BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAII

----- In the Matter of -----	)	
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PUBLIC UTILITIES COMMISSION	)	DOCKET NO. 2011-0206
	)	
Instituting a Proceeding to Investigate the Implementation Of Reliability Standards for Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited.	)	

ORDER NO. 32053

RULING ON RSWG WORK PRODUCT

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Company, Inc., and Maui)	
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RULING ON RSWG WORK PRODUCT AND OTHER RELIABILITY MATTERS

By this Order, pursuant to HRS §§ 269-6, 269-7, and 269-16, the commission makes various rulings regarding the final work product of the Reliability Standards Working Group ("RSWG"), which was filed by the Independent Facilitator ("IF") on March 25, 2013.[1] The commission also makes pertinent observations regarding reliability trends that have occurred since the IF submitted the final RSWG work product. Finally, the commission

[1]See Reliability Standards Working Group Independent Facilitator's Submittal, Final Report, and Certificate of Service, filed on March 25, 2013 ("IF's Final Report"). The RSWG's numerous work products were attached to the IF's Final Report. References in this Order to the IF's substantive report will be made to the "IF's Final Report." References to specific work product will be made using the labeling nomenclature in the IF's index of work product, attached as Appendix 1 to the IF's Final Report.

directs the HECO Companies[2], and also in some cases Kauai Island Utility Cooperative ("KIUC"), to make submissions regarding electric reliability matters as discussed herein.

I.

Procedural Summary[3]

The commission originally approved a process for the development of reliability standards for the HECO Companies through the RSWG in response to a proposal from the HECO Companies in the feed-in tariff ("FIT") investigation (Docket No. 2008-0273). For administrative reasons, and because the RSWG efforts were expected to have a much broader reach than the FIT docket, the commission subsequently opened the instant docket on September 8, 2011 to provide the RSWG with its own docketed proceeding.

The commission offered opportunities to the parties in the FIT and other dockets (e.g., net energy metering ("NEM") and the docket examining revisions to the HECO Companies' Tariff Rule 14H), who were likely to be impacted by the analysis and

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[2]"HECO Companies" collectively refers to Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited.

[3]The IF's Final Report provides a detailed explanation of the RSWG's purpose, membership, process, timeline, and work products. The commission only summarizes important aspects of these areas below to provide context for this Order.

recommendations of the RSWG, to become members of the RSWG. Ultimately, the following stakeholders, representing diverse interests, were made members of the RSWG: HECO Companies; KIUC; City and County of Honolulu, County of Hawaii; County of Maui; County of Kauai; Department of Commerce and Consumer Affairs, Division of Consumer Advocacy ("Consumer Advocate");[4] Department of Business, Economic Development, and Tourism; Tawhiri Power LLC ("Tawhiri"); Hawaii Renewable Energy Alliance; Hawaii Solar Energy Association; Hawaii PV Coalition; Sun Edison LLC; Solar Energy Industries Association; Molokai Renewables LLC; South Maui Renewable Resources, LLC; Zero Emissions Leasing LLC; Interstate Renewable Energy Council; SolarCity Corporation; Castle & Cooke Homes Hawaii, Inc.; Castle & Cooke Resorts, LLC; Lanai Sustainability Research, LLC; Life of the Land; Blue Planet Foundation; and HDBaker & Company Hawaii LLC (collectively, "Parties").[5]

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[4]The Consumer Advocate is statutorily mandated to represent, protect, and advance the interests of all consumers of utility service and is an ex officio party to any proceeding before the commission. See Hawaii Revised Statutes ("HRS") § 269-51; Hawaii Administrative Rules ("HAR") § 6-61-62.

[5]Additional entities were allowed membership to the RSWG, but were later removed, following the IF's recommendation, due to lack of diligent participation.

The commission retained the IF, Alison Silverstein, to facilitate the RSWG. In addition, the commission retained a reliability consultant, Brendan Kirby, who was originally intended to act as an advisor to the commission. Instead, however, the commission allowed Mr. Kirby to assist the RSWG as a technical resource.

The IF convened the first RSWG meeting on July 13, 2011. The RSWG met about every two months for the first year, and more frequently in the latter half of 2012.

In the early stages of the RSWG, the group formed several subgroups. As described by the IF, the subgroups and their scopes were:

- Gap Analysis: identify relevant studies and analyses of renewable development potential and integration in the islands, and what is and is not known;
- Integrated Resource Planning ("IRP") Coordination - what RSWG work products and information should feed into the parallel IRP docket;
- Reliability Definitions and Metrics ("RDM") - develop a common vocabulary; how to measure reliability; ancillary services;
- Reliability Standards Development ("RSDG") - assess and develop reliability standards tailored for Hawaii and large generator interconnection requirements;

- Minimum Load & Curtailments ("MLC") - how much curtailment is occurring; what is causing curtailments and how to reduce them;

- Photovoltaics ("PV") and Distributed Generation ("DG") ("PV-DG") - share PV data with the utility to help understand PV generation patterns; develop better PV-DG interconnection and queuing processes;

- Demand-Side Options ("DSO") - identify energy efficiency ("EE"), demand response ("DR"), and energy storage options to support renewable integration and protect grid reliability.[6]

Each subgroup had a leader who organized meetings on a regular basis.

The sharing of confidential information in the working group was governed by a Stipulated Protective Order that was filed by the Parties on November 18, 2011, and approved on November 29, 2011.[7]

By Order No. 30371, *Relating to Various Matters in RSWG Process*, filed on May 4, 2012 ("Order No. 30371"), the commission provided guidance and direction to the RSWG, including directing the Parties to respond to several technical and policy

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[6]See IF's Final Report at 8.

[7]By Order issued on November 16, 2012, the commission, sua sponte, amended the Stipulated Protective Order.

questions. The Parties filed their responses to those questions on June 4, 2012.

In addition, to assist the Parties' and the commission's assessment of actual system reliability of the HECO Companies' grids, in Order No. 30371, the commission directed the HECO Companies to file monthly reliability reports containing information relating to system frequency control performance, significant system events, and curtailment of non-dispatchable renewable resources.[8]

When the commission approved the proposal to form an RSWG in the FIT docket, it also created a Technical Review Committee ("TRC") "to provide independent technical review to the commission concerning the scope, quality, methods, and results of the studies . . . to support variable renewable energy integration."[9] By Order issued on July 16, 2012, the commission advised the RSWG that it had selected the following individuals to serve as the commission's TRC: (1) Richard E. Rocheleau; (2) Maurice Kaya; and (3) Abraham Ellis.

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[8]See Order No. 30371 at 17-19.

[9]*Order Approving, with Modifications, the HECO Companies' Proposal for a Reliability Standards Working Group and Technical Support Group*, filed on August 26, 2010, in Docket No. 2008-0273, at 4.

The commission initially expected the RSWG to complete its work by the end of calendar year 2012.[10] Subsequently, however, the commission clarified that the RSWG could continue working until the end of calendar year 2012, but it could have additional time to vote on work product and formally submit it to the commission.[11] Consistent with this direction, the IF held the final meeting of the RSWG on January 24, 2013.

On March 25, 2013, the IF filed her Final Report, attaching all of the RSWG's final work product.[12] The Parties were permitted to file comments on the IF's Final Report and attached work product by April 9, 2013.

Thereafter, the commission requested the TRC to review, and prepare a report on, the IF's Final Report and attached work product, as well as the Parties' comments filed on April 9, 2013.

The TRC submitted their "Report of the Technical Review Committee" dated May 15, 2013 ("TRC's Report"), which was transmitted to the Parties on May 29, 2013. The Parties were allowed to file comments on the TRC's Report by June 10, 2013.

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[10]See Order No. 30371 at 3.

[11]See Order No. 30694, *Clarifying Certain Procedural Matters*, filed on October 18, 2012, at 2.

[12]The IF also filed quarterly progress reports with the commission, including work products.

II.

Discussion

A.

Reliability Standards

The RSDG was tasked to develop reliability standards and large generator interconnection requirements tailored for Hawaii. The RSDG explained that it utilized current utility information, operating practices and procedures to create reliability standards based on the North American Electric Reliability Corporation ("NERC") standard format.[13] The RSDG developed the following ten reliability standards:[14]

1. HI-BAL-001: Real Power Balancing Control Performance (modified 1/25/13)

2. HI-BAL-002: Disturbance Control Performance

3. HI-BAL-502: Planning Resource Adequacy Analysis, Assessment and Documentation

4. HI-MOD-010: Development and Reporting of Steady State System Models and Simulations

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[13]See RSWG Reliability Standards Drafting Subgroup - Final Report and Recommendations ("RSDG's Final Report"), Attachment 2a-1 to IF's Final Report, at 1.

[14]The RSDG considered other NERC standards and organized them in three tables, as follows: (1) Table B-1 "Standards the RSWG is Considering, But Have Not Reviewed to Determine Applicability to Hawaii;" (2) Table C-1 "Standards the RSWG is Not Recommending for Stand-Alone Adoption in Hawaii;" and (3) Table C-2 "Standards the RSWG is Not Recommending for Adoption in Hawaii." See Attachments 2a-5, 2a-6, and 2a-7 to IF's Final Report.

5. HI-MOD-012: Development and Reporting of Dynamic System Models and Simulations

6. HI-MOD-016: Actual and Forecast Demands, Net Energy for Load, Controllable DSM and Distributed Generation

7. HI-MOD-025: Verification and Data Reporting of Generator Real and Reactive Power Capability and other Reactive Power Sources

8. HI-MOD-026: Verification of Models and Data for Generator/Transmission Equipment Excitation System or Plant Volt/Var Control System

9. HI-MOD-027: Verification of Models and Data for Governor and Load Control or Active Power/Frequency Control

10. HI-PRC-006: Under-frequency Load Shedding (approved in concept)[15]

With a few exceptions,[16] the ten reliability standards were approved by a majority of the RSWG. The RSDG also provided synopses of the standards, describing the purpose and key features of each of the standards.[17] In addition, in response to a suggestion at an RSWG meeting, the HECO Companies submitted comments regarding

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[15]See IF's Final Report at 11.

[16]Tawhiri objected to HI-BAL-001, and the Consumer Advocate submitted comments in response to the modeling standards (HI-MOD-010, HI-MOD-012, HI-MOD-016, HI-MOD-025, HI-MOD-026). In addition, one of the standards, HI-BAL-502, was incomplete, because key metrics were not defined.

[17]See Attachments 2b-20 through 2b-29 to IF's Final Report.

the implementation of the reliability standards, including estimated timeframes to accomplish such implementation.[18]

Regarding standards adoption, in the RSDG's Final Report, the RSDG concluded and recommended as follows:

> 1. Historical operating data was utilized and incorporated in the development of the approved standards[.]
>
> 2. Any limits, metrics, numbers used in the completed standards were best estimates at the time of drafting. Where such limits, metrics, numbers were indicated by a place holder, these limits, etc. should be determined by further impact analysis on the effected parties to the standard.
>
> 3. As Hawaii moves forward with the Reliability Standards process and recognizing the complexity of the process contained therein, the RSDG recommends that the Commission open a docket to address such issues, but not limited to, identification of the parties that will be responsible and liable once the standards are implemented, the costs associated with implementing the standards, compliance and enforcement of the standards, and a process that will allow vetting of these completed standards by the stakeholders that are affected by their formal adoption and implementation...
>
> 4. Adoption and implementation of each standard should proceed on the basis of a one year trial period to gain valuable operating experience and to allow time to revise the standard appropriately before the PUC/[Hawaii Electricity Reliability

[18]See Attachment 2a-8 to IF's Final Report.

Administrator ("HERA")] begin actual enforcement of each standard.

5. The standards drafted to date represent the beginning of a process that will lead to full implementation. Accordingly, detailed operating procedures and guidelines will need to be drafted by the Hawaii utilities to support their implementation.

6. The RSDG recommends that the PUC accept the standards drafting process and guidance given in the proposed Standards Framework documents, including the development of a compliance registry.

7. The RSDG recommends that the PUC allow the RSDG to continue its standards drafting efforts as a transition to the establishment of HERA to allow a seamless transfer of work, experience, and knowledge as possible and to facilitate the implementation of these reliability standards for Hawaii.[19]

In the TRC's Report, the TRC stated that the RSWG "established a viable approach and format for development of a complete set of reliability standards for Hawaii."[20] However, the TRC made a number of technical observations regarding the standards, shown in Appendix B of the TRC's Report, which could be considered in any future effort to establish a standards development framework.

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[19]RSDG's Final Report; Attachment 2a-1 to IF's Final Report, at 4.

[20]TRC's Report at 5.

Regarding HI-BAL-502, the TRC stated:

> [W]e note that the proposed standard is unclear with respect to treatment of variable generation for the purposes of resource adequacy. Requirement R1.5.2 of the HI-BAL-5[0]2 standard requires consideration of "Modeling assumptions of variable and energy limited resource such as wind, PV, and cogeneration," as well as "Dispatch characteristics (ramp rate, minimum values, regulation, etc.)" We believe that this does not provide sufficient guidance with respect to treatment of variable generation resources. While the capacity value of variable resources is lower than the corresponding nameplate capacity, it is not zero. Given the amount of renewable deployment in Hawaii, it would be advisable to explicitly account for the actual capacity value in the context of resource planning decisions. Finally, we recognize that resource adequacy is currently handled pursuant to the [IRP] process, and it has not been determine[d] how the requirements and procedures should be reconciled with the proposed HI-[B]AL-502 standard. For this reason, we believe that the proposed HI-BAL-502 standard needs more stakeholder input.

Ultimately, the TRC concluded that, with the exception of HI-BAL-502, "the proposed standards are sufficiently complete and vetted to justify an effort to expedite their adoption and implementation. To that end, the Commission should establish a docket to get the standards ready for implementation."[21]

After careful review of the record, the commission has decided to open a new docket focused on further evaluation and final

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[21] Id. at 7.

approval of the reliability standards. Consistent with the recommendation of the TRC, the commission will start the new docket with the final versions of the proposed standards approved by the RSWG, with the exception of HI-BAL-502, which requires further study. The TRC's comments on the standards that are included in Appendix B of the TRC's Report may be considered in the new standards docket. As noted in the RSDG's Final Report, many stakeholders, including independent power producers ("IPPs"), were not involved in the standards drafting process in this RSWG docket, but will be impacted by the standards that are finally approved in the new standards docket. As such, the commission intends to serve a courtesy copy of the order opening the new docket to affected IPPs to notify them of the proceeding and the opportunity to intervene. The focus of the new docket should be on the standards already approved by the RSWG (excluding HI-BAL-502); after these are fully vetted and approved in some form, the commission may ask the RSDG to develop additional standards and/or continue working on HI-BAL-502.

As a part of its work, the RDM Subgroup prepared a Glossary of Terms ("Glossary"), which was approved by the RSWG. The Preamble to the Glossary states that the RSWG will primarily use the Glossary in the formation and understanding of recommended reliability standards. The RDM also noted that the Glossary is a

"living document, to be reviewed and updated on a regular basis."[22] Subsequent to RSWG approval of the Glossary, the RSDG made revisions and additions to the Glossary during its effort to draft reliability standards.[23] In addition, the TRC offered comments and suggestions to the Glossary that are attached as Appendix A to the TRC's Report. The TRC also recommended that the Glossary be adopted in conjunction with the reliability standards.[24] The commission agrees with the TRC's recommendation, and accordingly, will direct that the Glossary (together with the revisions and comments made by the RSDG and the TRC) be further evaluated in conjunction with approval of reliability standards in the new standards docket.

B.

Interconnection Procedures

1.

PV-DG Subgroup

In the commission's Order No. 30371, the commission provided guidance to the RSWG on various matters, including

[22]See Attachment 1-7 to IF's Final Report.

[23]See Attachment 2a-4 to IF's Final Report.

[24]Specifically, the TRC maintained that: "Although some of the terms go beyond, the Glossary primarily addressed terminology used in reliability standards drafted by RSDG, and these standards mainly apply to the bulk system and not DG." TRC's Report at 3.

articulating specific subject areas for evaluation that fell within the purview of the PV-DG Subgroup. Specifically, the commission requested that the RSWG "craft recommendations on new, streamlined interconnection screening processes for DG for the HECO Companies[,]" based on a review of three sources: (1) a report issued by the National Renewable Energy Laboratory, U.S. Department of Energy, Sandia National Laboratories, and the Electric Power Research Institute titled "Updating Interconnection Screens for PV System Integration;" (2) California's recent modifications to their screening requirements in Rule 21, upon which the HECO Companies' Rule 14H was modeled; and (3) the DG screening processes utilized by KIUC.[25]

Order No. 30371 also noted that the parties to the Rule 14H docket disputed the "appropriate requirements for monitoring and control of DG" and requested the RSWG to consider this issue again.[26] More specifically, the commission suggested that the RSWG "consider whether the distribution screening process for PV could be further enhanced and streamlined to reflect any potential changes to the requirements for monitoring PV systems so that greater penetration of PV systems is possible."[27]

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[25]See Order No. 30371 at 12-13.

