QUANTA TECHNOLOGY

REPORT

SCE Integration Capacity Analysis Data Validation Plan Assessment

PREPARED FOR

California Public Utilities Commission – Energy Division
(CPUC-ED)

DATE

June 24, 2021
(Version 1.0)

INTERNAL PROJECT NUMBER

21D082

PREPARED BY

Stephen Teran
STeran@Quanta-Technology.com
(919) 224-9465

Vic Romero
VRomero@Quanta-Technology.com
(919) 428-9332

QUANTA TECHNOLOGY, LLC
4020 Westchase Boulevard, Suite 300, Raleigh, NC 27607 USA
RALEIGH (HQ) | TORONTO | SAN FRANCISCO BAY AREA | SOUTHERN CALIFORNIA | CHICAGO

DISCLAIMER: This report is prepared by Quanta Technology LLC. Quanta Technology was engaged by Southern California Edison ("the Client/s"). The report is to the parameters set by the Client/s and contained in the engagement documentation between Quanta Technology and the Client/s. Data for this report was provided by the Client/s, and Quanta Technology bears no responsibility if the data was incorrect. This report is solely for the use of the Client/s and is not intended to and should not be used or relied upon by anyone else unless their use is requested by the Client/s and approved in writing by Quanta Technology before any dissemination or use. If any other expected users are listed in the original engagement documentation, Quanta Technology shall be deemed to have accepted that those users are included as acceptable recipients. Quanta Technology does not accept any duty of care to any other person or entity other than the Client/s. This report has been prepared for the purpose set out in the engagement documentation between Quanta Technology and the Client/s. Any other recipients other than those approved by Quanta Technology should seek independent expert advice as this report was not prepared for them or for any other purpose than that detailed in the engagement terms with the Client/s and cannot be relied upon other than for this. Information contained in this report is current as of the date of this report and may not reflect any event or circumstances which occur after the date of this report. All queries related to the content or any use of this report must be addressed to the Client/s.

Report Contributors:

- Andrija Sadikovic
- Mehrdad Nasrpour

VERSION HISTORY:

Version	Date	Description
1.0	6/24/2021	Report submission

EXECUTIVE SUMMARY

Purpose

This Integrated Capacity Analysis (ICA) Data Validation Plan Assessment is submitted as ordered by the California Public Utilities Commission in Rulemaking (R.) 14-08-013 on January 27, 2021. The ruling ordered the investor-owned utilities (IOUs) to retain an independent technical expert within 60 days of the ruling to review their ICA data validation plans and review the IOU's data validation efforts. Quanta Technology was selected as the independent technical expert.

Sixty days after Quanta Technology was selected, the IOUs submitted improved ICA data validation plans that document the results of the IOUs data validation efforts, deficiencies discovered, efficiencies realized in ICA implementation, and plans for ICA improvements.

Within 30 days after the IOUs submitted their data validation plans, Quanta Technology is scheduled to provide a report to the Energy Division's DRP Section at the conclusion of the IOUs ICA data validation plan assessment. The 30th day is scheduled as June 28, 2021.

A report is being submitted for each IOU that includes the following topics:

- Review of the resubmitted, improved data validation plans
- Recommendations on best practices for data validation
- Areas for improvement of the data validation plans
- Sufficiency of the data validation efforts
- Recommendations for additional data verification if required

This assessment is a review of the improved data validation plan submitted by Southern California Edison (SCE) in Advice Letter 4508-E. While the assessment does not cover the actual model building, engineering analysis, and post-processing, it does cover the data validation for those processes.

Methodology

To ensure that the assessments of each IOU's improved data validation plans were balanced and equitable, Quanta Technology developed a reference ICA data validation program structured to align with the ICA process. It also encompasses the program management activities required to sustain a sufficient data validation program along with example activities that should take place at each step of the ICA process. Figure E-1 shows the structure of the reference ICA data validation program.

