consulting (Elevate).

Mr. Levitt is an expert on wholesale market design and reliability implications of changes in the power system. He has consulted to Independent System Operators and Regional Transmission Organizations (ISO/RTOs) such as the Midcontinent Independent System Operator (MISO), the New York Independent System Operator (NYISO), the Alberta Electric System Operator (AESO), and the Independent Electricity System Operator (IESO) of Ontario, and helped other clients navigate ISO/RTO changes nationwide. Prior to joining Brattle in 2022, Mr. Levitt was on staff at PJM for seven years (most recently as Lead Market Designer), where he developed reforms to reliably integrate new resource types. Mr. Levitt holds an MMP from University of Delaware and a BSc in physics from University of Toronto.

Dr. Mohan specializes in the evaluation of emerging energy technologies at a systems level, with expertise in electricity markets, techno-economic analysis, and energy policy. He has expertise in optimization models that support both resource and transmission planning and has published peer reviewed research in leading academic journals on the integration of emerging technologies in energy systems. He holds a PhD in Engineering & Public Policy from Carnegie Mellon University.

Dr. Quint has participated in and led numerous industry initiatives at the Energy Systems Integration Group (ESIG), Institute of Electrical and Electronics Engineers (IEEE), International Council on Large Electric Systems (CIGRE), and North American Electric Reliability Corporation (NERC) forums. Prior to founding Elevate, Dr. Quint spent nearly 9 years at the NERC, most recently as the Director of Engineering and Security Integration where he led strategic initiatives working with industry stakeholders focused on emerging reliability risk mitigation. Dr. Quint holds a PhD in power systems engineering from Virginia Polytechnic Institute and State University and is a registered Professional Engineer.

Sirisha Tanneeru has over 15 years of experience in the electric utility industry, spanning across utilities, renewable development, and consulting. She has extensive experience in transmission expansion planning, particularly generation and load interconnections and NERC compliance. She provided interconnection strategy support for several greenfield and brownfield renewable projects in the MISO, Southwest Power Pool (SPP), and the Western Electricity Coordinating Council (WECC) regions. Ms. Tanneeru holds an MS from New Mexico State University.

II. ASSIGNMENT

We were asked by Eolian Energy, Inc. to comment on the Secretary of Energy's Advance Notice of Proposed Rulemaking (ANOPR), specifically to substantiate and assess reliability aspects of the fourteen principles associated with studies and operations of hybrid facilities (i.e., generation facilities supporting on-site or nearby large load facilities) that can meet their own capacity needs without relying on the broader system for firm power. We focus on ANOPR principles numbered three, five, six, and seven.

III. SUMMARY OF PROPOSED PROCESS TO STREAMLINE CONNECTION OF HYBRID FACILITIES

The ANOPR proposes reforms to the process for interconnecting large loads to the transmission system guided by fourteen principles, several of which bear on studies and operations of hybrid facilities. The Federal Energy Regulatory Commission (FERC) has initiated a rulemaking to consider and take final action on the ANOPR, which may result in a NOPR and a subsequent final rule.

In this Affidavit, we develop and assess a proposal for one aspect of the streamlined interconnection study process specified in principle seven, while also addressing principles three, five, and six. **Our proposal relies on the key capability of a hybrid facility to meet its own power needs—i.e., achieve a zero net megawatt (MW) exchange with the grid—when so dispatched at any time (including load curtailment if the hybrid's facility's supporting generation cannot produce).** The potential for "net zero impact" for a hybrid facility, including the ability of the load to be curtailed if the generation is unavailable, is a compelling case to simplify the study process, minimize costly network upgrades, and maximize system operator controllability to ensure reliable operation of the bulk power system.

Because new supporting generation that is electrically close to a new large load (but not necessarily on-site) can provide the same benefits as a hybrid facility, our analyses include this broader configuration (following SPP's recent High Impact Large Load Generation Assessment (HILLGA) proposal that similarly allows for loads and generation that are electrically near each other but not necessarily at the same site).[1] We refer to both on-site and electrically close as hybrid facilities. We recommend that the Commission's proposed definition of hybrid facilities include both on-site and electrically close designs of hybrid facilities.

This proposal sets forth a streamlined study process for connecting a new hybrid facility. As explained further below, where such a facility meets certain flexibility requirements, its interconnection to the system can be streamlined by its interconnecting Transmission Owner in a serial fashion outside of the standard interconnection queues for either generation or load. In such circumstances, only one study process is required to connect both the load and generation components of the facility. The streamlined process yields transmission agreements and control mechanisms for connection and service for both the generation and load components of the hybrid facility, granting the necessary conditional permission for injection and withdrawal. Should the serial study process we set forth find major transmission network upgrades are likely to be needed at the requested level of service, then it identifies a lower operating limit at which the hybrid facility can connect without triggering such upgrades. In order to increase the operating limit or to request conventional firm service, the hybrid facility developer has the option to request a full load interconnection study through the standard load interconnection study process, and/or to require the generation components of the hybrid facility to be studied in the standard generation interconnection process (but in a manner that accounts for the existence of the associated load).

While the proposal is focused on dispatchable and curtailable hybrid facilities, the streamlined study methods we set forth are inherently applicable to curtailable large loads as well. Like a

[1] Southwest Power Pool, Submission of Tariff Revisions to Add the High Impact Large Load Processes and Generation Assessment, filed October 24, 2025, FERC docket number ER26-247

hybrid facility, a curtailable large load could also avail itself of the standard load interconnection study process in order to increase the operating limit identified in the streamlined process, or to firm up its service to avoid curtailment.

The streamlined study process we set forth is one mechanism through which the Commission can provide for quicker interconnection of curtailable and dispatchable hybrid facilities. As we explain, this study process, which allows for serial study of facilities by the interconnecting transmission owner outside the queue, is only appropriate where the facilities can meet a strict set of operational and other criteria.

