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JOSEPH P. VIOLA
Vice President
Regulatory Affairs

January 29, 2016

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PUBLIC UTILITIES
COMMISSION

The Honorable Chair and Members of the
Hawai'i Public Utilities Commission
465 South King Street
Kekuanaoa Building, Room 103
Honolulu, Hawai'i 96813

Dear Commissioners:

Subject: Adequacy of Supply ("AOS")
Hawaiian Electric Company, Inc. ("Hawaiian Electric" or "Company")

The following information is respectfully submitted in accordance with paragraph 5.3a. of General Order No. 7 which states:

> *The generation capacity of the utility's plant, supplemented by electric power regularly available from other sources, must be sufficiently large to meet all reasonably expectable demands for service and provide a reasonable reserve for emergencies. A Statement shall be filed annually with the Commission within 30 days after the close of the year indicating the adequacy of such capacity and the method used to determine the required reserve capacity which forms the basis for future requirements in generation, transmission, and distribution plant expansion programs required under Rule 2.3h.1.*

2016 Adequacy of Supply Report Summary

- Hawaiian Electric's AOS is based on the Company's May 2015 Sales and Peak Forecast and other key assumptions.

- Hawaiian Electric's reserve capacity, which does not include intermittent energy sources such as wind and solar, may not be sufficient to meet the Company's generating system reliability guideline of 4.5 years per day in 2018 and beyond, assuming Waiau Units 3 and 4 are deactivated at the end of 2017 and the Schofield Generating Station is in service from 2018.

- Hawaiian Electric may seek to mitigate reserve capacity shortfalls in 2018 and beyond by deferring future deactivation of units, implementing additional Demand Response Programs, optimizing maintenance schedules, reactivating units that are currently deactivated (i.e., Honolulu Units 8 and 9), installing temporary distributed generation, increasing the capacity of existing utility or non-utility units, or acquiring additional firm capacity.

- The adjusted peak load experienced on Oahu in 2015 was 1,232 MW net, and was served by Hawaiian Electric's total capability of 1,671 MW net, including firm power purchases. This represents a reserve margin of approximately 38% over the 2015 adjusted system net peak. This reserve margin did not include the capacity of Honolulu Units 8 and 9, which were deactivated in January 2014.
- Honolulu Units 8 and 9 (with a combined rating of 107.3 MW net) were deactivated on January 31, 2014. The 2016 AOS reference scenario reflects the Honolulu generating units remaining deactivated, and their capacities are not included in the reserve margin calculations.
- Waiau Units 3 and 4 (with a combined rating of 92.6 MW-net) are also candidates for deactivation. The 2016 AOS reference scenario reflects these units being deactivated at the end of 2017.
- Hawaiian Electric is anticipating the addition of approximately 50 MW of utility-owned and operated, firm, dispatchable, generation on federal lands, for the purpose of improving energy security and resiliency for the Hawaiian Electric grid and for the Army facilities in central Oahu, as well as enabling the integration of more variable generation renewable resources. It is estimated that the security project, i.e., the Schofield Generating Station Project, may be in service in the 2018 timeframe and is included in the 2016 AOS reference scenario. Hawaiian Electric anticipates that the acquisition of new firm generation capacity in 2018 may help to alleviate a portion of the projected reserve capacity shortfall in that year and beyond.

1. Peak Demand and System Capability in 2015

The adjusted peak load experienced on Oahu in 2015 was 1,232 MW net, and was served by Hawaiian Electric's total capability of 1,671 MW net, including firm power purchases. This represents a reserve margin of approximately 38%[1] over the 2015 adjusted system net peak. This reserve margin did not include the capacity of Honolulu Units 8 and 9, which were deactivated in January 2014.

The system peak occurred on Thursday, September 10, 2015 at approximately 7:22 pm, and was 1,206 MW-net based on net Hawaiian Electric generation, net purchased power generation, the peak reduction benefits of energy efficiency demand-side management programs,

[1] The total capability value used in the calculation of this reserve margin does not account for units not available due to maintenance outages, forced outages or derates in unit capacities. The reserve margin calculation takes into account the approximately 26 MW of interruptible load that may be available at system peak. In actual real-time operations, reserves may be reduced due to maintenance, forced outages or deratings.

and with several co-generators[2] operating at the time. Had these cogenerating units not been operating, the 2015 system peak would have been approximately 1,232 MW-net.

Hawaiian Electric's 2015 total generating capability of 1,671 MW-net includes 456.5 MW-net of firm power purchased from (1) Kalaeloa Partners, L.P. ("Kalaeloa"), (2) AES Hawaii, Inc. ("AES"), and (3) H-POWER.[3]

At times during 2015, Hawaiian Electric received energy from seven variable generation energy producers (i.e., Chevron, Hawaii Independent Energy, Kahuku Wind Power, Kapolei Sustainable Energy Park, Kawailoa Wind, Kalaeloa Solar Two, Kalaeloa Renewable Energy Park). Since these contracts are not for firm capacity, they are not reflected in Hawaiian Electric's total firm generating capability.