[26]See id. at 14.

[27]See id.

Moreover, Order No. 30371 encouraged the RSWG to review the differences in the screening requirements under Rule 14H and the HECO Companies' Tariff Rule 18, governing NEM. The commission further suggested that the RSWG propose revisions to the HECO Companies' tariffs that would resolve any present inconsistencies or ambiguities, making DG interconnection requirements consistent regardless of energy procurement method.[28]

In response to this direction, the PV-DG Subgroup developed the following primary work products: (1) proposed modifications to Rule 14H;[29] (2) proposed new proactive planning approach to PV interconnection ("Proactive Approach");[30] and (3) a distribution-level interconnection queue proposal ("Queue Proposal").[31] The Final Report of the PV Sub-Group for the Reliability Standards Working Group, Attachment 4b-1 to the IF's Final Report ("PV-DG Subgroup's Final Report") also describes the effort that the PV industry and the HECO Companies undertook to share data to facilitate the PV interconnection process.[32]

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[28]See id.

[29]See Attachments 4b-4 and 4b-5 to IF's Final Report.

[30]See Attachment 4b-7 to IF's Final Report.

[31]See Attachment 4b-3 to IF's Final Report.

[32]See Attachment 4b-6 to IF's Final Report.

With regard to the PV-DG's work on Rule 14H, in sum, the proposed changes are:

1. A new flow chart, modeled after the revised California Rule 21, which describes steps and technical criteria applied as part of the expedited interconnection process to evaluate interconnection requests.

2. A new set of gateway provisions that clarify which projects qualify for expedited interconnection. According to the proposed provisions, an interconnection request does not qualify for expedited interconnection if (a) it is not connecting to the distribution system, or (b) the equipment is not UL-741 certified, or (c) the interconnection customer elects to proceed directly to an Interconnection Requirements Study ("IRS").

3. Revisions to the set of Initial Technical Review screening criteria that are part of the expedited interconnection process. The proposed modifications consist of adding three new screens from Rule 21, revising three existing Rule 14H screens, and deleting two existing Rule 14H screens.

4. Addition of a Supplemental Review procedure that allows projects that fail the Initial Technical Review to be evaluated against three additional technical criteria to determine whether or not an IRS is required before proceeding to interconnection. The Supplemental Review procedure, imported from California Rule 21, consists of a Penetration Test, a Power Quality and Voltage Test, and a Safety and Reliability Test.

5. Inclusion of a Quick Review process providing discretion to the HECO Companies to allow a proposed project to be interconnected, without an IRS, after it has failed the Initial Technical Review and Supplemental Review. This would apply in situations where a solution to address a failed screen can be readily identified and agreed upon by the applicant.[33]

Regarding the Proactive Approach, the PV-DG Subgroup explains that:

> Through its distribution and transmission planning effort, [HECO] will proactively plan for the aggregate system impacts from expected DG development in order to accommodate higher penetration levels. The coordination of interconnection and planning will identify opportunities where infrastructure upgrades can accommodate both DG and load such that a number of generators and customers can benefit from the upgrades.
>
> Specifically, HECO will employ enhanced tools for modeling DG to inform both system and distribution-level planning and operations. . . . This improved modeling capability will, in turn, enhance a number of areas related to the interconnection of high penetrations of DG[.]
>
> The overall goal of this collaborative approach is to create a more transparent and efficient process for interconnecting higher levels of DG while maintaining safety, reliability, and power quality across the transmission and distribution infrastructure. The approach will benefit all parties involved, including customers, developers and utilities, as well as the broader public.[34]

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[33] See TRC's Report at 35.

[34] PV-DG Subgroup's Final Report at 14-15.

Regarding the PV-DG Subgroup's Queue Proposal, it would require HECO to maintain a single queue for all applications governed by Rule 14H. As further explained by the PV-DG Subgroup:

> The interconnection queue will give developers a window into the interconnection procedures and the status of projects within that process. Moreover, it will act as an indicator of expected interconnection upgrades, since a developer will be able to ascertain the size, timing and location of projects near its point(s) of interconnection. Further, it will reduce congestion in the interconnection process by reducing the resources HECO must spend responding to developers' requests for information. By increasing the information available to developers, the interconnection queue will improve timeliness, enhance transparency and defuse the potential for conflicts in the interconnection process. The PV Sub-Group recognizes the HECO Companies' Feed-In Tariff program has its own discrete queue process approved by the Commission in an October 2012 order, which is subject to review at the end of 2012.[35]

The PV-DG Subgroup recommended that the commission open a new docket to allow further review of their work products. In this regard, the PV-DG Subgroup averred that "[t]he revisions to Rule 14H . . . require more work to harmonize the suggested revisions with other parts of Rule 14H to ensure consistency

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[35]Id. at 15-16 (citation omitted).

throughout the tariff."[36] The subgroup additionally identified a number of outstanding issues that should be considered in a subsequent proceeding, including revisions to the IRS process. Here, the PV-DG Subgroup stated:

> PV Sub-Group discussions late in the RSWG process centered around other issues pertaining to the IRS that the PV Sub-Group believes should be considered in a subsequent proceeding. Issues for possible consideration for the IRS process include:
>
> - The need for, and applicability of, an IRS Letter Agreement and Non-Disclosure Agreement;
>
> - The re-examination of the timelines and interactions between the utilities and the project interconnection applicants;
>
> - Whether the interconnection process should be tightened with regard to providing complete project information in a timely manner in order to meet IRS deadlines, and the consequences if a project proponent does not comply with those deadlines;
>
> - The need for a scoping meeting, or other mechanism, to provide a delineation of the scope, cost and schedule of an IRS;
>
> - Whether an IRS's cost and schedule can be differentiated based on size, technology, intent to serve on-site load, and circuit penetration levels; and, if so, which projects should qualify for a "minor IRS" with a standardized cost;

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[36] Id. at 19. In addition, the PV-DG Subgroup noted that, due to the relatively short timeframe of the RSWG, they were unable to resolve discrepancies between Rule 14H and Rule 18, but that they had "laid a strong foundation upon which to efficiently achieve that task in any subsequent proceeding." Id. at 5.

- Whether the results of an IRS should be made publicly available and/or posted on the HECO website;

- Whether small net metering and non-export generators can be interconnected to the distribution system without having to go through an IRS; and

- The need for Group Studies and the details of a Group Study process.[37]

The TRC supported the PV-DG Subgroup's revisions to Rule 14H and recommended that the commission open a proceeding aimed at expeditiously implementing the proposed changes:

> The TRC believes that adoption of the proposed changes to Rule 14H will significantly improve the interconnection process in Hawaii. We believe that the new Initial Technical Review, Supplemental Technical Review and Quick Review processes would allow a large number of interconnection applications to proceed to interconnection quickly and cost-effectively, without compromising safety or reliability. We also believe that the proposed changes are sufficiently vetted based on the composition of the subgroup and the resources they used to formulate their proposed changes. For these reasons, the TRC recommends that the Commission open a proceeding aimed at expeditiously implementing proposed changes to Appendix III, Sections 3 and 4 of Rule 14H, as described in Section A of the PV-DG Subgroup report. Other issues identified in the report, which are likely to take more time to resolve, should be addressed in a separate proceeding so as not to delay implementation of changes where broad consensus has been achieved.[38]

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[37]Id. at 21-22.

[38]TRC's Report at 36-37.

The TRC offered some technical comments on the PV-DG Subgroup's proposed screening methodology that could be considered in a subsequent expedited proceeding.[39]

Regarding the Queue Proposal, the TRC believes that a single queue would be beneficial to increase transparency in the DG interconnection process. However, before a single queue is implemented, the TRC suggests that outstanding issues identified in the PV-DG Subgroup's Final Report be resolved, and the various interconnection provisions in the HECO Companies' tariffs be harmonized.

In connection with the Proactive Approach, the TRC states:

> From the TRC point of view, the proactive approach proposal can be viewed in two ways:
>
> 1. Whether the utility should proactively perform studies to identify potential system upgrades in locations where the interconnection activity is significant, and
>
> 2. How to allocate the cost of such upgrades.
>
> The TRC believes that the first concept above should be adopted as a best practice. We believe that planning studies aimed at identifying potential upgrades to accommodate higher penetration of DG need not be driven solely by interconnection requests. . . . With respect to cost allocation of system upgrades, we agree that there are significant policy implications that need to be resolved

[39] See Appendix C to the TRC's Report.

> before implementation. The underlying question is whether cost allocation should be consistent with or depart from the principle of causality reflected in Rule 14H and other applicable generator interconnection procedures. . . . This type of question should be subject to a broader stakeholder engagement process.[40]

In the commission's view, the PV-DG Subgroup produced concrete, practical, and well-designed proposed improvements to the interconnection process. Moreover, the PV-DG Subgroup seems to have achieved a high level of agreement on their work products.[41]

2.

Recent DG Interconnection Trends

The commission observes that substantial changes have occurred regarding DG interconnections since the PV-DG Subgroup submitted its report and recommendations.

1. Approximately 130 MW of additional solar PV was installed in 2013 on the HECO Companies' electric grids; the cumulative installed distributed generation capacity is 290 MW at

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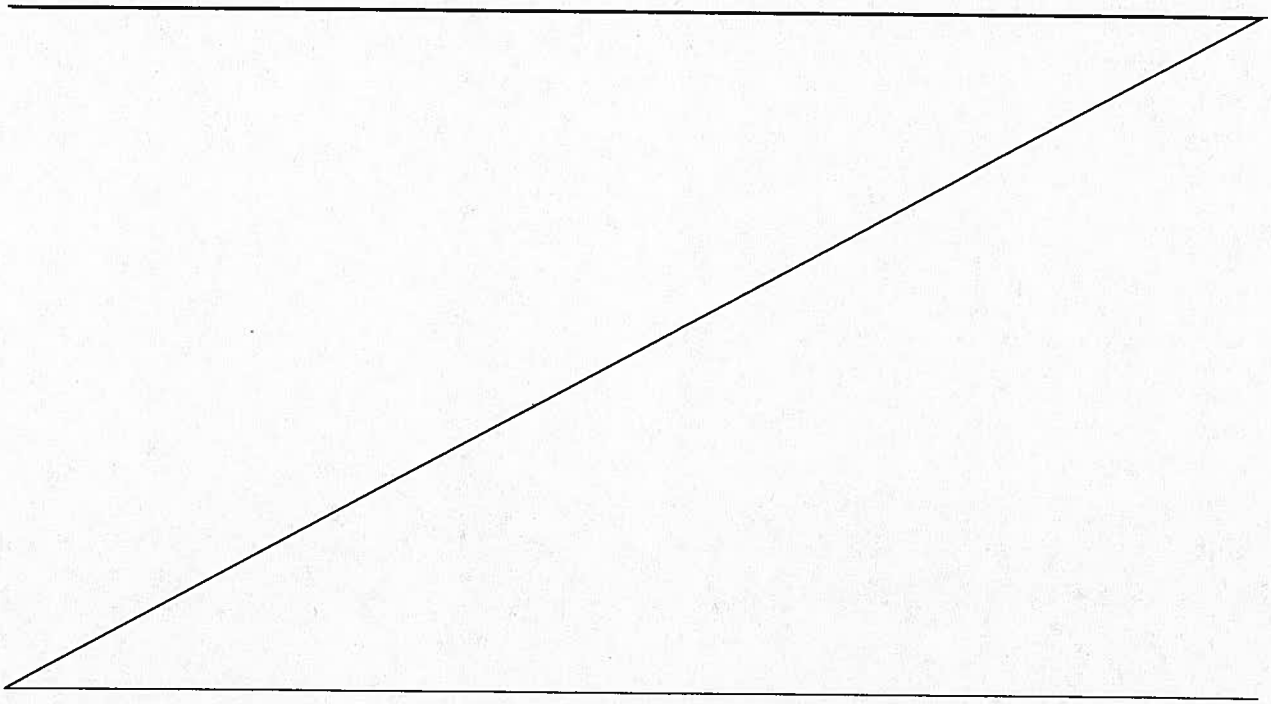
[40]TRC's Report at 40-41.

[41]See e.g., PV-DG Subgroup's Final Report at 3 (noting that the Final Report was being submitted with the unanimous support of its members).

December 31, 2013.[42] As a result, ten percent of residential customers on Oahu have rooftop solar PV systems.[43]

Approximately 4.8 MW of additional distributed solar PV was installed in 2013 on the KIUC's electric grid; the cumulative installed distributed generation capacity is 14 MW at December 31, 2013.[44]

The total amount of customer distributed solar PV capacity, including Net Energy Metering (NEM), Standard Interconnection Agreement (SIA) and Feed-In Tariff (FIT), installed



[42]Excluding two large solar PV systems interconnected into the sub-transmission system on Oahu.

[43]See HECO Companies' News Release dated January 22, 2014.

[44]Excluding one large solar PV system interconnected at the Port Allen generating facility.

on each of Hawaii's electric utilities at year-end 2013, is summarized in the table below.[45]

Attribute	Hawaiian Electric	Hawaii Electric Light	Maui Electric	KIUC
	NEM Program / Schedule Q (KIUC)			
Installed Systems	28,212	5,336	5,206	1,908
Installed Capacity (MW)	167	33	35	9
Average Installed Capacity (kW)	5.9	6.1	6.6	4.7
	Standard Interconnect (Non-Export)			
Installed Systems	97	22	13	12
Installed Capacity (MW)	27	5	3	3
Average Installed Capacity (kW)	278.4	204.5	215.4	275.0
	Feed-in-Tariff, PPA, & Other			
Installed Systems	1,249	19	35	3
Installed Capacity (MW)	27	1	3	2
Average Installed Capacity (kW)	21.9	65.8	97.7	533.3
Total Distributed PV Installed Capacity (MW)	**222**	**38**	**41**	**14**
System Peak Load (MW)	1,144	190	201	72
PV Capacity/System Peak	**19.4%**	**20.2%**	**20.3%**	**19.4%**

Source: Hawaiian Electric Company; Kauai Island Utility Cooperative

[45]The commission notes that KIUC's penetration level of NEM and Schedule Q systems, which are based primarily upon avoided wholesale energy costs, not avoided retail rates, is similar to the level of NEM penetration for Oahu.

2. As a consequence of the continued interconnection of distributed solar PV systems, approximately 26% of HECO's distribution circuits have distributed generation penetrations of greater than 100% of gross Day-time Minimum Load (DML) as of April 15, 2014 as shown in the table below. The Oahu grid appears to have a higher percentage of distribution circuits with penetrations in excess of 100% of DML than do the neighbor island grids.

Circuit Integration Level	No. of Circuits				Percentage of Circuits			
	Hawaiian Electric	Hawaii Electric Light	Maui Electric	KIUC	Hawaiian Electric	Hawaii Electric Light	Maui Electric	KIUC
> 120% Daytime Minimum Load ("DML")	78	19	15	0	18.8%	14.2%	10.5%	0.0%
> 100% up to and including 120% DML	29	5	7	1	7.0%	3.7%	4.9%	2.8%
≥ 75% up to and including 100% DML	49	17	20	2	11.8%	12.7%	14.0%	5.6%
< 75% DML	260	93	101	33	62.5%	69.4%	70.6%	91.7%
TOTAL	**416**	**134**	**143**	**36**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: HECO DML Report 4/1/14; KIUC DML Report 3/31/14

3. The HECO Companies have implemented several policy changes to the interconnection screening process intended to allow more customers with PV systems of 10 kW and under to interconnect

their systems without first conducting an interconnection study.[46] Specifically, the threshold at which an interconnection study is required was raised from 75% to 100% of circuit DML in September 2013, and most recently on February 24, 2014, the threshold was raised to 120% of circuit DML.[47] Solar PV customers on Oahu were also required, beginning in September 2013, to submit a NEM application before initiating a solar project to ascertain whether there is available circuit capacity and if system upgrades may be required.

