California Distribution Resources Plan (R. 14-08-013)
Integration Capacity Analysis Working Group
Final ICA WG Long Term Refinements Report

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1. Executive Summary

Assembly Bill 327 (Perea 2013) established Section 769 of the California Public Utilities Code, which requires the Investor Owned Utilities (IOUs) to prepare Distribution Resource Plans (DRPs) that identify optimal locations for the deployment of distributed energy resources. In August 2014, the Commission began implementation of this requirement through Rulemaking (R.) 14-08-013, the DRP proceeding. A Ruling from the Assigned Commissioner in November 2014 introduced the Integration Capacity Analysis (ICA) as a tool to quantify how much capacity circuits on the distribution system may have available to host Distributed Energy Resources (DERs). The IOUs submitted the results of their Demonstration A (Demo A) projects in December 2016. The ICA Working Group reviewed the Demo A results and submitted the ICA Working Group Final Report on May 15, 2017. A June 7, 2017 ACR provided scope and schedule to the continued long-term refinement activities for ICA and LNBA. The September 28, 2017 Decision (D. 17-09-026) ruled on the final ICA methodology for interconnection and ordered completion of the first rollout within nine months.

This document serves as the Final ICA Working Group Report on Long Term Refinements (LTR) to the California Public Utilities Commission (CPUC). The Working Group is comprised of the California IOUs and interested stakeholders. Participant lists from each WG meeting may be found in Appendix A. This report summarizes recommendations on long-term refinement issues identified by the June 7, 2017 ACR to continue refining and improving ICA methodology.

2. Introduction and Background
2.1 Overview and Procedural Background

Assembly Bill 327 (Perea, 2013) established Section 769 of the California Public Utilities Code, which requires the California Investor Owned Utilities (IOUs) to prepare Distribution Resource Plans (DRPs) that identify optimal locations for the deployment of distributed energy resources (DERs). In August 2014, the California Public Utilities Commission (CPUC, or Commission) began implementation of this requirement through Rulemaking (R.) 14-08-013, the Distribution Resources Plan (DRP) proceeding. A Ruling from the Assigned Commissioner in November 2014 introduced the Integration Capacity Analysis (ICA) as a tool to quantify how much capacity circuits on the distribution system may have available to host DERs.

Pursuant to Commission direction, the IOUs filed their DRPs as Applications, including a proposal to complete a Demonstration of their ICA methodology ("Demo A"). Stakeholders provided input on the IOU proposals, leading to an Assigned Commissioner's Ruling (ACR) issued in May 2016 containing final guidance on how the demonstration projects should be conducted. That guidance authorized IOUs' to complete Demo A. The ACR also established the ICA Working Group (WG) to monitor and provide consultation to the IOUs on the execution of Demonstration Project A and further refinements to the ICA methodology. CPUC Energy Division staff has oversight responsibility of the WG, but it is currently managed by the utilities and interested stakeholders on an interim basis. The utilities jointly engaged

More Than Smart (MTS), a 501(c)3 non-profit organization, to facilitate the WG. The Energy Division may at its discretion assume direct management of the WG or appoint a WG manager.

In December 2016, the WG filed its Final Interim Status Report on Long Term ICA Refinement which addressed the status and discussion to-date of both topics identified by the ACR, as well as topics proposed by WG members. In December 2016, Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E) submitted their final Demo A reports, representing a substantial milestone for the demonstration projects. These reports summarize Demo A results, lessons learned, and the IOUs' recommendations on the methodology selection and feasibility of implementation of the ICA across the entire distribution system. The ICA reviewed Demo A results and submitted its ICA Working Group Final Report in March 2017.

A June 7, 2017 ACR provided scope and schedule to the continued long-term refinement activities for ICA and LNBA, and the September 28, 2017 Decision (D. 17-09-026) ruled on the ICA final methodology and implementation of ICA to achieve the online maps plus interconnection use case within nine months. The ICA Working Group has convened since July to discuss the identified long-term refinement topics from the ACR. The WG has met six times to discuss 14 topics. The June 7, 2017 ACR additionally established two pre-WG scoping documents and two interim reporting milestones. The pre-WG scoping documents were submitted June 22, 2017. The interim report on Group I topics was submitted August 31, 2017, and the interim report on Group II-IV topics was submitted October 31, 2017. These documents may be found on the DRPWG website[1]. The ACR stated the final long-term refinements report as due six months after the first convening of the WG, which was established to be January 8, 2018.

2.2 Scope and Process

The "Working Group" (WG) references all active parties participating in ICA WG meetings, which include the IOUs, government representatives, DER developers, nonprofits, and independent advocates and consultants. Participant lists for each meeting may be found in Appendix A. The final report is the product of written proposals, edits and contributions from participants from the following organizations:

- CALSEIA
- Clean Coalition
- IREC
- ORA

- PG&E
- SCE
- SDG&E
- SEIA

- Stem
- TURN
- Vote Solar

For each topic discussed, WG participants were asked to present their proposal to the full WG and develop a written proposal following. All stakeholders were invited to provide edits and comments to the developed proposals, or submit their own written proposal if opinions differed. Certain topics were revisited when additional discussion provided clarity or built consensus, or additional analysis was

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[1] http://www.drpwg.org/sample-page/drp

conducted to support or refine an initial proposal. All submitted written proposals and comments may be found in Appendix B.

3. Recommendations Summary Table

The June 7 ACR directs the WG to document the extent of discussions, reason(s) for rescinding or tabling the topic, and relevant considerations and/or implementation plans (if any) for further discussion and methodological development beyond the WG process.

The following summary table identifies the issues discussed, ACR group (the ACR identified priority topics for discussion by developing four Groups), which parties submitted written proposals and comments, which WG members have stated agreement or disagreement with the proposal, and recommended next steps for further development.

Table 1: Summary of WG Recommendations on ACR Topics

Topic	ACR	Written Proposals	Written Comments	Agree with written proposal	Disagree with written proposal	Abstain	Recommended Next Steps
Planning use case	Group I Item 1	Joint IOUs (SCE, SDG&E, PG&E)	Joint stakeholder parties (IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem)	Joint IOUs	IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem		CPUC guidance on timing of implementation and planning use case definition
		Joint stakeholder parties (IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem)	Joint IOUs	IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem	Joint IOUs		
		Joint stakeholder parties modified proposal (IREC, ORA)	Joint IOUs	IREC, ORA	Joint IOUs		
		Joint IOUs (policy scenario analysis framework proposal)	Clean Coalition, IREC	Joint IOUs	IREC		
Standard PV profile	Group I Item 2	Joint IOUs	Clean Coalition	Joint IOUs			None
Smart inverters	Group I Item 5	Joint IOUs	Joint stakeholder parties (CALSEIA,	Joint IOUs			Additional IOU testing to

			Clean Coalition, IREC); Joint IOUs				incorporate the function with WG review following, additional functionality developed at a later date when needed
Comparative assessment	Group I Item 8	Joint IOUs		Joint IOUs			Independent third party review, IOU testing, and WG review
Single phase feeders	Group II Item A	Joint IOUs	ORA	Joint IOUs	ORA, Clean Coalition, IREC		IOUs will evaluate and WG review
Load modifying resources	Group II Item E	Joint IOUs	ORA	Joint IOUs	ORA, Clean Coalition (both support short term rec but not on continued long term discussion)		Additional WG work
Operational flexibility	Group II Item 4	Joint IOUs	ORA CALSEIA	Joint IOUs	ORA, CALSEIA, IREC		Yes, see Section 5.3
DERs serving peak load	Group II	Joint IOUs	IREC	Joint IOUs			None
Consider changes to ICA maps to reflect queued projects in online maps	Group II Item 6	None	None	Consensus			Yes, addressed in Rule 21 Proceeding
Data sharing, interactive ICA maps, and market sensitive info	Group III Items B, C, and D	More Than Smart CALSEIA (on developing an API)	None		Non-consensus on API development – CALSEIA, Clean Coalition, IREC		Yes, Commission direction with regards to API development
Incorporate findings and recommendations from DRP Track 3 Sub-track 1	Group III Item 3	Joint IOUs	ORA; IREC; Joint IOUs	Joint IOUs			Yes, additional WG discussion after Track 3 Decision
Voltage Regulating Devices	Group III	None	None	Joint IOUs			Yes, IOUs to work with vendors, WG review

Development of ICA verification plans	Group IV Item F	Joint IOUs	ORA	Joint IOUs			Yes, verification plans pending
Definition of quality assurance and quality control measures	Group IV Item G	Joint IOUs	ORA	Joint IOUs	ORA IREC		Yes, review after pending QA/QA plans are completed
Explore divergences and tradeoffs between load shapes methodology	Group IV Item 9	Joint IOUs		Joint IOUs			Yes, additional review after initial ICA deployment

4. Group I topics

4.1 Planning use case

Understanding how ICA may be used in planning ("planning use case") and recommending a methodology to do so was identified in the March 2017 ICA Working Group Final Report. The June 7 ACR guidance additionally identified this as a high priority item (Group 1). Decision D.17-09-026 also states, "we agree that there is a role that ICA should play in the distribution planning process. ICA results may be used to identify grid locations facing hosting capacity constraints in light of DER growth scenarios that would be candidates for grid upgrades to accommodate projected DER growth." The WG has agreed early on in the process that the definition of "use cases" for ICA is important to understand how the tool will be used, what methodology will be employed, and what factors of confidence, computational efficiency, spatial granularity, and other factors provide an optimum result.

This item was discussed at the August, October, November, and December WG meetings. The following proposals, counter-proposals, and written comments were submitted and may be found in Appendix B:

- Initial Joint IOU proposal
- Comments by Joint Stakeholder Parties (representing IREC, ORA, Vote Solar, Clean Coalition, SEIA and Stem)
- Joint IOU response to Joint Stakeholder Parties comments
- Modified proposal seeking consensus, after October WG meeting, by Joint Stakeholder Parties (representing ORA and IREC)
- Joint IOU response to modified proposal
- Joint IOU proposal for a modified "policy analysis use case"
- Suggested edits by Clean Coalition on Joint IOU proposal for a modified "policy analysis use case"

- General comments by IREC on its conclusions about open questions from Working Group discussions of planning use case

Through discussion, the ICA WG identified the following key issues:

- Definition of the planning use case
- Determination of the technical requirements corresponding to the defined planning use case
- Evaluation of ICA methodologies, including alternatives to the iterative methodology
- Selection of an appropriate and optimal ICA methodology, including specifying technical requirements, to support the planning use case
- Evaluation of methods of integrating load and DER forecasts into ICA
- Application of load and growth forecast methods within the planning use case

To sum WG discussion to date, the WG has parsed the "planning use case" into multiple subcomponents based on application of ICA (see Section 4.1.1). While consensus has generally been reached on the list of applications, there is some disagreement remaining about whether one application related to policy (Application 4) should be considered a subcomponent of the planning use case, or be treated as an entirely separate use case.

The WG has reached agreement on a list of planning use case applications and has discussed some technical requirements of the underlying methodology based on application, but has not reached full consensus on methodological details, including what methodology might most appropriately serve each use case. Development of the optimum ICA methodology is driven by the use case, but it is also an iterative process where information of cost and timing of development and implementation can and should be fed back into the definition of the use case. Currently, the IOUs are implementing ICA across their entire distribution systems, using the iterative method, by July 2018 to meet the interconnection use case. The WG understands that there is value in building on existing work, but that methodology choices for the planning use case should continue to be studied, including better understanding what limitations the iterative method may have and how DER growth forecasts may be modeled to best meet the planning context.

In addition, it is emphasized that hosting capacity is a relatively new topic and that methods of conducting hosting capacity analysis are continuously developing. The IOUs have tested and compared a streamlined method and an iterative method in Demo A, and are implementing the iterative method for interconnection purposes. The Joint IOUs additionally presented information on EPRI's method on conducting hosting capacity, discussed in brief below, that was not included in ICA WG evaluation through the Demo A process. Overall, the WG agrees that additional evaluation of ICA methodologies is needed.

The WG agrees that the utility annual distribution capacity planning process is a component of the ICA planning use case. The WG has also extensively discussed the application of ICA outside of the utility annual distribution capacity planning process, but the WG is in non-consensus as to whether the use of ICA here is considered a subset of the "planning use case" or an entirely separate "policy analysis use case." For discussion purposes, this report refers to this discussion as an "Application of ICA" to all identified types of planning uses. As the WG has not been able to determine how the ICA outputs may

be used, there has been much less discussion about the actual methodological requirements needed to serve this application, and thus it is not clear whether they are appreciably different from the methodological requirements for the other planning use case applications.

Finally, timing is an overarching issue with regards to the development of the planning use case and whether forecasted hosting capacity values may support the IOUs' 2018-2019 distribution planning process cycle. The IOUs are currently working to develop ICA using the iterative methodology by July 2018 to serve the interconnection use case. If the CPUC and WG agree that a different methodology may be needed to meet the needs of the planning use case, it may be difficult to develop a method in time for the 2018-2019 distribution planning cycle, which begins in September 2018. A large reason for this is the need to consider DER growth scenarios and the multiple methods of doing so for a planning ICA (a need that does not exist for the interconnection ICA). Demo A did not sufficiently test how growth scenarios (forecasts) would be applied along with the ICA, thus the group was unable to rely on the Demo A results to define the methodology in the same way it did for interconnection.

Despite the extensive work and discussion by all WG members on the planning use case, the WG was not able to achieve consensus on this topic or develop a consensus recommendation for next steps. The WG does agree that the planning use case is an important topic to resolve in 2018. Thus, the following next steps should be clarified by the CPUC to help develop a pathway forward:

- The CPUC should clearly define the planning use case, including the policy application, drawing on WG proposals and comments, consistent with the DRP Track 1 and 3 Decisions.
- The CPUC should provide direction on technical requirement questions to be resolved once the use case is clearly defined.
- The CPUC should also determine the most appropriate means of continuing to support the identification of appropriate ICA methodology to support the planning use case in 2018. The WG agrees that this is a priority topic. WG members have suggested several discussion venues; ORA and IREC have supported authorizing an extension of the ICA WG, while the joint IOUs ask the Commission to direct the IOUs to proceed with the use of one of the discussed methodologies based on each IOUs' capability and require direct reporting to the Commission on results, learnings, and recommendations, to prevent further delays. Additionally, with regards to the policy scenario analysis application (Application 4), the joint IOUs propose that future discussion related to methodology to meet this application be developed through future workshops related to the third LNBA (DERAC) use case, as defined in CPUC Track 1 Decision (D.17-09-026). Many of these suggestions were made at the Dec. 13 WG meeting through oral input, and no written comments were developed.[2]
- The CPUC should determine whether the use of ICA within the IOUs' 2018-2019 distribution planning process is a desired outcome.

The following sections summarize discussion and recommendations on the following: 1) definition of the planning use case; 2) ICA methodology and technical requirements to support the planning use case; 3)

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[2] The webinar recording of the December 13 ICA WG meeting can be found at:
https://attendee.gotowebinar.com/recording/4908234587864326402?assets=true

integration of load and DER forecasts; 4) application of ICA results for distribution planning; and 5) recommendations on next steps.

4.1.1   Use of ICA in Planning Applications

Determination of the optimum ICA methodology and methodological details requires a clear end-goal, primarily definition of how the ICA results will be used. Development of the optimum ICA methodology is driven by the use case, but it is also an iterative process where information about costs, timing of development, and implementation can and should be fed back into the definition of the use case.

The WG identified and discussed four general applications of ICA. The WG agrees to the characterization of Applications 1, 2, and 3. The WG is in non-consensus to Application 4.

1. ***Application 1: Identification of low Integration Capacity locations which may require mitigation, or justify additional data acquisition and analysis:*** Unanticipated changes to distribution equipment (e.g. equipment failures), forecasted load, and forecasted DER could reduce the hosting capacity of individual circuits. ICA results can provide a tool to help the IOUs to determine an appropriate and immediate response to these changes, including circuit reconfiguration, increased data gathering, or grid upgrades. It is noted that this use case may depend more on operational data versus modeling data - ICA may help flag and prioritize locations for review, but operational data will likely be used to determine final need. This application has WG consensus.

2. ***Application 2: Identification of locations where forecast DER and load growth may require mitigation:*** The purpose of this application is to identify system needs expected to be created by future DER growth, to preemptively address these needs. This application is envisioned to become an integral part of utility operations and fed directly into the utility annual distribution planning process. The outcome is expected to be either IOU capital investment to meet the need, sourcing of DERs to defer the conventional investment, or no action. Thus, forecasts and other policy assumptions should be consistent with current Commission policy for distribution planning and investment. WG members anticipate that additional guidance from the pending DRP Track 3 Decision regarding Growth Scenarios and Distribution Deferral, as well as the pending DRP Decision on Grid Modernization, will assist in defining this application. Final determination of grid upgrades will require additional data gathering and analysis within the planning process for identification of final mitigation. This application has WG consensus.

3. ***Application 3: Definition and prioritization of system-wide grid investments to accommodate DER or enable benefits from DER (grid modernization):*** It is likely that some grid investments will be system wide in nature, and justified based on the potential value of accommodating DER at specific locations. The CPUC grid modernization staff proposal included a schema that used ICA as one metric to help prioritize specific investments. The balance between confidence in results, processing time, cost, and the number of scenarios that can be run for this application may differ than the application of ICA in the utilities' distribution planning process. The WG anticipates that additional definition to how ICA results will be used will be provided in the pending Track 3 Decisions regarding Growth Scenarios, Grid Modernization, and Distribution Deferral. This application has WG consensus.

4. ***Application 4: Analysis of impacts and implications of potential policy interventions on the distribution grid, including, but not limited to, incentives, rate changes, and tariffs:*** The WG is in non-consensus as to whether this should be considered a planning use case or a separate policy scenario analysis use case. Further in-depth discussion of this application is below in Section 4.1.1.1.

4.1.1.1 Use of ICA to Inform Policy Analysis (Application 4)

With regards to Application 4, the WG engaged in discussion on the use of ICA outside of annual IOU distribution planning and within the grid modernization context. These uses can be characterized as "use of ICA to inform policy analysis". While all parties agree that the ICA is a powerful tool that can help inform future policy deliberations, the use case is currently identified as non-consensus due to two main issues: 1) how the potential use is characterized (as a separate use case or within the planning use case), and 2) how the use case is implemented.

1. Characterizing the use of ICA in the policy context: Non-IOU parties and the Joint IOUs have characterized this application differently.

- **Non-IOU parties**, representing the Office of Ratepayer Advocates (ORA), the Interstate Renewable Energy Council (IREC), Vote Solar, the Solar Energy Industries Association (SEIA), Clean Coalition (CC), and Stem, have identified this use of ICA as a subset of the ICA planning use case, stating that it is important to define all potential ICA planning scenarios within the planning use case, including the use of ICA in policy analysis. When discussing the planning use case, the non-IOU parties had a broader sense of how the ICA could be used to inform various types of planning decisions. For example, when the Commission makes policy decisions, it engages in a process of planning for how to adapt to the impacts of those decisions, and may make better decisions if it is able to understand how those decisions impact the distribution system. For example, if the Commission is considering a change in rates to incentivize certain electric vehicle charging behaviors, non-IOU parties state that the ICA could be used to help the Commission (and all stakeholders) understand how a proposed rate change could impact the distribution system.

  The non-IOU parties are comfortable prioritizing discussion about how the ICA will be used in the IOU annual distribution planning process, but are concerned that this bifurcation could unnecessarily result in the ICA results being inadequate to apply in the policy context. That could require the development of a separate policy-focused ICA, or result in the inability of the planning ICA to inform policy discussions or overall meet the needs envisioned by the Commission in the Ruling.

- **The Joint IOUs** characterize "planning" as exclusively focused on their individual annual distribution planning processes. The Joint IOUs note that, while they see the potential value of ICA to inform policy discussions, this use of ICA is substantively different in that it informs CPUC proceedings and Decisions rather than IOU operations, and propose to separate it out as a separate use case that should be further developed before formal implementation. The Joint

IOUs further note that using the ICA to inform future policy is a discussion outside of the ICA planning use case and directly related to the LNBA third use case[3] as defined in the CPUC Track 1 Decision (D.17-09-026). The IOUs recommend that, based on these definitions, only Applications 1-3 above should be included in planning use case and addressed within the current ICA WG process, and that Application 4 should be a "policy scenario analysis use case" addressed in subsequent discussions and workshops related to the LNBA third use case (related to using LNBA outputs for input into the DERAC to inform future DER policy).

Joint IOUs' proposed high level framework for policy scenario analysis

The Joint IOUs additionally propose a high-level framework for how a potential policy scenario analysis use case might be further developed. In this framework, the policy scenario analysis is implemented on a case-by-case basis within an active CPUC proceeding, to support specific needs. In identifying the potential analysis within the context of a CPUC proceeding, Commission staff or parties to a proceeding may identify proposed scenario analysis through formal or informal processes, such as a staff report, filed comments, workshop discussion, etc. A proposal for ICA scenario analysis should provide information on: what questions are being asked and how may ICA results help answer the questions, as well as how well the answers inform the scope topic; what is the detailed scope of the proposed analysis and what scenarios will be tested; what level of granularity may be needed, etc. With this information, the IOUs would estimate the workload associated with conducting the analysis and suggest options to minimize workload, estimate lead time required, and estimate cost. The PUC would then provide guidance on scope, data inputs, schedule, and cost recovery, and authorize the IOUs to open a memo account to track the incremental costs of the analysis.

The non-IOU stakeholders are not in agreement that the methodology and technical requirements necessary for the policy application are so different from the distribution planning applications such that they require implementation of this separate framework. It is possible that if Application 4 was included in the discussion now that a methodology could be developed that could serve all applications. They further note that *none* of the applications have been defined or tested in this manner to date.

2. Implementation of ICA to serve this use: All parties agree that the potential use of ICA in a policy context exists. Decision makers look at scenario analyses, such as those performed within LTPP and IRP, to consider the impacts of uncertainty when making policy decisions. As ICA is a tool that identifies impacts to the distribution grid, ICA may also be used to analyze impacts and implications of *policy interventions* on the distribution grid. As with the other distribution planning applications, there are questions warranting discussion about how this use of ICA would be implemented and how the results

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[3] The Joint IOUs note that the use of ICA to inform future DER policy is directly related to the LNBA third use case described in D.17-09-026 on Track 1 Demonstration Project A and B. Pg. 51 described the need within the LNBA third use case to determine DER integration costs stemming from Grid Modernization or hosting capacity. This would allow avoided T&D costs and DER integration costs to be evaluated alongside DER program and administrative costs in IDER cost effectiveness calculations.

would inform policy decisions. For example, it is generally understood that multiple runs of ICA may be needed to evaluate multiple scenarios. However, given that the exact use of ICA to support other CPUC proceedings has not been specified, it is not clear how multiple scenarios should be considered, and how the results of ICA would be used to support decision making. Given the lack of definition here, the WG has also not discussed the technical specifications that would support this use case (e.g., frequency of updates, temporal and spatial resolution, methodology, etc.)

The WG has exhaustively discussed this issue, defined each position in written comments, and determined that a consensus position will not be reached. The WG therefore seeks direction from the CPUC to define the planning use case based on the proposals and comments in Appendix B, and consistent with the Final Track 3 Decisions.

4.1.2   Methodology and technical requirements supporting the planning use case

Demo A tested and compared two ICA methodologies, the iterative and streamlined method. The ICA WG reviewed the Demo A results after they were published in December 2016, and recommended technical requirements for the application of the iterative method into the interconnection use case only. Demo A did not include sufficient testing of application of growth scenarios to enable the same level of evaluation of a planning use case and the WG members were still unclear on how the ICA would fit into the distribution or policy planning processes. Thus, the ICA WG Final Report (March 2017) identified that the use of ICA in interconnection was the highest priority use, and acknowledged that the methodological details of the planning use case should be discussed in long term refinements. Decision 17-09-026 defined the iterative ICA methodology for the interconnection use case to be deployed by July 2018.

Methodology
Identifying an appropriate ICA methodology and the corresponding technical requirements are closely interrelated components when considering an optimal ICA method. These additionally may differ based on ICA use case. Notably, a key technical requirement for planning that is distinct from the interconnection use case is the need to integrate load and DER growth projections into the ICA values. At a high level, there are multiple methods to model DER dispersion, as well as multiple options for considering DER growth forecasts. Understanding appropriate approaches to both necessitates additional discussion on appropriate ICA methodology, including whether the iterative method is additionally appropriate for the planning use case.

In discussion, PG&E stated that it believed that the iterative method is not an effective approach to use within the planning context, while SCE stated that the iterative method may be appropriate if Options 1 or 2a (see below) for including DER growth within the analysis is employed. The WG also briefly discussed the use of the EPRI DRIVE tool, a method that was not considered for Demo A (and thus not vetted through the CPUC) and not discussed in detail within the ICA WG long-term refinements discussion. This tool applies Weibull distribution algorithms to equations to account for dispersion of DER on a given circuit. While PG&E has suggested that the DRIVE tool may be the tool that provides the most confidence in ICA values that account for forecast DER growth, IREC in particular expressed

concern that the DRIVE tool is proprietary and would not provide required transparency, nor has it undergone any public vetting or testing within the ICA WG for use in the interconnection or planning context. IREC believes it currently also requires that scenarios be run using either a "large" or "small" DER dispersion scenario, which is unrealistic for how DER is deployed in California (i.e. in various sizes). IREC does agree that methodologies that utilize a stochastic or other randomized dispersion method may have value in a planning context, but DRIVE is just one proprietary tool that uses this method, and others exist and/or can be developed. IREC is not opposed to considering the use of DRIVE altogether, but believes adequate testing and results should be provided and sufficient transparency into underlying methods and assumptions needs to be provided.

Technical Requirements
ICA methodology should additionally consider and weigh the following technical requirements. Definition of these technical requirements impacts the granularity and confidence in ICA results, as well as the overall cost and effort required to implement ICA. The WG discussed the following technical requirement and its relevance to ICA results:

- **Engineering assumptions:** ICA involves a number of engineering assumptions including specific thresholds for each ICA criteria, pre-existing conditions, and status of load tap changers. Methods to increase computational efficiency were also recommended by the WG in the March 2017 Working Group Final Report.
- **Confidence of results:** the required confidence in ICA results depends on its application. For some applications, confidence in ICA results is critically important as results are used to justify targeted investments to increase local hosting capacity; other uses may not lead to direct decisions on upgrades and therefore may not require as much precision in the results. In all scenarios, ICA results are used to guide further steps, and functions as a "first screen", demanding relatively good confidence. There is a noted tension between obtaining increased confidence in results and spatial resolution due to the accuracy of DER forecasts over time.
- **Frequency of updates:** ICA should be run annually in accordance with the annual distribution planning process, performed after the load forecasting process is completed and before the final distribution analysis is performed. In addition, within the grid modernization context, ICA should align with the Grid Needs Assessment to be finalized in the DRP Track 3 Decision. The frequency of updates for a policy use would vary depending on the policy decision needing to be made, but may only require "one time" runs rather than regular updates.
- **Temporal resolution:** The hourly profile chosen should be chosen to balance the need for computational efficiency and needed granularity. For the interconnection use case, the WG agreed that a 576 hourly profile should be used for the initial statewide ICA rollout, and that a more granular hourly profile may be needed and justified. No decision has been reached on how temporal resolution may impact ICA results under the planning applications.
- **Spatial resolution:** For the interconnection use case, ICA values will generally be calculated at each circuit's three-phase electrical node. However, In the March 2017 Report, the WG agreed to limit the number of nodes analyzed based on computational efficiency for the initial

statewide ICA rollout.[4] While this remains an open topic, the WG initially recommends that ICA values related to the planning use case should only be calculated at a locational granularity that is supported by a reasonably accurate DER forecast. Granularity of forecasts and analysis may improve and become more granular than the feeder breaker, and thus may improve the confidence level in results. However, if DER forecasts are only accurate to the circuit level, then the spatial resolution will be lower (e.g. circuit level versus nodal level) which would reduce computational requirements.

- *Spatial modeling of DER:* Unlike the interconnection use case, which considers the impact of single DER placement on a circuit line section or node, the planning use case requires understanding of the broader impact of multiple generation sources and their aggregate impact over a longer time frame. This could be considered through stochastic placement (placing forecasted DG randomly across the circuit, and then performing power flows to identify the violations created by the forecasted DER. As ICA progresses, it is also important that the components of the tool be able to consider a dispersion of smaller DER throughout the circuit. Other ICA tools are being developed to include analysis of this dispersion, including the EPRI DRIVE tool. Additional exploration of these techniques would be useful to properly consider DER for the planning context.