2. Estimated Reserve Margins

Appendix 1 shows the forecasted reserve margin over the next five years, 2016-2020, based on Hawaiian Electric's May 2015 Sales and Peak Forecast, and includes estimated energy efficiency impacts and load management impacts.

3. Criteria to Evaluate Hawaiian Electric's Adequacy of Supply

Hawaiian Electric's capacity planning criteria are applied to determine the adequacy of supply and whether or not there is enough generating capacity on the system. Hawaiian Electric's capacity planning criteria take into account that Hawaiian Electric must provide for its own backup generation since, as an island utility, it cannot import emergency power from a neighboring utility. Hawaiian Electric's capacity planning criteria are described in Section 3.1.

The results of the annual analysis of the adequacy of supply on the Hawaiian Electric system are a function of a number of forecasts, such as:

- peak demand, including the forecasted peak reduction benefits of (a) energy efficiency demand-side management ("DSM") programs, and (b) customer-sited-photovoltaic ("PV") with battery installations; [§4.1]
- peak reduction benefits of existing load control programs; [§4.2]

[2] At the time of the peak, certain units at Hawaii Independent Energy, Chevron, and Pearl Harbor were generating about 26 MW of power for use at their sites.

[3] On May 25, 2012 in Docket No. 2012-0129, Hawaiian Electric submitted an application for approval of an Amended and Restated Power Purchase Agreement ("PPA") with the City & County of Honolulu to purchase up to an additional 27 MW of power from an expansion of the existing waste-to-energy facility. On November 15, 2012, Hawaiian Electric filed Amendment No. 1 to the PPA. On January 17, 2013 in Decision and Order ("D&O") No. 30950, the Commission approved the PPA as Amended. On July 5, 2013, the demonstrated firm capacity provided by H-POWER in accordance with the PPA was 68.5 MW.

- Equivalent Forced Outage Rate Demand ("EFORd") on the generating units; [§4.3]
- planned maintenance schedules for the generating units on the system; [§4.4]
- additions of firm generating capacity; [§4.5] and
- reductions of firm generating capacity. [§4.6]

Each of the current assumptions for these and other factors is discussed in Section 4. As with all forecasts, these elements are subject to uncertainties. Therefore, a range of scenarios was considered in the analysis.

3.1 Hawaiian Electric's Capacity Planning Criteria

Hawaiian Electric's capacity planning criteria consist of one rule and one reliability guideline. The reserve capacity shortfalls calculated herein are determined by the application of the reliability guideline based on various key inputs such as the EFORd's of each generating unit, the load to be served, the amount of capacity on the system, and the availability of the generating units.

3.1.1 Hawaiian Electric's Capacity Planning Rule

Rule 1:

The total capability of the system must at all times be equal to or greater than the summation of the following:

a. the capacity needed to serve the estimated system peak load, less the total amount of interruptible loads;

b. the capacity of the unit scheduled for maintenance; and

c. the capacity that would be lost by the forced outage of the largest unit in service.

Reserve Margin:

In Hawaiian Electric's Power Supply Plan filed on August 26, 2014, a proposed Reserve Margin guideline of 30 (thirty) percent was used for capacity planning analysis. Consideration will be given to maintaining a reserve margin of approximately 30 percent based on Reserve Ratings.

Rule 1 includes load reduction benefits from interruptible load customers. Because Hawaiian Electric will not build reserve capacity to serve interruptible loads, interruptible load programs such as Hawaiian Electric's current Rider I and load management programs can have the effect of deferring the need for additional firm capacity generation.

Rule 1 and Reserve Margin are deterministic in nature, meaning that the adequacy of supply can be determined through simple additions or subtractions of capacity without regard to the probability that the capacity will be available at any given time. For example, to determine whether or not Rule 1 would be satisfied at a given point in time, one would take the total capacity of the system in MW, subtract the capacity of the unit or units that are unavailable due to planned maintenance, subtract the capacity of the largest available unit, and determine whether the result is greater than or less than the system peak that has been reduced by the total amount of interruptible loads that would be available for interruption at that time. If the result is greater than the system peak, Rule 1 would be satisfied and no additional firm capacity would be needed. If the result is less than the system peak, Rule 1 would not be satisfied and additional firm capacity would be needed. The likelihood (or probability) that the largest unit will be lost from service during the peak is not a factor in the application of this rule.