The proposed approach to rapid interconnection of hybrid facilities, which is in many respects similar to SPP's recent HILLGA proposal, has the following features:

- **Is led by the transmission-owning utility**, following the current load interconnection processes.
- **Jointly studies** load and supporting generation facilities.
- **Offers rapid study to confirm minimal material impact**, conceptually similar to (although with a more thorough study than) the streamlined processes currently used for Surplus Interconnection Service in MISO and SPP, which quickly identifies only *de minimis* network upgrades.[2]
- **Utilizes the same studies already used today, except without deliverability studies** for firm net injections or withdrawals**,** since the hybrid facility relies on self-supply for firmness rather than on the network (and the hybrid facility can limit its net grid injections or withdrawals whenever necessary).
- **Resolves study violations through operational means (rather than physical upgrades) whenever practical and reliable**; for example, steady state pre-contingency violations that can be addressed through operational curtailment via Security Constrained Economic Dispatch (SCED) do not require network upgrades.

[2] GridLab, Surplus Interconnection: A Tool to Immediately Deploy New Electricity Supply to Enhance Grid Reliability and Affordability, January 2025

- **Relies on static operational limits** where necessary to avoid transmission upgrades by limiting the maximum allowable net grid injections or withdrawals to certain study-determined levels (or even zero) at any time.

We have assessed the timing of studies necessary to implement the proposed approach, and conclude that, in cases in which the process does not flag the need for additional detailed analysis, studies can be completed in 90 days—and potentially as quickly as in 60 days.

Finally, we observe that a hybrid facility that can self-supply its energy needs at any time (or otherwise curtail the load) can also use that capability to self-supply its resource adequacy requirements so that no resource adequacy responsibilities are imposed on the rest of the system. A Balancing Authority can recognize this in its resource adequacy construct (e.g., by not allocating capacity obligation to the load of such a hybrid facility and by ensuring that the dispatch and curtailment obligations of the hybrid facilities apply to both resource adequacy and transmission reliability events).

III.A. Benefits of Rapid Interconnection of Hybrid Facilities

The proposed reforms to rapidly study and connect hybrid facilities take advantage of the fact that their proximity and dispatch flexibility limits impacts on the broader transmission system at any time. This provides the below benefits.

Accelerates Economic Development Priorities: the proposed reforms apply reliability analysis techniques to closely coordinate transmission planning studies with state-of-the-art grid operations, enabling faster connection of data centers and other large loads that fulfill national and state priorities for artificial intelligence, critical energy infrastructure investments, electronics, critical minerals, and other public priorities.

Encourages Entry of New Supply: by making the avoided transmission value of new supply available to adjacent large load customers in the form of accelerated hybrid interconnection, the proposed reforms provide a substantial incentive for new loads to contract with and bring online new supply. Meanwhile, joint studies take advantage of adjacency to bring new supply on more quickly than would otherwise be possible. Compared to large load growth without such reforms, this aspect of the proposed streamlined hybrid study process offers these benefits:

- **Mitigation of Resource Adequacy Concerns**: the timely addition of on-site or electrically close new supply that would not otherwise enter service (or only with significant delays) mitigates both transmission capacity and resource adequacy concerns.
- **Reduction in Capacity Prices**: the additional supply relieves scarcity in markets for capacity and resource adequacy contracts, supporting affordability objectives for existing customers, including in restructured states.[3]
- **Reduction in Energy Prices**: greater supply (especially during tight periods) reduces average wholesale electricity prices.

Facilitates Practical Large Load Flexibility: by structuring hybrid facility operations such that the load component relies on the dispatch of the associated generation component, utilizing load curtailments only as a backstop measure, the proposed reforms unlock load flexibility in a way that is compatible with large load business models that rely on very high availability—that is, outsourcing much of the necessary overall flexibility to a supporting on-site or nearby generation facility. This allows large loads to continue to count on exceptionally high availability of nearby generation, while leveraging load curtailments (or backup generation) during those rare occasions when the hybrid facility's nearby generation resource cannot produce.

Limits Impact on Conventional Interconnection Requests: because the benefits of the reforms are achieved by recognizing the capability of hybrid facilities to limit net grid injections and withdrawals and their impacts on the transmission system (rather than by re-assigning available grid capability to them from other generators with interconnection requests), the proposed approach has less impact on conventional generator and load interconnection requests.

Can Rely on Protection Systems to Avoid Unauthorized Grid Use: the proposed reforms require that inadvertent net injections or withdrawals of electricity from the transmission system

[3] For example, an analysis by the Independent Market Monitor for PJM found that rising capacity costs were almost entirely due to the resource adequacy needs of new large loads seeking to connect to the grid.

in excess of standing operating limits can be avoided with site-level or local protection schemes, which may be either behind-the-meter or local contained protections. This requirement simplifies reliability study methodologies and the treatment of the hybrid facility's component outages. These protections do not need to be classified as "remedial action schemes," particularly when they are customer-controlled/owned.[4]

IV. PROPOSED PROCESS TO CONNECT HYBRID FACILITIES

To support development of a proposed rule for rapid interconnection of hybrid facilities, we describe high-level features of the proposed process.

In addition to generally providing direction to FERC to regulate the interconnection of new loads greater than 20 MW to the transmission system, the ANOPR distinguishes between the interconnection of firm loads and hybrid facilities and those that are curtailable and dispatchable. This most obviously covers two use cases important for accelerating interconnection, addressing transmission needs, and mitigating resource adequacy shortfalls: (1) curtailable large loads and (2) co-located hybrid facilities that can reduce net injection/withdrawals on demand. The ANOPR's concept of hybrid facilities can be extended to cases in which the large load is electrically close to the paired generation, metered separately,[5] and not necessarily at the same site. This "electrically close" hybrid approach can provide many of the same benefits as strictly on-site generation and load but is likely to be to more commercially feasible for some loads and generation and therefore would deliver more value to the ANOPR's objectives than a narrower approach. Such electrically close hybrid facilities allow more flexibility in terms of their development and siting, and do not require complex contracting to enable the on-site self-supply of power that may be inconsistent with state laws on utility franchises (or direct retail sales where applicable). Studying electrically close load and generation as a single hybrid facility adds some complexity relative to studying a hybrid facility with on-site (and behind the meter) co-located loads and generation (for example to address the potential for localized overloads);

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4 NERC governs remedial action schemes through standard *PRC-012-2 - Remedial Action Schemes*.

5 Large loads that are contracted with supporting generation within the same resource adequacy zone but are not electrically close such that they cannot offer the same transmission cost and speed benefits as on-site or electrically close hybrid facilities, fall outside our proposed definition—even though we recognize that they can still meet the resource adequacy needs of a balancing authority.

however, we find that this complexity is unlikely to add significant workload or slow down the study process.