4. These interconnection process review changes, and the increased levels of solar PV penetration on distribution circuits, have resulted in approximately 2,900 customers on Oahu, at the end of January 2014, who filed NEM applications but could not interconnect because they were on circuits with penetration levels in excess of 100% DML pending completion of certain engineering studies.[48] These studies will analyze representative high

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[46]See Hawaiian Electric News Release dated September 6, 2013, accessible at http://www.hawaiianelectric.com/heco/_hidden_Hidden/CorpComm/Hawaiian-Electric-Companies-implement-changes-to-help-more-customers-add-solar-photovoltaic-systems

[47]See HECO Companies explanation accessible at http://www.hawaiianelectric.com/vcmcontent/StaticFiles/pdf/TOV-Mitigation-Measures-Public-Brief-Feb-24-2014(Final).pdf

[48]See HECO Companies letter in response to PUC information requests PUC-IR-1 through PUC-IR-4, dated March 21, 2014.

penetration distribution circuits on Oahu and develop potential mitigation measures.[49] Consequently, solar contractors and their customers lack certainty as to whether additional solar PV systems may be interconnected to high penetration distribution circuits.

5. The number of Oahu solar PV building permits issued since January 1, 2012 by the City and County of Honolulu is shown below.[50] The solar building permit trend has fluctuated between 150 - 300 permits issued weekly during this time period with the noticeable exception of the fourth quarter 2012, when there was a substantial increase in permits issued. The large increase in permits at that time has been attributed to pending Hawaii Department of Taxation 2013 rule changes and uncertainty regarding potential 2013 legislative modifications to Hawaii's solar PV tax credits, among other reasons.[51]

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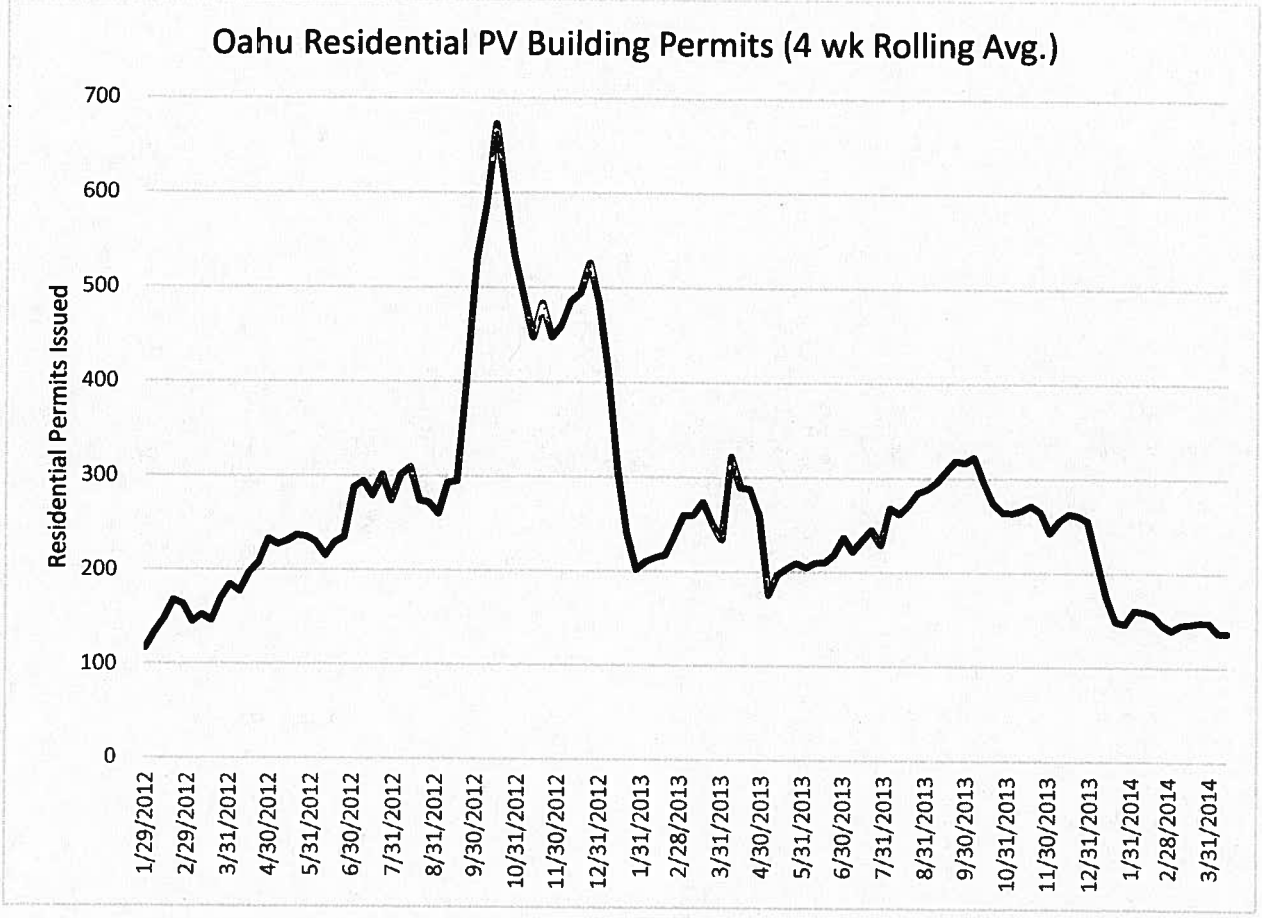
[49]See HECO Companies' Solar Photovoltaic Interconnection presentation dated October 14, 2013, presented during the Information Briefing at the Hawaii State Legislature.

[50]Data reported by State of Hawaii Department of Business, Economic Development, and Tourism, accessible at http://files.hawaii.gov/dbedt/economic/honolulu-pv-weekly.pdf

[51]See e.g., *Darkening Skies Over Hawaii Solar Industry.* Honolulu Civil Beat, July 9, 2013, accessible at http://www.civilbeat.com/voices/2013/07/09/19464-darkening-skies-over-hawaii-solar-industry/



6. There is emerging interest in customer battery energy storage systems for use with PV systems in Hawaii. According to recent news reports, solar contractors are apparently considering distributed battery energy storage systems as a means to avoid high penetration distribution circuit interconnection challenges.[52] Rule 14H does not currently contain specific interconnection requirements, or screening process, for distributed energy storage

[52]See e.g., *New Battery-storage System Promises Power to the People*. Pacific Business News. Aug. 8, 2013, accessible at http://www.bizjournals.com/pacific/blog/morning_call/2013/08/new-battery-storage-system-promises.html

systems.[53] Accordingly, in order to provide timely guidance and clarity for this new technology application, the commission directed the HECO Companies, after consultation with interested stakeholders, to file by May 1, 2014 "the interconnection requirements for a customer's battery back-up system and the screening process to review such a request for interconnection".[54]

7. Efforts are underway both on the mainland and internationally to develop technical standards for use of advanced inverter functionality with distributed energy resources. For example, the California Energy Commission and the California Public Utilities Commission, in conjunction with state's electric utilities, equipment manufactures, and other interested stakeholders, are developing standards for advanced inverters for inclusion in California's Rule 21 distribution interconnection requirements.[55] These requirements could potentially be adopted in Hawaii for inclusion in Rule 14H. Also, IEEE 1547 and UL 1741 standards are being revised to enable advanced inverters to be

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[53]See Hawaiian Electric Company, Inc., Rule No. 14, updated effective Dec. 3, 2011.

[54]See Decision and Order No. 31901 dated January 31, 2014 at 10.

[55]See Generally Recommendations for Updating the Technical Requirements for Inverters in Distributed Energy Resources dated December 2013, issued by the Smart Inverter Working Group to the California Energy Commission and California Public Utilities Commission.

certified, which will provide further technical guidance for utilities to employ advanced inverter capabilities to provide grid support services.[56]

8. Various inverter manufacturers and solar developers have developed extensive communication capabilities to remotely monitor the performance of PV inverters and PV system output in Hawaii.[57] The HECO Companies could leverage these capabilities to obtain solar PV output visibility.

3.

DG Observations and Perspectives

Based upon the work of the PV-DG Subgroup, and a review of recent DG interconnection trends, the commission puts forth the following wide-ranging observations and perspectives regarding distributed generation in Hawaii, which relate to all DG projects, regardless of procurement mechanism.

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[56]See, e.g., updates to IEEE 1547 at http://grouper.ieee.org/groups/scc21/1547/1547_index.html

[57]The commission is aware that inverter equipment suppliers routinely monitor solar output data from their systems. Also, solar leasing and PPA developers monitor their PV systems to ensure that contractual commitments are fulfilled.

Hawaii Leads Nation in Distributed Solar PV

1. The growth of customer solar PV capacity interconnected to-date has been substantial, in spite of technical interconnection challenges and customer and solar contractor frustrations associated with HECO Companies' management of the interconnection process. The HECO Companies and KIUC lead the nation in the penetration of residential rooftop solar PV systems and as a result, are at the forefront of the interconnection challenges associated with high distribution circuit penetration levels. Hawaii will, by necessity, become a leader in solving the challenges associated with high penetration of distributed generation. The HECO Companies and KIUC are to be commended for enabling solar PV penetrations to continue and to reach current levels.

HECO Companies Were Not Proactive

2. However, management of the interconnection process, including timely processing of NEM applications, did not keep pace with rapid growth over a short period of time in the volume of customer interconnection requests. It is not clear that the HECO Companies fully anticipated, or foresaw until recently, the consequences and implications of continued exponential growth in solar PV interconnections.

3. The HECO Companies appear to have been quick to identify interconnection technical challenges but slow to offer solutions to these problems. In short, HECO Companies have, until very recently, been playing catch-up in managing distributed generation interconnection technical challenges or processing interconnection applications. As a consequence, and as discussed below, the HECO Companies are directed to develop and file a Distributed Generation Interconnection Plan that will utilize forward-looking planning consistent with the "Proactive Approach" recommended by the PV-DG Subgroup and supported by the HECO Companies.

4. The HECO Companies have stated that increasing penetrations of solar PV could have potential adverse safety and reliability impacts on the electric grid.[58] As a consequence, it appears that the HECO Companies have recently adopted a more cautious approach to continued interconnections on high penetration circuits until additional technical assessments and operating experience is acquired.

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[58]See HECO Companies' Solar Photovoltaic Interconnection presentation dated October 14, 2013, presented during the Information Briefing at the Hawaii State Legislature.

5. However, lack of transparency and slow response to provide supporting technical information on reliability concerns foster public distrust about utility management of the distributed generation interconnection challenges. At times, the commission has had difficulty ascertaining the technical reasons supporting utility's reluctance to interconnect or allow customer mitigation measures.

6. The HECO Companies do not have adequate distribution circuit monitoring programs to gather field data to ascertain, *and demonstrate factually*, whether high circuit penetrations of solar PV create safety, power quality and reliability problems. As a consequence, stakeholders must rely upon utility-sponsored distribution system studies as the sole means to assess the safety, power quality and reliability impacts of high penetration circuits. As discussed below, the HECO Companies, and KIUC, are directed to implement a distribution circuit monitoring program.

7. It is not clear that the HECO Companies have ample knowledge of the existing, and evolving, technical capabilities of PV inverters and how they could be utilized to mitigate high penetration distribution circuit concerns. The HECO Companies have not indicated how they intend to leverage existing inverter technical capabilities to obtain solar PV output visibility and to

address other high penetration interconnection challenges, beyond transient over-voltage (TOV) concerns.[59]

8. Further, the HECO Companies have not indicated how they intend to utilize the technical features of advanced inverters, or to require that subsequent solar PV installations incorporate smart inverters in order to avoid potential future equipment retrofits, as has been experienced in Germany. As discussed below, the commission is establishing a Distributed Energy Resource - Technical Working Group to provide a structured forum to address these issues.

Distribution Circuit Interconnection Technical Challenges

9. It is axiomatic that customer distributed generation must be interconnected to electrical grids in a safe and reliable manner. The rapid growth in solar PV systems over the last several years has likely consumed the distributed generation safety, power quality, and reliability "reserve margins" that previously existed in electric distribution systems. A more cautious approach may be warranted, at this time, pending completion of representative

[59]For example, it took six months from September 2013 until February 2014 for the HECO Companies to determine that many new solar PV inverters are already equipped with necessary technical capabilities to mitigate TOV concerns. As a consequence, solar PV installations on many high penetration distribution circuits were effectively halted for six months after the September 2013 interconnection policy changes.

distribution circuit engineering studies. Distribution system challenges may be real, but must be demonstrated by engineering studies and field testing. It is the sole responsibility of the HECO Companies to address interconnection challenges before adverse consequences manifest themselves in terms of poor customer reliability or unsafe operating conditions.[60]

10. A significant technical challenge related to customer solar PV systems is the ability for net energy metering (NEM) customers to export their excess solar energy onto the grid, in an unscheduled and uncontrolled manner, regardless of whether the grid could physically or economically utilize the energy. The physical interconnection of a PV system to the electric grid is not the principal technical challenge. The ability to export power is currently desirable under the NEM program in order to export sufficient quantities of electricity necessary to achieve net zero grid electricity usage, thereby minimizing a customer's electric bill.[61] Solar PV systems in excess of 100 KW capacity, which are

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[60]As explained by the commission in Docket No. 2008-0273, "[T]he utility must not interconnect projects that will substantially compromise reliability or result in an unreasonable cost to ratepayers or would lead to significant curtailment of new or existing renewable energy generators." Decision and Order dated September 25, 2009 in Docket No. 2008-0273 at 56.

[61]To accomplish sufficient export to minimize customer bills, solar PV systems are typically designed to be substantially larger than customers' day-time electricity usage.

not eligible for the net energy metering program, are either physically precluded from exporting power onto the grid, or are uncompensated for any solar energy not actually used on-site.[62]

11. The HECO Companies have not provided the commission, or affected stakeholders, with engineering studies or analyses that set forth long-term plans to interconnect increasing amounts of solar PV capacity on already high penetration distribution circuits. The HECO Companies also have not provided any formal reports or studies that set forth the technical basis and engineering support for current interconnection screening criteria, or the *de facto* circuit interconnection limits.[63] As discussed below, the HECO Companies are directed to provide a Distributed Generation Interconnection Plan to further address these and other issues.

12. It appears that the HECO Companies, at this time, may have effectively "closed" interconnections of new PV systems on distribution circuits where the export of additional PV excess energy would likely result in frequent backfeed (reverse power flow) during day-light hours into the distribution substation, and

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[62]See HECO Companies' Rule 18 relating to Net Energy Metering.

[63]The HECO Companies, on March 21, 2014, responded to a commission request for such information. The majority of the information supplied by HECO Companies was a 2011 PowerPoint presentation prepared by the Southern California Edison Company.

potentially onto the sub-transmission system. The fact that the current screening policy, which enables interconnections on circuits with less than 120% of DML, is greater than 100% of DML is not an indication that the HECO Companies are willing to accept circuit backfeed. In fact, the exact DML percentage at which frequent circuit backfeed would occur is unknown due to the imprecise measurement of DML in relation to maximum aggregated export of PV energy.[64]

13. A potential but unresolved technical issue is whether continuous circuit backfeed represents a significant technical challenge, and if so, to what extent, if any, it could potentially represent a "hard" distribution circuit penetration limit. The HECO Companies are currently conducting engineering studies that will analyze a representative sample of high penetration distribution circuits on Oahu to assess whether, and to what extent, prevention of circuit backfeed may be necessary from a technical perspective, and more importantly, to develop potential mitigation measures. As discussed below, the HECO Companies are directed to provide a Distributed Generation Interconnection Plan to further address these and other issues.

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[64]The commission is aware that the majority of distribution circuits on Oahu are not equipped with SCADA equipment such that HECO could monitor real-time circuit power flows -- both level and direction, to ascertain whether circuit backfeed is occurring.

14. The commission is not aware of Hawaii-specific distribution system studies performed by the U.S. Department of Energy National Laboratories (e.g., NREL), or by nationally recognized engineering firms (conducted independently of the HECO Companies), to evaluate the impact of high solar PV circuit penetration on reliability and safety, as has been the case with system level studies of high renewable energy penetration scenarios conducted by NREL and HNEI.[65] The latter studies provided a solid foundation for understanding the system level impacts of high penetration of variable renewable energy resources, and the development of technical and operational strategies to mitigate adverse consequences. The commission is in discussions with US Department of Energy staff to address this shortcoming.

System Level Impacts of DG

15. Notwithstanding expansion of distribution circuit capacity to accommodate more solar PV systems, system level reliability, curtailment and operational challenges on each island grid, not individual distribution circuit penetration levels, will

[65]The HCEI agreement apparently did not contemplate the integration of substantial amounts of utility-scale or distributed solar PV resources. As a consequence, there were no early efforts to complete major engineering and planning studies related to distributed solar PV, as was the case for large-scale wind resources.

ultimately become the binding constraint, and thus limit the cumulative amount of customer solar PV capacity that can be interconnected to, and the amount of energy that can be exported onto, the grid.

16. System level reliability could be adversely affected in several ways as a consequence of integrating significant amounts of distributed solar PV capacity. First, conventional generators, which currently provide dispatchable power and ancillary services, would be displaced during the daily solar output period.