The Reserve Margin guideline is also a deterministic calculation. To determine whether or not the Reserve Margin consideration would be satisfied at a given point in time, one would take the total capacity of the system in MW less the estimated system peak after reduction by interruptible loads that would be available for interruption at that time, then divide it by the system peak less the total amount of interruptible load. This calculation will determine whether the result is greater than or less than 30 percent. If the result is greater than 30 percent, the Reserve Margin consideration would be satisfied and no additional firm capacity would be needed. If the result is less than 30 percent, additional firm capacity would be needed.

3.1.2 Hawaiian Electric's Reliability Guideline: Loss of Load Probability

The application of Hawaiian Electric's generating system reliability guideline does take into account the Loss of Load Probability ("LOLP") that generating units could be unexpectedly lost from service.

Reliability Guideline:

> *"Capacity planning analysis will include a calculation of risk (Loss of Load Probability) in years per day for each year of each plan of the long-range expansion study. In cases where risk is calculated to be less than 4.5 years per day, the plan will be reviewed by the Vice President of Power Supply, Senior Vice President of Operations, and the President for approval of use of the plan in the study."*

In order to determine whether there is enough capacity on the system to account for the probability that multiple units may be unexpectedly lost from service, the result of an LOLP calculation must be compared against Hawaiian Electric's generating system reliability guideline.

Hawaiian Electric has a reliability guideline threshold of 4.5 years per day. Hawaiian Electric plans to have sufficient generating capacity to maintain generating system reliability above 4.5 years per day. There should be enough generating capacity on the system such that the expectation of not being able to satisfy demand due to insufficient generation occurs no more than once every 4.5 years. Values less than 4.5 years per day indicate lower levels of reliability and an increased likelihood of generation-related customer outages.

The output from variable generation renewable resources such as wind or PV cannot be dispatched to provide a specified level of power upon demand to serve the peak load. Therefore, determining their capacity value (that is, the variable resource's ability to replace firm generation) with a high level of confidence is a considerable challenge. Notwithstanding this uncertainty, estimated capacity values of variable generation and demand response resources are reflected in the LOLP calculations towards meeting customer electricity demand.

One potential means to address the planning uncertainty and complexity would be to revise the capacity planning guideline. If the existing Loss of Load Probability of 4.5 years per day does not provide an adequate cushion to respond to quickly-changing parameters, such as changes in peak demand and individual unit availability factors, many of which may change rapidly from year to year, then the utility could plan for a higher reliability standard similar to that of many mainland utilities. Such an approach would not eliminate quickly-changing parameters, but it would add a measure of conservatism in recognition that the uncertainties undoubtedly exist.

In its direct testimony for the Campbell Industrial Park Generating Station and Transmission Additions Project (Docket No. 05-0145), filed on August 17, 2006, the Consumer Advocate stated:

> [HECO's reliability guideline] is less stringent than the guidelines used by mainland utilities. As will be addressed later in my testimony, this guideline should be re-evaluated to determine if it should be more stringent in the future (e.g., one day in 6 years) to ensure reliable service. However, this determination should be based on analyses that assess the tradeoff between electric service costs to the consumer and the increase in reliability to be gained. CA-T-1 at 32.

The typical reliability standard on the mainland is 10 years per day, which is more stringent than the 6 years per day suggested by the Consumer Advocate and the 4.5 years per day in Hawaiian Electric's reliability guideline. A scenario analysis of the reserve capacity shortfall based on a higher reliability guideline threshold of 10 years per day is included in Section 5. The results of the analysis show the additional amount of firm capacity that would be needed on the Oahu grid to meet a higher, 10 years per day, reliability standard based on the assumptions provided herein.

Please refer to Appendix 3 of the 2005 AOS for additional information related to Hawaiian Electric's reliability guideline.

3.2 Other Considerations in Determining the Timing of Unit Additions

The need for new generation is not based solely on the application of the criteria previously mentioned. As capacity needs become imminent, it is essential that Hawaiian Electric broaden its consideration to ensure timely installation of generation capacity necessary to meet its customers' energy needs.

Other near-term considerations may include:

1. the current condition and rated capacity of existing units;
2. required power purchase obligations and contract terminations;
3. the uncertainties surrounding non-utility generation resources;
4. transmission system considerations;
5. meeting environmental compliance standards; and
6. system stability considerations for Hawaiian Electric's isolated electrical system.

In the application of Hawaiian Electric's capacity planning criteria that are used to determine its adequacy of supply, the inputs drive the results. Two of the key inputs in the application of the capacity planning criteria are (1) projected peak demand (including the anticipated peak reduction benefits of energy efficiency DSM programs and demand response programs) and (2) the total firm capacity on the system. These key inputs are described in the following sections.