Because flexible loads, on-site hybrid facilities, and electrically close hybrid facilities can all address both resource adequacy needs and transmission reliability needs, they should all be enabled by the ANOPR. A streamlined interconnection option can be made available to all of these options whenever the operating arrangement avoids time-consuming grid upgrades. These fast-track options can presume that majority of the grid impacts are managed in the operations horizon through SCED (including pre-contingency dispatch to ensure N-1 security) via dispatch of generation (backstopped by curtailment of load), in combination with standing operational net injection and withdrawal limits established in the streamlined interconnection studies.

Allowing for non-firm net injections from a hybrid facility (when the grid can accommodate it) can benefit the wholesale energy market and also support the system during operational resource adequacy shortfalls. Such grid injections would be allowed only on an "as available" basis, subject to system operator (and market-based SCED) dispatch control. This is similar to the Electric Reliability Council of Texas's (ERCOT's) "connect and manage" approach to generator interconnection, and even less firm than existing Energy Resource Interconnection Service (ERIS).[6] Such conditional non-firm net injections based on available grid capacity are broadly similar to PJM's recent proposal for "provisional service" enabled by "Interim Deliverability Studies", as well as the Provisional Interconnection Service required under FERC Order Number 2023.[7] Our proposed fast-track process for hybrid facilities is also similar to SPP's recently proposed 90-day HILLGA process filed with FERC in October.

When the streamlined studies detect major planning impacts that cannot be resolved through operational redispatch (and therefore would require network upgrades), the process identifies the

[6] This level of very non-firm net injection service is well matched to generators whose primary purpose is to serve a local load, rather than to make net injections to the grid. However, developers of non-hybrid generators may also be interested in this level of service. While beyond the scope of this affidavit, we note that similar benefits to the energy market would be possible if the service were made available to all generators, and that such service could likely be processed more quickly than conventional ERIS or Network Resource Interconnection Service (NRIS), as evidenced by the comparative speed advantage in ERCOT. See e.g. LBNL, Queued Up: 2024 Edition, April 2024, slide 35.

[7] D. Bielak, PJM Manual 14: New Service Requests Cycle Process v3 Revisionary Summary, 2025; FERC, Order No. 2023, issued July 28, 2023, 184 FERC ¶ 61,054

lower operating limit that can be accommodated without such network upgrades. The hybrid facility's developer then has the option to connect with the identified lower operating limits (on either net injections or net withdrawals or both), and/or to proceed with additional studies through the usual interconnection processes (i.e., the generator interconnection or the conventional load integration processes, or both) in order to pursue the network upgrades needed to increase the applicable operating limit (and/or to decrease expected curtailment risk).[8] For example, if a hybrid facility requesting to inject and withdraw certain amounts were flagged for major grid upgrades to support both, it could choose to immediately connect with the lower net injection limit and the lower net withdrawal limit (identified by the transmission owner, potentially as low as zero megawatts), while simultaneously pursuing conventional load and generator interconnection request to increase one or both operating limits in the longer-term. The combination of streamlined studies allowing for immediate connection plus standard interconnection process to enhanced operating limits and firmness allows for an efficient and coordinated network upgrade process among all affected transmission systems.

Because the streamlined process avoids major network upgrades (if necessary, by limiting both net injections and net withdrawals as low as zero megawatts), each transmission owner can independently conduct streamlined hybrid interconnection processes (even within an ISO/RTO region) in serial fashion in as little as 60–90 days. Meanwhile, any network upgrades desired by the customer to increase the operating limit on net withdrawals or net injections can be processed through the conventional interconnection process (on a slower timeline). An ISO/RTO with two dozen transmission owners could therefore process up to 96 sets of hybrid facility[9] interconnection requests over the course of a year, with four 90-day study cycles a year and 24 of them running in parallel at any one time, even if each transmission owner can only conduct one at a time. However, in some cases a transmission owner may be able to study certain hybrid

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[8] We note that the generator interconnection process and the load integration process should both be enhanced with the study principles described here, namely: (a) joint study of contractually linked and electrically close generation and load; (b) recognition of curtailment as a reliability solution, if elected by the requestor and achievable in operations; and (c) recognition of fixed operating limits as a method to avoid upgrades where desired.

[9] Coordination of impacts among transmission owner regions is required when hybrid requests are electrically close to each other. Such coordination can be established upfront such that the study includes all impacts without requiring separate affected system transmission owner analysis.

facility requests in proximity together, so that across the ISO/RTO they can potentially process more than the 96 requests per year.

IV.A. Applicability and Qualification

To illustrate the proposed fast-track process for hybrid facility interconnection studies, we focus this discussion on the case of an agreement between a large new load and a new generator that are electrically close but not at the same site. While our discussion focuses on such electrically close hybrid facilities, the process is equally applicable to large loads that are curtailable and to hybrid facilities with on-site loads and generation, such as those configured as energy parks with behind-the-meter generation that can control their grid withdrawals and injections as required. Under this process, hybrid facilities qualify for streamlined interconnection when they can maintain specified operational limits that will be identified in the interconnection study, meet dispatchability requirements, and meet other applicable requirements such as readiness requirements, deposits, and a completed application.

The streamlined study framework would apply to a hybrid facility's generation resource even if the facility requests firm withdrawal rights for the entire load. While doing so would require the load interconnection request to be studied through the standard load interconnection process, the streamlined study process could still be applied to the hybrid facility's generation interconnection request as grid net injections from the hybrid facility would still be controllable (e.g., to zero MW). Energization of the generation component can be conditional on completion of the applicable load interconnection process. A generator and load of a hybrid facility are "electrically close" when power flows directly from the former to the latter within the confines of the local area. This "local area" is the set of nearby substations to which the hybrid facility's load and generation are connected, and the transmission facilities connecting them. When such self-supply of large loads induces material loop flows over transmission facilities outside this local area, it is not "electrically close"[10] and the generation and load cannot be treated as a hybrid facility for the purpose of the proposed streamlined interconnection process.

IV.B. Static Operating Limits and Configurations

Static operating limits play an important role in the present proposal. The operating limits represent the maximum curtailable levels of net injections and withdrawal under which the grid can be safely operated without material upgrades. The operating limits are static on a day-to-day basis, with dynamic dispatch of the hybrid facilities taking place within the outer envelope of the operating limits. Therefore, they do not represent firm access to transmission capacity, but rather the limit of non-firm access to transmission capacity.