17. Second, distributed solar PV, similar to utility-scale solar and wind resources, are electronically-coupled to the grid through power inverters that convert solar DC power into 60 Hz AC power. Unlike the displaced conventional synchronous generators, power inverters have technical limitations, that when aggregated in sufficient volume could create dynamic stability challenges for the power grid.[66]

18. The resulting lower day-time net system loads will, by necessity, displace the operation of conventional synchronous generation in order to balance supply and demand. As a consequence, a power grid would be less robust and resilient to reliably

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[66]Power inverters also can provide superior performance in several important respects, compared to conventional generators. See discussion infra, at 86 - 87.

withstand short-circuit faults or other grid contingency events from a system level perspective.[67] It is not clear whether the smaller, neighbor island grids, in particular, will be less robust during day-time periods under similar high distributed solar PV penetration levels, and hence subject to greater system level reliability risks due to the reduction in conventional synchronous generation on-line and available to respond to potential grid contingency events.[68]

19. The interconnection of distributed solar PV systems, and more importantly, the unscheduled and uncontrolled export of excess solar energy onto the grid, could eventually create curtailment risks for existing and future utility-scale solar PV, wind, and other renewable energy projects. This occurs because the total amount of variable renewable energy that could be accommodated reliably on each island grid, at the system level, is limited. When variable energy congestion occurs due to excess energy at the system level, utility-scale renewable energy projects would be curtailed due to the current technical inability to curtail distributed

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[67]The issue is not that distributed solar initiates grid contingency events. Rather, the resulting re-configured grid with fewer synchronous generators, as a consequence of high penetration of solar PV, is inherently less robust to reliably mitigate grid contingency events during day-time periods when solar PV will serve a significant amount of customer load.

[68]See discussion infra at 72 - 75 (regarding Molokai grid).

generation exports onto the grid. This can also result in loss of grid access to the reliability capabilities that are inherently provided by utility-scale wind and solar PV projects pursuant to generator performance standards set forth in interconnection requirements.

20. As a consequence, distributed solar PV customers effectively have higher priority and preferential grid access than do the utility-scale projects, which serve all customers, because the utility is forced, by technical default, to curtail the purchase of low-cost, wholesale renewable energy that otherwise may provide economic savings to utility customers.[69] In its place, the utility is effectively required to "purchase", at retail rate levels, uncontrolled solar PV energy exported onto the grid by distributed solar PV customers.

21. The current situation on Maui illustrates this curtailment risk. Low-cost wind energy production is currently being curtailed during on-peak periods because the continued growth in customer solar PV energy exported onto the Maui grid has reduced

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[69]Regulatory policies governing transmission access priorities have been established by FERC for mainland electric utilities, and generally assign the highest grid access priority to serving utility customers (native load) when grid congestion occurs. See FERC Order 888.

net system load at that time.[70] On Oahu, the developers of nearly 250 MW of low-cost utility-scale solar PV projects face potential curtailment risk if the rapid growth of distributed solar PV systems continues, because distributed system exports are not currently required to have the technical capability to be curtailed.[71] In both of these situations, utility scale projects, in addition to providing low-cost renewable energy, have the technical capability to support power system reliability through active control of real and reactive power by the system operator under adverse conditions, whereas distributed solar PV systems do not currently provide these benefits.

22. A large amount of solar PV capacity can create major daily operational challenges for island grids as a consequence of substantially reducing the day-time net system load that must be served by dispatchable fossil and renewable generation. If the island grid lacks sufficient quick-start generation, other flexible load-following generation capacity, or large-scale bulk energy

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[70]See Generally Maui Electric System Improvement and Curtailment Reduction Plan filed September 3, 2013 in Docket No. 2011-0092.

[71]See discussion infra at Section C.1.; See also, letter from HELCO to the commission regarding the pending Geothermal RFP (Docket No. 2012-0092), dated March 5, 2014, wherein HELCO suggests that continued growth of distributed solar PV capacity could have the effect of reducing ability of the HELCO system to otherwise accommodate potential, new low-cost, geothermal energy projects.

storage resources, it may not be possible to serve major morning ramp-down and late afternoon ramp-up of net system load requirements as a result of large quantities of solar PV capacity.[72]

23. Each of the HECO Companies is required to develop a Power Supply Improvement Plan to, among other purposes, address how the capacity of the island grid may be expanded in order to accommodate additional variable renewable energy resources. These plans will also address other major goals including reduction of energy costs and improvements in generation operational efficiencies. The appropriate allocation of costs associated with power supply improvements to the grid users who either necessitated, or benefit from, these improvements is an important regulatory policy issue[73] that the commission intends to address at the appropriate time in a subsequent PSIP review docket.

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[72]See MLC Subgroup's Final Report, and related discussion in section C.1., below. These challenges are not unique to distributed solar PV systems. Similar system operational challenges would also occur as a result of integrating large quantities of utility-scale solar PV capacity; however, a utility would have the capability to dispatch (curtail) these projects if required due to system conditions.

[73]See TRC's Report at 40-41.

Potential Mitigation Strategies and Measures

While not meant to be dispositive, the commission offers the following assessment regarding potential mitigation solutions to distributed generation integration challenges, with the objective to foster a collaborative dialogue among electric utilities, the Consumer Advocate, solar PV contractors and other interested stakeholders.

24. It is unlikely that a single measure exists to completely mitigate distribution circuit-level or system-level, or both, distributed generation integration challenges. A portfolio of measures is likely required.[74] Further, successful mitigation of distribution circuit level integration challenges, and the ensuing growth in distributed generation capacity, would likely only accelerate when system level challenges become the binding constraints, unless mitigation measures also address integration challenges at the system level.

25. System level curtailment challenges are the consequence of over-supply of energy to the grid. A pricing based mitigation measure could be utilized to allocate scarce grid network capacity. If the utility were to "purchase" excess distributed solar energy exported onto the grid at competitive wholesale market price

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[74]See e.g., J. Lazar. *Teaching the Duck to Fly*. Regulatory Assistance Project. January 2014.

levels comparable to the wholesale purchases foregone due to curtailment, then utility customers should be indifferent economically as to the source of the renewable energy supply.

26. However, pricing excess distributed solar energy at a competitive wholesale market level would not mitigate the technical and cost challenges of accommodating large quantities of solar PV capacity that occur only during a few hours of the day. Over-reliance on distributed solar PV capacity could also hinder development of attractive alternative renewable energy resources, which may have more favorable production characteristics (e.g., higher capacity factor, better economics, etc.) due to greater curtailment risk associated with excess energy and system level constraints.

27. Distributed solar PV generators could be required to utilize advanced inverter features, energy storage, demand response or other technologies to supply dispatchable capacity, ancillary services and other grid support services that otherwise would have been supplied by the conventional generators displaced by the distributed generation.

28. Limiting, or precluding, the export of excess distributed solar PV energy could be an effective, and perhaps significant, mitigation measure for a variety of reasons. First, cost-effective customer energy storage systems are commercially

available, as are energy management control systems to enable solar PV and storage systems to be integrated into a seamless customer-sited energy solution. Customers could have the incentive and capability to select any desired combination of solar and grid energy to meet their total electric energy needs. This could be accomplished without exporting excess PV energy onto the grid and would enable customers to avoid retail electric rates.[75]

29. Second, mitigation would occur closest to the source of the intermittency and excess energy. Thus, the impact on the electric grid from the distributed solar PV system is minimized.[76] Third, the solar customer's grid "footprint" is not enlarged due to exports, either to the detriment of other customers seeking to install solar PV systems, or remaining utility customers.

30. Lastly from an electric utility viewpoint, a non-exporting distributed solar PV customer should appear similar, from a technical and economic perspective, to a customer who implemented major energy efficiency measures, and thereby substantially reduced utility energy usage.

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[75]The value proposition for the participating customers could be enhanced by employing time-of-use rate structures where high prices reflect avoided capacity costs during evening system peak load and distribution circuit peak demand periods.

[76]It is unclear the extent to which such a no export strategy mitigates distribution circuit related issues such as voltage support.

Unified Distribution Interconnection Queue

31. In the almost four years since implementation of the FIT program, and concurrent exponential growth of NEM projects, the HECO Companies have not implemented a unified distribution interconnection queue that combines and merges all distribution circuit interconnection requests, regardless of the various procurement programs. Furthermore, there is an obvious lack of transparency regarding status of interconnection applications or information regarding completion of the various steps in the interconnection review process as to whether the time deadlines set forth in Rule 14H are being met.

32. The HECO Companies have modified the interconnection review process requirements for NEM customers, particularly for smaller, less than 10 kW systems. As a result, the commission is concerned that smaller solar PV systems could be accorded preferential treatment as compared to customers who seek to interconnect solar PV systems with a capacity in excess of 100 KW, and therefore do not qualify for inclusion in the NEM procurement program. Without a formal, transparent, unified distribution circuit interconnection queue, it is not possible to ascertain whether all customer generation projects seeking to interconnect to the distribution system are being accorded fair and reasonable access to the grid. As discussed below, the HECO Companies are

directed to develop a formal, transparent, unified distribution system interconnection queue.

33. As identified by the PV-DG Subgroup, the commission is concerned that the present IRS process for the HECO Companies may be delaying and frustrating interconnections. Similar concerns and problems were identified by the Independent Observer and some of the parties to the FIT re-examination (Docket No. 2013-0194). As discussed below, the commission is directing the HECO Companies to provide an IRS improvement plan.

Future Outlook

34. The commission believes it is unrealistic to expect that the high growth in distributed solar PV capacity additions experienced in the 2010 - 2013 time period can be sustained, in the same technical, economic and policy manner in which it occurred, particularly when electric energy usage is declining, distribution circuit penetration levels are increasing, system level challenges are emerging and grid fixed costs are increasingly being shifted to non-solar PV customers.

35. The commission submits that the distributed solar PV industry in Hawaii will, out of necessity due to their accomplishments thus far, have to migrate to a new business model, not unlike what is expected for the HECO Companies as a result of

disruptive technologies. The distributed solar business model will need to shift from a customer-value proposition predicated upon customers avoiding the grid financially - but relying upon it physically and thereby creating circuit and system technical challenges - to a new model where the customer-value proposition is predicated upon how distributed solar PV benefits both individual customers and the overall electric system, and hopefully becomes a key contributor to Hawaii's grid modernization, and most importantly as a consequence, customers are compensated by the utility for the grid value created.

4.

Distributed Generation Interconnection Plan

For the reasons identified by the PV-DG Subgroup and the observations and perspectives set forth above, the commission believes a proactive approach to distributed generation planning specifically, and utility planning in general, when done in a transparent manner and with opportunity for stakeholder participation, is the preferred course of action. The commission concludes that further information and analysis is necessary in order to analyze potential constraints that exist due to high penetration of solar PV systems, and as a result, develop strategies and plans to mitigate these constraints. The commission is,

therefore, ordering the HECO Companies to file a Distributed Generation Interconnection Plan ("DGIP") with the commission within 120 days of the date of this Decision and Order, which shall include, at a minimum, the following components:[77]

a. A ***Distributed Generation Interconnection Capacity Analysis*** which shall proactively identify distribution circuit capacity to safely and reliably interconnect distributed generation resources and the system upgrades requirements necessary to increase circuit interconnection capability in major capacity increments.

The Distributed Generation Interconnection Capacity Analysis shall, at a minimum, also consider:

i. Analyses of technical impacts and challenges associated with export of energy from distributed generation at levels that result in sustained

[77]By directing the HECO Companies collectively, and not HECO, HELCO and MECO individually, the commission intends that one plan be developed and submitted in recognition that the distribution system interconnection technical challenges are likely similar for each company. The HECO Companies should identify and discuss separately any technical challenges that are unique to an individual HECO Company, or a specific island grid. KIUC was excluded from the requirement to prepare a DGIP due to the few number of distribution circuits with high penetrations of solar PV capacity. Hopefully, KIUC can benefit from the HECO Companies DGIP.

backfeed of power from distribution circuits into the distribution substation during day-time hours;

ii. Development of recommended circuit upgrade requirements, including associated costs and ratepayer impacts, to enable circuit penetration limits to be raised in a logical, step-wise manner;

iii. Identification of circuit penetration limits (expressed as a percent of gross DML) that would represent a sound, technical-based progression to increase circuit penetrations in a step-wise manner as experience is gained, and technical feedback is acquired with higher penetration levels, including timelines to propose when those increasing limits would be implemented; and

iv. Impact of system level limitations on aggregate amount of variable renewable energy and how it relates to potential limits on interconnection of distributed generation incorporating analysis and conclusions from the Power Supply Improvement Plans.

b. An ***Advanced DER Technology Utilization Plan*** which shall set forth the near, medium and long-term plans by which customers would install, and utilities would utilize,

advanced inverters, distributed energy storage, demand response and EVs to mitigate adverse grid impacts starting at the distribution level and up to the system level. This Plan and associated implementation process shall also be submitted to the commission for approval in a subsequent proceeding, as appropriate.

The Advanced DER Technology Utilization Plan shall, at a minimum, also include:

i. Plans to utilize grid support functionality embedded in advanced inverters, including autonomous controls and two-way communication to provide, among other capabilities, real-time PV output visibility to the system operator and also the ability to limit export of excess solar PV energy;

ii. Proposed requirements for new DER inverters to utilize state-of-the-art technical capabilities such that these system can provide autonomous grid support functions, enable active utility control of DER and provide ancillary services as grid conditions require;

iii. Stakeholder input in the tariff development process by which standards for advanced inverters are adopted for inclusion in Rule 14H, prior to filing with the commission;

iv. Plans to enable two-way communications with all customer installed DER equipment using proposed AMI communications infrastructure or other suitable communications networks;

v. Plans to utilize distributed energy storage, sited either on utility distribution infrastructure or on the customer side of meter, to mitigate impacts of high penetration solar PV systems; and

vi. Plans to utilize the technical capabilities of advanced inverters, energy management control systems and customer energy storage systems to develop non-export options for distributed generators as well as options to provide ancillary and other grid support services, and appropriate tariff provisions to accommodate this.

c. A ***Distribution Circuit Improvement Implementation Plan*** which shall summarize the specific strategies and action plans, including associated costs and schedule, to

implement circuit upgrades and other mitigation measures to increase capacity of electrical grids to interconnect additional distributed generation.

The Distribution Circuit Improvement Implementation Plan shall, at a minimum, also consider:

i. Prioritization of proposed mitigation actions to focus on the immediate binding constraints for interconnection of additional distributed generation, whether on high penetration distribution circuits or at the system level, depending upon the situation on each island grid;

ii. Analysis of the cost and benefits of proposed mitigation strategies and action plans;

iii. Discussion of how distribution system design criteria, and operational practices, could be modified to enable greater interconnection of distributed generation systems; and

iv. Proposals for addressing the cost allocation issues associated with who bears responsibility for system upgrade costs.

The commission expects that the engineering studies of representative distribution circuits on the Oahu system currently underway will be included in the DGIP. The commission further

expects that the technical basis, including supporting engineering analysis, for any subsequent distribution system interconnection policy changes, will be provided to the commission prior to initiating the proposed changes.

In preparing the DGIP, the HECO Companies should focus on formulating well-reasoned technical strategies and resulting action plans that can be implemented expeditiously, and that are supported by analyses as appropriate. However, the commission is not interested in voluminous technical analyses that merely conclude additional studies are required.

The commission concurs with the observations of the TRC that there are significant policy implications regarding cost allocation of system upgrades that need to be resolved before wide-spread implementation of these upgrades occur.[78] These issues will be addressed in a future distributed energy resource proceeding that is discussed below.

The commission will consider the extent to which the HECO Companies solicit input from members of the DER-TWC, described below, to seek their perspectives and advice as part of the development of the DGIP. The commission intends to initiate a new investigatory docket which will include review the DGIP. Parties to the RSWG, or other stakeholders who are interested in continuing

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[78]See TRC's Report at 40-41.

analysis of the foregoing issues may choose to apply to intervene in the new docket, in accordance with the commission's rules of practice and procedure.

5.

