FERC 881 roadmap considerations for transmission owners

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Introduction

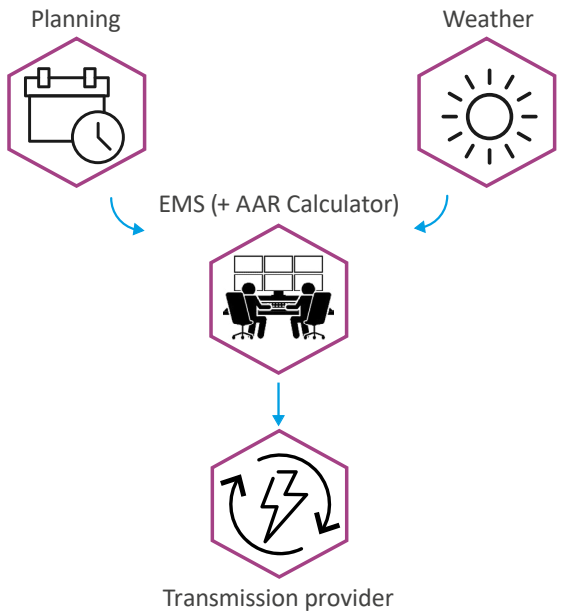
Most US electric utilities use seasonal ratings for their transmission lines in their energy management system (EMS) models. However, FERC order 881 mandates hourly Ambient Adjusted Ratings (AARs) by July 2025. As a result, transmission owners and providers, as well as EMS vendors, need to make significant changes to fulfill the order. This white paper provides the primary road-map considerations transmission owners can leverage to achieve compliance.

Roadmap considerations

Improving communications

Generally, three ratings (e.g., Normal, Emergency, Load Shed) are more prevalent in network applications like State Estimator (SE) and Contingency Analysis (CA), for example, and typically two sets of seasonal ratings are used. However, with FERC order 881, the entity must provide a minimum of four seasons, different weather ratings for day and night, and send limits forecasted for the next ten days to the transmission provider.

This order necessitates transmission owners' separate areas (aka "silos") collaborate, and transmission line limit calculations move into the operational arena (EMS) which is likely to impact existing policies and procedures. The diagram below aims to clarify the new communication channels needed for the appropriate data to be received on time.



Using the right data

The EMS contains several databases, such as the SCADA and the network model databases, and various applications that monitor the system's security for reliable operation. Since SCADA and SE monitor the transmission lines against limits in use, they may not be impacted, as long as the current limits are being updated. In contrast, other applications like look-ahead or study applications that use a future or past time for analysis would be affected since the limits to be used for the study time could be different from current limits in the network model database. Trainers who set up training scenarios also need to be aware of when different limits are likely to be effective.

Some EMS vendors have developed software solutions that provide Dynamic Line Ratings (DLR) via APIs (Application Programming Interfaces) to accommodate DLRs and/or changing limits based on current weather. However, even if such an application is part of the current system implementation, changes are still required because of mandated AARs where DLRs are not available or for future hours.

Main areas of impact

FERC defines a transmission line rating as "the maximum transfer capability of a transmission line, computed in accordance with a written transmission line rating methodology and consistent with Good Utility Practice, considering the technical limitations on conductors and relevant transmission equipment (such as thermal flow limits), as well as technical limitations of the Transmission System (such as system voltage and stability limits)".

We are confident that utilities have well-established methodologies and use good utility practices.

So, what are the chief areas of impact, questions to ask, and suggestions to accommodate these changes?

New interfaces

- In the past, weather data was used to a limited extent, mainly for system load forecasting and in case of abnormal weather. Now, an API must fetch data periodically (every hour) from a public source such as NOAA (National Oceanic and Atmospheric Administration) or a private provider. What is your plan for bringing in weather data?
- If any weather data is incorrect or missing, how do you plan to handle such a scenario?
- Would you rather have the above two taken care of by some other entity and simply provide you limits?
- A set of limits (e.g., three limits – Normal, Emergency and Load Shed) used to be shared in many network model-sharing arrangements. What is the impact of such arrangements?
- Because of the new features required to comply with this order, what is the likely impact on the EMS ecosystem?
- Is ICCP the best mechanism to exchange such data with an ISO/RTO? Is that going to increase database dimensions substantially?
- What are the performance hits and license impacts ($) related challenges?

SUGGESTION: We recommend studying how accessing and importing weather information is done, revisiting model-sharing mechanisms, reviewing potential changes to the EMS, and determining which communications protocol best suits this new environment.