As part of its application for streamlined interconnection, the hybrid facility would nominate initial static operating limits (in megawatts) for aggregate net injections and net withdrawals of power (consistent with ANOPR principle five). The streamlined process studies the nominated operating limits, and if necessary, establishes lower operating limits to avoid network upgrades.

The static operating limits are applied to any withdrawals (e.g., the sum of load and any battery storage charging, if applicable) net of any generation output, and vice versa (i.e., injections net of consumption). The grid operator can dispatch the combined load and generation components of the hybrid facility anywhere within the allowed operating limits as needed to ensure reliable and efficient operations, including effective curtailment of the joint withdrawals or injections. When the grid operator dispatches a curtailment below the operating limit, the hybrid facility must reduce power accordingly.

To secure reliability, interconnection studies may specify automatic controls to maintain net output within operating limits between dispatch intervals, for example in case of sudden loss of a generation unit within the hybrid. Such automatic controls may be required to ensure the operating limits are respected in a sufficiently timely fashion. When that timescale is less than

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[10] An initial concept for electrical closeness could allow for only 3% of self-supply power to flow through ties connecting the local area to the network, and 1% to flow over other transmission facilities outside the local area. See Appendix I, Sirisha Tanneeru, et al, "Reliability Assessment of Hybrid Facilities: Overview of Large Load and Generation Co-located Studies", slide 5.

SCED dispatch frequency (e.g., five minutes in most ISO/RTO markets), it may require the installation of automatic controls to limit net injection/withdrawal from the hybrid facility, potentially instantaneously.

As discussed further in Section IV.G below, we propose that static operating limits on net withdrawals are fixed. For the static operating limits on net injections, two alternative policies may be suitable: either operating limits that are perpetually fixed, or operating limits are adjusted periodically (e.g., annually or quarterly), including potential reductions. This could be similar to and coordinated with any existing Provisional Interconnection Service protocols.

Various configurations of the hybrid facility are possible, with implications for the corresponding operating limits:

- **Baseload self-supply**: the hybrid facility's generation matches demand at most times, except for possibly brief periods to allow for rebalancing following a contingency for loss of a hybrid generator unit or portion of the load;[11] in this case the operating limits would be zero net withdrawals and zero net injections.
- **As-available withdrawals**: the hybrid facility's generation matches demand when prices are high or when needed for the grid (including via load curtailment if necessary), but generation never exceeds demand; otherwise, the load is served from the grid as-available; operating limits are net withdrawals for the load, and zero net injections.
- **Storage-backed hybrid**: same as above (zero net injections) with the option to increase the withdrawal operating limit to accommodate simultaneous storage charging and withdrawal by the large load.
- **As-available withdrawals and net injections**: when transmission capability is available, the hybrid facility can withdraw from the grid when prices are cheap and inject when prices are high; when needed for the grid, the hybrid facility can self-supply (including load curtailment if needed).

[11] Note that these imbalances can also be handled with protection schemes, as mentioned in the ANOPR and above.

IV.C. Operational Obligations

The hybrid facility would have the following obligations:

- Must be available to dispatch to net-zero withdrawal or injection at any time (through increase in generation or curtailment of load, or a combination).
- Must follow dispatch signals for transmission security to reduce net withdrawals or injections, potentially with a higher degree of obligation and control than that faced by an ordinary generator (recognizing that loads may be more reluctant to curtail in operations than an ordinary generator would be to produce power).
- Must maintain net withdrawal and injection to within established static operating limits, including after loss of a portion of the hybrid facility, which may require protection schemes or rapid redispatch depending on the type of transmission security violation.
- When integrated into a resource adequacy construct, must follow dispatches for scarcity mitigation to reduce net withdrawals, with penalties for failure to perform that are comparable to ordinary generators.

IV.D. Studies and Mitigations

The proposed study approach has the following features:

- Studies the generation and load facilities of the hybrid facility in a combined fashion (consistent with ANOPR principle three).
- Studies the combinations of injection and withdrawal necessary to meet the nominated operating limits; if the nominated operating limit cannot be met without triggering network upgrades, the studies identify the lower maximum permissible operating limit (if necessary zero net injections or withdrawals) that can be accommodated;[12] (impacts that would trigger major network upgrades are those that cannot be managed in operations—

[12] Short circuit fault current impacts are completely mitigated through local upgrades

this may include stability-based operating limits not captured with SCED or other real-time operational tools).

- The interconnection studies recognize and incorporate any redundancies in the design of the hybrid facilities and local area that enhance the self-supply capability of the hybrid facility by limiting the impact of loss of any one element; examples include use of many smaller generating units, and substation configurations that avoid the loss of multiple generation units due to failure of a single element.

The streamlined hybrid facility connection process conducts the same studies as conventional load and generation connection processes, except that it omits studies of firm deliverability of net injections and withdrawals to and from the broader system (recognizing that firm deliverability instead takes place internal to the hybrid facility's local area). Therefore, the streamlined study process includes:

- Steady-state power flow (thermal and voltage) analysis, potentially under scenarios such as on-peak and off-peak (and otherwise as ordinarily applicable);
- Stability analysis;
- Short circuit and fault duty analysis; and
- Electromagnetic transient (EMT) stability screening (with detailed EMT impact studies where needed).

Unlike the conventional connection process where firm deliverability is required, study violations that can be resolved through operational redispatch and curtailment would not trigger grid upgrades. For example, if studies for a request for 500 MW as-available withdrawals for a hybrid facility indicate that the grid can only accommodate 200 MW securely (and there are not stability-based issues), then no network upgrades are required since system operators can resolve any violations in real-time through curtailment. This is similar to the ERCOT's connect and manage approach to generator interconnection.

If stability-based static operating limits are identified, they must be adhered to by the hybrid facility (or network upgrades must be put in place to address the instability if it cannot be detected and managed during real-time operations). Similarly, all short circuit fault duty analysis network upgrades are put in place since they cannot be detected and managed during real-time operations.