DG Further Actions

As a consequence of the PV-DG Subgroup's recommendations and the observations and perspectives discussed above, the commission:

1. Directs the HECO Companies, and KIUC, to submit to the commission, within 60 days of this order, a plan to implement an on-going distribution circuit monitoring program to measure real-time voltage and other power quality parameters (e.g., voltage fluctuation and flicker, voltage during transient events, harmonics, etc.) in order to ensure that distribution circuit voltages remain within the parameters set forth in General Order No. 7 or other appropriate widely recognized power quality metrics.[79] The plan shall be designed to successfully achieve full implementation of the distribution circuit monitoring program within 180 days of this order. The purpose of the monitoring program is to establish baseline technical data regarding distribution

[79]Examples could potentially include the IEEE 1453 and IEC 61000 standards, and the Information Technology Industry Council (ITI) power quality (CBEMA) curve.

circuit performance on both light and high penetration distribution circuits in order to ascertain whether and to what extent, if any, high circuit penetration of distributed solar PV is, or may, create safety, power quality or reliability problems. The HECO Companies and KIUC shall propose appropriate power quality standards to be used as a reference by which to gauge performance, and file periodic, public reports with the commission as to actual voltage level and power quality performance. The utilities are instructed to work with commission staff to identify the data to be reported and the frequency of reporting.

2. Establishes a Distributed Energy Resources Technical Working Group ("DER-TWG") to address the distribution system and interconnection technical issues associated with high penetrations of DER. The TWG will be chaired by the commission and be comprised of technical experts from Hawaii's electric utilities and Consumer Advocate. In addition, the commission will invite technical experts from affected stakeholders to participate, including, but not limited to, HNEI, solar contractors, DER equipment manufacturers, National Laboratories of the U.S. Department of Energy, and other industry experts. The purpose of the DER-TWG is to ensure that electric utilities have access to the best collective technical knowledge and expertise to address, and more importantly, expeditiously solve technical issues related to interconnection and

operation of distributed energy resources, including smart grid technologies, energy storage systems, and demand response.

3. Directs the HECO Companies to file an action plan for improving efficiencies in the IRS process within thirty days of the date of this Order. In developing the action plan, the HECO Companies are encouraged to build upon any effort already initiated in this docket, as well as the suggestions offered in other dockets, to improve the IRS process.[80]

Likewise, so that the commission may monitor the functioning of the IRS process, the commission directs the HECO Companies to file monthly reports providing details about IRSs, including, but not limited to, the following information: (a) total number of interconnection requests; (b) number of interconnection requests for which the HECO Companies determined an IRS is required; (c) date each IRS was initiated; (d) maximum kW electrical output of the applicable generating system; (b) distribution substation and circuit serving each project ; (c) proposed in-service date; (d) length of time IRS has been pending; and (e) explanations as to circumstances causing any delays in performing the IRS. The monthly IRS reports need not disclose the identity of interconnecting customers.

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[80]See e.g., Order No. 31354 *Providing Guidance for Development of the Draft Final Oahu 200 MW Renewable Energy RFP* issued July 11, 2013 in Docket No. 2011-0225.

These monthly reports may be filed in conjunction with the monthly reliability reports currently being filed by the HECO Companies, pursuant to Order No. 30371, filed on May 4, 2012. Thus, the IRS reports shall be filed within thirty days after the conclusion of any given month. The HECO Companies are instructed to work with commission staff to identify the data to be reported. This filing requirement shall be effective immediately and will terminate upon further order by the commission.

4. Directs the HECO Companies to establish and file with the commission within 120 days of this order a proposal to implement an integrated interconnection queue for each distribution circuit for each island grid to provide transparent information as to distributed generation penetration and other applicable data. This plan should identify how interconnection applications for all resource procurement programs (e.g., NEM, FIT, SIA, etc.) will be added to the interconnection queue, including appropriate rules, procedures, timelines, etc. The commission will consider stakeholder input on the utilities' interconnection queue proposal in a subsequent proceeding. Furthermore, the utilities shall be prepared to post the integrated interconnection queue and associated data to each company's website upon approval of the integrated interconnection queue proposal by the commission.

5. As expressed by the TRC and several other Parties, the commission believes that those portions of the PV-DG Subgroup's work products that can be expeditiously implemented should be stream-lined for approval and implementation as soon as possible. While cognizant of the PV-DG Subgroup's recommendation for a new proceeding to further evaluate their work products, the commission believes the better approach at this junction is to optimize to the greatest extent possible, the progress gained by the PV-DG Subgroup thus far and permit a continued effort to reach final agreement on the PV-DG Subgroup's work products in this docket.

Accordingly, the commission directs the PV-DG Subgroup to file a Stipulation in this docket that sets forth any and all areas of agreement they can reach on their work products, within thirty days of the date of this Order, or alternatively, the reasons agreements could not be reached. Other members of the RSWG (who are not members of the PV-DG Subgroup) may then have fifteen days after the Stipulation is filed to comment on the Stipulation.

The commission intends to rule on the Stipulation in this docket. In this way, any approved stipulated proposals may be implemented on an expedited basis, as opposed to being exposed to possible delays associated with opening a new proceeding. In the same vein, given the relatively short thirty-day timeframe,

the PV-DG Subgroup should focus on proposals that may easily be implemented via revisions to the HECO Companies' applicable tariffs, which in turn, would simplify the review and approval process for the commission. The commission will assess how best to process remaining unresolved PV-DG issues when it reviews the Stipulation.

The commission intends to initiate a proceeding to address the technical, economic and policy issues associated with distributed energy resources. The commission believes that the new proceeding will benefit greatly from the foundation of work developed by the RSWG and set forth in this decision and order. This proceeding will also benefit from the anticipated work products of the DER-TWG, the DGIP, and other utility submissions ordered in the instant decision and order. The commission also envisions that the new proceeding will be conducted procedurally in a similar manner to that utilized in the RSWG docket, wherein groups of subject matter experts would address the technical, economic and regulatory policy issues associated with distributed energy resources.

C.

System Level Considerations

1.

MLC Subgroup

The RSWG initially outlined the MLC Subgroup's work tasks as:

1. Identify additional technical studies and assessments that may be necessary to review and assess the HECO Companies systems to determine physical capabilities or limits of utility systems, to establish how much renewable generation can be added to the island grids without substantially compromising reliability, increasing curtailment of existing or planned renewable resources, or imposing unreasonable costs on the ratepayers. Understand that the PUC, rather than the RSWG or the utilities, may determine whether such studies will be undertaken.

2. Identify and recommend specific changes or enhancements, including estimated costs and timelines, to address and mitigate current factors that constrain the addition of further renewable resources, to increase renewable energy use without substantially compromising system reliability or markedly increasing renewable curtailments. Those recommendations can address but are not limited to:

- Utility infrastructure and operational practices, including procurement
- Renewable generation equipment, practices and contract or tariff terms
- Regulatory policies and processes

- Energy efficiency, demand response, energy storage, smart grid, and related policies and programs.

3. Understand when and why curtailment happens and develop transparent policies and rules that do not markedly increase curtailment and partial curtailment of existing and planned renewable generators.[81]

Three studies were developed that helped to inform the discussion and recommendations of the MLC Subgroup:

1. Brendan Kirby's minimum load and curtailment analysis for HELCO (filed under Protective Order);

2. Brendan Kirby's minimum load and curtailment analysis for MECO (filed under Protective Order); and

3. HECO/MECO Cycling Study performed by EPS/APTECH and funded by the HECO Companies ("EPS Study")[82]

The IF describes the EPS Study as follows:

> In response to the Kirby minimum load and curtailment studies, the Hawaiian Electric Companies initiated a more detailed set of studies of generator cycling capabilities and the renewable curtailment implications of current and possible central station operational patterns. Based on early results and analyses about curtailment issues, the Hawaiian Electric Companies developed and shared a work plan in September 2012 that made significant commitments for continuing

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[81]Hawaii Reliability Standards Working Group's Minimum Load and Curtailment Subgroup's Final Report ("MLC Subgroup's Final Report"), Attachment 3a-1 to IF's Final Report, at 1.

[82]See Attachment 3b-15 to IF's Final Report.

> generator modifications and changes in operational practices to reduce renewable curtailments going forward. The Hawaiian Electric Companies and its consultants completed its studies and presented them to the RSWG on January 24, 2013[.][83]

Regarding conclusions and implementation strategy, the EPS Study states:

- The study increases the use of renewable energy from both dispatchable and variable resources
- The EPS Study indicates that curtailments for both HELCO and MECO can be reduced from historical or previously projected 2013 levels
- The utilities are committed to implementing the study recommendations[84]

The EPS Study also sets forth specific work plans for implementing the findings of the study for both the MECO and HELCO grids.

In addition to reviewing the three studies noted above, the MLC Subgroup produced three major work products. First, the MLC Subgroup produced a paper titled, "RSWG Recommendation Concerning Cycling Capabilities and Minimum Load Capabilities of New Generation" ("Flexibility Recommendation").[85] As described by the MLC Subgroup:

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[83]IF's Final Report at 15.

[84]EPS Study, Attachment 3b-15 to IF's Final Report, at 3.

[85]See Attachment 3b-1 to IF's Final Report.

> The genesis of the Flexibility Recommendation was a paper from Brendan Kirby entitled, *Valuing Flexibility When Acquiring New Generation* (the "Paper") which was first sent to RSWG members on May 14, 2012. The Paper was initially adopted by the majority of members of the MLC on June 21, 2012. However, the IF requested further efforts to reach unanimity concerning disagreement between HECO and members of the MLC regarding issues such as the operating characteristics of the Hu Honua biomass project under development on the HELCO system and the potential lack or actual degree of operating flexibility the project could have. Concerted efforts were under taken to address these concerns and reach a consensus on the paper. The paper was further revised to stress the need for operating flexibility in future generation resources. The final paper was adopted by the MLC and presented to and accepted by the RSWG with HECO, the CA, and Hugh Baker dissenting.[86]

Second, the MLC Subgroup completed a paper titled, "Potential Contractual Treatments for Curtailment of Variable Renewable IPPs"[87] ("Contracts Recommendation"), with the following attachments:

- Attachment A: HECO Comments on an Alternative to a Take-or-Pay Contract - the Tiered Energy Purchase Agreement
- Attachment B: Take or Pay (Wholly Compensated Curtailment)

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[86]MLC Subgroup's Final Report, Attachment 3a-1 to IF's Final Report, at 3.

[87]See Attachment 3b-10 to IF's Final Report.

- Attachment C: Alternative Generation Contract Structures for Optimal Investment and Operations

As stated in the Contracts Recommendation, the scope of the paper "is limited to identifying potential contractual treatments which can assist in providing the correct economic signals to facilitate increased use of renewable energy while also considering potential impacts to utility ratepayers and shareholders. Issues will be identified, but specific recommendations will not be made as to a preferred treatment."[88]

The MLC Subgroup's third major work product was a paper titled, "RSWG Recommendations Concerning Central Generator Station Ancillary Service Supply Capabilities in a Renewable Based Grid"[89] ("Ancillary Service Recommendation"). This paper summarized key ancillary services, and was presented as an adjunct to an ancillary services study performed by General Electric Energy Consulting ("GE"), for and with the support of the Hawaii Natural Energy Institute ("HNEI"),[90] discussed further below.

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[88]Id. at 1.

[89]See Attachment 3c-6 to IF's Final Report.

[90]See GE's Ancillary Services Definitions and Capability Study - Parts I and II ("GE Study"), Attachments 3c-1 and 3c-2 to IF's Final Report.

In the commission's view, the MLC Subgroup tackled very complex and controversial issues relating to system reliability and excess energy curtailment. In this regard, the commission agrees with the TRC's assessment of the MLC Subgroup's efforts:

> The issues associated with minimum load and curtailment are, arguably, some of the most complex issues facing the utility and the Commission and are expected to require additional studies to resolve. However, the MLC Subgroup is to be commended for their efforts to address this very complex issue in a timely and quantitative manner. Many significant issues were raised, preliminary assessments were completed, and recommendations for future work, if not the suggested solutions, were provided.[91]

The MLC Subgroup made significant headway in examining minimum load, curtailment and system operation issues, but continued evaluation of these issues is warranted. The commission has benefited greatly from the work of the MLC Subgroup which has been incorporated into several recent decisions and orders.

First, the commission has directed HELCO to file a Power Supply Improvement Plan to formally address many of the issues identified by the MLC Subgroup. The key issues to be addressed in the PSIP include: fossil generation retirement plan, generation

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[91]See TRC's Report at 14.

flexibility plan, must-run generation reduction plan and review of generation unit commitment and economic dispatch.[92]

Second, the commission directed MECO to file a System Improvement and Curtailment Reduction Plan to address operational inefficiencies and reduce curtailment of lower cost wind energy.[93] The commission's consultant, Brendan Kirby, has reviewed MECO's plan and submitted his recommendations for commission consideration.[94] As a result of this submission, the commission has concurrently directed MECO to file a Power Supply Improvement Plan for the Maui system.[95] Finally, as discussed below, the commission will direct HECO, by way of this decision and order, to prepare and file a Power Supply Improvement Plan to address similar issues for the Oahu system.[96]

The commission intends to consolidate the review of the three Power Supply Improvement Plans into a new investigatory

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[92]See Decision and Order No. 31758, issued Dec. 20, 2013 in Docket No. 2012-0212, at 112-120.

[93]See Decision and Order No. 31288, issued May 31, 2013 in Docket No. 2011-0092.

[94]See MECO System Improvement and Curtailment Reduction Plan Review, filed Feb. 26, 2014 in Docket No. 2011-0092.

[95]See Order No. 32055, issued April 28, 2014 in Docket No. 2011-0092.

[96]See infra at 89-103.

docket. The commission will include for further review in the new PSIP docket, at minimum, the following RSWG work products:

- EPS Study - Specifically, the commission intends to monitor the HECO Companies' implementation of the strategies and work plans proposed in the EPS Study
- MLC Subgroup's Flexibility Recommendation
- MLC Subgroup's Contracts Recommendation
- MLC Subgroup's Ancillary Service Recommendation

In addition, the commission intends to include as an issue in the new Power Supply Improvement Plan docket, one that was previously raised in Order No. 30371 -- whether it would be constructive and appropriate for the commission to institute a formal review and approval process for the designation of must-run units.[97]

Parties to the RSWG who are interested in continuing analysis of the foregoing issues may choose to apply to intervene in the new PSIP docket, in accordance with the commission's rules of practice and procedure.

Finally, the commission observes that the RSWG benefited from the work of the Hawaii Solar Integration Study (HSIS).[98] The HSIS examined the reliability and operational challenges associated

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[97]See Order No. 30371 at 16.

[98]See IF's Report at 15.

with high-penetration wind and solar PV -- utility-scale and distributed -- scenarios for the Oahu and Maui grids. The commission finds the HSIS to be an invaluable tool to inform thinking, and stakeholder discussions, on the ability of Hawaii's electric grids to accommodate high penetrations of renewable resources while maintaining system reliability and minimizing curtailments. The commission appreciates the efforts of NREL, HNEI, GE and the HSIS TRC to identify and analyze potential mitigation strategies, and expects the HECO Companies to discuss how they intend to implement these mitigation strategies in their PSIPs. While HSIS focused on the Oahu and Maui grids, many of the mitigation strategies should also be applicable to the HELCO grid.

2.

Recent System Level Observations and Trends

The commission observes that substantial changes have occurred regarding system level reliability, curtailment and operational challenges since the MLC Subgroup submitted its report and recommendations. The HECO Companies submit monthly reports to the commission regarding system frequency control performance and

curtailment of renewable energy projects.[99] Based upon examination of these reports and other recent system level changes, the commission makes the following observations regarding system frequency control and curtailment performance trends since 2011. For some island grids, the observed trends are positive. For other island grids, the observed trends are negative and, in some instances, of increasing concern to the commission.

i.

System Dynamic Stability Performance

The following table compares the number of under frequency load shed (UFLS) events for each of the HECO Companies' island grids for 2012 and 2013.

Under Frequency Load Shed Events		
Island	2012	2013
Hawaii	12	19
Lanai	10	8
Maui	7	2
Molokai	3	19
Oahu	2	1

Source: Hawaiian Electric Company

[99]These reports include: Frequency Control Performance and Curtailment Report (Docket No. 2011-0206), HELCO Curtailment Report (Docket No. 2011-0040), and MECO Curtailment Report (Docket No. 2011-0092).

An UFLS event represents a utility-initiated interruption of customer load in response to a system contingency event, such as the loss of a generating unit caused by either a generator trip, or loss of a transmission line that interconnects generation to the remainder of the grid. Regardless of the initiating event, customer load may need to be interrupted in order to immediately balance system load with the reduced, but remaining, generation. More frequent occurrences of UFLS events represent a diminished level of customer reliability.

HECO utilizes on-line spinning reserves on Oahu to mitigate the single largest generator contingency event, which is the loss of the AES generating plant, to avoid UFLS customer interruptions. However, UFLS may also be required on Oahu after the sudden loss of generation, in the event that spinning reserves are not sufficient to arrest the decline in system frequency.