4. Key Inputs to the 2016 AOS Analysis

4.1. May 2015 Sales and Peak Forecast

Hawaiian Electric developed a sales and peak ("S & P") forecast in May 2015 ("May 2015 S & P forecast"), which was subsequently adopted by the Company for future planning purposes. Hawaiian Electric's AOS is based on the Companies May 2015 S & P forecast and other key assumptions.

Figure 1 illustrates Hawaiian Electric's historical system peaks, and the forecast used in the 2016 AOS analyses.

Figure 1: Recorded Peaks and Future Year Projections

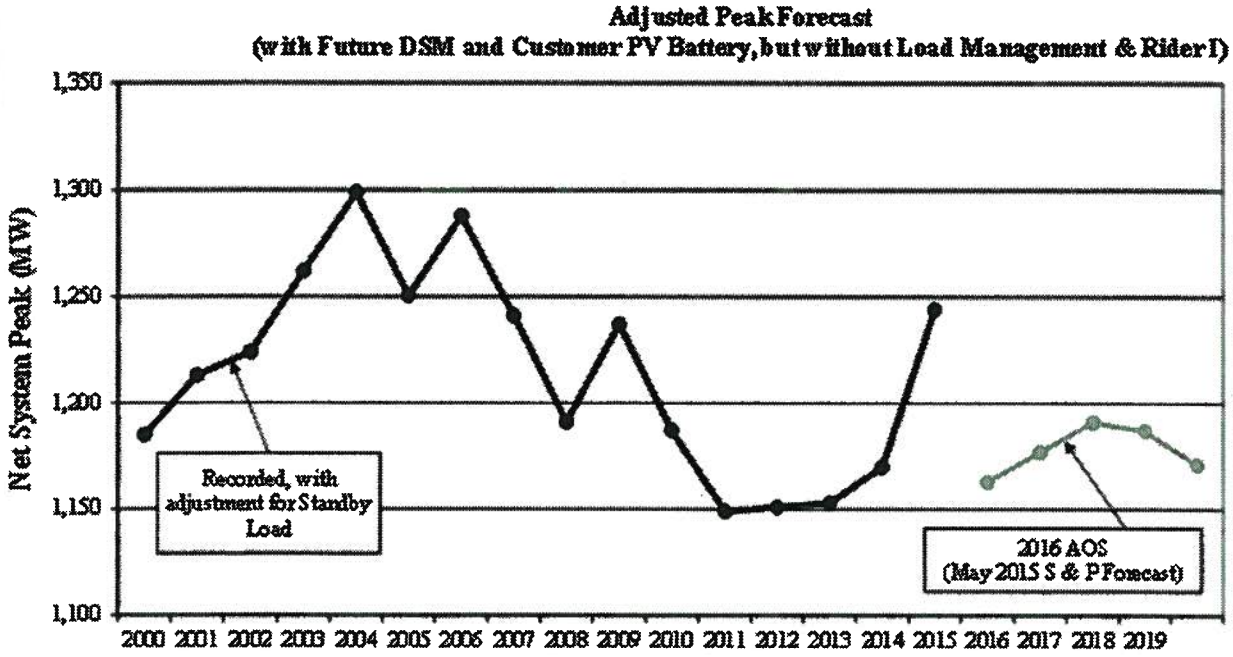

Table 1 below provides the recorded peaks from 2000 and the forecast used in the 2016 AOS.

For both the recorded and forecast data (from the May 2015 S & P Forecast), figures reflect an upward (stand-by) adjustment to account for the potential need to serve certain large customer loads (i.e., Chevron, Hawaii Independent Energy and Pearl Harbor) that are frequently served by their own internal generation. Figure 1 also includes estimated peak reduction benefits of energy efficiency programs and naturally occurring conservation. With the advent of storage technology (i.e., battery energy storage system ("BESS")) for the consumer market, impacts of customer-sited PV paired with batteries were included in the peak forecast. As solar capacity continues to grow year over year, daytime loads are projected to be reduced and, all else being equal, the average daily load profile is expected to have a more pronounced difference between daytime and evening peak. With an operating assumption of BESS charging during the day time hours, coincident with PV generation, and discharging the stored energy during the system priority peak period, the system peak has been reduced for this type of energy storage operation.