Since the system must not be put into an unstudied operating state, it is important that the study approach reflects consistency between planning/interconnection assumptions and operational capabilities. This approach is made possible by the operational obligation to be dispatchable/curtailable into a full net-zero withdrawal and injection state at any time, backstopping generation (or exhausted storage) with load curtailment (and/or by dispatching the load's run-time-limited backup generators) if necessary.

IV.E. Processing of Studies

Because the proposed approach utilizes load curtailment and backup generation as flexibility to manage system impacts, major reliability impacts (that would ordinarily require network upgrades) would only be identified when the issue cannot be managed by operations in real-time, for example via pre-contingency SCED actions. Further, because major network upgrades are not identified in this streamlined approach (upgrades are limited only to the local area), studies can be conducted in a fast-tracked serial study process. Similarly, avoiding regional upgrades reduces interactions among transmission owners, allowing each transmission owner to conduct streamlined hybrid facilities studies independently (similar to load connection processes today), which increases the number of such studies that can be undertaken simultaneously in a region.

When the streamlined studies identify critical impacts that would trigger transmission upgrades, a lower operating limit is identified that avoids these critical impacts (potentially as low as zero megawatts). Hybrid facility developers that wish to raise the operating limit have the opportunity to pursue the necessary network upgrades following the standard interconnection study processes and timeline. When a request is to increase the operating limit for net injections, that process is the generator interconnection queue (generally a cluster study process). When the requested operating limit increase is for net withdrawals, the existing load connection process is followed (which can be serial or cluster, depending on the region). Even if request for increased net withdrawals requires that the load interconnection request is studied through the conventional load interconnection process, the generation interconnection portion of the hybrid facility can continue to be analyzed in a streamlined fashion (since net injections would still be limited). Energization of the generation component can be conditional on completion of the applicable load interconnection process. Similarly, the reverse is true if the conventional generator interconnection study process is utilized to enhance requested net injections.

IV.F. Interaction with Resource Adequacy Constructs

The approach to studying hybrid facilities and their corresponding obligations can interact with resource adequacy studies. We observe that a hybrid facility that can self-supply its energy needs at all times (or otherwise curtail the load) can use that capability to self-supply its resource adequacy requirements so that no resource adequacy responsibilities fall on the rest of the system. A Balancing Authority should recognize this in their resource adequacy studies by not allocating capacity requirements to the load of a hybrid facility and by ensuring that the dispatch/curtailment obligation of the hybrid facilities applies to both resource adequacy and transmission reliability events.

IV.G. Ongoing Planning for Operating Limits

A holder of executed interconnection agreements of a hybrid facility will not have firm transmission service rights for injections or withdrawals. However, we propose that the maximum operating limit on curtailable net withdrawals of hybrid facilities is fixed in time (with increases possible through network upgrades via the applicable load study process). These non-firm withdrawal operating limits are therefore maintained as necessary in planning studies as the system evolves from year to year. For the operating limit on curtailable net injections of a hybrid facility, we recognize alternative potential policies. The first alternative would permanently fix operating limits on net injections, following the approach for net withdrawals. The second alternative would instead periodically adjust the operating limit (similar to “provisional service” for generators). Under the second alternative, hybrid facilities’ generators face substantial revenue risks because their net injection operating limits can be reduced, potentially to zero and potentially for extended periods of time. On the other hand, under the fixed operating limits of the first alternative, while revenue risk is lower, future generation planning studies must maintain the net injection operating limits.

V. STREAMLINED STUDY TIMELINE AND DURATION EXPECTATIONS

The streamlined reliability studies and assessments for hybrid facilities include relatively standardized studies that are already in use today (i.e., steady-state power flow, transient stability, short-circuit/breaker duty analysis) as well as studies that are increasingly becoming important with new technologies (e.g., EMT screens and analyses). These studies have been traditionally performed for both generator and load interconnections.

The standard study timeline depends on the operating limit configuration(s) defined in IV.B, the requested facilities that define the footprint of study (i.e., the local area connecting the hybrid facility generation and load), and the number of additional scenarios needed to identify operational impacts of the net grid withdrawals and injections.

When the large load is self-supplied at all times via a behind-the-meter configuration or a front-of-the-meter configuration at the same electrical node (i.e., a zero-megawatt operating limit for both injections and withdrawals), stability and short-circuit analysis can be performed simultaneously and study will focus on a much smaller footprint near the Point of Interconnection (POI). As shown in Appendix I, reliability studies for such cases can generally be completed within 60 days, assuming all information and modeling data is accurate and available from the interconnection application.[13] Steady-state analysis is not required as the net grid withdrawal and injection is zero megawatt and any inadvertent injection/withdrawals are dealt with operationally (e.g., with protection schemes).

When the hybrid facility's large load is self-supplied at all times via front-of-the-meter generation in a local area configuration (i.e., not at the same electrical node, but electrically close with a zero megawatt operating limit), steady-state analysis, stability, and short-circuit analysis must be performed on the local area network, which is a slightly bigger footprint than the

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[13] Appendix I, Sirisha Tanneeru, et al, "Reliability Assessment of Hybrid Facilities: Overview of Large Load and Generation Co-located Studies", slide 10.

behind-the-meter configuration. Nevertheless, it is still likely that these reliability studies can be performed in 60 days. Short-circuit analyses can be performed in parallel with steady-state and stability analyses to streamline the study.

Any configuration involving non-zero operating limits for curtailable grid withdrawals or injections requires broader reliability studies and analyses that encompass the broader transmission owner and/or ISO/RTO footprint in addition to the studies required for the local area. These additional studies include steady-state power flow and contingency analysis in addition to transient stability simulations of various load and generation patterns to uncover potential impacts that could be encountered in operations. These studies are used to identify and establish the net withdrawal/injection operating limits for the hybrid facility necessary to avoid critical impacts and identify network upgrades for impacts that cannot be mitigated in operations. Due to their broader reach, the timeline for these studies may exceed 60 days. While most requests can likely be assessed in 60–90 days, as hybrid facility interconnection requests increase, study complexity will rise, which may lead to longer study timelines.