HELCO and MECO do not typically utilize spinning reserves for large system contingency events on their island grids due to the high cost of doing so. Instead, UFLS is employed to shed customer load until quick-start diesels are brought on-line, at which time interrupted customer load is restored to service. A contingency event, if not mitigated immediately and properly, could potentially lead to larger-scale customer outages, or even an island-wide blackout.

The commission offers several noteworthy observations regarding UFLS utilization across Hawaii's different island grids.

1. Molokai - 19 UFLS events occurred on Molokai in 2013 as compared to 3 UFLS events in 2012. Eight of the UFLS events occurred in December 2013 alone.[100] Simply stated, the substantial increase in UFLS events represents a major deterioration in system reliability, and is unacceptable customer reliability performance that must be rectified.

The commission observes that distributed solar PV systems constitute almost a third of the day-time system load on the Molokai grid, and more solar PV system installations are planned.[101] The commission further observes that the system frequency nadir (low-point) during multiple Molokai day-time contingency events was below 57.0 Hz, which suggests that all of the solar PV systems, regardless of whether the PV inverter frequency trip set-point is 59.3 Hz or 57.0 Hz, would automatically trip off-line, thus exacerbating the supply/demand imbalance.[102] For the reasons

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[100]See RSWG Monthly Reports filed February 28, 2013 to January 24, 2014.

[101]See MECO/HNEI Molokai Informational Meeting presentation dated November 7, 2013, accessible at http://www.hnei.hawaii.edu/news/proposed-battery-energy-storage-system-molokai

[102]See RSWG monthly reports filed February 28, 2013 to January 24, 2014, which report the system frequency nadir for UFLS events.

discussed earlier, the commission is concerned that the dynamic stability response capability of the Molokai grid may have deteriorated to a level where the grid lacks sufficient resiliency to respond as designed to distribution system faults or other grid contingency events, regardless of the precipitating cause.[103]

The commission is aware that HNEI is finalizing plans to install a battery energy storage system (BESS) on the Molokai grid in an attempt to improve system reliability performance.[104] It is anticipated that the BESS could provide rapid frequency response and thus minimize need for UFLS events. The BESS could also reduce the frequency variability due to changes in variable generation and load.[105]

The commission also notes that MECO has informed the Molokai community that:[106]

a. "Kaunakakai Circuit study found that distributed PV on Molokai presented a risk to the entire grid, not just circuit";

b. "Potential risk confirmed by follow-up study";

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[103]See discussion supra at 39-43.

[104]See MECO/HNEI Molokai Informational Meeting presentation at 10-17.

[105]See MECO/HNEI Molokai Informational Meeting presentation at 21.

[106]See MECO/HNEI Molokai Informational Meeting presentation at 4-5.

c. "Circuit distributed generation screening (as described in PUC Rule 14) only addresses circuit-related risks of PV";

d. "Risks on the electric grid as a whole are not assessed in the screening process";

e. "All utilities are subject to unplanned events such as loss of generation";

f. The impact of these events is more significant on smaller, isolated grids";

g. "While events can happen any time of the day, significant events during the daytime can cause all PV on the island to stop operating, increasing the risks on the entire grid";

h. "The increased in PV generation has increased the need for new solutions to reduce the impact of loss of generation".

MECO was apparently aware for several years that reliability could potentially deteriorate on Molokai, given that the Kaunakakai Circuit initial and follow-up studies were conducted in 2011 - 2012 time period.[107]

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[107]See MECO-1008 at 4-5, filed July 22, 2011 in Docket No. 2011-0092.

The commission reminds MECO that Rule 14, as well as all rules of electric service, are MECO, not PUC, rules. Further, the commission states unequivocally that MECO is solely responsibility to determine and implement timely actions to accommodate the reasonable needs of its customers, including those seeking to interconnect solar PV systems, while maintaining adequate system reliability and customer service quality.

Based upon the foregoing, a pertinent but unanswered question is whether MECO has taken sufficient actions to reliably interconnect further customer-sited solar PV systems, and whether MECO has appropriately mitigated the evident weaknesses in the current power system and its operation on Molokai. As discussed below, MECO is directed to submit a plan to further address these issues.

2. Hawaii - The island of Hawaii experienced 19 UFLS events in 2013 as compared to 12 UFLS events in 2012.[108] While HELCO has not provided similar public assessments of Hawaii island's reliability deterioration, the commission notes that distributed solar PV capacity has increased on the island by approximately 12 MW with total installed solar PV capacity of 38 MW at December 31, 2013. In combination with existing wind resources, a

[108]See RSWG Monthly Reports filed February 28, 2013 to January 24, 2014.

total of approximately 69 MW of variable renewable capacity is currently installed on Hawaii island.[109]

During 2013, HNEI placed into operation a 1 MW BESS to demonstrate the capability of a fast response battery energy system to provide frequency regulation, which supplements two 100 kW BESS already connected to the HELCO system. HNEI's evaluation of the most recent BESS installation is not yet completed; however, early results indicate the BESS can provide valuable assistance in the maintenance of power quality and system reliability.

The commission expects HELCO will further address, in the commission's review of its Power Supply Improvement Plan submission, how it will utilize additional battery energy storage capacity to reduce UFLS events and also accommodate additional variable renewable energy resources without substantially compromising reliability, resulting in an unreasonable cost to ratepayers or causing significant curtailment of existing, and potential new renewable energy projects.

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[109]Excluding approximately 17 MW of run-of-river hydroelectric generation, which, while variable, provides a more steady and predictable output when the resource is available than do wind or solar resources.

3. Maui - In contrast, on Maui, the number of UFLS events has declined from 7 to 2 in 2012 versus 2013, respectively. During 2013, MECO integrated two new wind farms onto the Maui grid, which combined with the existing Kaheawa wind farm total 72 MW of wind capacity.[110] Total installed solar PV capacity is approximately 41 MWs at December 31, 2013. It is noteworthy that each of the new wind farms has a large battery energy storage system to provide primary frequency response and other grid support services.[111] In combination with several other BESS installed on the island, MECO benefits from more than 22 MW of battery energy storage, compared to approximately 113 MW of variable renewable capacity.

ii.

Curtailment of Renewable Resources

The commission notes several observations regarding curtailment of renewable energy resources during 2013.

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[110]See RSWG Monthly Reports filed February 28, 2013 to January 24, 2014.

[111]See Docket No. 2010-0279, Decision and Order filed February 11, 2011 at 4-5; Docket No. 2011-0060, Decision and Order filed June 15, 2011 at 5-6.

1. Oahu - There were several reported instances of wind farm curtailments during off-peak periods due to excess energy.[112] The emergence of such curtailments is an area of concern, given that the Oahu Wind Integration and Transmission Study ("OWITS") and Hawaii Solar Integration Study ("HSIS") studies of the Oahu grid did not project any curtailment of existing Oahu wind farms; only potential curtailment of new wind and solar resources.[113] These studies reflected HECO's plan to implement major operational changes to its fossil generating units in order to reduce generator minimum output levels and increase generator unit flexibility.[114] The scope of HECO's fossil generation operational changes or the status of their implementation by HECO has not been provided to the commission. As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

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[112]See RSWG Monthly Report filed March 28, 2013, Attachment 6. The commission also observes that there were numerous reported instances of wind and solar PV curtailments in 2013 due to reasons such as pole replacements, sometimes daily occurrences for consecutive weeks. The commission questions whether HECO would have performed these numerous pole replacements in the same manner, if, by doing so, it would have adversely affected HECO's revenue stream, as was the case for IPPs. The commission intends to examine HECO's performance in this regard, in the forthcoming 2014 test year rate case.

[113]See HSIS Final Technical Report for Oahu dated December 7, 2012 at 82-84.

[114]See HSIS Final Technical Report for Oahu dated December 7, 2012 at 129-139.

2. Hawaii - Overall, the hours of curtailment of renewable energy projects decreased in 2013, with many months in 2013 having no curtailments due to excess energy. However, the decrease in curtailment has mostly benefited the Hawi Renewable Development and Puna Geothermal Venture projects, while Tawhiri wind farm continues to experience comparable curtailment as in 2012.

Hours of Curtailment Due to Excess Energy						
Quarter	Tawhiri Wind		Hawi Wind		PGV	
	2012	2013	2012	2013	2012	2013
Q1 (Jan-Mar)	90	165	25	21	24	3
Q2 (Apr-Jun)	76	24	22	0	15	0
Q3 (Jul-Sept)	6	0	30	0	26	0
Q4 (Oct-Dec)	26	1	23	0	19	0
Total	198	190	100	21	84	3

Source: HELCO Monthly Curtailment Report, filed in Docket No. 2011-0206

The apparent reason for the reductions in hours of curtailment was the change in the mode of operation of the Hamakua Energy Partners ("HEP") generating units in early 2013.[115] The commission again reiterates its concerns articulated in Decision and Order No. 31758, Docket No. 2012-0212, wherein it stated that "it appears that HELCO's strategy is to continue operation of its steam fossil generation plants even though they are apparently less fuel efficient and more expensive than IPP base load generation". The

[115]See HELCO Calibration Factor Report, filed March 14, 2014, at 10 ("In February 2013, the HEP operation has changed from baseload operation to cycling operation.").

commission expects HELCO to address these concerns in the commission's review of HELCO's Power Supply Improvement Plan.

3. Maui - The amount of wind energy curtailmentas reduced in the second half of the year following the issuance of the MECO rate order[116] and MECO's subsequent implementation of portions of its System Improvement and Curtailment Reduction Plan. Notwithstanding the significant reductions, the amount of curtailment still remaining represents energy that could have been delivered without incurring any fuel expense.

	Maui Wind Curtailment 2013		
	Potential Wind Output (MWh)	Curtailed Wind Output (MWh)	Percentage Curtailed
Quarter 1	68,400	24,100	35%
Quarter 2	68,700	12,000	17%
Quarter 3	90,300	7,800	9%
Quarter 4	49,700	2,800	6%
Total	**277,100**	**46,700**	**17%**

Source: MECO Monthly Curtailment Report, filed in Docket No. 2011-0092

[116]See Decision and Order No. 31288 in Docket No. 2011-0092, issued May 31, 2013.

iii.

System Level Challenges Related to Integration of Solar PV

The commission notes that the MLC Subgroup focused on reliability, excess energy curtailment and system operational issues primarily on the Hawaii and Maui island grids given the challenges that existed in 2011 when the RSWG initiated its work activity. These challenges largely involved integration of wind energy, including wind curtailment as a result of excess energy during off-peak periods. The penetration levels of variable renewable energy resources on Oahu, at that time, were small in comparison to those that existed on the Hawaii grid, or would soon exist on the Maui grid, with the pending addition of two new wind farms.

Renewable energy curtailments have been reduced on Hawaii and Maui islands, as discussed above. The principal power supply challenge now confronting HELCO and MECO is how to integrate additional, low-cost utility-scale renewable energy resources, retire old, inefficient fossil generators and improve generation operational efficiencies in order to reduce energy costs for customers.[117] The commission expects that the HECO Companies' PSIPs

[117]See Exhibit A, attachment to Decision and Order No. 32052 issued April 28, 2014 in Docket No. 2012-0036.

will provide the strategic roadmap, and action plans, to accomplish this.

At this time, the commission believes the most pressing system level reliability, curtailment and operational challenges for the Oahu and Kauai island grids are related to the anticipated additions of large quantities of new utility-scale and distributed solar PV capacity by 2016.[118] These levels of solar PV penetration have system operation and reliability implications that have not been fully analyzed. These technical, economic and operational challenges are not well understood publicly, yet have important ratepayer implications. The challenges appear to be more significant for the Oahu grid for the reasons discussed below.

1. Substantial quantities of solar PV capacity have and will continue to be added to the Oahu grid. There were approximately 220 MW of installed solar PV capacity on Oahu as of December 31, 2013, most of which is residential rooftop systems. Nearly 85 MW of rooftop solar PV systems were installed in 2013 alone on Oahu.[119] HECO is presently negotiating contracts for

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[118]Including approximately 250 MW of utility-scale solar PV on Oahu. In addition, two new utility-scale solar PV projects are under construction on Kauai. Furthermore, both Oahu and Kauai can expect continued strong demand for interconnection of distributed solar PV systems.

[119]See Hawaiian Electric Company, Inc. NEM Report, dated Jan. 31, 2014, at 5.

approximately 250 MW of utility-scale solar PV waiver projects to be installed by 2016 on Oahu.[120] Cumulatively, it is possible for total solar PV capacity on Oahu to reach 600 MW by 2016, with future annual installations of distributed solar PV at levels that would be lower than experienced in 2012 and 2013.

2. There is potential for approximately 25 - 50 MW of new wind capacity in addition to the approximately 100 MW of wind capacity already installed on Oahu. This wind capacity in combination with 600 MW of potential solar PV capacity, translates into potentially 750 MW of variable renewable generation on Oahu by 2016. Additionally, the existing H-Power waste-to-energy project represents another 68.5 MW of low-cost renewable energy output that must also be accommodated.

3. Currently, day-time total system loads on Oahu grid are approximately 900 - 1,000 MW, including the loads served by distributed solar PV systems. Potentially 75% of the day-time system load could be supplied by wind and solar PV capacity on sunny days. When these conditions occur, most of the renewable energy

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[120]See HECO Companies' News Release dated January 22, 2014; See also Report To The 2014 Legislature On The Public Utilities Commission Review Of Hawaii's Renewable Portfolio Standards filed December 2013; Docket No. 2013-0156, Decision and Order filed February 13, 2014 (proposing the addition of approximately 33 MW of additional power); Docket No. 2013-0381, Hawaiian Electric Application for Additional Waivers filed November 4, 2013 (proposing the addition of approximately 210 MW of additional power).

output on Oahu will be concentrated across only a few hours during the mid-day period, which is different from what occurs currently on the Hawaii and Maui island grids.

4. The large concentration of solar PV capacity will likely create major daily operational challenges for the operation of the Oahu grid, by substantially altering the day-time net system load that must be served by fossil generation. The Oahu grid does not appear to have sufficient quick-start, or flexible cycling generation capacity, at this time, to respond to major morning ramp-down, and late afternoon ramp-up, system load requirements that would result from large amounts of solar PV capacity. Oahu's existing fossil generation fleet is comprised primarily of steam turbine generators. These generators cannot be currently cycled on and off-line quickly or easily to accommodate, for several hours, a potential 600 MW drop in day-time net system load. HECO has not indicated how it intends to meet these ramping requirements, and the costs associated with doing so, under a high solar PV penetration scenario.[121] As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

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[121]The commission notes that while net system loads would be low during the time of high solar PV output, customer load (gross system load) would be high, presenting a possible opportunity to use demand response for fast response ancillary services.

5. Without sufficient flexible fossil generation or other resources such as demand response and energy storage, HECO may be required to curtail solar PV output in order to have adequate must-run generation on-line to serve the evening system peak loads even after reducing steam generators to minimum output levels. Also, some level of on-line fossil generation capacity will be required in order to ensure adequate system stability and reliability, though the amount of required generation may be reduced through appropriate use of demand response as a reliability resource. The Oahu grid also does not have large-scale energy storage systems, relative to size of total system load, as currently is the case for the Kauai, Lanai and Maui grids, and potentially later this year, the Molokai grid. These energy storage systems can provide frequency control and other important grid support services, that otherwise would have been provided by conventional generators.

6. The commission is concerned that HECO has a significant amount of must-run generation that may preclude acceptance of low-cost renewable energy, and/or introduce a number of security constraints, that preclude optimal generation economic dispatch. The commission is unaware how HECO intends to operate the Oahu grid under a high solar PV penetration scenario to ensure system reliability is not compromised, or energy costs are not increased.

As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

7. The majority of total potential solar PV capacity is expected to be distributed generation systems which cannot currently be controlled or dispatched by HECO. Instead, utility-scale solar PV projects will, by default, have to be curtailed in order to avoid cycling steam generators until new, flexible generation is installed and old, inefficient, inflexible fossil generation is retired, or until demand response and energy storage resources are available. As a consequence, customer energy costs could be higher than would be the case otherwise, if lower-cost utility-scale solar PV generation could be accepted. HECO has not indicated its plans to retire fossil generation and install new, low-cost flexible generation. As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

8. Wind, solar, and also battery energy storage resources, are electronically-coupled to the electric grid through power inverters that convert DC power input into 60 Hz AC power output. Unlike conventional synchronous generators, power inverters have inherent technical limitations with respect to supplying fault current output, which is an important electrical characteristic necessary to ensure the safe and reliable operation

of the power grid, from both system steady-state and dynamic stability perspectives.[122] The potential for 750 MW of electronically-coupled wind and solar renewable generation on Oahu would comprise approximately 75% of the total system generation resources during day-time solar output periods.[123] An important but unresolved issue is the extent to which large quantities of non-synchronous generator supply (i.e., electronically-coupled, inverter-based wind and solar systems) may be accommodated reliability on small isolated, independent island power grids. HECO has not indicated how it intends to operate the Oahu grid under a high electronically-coupled supply scenario and how it will ensure system reliability and safety are not compromised. As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

9. The commission is concerned that the Oahu grid currently may not be sufficiently robust to accommodate a large

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[122]Power inverters also have technical capabilities that are superior to conventional synchronous generators, particularly as it relates to precise control of power output, and the speed at which power output levels may be adjusted, due to the digital electronic controls inherent in these devices.