- *Scale of DER:* The increment size of DER used to calculate ICA impacts computational efficiency, cost, and usability of results. For the interconnection use case, the IOUs are using an equivalent of 500 kW increment. The DER increment needed for planning is likely different than that used in interconnection, depending on the methodology used to calculate ICA. It is noted that the streamlined methodology calculates capacity level directly versus testing the capacity limit using increments, as the iterative method does.

- *Size/Type of DER:* the WG discussed whether wholesale DER should be included in hosting capacity analysis. Stakeholders discussed that due to the size of the systems and the fact that they may be sited separately from load, wholesale DERs are much more likely to significantly impact the hosting capacity of a circuit, which makes it difficult to include in the forecasted ICA. Currently, wholesale forecasting is not locationally granular enough that it could be used with any confidence within the ICA. It is expected that the interconnection process can sufficiently capture these upgrades, as is currently done. IREC and ORA state, however, that wholesale DER systems will significantly affect the hosting capacity of the distribution system in various ways and will need to be considered in the planning process in some manner.

- *Consideration of DER growth:* The WG discussed that DER growth scenarios could be analyzed either before or after ICA is calculated. The IOUs presented on these two methods of incorporating DER growth scenarios, which is summarized below in Section 4.1.3.

4.1.3   Evaluation of methods to integrate load and DER forecasts into ICA

The planning use case must consider both 1) how DER growth is modeled across the circuit and 2) how DER growth forecasts are considered in calculating ICA.

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[4] March ICA WG report, p.33.

There are multiple ways to consider the small dispersion of DERs across the circuit and evaluate their aggregate impact. In the adopted iterative ICA methodology, DER is added as a single source at each node for each iteration. This approach does not account for a wider, and potentially more realistic distribution of DER on the circuit. To consider DER growth, the utilities can assume uniform distribution of forecasted DER across each circuit. Alternatively, stochastic placement of forecasted distributed generation across the circuit can be used, and then power flows can be performed to identify the violations created by the forecasted DER. PG&E additionally notes that the EPRI DRIVE methodology applies Weibull distribution algorithms to equations to properly account for dispersion of DERs.

Next, DER growth forecasts can be considered either before or after ICA is calculated. These are identified as "Option 1" and "Option 2".

- **Option 1: Consider DER growth before ICA is calculated.** DER growth forecast is included within the load allocation, before ICA is calculated. This method attempts to more directly account for load growth, but assumes an even distribution of DER on a given circuit
- **Option 2: Consider DER growth after ICA is calculated.**
  - **Option 2A:** After ICA is calculated, the forecasts of each type of DER is applied, and ICA values are adjusted. This value is compared at a single point. This option may be relatively easy to implement mathematically, but making the correct ICA adjustment for each type of DER based on each ICA criteria (thermal, protection, etc.) may be difficult.
  - **Option 2B:** This Option is similar to Option 2A, but this analysis considers DER distribution option across the circuit using stochastic modeling.

The IOUs presented on these two methods and developed the following illustrative flow charts on how ICA can incorporate DER growth scenarios at the August WG meeting, though the WG did not discuss the merits of each option in sufficient detail to develop consensus on merits of different methods in specific planning applications.

Figure 1: Option 1, Incorporating DER and Load Growth Forecasts into ICA
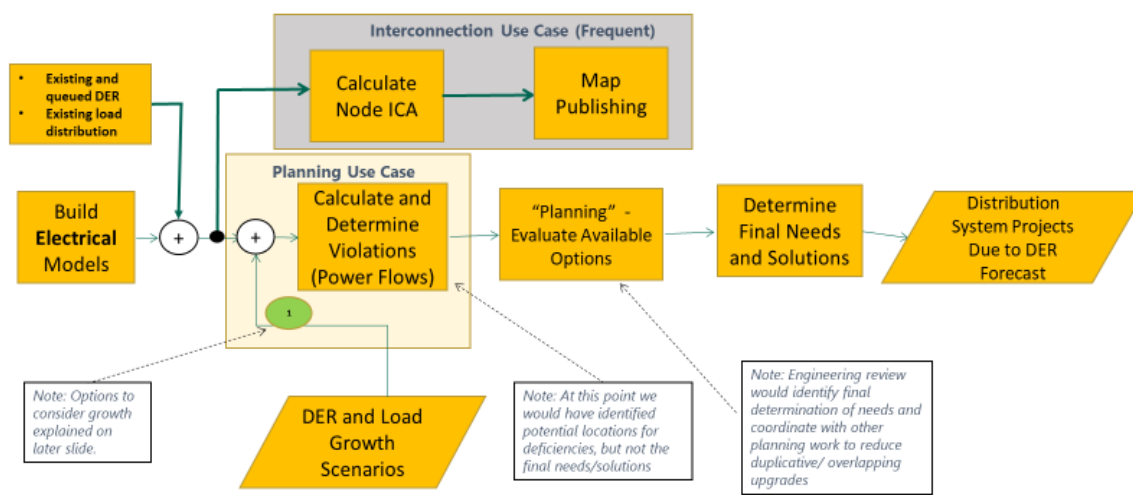
As noted above, in Option 1, DER growth forecasts are netted into the load allocation before ICA is calculated. Power flow analysis is then run to determine violations. This option attempts to more directly account for DER growth, but only accounts for an even distribution of DER across the circuit. IOUs note that this analysis is the easiest to perform, but the simplistic assumption of DER dispersion within the circuit may limit accuracy.

Figure 2: Options 2a and 2b, Incorporating DER and Load Growth Forecasts into ICA
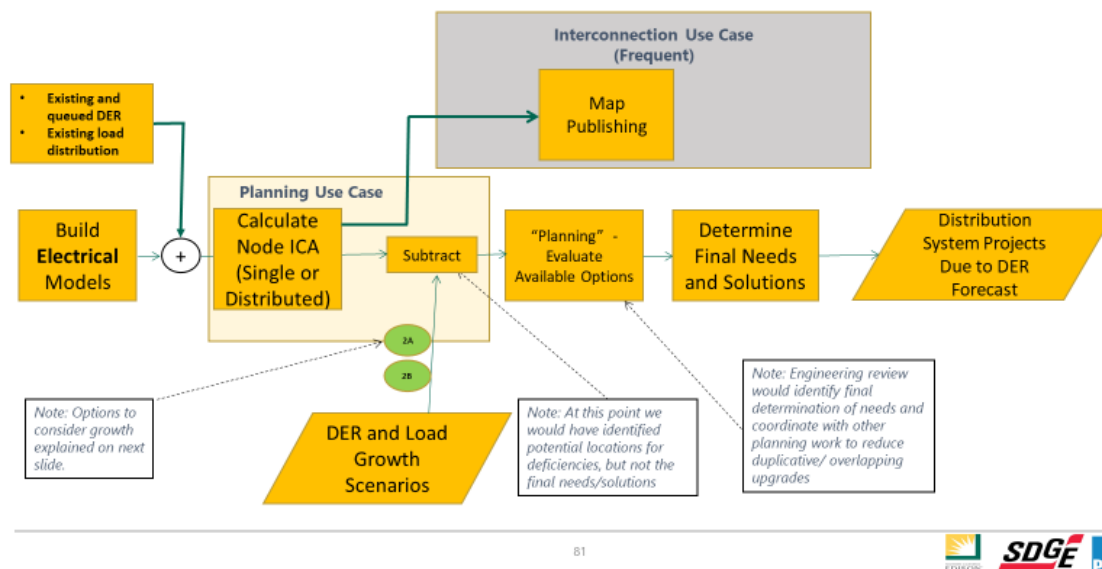
In Option 2, ICA is calculated, then DER growth forecasts are compared to the ICA. There are additionally two means of comparison (2a and 2b). In 2a, the forecast is subtracted from ICA. The Joint IOUs note that this analysis is easier to perform, but the results do not consider DER dispersion within the circuit. In 2b, the ICA is adjusted during calculations to consider small dispersed DER rather than large, single point DER. Then, the DER growth forecasts are compared to the end ICA results.

In WG discussion, the Joint IOUs noted that Option 2A is easier to calculate, but is less effective at considering dispersion of DER on a circuit given that the ICA results are compared at a single point. This however, would still provide indication of when a given circuit may reach its ICA limit and thus may still provide value in terms of ICA planning use case. Further, results differ based on what point on the feeder is used for comparison (e.g., head, middle, end). Option 2B uses an ICA output that already considers the distribution of DER in the circuit using stochastic modeling. Result are then further adjusted to consider distributed versus single point DER. It was suggested by PG&E in the December 13 WG meeting that Option 2B can most efficiently be conducted using the EPRI DRIVE tool, but can also be incorporated into the streamlined method with significant development work. Some WG members familiar with the EPRI Drive tool, including PG&E and Vote Solar, have stated in WG meetings that Option 2B provides the most accurate ICA values, though concerns regarding the transparency of the proprietary tool have been expressed. IREC would like to see support for this assertion since there do not appear to be any publicly published materials that demonstrate DRIVE's accuracy or even discuss its application in a planning context.

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WG members agree the incorporation of the net load forecast is an important element of the ICA methodology that is unique to the planning use case, and that it must be consistent with the pending Track 3 decision regarding load and DER growth forecasts. The WG recommends that the three options above be considered by the WG integrally with the overall ICA methodology and methodological details once the planning use case is defined. The WG also welcomes direction from the Commission on how to approach questions about the different methodologies and which should be evaluated at this stage.

4.1.4   Application of ICA results to support the planning use case

After the planning use case is defined and an appropriate ICA methodology is developed, it is necessary to determine how the ICA will be used to make decisions. While the WG had limited discussion of this issue, the Joint IOUs highlighted that regardless of the ICA methodology, the results would have some significant level of uncertainty since they are based on forecasts of circuit level DER and load growth, and that determination of final grid needs and solutions will require additional engineering analysis.[5] The WG generally agrees with the IOUs' characterization of how ICA is used to make decisions (as an initial indicator of areas for further review) conceptually, though notes that exactly how ICA is used would depend on the characteristics of the ICA results. For example, a less accurate or robust ICA methodology might require more subsequent IOU analysis in determining the final grid need and solution. In addition, the need for subsequent project level analysis should be consistent with the pending Track 3 Decision regarding the Grid Needs Assessment (GNA).

4.1.5   Remaining issues and proposed next steps

Overall, it is challenging to make decisions about methodology when there is lack of consensus and/or understanding on how ICA results will be used, and there are multiple methodological options which have not been fully explored by the WG or demonstrated in the Demo A projects. The planning use case is notably different than the interconnection use case in that, rather than determining ICA with confidence at individual nodes on the system, it is more necessary to understand the impact of DER dispersed across the system and across a longer time horizon, necessitating different methodology decisions than the ones the WG recommended for the interconnection use case. While the WG has discussed methodological options and indicated benefits and drawbacks to each (and consensus has been noted where it exists), and while all stakeholder groups express support for using ICA in the planning context, in general the WG has not developed enough clear understanding to make definitive recommendations on ICA methodology for the planning use case.

In the final WG meeting on December 13, 2017[6], WG members discussed four initial alternatives on how best to move forward in determining the optimal ICA methodology for the planning use case.

1. Once the planning use case has been defined, an evaluation of methodology options could take place from scratch, similar to testing within Demo A and mirroring the ICA WG efforts from May 2016 to March 2017. This option would ideally lead to an optimal methodology to use within the

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[5] See slide deck from August 15, 2017, slide 11: https://drpwg.org/wp-content/uploads/2016/07/08.15.17-ICA-LNBA-deck.pdf

[6] See webinar recording from December 13, 2017:
https://attendee.gotowebinar.com/recording/4908234587864326402?assets=true

first iteration of ICA for planning, but would take significant time and potentially require a new demonstration project to test potential methods.

2. The iterative ICA methodology currently being implemented could be used as a starting point, and either Option 1 or Option 2A of applying load and DER growth forecasts could be initially adopted. This alternative would quickly lead to an initial development of forecast ICA values to use in planning, but should only be taken as an initial starting point, with the understanding that additional evaluation is required to develop an optimal methodology.

3. The third option is similar to the second option above, with the exception that each IOU would have the flexibility to choose an ICA methodology for the first iteration rather than only using the iterative method.

4. Finally, each IOU could have the flexibility to choose both an ICA methodology and an option for applying load and DER growth forecasts.

It is not clear to the full WG which option would converge on the optimum methodology the most efficiently. Whichever option is selected by the CPUC should additionally require evaluation of the methodology and technical requirements' effectiveness, costs, and limitations, and reviewed through a stakeholder forum.

The Joint IOUs support Option 4 above, and additionally note that, given there is no consensus on a given methodology of ICA for planning, each of the options discussed have a merit for use and each option can provide relevant information to be used in the planning process and develop a baseline to further refine the ICA methodology in future planning cycles. The Joint IOUs independently recommend that the Commission direct the IOUs to develop a planning ICA based on each IOUs' implementation capability. They additionally recommend direct reporting to the Commission with regards to results, learnings, and further recommendations for refining the planning use case for future planning cycles.

To recap from earlier, the WG makes the following suggestions to the CPUC:

- The CPUC should clearly define the planning use case, including the policy application, drawing on WG proposals and comments, consistent with the DRP Track 1 and 3 Decisions.
- The CPUC should provide direction on technical requirement questions that should be resolved once the use case is clearly defined.
- The CPUC should also determine the most appropriate means of continuing to support the identification of appropriate ICA methodology to support the planning use case in 2018. The WG agrees that this is a priority topic. WG members have suggested several discussion venues; ORA and IREC have supported authorizing an extension of the ICA WG, while the Joint IOUs ask the Commission to direct the IOUs to proceed with the use of one of the discussed methodologies based on each IOUs' capability and require direct reporting to the Commission on results, learnings, and recommendations, to prevent further delays. Additionally, with regards to the policy scenario analysis application (Application 4), the Joint IOUs propose that future discussion related to methodology to meet this application be developed through future workshops related to the third LNBA (DERAC) use case, as defined in CPUC Track 1 Decision (D.17-09-026).
- The CPUC should determine whether the use of ICA within the IOUs' 2018-2019 distribution planning process is a desired outcome.

4.2   Develop standard PV generation profile

The ICA WG agreed that the ICA maps would include two sets of PV ICA values (one with the operational flexibility limit and one without). In Demo A, the IOUs used a common PV profile to develop a typical PV ICA value. The ICA WG agreed that it would develop an appropriate PV ICA value using a typical PV curve, and during the long-term refinement phase review underlying assumptions and data used to refine the typical curve. This PV profile should be appropriate for use in interconnection approval of PV-based connections, so that if a proposed fixed tilt PV system is smaller than the PV ICA value, the size and location of the system will be deemed acceptable for interconnection. The PV ICA values are based on set of assumptions on a given installation and thus this limitation would be subject to fixed PV systems meeting such assumptions. Interconnection requirements are to be determined in the interconnection OIR.

The ICA WG agree on the following:

- The data used should be cleaned from inaccurate data fields, such as verifying the zero values for periods where PV output is greater than zero
- The proposed PV profile should have adequate temporal details covering 12 months of PV performance
- The PV profile should be developed with the same nameplate PV modules as that of the inverter nameplate (e.g., 100kw of PV modules connected to a 100kw inverter)

The WG discussed that the NREL PVWatts® Calculator can be used to develop a standard profile for the 2018 system wide role out. The joint IOUs state that, given that this information will be used for interconnection of DERs into the distribution grid, the IOUs will use PVWatts® in the short term but should continue to research the development of additional tools to create PV profile from utility sources of data without having to rely on third party data which may not be supported in future years. CALSEIA disagrees with this statement, and maintains that the NREL PVWatts® Calculator has been supported for a long time and is very reliable.

Each utility analyzed their service territories to determine the most prevalent parameters for PV systems, and input those parameters into the PVWatts® calculator to obtain performance (AC watts) information. The outputs of the calculator from the PVWatts ® tool are used to produce AC output value of PV curves for typical fixed PV systems at a regional level. The agnostic ICA values calculated by the ICA tool are then are used to generate a PV ICA value as was demonstrated in Demo A.

The three IOUs used different data specific to their service territories to create input parameters for discussion. These data sources are:

- PG&E: PG&E combined system specification data taken from their SolSource project, which accounts for historical irradiance and presents locational data in a gridded format, California Solar Initiative Data, ENOS data (interconnection list), and customer to DPA and customer to CECCZ mappings, combined with typical meteorological year (TMY)data, as input into PVWatts®. The output created 8760 profiles for each DPA.

- SCE: SCE took 100,000 PV systems from SCE's interconnection database to determine the most prevalent parameters to input into PVWatts®. PV-Watt weather stations nearest to the zip codes were will be used to develop regional PV output curves at 95 percentile shapes for its 8 service territory regions.
- SDG&E: SDG&E took data from seven weather stations and 500 data points, using the 95th percentile of data points as input into PVWatts®.

Table 2: The input data used in developing parameters for NREL PVWatts® Calculator

System Info	PG&E	SDG&E	SCE
DC System Size	1 (normalized)	1(normalized)	1(normalized)
Module Type	Standard	Standard	Standard
Array Type	Fixed	Fixed	Fixed (roof mount)
System Losses	14%	14%	14%
Tilt	20 (res.) 15 (com/ind)	18	18
Azimuth	180	180	180
DC to AC Ratio	1.0	1.0	1.0
PV Inverter Efficiency	96%	96%	96%
Ground Cover Ratio	0.4	0.4	0.4

The ICA WG is in consensus that these data inputs are appropriate and the utilities will finalize the PV curves used to develop PV ICA values in the first system-wide rollout of the ICA, pending IOUs' technical committees or management approval.

4.3   Smart Inverters

The IOUs conducted an initial analysis of smart inverter reactive power functions within Demo A, to test how the proposed volt-VAR curve would affect ICA values. The general finding was that prevalence of inverters with volt-VAR functionality can increase hosting capacity. However, Demo A did not allocate sufficient time for the IOUs to evaluate how the ICA tools may need to be modified to effectively incorporate this function without manual modifications.

These studies also only assumed reactive power priority, which is not yet required but has been proposed by the utilities for new inverters (active power priority is what is currently required under Rule 21). It was identified that volt-VAR with reactive (VAR) power priority will support greater ICA values. The WG discussed the benefits of volt-VAR with active power priority, but ultimately decided it is better to continue to assume reactive power priority because active power priority has fewer benefits for ICA

and is not worth incorporating into the ICA methodology if there is a reasonable likelihood that reactive power priority will become the standard in 2018

The ICA WG discussed the various smart inverter functions and agreed that volt-VAR with reactive power priority should be included in the ICA tool, pending additional engineering study to incorporate and develop functions for inclusion into the modeling tools by Cyme and Synergi. The IOUs will use the volt-VAR curve required in the Rule 21 tariff section Hh. The IOUs identified that incorporation of the functionality would follow the following three steps:

1) Perform internal research and analysis to determine how the tools should be updated to perform an automated ICA
2) Work with modeling tool vendors to incorporate the required functions
3) Update the ICA with smart inverter ICA values when the volt-VAR function has been incorporated into the modeling tool

The Joint IOUs recommended that additional engineering analyses should be conducted to make sure the functions incorporated into ICA are appropriate, results converge, and that the function can be fully incorporated into the ICA tool in an automated manner (rather than manually assigning the volt-VAR curve at each node). Non-IOU parties stated concern, and asked for clarification with regards to the necessity of performing the studies, as opposed to working with power flow analysis vendors to incorporate the volt-VAR modules into the tools. The non-IOU parties also asked the Joint IOUs for a draft implementation timeline of when they plan to work with power flow analysis vendors to incorporate the volt-VAR modules into the tools. The utilities agreed to conduct model runs of Cyme and Synergi to determine how to get the tools to converge with volt-VAR functionality included, then work with the vendors to incorporate the methodology into the software. The results of these engineering studies would then be shared with the software vendors to build appropriate smart inverter modules. When the smart inverter modules are built in the tools, the ICA will then be updated to incorporate the new volt-VAR smart inverter capabilities.

4.4   Comparative assessment

For Demo A, the IOUs used the IEEE 123 test feeder to compare results of both the iterative and streamlined methods, and between power system analysis tools. It was concluded that ICA results do not show significant variation when tested across the IEEE 123 test feeder, with slight variations attributed to how power flow models are treated between CYME and Synergi. However, the IEEE 123 test feeder is a simplistic 123 node 4 kV circuit which many WG members state is a low bar for comparison. The ICA WG recommended in its March 2017 Final Report that a more representative California feeder be used to conduct comparative analysis. This topic additionally aligns with two Group IV long-term refinement items: 1) development of ICA validation plans, and 2) definition of QA/QC measures.

The IOUs identified that the most appropriate first step is to conduct a third-party analysis of the IEEE 123 test feeder, and compare the results to IOU results. The IOUs made one minor modification to the

IEEE 123 test circuit during Demo A testing to ensure operational flexibility, and can make the modified file available to a third party for external validation.

The WG discussed how, and with what tools, non-IOU parties may be able to perform this validation. While similar tool comparison would ensure consistency, the WG also discussed whether different tools may additionally help with validation. The WG was not yet able to identify a qualified third party who would be willing to voluntarily, and at no-cost, to conduct the independent validation. It also has not decided whether the validation should be conducted using a similar tool or a different tool. Given that the WG could not identify a willing third party, the WG recommends that the Commission consider hiring a third party to perform the additional comparative assessment while the Joint IOUs perform the identified quality assurance and quality control (QA/QC) tests identified further in the report.

Additional EPRI and IEEE test circuits exist that are more representative of circuits in California; however, these include a significantly larger number of nodes. After third-party analysis is conducted, the WG agrees that additional comparative assessment using more detailed EPRI test circuits is appropriate.

Conducting comparative assessment is closely related to recommendations related to conducting independent verification and quality control/quality assurance (QA/QC), which are discussed further in the report under Section 7 (Group IV topics).

5. Group II topics

5.1 Single Phase Circuits

The ICA WG agreed that the location of single phase radials will be displayed in the IOUs' interconnection maps within the 2018 first system wide roll out of ICA in 2018. This iteration of the interconnection maps will identify the locations of all single phase line sections and their points of interconnection with three-phase feeders with a unique color. Conducting ICA on single phase circuits is currently not possible due to incomplete or less accurate information on single phase laterals. Two major sets of information are required in addition to that of what is required for three phase ICA calculations:

1. **Phasing information.** This information depicts how the electrical single phase and its single phase load (aΦ, bΦ, cΦ) is connected to the 3 phase system. In the modeling of the network, it is important that the each of the laterals accurately represents to which phase it is connected in the field. Not having the proper phasing information may potentially yield inaccurate ICA values.

2. **Single Phase fusing information.** This information depicts how the single line radials are protected. In order to calculate the ICA value for protection, the fuse size is required to ensure that the ICA value does not exceed what the ratings of the protection fuse.

In addition, there are limitations to current ICA modeling tools to evaluate voltage imbalances, load imbalances, protection limits on imbalance load, etc.

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The ICA WG agrees that the feasibility of extending ICA to single phase circuits should be evaluated, and that, if deemed viable, whether methodological modifications are required based on the unique characteristics of single phase circuits and the loads and DER connected to them.

The Joint IOUs propose to begin an evaluation of one feeder to better understand what would be required to extend ICA to single phase laterals, to begin Q1 2018 and deliver results Q2 2018. This study will help the IOUs better understand 1) the level of complexity needed to accurately determine the properties of each single phase radial, 2) the cost of having to verify each single phase radial; 3) the time required to complete a system-wide evaluation; 4) the capabilities of the existing modeling tools to account for impacts of single phase DER installations; and 5) the potential use of single phase ICA values.

The WG is not in consensus with the IOU proposal, with some WG members expressing concern that system level conclusions cannot be gleaned from evaluating a single circuit. ORA's written comments assert that IOUs should already have a good understanding of the scope of the issue and potential mitigation costs, based on CPUC guidance. ORA further notes that the IOU proposal provides limited details explaining why a single evaluation on one circuit (compared to a more detailed evaluation) will yield sufficiently accurate estimates for each IOUs' system. ORA also asks for additional information on why the IOUs do not currently have sufficient information on single phase radials, and whether that lack of information impacts planning and operations. As next steps, ORA has proposed that each IOU should provide a proposal that summarizes the following:

- Scope of single phase or other types of circuits (e.g. two phase, network, etc.) currently excluded from the ICA in terms of circuit miles and customers served
- Summary of the types of customers currently connected to non-three phase circuits
- Summary of the types of DER currently connected to non-three phase circuits
- Detailed information on the type of required circuit data that is not currently available, and the scope of the lack of data
- Detailed information on the quality of existing data, and the steps required to convert the data into model inputs consistent with ICA requirements
- An explanation of why the required data does not currently exist, and how the IOU meets the requirements of PUC 451 without this data. This explanation should include discussion of planning and operational procedures that are used in lieu of this data
- Existing challenges the IOU is experiencing because of the lack of data
- A detailed evaluation plan describing how it will determine an accurate system wide cost and schedule for collecting and validating the required data, and making the data available to the ICA calculation process
- Results of discussions to date with ICA software vendors regarding the technical challenges, estimated cost, and timing of extending ICA to single phase circuits, and
- List of related pilot, demonstration, or other RD&D projects and current estimate of completion

The Joint IOUs respond that the level of work required as proposed by ORA is unnecessary, given the limited benefit that it would provide and can provide delays to finishing larger items such as implementation and planning use case. The Joint IOUs have stated in WG discussions that currently, the

IOUs successfully interconnect the majority of projects (PV and PV paired with storage) - most of which are single phase - within a few days with no upgrades. This is because single phase radials are generally properly sized to meet the need of the customers and their DER sizing capabilities allowed under the NEM sizing limitation. Further, developers are not interested in interconnecting large DER directly into a single phase line, as single phase service is not adequate to provide the required electrical service to the large DER owners. Therefore, the added scope of collecting data, validating, adjusting models, and modifying the tools will be quite significant with limited benefit given the fast interconnection times for small residential DER which are typical for single phase line sections. The IOUs instead recommend that this topic be revisited once ICA is implemented and after IOUs have single phase/phasing fully incorporated into their models.

5.2   Method for reflecting the effect of potential load modifying resources

In the ICA WG formed for Demo A, some stakeholders expressed desire for the ICA to reflect the effect of load modifying resources (LMR). The final WG report included this item as a non-consensus item based on its proposed definition and recommendation to use probabilistic modeling approaches. During the long-term refinement phase of work, the ICA WG is in consensus to maintain current ICA calculation methods using power flow analysis, given that this method reflects load modifying resources within the existing load curves.

ORA noted that additional investigation of more robust methods to reflect the impact of LMRs is needed. The load modifying characteristics of DER included in current load profiles are static, include many assumptions to provide a single load curve per circuit, and that the value of DER as flexible LMRs may be underestimated using the current approach. ORA and Clean Coalition recommend that this issue be considered a long-term topic to be addressed early in 2019 once the initial ICA has been deployed and stakeholders have had the opportunity to use it for each adopted use case

5.3   Operational flexibility

Currently, the IOUs do not consider the impact of DERs on adjacent circuits during abnormal operating conditions. However, the IOUs believe that with the increased penetration of DERs, this impact should begin to be assessed. To study this under Demo A, the IOUs used two power flow scenarios to test ICA: a no-reverse flow scenario, and an ICA value irrespective of power flow direction across SCADA devices. Demo A results showed that the operational flexibility ("OpFlex") criteria has a significant impact on overall ICA values. Based on these results, the WG recognized that the method used to determine operational flexibility may be overly conservative, and recommended that two ICA values are published for the first system-wide roll out (one with operational flexibility limitations, and one allowing reverse power flow across SCADA operated switches and reclosers). This was deemed a reasonable short-term solution.

For long-term refinement, many WG members placed high priority on developing a new approach to understanding operational flexibility results, enabled by an improved understanding of the ICA's ability to evaluate a large number of scenarios and configurations or by a discussion of how the utilities study

the operational flexibility impact of an interconnection application that requires such a study. This improved value is expected to replace Screen P (the Safety and Reliability Screen) within the Rule 21 process.

The Joint IOUs agreed to begin working with vendors and the research community on best methods to analyze abnormal switching conditions. The Joint IOUs identified several challenges in developing a non-heuristic method to address operational flexibility, including:

- There is no efficient method to create abnormal switching conditions in vendor tools other than manually opening and closing switches
- There could be hundreds of switching scenarios for a circuit, so the IOUs are challenged in finding a way to limit switching scenarios and decide which will be the most applicable configurations
- Calculation times and computing costs will significantly increase due to the multitude of possible switching conditions

While no conclusion was drawn, the ICA WG discussed that operational flexibility may be better applied in operational situations and configured on an as-needed basis, rather than pre-calculated for inclusion into the ICA tool. An EPRI presentation to the WG at the September meeting also suggested that it may be more practical to recalculate hosting capacity on a daily basis, and use those results to potentially curtail DER.