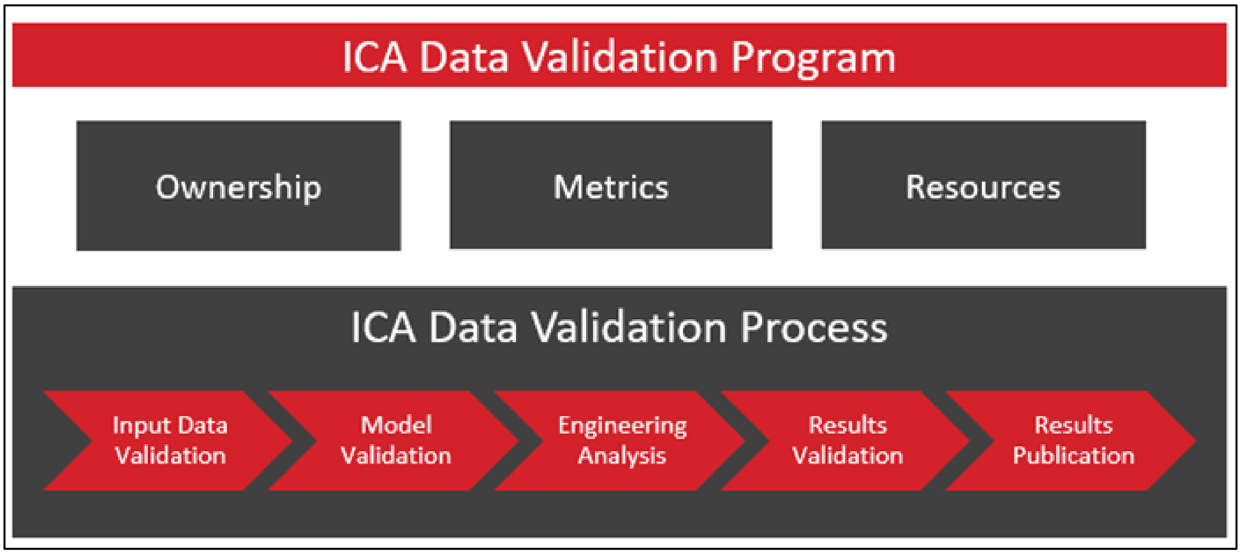


Figure E-1. Reference ICA Data Validation Program Framework

Quanta Technology assessed each IOU's improved data validation plan relative to the reference framework to identify areas for improvement and recommendations. The program management layer of the framework encompasses the need for an identified, recognized owner of the ICA results, metrics to monitor the process and ensure the quality of the output at each stage of the process, and the resources to support any manual intervention activities or investigations into potential issues.

The ICA data validation process spans the entire ICA process and has five stages:

1. **Stage 1: Input Data Validation**—Ensure that input data is sensible and complete. The input data is used to build the CYME or Synergi models and includes GIS and tabular data. Datasets include circuit topology, conductor size, equipment settings, and existing or queued generation.
2. **Stage 2: Model Validation**—Ensure that the CYME or Synergi models properly interpret the data, and the models reflect field conditions.
3. **Stage 3: Engineering Analysis**—Ensure the process runs successfully using the streamlined ICA process and manual intervention. This effort can include using commercial software packages to run the analysis and help minimize human error.
4. **Stage 4: Results Validation**—Ensure that ICA results are sensible before publication. Cases to evaluate include potential invalid zero capacity results.
5. **Stage 5: Results Publication**—Verify that the published results reflect the results of the engineering analysis.

Results

1. SCE structured its improved data validation plan using the reference framework developed for this assessment. The ICA organization is the business owner for the process and is staffed with dedicated engineering resources to support all related activities. The ICA organization has established performance metrics for the manual ICA tasks that the engineers perform. SCE's program

management fulfills all the responsibilities identified in the reference framework except for establishing metrics to track the quality of the ICA results.

2. SCE identified activities in its improved plan for each stage of the ICA data validation process. The activities described largely reflect objectives defined in the reference framework, although SCE has not defined metrics for each stage.
3. SCE has multiple IT projects in flight to enable the following capabilities:
    a. Transition portions of their ICA process from custom-developed tools to commercial tools.
    b. Improve the computational efficiency of the ICA process.
    c. Support business process changes to integrate portions of the ICA process with annual planning activities.
    d. Enable the review of load profile data and circuit models by its distribution system planning engineers. These IT projects will support more frequent ICA result refreshes with more recent data and increased data validation activities.

Table E-1 summarizes Quanta Technology's recommendations for SCE's ICA data validation plan.

Table E-1. Focus Area Recommendations

Focus Area	Recommendations
Program Management	• Establish metrics to track the quality of ICA results. The previously completed investigation of null results and the pending investigation of load ICA zero results are good examples of issues that can be regularly monitored with appropriate metrics.
Input Data Validation	• Incorporate asset data, equipment settings, and distribution circuit topology into its ICA data validation plan. SCE could accomplish this task by establishing new metrics and processes or referencing existing data validation efforts owned outside the ICA organization. • Begin tracking metrics for all input datasets to identify potential issues or trends that could propagate through the ICA models into the results.
Model Validation	• Include more details of the process ICA engineers use to validate the circuit models that do not pass the automated checks. • Develop non-performance metrics related to the model quality control flags to help identify potential recurring issues in the model building process.
Engineering Analysis	• Quanta Technology has no recommendations for SCE related to the engineering analysis stage of the process.
Results Validation	• Continually expand the automated checks in the ICA results validation process to account for potential upstream issues identified over time. • Add automated checks for other edge cases that could identify upstream issues (a more inclusive zero results check or checks where results are 100% of rated capacity). • Establish and track metrics related to failed checks.
Results Publication	• Quanta Technology has no recommendations for SCE related to the results publication stage of the process.

TABLE OF CONTENTS

List of Figures

List of Tables

1 INTEGRATION CAPACITY ANALYSIS DATA VALIDATION PROGRAM ASSESSMENT PROCESS

1.1 Overview

Quanta Technology began the integration capacity analysis (ICA) data validation program assessment process with two parallel tasks:

- Review existing investor-owned utility (IOU) ICA data validation efforts to develop a baseline understanding of each IOU's practices
- Develop a reference ICA data validation program framework to assess the ICA data validation plans and structure recommendations

Upon completing these tasks, Quanta Technology provided recommendations to each IOU for consideration in developing their improved data validation plans.

Lastly, Quanta Technology assessed the filed improved data validation plans using the reference ICA data validation program framework and provided the results in this report. The assessment was performed from the perspective of the generation ICA methodology and results. However, many of the findings and recommendations could apply to load ICA. This assessment was neither a validation of the ICA results nor a review of any engineering analysis, assumptions, or modeling efforts required to develop the ICA results and maps.

1.2 Review of Existing ICA Data Validation Efforts

Before the IOUs submitted their improved data validation plans, Quanta Technology met with each IOU and reviewed their current data validation efforts. This review covered all steps of the ICA process, including input data for the process and publishing results. After reviewing the IOUs' current practices, Quanta Technology provided recommendations for inclusion in the improved data validation plans.