Lastly, the stability analyses for hybrid facilities includes a preliminary screen to identify the need for detailed EMT studies. EMT studies are used to identify potential reliability risks, system performance deficiencies, controller interactions, converter instability, weak grid issues, sub-synchronous oscillation risks, and other complex phenomena that cannot be identified using phasor-domain simulation platforms conventionally used in interconnection studies, long-term planning, and operations. Irrespective of the facility’s configuration, when the EMT screening results call for comprehensive EMT study, the resulting assessment is resource- and computationally intensive, requires much more detailed and specific data from the interconnection customer, and often requires several months to complete. In situations where EMT studies are identified as necessary, particularly for AI data centers or cryptocurrency loads, these studies should not be overlooked given their criticality in maintaining a reliable bulk power system. When appropriate, EMT studies for multiple hybrid requests could be performed in parallel. Study timelines will exceed 60 days if detailed EMT studies are triggered by the screenings and should be accommodated as such. It is expected that the integration of large electronic loads and the growth of inverter-based generation, each with their unique inverter-based characteristics, will accelerate the need for EMT studies moving forward.

VI. CONCLUSION

Most hybrid facilities can likely be connected without major network upgrades outside their local area when they are curtailable and subject to static operating limits. They can therefore be studied in a rapid, serial, utility-led process focused on identifying the level of fixed operating limits on the net injections and withdrawals from the broader grid that can reliably be accommodated. This meets key objectives of speed to market, associated economic development, and improved outcomes for reliability and affordability. In many cases, such studies can be completed in 60 days for hybrid facilities that self-supply at all times (i.e., zero megawatt operating limit for withdrawals and injections) or in 90 days for other hybrid facilities (e.g., those that request the ability to withdraw power when the grid can accommodate it). For hybrid facilities' interconnection requests that fail EMT screens (e.g., due to weak grid problems) or that are in areas with numerous hybrid facility connection requests, studies may take longer than 90 days but will still benefit from the concepts outlined herein that propose these studies jointly consider both generation and load and the dispatchability of both resources.

Affidavit of Andrew Levitt

I, Andrew Levitt, do hereby swear, that I have co-authored the Affidavit of Andrew Levitt, Aniruddh Mohan, Ryan Quint, and Sirisha Tanneeru, and the statements contained therein are true and accurate to the best of my knowledge and belief.

Andrew Levitt Date: November 21, 2025.

Affidavit of Aniruddh Mohan

I, Aniruddh Mohan, do hereby swear, that I have co-authored the Affidavit of Andrew Levitt, Aniruddh Mohan, Ryan Quint, and Sirisha Tanneeru, and the statements contained therein are true and accurate to the best of my knowledge and belief.

Aniruddh Mohan Date: November 21, 2025

Affidavit of Ryan Quint

I, Ryan Quint, do hereby swear, that I have co-authored the Affidavit of Andrew Levitt, Aniruddh Mohan, Ryan Quint, and Sirisha Tanneeru, and the statements contained therein are true and accurate to the best of my knowledge and belief.

Ryan Quint Date: November 21, 2025

Affidavit of Sirisha Tanneeru

I, Sirisha Tanneeru, do hereby swear, that I have co-authored the Affidavit of Andrew Levitt, Aniruddh Mohan, Ryan Quint, and Sirisha Tanneeru, and the statements contained therein are true and accurate to the best of my knowledge and belief.

Sirisha Tanneeru Date: November 21, 2025

Reliability Assessment of Hybrid Facilities

Overview of Large Load and Generation Co-located Studies

Sirisha Tanneeru, Elevate Energy Consulting

Kyle Thomas, Elevate Energy Consulting

Andrew Levitt, The Brattle Group

November 21, 2025

Summary of Reliability Assessment of Hybrid Facilities

- **Hybrid facility (load and near-by generation) obligated to be capable of self-supply** (i.e., zero net MW) when so dispatched (including load curtailment if near by generation cannot run for any reason)
- **Hybrid facility dispatched independently** by SCED* to ensure N-0 and N-1 flows are within limits
- **No deliverability**: gen is not deliverable, and load does not require deliverability
- **TO conducts independent studies** (like load connection), potentially allowing simpler serial approach

** Unless subject to joint operating limit*

Rapid interconnection is achieved by focusing planning mitigations to only those needed to cover reliability needs not secured in EMS/SCED:

Potential Violations	Potential Mitigations
Short circuit violations	Assume local upgrades needed, not further discussed
Common-mode contingency steady-state violations if not studied in Contingency Analysis (i.e., EMS)	• Post-contingency curtailment via RAS (where practical, potentially as interim measure), *or* • Pre-contingency curtailment (w/ common-mode outages in Contingency Analysis/SCED)
Post-contingency dynamic stability violations especially for severe, rare common-mode outages (P4/P5/P7); add'l stress-test dispatch cases, 60-90 days adequate. **90+ days** in some cases	Combination of: • Joint operating limit on net withdrawal or injection (potentially interim) • RAS (potentially interim) • Network Upgrades

Existing Load & Generation Interconnection Processes Today

1. Load Integration Studies
2. Violations get identified through Interconnection and Do No Harm Studies
3. Network Upgrades get identified to resolve all violations
4. Load gets firm transmission service once all Network Upgrades get constructed

1. Generation Interconnection Studies
2. Violations get identified through Interconnection Studies
3. Network Upgrades get identified to resolve all violations
4. Generation gets interconnection once Network Upgrades get constructed

Hybrid Facility Co-located Study - High-Level Process

<u>New co-located Interconnection Study</u>

Load Integration studies occur *with the addition of the near-by Generation included*

Violations get identified through the Interconnection and Do No Harm Studies

Hybrid facility introduces the concept of having most of the violations being mitigated by Real-time Operations via SCED

*Possible due to the flexible, curtailable nature of these loads

Some hybrid facility violations must be addressed with conventional Network Upgrades:

(1) Ensure Local Area is N-0 and N-1 secure

(2) Resolve severe violations (e.g., instability, breaker duty overloads etc.) that <u>cannot</u> be resolved in Real Time Operations via SCED