It was also discussed that the operational flexibility limitation may be resolved in the future with either the implementation of a Distributed Energy Management System (DERMS) capable of evaluating operational restrictions on a real-time basis, and/or the scheduling function in Phase 3 smart inverter standards, which may be able to address operational flexibility by curtailing systems during abnormal operating conditions. However, operational flexibility should still be properly modeled within the ICA methodology. Some non-IOU parties have suggested limiting the number of devices that the IOUs are using to segment feeders for calculating potential backflow.

While the ICA WG did not agree on a process for how the operational flexibility limit will be considered in interconnection, WG members propose to coordinate with the Rule 21 Working Groups under R.17-07-007 to decide how the limit can inform specific requirements that may be needed within the interconnection process. In concurrence, the IOUs will also continue their work with the research and vendor communities on efficient and reasonable techniques to perform ICA on abnormal switching conditions. CALSEIA further suggests that, in the absence of more detailed methodology, that R. 17-07-007 may be an appropriate venue to consider the conditions under which backfeed ICA values vs. no-backfeed ICA values should be used.

Finally, it is noted that the WG did not discuss how the operational flexibility limit is taken into account in the planning use case.

Some ICA WG stakeholders stated that the IOUs should develop a more thorough classification of circuits and devices to better understand the limitations of the operational flexibility criteria. Two stakeholders provided specific recommendations:

1. ORA recommends that each IOU catalog the SCADA devices in its distribution system that will be used in the short term OpFlex criteria and provide the results to the CPUC and ORA. Without this data, the CPUC will lack an understanding of how restrictive the OpFlex criteria is, and the level of added accuracy other alternatives provide relative to the short-term OpFlex criteria. This information will allow the benefit to be defined in cost benefit analyses which should accompany an evaluation of alternatives.

2. CALSEIA recommends that utilities should improve their data quality and classify circuits to determine which circuits are stiff enough that they will allow for operational flexibility even with reverse power flow from DERs, and those that are less stiff where operational flexibility will be significantly compromised by reverse power flow. This should include the following criteria: a) voltage regulation capability including automated voltage regulators, b) power electronic voltage controllers like D-STATCOM, c) automatic capacitor banks controls, d) configurable relay settings, e) storage capacity. As an example, some utilities already undergo circuit classification to determine whether they are good candidates for CVR. CALSEIA states that this process of classification would improve utility data on system assets.

With regards to next steps, the non-IOU WG members recommend that the CPUC consider this topic for further refinement at a later date, given that there was not an immediate solution presented to improve current modeling. These parties also note that the CPUC should also make a determination on the recommendations made by ORA and CALSEIA with regards to classification of circuits and devices.

The Joint IOUs see these data elements suggested by non-IOU stakeholders as not sufficiently addressing the operational flexibility and more qualitative in nature requiring extra engineering context. The IOUs recommend that stakeholders request these elements to be added to the Rule 21 Pre-Application in their respective Rule 21 proceedings. The Pre-Application provides similar data points about circuit configuration and line device information with the appropriate engineering context needed to assess these data points.

5.4   Queued projects in online maps

The WG is in consensus that the online maps should reflect queued projects on a given circuit and indicate if an earlier-queued project has absorbed the stated available capacity since the most recent ICA update. This refinement requires coordination with the Rule 21 proceeding discussions on the public interconnection queue.

5.5   DERs serving peak load

One member of the ICA Working Group reviewing Demo A proposed that ICA should include additional load profiles to allowing scheduling of DERs to meet the demands of hot days, while self-restricting generation on cold days. The ICA WG identified it as an additional non-consensus long-term refinement item in the development of the December 2016 Long Term Refinement Report. Additional discussion

focused on 1) whether additional load profiles are necessary, and 2) how increased granularity in load data may be useful to include in the ICA tool.

Applicants to Rule 21 and WDAT are not restricted on system size; rather, interconnection agreements provide dispatch limitations to prevent criteria violations. The ICA tool provides indication as to the size of DER required to meet high load conditions, while also providing the most likely dispatch limit during low load conditions. While additional load data granularity would help DER developers better understand possible operational configurations and interconnection parameters to allow a customer to optimize the sizing and operation of the system, currently DER developers designing projects operated to closely track load curves will likely undergo interconnection review.

 The IOUs also noted that they believe that many of the concerns identified in the earlier scoped proposal from Dec. 16 will be addressed with the implementation of DERMS to allow real-time dispatch instructions, as well as smart inverters to allow DERs to schedule dispatch based on day-ahead schedules and respond to real-time signals. The adoption of these tools will increase DERS' ability to load follow. The WG does acknowledge that when the ICA limit is noted to be a protection limitation, the ability to increase the size of DER behind the ICA may not be available.

The ICA WG agrees that the existing ICA curves adequately account for high and low days, and that no modifications to the ICA are necessary at this time to enable the design of appropriately sized DER systems to meet peak load. At this time, the WG determined that immediate work to increase the granularity of peak load data is not a high priority, but could be an issue that is revisited over time as ICA is deployed, and its potential role in project siting and operations is better understood.

6. Group III topics

6.1 Ways to make ICA information more user friendly and easily accessible (data sharing), Interactive ICA maps, and Market sensitive information

 The ICA WG discussed these three long-term refinement items (Items A, 8, and 9) as a group, given that they all relate to IT requirements for data sharing, access to market sensitive information, and expanding the functionality and range of data displayed on ICA maps. The WG agreed that many of the questions posed were best answered by envisioned future users of the ICA tool, which were not fully represented within the ICA group. The WG hosted a one-hour "Introduction to ICA" webinar aimed at DER developers to solicit input on what modifications may make the ICA maps and downloadable data sets more user friendly. The WG also hosted a one-hour call with a smaller subgroup of DER developers specifically focused on the development of a queryable application programming interface (API).

The recommendations discussed in this report section thus represent discussion from both the ICA WG and a separate subgroup of DER developers.

6.1.1 Ways to make ICA information more user friendly and easily accessible

Currently, the ICA online maps require a user either to search for each specific location on the map and point-and-click to extract relevant information, or type in an address, then copy and paste the data into the user's application. It is not feasible to do this for some applications when users are assessing opportunities for deploying a high volume of DERs on multiple circuits that require many potential interconnection locations to be evaluated. The WG discussed that an API capability would allow a user to programmatically extract this information from the ICA online maps' back-end servers in bulk, which will save time and resources and make more robust use of the ICA possible.

An API is a commonly-used internet tool that enables users to draw data that is available via a website directly into a remote application. DER developers have tools that model DER design and economics. An API would enable users to work within their own design tools and draw on the ICA data. If they are forced to manually search each location by address and copy and paste data into their design tools, it will greatly limit the ways in which ICA can be used.

During the "Introduction to ICA" webinar[7], held with 200 participants (primarily DER developers), a question was raised regarding the availability of API capability for the ICA online maps, where the IOUs mentioned the capability is not currently available. At the following WG meeting, CALSEIA identified this topic as a priority item, supported by multiple other WG members, due to its usefulness to DER developers, and the WG agreed to host a second conference call with a smaller group of stakeholders to discuss API capability. Subsequently, a conference call was held with the IOUs and select likely users of the ICA online maps (DER developers) to discuss the request for developing the API capability. The API capability would allow users to programmatically collect the data presented in the ICA online maps including, but not limited to, location of circuits, existing and projected load profiles of circuits, identified hosting capacity, etc. The preferred method for API development would be for IOUs to follow the ESRI ArcGIS built-in capabilities as shown on: https://developers.arcgis.com/python/.

PG&E and SDG&E stated that potential privacy and security issues in providing full access to such things as system and circuit maps, location of assets and circuit routes that may prevent them from developing an API capability. SCE stated that they have API functionality available in its ICA map, but need to work with ArcGIS developers to make this data accessible to users.

CALSEIA disagrees with PGE and SDG&E and contends that simply providing the hosting capacity values geographically poses no security or privacy risk, given that the data is already available in a less user-friendly fashion. IREC similarly has concerns that blanket statements about security concerns are not sufficient here and there needs to be a more robust explanation of the concerns and discussions about how to address them rather than forcing the ICA to be in a highly un-user friendly format. Clean Coalition additionally notes that an ability for users to select a specific range in the ICA maps (see Section 6.1.2 below) may partially mitigate API restrictions, allowing easy identification of circuits conforming to ICA value ranges associated with standard DER profiles.

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[7] The webinar recording may be found here: https://attendee.gotowebinar.com/recording/1115282309039012355

In determining next steps, it would be helpful for the Commission to make determinations on:

- What is the exact nature of the security or privacy concerns identified? Are there proxies or alternatives available? For example, the Commission could decide that some types of information could be made available via an API - if so, which data should be available and which should not?
- What are the IT and other engineering resources required to develop API functionality?

Based on these determinations, the Commission should then identify appropriate next steps on whether an API should be a required development.

6.1.2 Interactive ICA Maps

Based on discussions with the ICA WG and a group of DER developers on the "Introduction to ICA" webinar, the WG identified the following updates to the ICA map that can be implemented during the first system-wide rollout to as much as the utility mapping system may allow:

- The joint IOUs should use the same key and color scheme to represent integration capacity on the maps, and the color ranges used to indicate hosting capacity ranges should be uniform across the IOUs. Red should represent a lower ICA (closer to the capacity limit) and green should represent a higher ICA.
- The range that the colors represent should also be uniform. The Working Group discussed whether a fixed (e.g., MW increment) or relative range (e.g., 20% increments over the specific circuit) would be more useful, and it was decided that fixed range would be most useful for users. The Joint IOUs propose to work together to decide the range of fixed values. Clean Coalition suggests that a fixed range KW range of <10, 10-99, 100-499, 500-999, 1000-2999, 3000+. IREC notes that increments need to be granular enough to be relevant to both small and large developers.
- Load profiles should be displayed in a standardized format and the axis units should be labeled.
- For data that cannot be published due to customer confidentiality issues around load profiles, the ICA map should include a footnote of why that data is unavailable rather than showing a blank.

Finally, some WG members suggest that the RAM map should be made available either as a toggle, or a separate tab directly part of the ICA map interface, given that the RAM maps include circuit information, such as line voltage, that is important to include for users. SDG&E and SCE disagree and state that this option may be confusing to users, instead proposing to phase out the RAM map and have users utilize only the ICA map.

The ICA WG also agreed that an ICA User Guide should be created to facilitate the use of the ICA tool by developers. The ICA User Guide should be available by the first system-wide rollout, and should include the following information, at a minimum:

- How to access and understand the downloadable Excel file
- Explanation of the power system criteria limits

- Explanation of the different ICA values shown (load, generation, and PV, with and without the operational flexibility criteria)
- How to use the ICA Translator tool
- Provide clear understanding of the outcome of the ICA process

6.1.3   Market sensitive information

The Track 3 Proposed Decision will address some of the data access and market sensitivity questions the ICA WG has identified in its discussions, through the Grid Needs Assessment required for grid modernization. The WG discussed that there are market sensitivity issues with regards to certain load profiles that meet the 15-15 Rule. For these profiles, the WG recommends that the IOUs should state clearly on the maps why the data does not exist, rather than displaying a null value.

6.2   Incorporate findings and recommendations from DRP Track 3 Sub-track 1 on DER and load forecasting into ICA as appropriate

The ICA planning use case envisions that ICA will assist with future planning decisions. ICA, combined with growth forecasts (discussed under DRP Track 3, Sub-track 1), can be used to identify circuits that require upgrades to accommodate forecasted DER. This activity will take findings and recommendations from CPUC Final Decisions on Track 3 issues and incorporate any necessary changes into ICA, as appropriate.

The WG discussed that ICA can be used in conjunction with growth scenarios to inform the planning process and guide decision making. The results from the ICA process are not intended to be a solution set, but only an identification of forecasted hosting capacity. Thus the direct results of ICA in the planning context, which includes a forecast of net load growth, will not directly result in IOU identification of needed upgrades and/or projects. It will simply be a point of information on deficiencies to host forecasted DERs which will be fed into the planning process to find coordinated solution sets with other planned work on the system. However, this does not mean that relative accuracy of those results is not important since it will be a first step in determining where to analyze further.

The WG is in consensus that the growth scenario requirements adopted in Track 3 Sub-Track 1 will be used with ICA. A potential exception, depending on the final Track 3 Decision with regards to growth scenarios, is that wholesale growth forecasts will not be included due to a lack of locational granularity and certainty, and cost allocation concerns, given that wholesale projects pay to mitigate their interconnection costs. It is acknowledged that not including wholesale projects may mask additional opportunities for cost sharing and use of DERs to defer upgrades. The WG recommends that ongoing review and development of the ICA should maintain consistency with CPUC direction regarding incorporation of load and DER forecasts, and that any deviations be articulated and justified by the IOUs.

6.3   Voltage regulating devices

The Commission authorized the IOUs to model voltage regulating devices in the initial system-wide rollout, as was done for Demo A. The IOUs are currently working with software vendors to incorporate this function as part of the software modeling tools. The IOUs suggested that this implementation should be done in a way that accounts for computing power and ability to meet the needs of ICA updates. The IOUs will report progress of this work in the system implementation interim reports.

7. Group IV topics

7.1   Development of ICA verification plans

This item was originally scoped in December 2016 as part of the initial long-term refinement efforts. That written proposal asked four scoping questions on the objective of validation, components that should be verified, acceptable amounts of uncertainty, and appropriate data sets to perform validation. The WG did not have the opportunity to discuss this item in detail, but generally agrees to the following guidelines to develop ICA verification plans.

Objectives of validation: the main objective of conducting validation is to provide transparency and confidence on the results. This can be approached in two ways: 1) to compare across tools used (conducted as part of comparative assessment), and 2) evaluate the usefulness of the results towards their application. To the latter, the ICA WG agrees that the IOUs should review and compare results as ICA is implemented and integrated into the Rule 21 process, to evaluate its effectiveness in streamlining the interconnection process.

Verifying input components: One of the main input (data) components that is important to verify is the load allocation inputs to the model. The IOUs agree to continue alignment of how hourly metering data is used (this is further discussed Section 7.3: Explore divergences and tradeoffs between load shape methodology).

Validation of the tools and comparison of methodology is conducted through comparative assessment. The IOUs will use the results of comparative assessment to continue validation and comparison across their separate tools. This will include the use of reference circuits more representative of California feeders.

Existing uncertainty, acceptable uncertainty, and where it can be reduced: A major source of uncertainty for the IOUs is understanding how circuit loading is allocated in the model. The IOUs will continue alignment in the use of hourly metering data under Item 9.

Appropriate data sets to serve as a reference point for validation and third party improvements to the ICA method: The IEEE 123 feeder serves as the most appropriate data starting point for validation currently; after comparative assessment is conducted, additional data sets may be identified. One WG

member recommended that the IOUs continue to compare and validate ICA results using reference circuits more representative of actual IOU circuits compared to the IEEE 123 circuit.

With regards to next steps, the WG agrees that the ICA validation plans will be conducted following these general guidelines. Results of validation through comparative assessment and comparisons with interconnection studies may be addressed in the system implementation status reports and on an ongoing basis.

7.2   Definition of quality assurance and quality control measures

The ICA WG agrees that the IOUs should design, document, and implement QA/QC plans that demonstrate to the CPUC and stakeholders that the ICA results are accurate and thereby useful. Conducting QA/QC provides additional transparency and builds confidents around ICA results. This is achieved through discussing methods and assumptions with stakeholders, comparing independent ICA results with other stakeholders, and comparing the ICA results to the operational data point of intended use.

Many new processes, including circuit modeling, calculation, data management, and presentation of data will be developed to support the first system-wide deployment of ICA in 2018. In addition, performing system wide ICA per D.17-09-026 requires a monthly review of circuit changes and rerunning the ICA on circuits that have changed, a process which involves extensive data management. Every step of the ICA process is subject to errors that must be subjected to a rigorous QA/QC plan to avoid, identify, and mitigate errors to ensure ICA results are accurate.

The IOUs propose to conduct QA/QC through comparing the resulting ICA data points to its intended use within the interconnection process and for planning purposes, to ensure that the ICA results are accurate based on current and complete input data. Defining appropriate QA/QC measures is defined by use case:

- Interconnection QA/QC: effectiveness of ICA in providing appropriate answer to pass Rule 21 screens when compared to the results of the normal interconnection study process
- Planning QA/QC: the validation and replicability of ICA results within different tools and stakeholders

To conduct interconnection QA/QC, the IOUs agree to evaluate the results of ICA with their actual use within the Rule 21 interconnection process (e.g., evaluating the calculated ICA results against their ability to pass Screen F (short circuit current contribution) within the Rule 21 Fast Track process.). The existing interconnection process will provide a good baseline of assessment for which to perform QA/QC given its long history.

To conduct planning QA/QC, the IOUs agree to utilize the comparative assessment across stakeholders and tools via their efforts to conduct verification plans and comparative assessment.   This is the appropriate route given that the ICA planning process is still in development and the fact that planning is

a forecast/modeling exercise with limited baseline comparison points. The IOUs should propose a plan and timeline for accomplishing this analysis.

The ICA WG is in non-consensus with regards to when QA/QC plans should be developed. The IOUs recommend that QA/QC plans should implemented a formalized QA/QC after the first system rollout. ORA recommends that, given that performing system-wide ICA requires a monthly review of circuit changes and re-running the ICA on changed circuits, the extensive data management needed warrants that QA/QC plans be developed as part of development and deployment of the initial statewide ICA deployment, and provided in conjunction with the final status report required per D.17-09-026, Ordering Paragraph 9.

7.3 Explore divergences and tradeoffs between load shape methodology

The IOUs are employing the methodologies for determining load shapes that were used in Demo A during the first system wide rollout. During the May 2016 – March 2017 phase of the ICA WG, which focused on discussing the results of Demo A, the WG discussed the IOUs' methods of using customer load data and advanced metering infrastructure to develop more localized load shapes. Some stakeholders had asked for additional clarification as to what differences exist in the IOUs' methods, as it was identified that SCE and PG&E used one method, and SDG&E used a different method. The WG agreed to revisit this item during the long-term refinement phase to better understand the differences between the methods used in Demo A and discuss proposed improvements.

During WG discussion, the IOUs detailed that they create load shapes using data from the following profiles:

- Customer load profiles: utilities use AMI data aggregated at the service transformer
- Service transformer load profiles: this data is aggregated from customer profiles
- Circuit and substation load profiles: these are developed from SCADA data when available

After clarifying the IOUs' method, the WG agrees the current methods should be used for the first system-wide rollout.

8. Recommendations for future ICA WG action

The ICA WG identified multiple recommendations which require additional CPUC direction, and/or discussion or follow up within a stakeholder group. The DRP Proceeding has currently not scoped any additional meetings of the ICA WG. The WG agrees that some items require additional discussion; multiple stakeholders have suggested venues for revisiting these topics. The CPUC should determine the appropriate means of revisiting such topics.

Various WG members have suggested potential avenues for continued discussion, including (but not limited to) another iteration of the ICA WG to address continuing refinement issues, or addressing ICA refinements through DRP Working Groups focused on Track 3 issues, including the GNA process and

DPAG review. The Joint IOUs have additionally proposed moving discussion on using ICA for policy scenario analysis to the ED-led process on the DERAC/cost-effectiveness use case for LNBA. There is not WG consensus on any ideal venue for revisiting ICA issues. Additionally, some issues are time sensitive, others rely upon discussions in other CPUC proceedings, and still others rely on a review and comparison of results after the IOUs complete their first system rollout of ICA.

A resulting Commission Decision is asked to identify appropriate avenues to revisit unresolved and continuing ICA methodology topics using a robust stakeholder process.

Appendix A

Table 3: Summary of ICA Working Group Meetings and Meeting Documents

July 7	Webinar recording Slide deck High level project plan proposal Meeting notes Participant list
August 15	Webinar recording Slide deck Participant list
September 19	Webinar recording Slide deck Participant list
October 11	ICA Demonstration Webinar: Webinar recording
October 17	Webinar recording Slide deck Participant list
November 13	Webinar recording Slide deck Participant list
December 13	Webinar recording Slide deck Participant list

Table 4: Summary of Written Proposals and Written Comments

All proposals may additionally be found online at: http://drpwg.org/sample-page/drp.

Topic	ACR or Working Group Report Item	Written proposals	Written comments
Further define ICA planning use case and methodologies	Group I: WG Report Item 1	Joint IOUs	
		Joint stakeholder parties (IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem)	Joint IOUs
		Modified proposal seeking consensus: Joint stakeholder parties (ORA and IREC)	Joint IOUs

		Joint IOUs: policy scenario use case framework	Clean Coalition IREC
Develop standard PV generation profile for use in online maps	Group I: WG Report Item 2	Initial proposal: Joint IOUs Updated proposal: Joint IOUs	Clean Coalition
Develop methods and tools to model smart inverter functionality in ICA calculations	Group I: WG Report Item 5	Joint IOUs	Joint stakeholder parties (CALSEIA, Clean Coalition, IREC) Response: Joint IOUs Response: CALSEIA and IREC Response: Joint IOUs
Perform comparative assessment of IOUs' implementation of ICA methodology on representative CA reference circuits	Group I: WG Report Item 8	Initial proposal: Joint IOUs Revised proposal: Joint IOUs	
Expansion of the ICA to single phase feeders (*requires creation of network models for single-phase feeders*)	Group II: ACR Item A	Joint IOUs	ORA
Method for reflecting the effect of potential load modifying resources on integration capacity	Group II: ACR Item E	Joint IOUs	ORA
Develop a non-heuristic approach to modeling operational flexibility	Group II: WG Report Item 4	Joint IOUs	ORA
Consider how online maps could reflect queued projects on a given circuit (*requires coordination with Rule 21 rulemaking and public interconnection queue*)	Group II: WG Report Item 6		
DERs that serve peak load	Group II: Interim Report	Joint IOUs	IREC

Ways to make information more user-friendly and easily accessible (data sharing), interactive ICA maps, and market-sensitive information *(pertain to IT requirements for data sharing, access to market sensitive information, and expanding the functionality and range of data displayed on ICA maps)*	Group III: ACR Items B, C, and D	More Than Smart	Comments on API functionality: CALSEIA
Incorporate findings and recommendations from DRP Track 3 Sub-track 1 on DER and load forecasting into ICA as appropriate	Group III: WG Report Item 3	Joint IOUs	ORA IREC Response: Joint IOUs
Voltage regulating devices	Group III		
Development of ICA validation plans, describing how ICA results can be independently verified *(need to solidify ICA methodologies for interconnection and planning use cases before developing validation methods)*	Group IV: ACR Item F	Joint IOUs	ORA Response: Joint IOUs
Definition of quality assurance and quality control measures *(need to solidify ICA methodologies for interconnection and planning use cases before developing validation methods)*	Group IV: ACR Item G	Joint IOUs	ORA Response: Joint IOUs
Explore divergences and tradeoffs between the employed by SCE and PG&E v. SDG&E to create load shapes at the feeder, transformer, and customer levels	Group IV: WG Report Item 9	Joint IOUs	

Appendix B

Appendix B is provided for reference only, i.e., to provide context for the proposals in the Final Report, but should not be considered a full component of the Final Report's recommendations.

Item 1: Planning Use Case

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- IOUs recommend that the term "planning" use case refer only to use cases that will directly feed into distribution planning activities. The two visions should be considered separate and distinct use cases.

- Evaluate proposed options of assessing DER growth scenarios within ICA

Introduction and Background

The ICA WG identified two use cases for ICA: 1) to inform and improve the Rule 21 interconnection process, and 2) to inform and identify DER growth constraints and opportunities in the planning process. The interconnection use case is detailed in the Final ICA WG report. With regards to planning, the ICA may be used to inform the distribution planning process by identifying when and where capacity upgrades may be needed as a result of DER growth, as well as where there is opportunity for additional DER deployment and where DERs could be used to address capacity constraints using various growth scenarios. The ICA has been identified by the CPUC for use in multiple planning processes, including, but not limited to, grid modernization (within the DRP proceeding) and the IRP proceeding.

The ICA WG will determine how the ICA may inform and identify DER growth constraints and opportunities in the planning process; in which applications and how ICA may be used; and in what methodology (streamlined or iterative), levels of granularity and frequency of updates, may best serve the planning use case.

Clarification of Multiple visions of "planning use case"

During the Working Group discussion, it became clear that stakeholders had different visions for the definition and purpose of "planning use case." Two distinct versions emerged from the discussion:

"**Distribution Capacity Planning Use Case**": This purpose of the use case is to *identify system needs expected to be created by future DER growth, for the purpose of preemptively addressing these needs.* This use case is envisioned to become an integral part of utility operations and feed in directly to the utility annual distribution planning process. The outcome is expected to be either IOU capital investment to meet the need, or sourcing of DERs to defer the conventional investment. Thus, forecasts

and other policy assumptions should be consistent with current commission policy for distribution planning and investment. **This IOU proposal contained in this write-up refers to this Distribution Capacity Planning Use Case**.

"**Policy Scenario Analysis Use Case**": This use case would involve alternative assumptions for growth scenarios, policies, tariffs, incentives, etc. The outcomes of this use case would clearly *not* feed into any utility operations, planning or investment activity. Rather, the results of this use case would inform future policy discussions. This use case has not yet been well defined. The IOUs invite stakeholders to develop proposals for this use case. Many questions that need to be addressed regarding what scenarios would be analyzed, how (and in what forums) the results would be used, and whether there would be incremental ratepayer cost to fund these analyses. While this use case is not yet defined, the IOUs' tools will be able to accommodate this use case: it is not a question of developing new tools to accommodate this use case; rather, the current need is simply to define the assumptions and use of this use case.

These are two *different* use cases. Whether or not one refers to both use cases under the umbrella term of "planning," it is critical to recognize the fundamental difference in these use cases: The former use case is envisioned to provide results that will be incorporated into actual IOU operational activities. The latter case is envisioned to provide results that inform policy decisions, *but will not directly be used in utility activities* as the results are based on policies, forecasts, or other assumptions that have not yet been adopted. To avoid confusion, the IOUs therefore recommend that these two visions be considered separate and distinct use cases. Furthermore, to avoid confusion, the IOUs recommend that the term "planning" use case refer only to use cases that will directly feed into distribution planning activities.

Technical Discussion

It is important to acknowledge that ICA is intended to determine deficiencies in the grid to integrate DER, but not the solutions. ICA can be useful to help identify locations and timing of deficiencies, but further review and engineering is required to determine the solutions to mitigate. The hosting capacity upgrade would also have to be coordinated with the normal planning efforts to not duplicate any work already being proposed.

Timing

It is proposed that the IOUs perform in a similar cadence and timing that aligns with distribution planning efforts. Analysis would be performed once a year after the load forecasting is complete and before final distribution analysis is performed. The analysis would be seen helpful to be done in a 1 to 5 year planning horizon. Anything past 5 years on the distribution circuits is not as precise unless you are looking are larger scale impacts at the substation.

Types of Resources Analyzed

The California ICA working group and methodology has thus far been focused on the interconnection use case which isolates analysis to single interconnections. The analysis has reflected this by only really considering the impacts of single DER placement on a circuit. In the planning context, it is important to understand the broader impact of multiple generators and what the combined aggregate effect would

be over a longer time frame. As ICA progresses, it is important that the components of the tool be able to consider a dispersion of smaller DER throughout the circuit. EPRI's tools have developed to be able to include analysis of this dispersion and the working group should research and explore the incorporation of these techniques in order to properly consider DER for the planning context.

Using the DER Growth in the Analysis

One challenging fact is that the utilities can't forecast growth to the nodal precision of the models with proper accuracy. Typically we will have growth factors granular down to the feeder at the max. The IOUs must then determine how feeder level growths are to be considered in a nodal level analysis. Two general ways of inclusion have been identified which are:

1. Pre-Analysis Modeling

2. Post-Analysis Comparison

    a. Based on single DER ICA

    b. Based on dispersed DER ICA

The first approach would take the expected growth and embed within the load allocation methods to distribute into the model. The dispersion would assume the same dispersion of load on the circuit. While not as sophisticated, this approach seems reasonable to perform in the short term while more complex approaches are being explored.