Dimensionality

- In the past, limits were not updated often, but now limits need to be computed hourly for transmission lines, due to a rolling 240-hour window.
- The number of transmission lines in EMS models is higher than that of substations, typically 10-40% more.
- Each transmission line will have many towers, and it may be a short, medium or long line. Potentially, there is a need for additional modeling granularity, i.e., separating a single transmission line into separately rated segments (e.g., due to varying physical elements). Another option would be to separate AAR calculations and thus relegate modeling to a new application.

SUGGESTION: These changes mean that computing limits at each tower location where weather information is available will be voluminous, so utilities should plan for this magnitude of computing capacity. We found that it is also possible to reduce this burden based on data insights.

Project management

- **Time Management:** The deadline for implementation is July 2025. Therefore, utilities need to work backward to ensure the rollout and implementation will be done ahead of time with minimal hiccups. Do you have the right resources to manage within this timeframe?
- **Feature Management:** What minimum viable product (MVP) is needed to fulfill compliance and ensure reliable, safe service?
- **Resource Management:** Do you have the required personnel and budgets (known and unknown) to support this transition?

SUGGESTION: Utilities have a hard deadline with many requirements and interfaces to sort out, which means people and budget. We advise estimating budgets based on pilots, if available, and acknowledging that if the transmission provider hasn't finalized the interface to receive limits, this may be an opportunity to influence this mechanism.

Security

- What are the security requirements for the utility?
- If CIP requirements apply, how does one get weather data into the operational network if not done currently?
- Can the application reside on the corporate network but with security, logging, and updated limits transmitted to EMS via a secure mechanism?

SUGGESTION: We recommend objective third-party assistance for reviewing critical cybersecurity impacts, keeping in mind the recent 2022 Staff Report - Lessons Learned from Commission-Led CIP Reliability Audits. Given the recent attacks on utility physical infrastructure, we recommend utilizing operational data related to physical infrastructure security for further analysis and follow-up.

Technology management

- Is the limits calculator itself legacy software? Have you considered an upgrade?
- How much of the application resides on the cloud or on-premises?
- What type of data/API arrangements need to be made with the weather service provider?
- Are they consistent with a utility's preferences for databases (e.g., Oracle, SQLServer, etc.) and implementation (e.g., Windows or Linux, etc.)?
- What are the archival and retention requirements (especially if brought under CIP, Critical Infrastructure Protection)?

SUGGESTION: Utilities may need to upgrade or find new software, interfaces to other systems (weather providers, etc.) need evaluation, and annual foundational software costs for maintenance will need to be incorporated. We recommend prioritizing technology management by evaluating potential options, prototyping, performing an impact analysis, and a risk and cost-benefit analysis.

Risk management and data mining

- Like any other typical project, risks need to be considered, evaluated and managed.
- With tremendous weather data coming in, it may provide a historical base to be mined for data patterns and predictions if the data is archived.

SUGGESTION: We recommend a 'Fail Fast' approach through a pilot that represents typical utility needs to understand the various intricacies and then scale up to minimize risk. We also recommend exploring ways and means to mine the data. For example, determine the chronically congested transmission lines to see if they are good candidates for DLRs.