1.3 Reference ICA Data Validation Program Framework

The reference ICA data validation program is structured to align with the ICA process. It encompasses the program management activities required to sustain a data validation program and some example activities that should take place at each step of the ICA process. Figure 1-1 shows the structure of the reference ICA data validation program.

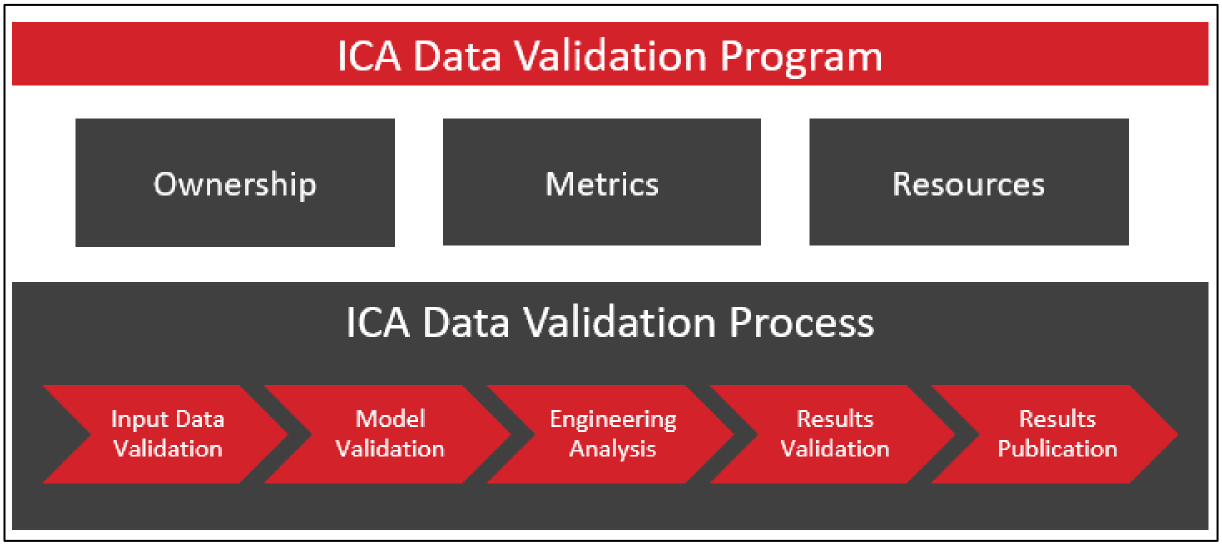


Figure 1-1. Reference ICA Data Validation Program Structure

The potential issues and metrics identified in this assessment are not an exhaustive set of issues that data validation could help address. Instead, the issues and metrics highlight the types of activities that the utilities should include in their data validation efforts. Given the complexity of the ICA process and the different system architectures that support the process at each IOU, identifying all potential issues and metrics was outside the scope of this assessment.

1.3.1 ICA Data Validation Program Management

The reference framework's program management layer includes the organizational ownership, objectives, and resources required to maintain a healthy data validation function. While some data validation activities can be and have been automated, there is still a need for an organization responsible for the quality of the ICA results.

1.3.1.1 Ownership

To ensure that there is long-term, ongoing improvement in the ICA results, each IOU should have an identified business owner solely responsible for those results. The business owner's responsibilities should include, but not be limited to, the following tasks:

- Establishing performance targets and metrics for ICA results
- Establishing a long-term strategy to maintain ICA results quality
- Validating sample results regularly (spot-checking)
- Managing resources that support ICA validation
- Documenting the ICA process
- Tracking and implementing identified needs for improvement

The responsibilities listed above provide strategic direction, identify specific objectives, and provide structure for the data validation activities.

1.3.1.2 Metrics

The ICA business owner should establish metrics to ensure that the ICA process is functioning as designed and that the results are of sufficient quality. These metrics should be defined to assess the state of the data in each step of the process.

While individual values for the metrics are informative (e.g., there are currently 100 nodes with zero hosting capacity), trends in the metrics can help identify emerging issues in the input data or process (e.g., the count of nodes with zero hosting capacity is not changing over time) or show improvements in quality (e.g., the count of nodes with zero hosting capacity is decreasing on feeders that have recently had limiting factors mitigated). The metrics should also be tracked to support analysis at various levels of system granularity (e.g., system-level, feeder-level, node-level, etc.) and troubleshoot potential data issues.

Section1.3.2, which covers the ICA process steps, includes example metrics that could support data validation at each step of the ICA process.

1.3.1.3 Resources

While portions of the ICA data validation program can be automated, there will be a need for resources that can correct models with convergence issues, perform spot-checks of results, and investigate any issues identified by the ICA metrics or the validation process.

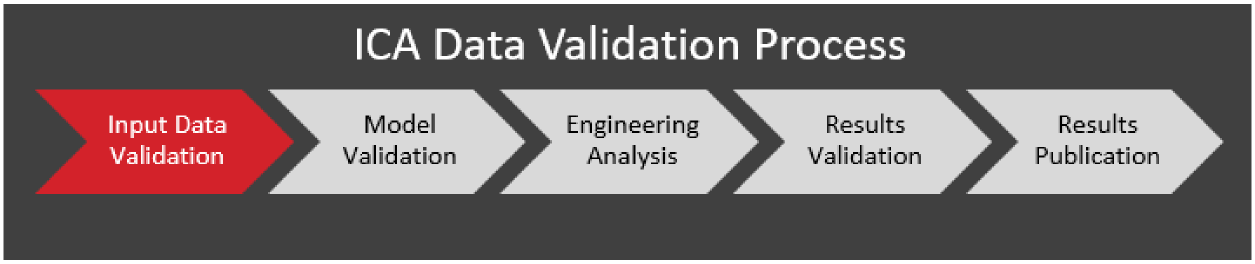
The resources should have experience with their utility's distribution engineering practices, circuit models, and design standards. They should also be familiar with the ICA methodology, their utility's implementation of the methodology, and the entire ICA process from the input data sources to the publication of the results.