The second approach would not change the input to the model to reflect the DER growth, but compare the DER growth to the calculated ICA. For instance, if ICA is calculated to be 1MW and DER growth is 1.5MW than there would be a 0.5MW deficiency to be addressed. As mentioned earlier, it could be deceptive when performing this if comparing retail growth to single DER ICA. This is why there are two options under approach 2. The first would calculate based on single DER ICA and the second would calculate based on dispersed DER ICA. Ideally the tools would need to properly consider dispersed DER in the analysis, but this is not fully supported yet in the tools. The other challenge to the post analysis approach is how to determine which forecasts to embed in the future time horizon and which to analyze post analysis.

The IOUs will explore the different options and evaluate which one will be the best to implement moving forward.

Conclusion and Next Steps

- Determine the definition of the "Planning" use case and if we need to define a new use case

- Determine DER forecasts to include to use in the Distribution Capacity Planning use case.

- IOUs to evaluate best option of implementation of incorporating growth scenarios as well as the best long term

Item 1: Planning Use Case

Draft Non-IOU Proposal (IREC, ORA, SEIA, Vote Solar, Clean Coalition, Stem)
ICA Working Group

Summary and Next Steps

- All anticipated planning use case scenarios are defined in this report.
- IOUs recommend that the term "planning" use case refer only to use cases that will directly feed into grid investments.
- Non-IOUs recognize that "planning" encompasses both the annual Distribution Planning Process that will likely be addressed in a Track 3 decision this fall and broader planning activities that shape the grid, including policymaking.
- Non-IOUs recommend that the planning use case be defined and evaluated before defining a methodology that will be used for the "planning" ICA or ICAs.
- Open issues to be evaluated and resolved:
  - Define desired functionality of the ICA for the planning use case
    - This could be characterized as multiple different use cases, or rather an identification of the specific ways it would be used in order to shape ICA modeling functionality (scenarios).
  - Define ICA requirements for the use case, while considering future needs for additional functionality
    - Incorporate findings, conclusions, and orders from the Track 3 proposed decision to help define planning use case, understanding that these are draft pending a final decision
    - Incorporate input from IRP proceeding
  - Evaluate proposed options of assessing DER growth scenarios within ICA
  - Determine if the iterative methodology and process for producing ICA values and maps can be modified to meet planning use cases, or if another methodology is needed.
  - Determine if any of the identified functionality will be difficult to meet within current capabilities and/or reasonable costs. Prioritize functionalities accordingly.
  - Finalize ICA methodologies to be used, and define interactions if more than one method is used.

Introduction and Background

The need for a definition of "use cases" was identified by the ICA Working Group (WG), rather than the CPUC, in part to help ensure compliance with ORA's proposed success criteria for ICA to provide accurate and "meaningful" results. Based on WG efforts to date, it is apparent that the optimum ICA methodology involves balancing accuracy, processing time, spatial granularity, and other factors, and that the optimum balance depends on the "use case" defining how the tool will be used. Development of the optimum ICA methodology is driven by the use case, but it is also an iterative process where information of cost and timing of development and implementation can and should be fed back into the

definition of the use case. Ideally, one ICA tool will meet all functionalities, but the WG recognizes that this may not be feasible.

The ICA WG March 15, 2017 Final Report on short-term issues identified two broad use cases for ICA, summarized as: 1) to inform and improve the Rule 21 interconnection process, and 2) to inform and identify DER growth constraints and opportunities in the planning process. The interconnection use case and its impact of ICA requirements were detailed in the Final ICA WG report.

This proposal documents a planning use case which includes the following:
- Descriptions of potential planning ICA applications and how ICA may be used, beyond the interconnection use case,
- A descriptive list of the technical ICA characteristics that are driven by this use case,
- A preliminary discussion of the technical ICA characteristics that are driven by this use case,
- Recommendations regarding how to minimize IOU effort and ratepayer costs to develop and maintain more than one ICA tool (if one is needed).

These recommendations are supported by the Office of Ratepayer Advocates, the Interstate Renewable Energy Council, Inc., Vote Solar, the Solar Energy Industries Association, the Clean Coalition, and Stem.

ICA Applications and Uses Beyond Interconnection Use Case

The ICA has been identified by the CPUC and parties for use in multiple planning processes, including, but not limited to the following scenarios:
1. Identification of low IC locations where current or queued DER require immediate mitigation,[8]
2. Identification of low IC locations where current or queued DER justify additional data acquisition and analysis,
3. Identification of locations where forecast DER and load growth could support mitigation through the annual IOU distribution planning process,
4. Identification of locations where forecast DER and load growth could support additional data acquisition and analysis identified through the annual IOU distribution planning process, for use in subsequent annual planning processes,
5. Definition and prioritization system wide grid investments, if any, to accommodate DER or enable benefits from DER (Grid Modernization), and
6. Analysis of impacts and implications of potential policy interventions, including, but not limited to, incentives, rate changes, and tariffs.

During the WG discussion in August 2017, it became clear that stakeholders had different visions for the definition and purpose of the "planning use case." The IOU vision focused on a "Distribution Capacity

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[8] Mitigation is typically determined following IOU "needs" assessments, and can include operational changes, capital investment in "traditional" upgrades to identified circuits and substations, and identification of DER portfolios to meet the identified need. Due to the uncertainties of circuit level DER and load forecasts, there will likely be situations where mitigations are required outside of the annual distribution planning process.

Planning Use Case"[9] that is intended to identify potential grid investments that the utilities would address directly:

> "The purpose of the use case is to *identify system needs expected to be created by future DER growth, for the purpose of preemptively addressing these needs.* This use case is envisioned to become an integral part of utility operations and feed in directly to the utility annual distribution planning process. The outcome is expected to be either IOU capital investment to meet the need, or sourcing of DERs to defer the conventional investment. Thus, forecasts and other policy assumptions should be consistent with current commission policy for distribution planning and investment."

This corresponds to scenario 3 in the application list above. While WG members generally agreed that this is an important component of the use case, the non-IOU parties believe this is only one relevant scenario under the planning use case. Additionally, ORA has previously expressed concern about using forecasts of DER growth and resulting IC values for proactive investments and this is reflected by the inclusion of Scenarios 1 and 2 below.[10]

The non-IOU parties also feel it is not appropriate to limit this use case to only considering upgrades for DERs where upgrades are socialized. Indeed, the scope of the new Rule 21 interconnection proceeding (R.17-07-007) includes consideration of how costs might be allocated among interconnecting DERs in a ways other the current last-in-line method of allocating costs for an upgrade. Forecasts of needs for such upgrades, and their costs, through the ICA planning scenario may be needed to facilitate a cost-sharing scheme. Utilities can break out socialized costs and pursue those costs in their rate cases as appropriate under current policy, but forecasting of upgrade needs should not be limited only to categories of eligible projects (i.e., net energy metering projects under 1MW).

Non-IOU parties felt it was important to define all potential ICA planning scenarios even if it subsequently decided to focus its current six month process on a prioritized list of scenarios. Non-IOU parties provide the following descriptions for the components of the planning use case listed above:

Planning Use Case Scenario 1 – Unanticipated changes to distribution equipment (e.g. equipment failures), forecasted load, and forecasted DER could reduce the integration capacity of individual circuits and require mitigation to prevent interconnection delays for new DER on those circuits. Even if the CPUC adopts policies that favor proactive Grid Modernization based on DER growth forecasts, uncertainty in the DER and load forecasts will result in DER or load growth where it was not expected. IOUs will be obliged to mitigate any adverse grid impacts that result to meet their responsibilities per PUC 451. This use case requires accurate ICA values that are updated frequently, and WG members agree that it can be met using an ICA tailored to the interconnection use case.

Planning Use Case Scenario-2 – This scenario arises from the same unanticipated changes as Scenario 1 above. However some situations may warrant additional data gathering and analysis rather than immediate capital investment for mitigation. ICA requirements are the as the same as Scenario 1.

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[9] This definition was provided in an IOU proposal following the August 15, 2017 WG meeting.
[10] See ORA's Grid Modernization comments dated June 19, 2017, pp. 19-21.

Planning Use Case Scenario 3 – The IOU description of this scenario is above, and detailed requirements are discussed in the following section. WG members anticipate that additional definition of this scenario can be provided in the final ICA WG report based on the pending Track 3 decision regarding Growth Scenarios, Grid Modernization, and Distribution Deferral.

Planning Use Case Scenario 4 – This scenario arises from the same planning analyses as Scenario 3 above. However some situations may warrant additional data gathering and analysis rather than capital investment for mitigation. ICA requirements are the as the same as Scenario 3.

Planning Use Case Scenario 5 – It is likely that some grid investments will be system wide in nature, and justified based on DER. The CPUC Staff Grid Mod proposal included a schema that used ICA as one metric to help prioritize specific investments. ORA's comments regarding the staff proposal posited that less accuracy is required for ICA in this application since "The only impact of an erroneous forecast is that one location would be enabled before another."[11] Detailed requirements for this scenario are provided below, but as with other scenarios above additional definition can be provided in the final ICA WG report based on the pending Track 3 decision regarding Growth Scenarios, Grid Modernization, and Distribution Deferral.

Planning Use Case Scenario 6 – The tools developed in the DRP and IDER will allow stakeholders to understand grid constraints and the relative locational values associated with addressing them. Numerous policy interventions may be proposed based on this information, including, but not limited to, incentives, rate changes, and tariffs. In addition, the state will be considering pathways for meeting state environmental and emissions goals, including in the IRP. The ICA is an important tool that will enable exploration of the grid impacts and implications of these numerous potential interventions. The ICA, alone, or potentially in combination with growth scenarios and the LNBA, should enable grid operators and stakeholders to see how policy changes may effect specific locations of the grid (such as, for example, a TOU rate specific for storage customers). This information can then be used to guide both policy making and planning decisions about grid investments. This use will require flexibility to consider multiple scenarios, both in a grid-wide and site-specific manner and the potential to run layered scenarios.

Technical Requirements for Planning Use Cases

It is important to acknowledge that ICA is intended to inform both the location of deficiencies in the grid to integrate DER and the types of potential solutions. ICA can be useful to help identify locations and timing of deficiencies, but further review and engineering is required to determine the solutions to mitigate. ICA also provides the type of deficiency (e.g. thermal, voltage, protection, and OpFlex) for each location which can help define the types of potential mitigations. The hosting capacity upgrade would

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[11]ORA's Grid Modernization comments dated June 19, 2017, p. 20: "For system-wide GM investments that enable DER benefits, forecasting uncertainty has minimal impact since the tools and technology will ultimately be deployed on most, if not all, distribution assets. The only impact of an erroneous forecast is that one location would be enabled before another."

also have to be coordinated with the normal planning efforts to not duplicate any work already being proposed. Technical requirements driven by the planning use case scenarios are listed below with preliminary discussion from the non-IOU parties.[12]

Engineering Assumptions
ICA involves a number of engineering assumptions including specific thresholds for each ICA criteria, pre-existing conditions, and status of LTCs. Methods to increase computational efficiency were also recommended by the ICA in its March 2017 Report.   Given the overarching goal of having a common methodology, the WG determined there is no need to use any different assumptions for the planning use. (Need to verify with IOUs)

Accuracy
The required ICA accuracy depends on the planning use case. For Scenario 5 and 6, granular accuracy by line-section is not critical, as the ICA is only proposed to prioritize investments as previously discussed. For Scenario 3, ICA accuracy is of paramount importance because it will be used to justify in targeted investments to increase localized hosting capacity. However, the accuracy of DER forecasts becomes increasingly uncertain as the analysis increases in spatial resolution so there is currently a clear tension between accuracy and spatial resolution where DER forecasts are involved. This is discussed more in the DER section below and is currently an unresolved issue.

Frequency of Update
Planning scenarios generally require annual or less frequent updates.[13] Scenario 2, 4, and 5 require updates annually in advance of the annual distribution planning process, and potentially the Grid Needs Assessment (GNA) based on the Track 3 decision. Analysis would be performed after the load forecasting process has been completed and before final distribution analysis is performed. Scenario 6 would likely be run on an as-needed basis.

Temporal Resolution
In the March 2017 report, the WG agreed that a 576 hour profile, based in part on computational efficiency, should be used for the initial statewide ICA roll out, but expressed that "a more granular hourly profile may be needed and justified.[14]

Spatial Resolution
For the interconnection use case, ICA values will generally be calculated at each circuit node. However, In the March 2017 Report, the WG agreed to limit the number of nodes analyzed based on computational efficiency for the initial statewide ICA rollout.[15] It is likely less spatial resolution will be required for planning. For Scenario 5, system-wide Grid Modernization upgrades would only be

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[12] As stated above, the ICA regularly performed to support the interconnection use case may be sufficient to support Cases 1 and 2 above. Case 4 will be addressed consistent with Case 3.
[13] See previous footnote regarding Cases 1 and 2.
[14] March ICA WG report, p.9.
[15] March ICA WG report, p.33.

prioritized based on ICA, and should be sufficient to target entire circuits for upgrades rather than specific nodes. For planning Scenario 3, there is currently significant uncertainty in DER forecasts more granular than for specific feeders that limits the accuracy of <u>forecast</u> nodal ICA values. This is discussed in the DER forecast section below. While this remains an open topic, the WG initially recommends that ICA values should only be calculated at a locational granularity that is supported by a reasonably accurate DER forecast.

Spatial Modeling of DER
The California ICA WG and methodology has thus far been focused on the interconnection use case which isolates analysis to single interconnections while only considering the impacts of single DER placement on a circuit. In the planning context, it is important to understand the broader impact of multiple generators and what the combined aggregate effect would be over a longer time frame. As ICA progresses, it is important that the components of the tool be able to consider a dispersion of smaller DER throughout the circuit. The iterative and streamlined methods discussed by the WG to date only provide for single DER placements.[16] Other tools have been developed to include analysis of this dispersion and the WG should research and explore the incorporation of these techniques in order to properly consider DER for the planning context.

Using the DER Growth in the Analysis
Most planning scenarios involve estimates of the future condition of the grid, loads, and DER, and how they impact hosting capacity.   The IOUs believe that this forecasts should be done in a 1 to 5 year planning horizon, as anything past 5 years on the distribution circuits is not as precise unless you are looking are larger scale impacts at the substation.

One challenging fact is that the utilities cannot forecast growth to the nodal precision of the models with proper accuracy. At maximum, growth factor forecasts will only be granular down to the feeder level. The IOUs must then determine how feeder level growths are to be considered in a nodal level analysis. Two general ways of inclusion have been identified which are:
1. Pre-Analysis Modeling
2. Post-Analysis Comparison
    a. Based on single DER ICA
    b. Based on dispersed DER ICA

At the August 15, 2017 WG meeting, the IOUs presented slides related to Scenario 3 above that focused on how forecasted DER should be incorporated. Three alternatives were presented. The first approach would take the expected growth and embed within the load allocation methods to distribute into the model. The dispersion would assume the same dispersion of load on the circuit. While not as sophisticated, this approach seems reasonable to perform in the short term while more complex approaches are being explored.

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[16] IOU input required here. Isn't it possible that the iterative method could be modified to provide distributed DER on each circuit, for example various levels of uniform distribution, and or distributions that are skewed towards the beginning of end of each circuit?

The second approach would not change the input to the model to reflect the DER growth, but would compare the DER growth to the calculated ICA. For instance, if ICA is calculated to be 1MW and DG growth is 1.5MW, then there would be a 0.5MW deficiency to be addressed. As mentioned earlier, it could be deceptive when performing this if comparing growth to single DER ICA. This is why there are two options under approach 2. The first would calculate based on single DER ICA, and the second would calculate based on dispersed DER ICA. Ideally, the tools would need to properly consider dispersed DER in the analysis, but this is not fully supported yet in the tools. The other challenge to the post analysis approach is how to determine which forecasts to embed in the future time horizon and which to analyze post analysis.

The ICA WG will explore the different options and evaluate which one will be the best to implement moving forward.

Scenario Analysis
Statewide long term planning such as LTPP and IRP typically involves performing analysis under a number of scenarios, as low, medium, and high penetration of Energy Efficiency. This allows decision makers to consider the impacts of uncertainty when determining policy. Initial ICA WG discussions indicated that the ability to perform scenario analyses is an advantage of the streamlined ICA method compared to the iterative method. The WG will investigate the types of scenarios planned for the IRP proceeding and also scenarios unique to ICA that should be performed for planning use cases, particularly Scenario 6.
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Item 1: Planning Use Case

Joint IOUs' Response to Stakeholder Proposal
ICA Working Group

Policy Analysis Should be Out of Scope

Upon reviewing the "Draft Non-IOU Proposal for the Planning Use Case", the Joint IOUs' agree with including proposed use case scenarios 1 through 5. These 5 scenarios seem to have relevance to how ICA can help inform investments made in the GRC. The Joint IOUs believe that use-case scenario 6, "the analysis of impacts and implications of potential policy interventions, including, but not limited to, incentives, rate changes, and tariffs" does not share the same unifying quality with use-cases 1 through 5 since the outputs of use case 6 are meant to inform stakeholders on potential policy impacts to hosting capacity rather than informing where investments are needed in the nearest planning cycle. Informing new tariffs and programs does not belong within the ICA scope and is a broader discussion outside of the scope of the ICA Long Term Refinements Working Group. The recent Track 1 Decision on the ICA and LNBA short term issues references proposals on informing tariffs and programs using DERAC[17]. The discussion on informing policy should remain in subsequent CPUC stakeholder engagement and workshops as referenced in the proposed decision.

As part of the Short Term working group discussions, the working group was tasked with coming up with and defining use cases for ICA. In those discussions only two use cases were identified where were (1) streamlining interconnection and (2) using for planned investments for hosting capacity needs. There was general consensus on these and no identification of a policy impact use case.[18]

Also as part of the short term final report, a consensus on planning use case was already made. The consensus for the planning use case was as followed:

> "Inform and identify DER growth constraints in the planning process. In the planning use case, the ICA information may be used as an input into system planning processes to identify when and where capacity upgrades are needed on the distribution system as a result of various DER growth scenarios."[19]

Referring back to the Proposed Decision filed on August 25th, 2017 on page 26:

> "We agree that there is a role that ICA should play in the distribution planning process. ICA results may be used to identify grid locations facing hosting capacity constraints in light of DER

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[17] Decision on Track 1 Demonstration Projects A (integration Capacity Analysis) and B (Locational Net Benefits Analysis), Proposed Decision Rev 1, 9/28/2017

[18] http://drpwg.org/wp-content/uploads/2016/08/Discussion-of-Stakeholder-Comments-7.25-ICA_draft.docx Page 5

[19] http://drpwg.org/wp-content/uploads/2016/07/ICA-WG-Final-Report.pdf Page 9

growth scenarios that would be candidates for grid upgrades to accommodate projected DER growth.”

This statement aligns well with use cases 1 through 5 since their outputs can readily be used to inform the distribution planning process where the end goal is to propose distribution infrastructure investments, grid modernization investments, or DER sourcing solutions to relieve forecasted hosting capacity constraints.

Wholesale Forecasts are too Uncertain to Include in ICA

With respect to the non-IOU parties feeling it is not appropriate to limit the Planning Use Case to only considering upgrades for DERs where upgrades are socialized, the IOUs' hold the position that the primary obstacle with any other form of cost responsibility allocation method based on forecasts is that there is not a good degree of confidence in forecasting methods for DERs participating in Wholesale and Rule 21 Export like there is for NEM. Therefore, this is not an issue of tool capabilities but rather forecast capabilities. Also, even if a high confidence forecast for these other DER programs did exist, then development of cost sharing rules would not be part of ICA but rather part of the Rule 21 interconnection proceeding.

Item 1: Planning Use Case

Modified Proposal Seeking Consensus – Draft by ORA and IREC
ICA Working Group
This draft includes tracked changes comments for discussion, which are not included in the final published version of this report. For the tracked changes version, please see the online document:
https://drpwg.org/wp-content/uploads/2016/07/ICA-Item-1-Planning-Use-Case-Concensus-DRAFT-R3.docx

Summary and Next Steps

- All anticipated planning use case scenarios are defined in this proposal.
- IOUs recommend that the term "planning" use case refer only to use cases that will directly feed into grid investments via the Distribution Planning Process (DPP).
- The IOUs showed three options for how DER growth forecasts can be included in the ICA for planning purposes during the August 15, 2017 working group meeting:
  - Option 1: Net Forecast into Load Allocation
  - Option 2A: Compare Growth to ICA
  - Option 2B: Compare Growth to modified ICA
- Non-IOUs recognize that "planning" encompasses both the annual DPP that will likely be addressed in a Track 3 decision this fall and broader planning activities that shape the grid, including policymaking.
- Non-IOUs recommend that the planning use case be defined and evaluated before defining a methodology that will be used for the "planning" ICA or ICAs.
- All parties agree that forecasts of DER on specific feeder segments at specific dates is subject to significant uncertainty, and that forecast ICA results require further planning review before specific mitigations are defined,
- All parties agree with the following as a plan towards defining and optimizing an ICA for the planning use case that strives for flexibility, transparency, accuracy, and cost effectiveness:
  - Use the iterative ICA developed for the interconnection use case for the 2017/2018 DPP:
    - DER forecast will be consistent with pending Track 3 decision,
    - Forecast DER and load growth will be applied to load per IOU option 1, and forecast ICA values compiled and archived,
    - ICA values using same input values except for DER and load growth will be calculated and archived as a baseline,
    - IOUs will provide a narrative description how the ICA was used for determination of grid needs and any adjustments or correction required will be explained and supported quantitatively
  - IOUs will compile data and report (referred to subsequently as the initial planning use case report) on how well the iterative ICA worked for the DPP, and recommendations going forward. The report should address accuracy, computational efficiency, cost, and limitations. This report will be included in the 2018 Grid Needs Assessment (GNA) if the GNA is adopted in the Track 3 decision, or by March 31, 2018 if not.

- o The ICAWG should reconvene to discuss the results of the initial planning use case report, options for the next DPP, and recommendations going forward.
  - o The ICAWG will also use the results from the first ICA use in the 2017/2018 DPP to discuss the policy uses within the planning use case, revisit the alternative methodologies (iterative, streamlined, stochastic, EPRI DRIVE, etc.) and recommend modifications for policy uses.
  - o QA/QC and validation plans will include all uses within the planning use case.

- Open issues to be evaluated and resolved:
  - o Define desired functionality of the ICA for the planning use case
    - ▪ This could be characterized as multiple different use cases, or rather an identification of the specific ways it would be used in order to shape ICA modeling functionality (scenarios).
  - o Define ICA requirements for the use case, while considering future needs for additional functionality
    - ▪ Incorporate findings, conclusions, and orders from the Track 3 proposed decision to help define planning use case, understanding that these are draft pending a final decision
    - ▪ Incorporate input from IRP proceeding
  - o Determine if the iterative methodology and process for producing ICA values and maps can be modified to meet planning use cases, or if another methodology is needed.
  - o Determine whether the iterative methodology is able to produce reliable and consistent ICA results when combined with the higher-level granularity of a forecast.
  - o Determine if any of the identified functionality will be difficult to meet within current capabilities and/or reasonable costs. Prioritize functionalities accordingly.
  - o Finalize ICA methodologies to be used, and define interactions if more than one method is used.

Introduction and Background

The need for a definition of "use cases" was identified by the ICA Working Group (WG), rather than the CPUC, in part to help ensure compliance with ORA's proposed success criteria for ICA to provide accurate and "meaningful" results and to help with evaluation of the methodologies being deployed. While the short term final report and Decision included a general discussion of the planning use cases, this was not a decision on the scope of the planning use case. Rather, that was explicitly deferred to this stage of the working group process. Based on WG efforts to date, it is apparent that the optimum ICA methodology involves balancing accuracy, processing time, spatial granularity, and other factors, and that the optimum balance depends on the "use case" defining how the tool will be used. Development of the optimum ICA methodology is driven by the use case, but it is also an iterative process where information of cost and timing of development and implementation can and should be fed back into the definition of the use case. Ideally, one ICA tool will meet all functionalities, but the WG recognizes that this may not be feasible.

The ICA WG March 15, 2017 Final Report on short-term issues identified two broad use cases for ICA, summarized as: 1) to inform and improve the Rule 21 interconnection process, and 2) to inform and identify DER growth constraints and opportunities in the planning process. The interconnection use case and its impact on ICA requirements were detailed in the Final ICA WG report.

This proposal documents a planning use case which includes the following:
- Descriptions of potential planning ICA applications and how ICA may be used, beyond the interconnection use case,
- A descriptive list of the technical ICA characteristics that are driven by this use case,
- A preliminary discussion of the technical ICA characteristics that are driven by this use case,
- Recommendations regarding how to minimize IOU effort and ratepayer costs to develop and maintain more than one ICA tool (if one is needed).

These recommendations are supported by the Office of Ratepayer Advocates, the Interstate Renewable Energy Council, Inc., Vote Solar, the Solar Energy Industries Association, the Clean Coalition, and Stem.

ICA Applications and Uses Beyond Interconnection Use Case

The ICA has been identified by the CPUC and parties for use in multiple planning processes, including, but not limited to the following scenarios:

7. Identification of low Integration Capacity (IC) locations where current or queued DER require immediate mitigation,[20]
8. Identification of low IC locations where current or queued DER justify additional data acquisition and analysis,
9. Identification of locations where forecast DER and load growth <u>could</u> support mitigation through the annual IOU distribution planning process,
10. Identification of locations where forecast DER and load growth <u>could</u> support additional data acquisition and analysis identified through the annual IOU distribution planning process, for use in subsequent annual planning processes,
11. Definition and prioritization of system wide grid investments, if any, to accommodate DER or enable benefits from DER (Grid Modernization), and
12. Analysis of impacts and implications of potential policy interventions on the distribution grid, including, but not limited to, incentives, rate changes, and tariffs.

During the WG discussion in August 2017, it became clear that stakeholders had different visions for the definition and purpose of the "planning use case." The IOU vision focused on a "Distribution Capacity

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[20] Mitigation is typically determined following IOU "needs" assessments, and can include operational changes, capital investment in "traditional" upgrades to identified circuits and substations, and identification of DER portfolios to meet the identified need. Due to the uncertainties of circuit level DER and load forecasts, there will likely be situations where mitigations are required outside of the annual distribution planning process.

Planning Use Case"[21] that is intended to identify potential grid investments that the utilities would address directly:

> "The purpose of the use case is to *identify system needs expected to be created by future DER growth, for the purpose of preemptively addressing these needs.* This use case is envisioned to become an integral part of utility operations and feed in directly to the utility annual distribution planning process. The outcome is expected to be either IOU capital investment to meet the need, or sourcing of DERs to defer the conventional investment. Thus, forecasts and other policy assumptions should be consistent with current commission policy for distribution planning and investment."

This corresponds to scenario 3 in the application list above. While WG members generally agreed that this is an important component of the use case, the non-IOU parties believe this is only one relevant scenario under the planning use case. Additionally, ORA has previously explained how uncertainty in circuit level forecasts of DER growth and resulting IC values limits supports the need for reactive IOU action as needs arise vs. proactive investments. [22] This is reflected by the inclusion of Scenario 1 below.

The non-IOU parties also feel it is not appropriate to limit this use case to only considering upgrades for DERs where upgrades are socialized. Indeed, the scope of the new Rule 21 interconnection proceeding (R.17-07-007) includes consideration of how costs might be allocated among interconnecting DERs in a ways other the current last-in-line method of allocating costs for an upgrade. Forecasts of needs for such upgrades, and their costs, through the ICA planning scenario may be needed to facilitate a cost-sharing scheme. Utilities can break out socialized costs and pursue those costs in their rate cases as appropriate under current policy, but forecasting of upgrade needs should not be limited only to categories of eligible projects (i.e., net energy metering projects under 1MW).

Non-IOU parties felt it was important to define all potential ICA planning scenarios even if it subsequently decided to focus its current six month process on a prioritized list of scenarios. Non-IOU parties provide the following descriptions for the components of the planning use case listed above:

Planning Use Case Scenario 1 – Unanticipated changes to distribution equipment (e.g. equipment failures), forecasted load, and forecasted DER could reduce the DER hosting capacity of individual circuits. ICA results can provide a tool to help the IOUs to determine the appropriate and immediate response to these changes, including circuit reconfiguration, increased data gathering, or grid upgrades. This use case requires accurate ICA values that are updated frequently, and WG members agree that it can be met using an ICA tailored to the interconnection use case.

Planning Use Case Scenario 3 – The IOU description of this scenario is above, and detailed requirements are discussed in the following section. WG members anticipate that additional definition of this scenario can be provided in the final ICA WG report based on the pending Track 3 decision regarding Growth Scenarios, Grid Modernization, and Distribution Deferral.