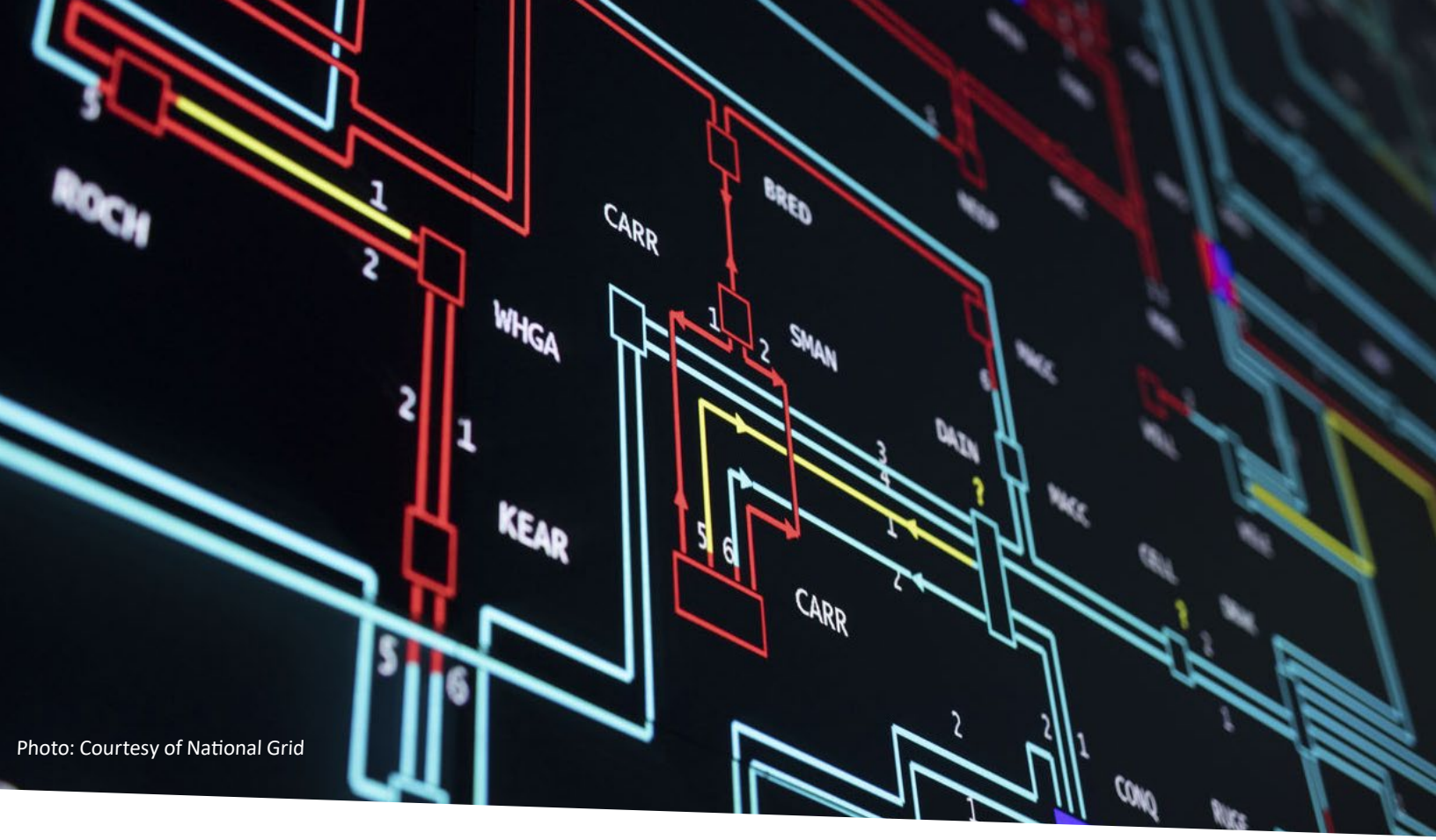


Photo: Courtesy of National Grid

Real-world scenarios

For illustration, we can look at how two Independent System Operators – California ISO (CAISO) and Midcontinent Independent System Operator (MISO) are responding to this order.

CAISO

CAISO plans to coordinate with affected stakeholders and work on multiple work streams. They expect to start by ensuring the ISO's real-time reliability applications can accommodate transmission line ratings. Additionally, to meet market requirements, CAISO expects the following outcomes:

1. For the day-ahead market, AARs, dynamic line ratings (DLRs) or alternate ratings are to be validated and submitted by transmission owners no later than 9 AM on the day before a trading day.

2. For the real-time market, AARs, DLRs or alternate ratings are to be validated and submitted by transmission owners no later than five hours before a trading hour.

MISO

MISO's Application of Forecasted and Real-time Ambient Adjusted Ratings and Emergency Line Rating Use and Methodologies projects are in the design phase. Their project team is developing requirements and beginning designs while collaborating with other ISOs and vendors for maximum efficiency. By expanding the use of AARs, MISO expects transmission utilization to increase and potential savings to be realized.

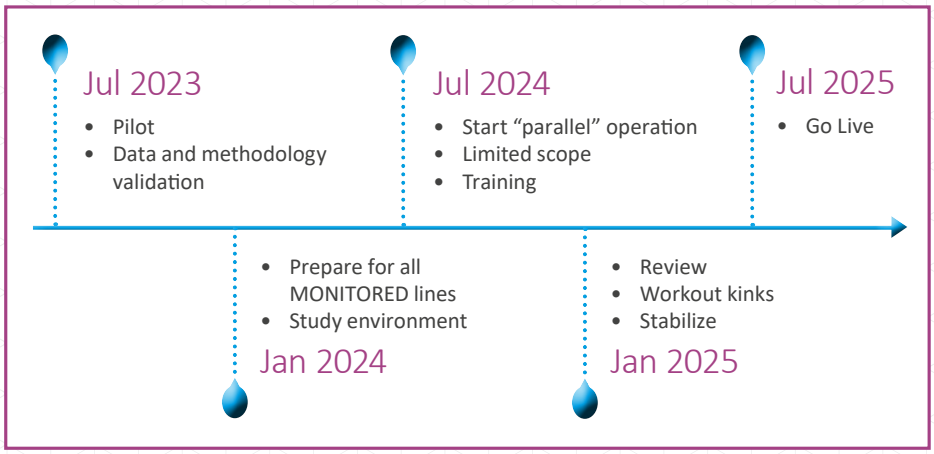
> *"Wide-spread use of ambient-adjusted transmission line ratings and emergency ratings would have produced roughly $100 million in savings this summer."*
>
> - *MISO IMM Quarterly Report: Summer 2022 (PPT)*