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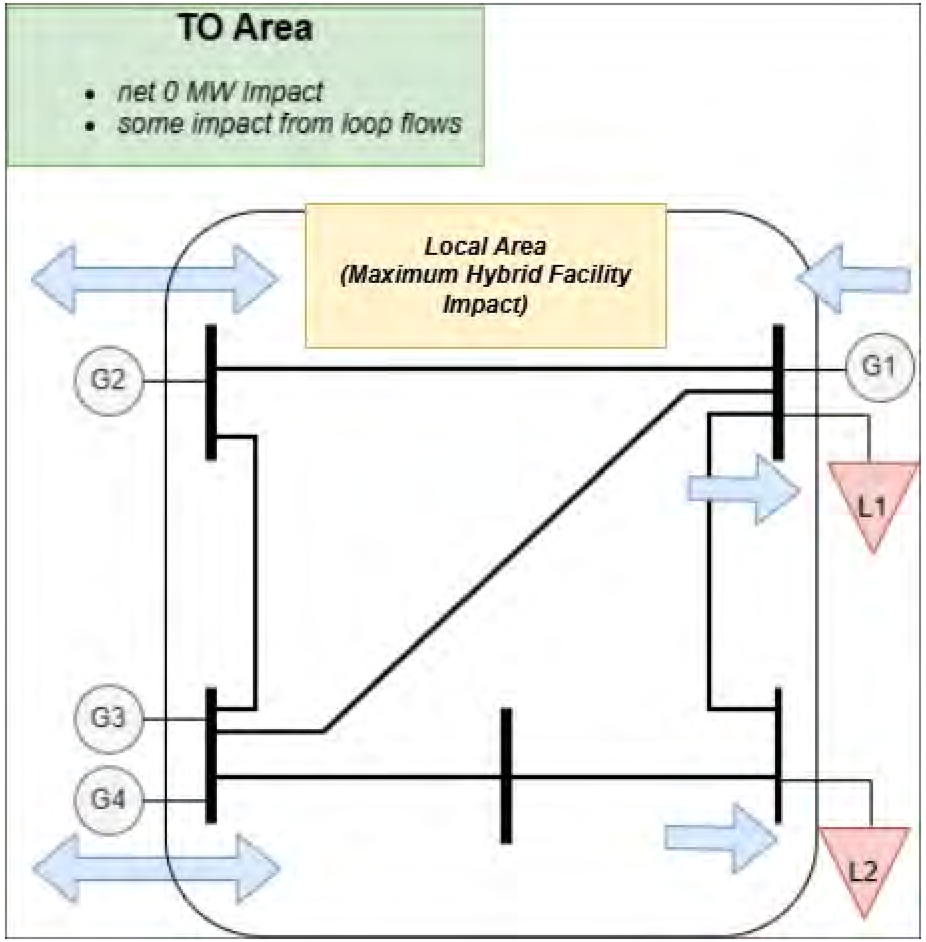
Electrically Adjacent System “Local Area”

Hybrid facility Local Area includes load and generation POIs only a few substations apart, confining impacts to the region. Simple dfax screening can be performed on the TO system to identify if a request qualifies as hybrid facility

Illustrative Picture of Local Area Per SPP Definition



Example – Local Area test criteria

Local Area Test – Example System Intact Criteria TO System up to 3 – 4 levels from Local Area monitored	
Level 1 and 2 Connections (Local Area ties)	**TO Level 3 and 4 Connections**
• Dfax of load on lines is <3%; and • Dfax of generation on lines is <3%	• Sum of all System intact flows on lines is <1% of line rating; and • Dfax of load on lines is <1%; and • Dfax of generation on lines is <1%.

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Grid Reliability Challenges & Studies for Large Loads

Common Contributors for Powerflow, Voltage, and Transient Stability Grid Impacts

- Transfers (Imports/ Exports)
- Reactive Power-Voltage Control
- Significant Gen/Load Loss
- Inadequate Reactive power
- Ride-Through Behavior

Common Contributors driving need for EMT Studies

- System Strength
- Controller interactions

Reliability Studies commonly performed for Large Loads (e.g., data centers)

Powerflow Studies
- Thermal overloads and voltage violations
- Congestion and available transmission services

Transient Stability Studies
- Angular stability and electro-mechanical oscillation
- Voltage stability, ride-through performance, etc.

EMT Studies
- Complex stability phenomena
- Power electronic interactions and oscillations

Short-Circuit Studies
- Breaker duty, protection coordination, co-located generation

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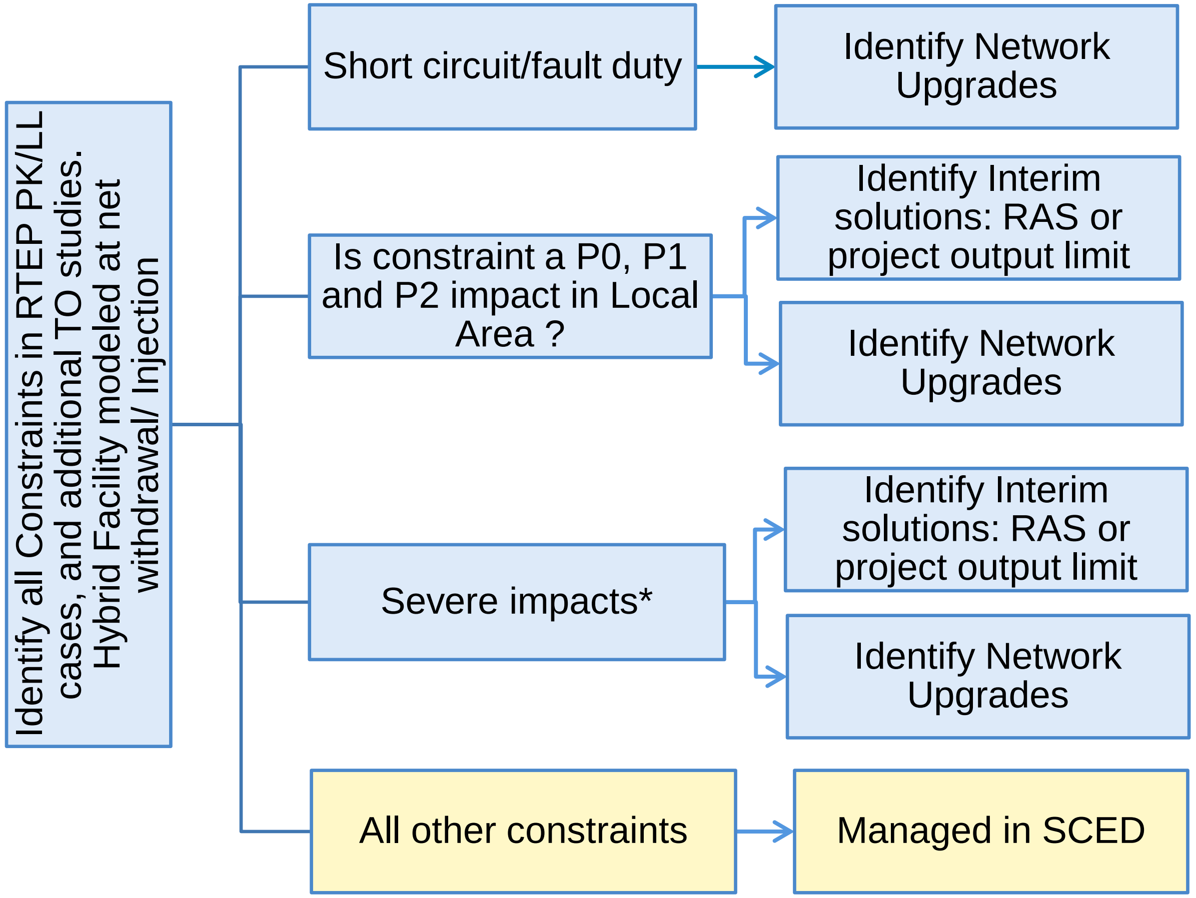
Hybrid Facility Co-located Interconnection Study Mitigations