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Planning Use Case Scenario 4 – This scenario arises from the same planning analyses as Scenario 3 above. However some situations may warrant additional data gathering and analysis rather than capital investment for mitigation. ICA requirements are the as the same as Scenario 3.

Planning Use Case Scenario 5 – It is likely that some grid investments will be system wide in nature, and justified based on the potential value of accommodating DER at specific locations. The CPUC Staff Grid Mod proposal included a schema that used ICA as one metric to help prioritize specific investments. ORA's comments regarding the Grid Mod staff proposal posited that less accuracy is required for ICA in this application since "The only impact of an erroneous forecast is that one location would be enabled before another."[23] Accuracy is still important, but may have less weight in the balance against processing time, cost, and the number of scenarios that can be run in this scenario. Additional definition can be provided in the final ICA WG report based on the pending Track 3 decision regarding Growth Scenarios, Grid Modernization, and Distribution Deferral.

Planning Use Case Scenario 6 – The tools developed in the DRP and IDER will allow stakeholders to understand grid constraints and the relative locational values associated with addressing them. Numerous policy interventions may be proposed based on this information, including, but not limited to, incentives, rate changes, and tariffs. In addition, the state will be considering pathways for meeting state environmental and emissions goals, including in the IRP. The ICA is an important tool that will enable exploration of the grid impacts and implications of these numerous potential interventions. The ICA, alone, or potentially in combination with growth scenarios and the LNBA, should enable grid operators and stakeholders to see how policy changes may effect specific locations of the grid (such as, for example, a TOU rate specific for storage customers). This information can then be used to guide both policy making and planning decisions about grid investments. This use will require flexibility to consider multiple scenarios, both in a grid-wide and site-specific manner and the potential to run layered scenarios.

Technical Requirements for Planning Use Cases

It is important to acknowledge that ICA is intended to inform both the location of deficiencies in the grid to integrate DER and the types of potential solutions. ICA can be useful to help identify locations and timing of deficiencies, but further review and engineering is required to determine the solutions to mitigate. ICA also provides the type of deficiency (e.g. thermal, voltage, protection, and OpFlex) for each location which can help define the types of potential mitigations. The hosting capacity upgrade would also have to be coordinated with the normal planning efforts to not duplicate any work already being

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proposed. Technical requirements driven by the planning use case scenarios are listed below with preliminary discussion from the non-IOU parties.[24]

Engineering Assumptions

ICA involves a number of engineering assumptions including specific thresholds for each ICA criteria, pre-existing conditions, and status of load tap changers. Methods to increase computational efficiency were also recommended by the ICA in its March 2017 Report

Accuracy

The required ICA accuracy depends on the planning use case. For Scenarios 1 and 3, ICA accuracy is of paramount importance because it will be used to justify targeted investments to increase localized hosting capacity. The other use cases may not lead to direct decisions about upgrades and thus may not require as much precision in the results, however under all scenarios the information is used to guide further steps and thus its function as a "first screen" still demands relatively good accuracy to be worth using. The accuracy of DER forecasts becomes increasingly uncertain as the analysis increases in spatial resolution so there is currently a clear tension between accuracy and spatial resolution where DER forecasts are involved. This is discussed more in the DER section below and is currently an unresolved issue.

Frequency of Update

Planning scenarios generally require annual or less frequent updates.[25] Scenario 2, 4, and 5 require updates annually in advance of the annual distribution planning process, and potentially the Grid Needs Assessment (GNA) based on the Track 3 decision. Analysis would be performed after the load forecasting process has been completed and before final distribution analysis is performed. Scenario 6 would likely be run on an as-needed basis.

Temporal Resolution

In the March 2017 report, the WG agreed that a 576 hour profile, based in part on computational efficiency, should be used for the initial statewide ICA roll out, but expressed that "a more granular hourly profile may be needed and justified.[26] No decision has been reached on how greater or lesser temporal resolution may impact the value of the ICA results under any of the six scenarios.

Spatial Resolution

For the interconnection use case, ICA values will generally be calculated at each circuit node. However, In the March 2017 Report, the WG agreed to limit the number of nodes analyzed based on computational efficiency for the initial statewide ICA rollout.[27] It is possible that less spatial resolution will be required for planning. For Scenario 5, system-wide Grid Modernization upgrades would only be

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[25] See previous footnote regarding Cases 1 and 2.
[26] March ICA WG report, p.9.
[27] March ICA WG report, p.33.

prioritized based on ICA, and should be sufficient to target entire circuits for upgrades rather than specific nodes. For planning Scenario 3, there is currently significant uncertainty in DER forecasts more granular than for specific feeders that limits the accuracy of <u>*forecast*</u> nodal ICA values. This is discussed in the DER forecast section below. While this remains an open topic, the WG initially recommends that ICA values should only be calculated at a locational granularity that is supported by a reasonably accurate DER forecast. While it will be difficult to accurately forecast down to the nodal level, it is clear the fact that higher resolution will result in less precise results as DER location on a circuit is a very important factor in determining the ICA accurately.

Spatial Modeling of DER
The California ICA WG and methodology has thus far been focused on the interconnection use case which isolates analysis to single interconnections while only considering the impacts of single DER placement on a circuit. In the planning context, it is important to understand the broader impact of multiple generators and what the combined aggregate effect would be over a longer time frame. As ICA progresses, it is important that the components of the tool be able to consider a dispersion of smaller DER throughout the circuit. The iterative and streamlined methods discussed by the WG to date only provide for single DER placements.[28] Other tools have been developed to include analysis of this dispersion and the WG should research and explore the incorporation of these techniques in order to properly consider DER for the planning context.

Scale of DER
With the iterative method, the change in DER size per iteration impacts the computational load, cost of analysis, and usability of results. For example, a 500 kW increment may have reasonable cost and time for the analysis, but would provide limited value for the development of roof top PV. The DER increment needed for planning is likely different that for the interconnection use case.

Type of DER
TBD pending feedback on whether wholesale DER in IEPR forecast. Large-scale DERs are much more likely to significantly impact the hosting capacity of a circuit, but for this reason it can be difficult to include wholesale DERs in the forecasted ICA. However, not including wholesale DERs also may lead to identification of upgrades that do, or do not, need to happen as a result of actual wholesale deployment.

Using the DER Growth in the Analysis
Most planning scenarios involve estimates of the future condition of the grid, loads, and DER, and how they impact hosting capacity. The IOUs believe that this forecasts should be done in a 1 to 5 year planning horizon, as anything past 5 years on the distribution circuits is not as precise unless you are looking are larger scale impacts at the substation.

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[28] IOU input required here. Isn't it possible that the iterative method could be modified to provide distributed DER on each circuit, for example various levels of uniform distribution, and or distributions that are skewed towards the beginning of end of each circuit?

One challenging fact is that the utilities cannot forecast growth to the nodal precision of the models with proper accuracy. At maximum, growth factor forecasts will only be granular down to the feeder level. The IOUs must then determine how feeder level growths are to be considered in a nodal level analysis. Two general ways of inclusion have been identified which are:

3. Pre-Analysis Modeling
4. Post-Analysis Comparison
    a. Based on single DER ICA
    b. Based on dispersed DER ICA

At the August 15, 2017 WG meeting, the IOUs presented slides related to Scenario 3 above that focused on how forecasted DER should be incorporated. Three alternatives were presented. The first approach would take the expected growth and embed within the load allocation methods to distribute into the model. The dispersion would assume the same dispersion of load on the circuit. While not as sophisticated, this approach seems reasonable to perform in the short term while more complex approaches are being explored.

The second approach would not change the input to the model to reflect the DER growth, but would compare the DER growth to the calculated ICA. For instance, if ICA is calculated to be 1MW and DG growth is 1.5MW, then there would be a 0.5MW deficiency to be addressed. As mentioned earlier, it could be deceptive when performing this if comparing growth to single DER ICA. This is why there are two options under approach 2. The first would calculate based on single DER ICA, and the second would calculate based on dispersed DER ICA. Ideally, the tools would need to properly consider dispersed DER in the analysis, but this is not fully supported yet in the tools. The other challenge to the post analysis approach is how to determine which forecasts to embed in the future time horizon and which to analyze post analysis.

The ICA WG will explore the different options and evaluate which one will be the best to implement moving forward.

Scenario Analysis
Statewide long term planning such as LTPP and IRP typically involves performing analysis under a number of scenarios, as low, medium, and high penetration of Energy Efficiency. This allows decision makers to consider the impacts of uncertainty when determining policy. Initial ICA WG discussions indicated that the ability to perform scenario analyses is an advantage of the streamlined ICA method compared to the iterative method. The WG will investigate the types of scenarios planned for the IRP proceeding and also scenarios unique to ICA that should be performed for planning use cases, particularly Scenario 6.

Item 1: Planning Use Case

Joint IOU comments on the ORA/IREC Modified Proposal Seeking Consensus
ICA Working Group

The Joint IOUs provided substantive comments via tracked changes as a response to the ORA/IREC modified draft proposal. To view these comments, please review the online version of the document: https://drpwg.org/wp-content/uploads/2017/11/ICA-Item-1-Planning-Use-Case-Concensus-DRAFT-R3_IOU-COMMENTS.docx. Separate IOU comments discussing the use of ICA in policy scenario analysis are provided in a separate document and can be found below.

Topic 1: Planning Use Case – Response regarding the Policy Scenario Analysis Use Case

Joint IOUs' Proposal in Response to ORA/IREC Proposal, focused on policy scenario analysis
ICA Working Group

Summary of Recommendations

- ICA is a powerful tool that can help inform future policy deliberation**.** This use case provides a framework for how the ICA tool can be used **in active CPUC proceedings to inform future CPUC Decisions.** Specifically, this use case is designed to help provide additional analysis to provide additional insights to build the on active topics in scope in a given proceeding.
- This use case contrasts with the interconnection and planning uses. Whereas both the interconnection and planning use cases are designed to inform specific IOU operations, the policy use case is designed to inform CPUC proceedings and Decisions.
- Furthermore, whereas the interconnection and planning use cases define specific analyses that the IOUs will perform on a recurring basis, the policy scenario analysis use case refers to potential future analyses to be scoped out and developed at a future date. This use case could ultimately encompass a recurring analysis, or it could encompass a series of one-off analyses
- The Policy analysis use case is not currently well defined. This proposal includes a high level framework to begin to define this use case. The IOUs recommend this use case be developed further before formal implementation.

Introduction and Background

- At the November 14 WG, the WG discussed a proposal for a version of the Planning Use Case that also included a policy scenario analysis component.
- The IOUs recognize the potential value for ICA scenario analysis to inform policy discussions. However, the IOUs see this a different use case. Additionally, the IOUs believe the policy scenario analysis use case requires further development before it can be formally implemented
- This response to the stakeholder proposal is designed to clarify why the Policy Analysis use case should be seen as a different use case than the planning use case.
- This response also proposes an initial framework for how the policy analysis use case might be further developed.

Discussion

Following a number of WG discussion, the IOUs have identified two main concerns with the policy analysis use case that require resolution. First, should the Policy Scenario Analysis Use Case be part of

the planning use case, or become its own use case? Second, how should the policy analysis use case be implemented? This document attempts to answer both of these questions.

The Policy Scenario Analysis Use Case is its own Use Case

The IOUs understand the policy analysis use case to be substantively different from the planning use case. The following chart illustrates this through comparison of all three use cases.

Comparison of use cases			
Use Case	**What the analysis does**	**Purpose of the analysis**	**How the analysis is used**
Interconnection	Estimate available hosting capacity for new resources	Streamline interconnection process by eliminating the need for certain screens and/or analyses	**Support the interconnection process** • Developers use the results to identify favorable locations. • IOUs will use the results to during the interconnection application process to avoid the need for certain engineering components of interconnection studies.
Planning	Identify grid locations where autonomous DER growth is forecasts to exceed hosting capacity	Identify potential grid investments to increase hosting capacity in advance of expected DER growth	**Support the Distribution Planning Process** • IOUs use the results to identify potential locations requiring projects in distribution plans and in GRC. • Stakeholders use the results to assess investments needed to meet expected autonomous retail growth of DER
Policy Scenario Analysis	Study various scenarios based on the needs of a given scope topic within an active proceeding.	Various, TBD: Purpose will be whatever is determined to be helpful to build the record for the given scope topic	**Support CPUC Policy Proceedings and Decisions** • Stakeholders use the results to advocate among policy options for a given scope topic. • CPUC uses the results as part of the record to inform a Decision on a scope topic

Proposed Framework for the Policy Scenario Analysis Use Case

This section provides a high level framework for developing the policy scenario analysis use case. This is just an initial proposal; the IOUs recommend this concept be developed further prior to formal implementation.

Under this concept, the Policy Scenario Analysis use case could be implemented on a case-by-case basis as needed by an active CPUC proceeding. This use case is not envisioned to be a "set" analysis. Rather, it is envisioned that policy scenario analyses would be developed to support the specific needs of a given proceeding.

1. Initial Identification of potential ICA scenarios for analysis
   a. Within the context of a CPUC proceeding, Commission staff or part(ies) to the proceeding identify proposed scenario analysis through formal or informal processes (e.g. via a Staff Report, Comments, PHC statement, workshop discussion, etc.)
   b. The part(ies) proposing an ICA scenario analysis should attempt to include the following information:
      i. Which scope topic (within the proceeding) is the ICA scenario analysis intended to support
      ii. What questions are being asked; how the ICA results answer the questions; how the answers will inform the scope topic
      iii. What is the detailed scope of the proposed analysis
         1. Can the existing 576 hourly ICA results be used to inform the policy?
         2. If not, what scenarios will be tested (i.e., alternative forecasts, alternative policy regimes, etc.)
         3. How the (numerical) inputs for the scenarios will be determined
         4. Etc.
2. Development of scope of analysis
   a. CPUC staff and parties collaborate to develop the proposed analysis.
   b. IOUs estimate the workload associated with the analysis, and suggest options to minimize additional workload.
   c. Once the proposed analysis is defined, IOUs estimate lead time required for the analysis, as well as the estimated cost of the analysis
3. CPUC formally provides guidance for the analysis, including cost recovery
   a. CPUC Ruling provides final guidance on scope, data inputs, schedule, etc., and authorizes IOUs to open a memo account to track incremental costs of the analysis

Conclusion and Next Steps
- The Policy Scenario Analysis use case should be considered its own use case, distinct from the planning use case.
- Further development of this use case is required; the above framework provides one potential path forward.

Topic 1: Planning Use Case – Response regarding the Policy Scenario Analysis Use Case

Clean Coalition recommended edits to Joint IOUs' Proposal in Response to ORA/IREC Proposal
ICA Working Group

Topic 1: Planning Use Case – Policy Scenario Analysis Planning Use Case

(Clean Coalition recommended edits to Joint IOUs' Proposal)
ICA Working Group

Preamble
Clean Coalition feels that there are clearly two primary Planning Use Case applications - Policy Planning, and Service Planning. The Ruling ordering development of a Planning Use Case did not distinguish between these applications. The Clean Coalition and other non-IOU parties have understood planning to included use by the Commission (i.e. policy planning) and not only planning by the IOUs, which appears to be limited to service planning.

Clean Coalition has reviewed the IOU response to the Planning Use Case proposal.
We continue to support the non-IOU modified "Planning-Use-Case-Consensus DRAFT" proposal as submitted by ORA and IREC, but the IOU response offers some clarification.
Clean Coalition is concerned over the IOU response that seeks to designate policy planning as a use case outside of the scope covered by the planning use case indicated in the prior Ruling.
It is unclear whether the distinction is merely semantic or intended to remove policy planning from the scope of work, but assuming the best, we offer a version of the IOU Policy Scenario Analysis Use Case with Clean Coalition edits to advance a consensus understanding.
The edits clarify the distinctions between the use cases, and differentiate service planning and policy planning as distinct applications with the Planning Use Case topic.

Summary of Recommendations

- ICA is a powerful tool that can help inform future policy deliberation**.** This use case provides a framework for how the ICA tool can be used **in active CPUC proceedings to inform future CPUC Decisions.** Specifically, this use case is designed to help provide additional analysis to provide additional insights to build the on active topics in scope in a given proceeding.

- This use case contrasts with the interconnection and service planning uses. Whereas both the interconnection and service planning use cases are designed to inform specific IOU operations, the policy planning use case is designed to inform CPUC proceedings and Decisions.
- Furthermore, whereas the interconnection and service planning use cases define specific analyses that the IOUs will perform on a recurring basis, the policy scenario analysis use case refers to potential future analyses to be scoped out and developed at a future date. This use case could ultimately encompass a recurring analysis and/or it could encompass a series of one-off analyses
- The Policy analysis planning use case is not currently fully defined. This proposal includes a high-level framework to begin to define this use case. The IOUs recommend this use case be developed further before formal implementation.

Introduction and Background

- At the November 14 WG, the WG discussed a proposal for a version of the Planning Use Case that also included a policy scenario analysis component.
- The IOUs recognize the potential value for ICA scenario analysis to inform policy discussions. However, the IOUs see this a different use case. Additionally, the IOUs believe the policy scenario analysis use case requires further development before it can be formally implemented
- This response to the stakeholder proposal is designed to clarify why the Policy Analysis planning use case should be seen as a different use case than the service planning use case.
- This response also proposes an initial framework for how the policy analysis use case might be further developed.

Discussion

Following a number of discussions, the WG has identified two main concerns that require resolution. First, should policy planning and service planning be part of the same use case, or become two separate planning use cases? Second, how should the policy analysis planning use case be implemented? This document attempts to answer both of these questions.

The Policy Scenario Analysis Use Case is its own Planning Use Case

The IOUs understand the policy analysis use case to be substantively different from the service planning use case. The following chart illustrates this through comparison of all three use cases.

Comparison of use cases			
Use Case	**What the analysis does**	**Purpose of the analysis**	**How the analysis is used**
Interconnection	Estimate available hosting capacity for new resources	Streamline interconnection process by eliminating the need	**Support the interconnection process** • Developers use the results to identify favorable locations.

		for certain screens and/or analyses	• IOUs will use the results to during the interconnection application process to avoid the need for certain engineering components of interconnection studies.
Service Planning	Identify grid locations where autonomous DER growth forecasts exceed hosting capacity	Identify potential grid investments to increase hosting capacity in advance of expected DER growth	**Support the Distribution Service Planning Process** • IOUs use the results to identify potential locations requiring projects in distribution plans and in GRC. • Stakeholders use the results to assess investments needed to meet expected autonomous retail growth of DER
Policy Planning Scenario Analysis	Identify interactions of policy driven DER growth forecast scenarios and grid hosting capacity	Compare hosting capacity impacts of policy alternatives, by scale and location, for optimizing goal achievement and ratepayer value	**Support CPUC Policy Proceedings and Decisions** • Stakeholders use the results to advocate among policy options • CPUC uses the results to compare investments needed to meet alternative policy driven growth of DER, or target locations for investments and incentives

Proposed Framework for the Policy Scenario Analysis Planning Use Case

This section provides a high-level framework for developing the policy scenario analysis use case. This is just an initial proposal; the IOUs recommend this concept be developed further prior to formal implementation.

Under this concept, Policy Scenario Analysis use could be implemented on a case-by-case basis as needed by an active CPUC proceeding. This use case is envisioned to reflect alternative DER growth scenarios associated with policy options in support the specific needs of a given proceeding. This is additional to the use of baseline ICA results in proceedings to identify or target locations for investments and incentives.

4. Initial Identification of potential ICA scenarios for analysis
   a. Within the context of a CPUC proceeding, Commission staff or part(ies) to the proceeding identify proposed scenario analysis through formal or informal processes (e.g. via a Staff Report, Comments, PHC statement, workshop discussion, etc.)
   b. The part(ies) proposing an ICA scenario analysis should attempt to include the following information:

      i. What questions are being asked; how the ICA results answer the questions; how the answers will inform the scope topic

      ii. What is the detailed scope of the proposed analysis

         1. Can the existing 576 hourly ICA results be used to inform the policy?

         2. If not, what scenarios will be tested (i.e., alternative forecasts, alternative policy regimes, etc.)

         3. How the (numerical) inputs for the scenarios will be determined

         4. Etc.

5. Development of scope of analysis

    a. CPUC staff and parties collaborate to develop the proposed analysis.

    b. IOUs estimate the workload associated with the analysis, and suggest options to minimize additional workload.

    c. Once the proposed analysis is defined, IOUs estimate lead time required for the analysis, as well as the estimated cost of the analysis

6. CPUC formally provides guidance for the analysis, including cost recovery

    a. CPUC Ruling provides final guidance on scope, data inputs, schedule, etc., and authorizes IOUs to open a memo account to track incremental costs of the analysis

Conclusion and Next Steps

- The Policy Scenario Analysis use case should be considered its own use case, distinct from the planning use case.

Further development of this use case is required; the above framework provides one potential path forward.

Item 1: Planning Use Case

IREC Comments in Response to Revised Drafts on the Planning Use Case[29]
ICA Working Group

Summary of Discussions to Date

The ICA working group discussed the planning use case during multiple meetings and while some progress has been made (as reflected in the redlined drafts that have been circulated), the group has not able to coalesce around a clear definition of the use case and its subcomponents or, importantly, what the methodology or methodologies should be used for said use case.

It has been difficult to reach consensus on descriptions of the potential uses in the planning context, one reason is that the IOUs are operating under a more narrow concept of the word "planning" than that envisioned by other stakeholders, but even in areas where there is fairly general agreement the details have not yet been worked out.

There does appear to be general agreement amongst participating parties on one aspect of the planning use case. Broadly speaking that is to use the ICA to "identify system needs expected to be created by future DER growth, for the purpose of preemptively addressing these needs." The non-IOU stakeholders broke that use case into multiple discrete parts in order to further discussion toward selection of a methodology, but there is still disagreement on the details.

We know that the ICA results can identify where system constraints currently exist because this was a basic requirement of the interconnection use case. This information alone could be used to inform decisions in the utility's annual distribution system planning context, but that is likely not sufficient to really assist with proactive integration of DERs. Beyond that, however, the "planning" aspect requires layering on a forecast of expected DER and load growth. This could be a forecast narrowly developed for the purposes of helping the utilities identify future system constraints during their annual distribution planning process. It could also be a forecast developed to demonstrate how DERs will be deployed under different policy frameworks for the purposes of understanding how those policy frameworks would impact distribution system needs. The stakeholders and IOUs now both appear to agree that both of these are possible uses for the ICA, although the IOUs still consider only the former forecast to be the "planning" use case.

Putting the semantics aside, where the disagreement appears to lie is in what exactly will be done from a decision making standpoint with the results of the ICA under these two different types of forecasts.

During the working group discussion of the interconnection use case, we found that understanding how the ICA outputs would be used shaped what was needed out of the methodologies being tested. Since

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[29] Since at this point there have been many heavily edited drafts circulated with a lot still unresolved IREC is providing this separate document as a statement of our current position on the Planning Use Case.

the working group has had difficulty getting agreement on how the results would be used, we have not had the more detailed discussion about what is needed out of the methodology.

In order to move this discussion forward it may be helpful for the Commission to provide more direction during Track 3 of this proceeding about how exactly it would like the ICA results to actually be used in the decision-making process (i.e. at what stage, what level of granularity should the results provide, how will those results inform later steps and what additional data or inputs will be used in addition to the ICA results to inform both investment decisions and future policy making). IREC recognizes, however, that Track 3 is principally focused on the distribution system planning process, so it may be necessary to convene a conversation about the policy uses separately.

What Further is Needed to Select a Methodology

Even when just focusing on the one aspect of the use case where there has been common agreement, IREC believes that there is still a lack of clarity both about how the ICA will actually be used to identify system needs and what methodology or methodologies are appropriate to use for this task.

The utilities have identified three different possible approaches for how growth forecasts will be compiled with the ICA results to help identify areas with possible system needs. It has been acknowledged that each of these approaches have different pros and cons but there has not been any actual testing of these approaches with the ICA methodologies developed during the Demonstration Projects to see which produces the most meaningful and actionable results. Because the planning use case requires combining a forecast with the ICA there are potentially different methodological question than were faced in the context of the interconnection use case. Principally, the interconnection use case requires consideration of what the ICA would be at particular nodes on the system. Since the planning use case is more prospective and will necessarily be relying on a forecast of DERs installed across the system vs. in a particular location (whether for system planning or policy planning purposes) it may be difficult to analyze down to the nodal level. It has not yet been tested whether the methodologies produce reasonably accurate predictions of system needs at a substation or circuit level.

The utilities have not proposed using a common methodology for the planning use case, and indeed PG&E has even suggested it would now like to consider using EPRI's DRIVE tool which has not yet gone through any vetting by this working group or the Commission for this use case or any other purpose. At this time IREC is not advocating for the use of any particular methodology because it is our view that there has not been any real demonstration of how the results would differ when used in these planning scenarios. In particular, IREC has real concerns about relying on the results of the ICA to authorize investments in some form if there has been no credible testing of whether the results inflate or deflate the predicted system needs. IREC does strongly believe that the ICA should be used to help move toward proactive ways of accommodating higher penetrations of DERs, but any tool that will be used to determine authorization for additional spending needs to be at least minimally tested.

Finally, with all of the ICA distribution system planning use cases that have been discussed, the utilities have indicated that the IOUs would not actually rely on the outcomes of the ICA to identify upgrades, but instead would use it as a guide upon which additional operational data would be used to determine

final need for upgrades. Since the ICA tested to date only identifies the limiting criteria and does not actually identify what the best solution would be, it makes sense that there will need to be further analysis. However, if the Commission intends for the ICA to be used in a transparent manner to support authorization of utility expenditures for proactive upgrades to the distribution system it is important that the Track 3 process more clearly indicate what additional inputs will be used and how the information from the ICA will be refined so that there is confidence in the spending ultimately authorized.

Conclusion/Recommendations

IREC is strongly supportive of using the ICA to guide both utility distribution system planning and also to inform Commission understanding of how policies and programs may alter distribution system needs over time. Unfortunately, however, IREC has not acquired during this working group process a clear sense of how the results from the existing methodologies may vary when the forecasts/growth scenarios are applied.

IREC believes the Commission should adopt the full range of use cases identified by the stakeholders in this process. However, there likely needs to be further discussion about what the needs are for using the ICA results in the manner identified in the selected use cases. There should be some (ideally abbreviated) process to have the utilities actually provide some demonstration of how the methodologies they propose to use differ in their results and some vetting of the overall potential accuracy of those results to ensure that the ICA is not over or underestimating system needs when the forecasts are applied.

Item 2: Develop standard PV generation profile

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- There is general consensus that a standard PV profile should be incorporated into the ICA tool.
- The IOUs are currently performing additional analysis to develop a standard PV profile, as discussed further below.
- The IOUs plan to present this standard profile in the November meeting.

Introduction and Background

In DRP Demonstration Project A, the IOUs utilized a common PV profile to show how a PV profile could be used in combination with the technology agnostic ICA to develop common PV ICA values. Those values where then further mapped on the IOU's online maps.

The Objective of this topic is to develop a PV profile which can be used for ICA system-wide rollout and which is can be used for interconnection approval of PV based DER interconnections.

Discussion

During the July 7, ICA working meeting it was agreed on that the IOUs would proceed with the determination of the appropriate PV curve. To do this, the IOUs plan to collaborate for three months to evaluate the available data sets. Subsequently, the IOUs plan to present to the ICA working group a proposed PV curve along with the underlying assumptions and data used to determine the proposed PV curve.

The ICA working group agreed that at minimum the following would be evaluated by the IOUs in their determination of the PV curve:

1. The data used should be cleaned from inaccurate data. Such as verifying the zero values for periods where PV output greater than zero
2. NREL PVWatts ® Calculator should be evaluated to determine adequacy. (Note: Ultimately the ICA should not rely upon a third-party tool, as the ICA will be used in the interconnection process, and the interconnection process should not rely upon a third party tool. Instead, the PVWatts calculator can be used to develop a standard profile that will then be used in the ICA, independent of any further modifications (or potential discontinuation) of the PVWatts tool.)
3. The proposed PV profile should have adequate temporal details covering 12 months of PV performance.
4. The PV profile should be develop with the same nameplate PV modules as that of the inverter nameplate. Example: 100KW of PV modules connected to a 100KW inverter
5. The IOUs plan to evaluate the impact to PV-ICA when the DC power is oversized as compared to the inverter. For example: 120KW of PV modules connected to a 100KW inverter
6. The IOUs plan to evaluate how tracking systems (PV with trackers) affect ICA

It was also agreed that IOU should provide the underlying data to the ICA working group at least one week prior to IOU presentation of the proposed PV profile

Conclusion and Next Steps

- The IOUs are currently in the process of evaluating a standard PV profile as described above.
- The IOUs plan to review the proposed PV shape at the November WG meeting
- The IOUs will provide the detailed data prior to the WG meeting.