[123]The commission is aware that during the HSIS, GE and TRC monitored the aggregate amount of electronically-coupled wind and solar supply that would be on-line under high renewable energy penetration scenarios. There is limited industry knowledge about the impact of operating an isolated island power grid with large quantities of total energy being supplied by electronically-coupled resources, for extended periods of time.

portfolio of variable solar PV and wind resources without new mitigation measures. The Oahu grid has experienced three UFLS events in 2012 and 2013 related, directly or indirectly, to the loss of AES generation. HECO has traditionally relied upon on-line spinning reserves to mitigate the loss of the AES generating plant. The last Oahu UFLS event occurred on April 2, 2013 at 10:31 a.m., during the period of time solar PV traditionally reaches full output, when the 180 MW AES generator tripped and triggered blocks 1, 2 and 3 of the UFLS interruption scheme. The commission is aware that HECO has investigated this event and has initiated changes to mitigate future potential loss of significant customer load. The AES plant is a major, low-cost resource for the Oahu ratepayers, and should be economically dispatched to avoid adverse economic consequences for ratepayers. Accordingly, HECO should ensure that the AES plant may be operated at full capacity while, at the same time, maintain system reliability on Oahu, consistent with the requirements of a major urban service territory. As discussed below, HECO is directed to provide a Power Supply Improvement Plan to further address these and other issues.

10. The extent to which high penetration of solar PV will occur, by 2016 on Oahu, is unknown. However, it is not clear that HECO has implemented, or even developed, plans to accommodate high solar PV accommodations from system level reliability, curtailment

and operational perspectives. As previously discussed, the HECO Companies failed to anticipate the rapid growth in distributed solar PV interconnections, and thus did not proactively plan and manage the distribution circuit interconnection process or technical challenges. HECO is likely to face major technical and operational challenges in order to integrate, at the system level within three years, large amounts of utility-scale and distributed solar PV capacity on the Oahu grid with the current generation portfolio.

11. Based on the above observations, the commission concludes that further analysis of HECO's power supply planning and operations is necessary. The commission is, therefore, ordering HECO to file a Power Supply Improvement Plan ("PSIP") with the commission within 120 days of the date of this Decision and Order, among other reasons, to provide plans as to how HECO intends to accomplish the integration of substantial amounts of variable renewable energy resources, in a reliable and economic manner, without significant curtailments of existing or future renewable resources.[124] The PSIP shall include, at a minimum, the following components:

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[124]The commission notes that the CA recommended that HECO prepare a plan to address principally the same concerns in its recent filing in Docket No. 2013-0381. See CA SOP, dated March 4, 2014, at 14-16 and 20-21.

a. A ***Fossil Generation Retirement Plan*** which shall be supported by an analysis of which existing utility fossil fuel generating units (beyond the Honolulu units) can be retired, when it is feasible to retire each such unit, why it is not feasible to retire each such unit sooner, the effect on system operations of retiring each such unit, and the anticipated ratepayer savings that would result.

The Fossil Generation Retirement Plan shall, at a minimum, also consider:

i. An analysis of the potential roles each HECO fossil generating unit should perform in the future;

ii. An analysis of future fuel expenses, operation and maintenance expenses, and capital expenditures that would be avoided if each existing fossil generating unit were to be retired;

iii. The impact each retirement, without replacement, would have on adequacy of power supply and reserve margins under existing capacity planning criteria;

iv. An analysis of how the capacity value of solar, wind, energy storage, and demand response resources

will be factored into the determination of the adequacy of power supply;

v. An analysis of feasibility of utilizing existing power plant sites to locate new, quick-start, fuel-efficient, flexible generation, to leverage existing site transmission and fuel supply infrastructure capacity that would be freed-up by retirements of existing generating units;

vi. A discussion of the action plans, including costs, schedules and ratepayer impacts, to implement the Fossil Generation Retirement Plan, or a detailed explanation of why such actions are not feasible.

b. A ***Generation Flexibility Plan*** designed to enable HECO to accommodate greater quantities of low cost energy resources. The Generation Flexibility Plan shall, at a minimum, provide the following:

i. An analysis of whether or not HECO's existing generation mix has sufficient quick-start, flexible, fuel efficient dispatchable capacity to accommodate integration of substantial quantities of variable renewable energy resources without significant curtailment;

ii. An analysis of methods by which to increase cycling flexibility and ramp rate response, and decrease start-up times, of HECO's and IPP's base load generating units including specific discussion of what such methods have been attempted or currently underway by HECO;

iii. An analysis of the optimal deployment, including potential site locations, of new fuel-efficient, quick-start, flexible generation utilizing lowest cost fuels on the HECO power supply system versus modifying existing generators as required in item (b)(ii);

iv. A discussion of the strategies and action plans, including costs, to implement such methods as necessary to enhance the generation flexibility and fuel-efficiency of the generation mix on the HECO power supply system and to otherwise enable HECO to accommodate higher-amounts of lower-cost energy supplies, or a detailed explanation of why such actions are not feasible; and

c. A ***Must-Run Generation Reduction Plan*** to reduce or eliminate the must-run designation and operation of generating units on HECO's power supply system and enable HECO to accept additional lower-cost energy resources and maintain system reliability. The Must-Run Generation Reduction Plan shall, at a minimum, provide the following:

i. An analysis of the costs of HECO's current must-run designation policies, including the costs of providing ancillary services required for system reliability, and the potential economic savings of implementing such methods to reduce minimum plant generation levels of HECO and IPP generating units;

ii. An analysis of methods by which wind, solar and other renewable energy generators may be utilized to supply ancillary services in lieu of utilizing must-run generation to supply these services, and the potential economic savings of implementing such methods;

iii. An analysis of how to utilize demand response programs and energy storage technologies to reduce the need for on-line, must-run fossil generation and

to provide operating reserves and other ancillary services;

iv. Analysis of how system stability will be maintained and enhanced to reduce the number of Oahu UFLS events, with future substantial amounts of electronically-coupled renewable energy resources;

v. A discussion of the strategies and action plans, including costs, benefits and timelines, to implement such methods as necessary to reduce or eliminate must-run designation and operation of generating units on HECO's power supply system and to otherwise enable HECO to accommodate higher-amounts of lower-cost energy supplies, or a detailed explanation of why such actions are not feasible; and

d. An ***Environmental Compliance Plan*** to meet expected and possible changes in environmental regulations, including Section 111-D and Hawaii Green House Gas (GHG) requirements, in a least-cost manner. The Environmental Compliance Plan shall, at a minimum, provide the following:

i. An analysis of the fuel, operation and maintenance and capital costs of fuel switching from LSFO to

ULSD, and the resulting reductions in generating unit and system emission levels;

ii. An analysis of the fuel, operation and maintenance and capital costs of fuel switching from LSFO to natural gas, and the resulting reductions in generating unit and system emission levels;

iii. An analysis of which existing utility and non-utility fossil generating units should be candidates for fuel switching versus replacement with new, quick-start, flexible, fuel-efficient generators;

iv. A discussion of the strategies and action plans, including schedule, to modify existing fuel supply portfolio and delivery infrastructure for existing utility and non-utility fossil generating units, including costs and benefits of such plans, or a detailed explanation of why such actions are not feasible; and,

e. A ***Key Generator Utilization Plan*** to address unique economic and operational challenges for key Oahu generating units to ascertain whether these units should be retired, generating unit or contract life extended,

or operations altered, to ensure these units create benefits for Oahu's ratepayers, to the extent these challenges are not addressed elsewhere in the PSIP. The Key Generator Utilization Plan shall, at a minimum, address the following units:

i. AES coal plant -- provides significant annual fuel cost savings for Oahu ratepayers yet creates potential reliability challenges due to the size of generator unit capacity compared to total system load. What are the appropriate future operational strategies to maximize energy cost savings for ratepayers while accommodating reliably a large portfolio of mostly variable renewable energy?

ii. Kalaeloa Energy Partners dual-train combined cycle plant -- represents the most fuel-efficient, flexible existing base load generation on Oahu. What is the appropriate fuel supply for these units, and who should be responsible for new fuel supply infrastructure implementation? How should future plant operations be structured; is it primarily to focus on operational flexibility, or low-cost base load duty, or perhaps some combination thereof?

iii. CT-1 generating plant -- represents the highest cost generator on Oahu due to, among other factors, its high cost of fuel. What is the most appropriate fuel supply and future operating role (i.e., peaking, cycling, etc.) in order to achieve the highest and best use of CT-1 generating unit for ratepayers, besides converting plant to a combined cycle operation?

iv. Kahe Units 5 and 6 -- represent nominal 135 MW, relatively in-flexible base load units that create potential large contingency event reliability risks (second highest on Oahu), but do not appear to provide any offsetting economic or operational benefits as compared to the Kahe and Waiau nominal 80 MW base load generators. Should Kahe Units 5 and 6 be retired, and further, be replaced with new quick-start, flexible, fuel-efficient generators? If not, provide a detailed explanation of why such actions are not appropriate.

f. An ***Optimal Renewable Energy Portfolio Plan*** to identify the key technical, economic and geographic location parameters that delineate the optimal, least-cost,

diverse portfolio of renewable energy resources. The Optimal Portfolio Plan shall, at a minimum, analyze the following:

i. Appropriate mix of variable and firm renewable energy resources;

ii. Appropriate mix of solar PV resources versus other, higher capacity factor renewable energy resources;

iii. Appropriate geographic location considerations, including on and off-island resources, to harness world-class renewable energy regimes but balanced against grid interconnection costs, capture meteorological diversity benefits and diversify project locations to minimize local community impacts;

iv. Costs and technical challenges, including reserve margins, ancillary services and generation unit upgrades or replacements required, to integrate different levels, mixes and locations of renewable energy technologies;

v. Cost and ratepayer impacts that result from full attainment of renewable energy portfolio standards (RPS) and also include a comparison of full

attainment of the RPS with various levels of exceeding the RPS; and

g. A ***Generation Commitment and Economic Dispatch Review*** to ensure that existing generation resource allocation policies and practices yield the most fuel-efficient and cost-effective outcome given HECO's potential evolving portfolio of power supply resources. The Generation Commitment and Economic Dispatch Review shall, at a minimum:

i. Demonstrate that HECO's current unit commitment and economic dispatch policies and operational practices ensure that total fuel expense and purchased energy costs are and will continue to be minimized in the future;

ii. Demonstrate that HECO's current policies and operational practices by which supply resources are selected to provide ancillary services and operating reserves ensure that the combined total cost of generating electricity and providing ancillary services are and will continue to be minimized collectively in the future (i.e., co-optimization of energy and ancillary service dispatch);

iii. Demonstrate that HECO's current unit commitment and economic dispatch policies and operational practices do not accord preferential treatment to HECO's generating units as compared to similarly situated IPP generating units or otherwise provide preferential treatment among or between similarly situated IPPs;

iv. Describe the process by which HECO ensures that the economic dispatch formula and performance parameters for each HECO and IPP generating unit accurately reflects the actual technical and operating characteristics of the respective generating units, including fuel supply costs;

v. Describe the methodology by which HECO forecasts the supply of as available solar and wind renewable energy resources and how these forecasts are then incorporated into its generation unit commitment and economic dispatch processes;

vi. Describe the methodology by which HECO incorporates energy storage or demand response resources into its generation commitment and economic dispatch process;

vii. Identify whether HECO's current unit commitment and economic dispatch policies and operational practices explicitly, or implicitly, favor specific generation technologies or resources or PPA pricing structures;

viii. Identify any potential technical, economic, contractual or regulatory policies that could constrain or otherwise preclude the optimal unit commitment and economic dispatch of fossil and renewable generation resources on the HECO power supply system;

ix. Identify ways in which HECO could provide visibility and transparency regarding its generation commitment and economic dispatch process for the purpose of providing greater public confidence that the process minimizes energy costs, maximizes renewable energy generation, and dispatches both utility and IPP generation in a non-preferential and non-discriminatory manner.[125]

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[125]The commission acknowledges the HECO Companies' recent rollout of their "Renewable Watch" websites. The HECO Companies are encouraged to examine mainland RTO/ISO websites to benchmark the type of system operational information that is publicly available, and the frequency of information updating, for potential inclusion in the Renewable Watch websites.

The commission concludes that HECO has the responsibility to make major changes to its existing fossil generation portfolio, its demand response portfolio and its current power supply operational practices in order to accommodate large amounts of variable renewable energy, reduce power supply costs and to provide significant customer rate relief. The commission expects HECO to utilize the PSIP process as an opportunity to re-examine its existing fossil generation portfolio, demand response program and current power supply operational practices in order to develop actionable strategies and implementation plans to expeditiously retire older, less-efficient fossil generation, reduce must-run generation, increase generation flexibility, and adopt new technologies such as demand response for ancillary services and energy storage and institute operational practice changes, as appropriate to enable integration of a diverse portfolio of additional low cost renewable energy resources.

In preparing the PSIP, HECO should focus on formulating well-reasoned strategies and resulting action plans that can be implemented expeditiously, and that are supported by analyses as appropriate. The commission is interested in a PSIP submission that contains improvement strategies and action plans. The commission further directs HECO to include as part of the PSIP appropriate reliability analyses and studies to demonstrate that the Oahu grid

may be operated reliably with substantial quantities of variable renewable energy resources.

iv.

KIUC

KIUC will have substantial utility-scale and distributed solar PV capacity in operation by 2015 such that it is likely that at least 50%, if not substantially more, of the day-time system load will be supplied by solar PV resources. This level of solar PV penetration has system operation and reliability implications that are not well understood.[126] However, the commission observes that there are several important differences regarding the KIUC electric grid, which should make the integration of large amounts of solar PV less, but nevertheless, challenging on Kauai, than would be the case with the Oahu grid.

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[126]See KIUC Energy Storage/Dispatchable Renewable Energy Request for Proposal, dated March 3, 2014, at 4 ("Following commercial operation of the second project, Kauai will be getting over 16% of its annual electricity from solar, with 80-95% of the daytime demand provided by solar during periods of clear sun. This will create a significant challenge: maximizing the contribution of low-cost solar, maintaining the ability to take output from existing energy-only renewable energy PPAs, and keeping the absolute minimum conventional generation online in order to maintain grid reliability, specifically frequency control.").

1. KIUC's existing fossil generation fleet has a greater amount of diesel generation that is inherently more flexible than the fossil steam generation that currently exists on Oahu.

2. Utility-scale projects constitute the majority of the solar PV portfolio on Kauai, which enable real-time output visibility and control by KIUC, as compared to the majority of solar PV on Oahu, which will be distributed generation, and not visible to or controlled by HECO.

3. KIUC has embraced use of battery energy storage systems to provide system frequency control and other grid support service to enhance system dynamic stability whereas HECO has yet to do so.[127] The commission also observes that KIUC is contemplating installation of additional energy storage systems.[128]

4. KIUC has greater real-time visibility of its electric grid through widespread use of SCADA at the distribution system level, and the recent implementation of smart meters, than is the case on Oahu.

The commission appreciates the leadership KIUC has demonstrated in aggressively moving forward with integrating high

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[127]See e.g., Docket No. 2010-0179, Decision and Order issued on March 3, 2011; Docket No. 2010-0307, Decision and Order issued on July 7, 2011; Docket No. 2008-0167, Decision and Order issued on October 31, 2008; Docket No. 2011-0180, Decision and Order issued on March 16, 2012.

[128]See KIUC Energy Storage/Dispatchable Renewable Energy Request For Proposal, dated March 3, 2014.

penetrations of cost-effective solar PV resources onto the Kauai grid. The commission instructs KIUC to submit reliability studies and analyses that have, or will be conducted, regarding the reliability, curtailment and operational issues associated with high penetration of solar PV.

V.

Further Action

As a consequence of the issues discussed above, the commission:

1. Directs the HECO Companies to develop and file a plan to utilize energy storage resources on the islands of Oahu, Hawaii and Molokai to address steady state frequency control and dynamic stability requirements discussed above, as well as mitigate other renewable energy integration challenges. The plan should also include details as to how MECO could better utilize existing storage systems on the Lanai and Maui grids to improve system reliability and/or reduce system operation costs. These plans should be included as part of the HECO Companies' respective PSIPs.