Table 1: Recorded Peaks and Future Year Projections

Net System Peak (MW) (with Future DSM and Customer PV Battery, but without Load Management & Rider I)			
Year	Actual	Actual Adj for Standby Load	2016 AOS May 2015 S&P Forecast
2000	1,164	1,185	
2001	1,191	1,213	
2002	1,204	1,224	
2003	1,242	1,262	
2004	1,281	1,299	
2005	1,230	1,250	
2006	1,265	1,288	
2007	1,216	1,241	
2008	1,186	1,191	
2009	1,213	1,237	
2010	1,162	1,187	
2011	1,141	1,149	
2012	1,141	1,151	
2013	1,144	1,153	
2014	1,165	1,170	
2015	1,206	1,232	
2016			1,163
2017			1,177
2018			1,191
2019			1,187
2020			1,171

4.2. Projected Peak Reduction Benefits of Load Control Programs

Hawaiian Electric is committed to pursuing Demand Response ("DR") programs designed to provide cost-effective resource options to meet the capacity needs and support the reliable operation of the system, as identified in the Integrated Demand Response Portfolio Plan ("IDRPP") filed with the commission on July 28, 2014, Update filed March 31, 2015, and Supplement filed November 20, 2015, in Docket No. 2007-0341.

On December 30, 2015, the Hawaiian Electric Companies submitted to the Commission for approval an interim DR Portfolio Application requesting:

- Approval of proposed tariff structure for DR programs;
- Approval of cost recovery mechanism;
- Approval of a 2-year program and budget approval cycle; and,
- Approval of the Companies' proposed reporting structure.

An update to the interim DR Portfolio Application, to be filed in mid-2016, will publish finalized DR program design and targets (MW) following the Power Supply Improvement Plan ("PSIP") update filing in April 2016. Pending Commission approval of the DR Portfolio Application, the next AOS filing will be updated with the revised program load amounts. Hawaiian Electric will continue to implement DR in accordance with these targets in future years. Participants of the Fast DR Pilot Program will be provided an opportunity to transition to future DR programs as they become available.

Given the pending DR Portfolio Application now before the Commission, for the purposes of the analysis in this report, the peak reduction benefits of DR were assumed to be based on the impacts from the existing Commercial & Industrial Direct Load Control ("CIDLC") and Residential Direct Load Control ("RDLC") programs (collectively referred to as the "EnergyScout Programs").

Table 2 shows the forecast of the peak reduction benefits towards Rule 1 and reserve margin calculations from Hawaiian Electric's existing load management programs.[4]

Table 2: Commercial, Residential Demand Response Impacts for Capacity Planning Purposes (MW)

Year	Residential	Commerical	Rider I	Total
2015	5.3	16.0	4.3	25.6
2016	5.3	16.0	4.3	25.6
2017	5.3	16.0	4.3	25.6
2018	5.3	16.0	4.3	25.6
2019	5.3	16.0	4.3	25.6
2020	5.3	16.0	4.3	25.6

[4] Forecasted impacts available at system peak at the net-to-system level.

4.3. Hawaiian Electric Generating Unit Forced Outages

Forced outages and de-ratings reduce generating unit availability and are accounted for in the EFORd statistic. EFORd, a measure of forced outages and operations in derated conditions, is a subcomponent of generating unit availability – and a key driver in the capacity planning criteria and reserve capacity shortfall calculations. The definition of EFORd and an example of the application of the EFORd formula is provided in Appendix 2.

Outages for planned work and maintenance will continue to be more numerous and longer in duration than in previous years. Maintenance will continue to be a challenge for the existing units. As the generating units age,[5] they will need to be maintained more often and for longer periods of time. As the demand on existing generating units change to mitigate different resources on the system such as variable generation resources, the generating units operate harder to counteract the increasingly dynamic changes, which increase the likelihood of unscheduled (forced) outages and operations at derated power levels. Generating units that are shutdown unexpectedly generally require immediate maintenance. As resources shift to make the emergency repairs, maintenance outage schedules slip, making maintenance scheduling flexibility difficult. In addition, generating units operating in a derated capacity typically cannot be afforded the luxury of a maintenance shutdown to restore the unit to full power operations. These units are generally operated for long periods in a derated state.

Based on Hawaiian Electric's maintenance experience, lower generating unit availabilities and higher EFORd estimates are expected to continue in the near future.

Lower generating unit availability and higher EFORd both contribute to an increase in reserve capacity shortfalls.

Table 3 provides the forward looking Hawaiian Electric EFORd data by unit. The forward looking EFORd values utilized in the 2016 AOS analysis are forecasted EFORd expectations for planning purposes based on a combination of historical data, experience, and operational judgment. The EFORd assumption generally reflects the 5-year average of the specific unit, or group of similar units. EFORd projections are not certain, however, and actual experience may differ from the projections. It is difficult to forecast EFORd due to unforeseen conditions of aging units, longer planned maintenance schedules, and the operating stress placed on the units. Refer to Appendix 3 for specific generating unit information on EFORd.

[5] Hawaiian Electric's generating units (not including the Campbell Industrial Park combustion turbine installed in 2009) are between 35 and 69 years old. Firm capacity IPP units are between 24 and 26 years old.