Item 2: Develop standard PV generation profile

Joint IOUs' Parameter Comparison
ICA Working Group

IOU Comparison Chart

Comparison for inputs used in parameters of NREL PVWATTS tool.

System Info	PG&E	SDG&E	SCE	Notes
DC System Size	1 (normalized)	1(normalized)	5.2	Application Information (Average)
Module Type	Standard	Standard	standard	Default
Array Type	Fixed	Fixed	fixed (roof mount)	Application Information (Average)
System Losses	14%	14%	14%	Default
Tilt	20 (res.) 15 (com/ind)	18	18	Application Information (Average)
Azimuth	180	180	180	Application Information (Average)
DC to AC Ratio	1.03	1.15	1.15	Application Information (Average)
PV Inverter Efficiency	96%	96%	96.5%	Application Information (Average)
Ground Cover Ratio	0.4	0.4	0.4	Default

Item 2: Develop standard PV generation profile

Clean Coalition tracked changes edits to Joint IOUs' Initial Proposal
ICA Working Group

Clean Coalition provided tracked changes edits with language modifications and a note that IEEE 1547.1 is considering requiring inverter oversizing that would provide capacity that would increase ICA. To view the tracked changes edits, please see the online version of the document: https://drpwg.org/wp-content/uploads/2016/07/ICA-Item-2-Standard-PV-Profile_CleanCoalition.docx

Item 5: Smart Inverters
Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- The ICA WG concurred that the volt/var function with reactive priority should be incorporated into the ICA tool.
- The ICA WG had concurred that evaluating the impact of the volt/watt function in to ICA and particularly on impact to interconnected DER nameplate capacity
- The ICA WG concurred that there is need to evaluate the ramp rate and soft reconnect function and their impact to ICA
- The evaluation would then be used to determine automation tool requirements (Requirements on the CYME tool, Synergy Tools, etc.)
- The studies would include:
  - Evaluation of the Rule 21 volt/var function with reactive power priority, evaluation of the proposed Rule 21 volt/watt function and evaluation of the Rule 21 Soft Star with Ramp control function
  - Evaluation of the requirements for such as CYME and Synergy
  - Evaluation on a system wide implementation plan of ICA with Smart Inverters
- The ICA WG concurred that due to the timing of when Smart Inverter with reactive priority will be available on the market, the studies to be completed in Q2-2018 for a potential system wide implementation on Q4-2018 through Q2-2019

Introduction and Background

In DRP Demonstration Project A, the IOUs performed a high level analysis utilizing the Smart Inverter reactive power functions. Due to the timeline associated with the completion of Demo A, the studies needed additional coordination in terms of methodologies and limitations.   During the July and August ICA working group meetings, the various smart inverter function were discussed and consensus on which functions should be further evaluated for including into the ICA tool was reached.

Discussion

In the August ICA working group meeting, the various smart inverter function were discussed and a concurrence was reached on which smart inverter function should be further investigated to determine their impact into ICA and determine how the ICA tools such Cyme and Synergy would need to be modified to allow automation of the Smart Inverter in the tools. *Table 1- Smart Inverter function* shows the function which the ICA working group concurred on for further investigation.

Function	Phase	Timing	Supports Higher ICA Values	Supports Higher Connected KW(KVA) Values	Comment	Limintations	Further Investigated
Anti-Islanding	I	Q4-2017	NO	NO	Safety Functions Requirement		NO
Low/High Voltage Ride-Through	I	Q4-2017	NO	NO	System Contribution		NO
Low/High Frequency Ride-Through	I	Q4-2017	NO	NO	System Contribution		NO
Dynamic Volt-Var Operations (Watt priority)	I	Q4-2017	Partially	Partially	Produces all real (KW) first and only reactive power if inverter has capacity remaining	Watt Priority Reduces Ability To Support Voltage Control	NO
Dynamic Volt-Var Operations (Reactive priority)	Extended Phase I	Q4-2018 - Q4 2019	Yes	Yes	Rule 21 does not require oversize. Reduction on real power when reactive power absorved	Pending IEEE 1547.1 or CA stakeholders suport to activity earlier in CA	YES
Ramp Rates Controls	I	Q4-2017	Evaluate	No	May support the flicker ICA limitation		YES
Fix Power Factor	I	Q4-2017	Yes	Yes	Rule 21 does not require oversize. Reduction on real power when reactive power absorved	Deactivated, may connflict with voltage control	NO
Reconnect via soft start	I	Q4-2017	Evaluate	NO	May support the flicker ICA limitation		YEs
Communciation Capability	II	Q4-2018	NO	NO	Not intended to mitigate the violations which limit ICA	Capability Only - Not a requirement to apply	NO
Frequency Watt	III	Q4-2018	No	NO	System Contribution	Same as Volt/Watt	NO
Voltage/Watt	III	Q4-2018	NO	Yes	Will Reduce Real Power Production	Likely not available unitl Q3-2018. 12 months after approval of Phase III AL.	YES
Monitor Key Data	III	Q4-2018	No	NO	Information	Capability Only - Not a requirement to apply	NO
DER Cease-to Energy/Return to service	III	Q4-2019	NO	NO	Control	Pendinng IEEE 1545.1 Standard Development- Capability Only	NO
Limit Maximum Active Power Mode	III	Q4-2019	NO	NO	Not intended to mitigate the violations which limit ICA	Pendinng IEEE 1545.1 Standard Development- Capability Only	NO
Scheduling Power Values and Modes	III	Q4-2018	NO	NO	Scheculing Capabilities	Capability to Schedule Only	NO

Table 1 – Smart Inverter Functions

In its evaluation, the IOUs will baseline the analysis utilizing of each function utilizing the default settings being proposed as part of the CA Rule 21 Smart Inverter Working group. These function and their default settings are as follows:

Volt-Var with reactive power priority

For the volt-var function with reactive priority evaluation, the curve depicted on *Figure 1- Rule 21 reactive power volt/var curve will* be used to baseline the impacts of the volt/var function to ICA values as well as to evaluate the impact to the reactive power flow and need of the distribution system.
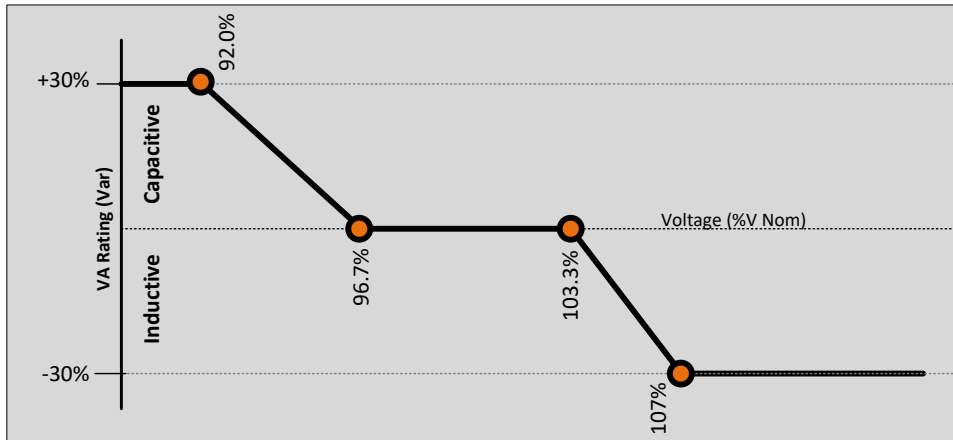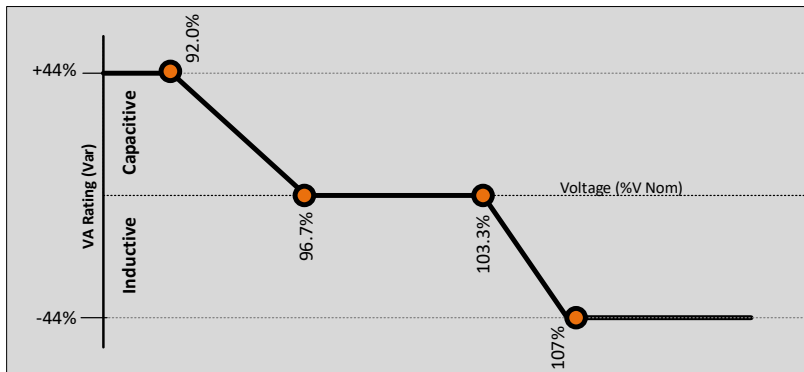

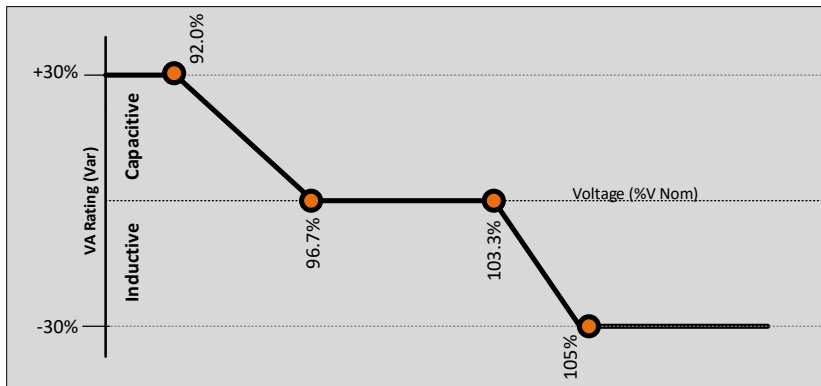*Figure 1- Rule 21 reactive power volt/var curve*

Further evaluation will be conducted as follows:

1. At 44% maximum reactive power as shown in the diagram below to evaluate the higher level of reactive power draw on the distribution system
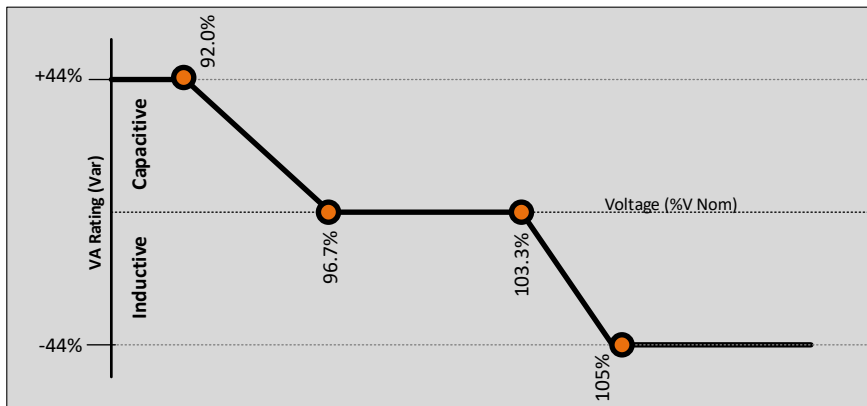

2. At adjusted high voltage of 105% as shown below

3. At 44% reactive power and 105% voltage as shown

The evaluation should be conduction on at minimum three feeders:
1. Short feeder with high peak, medium and low recorded load
2. Medium feeder with high peak, medium and low recorded load
3. Long feeder with high peak, medium and low recorded load

Volt-Watt Function

For the volt-watt function, the curve depicted on *Figure 2 – proposed Rule 21 volt/watt curve* will be used to baseline the impacts of the volt/watt function to ICA values
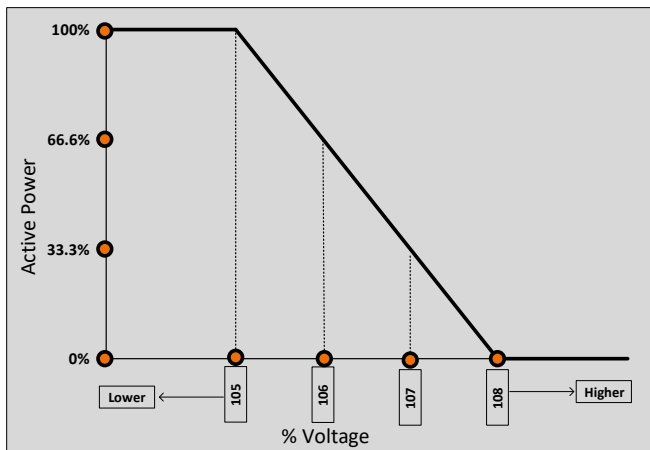
Figure 2- Proposed Rule 21 Volt/Watt Curve

The evaluation will be based on:

1. Exclusively using only the volt/watt curve as shown in Figure 2
2. Combination of the volt/var curve as shown on figure 1 and the volt/watt in figure 2.

The evaluation should be conduction on at minimum three feeders:
1. Short feeder with high peak, medium and low recorded load
2. Medium feeder with high peak, medium and low recorded load
3. Long feeder with high peak, medium and low recorded load

Ramp Rate and Soft Start Controls

For the ***Soft Start with Ramp Control function***, the default settings on ***Figure 3- Rule 21 Ramp Control Default Settings*** will be used to baseline the impacts of the these functions to ICA values.

Connect/Reconnect Ramp-up rate: Upon starting power into the grid, following a period of inactivity or a disconnection, the inverter shall be able to control its rate of increase of power from 1 to 100% maximum current per second. The default value is **2% of maximum current output per second**

Figure 3- Rule 21 Ramp Control Default Settings

The evaluation should be conduction on at minimum three feeders:
1. Short feeder with high peak, medium and low recorded load
2. Medium feeder with high peak, medium and low recorded load
3. Long feeder with high peak, medium and low recorded load

Conclusion and Next Steps

The ICA working group concurred that these studies should be completed by end of Q2-2018 (6/30/2018) and should include:

- Report on the findings of the evaluation
- Tool implementation requirements
- System wide implementation plan. Depending on the findings of the study and the requirements for tool development, a system wide implementation for Smart Inverter function may be Q4-2018 to Q2-2019

Item 5: Smart Inverters

Non-Utility Party Comments (representing CALSEIA, Clean Coalition, and IREC)
on Joint IOUs' Initial Proposal
ICA Working Group
August 29, 2017

Summary of Recommendations

- The IOUs should not be conducting studies on potential changes to the Volt/Var curve in this proceeding.
- The initial system-wide rollout of ICA should incorporate the benefits of Volt/Var functionality with reactive power priority.
- The Volt/Watt function will support larger DER sizes without further studies.
- The Phase 3 scheduling function will support increased sizes of DERs.

Background

SCE, on behalf of the IOUs, made a presentation at the August ICA Working Group meeting on the impacts of smart inverter functions on ICA. There was limited time for discussion during that meeting. The California Solar Energy Industries Association (CALSEIA), the Interstate Renewable Energy Council (IREC), and the Clean Coalition offer the following comments and recommendations in response to the IOU proposal.

Discussion

The three smart inverter functions that are most important to consider in an interconnection context are Volt/Var, Volt/Watt, and Scheduling.

Volt/Var

The Volt/Var function with active power priority will provide a large amount of voltage support, but the non-utility parties recognize that with active power priority it will be difficult for utilities to rely on that functionality when it is needed most. When the default setting of this function is changed to reactive power priority, it will increase hosting capacity.

Approximately 100,000 customers per year will install smart inverters throughout California IOU service territories. This will quickly become an asset that will have positive impacts on hosting capacity.

As part of Demo A, the utilities worked with Cyme and Synergi to begin building modules to incorporate smart inverter functionality into the ICA. At previous Working Group meetings, the utilities expressed that the vendors are willing to enhance that capability as needed and as feasible.

Rather than incorporating this functionality into the ICA calculation, the IOUs have proposed unnecessary studies. The IOUs propose to use the adopted Volt/Var curve as a baseline and measure the

impacts of changes to the Volt/Var curve against the baseline. Such an exercise is out of place in this proceeding. The utilities and other stakeholders in the Smart Inverter Working Group (SIWG) have put a lot of work into developing the adopted Volt/Var curve. If the utilities want to revisit the outcome of that work, they should do so within the SIWG or in the new Rule 21 proceeding, R17-07-007.

The task in this proceeding is to produce numbers for the ICA. In Demo A, the utilities did not incorporate the benefits of Volt/Var with reactive power priority in the ICA. They should begin immediately to do so for the first system-wide rollout. The deadline for inverters to be set to reactive power priority is still not settled, but most or all parties agree that the requirement is coming in the near future. By the time the final report is submitted by this Working Group, the start date for reactive power priority will likely have been set.

The utilities will need to make assumptions for smart inverter penetration for purposes of ICA calculation. The non-utility parties recommend assuming the same number of monthly DER installations in 2018 and beyond as in 2016, dispersed according to the disaggregation methodology adopted this month in this proceeding.[30]

Scheduling

With Phase 3 functions, customers will be able to interconnect systems that would exceed constraints in certain hours of the year if they guarantee that they will curtail production during those hours to avoid exceeding the constraints.

The advice letters that utilities recently issued for the technical standards of Phase 3 functions include the Scheduling function. Discussion of scheduling of inverter settings in the SIWG was mostly in the context of demand response. However, the same functionality that enables day-ahead settings changes for demand response purposes will enable seasonal scheduling for interconnection purposes.

Since scheduling is likely a few years out, any impacts of scheduling on modeling ICA do not have to be addressed immediately. Scheduling will give options to customers according to the current methodology for the ICA. The rules for scheduling changes to inverter settings in response to ICA limitations will be developed in R.17-07-017. In this proceeding, the Working Group report simply needs to acknowledge that it is a technically appropriate use of the ICA to schedule changes to inverter settings to alter the generating or load profile during certain periods of the year in order to avoid ICA constraints.

Volt/Watt

The Joint Parties agree that the Volt/Watt function will not increase the ICA value but will allow interconnection of larger systems. The Volt/Watt curve proposed by the utilities in pending advice letters does not require a DER system to reduce production until voltage is above 106% of the nominal voltage. This is above the upper limit of the acceptable ANSI range, meaning that utilities should be managing the circuit in ways that ensure that level is only reached on very rare occasions. The Volt/Watt

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[30]   "Assigned Commissioner's Ruling on the Adoption of Distributed Energy Resources Growth Scenarios," August 9, 2017.

function may be employed on circuits that have unstable voltage despite the utilities' efforts to keep voltage within range, but that is not a scenario the utilities should plan for.

To the extent that DERs are assumed to provide a negative impact when the circuit segment is at or near 106% of the nominal voltage, that impact should not be applied for inverter-based DERs with Volt/Watt functionality. This will allow larger DERs to be allowed within the ICA values.

The utilities propose to study the impacts on ICA of having Volt/Var functionality in combination with Volt/Watt as compared to only having Volt/Watt. It is not clear to the non-utility parties why this is a useful analysis. The SIWG has accepted that both functions can work in tandem. The utilities should be including both functions for purpose of ICA calculation.

Item 5: Smart Inverters
IOU Comments on Non-Utility Joint Initial Proposal
ICA Working Group
August 29, 2017

IOUs agree with stakeholders that the technical benefits of smart inverters should be incorporated to ICA as soon as practicable. However, in order to do so, the system modeling tools used to calculate the ICA must be updated to effectively and efficiently incorporate the Smart Inverter function to the ICA automated algorithms.

Currently the tools require that smart inverter functions, in particularly, the Volt/var function be performed manually for each power flow simulation. That is, at each node, it is require that the engineer assigns the volt/var curve for the DER specified at each node. Given the millions of electrical nodes which will have to be analyzed as part of ICA, it is imperative that the modeling tool incorporate the smart inverter volt/var function within the automated ICA modules. Without this automation being incorporated in the modeling tools, it would be an impossible task for engineers to perform this evaluation for all the electrical nodes.

Furthermore, in order to determine how the modeling tools need to be updated, more robust analysis must be performed. While in Demonstration Project A, limited ICA with volt/var curve was performed, that analysis was geared toward determining how the proposed volt/var curve would affect ICA values not how the tools would need to be modified to effectively incorporate. Also, in that analysis, the IOUs assumed that a reactive power would always be available (reactive power priority) and the IOUs did not take into account that smart inverters would be program as active power priority as currently allowed in Rule 21.

 For the reasons specified below, the IOUs believe that a proper method of incorporating Smart Inverter's Volt/var function into ICA is as outlined in the Joint IOU proposal:

- Performed more detail analysis to determine how the tools should be updated to performed an automated ICA process
- Work with modeling tool vendors to incorporate the required functions
- Update ICA with Smart Inverter ICA values when the volt/var functions has been incorporated in the modeling tools ICA modules

Item 5: Smart Inverters
CALSEIA and IREC reply to IOU response
ICA Working Group
October 27, 2017

Comments

In response to comments from non-utility parties on smart inverter functionality, the IOUs submitted comments to the Working Group on September 29.[31] In those comments, the IOUs seemed to back away from their earlier proposal for extensive new studies on potential changes to the Volt/Var curve. Instead, they stated "the system modeling tools used to calculate the ICA must be updated to effectively and efficiently incorporate the Smart Inverter function to the ICA automated algorithms." We agree this is the work to be done and that reactive power priority should be assumed for the smart inverter functionality.

In the response document, the IOUs offer three bullet points as steps forward:

1. Perform more detail analysis to determine how the tools should be updated to performed an automated ICA process.
2. Work with modeling tool vendors to incorporate the required functions.
3. Update ICA with Smart Inverter ICA values when the volt/var functions has been incorporated in the modeling tools ICA modules.

We agree with the second and third points, but the first point is still a vague statement about the need for more study: "Perform more detail analysis to determine how the tools should be updated to perform an automated ICA process." In absence of clarity on what this analysis would entail and when it would be completed, the IOUs should simply be working with the software vendors to incorporate smart inverter functionality and use it in the ICA calculations. If there is a problem getting the modeling tools to converge on a solution when smart inverters are enabled, it can be addressed by the IOUs and the software vendors working together to refine the tools.

While we are not opposed to the IOUs doing ongoing internal research and analysis as they roll out the ICA, we believe that it is essential that the smart inverter functionality being deployed in California be included in the ICA. Without its inclusion the ICA results will be inaccurate and likely under-calculate available capacity.

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[31] The IOU document was dated August 29, which was presumably a typo.

Item 5: Smart Inverters

IOU response to CALSEIA's and IREC's response to IOU response
ICA Workshop Group

In IOU's response to stakeholder comments in regards to the Smart Inverter Implementation in the ICA calculations, IOUs offered three bullet points as steps forward to address stakeholder's comments:

1. *Perform more detail analysis to determine how the tools should be updated to perform an automated ICA process.*
2. *Work with modeling tool vendors to incorporate the required functions.*
3. *Update ICA with Smart Inverter ICA values when the volt/var functions has been incorporated in the modeling tools ICA modules.*

CALSEIA and IREC do not view the need to perform additional analysis as outlined in bullet #1 and comment that "IOUs should simply be working with the software vendors to incorporate smart inverter functionality and use it in the ICA calculations". While the IOUs do not agree that additional studies are not necessary, the IOUs are in agreement to remove bullet #1 and perform "internal research and analysis as they roll out the ICA" as suggested by CALSEA and IREC.

The IOUs do want to clarify that since the existing ICA tools do not have the automated functionality to incorporate the volt/var function in the ICA calculations, this function may not be ready for utilization as part of the first system wide rollout as required by Track I Decision. This function would be utilized on subsequent ICA updates when the tool has been updated with this functionality.

Item 8: Comparative Assessment
Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- The IOUs invite stakeholder feedback on Demo A Comparison of IEEE 123 test feeder
- The IOUs recommend that a non-IOU analysis of IEEE 123 test feeder should be completed, including comparison to IOU results
- The above analysis and comparison can be used to indicate whether there are any major gaps or needed improvements for ICA implementation
- The WG Final Report should summarize non-IOU analysis comparison

Introduction and Background

The May 23 2016 ACR required the IOUs conduct a comparative assessment on one or more representative California feeders. In Demo A, the IOUs used the IEEE 123 test feeder as a reference circuit to compare IOU Demo A results (using both the "streamlined" and "iterative" methodologies) and between power system analysis tools (PG&E and SCE use CYME software, while SDG&E uses Synergi software). It was concluded that ICA results do not show significant variation when tested across the IEEE 123 test feeder, with slight variations attributed to how power flow models are treated between CYME and Synergi. In the ICA WG Final Report, the WG recommended utilizing more representative California feeders as a long-term refinement issue, while considering prioritization of other long-term refinement studies, give potential costs and resource needs.

At the July 7 ICA WG meeting, Tom Russell (PG&E), on behalf of the joint utilities, presented a review of the results from Demo A on the comparison of the IEEE 123 feeder. The presentation explained how variations within modeling on the IEEE 123 feeder were the most significant factor in the discrepancies. Due to the inherent differences in models and tools, it was expected that the numbers would not be exactly identical across the IOUs. The IOUs did find good tracking of similar results. Because the analyses were converging on similar results, the IOUs concluded that the IOUs' respective ICAs are sufficiently consistent and accurate.

It was identified that Item 2 overlaps considerably with Group IV Items F and G, which cover validation and QA/QC of ICA results, respectively. It was also identified that there are additional EPRI test circuits that are more realistic, with geography more similar to urban and rural circuits in California. Given that these include a significantly larger number of nodes (1000-6000 vs. 123 nodes), the joint IOUs recommend the first step should be external validation by a non-IOU party on the IEEE 123 circuit, which should occur prior to a comparative assessment using more detailed EPRI test circuits. The joint IOUs only made one modification to the IEEE 123 test circuit to ensure operational flexibility and can supply the modified file for external validation.

Discussion

The Working group discussed how, and with what tools, non-IOU parties may be able to perform this validation. While similar tool comparison would ensure consistency, there is question on if we need different tools to help validate as well.

One stakeholder representing DNV GL volunteered to help given that they are the developers of the Synergi tool used by SDG&E. They are currently performing validation on the ICA modules, and mention that this may be a good opportunity to compare notes and results with the ICA WG.
Overall there seemed to be consensus that third party validation was the next step to ensure non-IOU consistency.

Conclusion and Next Steps

- Variations in IOU results differ mainly due to model assumptions and deviations versus hosting capacity method
- Align with items F and G from Group IV
- Get third party results on IEEE 123 test feeder to compare
- Tom Russell (PG&E) will follow up with potential third party volunteers to perform this external validation.
- The Group IV topic on validation/verification was originally scoped by LBNL/LLNL.

Item 8: Comparative Assessment: Update

Joint IOUs' Update
ICA Working Group

Discussion

It was agreed upon in earlier working groups meetings that before any expansion to additional circuits that an external party provide validation of the IEEE 123 circuit comparison. At the time DNVGL volunteered to do such an analysis. After that, DNVGL never followed up with the working group on completing this work. The IOUs do not think it makes sense to continue with any extra internal IOU assessment until there is good alignment with an external party.

Conclusion and Next Steps

- The Demo A dataset provided a good indication that ICA is overall aligned across the utilities
- Alignment is desired with external validation before moving forward with more time intensive comparative assessments
- Since an external party is not willing to volunteer, it is suggested that the commission look to hire a third party to perform the additional assessment if this is desired.
- Continue with other forms of alignment and QA in other long term items

Item A: Single Phase

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- Utilities to evaluate one feeder to use as baseline to estimate the following:

- Utilities to evaluate applicability of DER connecting to single phase DER
    - What type of DER connects to single phase
    - What level of DER typically requires 3 phase
- Analysis should commence in Q1 2018 with results to be delivered in Q2 2018

Introduction and Background

As part of the Demonstration Project A working group meetings, the possibilities to calculate single phase ICA was discussed. In those discussion, the IOUs agreed that ICA values for single phase radial nodes could be additional ICA data which may be provided but stated that accurate ICA values would be difficult to be determined because of the limitation of information for single phase radials and limitation of the modeling tools.