1.3.2 ICA Data Validation Process

This section presents the focus of data validation efforts at each step of the ICA process with some potential issues that could be identified at each step. The ICA data validation process spans the entire ICA process from input data to results publication.

1.3.2.1 Input Data Validation

The initial stage of the data validation process is a critical gate to ensure that the data being used throughout the ICA process are of sufficient quality and will lead to valid results. This stage can be complex when considering the multiple sources and high volume of data required for ICA.



The objective is of this stage is to ensure that the data being used for the calculations are complete and sensible. Since the data have not been transformed into models at this stage, each dataset is checked for internal consistency. For the ICA process, the following datasets should be included in the input data validation program. Examples of potential issues are also provided:

- **Asset Data:** Incorrect data such as conductor size or equipment capacity could adversely impact hosting capacity results by imposing improper limits or excessive allowances.
- **Equipment Settings:** Incorrect equipment settings would improperly characterize system performance. For example, incorrect capacitor and voltage regulator model settings could lead to incorrect voltage analysis.
- **Distribution Circuit Topology:** Incorrect circuit topology could result in equipment, load, or generators being modeled at the wrong node or segment of a circuit.
- **Load Profiles:** If a circuit's load profile does not reflect its normal operating configuration, the ICA results could be artificially limited due to temporary operating conditions (e.g., temporary load transfers or outages).
- **Existing and Queued Generators:** Missing or incorrectly modeled generators could result in artificially high or low integration capacity.

If existing data validation programs are in place for any input datasets, the ICA data validation business owner should coordinate with the business owner(s) for those datasets. Awareness of input data issues could prevent the issue from propagating through the ICA process to publication. Likewise, the ICA business owner might identify a potential issue with the input dataset that should be communicated to that data's business owner.

Table 1-1 includes some of the potential issues, example metrics, and potential corrective actions that can be addressed during input data validation. These potential issues highlight the types that IOUs could consider at this stage in the process.

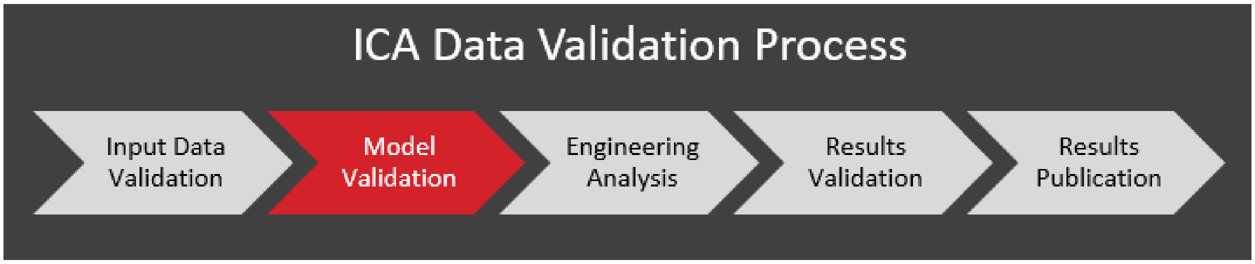
Table 1-1. Potential Issues Identified during Input Data Validation

Potential Issue	Example Metrics	Potential Corrective Actions
Missing or incomplete asset data	• Types of infrastructure data discrepancies as a percentage leading to incorrect ICA results	• Monitor causes of inaccurate results and develop a sample field verification plan for high causes of incorrect results • Field verification can be done using SCADA data and/or limited field checks • Review practice of updating GIS data
Missing or incomplete equipment settings	• Number of limitations due to improper voltage settings	• Confirm capacitor and regulator settings match field implemented settings

Potential Issue	Example Metrics	Potential Corrective Actions
Inclusion of abnormal operating conditions	• Time and duration of abnormal events on distribution feeders	• Exclude data recorded during temporary abnormal operating conditions that would artificially skew ICA results (e.g., public safety power shutoff events or temporary load transfers)

1.3.2.2 Model Validation

This second stage of the data validation process ensures that the models used to perform the calculations are complete and sensible. The conditioning process should be consistent across distribution planning activities, such as interconnection studies and ICA.



During this stage, the objective is to validate that equipment, asset, and generation data are correct in the context of the distribution circuit model. While datasets are checked for internal consistency in the previous stage, now that the datasets have been transformed into a model, it is possible to check if data that appears valid out of context is sensible (e.g., a span of #6 ACSR between spans of #336 ACSR or a *C* phase-to-ground tap being fed off an *AB* phase-to-phase line section). Some areas of focus during model validation include equipment settings, asset sizes and ratings, phase mapping, and existing and queued generation.

Table 1-2 includes some potential issues, example metrics, and potential corrective actions addressed during model validation. These potential issues highlight the types of issues that the IOUs could consider at this stage in the process.