Table 3: Forward-looking EFORd

AOS EFORd Rates	
	2016 Forward Looking
Honolulu 8	8.5%
Honolulu 9	8.5%
Waiau 3	6.7%
Waiau 4	4.7%
Waiau 5	3.6%
Waiau 6	3.6%
Waiau 7	3.5%
Waiau 8	3.5%
Waiau 9	7.8%
Waiau 10	7.8%
Kahe 1	4.3%
Kahe 2	4.3%
Kahe 3	3.5%
Kahe 4	3.5%
Kahe 5	4.7%
Kahe 6	4.7%
CIP CT-1	2.5%
System	**4.1%**

Note: Honolulu units 8 & 9 were deactivated in 2014. Forward looking EFORd values for these units are based on historical data and shown for comparison purposes.

4.4. Planned Maintenance Schedules For The Generating Units On The System

Planned outages and maintenance outages reduce generating unit availabilities. The schedules for planned overhaul and maintenance outages change frequently due to unforeseeable findings during outage inspections or to changes in priorities due to unforeseeable problems. When major revisions to planned and/or maintenance outages occur, the Planned Maintenance Schedule is revised. The uncertainty of future maintenance schedules contributes to future planning uncertainty and may influence the magnitude of reserve capacity surplus or shortfalls.

4.5. Additions of Capacity

4.5.1 Firm Capacity Additions

The State of Hawai'i Department of Transportation, Airports Division ("DOT"), 8 MW of distributed standby generation ("Airport DSG") is anticipated to be on-line and available for Hawaiian Electric's dispatch in mid-2016. Under an agreement between Hawaiian Electric and

DOT ("Airport DSG Agreement"), Hawaiian Electric will be able to use the Airport DSG to serve system needs under certain conditions. Nearly all of the generation provided by the Airport DSG will be dispatchable by Hawaiian Electric under the conditions given in the agreement. The Commission approved the Airport DSG Agreement by Decision and Order issued March 2, 2010 in Docket No. 2009-0317. This capacity was included in the adequacy of supply analysis.

On December 27, 2011, in Docket No. 2011-0386, Hawaiian Electric submitted to the Commission a request for approval of a waiver from the competitive bidding framework for an approximately 50 MW of utility owned and operated, firm, renewable, dispatchable, generation security project on federal land, Schofield Generating Station Project ("SGS Project"). On August 1, 2012, in Decision and Order ("D&O") No. 30552, the Commission granted, subject to conditions, Hawaiian Electric's request for a waiver from the framework for competitive bidding for the purposes of allowing discussions and negotiations to occur with the United States Department of the Army ("Army"). On September 30, 2015, in D&O No. 33178, the Commission approved the SGS Project with certain conditions and modifications. It is anticipated that this project could be in service in the 2018 timeframe. This capacity was included in the adequacy of supply analysis.

On October 29, 2015, Hawaiian Electric submitted a letter to the Commission providing its detailed outline of tasks necessary to shift its biodiesel use from the Campbell Industrial Park Combustion Turbine 1 ("CIP CT-1") to the SGS Project in accordance with ordering paragraph 6 of the Commissions D & O No. 33178. Following the shift of biodiesel use, Hawaiian Electric intends to use diesel at CIP CT-1. The operating capacity of CIP CT-1 using diesel may increase subject to performance testing.

4.5.2 Non-Firm Additions

In addition to firm generation power projects, Hawaiian Electric purchases energy on an as-available basis from seven producers and anticipates adding additional variable generation renewable energy projects to the Hawaiian Electric system in the near future as these facilities achieve commercial operation.

Several variable generation independent power producers have power purchase agreements ("PPA") with Hawaiian Electric and others are in various stages of Commission approval. For example:

On December 12, 2013, in Docket No. 2013-0423, Hawaiian Electric submitted an application for Commission approval of a waiver from the Framework for Competitive Bidding and approval of a PPA with Na Pua Makani Power Partners, LLC, for up to 24 MW of wind power. On December 31, 2014 in D&O No. 32600, the Commission approved a waiver from the Framework for Competitive Bidding, subject to the conditions set forth in D&O No. 32600.

On December 4, 2014, Hawaiian Electric submitted applications for Commission approval of six (6) Power Purchase Agreements. The Commission approved four (4) projects with conditions. These projects (Docket No. 2014-0354 – EE Waianae Solar;[6] Docket No. 2014-0356 – Kawailoa Solar, LLC;[7] Docket No. 2014-0357 – Lanikuhana Solar, LLC;[8] and Docket No. 2014-0359 – Waiawa PV, LLC[9]) are planned to produce a combined total of up to 137.2 MW of solar power.