2. Directs MECO to provide the commission, within 30 days, with a report which examines the 2013 - 2014 customer outages on Molokai, including the underlying cause or causes of the outages, an assessment of the current dynamic stability of the Molokai electric grid to respond to distribution system faults and other

grid contingency events, and MECO's action plans to promptly restore reliability to previous levels. The report should also examine what effect any changes in the Molokai electrical system, including generation operations and electrical protection schemes, may have had to potentially exacerbate the number of affected customers and/or outage durations. As part of this submission, MECO shall provide technical support, including descriptions of mitigation measures utilized, to enable continued additional interconnection of customer solar PV systems on the Molokai grid, prior to the HNEI BESS being placed into service, without substantially compromising reliability, or resulting in unreasonable costs to ratepayers.[129]

D.

Demand Response

The DSO Subgroup produced a white paper titled "Demand Response as a Flexible Operating Resource" ("DR Paper"), which discussed "the opportunity for Hawai'i's utilities to obtain additional operating flexibility via the use of flexible

[129]These costs could be in the form of damage to customers' electrical equipment and appliances. See recent public statements from the Consumer Advocate accessible at *http://khon2.com/2014/03/19/state-investigates-illegal-photovoltaic-systems/* ("Your electronic equipment in your household can be burnt out and we're seeing some of that already on Molokai…").

demand-side programs."[130] The DR Paper provides a comprehensive discussion on DR, including the prerequisites for DR programs, the implementation of DR, customer-side implementation of DR, the use of DR and storage to provide ancillary services, DR business model options, and the status of demand-side initiatives in the HECO Companies' systems.

The TRC summarized several important observations made by the DSO Subgroup in the DR Paper:

- There have been no load research studies performed in some time that would help determine the types and levels of penetrations of particular end-use loads that would be candidates for demand response.

- HECO is working with the Commission's Public Benefits Fund Administrator (PBFA) evaluation consultant to conduct surveys to obtain end-use data that will be used for both energy efficiency and demand response potential studies.

- Most of the current demand response programs are limited to addressing immediate energy delivery problems, are concentrated on Oahu with one pilot program at MECO. There are no demand response programs in the HELCO service area at the present time.

- The [GE Study] clearly identifies demand response and energy storage as potential resources for providing certain ancillary services.

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[130] See Attachment 3d to IF's Final Report, at 1.

- The time to market for additional demand response programs is projected to be lengthy, likely in two years given the end use studies underway and the anticipated evaluations and program design timeframe needed for implementation.

- There are opportunities in the near-term within the HECO companies that deserve to be developed and exploited that could provide meaningful capacity, energy and ancillary service resources.

- The Commission should consider allowing the HECO companies and end users and possibly curtailment service providers (demand-side aggregators) to explore and develop demand response programs that can be implemented in the near-term.[131]

The TRC concurred with the findings of the DR Paper. In so doing, the TRC stated: "The TRC wishes to stress that demand resources, both energy efficiency and demand response, must be a core strategy in addressing both renewable energy integration and electricity reliability."[132] The commission wholly agrees, and believes that increased utilization of demand resources must be an imperative moving forward and views this area as a priority. Accordingly, the commission provides a full discussion of its observations and directives regarding demand response policies and implementation in Order No. 32054 in Docket No. 2007-0341.

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[131]TRC's Report at 46-47.

[132]Id. at 47-48.

E.

HERA

In 2012, the Hawaii State Legislature passed Act 166, Session Laws of Hawaii 2012, now codified as HRS §§ 269-141 - 269-149 ("HERA Law"), which authorizes the commission to perform various electric system reliability oversight functions, including, but not limited to:

- Adopting, by rule or order, reliability standards and interconnection requirements (HRS § 269-142(a));
- Monitoring the reliability and operation of the Hawaii electric system (HRS § 269-143(a));
- Taking all necessary steps to ensure that any electric utility, user, owner, or operator of the Hawaii electric system, or any other person, business, or entity connecting to the Hawaii electric system is in compliance with all adopted reliability standards and interconnection requirements (HRS § 269-144(a));
- Contracting for the performance of the commission's functions under Act 166 with a person, business, or organization to serve as the Hawaii electricity reliability administrator or "HERA" (HRS § 269-147(a)).

In the commission's view, several important components of the RSWG's work product are closely linked to HERA. As the most prominent example, the reliability standards developed by the RSDG, once finally approved, will likely transfer to HERA for implementation. The RSDG was mindful of this nexus and developed

a host of HERA-related proposals that were included in RSDG's Final Report.[133] The commission acknowledges the RSDG's effort, foresight, and attention to detail on these proposals. However, given the broad authority and discretion granted to the commission in the HERA Law, the commission decided to initiate its own framework addressing the purpose, scope, and organizational structure of HERA ("HERA Framework"), which is under development.

The commission intends to open a new HERA docket and propose the HERA Framework in that proceeding as a starting point to establish the issues for the docket and receive stakeholder input. In normal course, pursuant to the commission's rules of practice and procedure, interested parties will have the opportunity to intervene or participate in the new HERA proceeding. The creation of additional reliability and interconnection standards and implementation of related studies, as discussed more fully in the subsections below, will also occur under HERA's oversight.

The commission recognizes that the development of HERA will require time to conduct the aforementioned HERA proceeding, to retain a potential contractor to perform HERA functions and secure a source of funding for HERA. In the interim, the commission

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[133]See Attachments 2c-1, 2c-2, 2c-3, and 2c-4 to IF's Final Report.

will continue to effectively serve as HERA, until formally established. The commission's consultant for the RSWG process will continue to support the commission on reliability, interconnection and system operational issues.

1.

Baseline Reliability Assessment and Reliability Adequacy Studies

The commission believes that it is appropriate to conduct studies related to defining what constitutes adequate levels of reliability for each of Hawaii's electrical grids. These studies include a baseline reliability assessment (Baseline Study) to evaluate current reliability trends, technical challenges and economic costs to provide reliable electric service and based upon these assessments, define the characteristics, and associated metrics, that define what constitutes adequate levels of reliability for each island electric grid (Reliability Definitions Study). The commission believes these studies are an essential follow-on to the RSWG's work, and that they will inform the development of future reliability standards and assessments.

With respect to the Baseline Study, the commission will hire a contractor who can design and conduct reliability assessments for each of Hawaii's electrical systems, including KIUC's, establishing a snapshot view of the current state of Hawaii electric

system reliability and a methodology for future reliability assessments. Performing reliability assessments will require an understanding of, and sensitivity to, the requirements of each of Hawaii's different island systems in terms of technology, operations, regulation, and underlying customer and utility concerns. The commission envisions the evaluation of electric system reliability in Hawaii to focus on the economic considerations of customers and utilities to a greater extent than currently afforded in electric system reliability oversight throughout North America. The existing monthly reliability status reports that are filed by the HECO Companies are anticipated to serve as resources for developing Hawaii-specific reliability assessments and associated reports.

Using the information obtained from the various island-specific baseline reliability assessments, a contractor will perform a Reliability Definitions Study, focused on the development of a set of definitions, including metrics, for what constitutes "adequate levels of reliability" in relation to each of Hawaii's grids. As the technology and priorities of utilities and customers may differ significantly from island to island, the creation of this set of definitions will assist the commission in developing and adopting a proper set of Hawaii-specific electric reliability standards, interconnection requirements, and any other

reliability-specific processes and procedures. Taking into consideration the availability of resources and time necessary to carry out these studies, it is anticipated that all or some of these studies will commence sometime in the next fiscal year.

2.

Large Generator Performance Requirements

The commission directed the RSWG to "develop proposed interconnection requirements for utility-scale wind and utility-scale solar generators, using reports and summaries that have already been prepared by NERC and others, and Hawaii's best generator performance requirements imposed to-date as a starting point."[134] The commission continues to be concerned that there is a lack of state-of-art, uniform generator performance requirements for interconnecting utility-scale generation projects in Hawaii. The commission believes such requirements are necessary in order to maximize the amount of variable renewable energy resources that may be accommodated on each island grid.

The RSDG attempted to develop standardized large generator interconnection requirements for Hawaii. The RSDG's Final Report explained that the chair of the RSDG undertook an

[134]See Order No. 30371 issued May 4, 2012 in Docket No. 2011-0206, at 8.

effort to coordinate with HECO to draft a representative Generator Interconnection Procedure (GIP) that could be extended to all of the HECO Companies involving interconnection to the sub-transmission and transmission systems.[135] The proposed procedure was summarized in Appendix E attached to the RSDG's Final Report.[136] Regarding Appendix E, the TRC noted, "[w]hile not completed, the subgroup report and accompanying appendix provide a basis from which to continue development of this standard."[137] The HECO Companies filed comments in response to Appendix E,[138] and further proposed a work plan to develop a complete GIP over several months.

The commission is grateful for the efforts of the RSDG in starting the process of developing GIP for large generators (i.e., those connecting to the sub-transmission and transmission systems). The RSDG proposed GIP was modeled after FERC's pro forma Large Generator Interconnection Procedure (LGIP).[139] The FERC LGIP governs the procedures by which a request for interconnection by a

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[135]See RSDG's Final Report, Attachment 2a-1 to IF's Final Report, at 5.

[136]See Hawaiian Electric Company, Inc. Generator Interconnection Procedures - Interconnection Requirements Study Process, Attachment 4a-1 to IF's Final Report.

[137]TRC's Report at 41.

[138]See Attachment 4a-2 to IF's Final Report.

[139]See RSDG's Final Report, Attachment 2a-1 to IF's Final Report, at 5.

utility-scale generator must be processed by an electric utility. The FERC LGIP is different from NERC's "model" generator performance requirements for variable generators which sets forth technical parameters and requirements that a variable generator should be capable of performing, in order to minimize adverse consequences to grid reliability, when variable wind and solar PV resources replace conventional firm dispatchable generation. The commission believes a higher priority should be accorded to developing generator performance requirements for variable resource generators and new, flexible conventional generators.

With respect to GIP, the commission agrees that much can and should be done to improve the HECO Companies' interconnection processes. In this regard, the commission has recently provided specific guidance to the HECO Companies on ways to streamline, reduce costs and otherwise improve its interconnection process for utility-scale projects.[140] The commission believes that this is an important work task that should, once completed, contribute significantly toward simplifying interconnections of utility-scale generation, and therefore directs the HECO Companies to continue to work with members of the RSWG and other interested stakeholders to develop a GIP for Hawaii.

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[140]See Order No. 31354, filed July 11, 2013 in Docket No. 2011-0225; Decision and Order No. 31913, issued Feb. 13, 2014 in Docket No. 2013-0156.

The commission further instructs the HECO Companies to work with members of the RSWG and other interested stakeholders to develop generator performance standards for utility-scale projects that reflect state-of-art requirements from NERC Interconnection Requirements for Variable Generation and other similar industry generator performance requirements, modified, as appropriate, for Hawaii. The process for inviting input from stakeholders on the HECO Companies' draft utility-scale generator performance requirements, GIP and possibly a proposed Generator Interconnection Agreement ("GIA") will be established at a later time.

3.

Ancillary Services

The subject of ancillary services[141] was an important piece of the RSWG's evaluative work, and the principal RSWG-related product on this subject was the GE Study. As described by the IF:

> Thanks to financial support and contract management from [HNEI], the RSWG was able to secure consulting services from [GE] to prepare a report that defines all ancillary services in performance-based,

[141]FERC defines "ancillary services" as "those functions performed by the equipment and people that generate, control, transmit, and distribute electricity to support the basic services of generating capacity, energy supply, and power delivery. They are required to maintain reliable operations of the electric power system." GE Study (Part I), Attachment 3c-1 to IF's Final Report, at 7.

> technology-neutral terms, lays out a method and process for determining the amounts of each ancillary service needed for a given mix of generation, and offers suggestions on how to acquire an economical portfolio of ancillary services. The [RDM] subgroup provided review and guidance for this effort and the [GE] team gave several detailed briefings to the full RSWG and the subgroup.[142]

The IF filed the GE Study as an "RSWG-associated work product." The HECO Companies and the RDM Subgroup filed comments on the GE Study.[143] The GE Study produced various definitions of ancillary services related to integration of new generation resources, and acknowledged that the definitions may have to be updated to be consistent with Hawaii practices and scenarios.[144] The MLC Subgroup offered various recommendations regarding ancillary services, but further analysis and evaluation needs to be conducted before a decision is made as to implementation of the MLC recommendations.

The commission intends to address the important issue of ancillary services in several ways. First, each of the HECO Companies has been directed to prepare and file Power Supply Improvement Plans (PSIP). The relevant parts of these Plans regarding ancillary services include those set forth below:

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[142]IF's Final Report at 16.

[143]See Attachments 3c-4 and 3c-5 to the IF's Final Report.

[144]See Ancillary Services Definitions and Capability Study dated December 19, 2012.

c. A **Must Run Generation Reduction Plan** to reduce or eliminate the must-run designation and operation of generating units on HELCO's power supply system and enable HELCO to accept additional lower-cost energy resources. The Must-Run Generation Reduction Plan shall, at a minimum, provide the following:

ii. An analysis of methods by which non-dispatchable renewable energy generators may be utilized to supply ancillary services in lieu of utilizing must-run generation to supply these services;

iii. An analysis of how to utilize demand response programs and energy storage technologies to reduce the need for on-line, must-run fossil generation and to provide operating reserves and other ancillary services;

d. A **Generation Commitment and Economic Dispatch Review** to ensure that existing generation resource allocation policies and practices yield the most fuel-efficient and cost-effective outcome given HELCO's rapidly changing portfolio of power supply resources. The Generation Commitment and Economic Dispatch Review shall, at a minimum:

ii. Demonstrate that HELCO's current policies and operational practices by which supply resources are selected to provide ancillary services and operating reserves ensure that the combined total cost of generating electricity and providing ancillary services are and will continue to be minimized collectively in the future (i.e., co-optimization of energy and ancillary service dispatch);[145]

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[145]See Decision and Order No. 31758 in Docket No. 2012-0212, issued Dec 20, 2013 at 115-117.

The commission intends to consolidate the three PSIPs into a single docket to better facilitate stakeholder input on these plans and review by commission's consultant.

Second, depending upon the outcome of the PSIP review, the commission may initiate a follow-up initiative with GE, through HNEI, regarding their "RSWG associated product" ancillary services study to examine the amounts of ancillary services required for each island grid, as well as quantify the costs associated with providing those services.

While several RSWG Parties recommended that the commission open a new docket to further study ancillary services, the commission has decided to address ancillary services as part of HECO Companies' PSIPs to be conducted in a separate docket. If necessary, the commission may also review some of the findings on ancillary services through follow-up studies with GE and HNEI.

4.

Reliability and System Operation Data Reporting

The commission directs the HECO Companies to modify the current monthly reliability reports that provide frequency control performance and contingency resource utilization information to also include additional reliability data for generation, transmission, subtransmission and distribution systems. The commission also directs the HECO Companies to identify other

potential reliability, curtailment and system operational data, currently being submitted periodically to the commission, that could be consolidated into the monthly reliability report so that all related technical information is readily accessible in a single document and filing.

KIUC is also directed to submit periodic reliability reports. The HECO Companies and KIUC are instructed to work with commission staff to identify the data to be reported, and the frequency of reporting.

III.

Orders

THE COMMISSION ORDERS:

1. The rulings and findings set forth herein regarding the final work product of the RSWG filed by the IF on March 25, 2013 are adopted as of the date set forth below.

2. Each of the HECO Companies shall undertake the actions and provide to the commission the written submissions as directed herein, together with all relevant supporting analyses, studies and other documents, and within the respective deadlines set forth in this Order.

3. KIUC shall undertake the actions and provide to the commission the written submissions as directed herein, together with all relevant supporting analyses, studies and other documents, and within the respective deadlines set forth in this Order.

4. The PV-DG Subgroup shall file a Stipulation in this docket that sets forth any and all areas of agreement they can reach on their work products, within thirty (30) days of the date of this Order. Other members of the RSWG (who are not members of the PV-DG Subgroup) may have fifteen (15) days after the Stipulation is filed to file comments on the Stipulation.

DONE at Honolulu, Hawaii APR 2 8 2014.

PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

By Hermina Morita
Hermina Morita, Chair

By Michael E. Champley
Michael E. Champley, Commissioner

By Lorraine H. Akiba
Lorraine H. Akiba, Commissioner

APPROVED AS TO FORM:

Shohei Nishimoto
Commission Counsel

2011-0206.rs

CERTIFICATE OF SERVICE

The foregoing order was served on the date of filing by mail, postage prepaid, and properly addressed to the following parties:

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