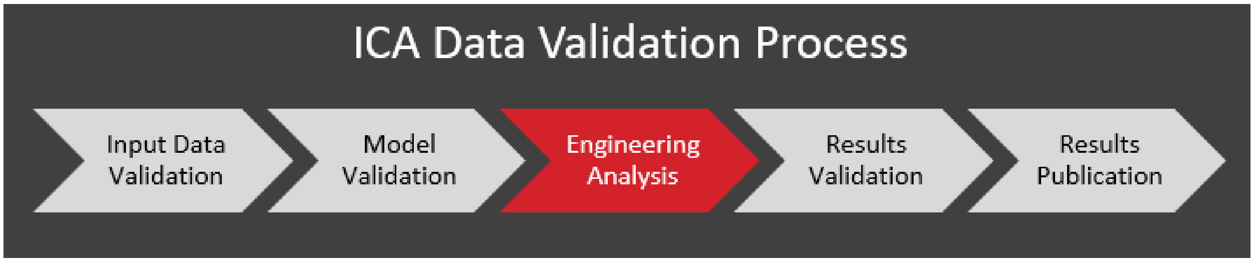
Table 1-2. Potential Issues Identified during Model Validation

Potential Issue	Example Metrics	Potential Corrective Actions
Incorrect asset data	• Invalid or default material types	• Communicate incorrect data and propose a fix to input dataset owners
Preexisting conditions in the model	• Presence of over-/under-voltage or thermal overloads	• Verify that the model reflects field conditions • Modify the model to reflect field conditions

Potential Issue	Example Metrics	Potential Corrective Actions
The model will not converge	Not applicable	• Correct asset data and equipment settings • Temporarily modify load flow algorithm parameters and investigate the impact on ICA results • Work with software developers to solve convergence issue

1.3.2.3 Engineering Analysis

This third stage of the data validation process includes the automated ICA process and the manual intervention required to run the process successfully.



Given the amount of computation required to implement the ICA methodology, using commercial software packages to run the analysis will help minimize human error. However, even with the use of commercial software, there are still situations that require manual intervention. For example, if the ICA process fails, a root cause analysis will need to be performed, and the model will need to be modified so that the ICA process can run successfully.

A best practice to reduce potential human errors when manual intervention is required is using a standardized approach to identify and resolve issues with the distribution circuit models and the ICA process.

1.3.2.4 Results Validation

The objective of the results validation stage is to ensure that the engineering analysis results are sensible.

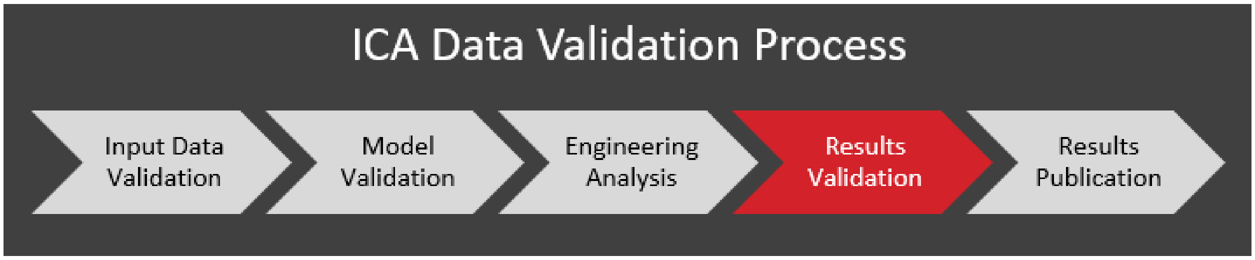


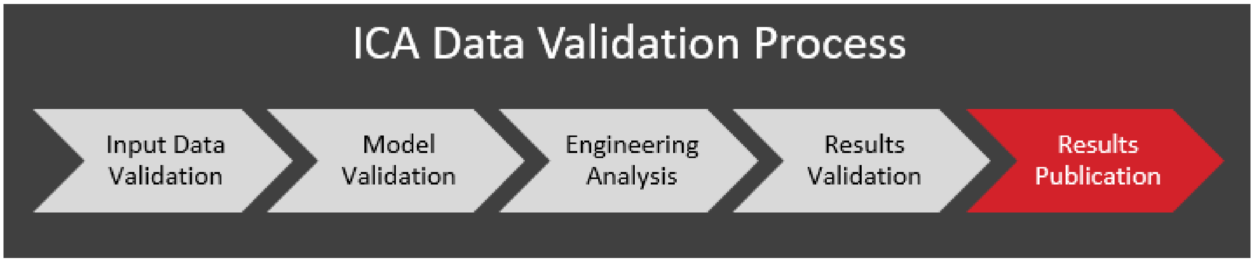
Table 1-3 includes some potential issues, example metrics, and potential corrective actions addressed during results validation. These potential issues highlight the types of issues that the IOUs could consider at this stage in the process.

Table 1-3. Potential Issues Identified during Results Validation

Potential Issue	Example Metrics	Potential Corrective Actions
Invalid zero capacity results	• Count of zero node-hour results • Distribution of limit triggers, for example, dominant reverse flow for operational flexibility scenario	• Implement rule-based screening of zero hosting capacity sections to identify potential suspects (e.g., identifying zero reverse flow at upstream switching locations). • Track trends in the count of zero node-hour results at each analysis refresh. Any significant changes (increase or decrease) could indicate an issue in the analysis. • Develop criteria (e.g., > 10% results) to flag a need for manual validation.
Invalid results due to incomplete load profile data	• Count of node-hour results	• A count of node-hour results less than 576 could flag missing input data or failed engineering analysis. This metric could trigger manual validation unless input data is intentionally excluded (e.g., newly energized feeder).
Invalid results due to load profile processing	• Variation of nodal results over 576 h simulations	• Comparison of load profile variation with nodal results variation could signal an analysis error (e.g., if a load profile varies over time but the hosting capacity at a node does not).
Invalid limiting factor	• Percentage breakdown of limiting factors • Variation of limiting factors at a node	• Track trends in limiting factors. Any significant changes should be verified to see if they are a result of completed upgrade projects • If a node has multiple limiting factors over the analysis period, it could be a sign to verify the results.