4.6. Reductions of Firm Generating Capacity

4.6.1 Honolulu Units 8 and 9 Deactivation

Honolulu Units 8 and 9 (with a combined rating of 107.3 MW net) were deactivated on January 31, 2014. The 2016 AOS reference scenario reflects the Honolulu generating units remaining deactivated, and their capacities are not included in the analysis.

4.6.2. Waiau Units 3 and 4 Deactivation

Waiau Units 3 and 4 (with a combined rating of 92.6 MW-net) are also candidates for deactivation. The 2016 AOS reference scenario reflects these units being deactivated at the end of 2017. The decision on whether to continue operating or deactivating these units would depend largely on factors such as operation and maintenance costs, environmental regulations, new and replacement capacity, timing available to install replacement capacity, and transmission infrastructure improvements.

4.6.3. Reactivation

Deactivated units may be reactivated in the event of an emergency and/or to mitigate reserve capacity shortfalls. Reserve capacity shortfalls may occur for a variety of reasons including unexpected long term outages of generating units or existing PPAs with IPPs for firm capacity being terminated or not being renegotiated and extended. In the case of Honolulu Units 8 and 9, reactivation would take approximately 3 months. In the event a situation warranted the reactivation of any deactivated units, the Company would inform the Commission accordingly and provide details supporting the basis for the need for such reactivation and its planned course of action.

4.7 Capacity from Kalaeloa Partners, L.P., Combined Cycle Unit

The existing PPA with Kalaeloa expires on May 23, 2016. The PPA states:

[6] See Order No. 33035, issued on July 31, 2015, in Docket No. 2014-0354.
[7] See Order No. 33036, issued on August 3, 2015, in Docket No. 2014-0356.
[8] See Order No. 33037, issued on August 3, 2015, in Docket No. 2014-0357.
[9] See Order No. 33038, issued on August 3, 2015, in Docket No. 2014-0359.

> *"...should the original Term end with the parties hereto actively negotiating for the purchase of the Facility or the Net Electric Energy Output of the Facility, then such Term shall be automatically extended on a month-to-month basis under the same terms and conditions as contained in this Agreement for so long as said negotiations continue in good faith. The month-to-month term extensions shall end sixty (60) days after either party notifies the other in writing that said negotiations have terminated."*

On November 10, 2011, Hawaiian Electric submitted to the Commission a Petition for Declaratory Order regarding the Exemption of Kalaeloa Partners, LP's project from the Framework for Competitive Bidding, or in the alternative, Approval of Application for Waiver from the Framework for Competitive Bidding. On May 14, 2012, in D&O No. 30380, the Commission declared that the proposed renegotiation of the amended PPA is exempt from the competitive bidding process. Hawaiian Electric is currently in discussions with Kalaeloa on alternatives related to the continued operation of the facility.

For the purposes of the 2016 AOS analysis, it is assumed that the 208 MW of capacity provided by Kalaeloa remains in service beyond May 23, 2016.

4.8 Capacity from AES Hawaii, Inc.

The existing PPA with AES expires on September 1, 2022. On August 13, 2012, Hawaiian Electric submitted to the Commission a Petition for Declaratory Order regarding the Exemption of AES Hawaii's project from the Framework for Competitive Bidding, or in the alternative, Approval of Application for Waiver from the Framework for Competitive Bidding. On April 25, 2013, in D&O No. 31200, the Commission declared that the proposed renegotiation of the amended and restated PPA is exempt from the competitive bidding process. On November 13, 2015 Hawaiian Electric entered into Amendment No. 3 to the PPA. On January 22, 2016, the Company submitted to the Commission an application for approval of Amendment No. 3. Under the amendment, if approved by the Commission, the capacity of the AES facility would increase from 180 MW to 189 MW.

For the purposes of the 2016 AOS analysis, it is assumed that the capacity from AES is 180 MW.

5. Scenario Analysis

5.1 Description of Scenarios

In energy planning uncertainty is an important aspect. Therefore, a range of forecasts was considered in the analysis. Descriptions of the various planning scenarios are provided below:

- Higher load forecast (60 MW increase in peak load)
- Planning scenario with the deactivation of Waiau 3 and 4 generating units deferred and the units remain in service
- Revised system reliability guideline – Increased stringency of Hawaiian Electric's generating system reliability guideline from 4.5 years per day to 10 years per day
- Alternate 30% reserve margin guideline from PSIP

A scenario using a lower load forecast was not performed in the analysis. However, should lower loads occur in the future, it may provide more certainty regarding decisions to deactivate or decommission existing generation units.