Study will model Hybrid Facility gen per the expected output for that fuel type.

Analysis Includes:

- Steady state thermal/voltage
- Stability
- Short circuit/fault duty
- EMT Screening and detailed studies

***Severe Impacts**

If impact is severe enough resolving the violations in the Operational timeframe is not feasible, Network Upgrades are identified. Examples may include:

- Thermal overloads encroaching on relay trip limits
- Uncontrolled separation
- Instability
- Large MW load curtailment
- EMT controller interactions
- Breaker over duty limit violations

Remedial Action Schemes (RAS)

- Practical for 1–2 busses near POI
- Challenges for wider area implementation
- Requires SCADA/EMS integration
- Operator training needed

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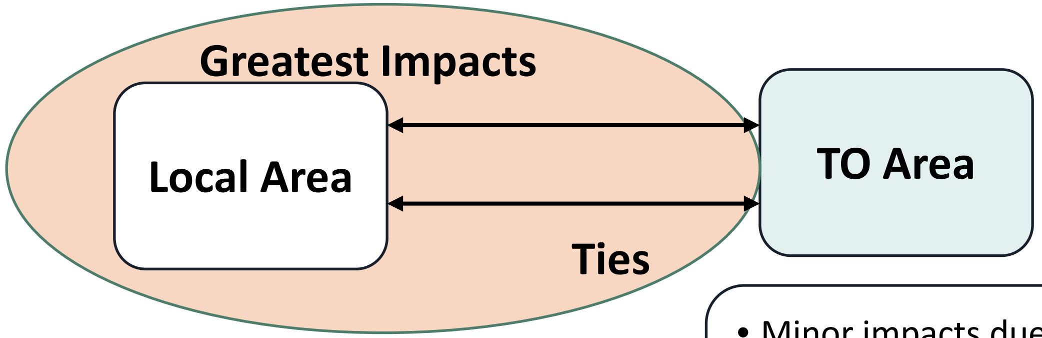
Reliability of Large Loads

NO GRID WITHDRAWALS

- *Local Area most impacted*
- *Interconnection study will identify all impacts in PK case.*
- *Local Area is N-0 and N-1 secured. Also, severe constraints that cannot be managed in Operations/SCED are mitigated. Remaining constraints managed by Operations/SECD via load curtailment*

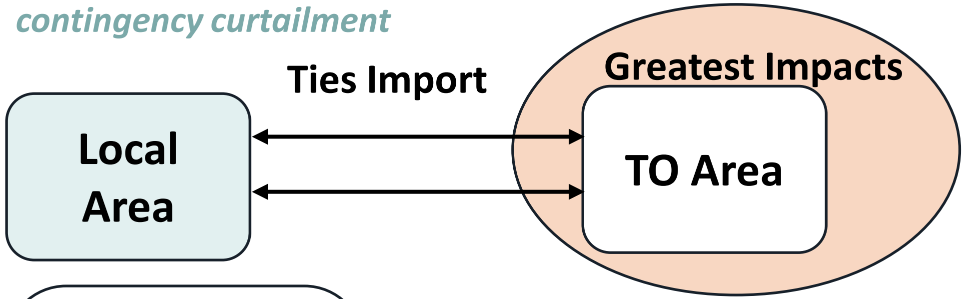


- Steady state thermal
- Steady state voltage
- Voltage/angular stability
- Oscillations, Power Quality and control interactions (EMT studies) if Local Area has low system strength

- Minor impacts due to loop flows
- Wider TO impact not expected

GRID WITHDRAWALS and INJECTIONS

- *Wider TO area is most impacted. TO shall identify appropriate study case and assumptions to identify potential reliability constraints that could be encountered in SCED*
- *Interconnection study identifies mitigations for severe contingencies that cannot be managed under SCED*
- *Analysis in Operational Planning/SCED required to identify pre-contingency curtailment*



- Thermal, voltage and stability impacts for imports and exports
- EMT oscillations, EMT stability

Assessment of imports/exports:

- Thermal constraints
- Steady state voltage constraints and voltage transfer limits (PV, QV)
- Transient voltage/angular stability
- Extreme event analysis e.g., cascading failure due to low voltage or ride-through failure

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Potential Operational Planning/SCED Enhancements

- SCED often includes P0 and P1 thermal impact management only. Stability analysis is performed offline in regular intervals or in day-ahead studies performed by operations
- Enhance SCED to include all other contingencies, if possible, otherwise, incorporation of select contingencies impactful to each hybrid facility is recommended. In addition, the enhancements would benefit from the inclusion of analysis for thermal/voltage/stability (to the extent not mitigated in planning)
- Select reliability/congestion limits in operations are nominated by operations and mitigated in the transmission expansion process (status quo)

Co-located Interconnection Study – 60 to 90 days

Co-located Interconnection Study can be completed in 60 to 90 days if extensive scenario analysis is not required and EMT screening passes

Serial Study Timeline

- Standard studies could be performed in 60 to 90 days
- In case of failed screen, EMT special studies take 4+ months. Multiple requests in same region can be studied together

Commonly performed studies for Large Load and IBR interconnections