1.3.2.5 Results Publication

Once the analysis results have been verified, the results are published to the IOUs' web-based mapping systems. The objective of the final stage of the data validation process is to ensure that the published data matches the validated results.



Map symbology, displayed data and downloaded data are compared with the validated results during this stage. This stage can be facilitated with unit tests for the data extraction processes that support the publication of the ICA results. Sample verification, or spot-checking, can also be used to verify that the correct information has been published.

2 ASSESSMENT OF SCE'S IMPROVED ICA DATA VALIDATION PLAN

The remainder of this report reviews the improved data validation plan submitted by SCE in Advice Letter 4508-E. As described in sections 1.1 and1.2, Quanta Technology reviewed the ICA data validation practices employed at SCE and recommended improvements in line with the reference ICA data validation program framework before SCE submitted its improved data validation plans.

Following is an assessment of SCE's improved data validation plans using the reference framework's structure. Where there are areas for improvement, recommendations are made to ensure the sufficiency of their data validation efforts.

2.1 ICA Data Validation Program Management

SCE has a business owner responsible for maintaining the distribution circuit models used in the ICA process and for the accuracy of the ICA results. The Interconnection Capacity Analysis organization sits within SCE's Distribution Technical Studies organization, is led by an Engineering Manager, and is staffed by seven engineers and a professional trainee (see Figure 2-1).

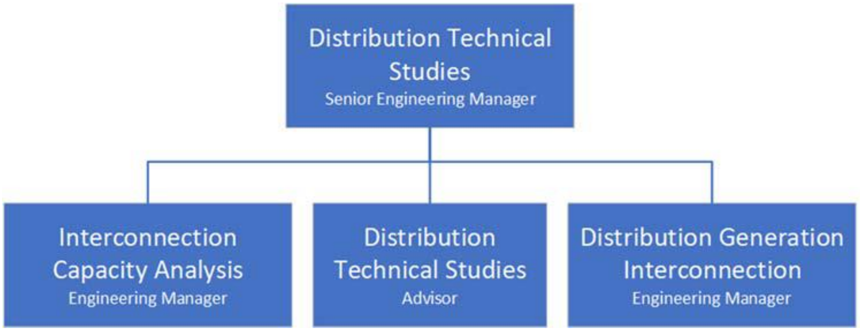


Figure 2-1. SCE's Distribution Technical Studies Organizational Structure

The Interconnection Capacity Analysis organization has established performance targets for its team members for the manual model quality control and ICA results validation tasks to which they are assigned.

2.1.1 Assessment

SCE has a clearly defined business owner with sufficient resources to support the ICA process and data validation tasks.

Table 2-1 shows the responsibilities identified for the business owner in section 1.3.1.1 with a summary of SCE's corresponding plan.

Table 2-1. SCE's Approach to Business Owner Responsibilities

Business Owner Responsibility	SCE's Improved Data Validation Plan
Establishing performance targets and metrics for ICA results	• The ICA organization established performance metrics to ensure that manual tasks performed by its engineering resources are completed in a timely manner. • The plan does not reference metrics related to the ICA results.

Establishing a long-term strategy to maintain ICA results quality	• SCE has established and staffed an organization with engineering resources to support the ICA process and maintain results quality.
	• SCE is implementing multiple IT projects that should have a positive impact on its ICA data validation practices. They include:
	  ○ Transitioning from the custom-developed GridPulse tool to the Grid Analytics Tool
	  ○ Transitioning from stand-alone circuit models developed for ICA to models generated from the Grid Connectivity Model, which is based on the Common Information Model format
	  ○ Implementing the Release 3 system architecture to provide computational benefits and support more frequent ICA updates
	• SCE will have an additional team of engineers (Distribution System Planning) reviewing the load profile data.

Validating sample results regularly (spot-checking)	• SCE employs an automated results validation process that is described in section 2.2.4.
Managing resources that support ICA validation	• The ICA organization comprises an Engineering Manager, seven engineers, and a professional trainee.
Documenting the ICA process	• SCE has maintained ICA process documentation and included it in the September 9, 2019 workshop on ICA refinements and in their improved plan.

Tracking and implementing needs for improvement	• SCE is considering or has started several improvements, including:
	  ○ Implementing the rolling 12-month for load profiles
	  ○ Expanding the trigger criteria for ICA updates
	  ○ Evaluating the potential increase in the lower limit of steady-state voltage criteria
	  ○ Investigating load ICA zero results

2.1.2 Recommendations

SCE has an established business owner with dedicated resources to support ICA-related tasks. The ICA organization already performs many of the responsibilities identified in the reference framework. However, Quanta Technology recommends that the ICA organization establish metrics to track the quality of the ICA results. The previously completed investigation of null results and the pending investigation of load ICA zero results are good examples of issues that can be monitored regularly with appropriate metrics.

2.2 ICA Data Validation Process

2.2.1 Input Data Validation

SCE's plan includes information related to the validation of the input load profile and DER project data.

There are three improvements related to the load profiles in SCE's improved plan. These improvements include implementing the Grid Analytics Tool to support an increased manual review of automatically cleansed data, including an additional team of engineers reviewing load profiles and process changes to ensure that the load profiles lag the ICA process by no more than 2 months.