Discussion

In order to accurate determine ICA at single phase laterals, it is necessary accurately model the conditions are currently in the field. Two major sets of information are required in addition to that of what is required for 3phase ICA calculations:

3. **Phasing information.** This information depicts how the electrical single phase and its single phase load (aΦ, bΦ, cΦ) is connected to the 3 phase system. In the modeling of the network, it is important that the each of the laterals accurately represents to which phase it is connected in the field. Not having the proper phasing information may potentially yield inaccurate ICA values

4. **Single Phase fusing information.** This information depicts how the single line radials are protected. In order to calculate the ICA value for protection, the fuse size is required as to insure that the ICA value does not exceed what ratings of the protection fuse
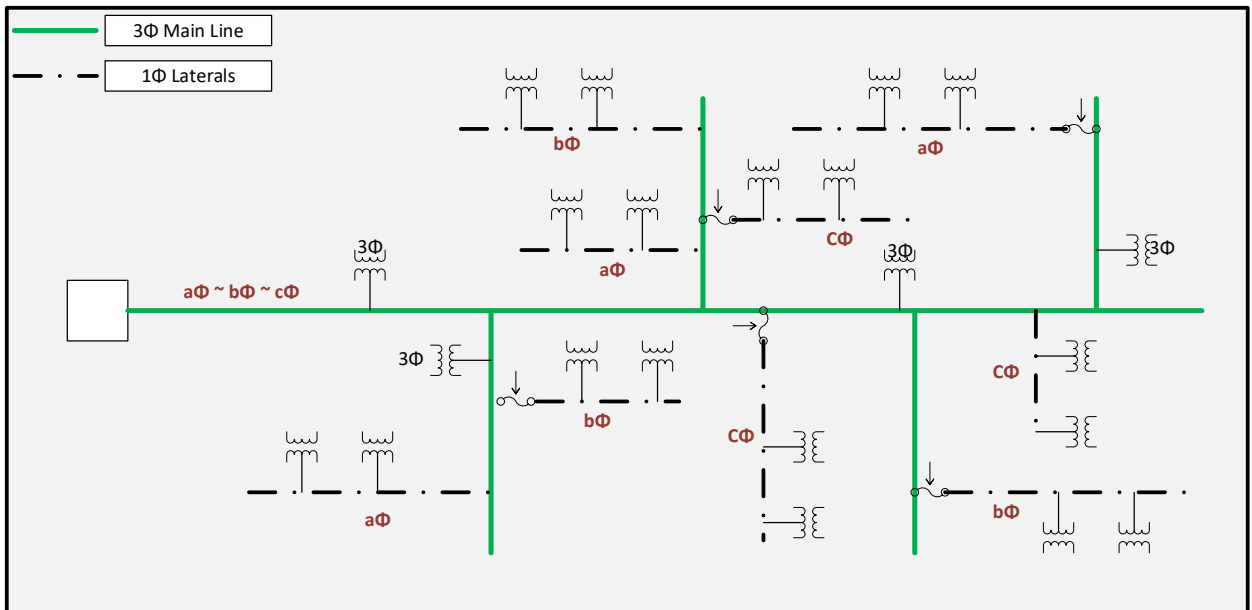
   This information above is depicted in figure 1

Figure 1 – Circuit diagram with single phase radials

In addition to the data stated above (phasing and fusing), the ICA tool needs to be modify to take into account limitation such as voltage imbalance, load imbalance, protection limitation on imbalance load, etc.

Conclusion and Next Steps

The IOUs proposed to evaluate one feeder to approximate the following areas what would be required for system wide roll-out.

- Single phase radials will be displayed in the IOU's interconnection maps as part of the 2018 system wide rollout of ICA.
- Level of complexity to accurate determine the properties of each single phase lateral including phasing, fusing (protection) and other related characteristics
- Cost of having to verify each single phase radial
- Time required to be able to complete system wide evaluation
- The capabilities of the existing modeling tools to account for impacts of single phase DER installations such as single phase limits caused by balancing
- Potential use of single phase ICA values
- Commence evaluation Q1 2018
- Deliver results Q2 2018

Item A: Single Phase

ORA's Initial Proposal
ICA Working Group

Summary

- Given prior CPUC direction regarding ICA and single phase circuits, the IOUs' evaluation of expanding ICA analysis should be well underway.
- The IOU proposal to provide a simplistic evaluation beginning in 2018 is unreasonable.
- ORA proposes that a more detailed evaluation, as discussed below, be completed by December 1, 2017.

Introduction and Background

For the initial ICA deployment, ICA values will be calculated and presented for all three phase circuits, but only the location of single phase circuits will be shown on ICA maps.[32] The proportion of distribution circuits that are single phase is significant. For example, they represent 34% of circuit miles and feed 50.0% of customers for PG&E.[33] SCE has indicated that most DER connected under NEM are on single phase circuits. The IOU presentation to the Working Group on September 19 and the IOU initial proposal provided reasons why expanding the ICA analysis to all circuits would be difficult:

- The information for single phase laterals is not as accurate as that of three phase systems,
- Single phase laterals have significant limitations based on capacity, load imbalance, and fusing,
- Limitation of the modeling tools.

The status and limitations of single phase circuit hosting capacity were discussed at the September 19 meeting, and WG members noted the ICA methodology details must account for the limits of these circuits. For example, if a small rooftop PV is the primary source of DER on single phase circuits, iterative ICA using a 500 kW increment may have limited value. The IOUs' initial proposal offers to evaluate "one feeder" to determine the feasibility and cost of performing ICA on singe phase circuits, and lists the scope and schedule of the evaluation.

Discussion

ORA agrees that the feasibility of extending ICA to single phase circuits needs to be evaluated, and that if deemed viable, whether methodological modifications are required based on the unique characteristics of single phase circuits and the loads and DER connected to them. However, ORA does not agree with the IOU proposal. First, system level conclusions cannot be gleaned from evaluation of a single circuit. Moreover, the IOUs should have already evaluated the scope of the issue and potential mitigation costs based on existing CPUC guidance. Second, the IOU proposal provides limited details for

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[32] Cite to D.17-09-026.
[33] PG&E response to data request ORA-PG&E-3, Q2. 33% of overhead circuit miles and 39% of underground circuit miles are single phase. This data is valid as of September 24, 2015.

a single evaluation on one circuit than detailed evaluations that will yield accurate estimates for each IOU's system.

Third, ORA believes it is important to document the baseline condition of single phase circuits, including why IOUs lack fundamental information about these circuits and how it fulfills its obligations under PUC 451 without this information. The IOUs have explained that they lack information on single phase portions of its distribution system, but have not explained why this situation exists or how the lack of this information impacts planning and operations. A similar situation existed for three phase circuits, but in that instance, the issue pertained to compiling and verifying data that already existed. In contrast, the IOUs' presentation and initial proposal implies that data on phasing of loads, fuses, and conductors for single phase circuits is inaccurate or non-existent.[34] This lack of information on single phase circuits is troubling considering that the IOUs state that single phase circuits are "designed with levels of load as to not create significant imbalance - Imbalance creates circuit overloads, operational issues, voltage issues."[35] It is unclear how the IOUs currently are able to manage these issues without accurate information on phasing, fusing, and physical characteristics of the circuit, such as the type of wire or conductor.

Finally, PG&E stated in the meeting that it was currently evaluating a method of determining phase information through an EPIC project.[36] This and other similar projects should be defined, and the timing of results should be incorporated into IOU evaluations of this issue.

Conclusion and Next Steps

The IOU initial proposal is inadequate and untimely. ORA proposes the following next steps

- Single phase radials will be displayed in the IOU's interconnection maps as part of the 2018 system wide rollout of ICA.
- Each IOU should separately provide a proposal based on the specific situation within its service territory including the following by December 1, 2017:
  - Scope of single phase or other types of circuits (e.g. two phase, network, etc.) currently excluded from the ICA in terms of circuit miles and customers served,
  - Summary of the types of customers currently connected to non-three phase circuits,
  - Summary of the types of DER currently connected to non-three phase circuits,
  - Detailed information on the type of required circuit data that is not currently available, and the scope of the lack of data (hypothetical example: SDG&E lacks accurate phasing data for all single phase circuits feeding single family residences)
  - Detailed information on the quality of existing data, and the steps required to convert the data into model inputs consistent with ICA requirements,

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[34] Inaccuracy of wire/conductor type is indicated on page 10 of the ICAWG September 19, 2017 slide deck.
[35] Page 11 of the ICAWG September 19, 2017 slide deck.
[36] Electric Program Investment Charge (EPIC) project #2.14 "Automatically Map Phasing Information." Per PG&E, this project is scheduled to be completed in December 2017.

- o An explanation of why the required data does not currently exist, and how the IOU meets the requirements of PUC 451 without this data. This explanation should include discussion of planning and operational procedures that are used in lieu of this data.
  - o Existing challenges the IOU is experiencing because of the lack of data,
  - o A detailed evaluation plan describing how it will determine an accurate system wide cost and schedule for collecting and validating the required data, and making the data available to the ICA calculation process,
  - o Results of discussions to date with ICA software vendors regarding the technical challenges, estimated cost, and timing of extending ICA to single phase circuits,
  - o List of related pilot, demonstration, or other RD&D projects and current estimate of completion.
- WG members should l review the IOU proposals by December 15, 2017 and provide a review to include in the final ICA WG report. This report should also address the potential use of single phase ICA values.

Item E: Method for Reflecting the Effect of Potential Load Modifying Resources on Integration Capacity

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations
- Maintain current ICA calculation methods
- Maintain current methods for integrating existing DERs within the ICA

Introduction and Background
In the ICA Working Group (WG) formed for Demo A, some stakeholders expressed desire for the ICA to reflect the effect of load modifying resources (LMR). The final WG report included this item as a non-consensus item and stated that all DERs are load modifying resources. With this in mind, the ICA WG long term scoping document rescoped this item to include probabilistic modeling approaches and LMR impact on key indicators and historical and forecast load profiles.

Discussion
ICA as an interconnection and planning tool is intended to provide DER developers the hosting capacity at each electrical node that will not result in distribution upgrades. With this value, the developer can enter the interconnection queue and have a reasonable amount of certainty that an upgrade will not be triggered if the project is below the ICA limits.

A probabilistic approach to ICA would determine the limits for each criterion based on a range of values for load and DER.   The calculated ICA limits would then also be a range, and not provide the certainty required for the interconnection study process. Upon submitting an interconnection application, a DER project would then trigger a study by the IOUs, which would run counter to the goals of the ICA, which is to streamline the interconnection process. Further, depending on how the study is performed, upgrades may be identified for the project even if it is sized within the identified ICA range. For these reasons, the IOUs propose to maintain the current ICA method, which provides more certainty within the interconnection study process.

In addition to probabilistic approaches, stakeholders expressed concern that existing DERs are not added into the load profiles that are used within the ICA. Without including the impact of existing DERs, the thought is that the ICA may overestimate the available capacity. At the September 19th ICA WG meeting, the IOUs explained that the load profiles used within the ICA are inclusive of both the existing load and DER installed on the distribution system. in this manner, the impact of existing DERs is already accounted for when calculating the ICA limits.

Conclusion and Next Steps

- Probabilistic ICA calculations can degrade the usefulness of the ICA for interconnection and planning
- The ICA currently reflects the effects of LMR in the existing load curves which are then used in forecasting.
- No modifications are necessary to incorporate LMR

Item E: Method for Reflecting the Effect of Potential Load Modifying Resources on Integration Capacity

ORA Proposal
ICA Working Group

Summary of Recommendations

- ORA supports recommendations from the IOU initial proposal.
- Investigation of more robust methods to reflect the impact of Load Modifying Resources (LMRs) on hosting capacity should be retained as a long-term issue to be considered after stakeholders have had the opportunity to use results from the initial ICA deployment and critique both the results and methodology used.

Introduction and Background

Please refer to IOU initial proposal.

Discussion

ORA agrees with the recommendations of the IOU proposal that current calculation methods are appropriate and should be maintained for the initial deployment and the near-long-term. However ORA understands that the load modifying characteristics of DER included in current load profiles are static, include many assumptions to provide a single load curve per circuit, and that the value of DER as flexible LMRs may be underestimated using the current approach. ORA agrees with the concerns expressed by the IOUs, but does not agree that the current treatment is the best one for the long-term. ORA, therefore, recommends that this issue be considered a long term issue to be addressed early in 2019 once the initial ICA has been deployed and stakeholders have had the opportunity to use it for each adopted use case.

Conclusion and Next Steps

- ORA supports the conclusions from IOU initial proposal.
- Investigation of more robust methods to reflect the impact of LMRs on hosting capacity should commence in early 2019.

Item 4: Develop Non-Heuristic Approach to Operational Flexibility

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- IOUs will display ICA with and without Operational Flexibility using the "reverse flow" method
- There is no established method other than performing power flows on various possible switching scenarios
- The IOUs continue to invite researchers and the vendor community to develop approaches to efficiently analyze abnormal conditions

Introduction and Background

The intent of the safety/reliability constraint is to ensure that all operational flexibility is preserved when DERs are added to the grid. Because the ability of the grid to tolerate reverse flow depends on the configuration, by prohibiting reverse flow at these points, the ICA determines the DER adoption that produces no reverse flow in any configuration. The WG recognized that the method used to determine operational flexibility is heuristic in nature and encouraged further discussion to determine non-heuristic methods to analyze operational flexibility.

The WG agreed and recommended that the operational flexibility criterion based on no reverse power flow across SCADA-operated devices is a reasonable short-term solution to the preservation of operational flexibility. The WG recommended that in the first system-wide rollout of ICA results, two sets of values be published, one with Operational Flexibility as a constraint and the other without.

Discussion

The IOUs will display ICA with and without "Reverse Flow" Operational Flexibility for implementation of ICA. No additional analytical approaches were provided to the working group other than what utilities have performed using reverse flow. Because of this the IOUs will start working with the vendor and research community on best methods to analyze abnormal switching conditions.

While the IOUs look to implement this approach, there will be challenges to face in performing it in a completely non-heuristic manner:

- There is no efficient method to create abnormal switching conditions in vendor tools other than manually opening and closing switches
- There could be hundreds of switching scenarios for a circuit so we must find a way to limit and decide which will be the most applicable configurations
- Calculation times and computing costs will significantly increase due to the multitude of possible switching conditions

EPRI was invited to speak on recent work that they have been performing on Operational Flexibility. They believe that the best procedure to determine absolute minimum hosting capacity for feeders is to analyze each individual state. Because of this EPRI believes that:
1. Planning Margins for a reduction in hosting capacity would be difficult to mandate
2. Operational Flexibility may be impractical to pre-calculate and better applied in operations on an as configured as needed basis.

The working group seems to general agree with these two statements. We are in line with point 1 with our implementation of displaying ICA with and without the operational flexibility constraint applied. As for point 2, the working group also generally agrees that while informative, this constraint may be better applied in an operational sense within a Distributed Energy Management System. Operational flexibility could be too constraining to be applied as a planning margin within interconnection. However, the working group will work with the Rule 21 working groups to decide how the limit can help inform specific requirements that may be needed within the interconnection process.

Conclusion and Next Steps

- IOUs will display ICA with and without Operational Flexibility using the "reverse flow" method
- IOUs will work with vendor and research community on efficient and reasonable techniques to perform ICA on abnormal switching conditions.
- Coordinate with Rule 21 ICA Working Group on best application of "Operational Flexibility" within the interconnection rules and process.

Item 4: Develop Non-Heuristic Approach to Operational Flexibility

Joint IOUs' Initial Proposal, with ORA edits
ICA Working Group

Summary of Recommendations

- IOUs will display ICA with and without Operational Flexibility (OpFlex) using the "reverse flow" method
- There is no established method other than performing power flows on various possible switching scenarios
- The IOUs continue to invite researchers and the vendor community to develop approaches to efficiently analyze abnormal conditions
- The IOUs will catalog SCADA operated devices in their systems and provide them to the CPUC and ORA[37]

Introduction and Background

The intent of the safety/reliability constraint is to ensure that all operational flexibility is preserved when DERs are added to the grid. Because the ability of the grid to tolerate reverse flow depends on the configuration, by prohibiting reverse flow at re-configurationthese points the OpFlex ICA values determinedetermines the DER adoption level that produces no reverse flow in any configuration. The WG recognized that thisthe method used to determine operational flexibility is heuristic in nature and encouraged further discussion to determine non-heuristic methods to analyze operational flexibility and its impact on hosting capacity.

The WG agreed that it was acceptable to use this heuristic approach for the initial ICA deployment and further recommended that thisthe operational flexibility criterion should be based on no reverse power flow across SCADA-operated switches and voltage regulators on devices is a reasonable short-term solution to the distribution circuits. Based on Demo A results, the OpFlex/safety criteria has a significant impactpreservation of overall ICA values.[38] operational flexibility. The WG recommended that in the first system-wide rollout of ICA results, two sets of values be published, one with Operational Flexibility as a constraint and the other without.

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[37] Other parties are not included here due to data confidentiality and security issues. This is not intended to define actual distribution of this data based on the outcome of overarching discussions of data in the DRP context.
[38] OpFlex/safety was the limiting criteria (in other words, the criteria that determined the overall ICA value) as follows based on Demo A final reports issued by each utility on December 27, 2016: for PG&E, 52% of rural DPA circuits and 33% of urban DPA circuits (see Figure 30, page 74); SDG&E provided a snapshot of two circuits in which safety set the ICA value in 17 of 24 scenarios using the streamlined ICA methodology (see Tables 3 and 4 in Section 5); SCE did not provide quantified impacts, but stated "while removing the OpFlex ICA limitation category would significantly increase the Integration Capacity…" (see page 73.)

Discussion

The IOUs will display ICA with and without "Reverse Flow" Operational Flexibility for initial implementation of ICA. No additional analytical approaches were provided to the working group other than what utilities have performed using reverse flow. Because of this the IOUs will start working with the vendor and research community on best methods to analyze abnormal switching conditions.

While the IOUs look to implement this approach, there will be challenges to face in performing it in a completely non-heuristic manner:

- There is no efficient method to create abnormal switching conditions in vendor tools other than manually opening and closing switches
- There could be hundreds of switching scenarios for a circuit so we must find a way to limit and decide which will be the most applicable configurations
- Calculation times and computing costs will significantly increase due to the multitude of possible switching conditions

EPRI was invited to speak on recent work that they have been performing on Operational Flexibility. They believe that the best procedure to determine absolute minimum hosting capacity for feeders is to analyze each individual state. Because of this EPRI believes that:

3. Planning Margins for a reduction in hosting capacity[39] would be difficult to mandate,[40]
4. Operational Flexibility may be impractical to pre-calculate and better applied in operations on an as configured as needed basis to evaluate reconfiguration options,.
5. It might be more practical to recalculate hosting capacity on a daily basis and use those results to potentially curtail DER.

The working group seems to generally agree with these two statements. We are in line with point 1 with our implementation of displaying ICA with and without the operational flexibility constraint applied. As for point 2, the working group also generally agrees that while informative, this constraint may be better applied in an operational sense within a Distributed Energy Management System. Operational flexibility could be too constraining to be applied as a planning margin within interconnection. However, the working group will work with the Rule 21 working groups to decide how the limit can help inform specific requirements that may be needed within the interconnection process. Regarding point 3, some non-IOU working group members suggested that since abnormal circuit configurations exist for limited periods of time, other alternatives need to be considered including DER curtailment using Phase 3 smart inverter functions, and limiting circuit reconfigurations.[41]

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[39] "Planning Margin" in this case is establishing a hosting capacity value lower than baseline value to account for circuit reconfiguration. For example, if the hosting capacity for a circuit using an ICA without OpFlex criteria is 10 MW, a 50% planning margin would yield a hosting capacity of 5 MW.

[40] The difficulty is not mandating a planning margin per se, but establishing a margin that is accurate for all circuits, loads, DER penetration, and reconfiguration options. A fixed planning margin like 50% could be too restrictive for DER is some cases, and insufficient to mitigate safety and reliability concerns in others.

[41] WP members acknowledge that limiting circuit reconfigurations would result in outages impacting more customers or outages with longer duration, but suggest that this undesirable "cost" must be compared to the costs and benefits of other alternatives.

As part of the investigation of alternatives to non-heuristic safety criteria, ORA recommends that each IOU catalog the SCADA devices in its distribution system that will be used in the short term OpFlex criteria and provide the results to the CPUC and ORA. Without this data, the CPUC will lack an understanding of how restrictive the OpFlex criteria is, and the level of added accuracy other alternatives provide relative to the short-term OpFlex criteria. This information will allow the benefit to be defined in cost benefit analyses which should accompany an evaluation of alternatives. For example, outage costs are highest for commercial and industrial (C&I) customers, so evaluation of alternative methods would benefit from information on the level of SCADA automation on predominantly C&I circuits. ORA acknowledges that there is an open issue of how this information will be shared beyond the CPUC and ORA. While this is an important issue, ORA believes it is out of scope of the current discussion.

Conclusion and Next Steps

- IOUs will display ICA with and without Operational Flexibility using the "reverse flow" method.
- IOUs will work with vendor and research community on efficient and reasonable techniques to perform ICA on abnormal switching conditions.
- Coordinate with Rule 21 ICA Working Group on best application of "Operational Flexibility" within the interconnection rules and process.
- The IOUs will catalog SCADA operated devices in their systems and provide them to the CPUC and ORA.

Item 5: DERs That Serve Peak Load
Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- Continue to utilize the existing ICA load profiles
- DER providers should utilize existing load profiles to determine ability to serve peak load

Introduction and Background

In the ICA Working Group (WG) formed for Demo A, stakeholders from Solar Retina expressed desire for the ICA to identify peak load days, and to correlate the ICA curves to specific weather conditions. Within the working group long term scoping documents, this issue was further clarified to evaluate a proposal to add four additional load shapes to the ICA.

Discussion

Stakeholders from Solar Retina expressed the desire to have additional ICA profiles that would allow the scheduling of DERs to meet the demands of hot days, while self-restricting generation on cold days so as not to exceed the ICA limits. The published ICA limit was thought to be too restrictive, and that significant capacity is left on the table that could be utilized by a DER system if properly operated such that it does not violate any ICA limit.

The IOUs note that applicants to Rule 21 and WDAT are not restricted on the size of the system they can install, rather, their respective interconnection agreements spell out dispatch limitations. If a DER provider wants to install a larger system, and have it restricted to a lower dispatch to meet distribution system limitations, they are free to do so, so long as they don't cause voltage, thermal, or other criteria violations. The current ICA curves give a very good indication as to the size of DER required to meet those high load conditions, while also providing the dispatch limit it is likely to see during low load conditions.

Regardless of the granularity of the ICA, it remains a tool to be used in interconnection study, not an operating tool. Additional curves would not guarantee that a DER could reach a certain level of dispatch on a hot day. Due to system conditions, that DER could be limited by factors not considered in the ICA, such as abnormal circuit configurations. The DER's interconnection agreement would still identify that the DER may be dispatch limited due to operating constraints, regardless of the value calculated in the ICA.

The IOUs expect that much of the concern surrounding this issue will be mitigated when new tools and systems such as DERMs are deployed that will allow real time dispatch instructions to be issued to DERs. The proliferation of smart inverters will also allow DERs to schedule dispatch based on day ahead

schedules, as well as real time signals. In this manner, DERs will be able to load follow, taking advantage of those high load days will ensuring system integrity during low load days.

Conclusion and Next Steps

- Existing ICA curves appropriately account for high and low load days
- No modifications to the ICA are necessary to size a DER system to serve peak load
- Future operating tools and systems (such as DERMS) will enable DERs to load follow
- When the limiting ICA value is a protection limitation, the ability to increase the size of DER behind the ICA may not be available.

Item 5: DERs That Serve Peak Load

IREC edits to Joint IOUs' Initial Proposal
ICA Working Group

IREC provided edits and comments in tracked changes to the IOU proposal. To view these tracked changes, please see the online document: https://drpwg.org/wp-content/uploads/2016/07/ICA-Item-DERs-to-Serve-Peak-Load-IREC.docx

Summary of Recommendations

- Continue to utilize the existing ICA load profiles
- DER providers should utilize existing load profiles to determine ability to serve peak load

Introduction and Background

In the ICA Working Group (WG) formed for Demo A, stakeholders expressed desire for the ICA to identify peak load days, and to correlate the ICA curves to specific weather conditions. Within the working group long term scoping documents, this issue was further clarified to evaluate a proposal to add four additional load shapes to the ICA.

Discussion

Stakeholders expressed the desire to have additional ICA profiles that would allow the scheduling of DERs to meet the demands of hot days, while self-restricting generation on cold days so as not to exceed the ICA limits. The published ICA limit was thought to be too restrictive, and that significant capacity is left on the table that could be utilized by a DER system if properly operated such that it does not violate any ICA limit.

The IOUs note that applicants to Rule 21 and WDAT are not restricted on the size of the system they can install, rather, their respective interconnection agreements spell out dispatch limitations. If a DER provider wants to install a larger system, and have it restricted to a lower dispatch to meet distribution system limitations, they are free to do so, so long as they don't cause voltage, thermal, or other criteria violations. The current ICA curves give a indication as to the size of DER required to meet those high load conditions, while also providing the dispatch limit it is likely to see during low load conditions.

Further granularity in the load data would help customers further understand the possible operational configurations and interconnection parameters that might allow a customer to optimize the sizing and operation of their system without triggering significant upgrade costs. However, there are limitations to the modeling of the ICA that at this time would likely require projects to undergo some level of interconnection review if they are proposing operations designed to closely track past load curves.

The IOUs expect that much of the concern surrounding this issue will be mitigated when new tools and systems such as DERMs are deployed that will allow real time dispatch instructions to be issued to DERs.

The proliferation of smart inverters will also allow DERs to schedule dispatch based on day ahead schedules, as well as real time signals. In this manner, DERs will be able to load follow, taking advantage of those high load days will ensuring system integrity during low load days. At this time, the working group determined that immediate work to increase the granularity of the peak load data was not a high priority, but it may be an issue that could be revisited over time as the ICA tool is deployed and its role in helping to optimize project siting and operations becomes more clear.

Conclusion and Next Steps

- Existing ICA curves appropriately account for high and low load days
- No modifications to the ICA are necessary to size a DER system to serve peak load
- Future operating tools and systems (such as DERMS) will enable DERs to load follow
- When the limiting ICA value is a protection limitation, the ability to increase the size of DER behind the ICA may not be available.

Items B, C, and D: Ways to make ICA information more user friendly and easily accessible (data sharing), Interactive ICA maps, and Market sensitive information

More Than Smart summary, for WG review
ICA Working Group

Summary of Recommendations

- IOUs will include refinements to 1) load profiles display, 2) color display, and 3) range display within the first system roll out.
- CALSEIA will arrange another conversation with DER developers and the joint IOUs on the functionality and usability of the ICA tool, to inform the user guide, map display, and potential development of an API.
- Stakeholders will provide additional information on what should be included in the ICA User Guide. It is not yet determined whether the User Guide will be available by the first system roll out.

Introduction and Background

During the development and review of Demo A, the Working Group agreed that the joint IOUs should work to standardize the map and downloadable data set format for the first system rollout, and that additional enhancements to maps for the full system roll-out may be added by the utilities as allowed by their tools and respective limitations.

All IOUs make the following information available via downloadable data set from their Demo A projects: 1) Demo A final report; 2) ICA Translator; 3) load profiles; 4) customer type breakdown; 5) detailed ICA results by circuit. The WG agrees that the following attributes should be available across all three IOU maps: 1) circuit; 2) section ID; 3) voltage (kV); 4) substation; 5) system15; 6) customer breakdown percentage (agriculture, commercial, industrial, residential, other); 7) existing generation (MW); 8) queued generation (MW); 9) total generation (MW); 10) ICA with uniform generation (MW); 11) ICA with uniform load (MW); 12) integration capacity of a generic PV system (MW).

For additional enhancements, the Working group should discuss whether the addition may be included within the first system-wide rollout, as well as an estimate of associated IT requirements and potential costs.

Discussion

The Working Group discussed these three ACR combined items at the October in-person meeting. In addition to identified asks from stakeholders, the conversation was informed by a one-hour

"Introduction to ICA" webinar aimed at DER developers, which gave additional insight on what modifications may make the ICA maps and downloadable data sets more user friendly.

The following items have been identified so far as additional refinements to increase data sharing and usability of the ICA tool, within the interconnection use case:

Development of an Queryable API

DER developers and some Working Group members have identified the development of a queryable application programming interface for the ICA tool to support search functions and possible integration with other tools. It is suggested that a good first step would be to understand what type of data developers are looking for, and in what format, before the joint IOUs determine feasibility with their respective IT departments. The WG should also consider the applications of this request within the Rule 21 proceeding.

Map key and other map enhancements

WG members agreed that the joint IOUs should use the same key and color scheme to represent integration capacity on the maps. First, the color ranges used to indicate hosting capacity ranges should be uniform across the IOUs. The Working Group discussed that red should represent a lower ICA (closer to the limit) and green should represent a higher ICA. The range that the colors represent should also be uniform. The Working Group discussed whether a fixed (e.g., MW increment) or relative range (e.g., 20% increments over the specific circuit) would be more useful. While the WG did not come to a conclusion, it agreed to pose the question to DER developers for input.