While the benefits of FERC 881 are apparent, and since AAR systems have not been a requirement previously, ISOs and RTOs will need to develop methodologies, data specifications, collection requirements, and a standardized unit format for transmission line ratings.

PSC can help

PSC has the experience and talent to work with your unique installation and team. The engagement can be advisory or hands-on based on your needs and budget.

Here's an example timeline showing that transmission providers and transmission owners should already be in the discovery phase so their budgets can be determined and approved, followed by a project kick-off for the pilot/POC phase. We recommend getting started early by gathering ambient weather information for later use.



Compliance is mandated by July 25, 2025, so the sooner the loose ends are handled, the better!

Our PSC engineering team can guide you cost-effectively through the FERC Order 881 planning process, pilot phase and deployment. If you'd like to talk about your project, please get in touch with anil.jampala@pscconsulting.com.

Visit us at pscconsulting.com, follow us on LinkedIn or subscribe to our bi-monthly newsletter.

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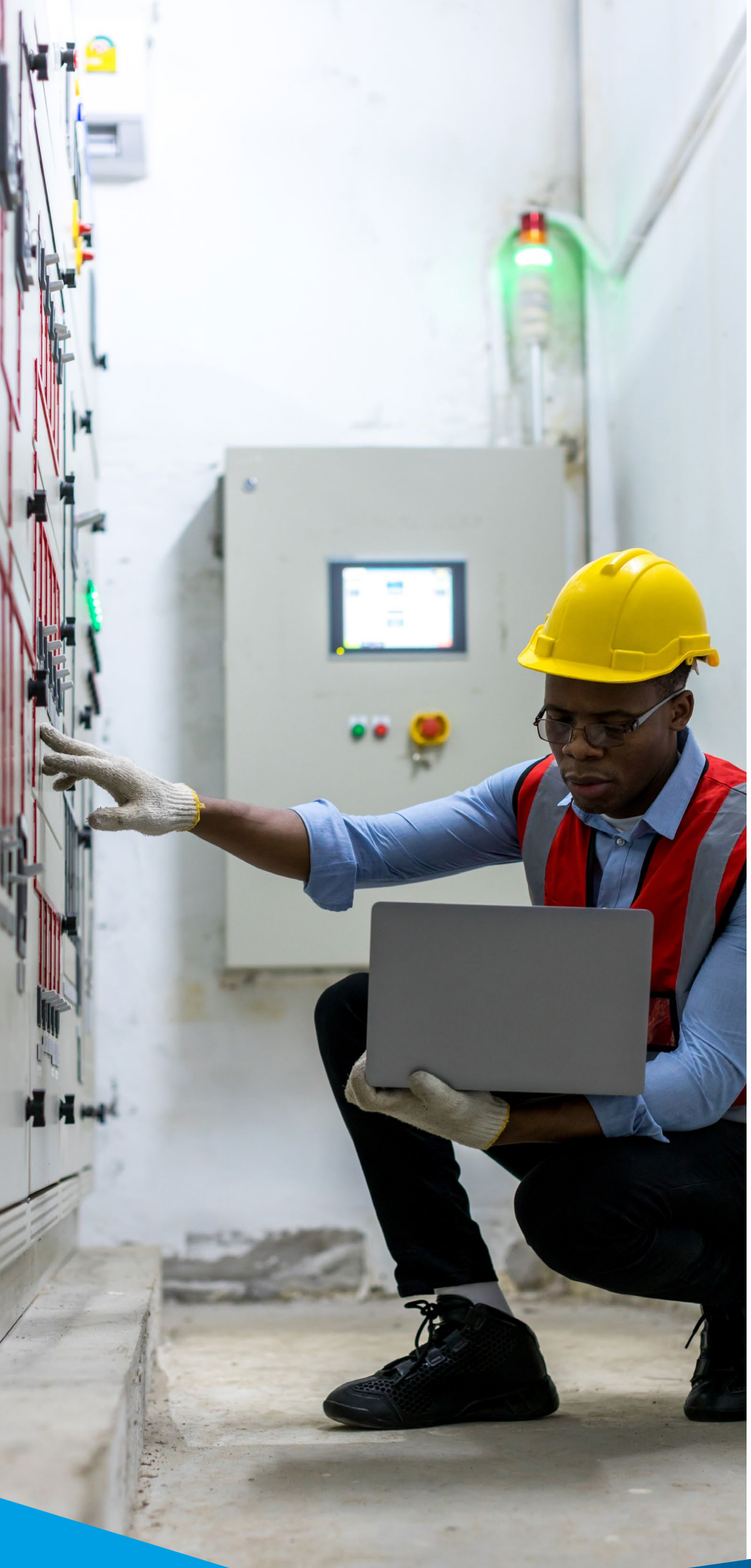
Dr. Jampala is a respected PSC North America team member with more than 35 years of technical and management experience in the international energy industry. He is an IEEE Fellow and a registered Professional Engineer in Washington. He has participated as a member in several committees and working groups collaborating on outage mitigation and resiliency, and smart grid initiatives, including EMS, WAMS and Simulation Projects. In addition, he is the author and contributing author of several publications and patents.