SCE is expanding its trigger criteria to update ICA models and results to capture more changes in the configuration of its circuits (see Table 2-2). Also, SCE is exploring the addition of a time-based trigger to account for changes to its circuits not captured in the trigger criteria.

Table 2-2. SCE's Trigger Criteria to Update ICA Results

Parameter	Trigger Criteria
Remote Controlled Switch (RCS)	Any change in count
Regulator	
Recloser	
Shunt Capacitor	
Recloser Ground Trip	Any change in sum
Recloser Phase Trip	
Regulator Rated kVA	
Regulator Current Transformer Rating	
Shunt Capacitor kVAR	
Breaker Phase & Ground Pickup	
Count of Spot Loads	Count change +/- 20
Count of Generators	
Total Load kVA	Trigger criteria based on circuit voltage class: <5 kV: +/-37.5 >5 kV and <15 kV: +/-400 >15 kV and <31 kV: +/-500 >31 kV and <100 kV: +/-1000
Total Generation kVA	Trigger criteria based on circuit voltage class: <5 kV: +/-30 >5 kV and <15 kV: +/-150 >15 kV and <31 kV: +/-200 >31 kV and <100 kV: +/-500

The DER project data used for ICA exists within multiple databases. SCE's plan describes the monthly validation process used to merge this data into a single source for ICA. This process includes integrity checks to avoid duplicate, canceled/withdrawn, or isolated backup DER projects from being included in the ICA models. There are also quality checks for the parameters required to model each DER project accurately. Lastly, source data feedback loops to business owners inform them of potential record updates. After the validation process is complete, the DER project data is compared to the modeled DER projects to determine if any changes are required.

Aside from the monthly DER project validation process, SCE is consolidating multiple generation databases into the grid interconnection processing tool. This consolidation effort will simplify future data validation efforts and improve SCE's DER modeling capabilities.

2.2.1.1 Assessment

SCE's improved data validation plan covers two of the five datasets required for ICA—load profiles and existing and queued generators. SCE can validate the data for each of the datasets and plans IT infrastructure improvements to their process for data validation and ICA.

Internal business process changes that will result in the input load profiles being used by Distribution System Planning will provide an additional review of the data and increase scrutiny on the profiles as their use increases.

2.2.1.2 Recommendations

SCE has a thorough data validation plan and long-term strategy for load profile and DER project data. However, Quanta Technology recommends that SCE incorporate asset data, equipment settings, and distribution circuit topology into its ICA data validation plan. SCE could accomplish this by establishing new metrics and processes or referencing existing data validation efforts owned outside the ICA organization.

Quanta Technology also recommends that SCE track metrics for all input datasets to identify potential issues or trends that could propagate through the ICA models and into the results.

2.2.2 Model Validation

SCE provided its model quality control process (see Figure 2-2), which includes automated checks and manual intervention when those checks meet specific criteria.

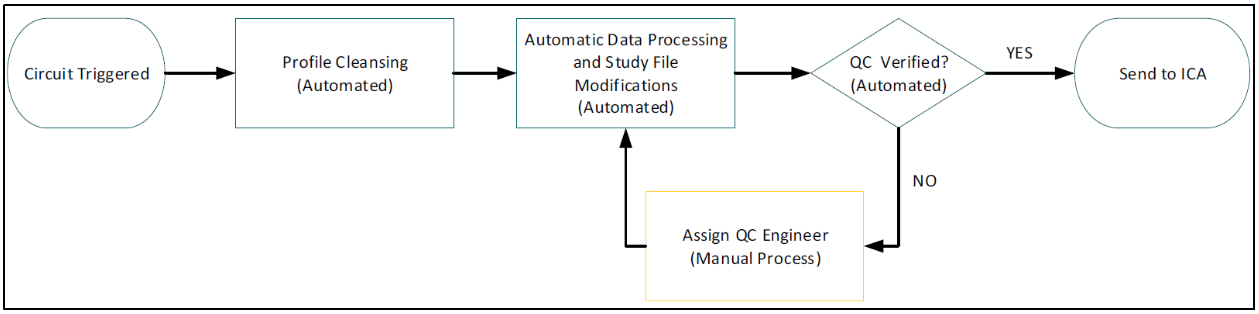


Figure 2-2. SCE's Model Quality Control Process

The flags and criteria checked to validate the integrity of the circuit model are listed in Table 2-3. If any of the criteria are met, the circuit is assigned to an engineer in the ICA organization for manual intervention. The ICA engineer will 1) review the connectivity, equipment settings, and load and voltage profiles, 2) make necessary changes to the model, and 3) validate load flow convergence. Once the ICA engineer has completed the intervention, the model is run through automated checks. Finally, the manual intervention process is repeated until the circuit model passes all the checks.

Table 2-3. SCE's Circuit Model Quality Control Flags

Model Quality Control Flag	Model Quality Control Flag Criteria
Isolated Section	Total count of 50 or more
Loop	One or more electrical loops
Default Wires	Total count of 10 or more
Load Profile	Any zero on profile
Voltage Profile	
Source Equipment	Any default equipment ID
Breaker Setting	Any zero on phase or ground settings
Recloser Setting	
Primary Customer	Missing profile for any primary-metered customer
Load Flow	Circuit does not converge under peak loading from 576 profile

Similar to the business process change described in section 2.2.1 that will result in the Distribution System Planning engineers reviewing the load profiles, the transition to the long-term planning tool's engineering analysis functionality will drive the Distribution System Planning engineers to review the circuit models as they become the basis for time-series power flow studies.