In addition to the map key, WG members identified several additional enhancements. First, joint IOUs are asked to standardize how load profiles are displayed on the maps, using the same labelled axis units. The WG discussed how the primary criteria violation is identified and whether it should be shown on the map as well as within the downloadable data set. It was discussed that displaying the primary violation directly on the map interface may be too misleading or simplistic, and that the way it is displayed now in the downloadable Excel file may be sufficient. The joint IOUs also discussed that some of the load profile information may fall under customer confidentiality issues. It was suggested that, for data that can't be published, the ICA map should make a note of why the data is unavailable rather than showing a blank. Finally, stakeholders requested that the RAM map be available either as a toggle or a separate tab as part of the ICA map interface.

It was suggested that these changes may be included within the first system-wide roll out.

ICA User Guide

WG members agreed that an ICA User Guide should be created to facilitate the use of the ICA tool by developers. This user guide should cover the following:

- How to access and understand the downloadable Excel file
- Explanation of the operational flexibility ICA number
- How to use the ICA Translator tool

Conclusion and Next Steps

- More Than Smart looks forward to comments from WG members to refine and include any additional desired enhancements to the ICA tool to improve user friendliness and data sharing capabilities, including from Joint IOUs on affirming timeline of when enhancements may be available (i.e., as part of the first system roll out, or as a goal for long-term refinement).
- CALSEIA will work with the joint IOUs to schedule a follow up conversation with DER developers to better inform the usability conversation, particularly around 1) whether the ICA map should demonstrate fixed or variable ranges, 2) what should be included in the ICA user guide, and 3) how to potentially develop an API and what data is necessary to include.

Item 2: Develop API capability for ICA online maps
Summary of Issue Development

CALSEIA

Introduction and Background

Discussion

During the ICA webinar, a question was raised regarding the availability of application programming interface (API) capability for the ICA online maps. The IOUs mentioned the capability is not available. In the following Working Group meeting, CALSEIA identified this as a priority item and the IOUs expressed willingness to work with the stakeholders to develop the capability. Subsequently, a conference call was held with the IOUs and select users of the ICA online maps to discuss the request for developing the API capability. The API capability would allow users to programmatically collect the data presented in the ICA online maps. Example of data includes but is not limited to: location of circuits, existing and projected load profiles of circuits, distributed energy resource hosting capacity, etc. The preferred method for API development would be for IOUs to follow the ESRI ArcGIS built-in capabilities as shown on: https://developers.arcgis.com/python/.

Currently, the ICA online maps require a user either to search for each specific location on the map and point and click to extract relevant information or to type in an address. It is not feasible to do this for some applications of assessing opportunities for deploying high volume of DERs on multiple circuits that require many potential interconnection locations to be assessed. The API capability would allow a user to programmatically extract this information from the ICA online maps back-end servers in bulk which will save time and resources and make more robust use of the ICA possible.

APIs are a set of protocols and routines that enable users to draw data that is available via a website directly into another software application and tools. DER developers have tools and software that model DER design and economics. An API would enable users to work within their own design tools and draw on the ICA data. If they are forced to manually search each location by address and copy and paste data into their design tools, it will greatly limit the ways in which ICA can be used.

PG&E stated potential privacy and security issues may prevent them from developing an API capability. SCE has API functionality in its ICA map but has chosen not to make it available to users.

Conclusion and Next Steps
- The Commission should decide whether security or privacy concerns warrant prohibition of API functionality for the ICA. The Commission could decide that some types of information should be made available and other types should not.

Item 3: Incorporate Learnings from Track 3 DER Growth

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- Follow related proposals in Planning use case around using DER Growth
- Relating Growth to ICA will determine forecasted needs, but not necessarily upgrade solution

Introduction and Background

The ICA planning use case envisions that ICA will assist with future planning decisions. ICA, combined with DER growth forecasts (discussed under DRP Track 3, Sub-track 1), can be used to identify circuits that require upgrades to accommodate forecasted DER. This activity will take findings and recommendations from the Revised Frameworks and Assumptions document and/or the ACR Ruling on DER Growth Scenarios and incorporate any necessary changes into ICA, as appropriate.

The Interstate Renewable Energy Council (IREC) additionally presented discussion questions regarding methodologies for determining growth scenarios that are integrated with ICA, and how the ICA results can be used for planning and decision-making processes (including recommendations and results from the DRP Track 3 Sub-Track 1 workshops on DER growth scenarios). These questions are summarized from the original scoping proposal below:

a. An evaluation of the results of the ICA analysis integrated into the growth scenarios (and if the methodologies used provide accurate results that can be used for planning purposes, including annual distribution planning and informing assessments proposed for grid modernization).

b. Are the results actionable over a useful time period, and accurate and granular enough to identify where upgrades will be needed? Do the results inform which type of action that can be taken, or should they?

Discussion

As discussed within the Planning use case discussions, the growth can be used to help determine forecasted areas of system deficiency. Item 1 established some of the framework of which this would work and what technical considerations have to be considered. The details of the three points can be found in the Item 1 proposal and will follow the discussion there. They are:

1. Granularity of DER Growth Forecast projections
2. Application of ICA results in comparison to DER Growth Forecast
3. Which DER Growth to consider due to granularity and applicability in tariffs

As for the mentioned questions, the IOUs see the results of the analysis using ICA and growth scenarios to be sufficient in identifying possible deficiencies. Using the DER growth in conjunction with the ICA results will help provide locations and characteristics of forecasted deficiencies in the system to

accommodate the expected DER growth. This assessment does not however provide a final solution set of identified projects to use in the GRC. This data set can then be provided to the distribution planning teams to continue with finding a solution to solve the deficiency. These solutions would be solved for and identified in conjunction with projects associated with loading to ensure a coordinated effort to solve the deficiencies.

The IOUs see usefulness and applicability to using the results to help inform the planning process. However, the results from the ICA process are not intended to be a solution set, but only an identification of available capacity. Thus the direct results of comparing DER growth and ICA will not directly result in needed upgrades and/or projects. It will simply be a point of information on deficiencies to host forecasted DERs which will be fed into the planning process to find coordinated solution sets with other planned work on the system.

The use of the forecasts was discussed to limit the inclusion of wholesale forecasts at this time. As time progresses, the wholesale forecasts will need to become more granular for use within the tools and processes to properly use. Also, the current cost sharing structure does not make it practical to include wholesale in the specific planning use case. That being said, cost sharing structures is a topic in the R.17-07-007 proceeding. These discussions will be followed and considered as appropriate.

Conclusion and Next Steps

- Use the Track 3 DER growth scenarios to compare/utilize with ICA to determine forecasted deficiencies to host DER for further study
- Do not use wholesale growth in analysis due to (1) lack of granularity/certainty of placement and (2) rules require them to mitigate and pay for the issues that they cause

Item 3: Incorporate Learnings from Track 3 DER Growth

Joint IOUs' Initial Proposal with ORA tracked revisions
ICA Working Group

Summary of Recommendations

- Follow related proposals in Planning use case around using DER Growth
- Relating Growth to ICA will determine forecasted needs, but not necessarily upgrade solution

Introduction and Background

The ICA planning use case envisions that ICA will assist with future planning decisions. ICA, combined with DER growth forecasts (discussed under DRP Track 3, Sub-track 1), can be used to identify circuits that require upgrades to accommodate forecasted DER. This activity will take findings and recommendations from the Revised Frameworks and Assumptions document and/or the ACR Ruling on DER Growth Scenarios and incorporate any necessary changes into ICA, as appropriate.

The Interstate Renewable Energy Council (IREC) additionally presented discussion questions regarding methodologies for determining growth scenarios that are integrated with ICA, and how the ICA results can be used for planning and decision-making processes (including recommendations and results from the DRP Track 3 Sub-Track 1 workshops on DER growth scenarios). These questions are summarized from the original scoping proposal below:

a. An evaluation of the results of the ICA analysis integrated into the growth scenarios (and if the methodologies used provide accurate results that can be used for planning purposes, including annual distribution planning and informing assessments proposed for grid modernization).

b. Are the results actionable over a useful time period, and accurate and granular enough to identify where upgrades will be needed? Do the results inform which type of action that can be taken, or should they?

Discussion

As discussed within the Planning use case discussions, the growth can be used to help determine forecasted areas of system deficiency. Item 1 established some of the framework of which this would work and what technical considerations have to be considered. The details of the three points can be found in the Item 1 proposal and will follow the discussion there. They are:

1. Granularity of DER Growth Forecast projections
2. Application of ICA results in comparison to DER Growth Forecast
3. Which DER Growth to consider due to granularity and applicability in tariffs

As for the mentioned questions, the IOUs see the results of the analysis using ICA and growth scenarios to be sufficient in identifying possible deficiencies. Using the DER growth in conjunction with the ICA results will help provide locations and characteristics of forecasted deficiencies in the system to

accommodate the expected DER growth. However, given known and unknown uncertainties in circuit level forecasts, tThis assessment does not however provide a final solution set of identified projects to use in the GRC and other uses identified in the ICA planning use case. This data set can then be provided to the distribution planning teams to continue with finding a solution to solve the forecast deficiency. These solutions would be solved for and identified in conjunction with projects associated with loading to ensure a coordinated effort to solve the deficiencies.

The IOUs see usefulness and applicability to using the results to help inform the planning process. However, the results from the ICA process are not intended to be a solution set, but only an identification of potentially available capacity. Thus the direct results of comparing DER growth and ICA will not directly result in needed upgrades and/or projects. It will simply be a point of information on deficiencies to host forecasted DERs which will be fed into the planning process to find coordinated solution sets with other planned work on the system.

The use of the forecasts was discussed to limit the inclusion of wholesale forecasts at this time based on the assumption that wholesale DER is not included in the IEPR forecast. As time progresses, the wholesale forecasts will need to become more granular for use within the tools and processes to properly use. Also, the current cost sharing structure does not make it practical to include wholesale in the specific planning use case. That being said, cost sharing structures is a topic in the R.17-07-007 proceeding. These discussions will be followed and considered as appropriate.

Conclusion and Next Steps

- Use the Track 3 DER growth scenarios to compare/utilize with ICA to determine forecasted deficiencies to host DER for further study
- Do not use wholesale growth in analysis due to (1) lack of granularity/certainty of placement and (2) rules require them to mitigate and pay for the issues that they cause

Item 3: Incorporate Learnings from Track 3 DER Growth Scenarios

IOU response to ORA revisions
ICA Workshop Group

The Office of Ratepayers Advocates (ORA) provided redlines to the IOU's initial proposal on the incorporation of learnings from Track 3 DER growth. The IOUs understanding of the redlines modification provided by ORA is that the redlines clarifies that the IOU's distribution planning teams will use data from the ICA planning use case to determine a solution to an identified deficiency of the grid based on the forecasted DER at the feeder level. If IOU's understanding of ORA's redline is not what ORA's intended, the IOUs then recommend additional clarification.

Item 3: Incorporate Learnings from Track 3 DER Growth

IREC's Proposal
ICA Working Group

Summary of Recommendations

- Follow related proposals in Planning use case around using DER Growth
- Relating Growth to ICA will determine forecasted needs, but not necessarily upgrade solution

Introduction and Background

The ICA planning use case envisions that ICA will assist with future planning decisions. ICA, combined with DER growth forecasts (discussed under DRP Track 3, Sub-track 1), can be used to identify circuits that require upgrades to accommodate forecasted DER. This activity will take findings and recommendations from the Revised Frameworks and Assumptions document and/or the ACR Ruling on DER Growth Scenarios and incorporate any necessary changes into ICA, as appropriate.

The Interstate Renewable Energy Council (IREC) additionally presented discussion questions regarding methodologies for determining growth scenarios that are integrated with ICA, and how the ICA results can be used for planning and decision-making processes (including recommendations and results from the DRP Track 3 Sub-Track 1 workshops on DER growth scenarios). These questions are summarized from the original scoping proposal below:

c. An evaluation of the results of the ICA analysis integrated into the growth scenarios (and if the methodologies used provide accurate results that can be used for planning purposes, including annual distribution planning and informing assessments proposed for grid modernization).

d. Are the results actionable over a useful time period, and accurate and granular enough to identify where upgrades will be needed? Do the results inform which type of action that can be taken, or should they?

Discussion

As discussed within the Planning use case discussions, the growth can be used to help determine forecasted areas of system deficiency, but it has not yet been determined or demonstrated which methodology is best suited to accomplish this goal or how accurate the results will be at identifying grid deficiencies (even assuming the forecast was completely accurate). Item 1 is currently under consideration and may provide some direction as to the manner in which the ICA combined with the growth forecasts may be used. The details of the three points can be found in the IOUs Item 1 proposal and will follow the discussion there. They are:

4. Granularity of DER Growth Forecast projections
5. Application of ICA results in comparison to DER Growth Forecast

6. Which DER Growth to consider due to granularity and applicability in tariffs

As for the mentioned questions, the IOUs see the results of the analysis using ICA and growth scenarios to be sufficient in identifying possible deficiencies. IREC does not believe there have been any results published to support this conclusion at this time. There needs to be further discussion and analysis of which methodology should be used to run the planning scenarios. Some of the open questions include: If the forecasts are done only at the substation or circuit level, how does that impact the results of the ICA which is currently run on a nodal level? Is the iterative method the appropriate tool to run in conjunction with forecasts if the specific locations of the DER are not known (they likely never will be since the forecasts are a prediction only)? Are the results produced when combining a growth forecast with the ICA sufficiently accurate to guide decision making? Is the streamlined tool or a stochastic approach better suited to provide more meaningful results in light of the imprecise nature of the DER locations in any forecast?

Using the DER growth in conjunction with the ICA results could help provide locations and characteristics of forecasted deficiencies in the system to accommodate the expected DER growth. This assessment does not however provide a final solution set of identified projects to use in the GRC. This data set can then be provided to the distribution planning teams to continue with finding a solution to solve the deficiency. These solutions would be solved for and identified in conjunction with projects associated with loading to ensure a coordinated effort to solve the deficiencies. However, even though the DER growth + ICA results will not result in the final decision on what solutions are needed, it is still necessary to have a reasonably accurate starting point. Otherwise areas where needs might arise will be missed, or needs might be forecasted that won't arise and unnecessary efforts could be expended to determine this.

The IOUs see usefulness and applicability to using the results to help inform the planning process. IREC also is optimistic that the ICA can be used in conjunction with the growth scenarios to guide decision making. However, the results from the ICA process are not intended to be a solution set, but only an identification of available capacity. Thus the direct results of comparing DER growth and ICA will not directly result in needed upgrades and/or projects. It will simply be a point of information on deficiencies to host forecasted DERs which will be fed into the planning process to find coordinated solution sets with other planned work on the system. However, this does not mean that relative accuracy of those results is not important since it will be a first step in determining where to analyze further.

The use of the forecasts was discussed to limit the inclusion of wholesale forecasts at this time. As time progresses, the wholesale forecasts will need to become more granular for use within the tools and processes to properly use. Also, the current cost sharing structure does not make it practical to include wholesale in the specific planning use case. That being said, cost sharing structures is a topic in the R.17-07-007 proceeding. These discussions will be followed and considered as appropriate. While IREC agrees that there are challenges associated with incorporating wholesale projects into the forecasts, it should also be recognized that, for those same reasons, the results are not likely to be as meaningful in terms of predicting where upgrades may or may not be needed if wholesale projects are left out. There

is a risk that this could mask opportunities for cost sharing and use of DERs to defer upgrades as well. The Commission should be aware of this as it considers actions based upon the ICA results.

Conclusion and Next Steps

- Further discussion and analysis may be needed to understand how to ensure sufficiently accurate ICA results when layering on forecasts which are not precise regarding DER locations.
- Use the Track 3 DER growth scenarios to compare/utilize with ICA to determine forecasted deficiencies to host DER for further study
- Do not use wholesale growth in analysis due to (1) lack of granularity/certainty of placement and (2) rules require them to mitigate and pay for the issues that they cause. Consider how this may impact the meaning of the results in later decision making processes.

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Item F: Develop ICA Validation Plans

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- Continue to validate through comparative assessments across tools
- Evaluate effectiveness in streamlining interconnection process when implementing in Rule 21
- Continue to drive alignment on IEEE 123 feeder (Item 8) and use learnings to inform validation and comparison across tools and stakeholders
- Continue alignment of use of hourly metering data to reduce the main driver of uncertainty in the model (Item 9)

Introduction and Background

This activity was outlined in the May 23, 2016 ACR as a long-term refinement item. A scoping proposal was presented by LNBL/LLNL, and discussed by the WG. The scoping proposal identifies that any of the concerns with the initial ICA methods have been addressed by moving to more of the iterative methods (i.e., direct simulation of the distribution grid using the commercial models), applying the analysis to all feeders, etc. Some questions regarding validation still remain, as outlined below, and more fully in the scoping proposal.

The original scoping proposal developed a number of questions – a summary of the types of questions are included here. The WG should refer to the original proposal when it begins discussion of this topic.
   i) What are the objectives of validation (e.g., believability, repeatability, applicability, etc.)?
   ii) Which components need to be verified (input, methodology, tools)?
        i. With regards to input data, what steps should be taken by IOUs, and how well are capabilities and impacts of DER captured in the hourly profile?
        ii. Within the methodology, are methods/assumptions transparent, and can results be compared across ICA methods (e.g., EPRI, Sandia, NREL)
        iii. With regards to verifying the tools, how do results compare across tools (e.g., CYME, Synergi, OpenDSS, GridLab-D)?
   iii) How much uncertainty exists, how much is acceptable, and where can it be reduced?
   iv) What are the appropriate datasets to serve as a reference point for validation and third-party improvements to the method (e.g., IEEE 123, IEEE 8500, PG&E 12 representative feeders)?

Discussion

There is much overlap with the comparative assessment item and thus will utilize recommendations from that proposal where appropriate.

The main objective of the validation is to provide transparency and confidence on the results. The IOUs see two main ways to approach validation. The first is to continue down the path of industry

engagement and comparison across tools as being explored in Item 8. The second is to evaluate usefulness of results towards application in the interconnection process. As ICA is implemented into Rule 21, the IOUs can start to see how well it helps streamline the process.

As far as the input components, the IOUs always strive to ensure data is adequate to serve the analytical need and continue to increase precision of data to help make better models where feasible and cost effective. The main component to which the IOUs see great importance to its impact to the analysis is the load allocation inputs to the model. As performed in Demo A, the IOUs are making sure to use the hourly metering data that is available to help allocate loading throughout the model more appropriately.

As for transparency of methods/assumptions/tools, the IOUs can rely on the continuation of comparative analysis (Item 8) and reporting of methods and assumptions already provided to the working group. The IOUs see the most uncertainty being in the loading of the circuits and how it is allocated in the model. The use of hourly metering data drastically helps reduce uncertainty around loading in the model.

As established in Item 8 the best starting reference point at the moment is the IEEE 123 feeder. The comparative assessment will ensure to align and compare on that model and then progress to more complex models.

Conclusion and Next Steps

- Continue to validate through actions in comparative assessments (item 8) across tools use learnings to inform validation and comparison across tools and stakeholders
- Evaluate and compare with interconnection studies during implementation
- Continue alignment of use of hourly metering data to reduce the uncertainty in the model (Item 9)

Item F: Develop ICA Validation Plans

Joint IOUs' Initial Proposal with tracked ORA revisions
ICA Working Group

Summary of Recommendations

- Continue to validate through comparative assessments across tools
- Evaluate effectiveness in streamlining interconnection process when implementing in Rule 21
- Continue to drive alignment on IEEE 123 feeder (Item 8) and use learnings to inform validation and comparison across tools and stakeholders
- Continue alignment of use of hourly metering data to reduce the main driver of uncertainty in the model (Item 9)

Introduction and Background

This activity was outlined in the May 23, 2016 ACR as a long-term refinement item. A scoping proposal was presented by LNBL/LLNL, and discussed by the WG. The scoping proposal identifies that any of the concerns with the initial ICA methods have been addressed by moving to more of the iterative methods (i.e., direct simulation of the distribution grid using the commercial models), applying the analysis to all feeders, etc. Some questions regarding validation still remain, as outlined below, and more fully in the scoping proposal.

The original scoping proposal developed a number of questions – a summary of the types of questions are included here. The WG should refer to the original proposal when it begins discussion of this topic.
  i) What are the objectives of validation (e.g., believability, repeatability, applicability, etc.)?
  ii) Which components need to be verified (input, methodology, tools)?
      i. With regards to input data, what steps should be taken by IOUs, and how well are capabilities and impacts of DER captured in the hourly profile?
      ii. Within the methodology, are methods/assumptions transparent, and can results be compared across ICA methods (e.g., EPRI, Sandia, NREL)
      iii. With regards to verifying the tools, how do results compare across tools (e.g., CYME, Synergi, OpenDSS, GridLab-D)?
  iii) How much uncertainty exists, how much is acceptable, and where can it be reduced?
  iv) What are the appropriate datasets to serve as a reference point for validation and third-party improvements to the method (e.g., IEEE 123, IEEE 8500, PG&E 12 representative feeders)?

Discussion

There is much overlap with the comparative assessment item and thus will utilize recommendations from that proposal where appropriate.

The main objective of the validation is to provide transparency and confidence on the results. The IOUs see two main ways to approach validation. The first is to continue down the path of industry

engagement and comparison across tools as being explored in Item 8. The second is to evaluate usefulness of results towards application in the interconnection process. As ICA is implemented into Rule 21, the IOUs can start to see how well it helps streamline the process.

As far as the input components, the IOUs always strive to ensure data is adequate to serve the analytical need and continue to increase precision of data to help make better models where feasible and cost effective. The main component to which the IOUs see great importance to its impact to the analysis is the load allocation inputs to the model. As performed in Demo A, the IOUs are making sure to use the hourly metering data that is available to help allocate loading throughout the model more appropriately.

As for transparency of methods/assumptions/tools, the IOUs can rely on the continuation of comparative analysis (Item 8) and reporting of methods and assumptions already provided to the working group. The IOUs see the most uncertainty being in the loading of the circuits and how it is allocated in the model. The use of hourly metering data drastically helps reduce uncertainty around loading in the model.

As established in Item 8 the best starting reference point at the moment is the IEEE 123 feeder. The comparative assessment will ensure to align and compare on that model and then progress to more complex models.

Conclusion and Next Steps

- Continue to validate through actions in comparative assessments (item 8) across tools use learnings to inform validation and comparison across tools and stakeholders
- Evaluate and compare with interconnection studies during implementation
- Continue alignment of use of hourly metering data to reduce the uncertainty in the model (Item 9)
- Continue to compare and validate ICA results using reference circuits more representative of actual IOU circuits compared to the IEEE 123 circuit.

Item F: Develop ICA Validation Plans

IOU response to ORA revisions
ICA Workshop Group

In IOU's initial proposal on the Development of ICA Validation Plans proposed the following next steps:

- Continue to validate through actions in comparative assessments (item 8) across tools and use learnings to inform validation and comparison across tools and stakeholders
- Evaluate and compare with interconnection studies during implementation
- Continue alignment of use of hourly metering data to reduce the uncertainty in the model (Item 9)

The Officer of Ratepayer Advocates (ORA) added the following next step item:

- *Continue to compare and validate ICA results using reference circuits more representative of actual IOU circuits compared to the IEEE 123 circuit*.

While the IOUs support the concept of additional comparison and validation, the IOUs believe that the activities outlined within the comparative assessments (item 8) must be completed prior to initiating another validation process. Once the activities outlined in item #8 are completed and results evaluated, that information can be used to determine what if any additional validation is required.

Item G: Definition of QA/QC of ICA

Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations

- Utilize efforts in Item F to evaluate effectiveness of results within interconnection process
- Utilize efforts in item 3 and F to compare and validate results across tools and stakeholders to provide a common level of assurance and collective consensus

Introduction and Background

This activity was listed in the May 23 ACR, but the WG had decided to re-visit this topic after Demo A results are published and after the planning use case methodology is solidified before identifying what QA/QC measures may be needed.

i)   What QA/QC methods are necessary for ICA, for both use cases?
ii) Are there additional QA/QC verification needed by either the software vendor or IOU?

Discussion

QA/QC for Use Cases

As with Item F, this item has much overlap with item 8 as well as item F itself. As mentioned in item F, the main concern is transparency and confidence around results. This is achieved through (1) discussing methods and assumptions with and across stakeholders, (2) comparing independent results with stakeholders, and (3) relating to operational data point of intended use.

Point 3 has the most applicability to QA/QC so we can explore that further. The most relevant data point to help inform QA of ICA is the interconnection process. Evaluating effectiveness of ICA in the interconnection process from item F can be used to help this item. Interconnection is relatively deterministic in comparison to a planning assessment and thus has more applicability of this method.

Since the planning use case is generally doing the same analysis, then it will get informed by this effort as well. However, there is some probabilistic nature within the planning assessments that won't be properly informed by comparing to interconnection applications. Since we cannot perform assessments of randomly placing DERs across the utility grid and switching them on and off, we must rely on the scientific method to help us. Using item 3 and F by comparing across stakeholders and tools helps provide a scientific method of reaffirming that what we are doing is the most appropriate method.

Proposed Definitions

- **Interconnection QA/QC** will be defined as effectiveness in providing appropriate answer to pass screens when compared to the results of the normal interconnection study process

- **Planning QA/QC** will be defined as the validation and replicability of results within different tools and stakeholders

Conclusion and Next Steps

- Utilize efforts in Item F to evaluate effectiveness of results within interconnection process
- Utilize efforts in item 3 and F to compare and validate results across tools and stakeholders to provide a common level of assurance and collective consensus

Item G: Definition of QA/QC of ICA

ORA's Initial Proposal
ICA Working Group

Summary of Recommendations

- IOUs should develop QA/QC plans to ensure that ICA results are accurate based on current and complete input data

Introduction and Background

This issue was teed up as ORA success criteria #10 and the March 15, 2017 ICA Working Group Report (p.36) showed this as an issue that should have been resolved, from ORA's perspective, prior to full scale deployment. Page 37 of the ICA WG report also stated "SCE will create the necessary steps to maintain accuracy of the network models as part of its deployment." QA/QC protocols were not adopted as part of the initial statewide deployment per D.17-09-026 but were instead scoped as a long term refinement.

Discussion

ICA results are only useful if they are accurate. ICA is a new tool and many new processes, including circuit modeling, calculation, data management, and data presentment will be developed to support the first system wide deployment in 2018. In addition, performing system wide ICA per D.17-09-026 requires a monthly review of circuit changes, and rerunning the ICA on circuits that have changed, and this process involves extensive data management. Every step of the ICA process is subject to errors than must be subjected to a rigorous QA/QC plan avoid, identify, and mitigate errors to ensure ICA results are accurate. SCE, as well as PG&E and SDG&E, should design, document, and implement QA/QC plans that demonstrate to the CPUC and stakeholder are accurate and thereby useful. ORA recommends that that these plans be developed as part of development and deployment of the initial statewide ICA deployment, and provided in conjunction with the final status report required per D.17-09-026, Ordering Paragraph 9.

Conclusion and Next Steps

IOUs should develop QA/QC plans to ensure that ICA results are accurate based on current and complete input data

Item G: Definition of QA/QC of ICA

IOU Comments on ORA's Initial Proposal
ICA Working Group

The Joint IOUs provided edits in tracked changes to the ORA comments for clarification purposes. Those tracked change edits may be found in the online document: https://drpwg.org/wp-content/uploads/2016/07/ICA-Item-G-Definition-of-QAQC-IOU-Response-to-ORA-Comments.docx

Item 9: Load Shapes
Joint IOUs' Initial Proposal
ICA Working Group

Summary of Recommendations
- The IOUs utilize a similar approach to gather data to create load shapes as in Demo A.
- Recommend utilizing the same methods, data sources and means to create load shapes as this is similar and consistent amongst the IOUs.

Introduction and Background

- This activity originated form the ICA working group (WG) scoping document with the objective that the WG will revisit the means the IOUs develop load shapes, first fully understanding the differences and tradeoffs between those methods used in Demo A, then discussing proposed improvements.
- The WG discussed these methodologies in detail and agreed upon their use in Demo A, but further explored reasons for divergence in methodology, as well as trade-offs between methods, as part of long-term refinement.

Discussion
- All IOU's gather data and create Load shapes from the following profiles:
  - Customer Load Profiles
    - Developed from AMI Data
    - Aggregated at the service transformer
  - Service Transformer Load Profiles
    - Aggregation of customer profiles
  - Circuit Load Profiles
    - Developed from SCADA data
  - Substation Load Profiles
    - Developed from SCADA data

Conclusion and Next Steps
- The means the IOUs use to develop load shapes are similar and consistent amongst the IOUs.