Acronyms

FERC .....Federal Energy Regulatory Commission

EMS .....Energy Management System

AAR .....Ambient Adjusted Ratings

SE.....State Estimator

CA.....Contingency Analysis

SCADA ....Supervisory Control and Data Acquisition

DLR .....Dynamic Line Ratings

API .....Application Programming Interface

ICCP .....Inter-Control Center Communications Protocol

NOAA .....National Oceanic and Atmospheric Administration

ISO .....Independent System Operator

RTO.....Regional Transmission Operator

MVP.....Minimum Viable Product

CIP .....Critical Infrastructure Protection

CAISO .....California ISO

MISO .....Midwest ISO

PJM.....Pennsylvania Jersey Maryland

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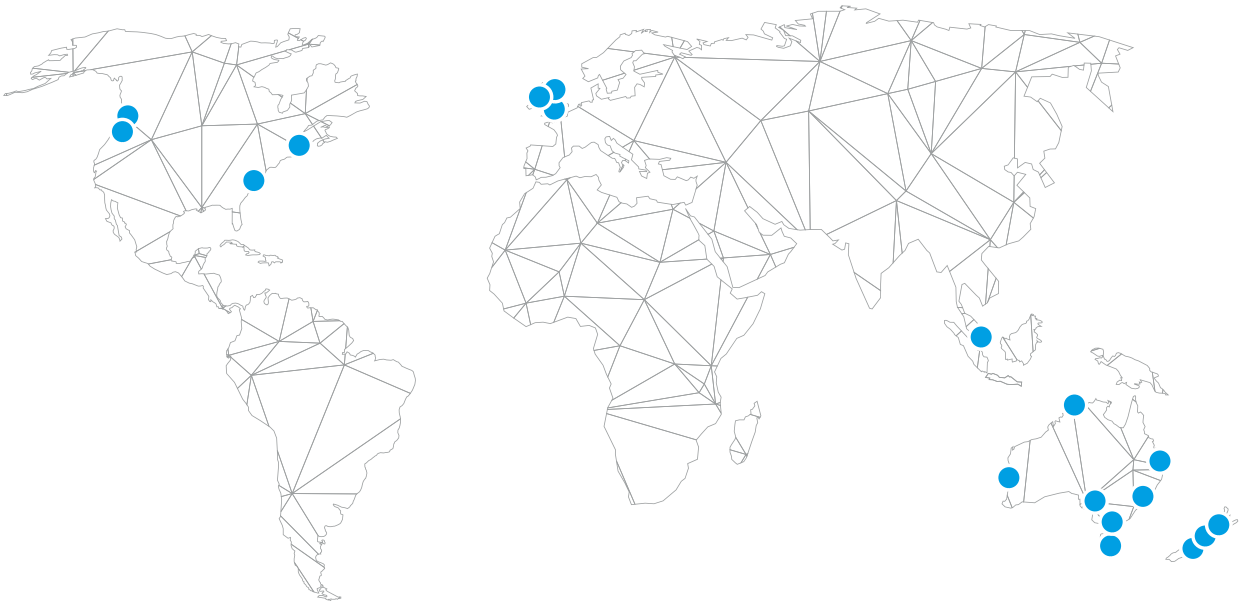

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