2.2.2.1 Assessment

SCE's improved plan describes an iterative model validation process that includes automated checks and manual intervention by a dedicated team of engineers. SCE will have a second team of engineers validate the models as their annual distribution system planning process changes to include time-series power flow studies.

2.2.2.2 Recommendations

Quanta Technology recommends that SCE include more details of the process used by the ICA engineers to validate the circuit models that do not pass the automated checks and develop non-performance metrics related to the model quality control flags to help identify potential recurring issues in the model building process.

2.2.3 Engineering Analysis

SCE is transitioning to the Release 3 ICA environment enabling some of the process improvements described previously. The Release 3 environment will use CYME version 9.0 with the built-in ICA module to perform the ICA methodology and calculations.

2.2.3.1 Assessment

SCE is using a commercial software package to perform the ICA methodology and calculations. Other IT environment investments support more frequently refreshed ICA results reflecting recent load profiles, DER projects, and circuit topology changes.

2.2.3.2 Recommendations

Quanta Technology has no recommendations for SCE related to the engineering analysis stage of the process.

2.2.4 Results Validation

Similar to its model quality control process, SCE's ICA results validation process (see Figure 2-3) includes automated checks and manual intervention when those checks are flagged.

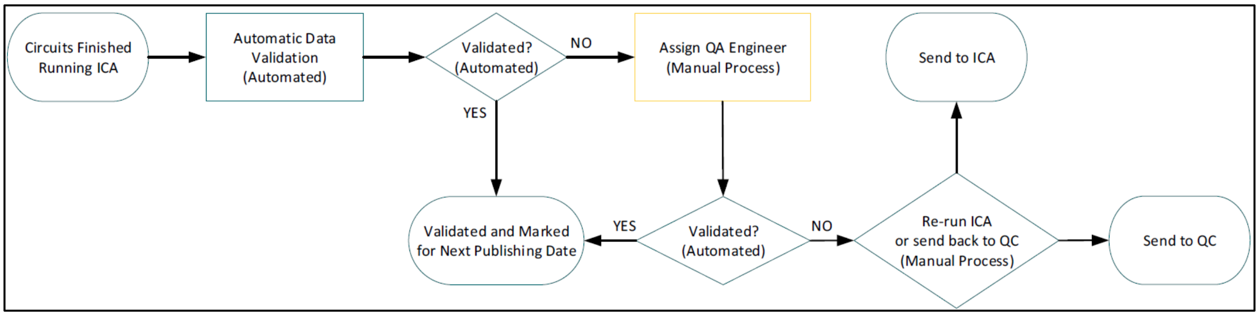


Figure 2-3. SCE's ICA Results Validation Process

The automated checks identify if the results for a circuit meet the following criteria for manual intervention by addressing the following questions:

1. Are the operational flexibility results constant?
2. Are more than 20 node-hour results blank (null)?

3. Are 10% or more of the results equal to zero for each study criteria?

If any of these questions are answered with a "yes," the ICA engineer will review and validate if zero results are due to existing limitations, identify and correct model errors, and review and edit load and voltage profiles as needed. After the ICA engineer has completed the invention, the circuit is sent back through the model quality control process, or the ICA is re-run.

2.2.4.1 Assessment

SCE's improved plan describes a results validation process with automated checks and manual intervention by a dedicated team of engineers. Two automated checks help identify if there were input data issues or calculation issues (checks 1 and 2), and one check establishes a manual review of zero capacity results.

2.2.4.2 Recommendations

Quanta Technology recommends that SCE incorporate the following items into its data validation plan:

1. Continually expand the automated checks in the ICA results validation process to account for potential upstream issues identified over time
2. Add automated checks for other edge cases that could identify upstream issues (a more inclusive zero results check or checks where results are 100% of rated capacity)
3. Establish and track metrics related to failed checks

2.2.5 Results Publication

SCE's improved plan describes a monthly results publication process composed of pre-publication and post-publication activities.

The pre-publication process includes the following steps to ensure that results are complete and that only the appropriate circuits are published:

1. **Step 1:** Perform an integrity check on the circuits to be updated to ensure that none of the circuits has been taken out of service permanently
2. **Step 2:** Perform a quality check of key facility-level loading parameters
3. **Step 3:** Exclude customer-dedicated facilities
4. **Step 4:** Check the count of segment-level ICA results to ensure that each segment has a complete set of results
5. **Step 5:** Compare the count of null results with the previous month, and if there is a 5% or greater increase, the ICA organization investigates the cause
6. **Step 6:** Redact the results per the provisions of the 15/15 rule using the most recent 12 months of customer usage data

The post-publication process is performed using the commercial tool Dynatrace per the following process:

1. Confirm the ICA layer loads at the proper scale

2. Confirm the legend, symbology, and widgets display properly
3. Confirm the ICA results files can be downloaded
4. Perform a system-wide comparison of most limiting results on each line segment to previously published results, and if there is a 5% or greater difference, the ICA team validates and investigates the cause
5. Validate redactions per the 15/15 rule

2.2.5.1 Assessment

SCE's results publication process includes system-wide checks to see if the newly published results significantly change the count of line segment null results or most limiting results. Using a commercial tool to validate the published data and functionality of the map minimizes human error and ensures that the map is an accurate representation of the results.

2.2.5.2 Recommendations

Quanta Technology has no recommendations for SCE related to the results publication stage of the process.