5.1.1 Higher Load Forecast

The Higher Load Scenario uses the assumption that the system peaks are higher by 60 MW. Such a scenario is possible if energy usage is higher than projected due to hotter or more humid than average weather conditions, lower than anticipated adoption of energy efficient measures and practices and/or an upswing in the economy as compared to the forecast occurs in the future. A 60 MW higher peak load is roughly equivalent to one standard deviation over a 20 year period of historical peaks. A 60 MW sensitivity is reasonable because the actual recorded peak in 2015 (1,206 MW-net, unadjusted for standby load) was 43 MW higher than the 1,163 MW-net peak forecasted for 2016. On an adjusted basis, the 2015 peak would have been 1,232 MW-net, as explained earlier. This is 69 MW higher than the forecasted peak for 2016. The weather in 2015 was unusually warm and humid, and this contributed to the higher loads. This weather pattern may not necessarily be repeated in 2016. Table 4 summarizes the Higher Load Scenario peak requirements.

Table 4: Higher Load Scenario

Year	2016 AOS May 2015 S&P Forecast (MW)	60 MW higher May 2015 S&P Forecast (MW)	Difference (MW)
2016	1,163	1,223	60
2017	1,177	1,237	60
2018	1,191	1,251	60
2019	1,187	1,247	60
2020	1,171	1,231	60

5.1.2 Waiau 3 and 4 Deactivation Deferral

The planning scenario of Waiau Units 3 and 4 remaining in service examines the generating system reliability if the Waiau Units are not deactivated at the end of 2017.

5.1.3 Revised System Reliability Guideline

Another potential means to address the ever-increasing planning uncertainty and complexity is to revise the capacity planning guideline. As explained in Section 3.1.2, Hawaiian Electric currently uses a reliability guideline threshold of 4.5 years per day. If the existing Loss of Load Probability of 4.5 years per day does not provide an adequate cushion to respond to quickly-changing parameters, such as changes in peak demand and individual unit availability factors, many of which may change rapidly from year to year, then the utility could plan for a higher reliability standard similar to that many mainland utilities. Such an approach would not eliminate quickly-changing parameters, but it would add a measure of conservatism in recognition that the uncertainties undoubtedly exist.

Hawaiian Electric performed a high-level evaluation using a more stringent reliability guideline of 10 years per day. The purpose of this analysis was to determine the amount of firm capacity that would be required to meet this higher reliability guideline. The results of this high level evaluation are shown in Section 5.2.

5.1.4 Alternate 30% Reserve Margin Guideline from PSIP[10]

In Hawaiian Electric's Power Supply Improvement Plan filed on August 26, 2014 in Docket No. 2011-0206, a proposed reserve margin target of 30% was used for capacity planning analysis.[11]

[10] On August 26, 2014, Hawaiian Electric filed its PSIPs in Docket No. 2011-0206. Order No. 32291 issued on September 12, 2014, transferred Hawaiian Electric's PSIP Report from Docket No. 2011-0206 into Docket No. 2014-0183.

5.2 Results of Analysis

Table 5 shows the capacity, in MW, in excess of the amount needed to satisfy Rule 1 of the capacity planning criteria. The analysis shows that Rule 1 is satisfied for the reference scenario for each year through 2020 under a reference set of assumptions including, but not limited to: (1) continued residential and commercial load management impacts at the levels described in Table 2; and (2) continued acquisition of third-party energy efficiency. However, as previously explained, Rule 1 results are deterministic and do not incorporate unit specific EFORd rates in their calculation.

Table 5: Rule 1 Analysis

Year	Rule 1 Results (MW)
2016	101
2017	164
2018	49
2019	86
2020	102

The LOLP for the reference and planning scenarios were calculated using a production simulation model for each year through 2020 under reference and variable sets of assumptions described in Section 4.

In 2018 and beyond, the generating system reliability is projected to be less than 4.5 years per day in the reference scenario. Based on the Company's May 2015 forecast, Hawaiian Electric's firm generating capacity, which does not include intermittent energy sources such as wind and solar may not be sufficient to meet projected peak demand in 2018 and beyond. The expected completion of SGS Project and its resulting new firm generating capacity in 2018 may alleviate a portion of the projected reserve capacity shortfall in that year and beyond. Reactivation of Honolulu Units 8 and 9 or the deferral of the deactivation of Waiau Units 3 and 4 may also alleviate, or remove, the future projected reserve capacity shortfalls.

Table 6 shows the results of the Generation System Reliability analysis. The system reliability in the scenarios shown varies depending on the firm generating units available, and the planned maintenance schedules.

[11] Refer to Appendix M of Hawaiian Electric's PSIP report for reference.

Table 6: Generation System Reliability Guideline (years/day)

Generation System Reliability (years/day)				
Year	Reference Scenario	Higher Load (Add 60 MW)	No W3 & W4 Deactivations	10 yrs/day reliability scenario
2016	6.7	1.8	6.7	6.7
2017	12.0	2.9	12.0	12.0
2018	0.8	0.2	3.6	0.8
2019	4.0	1.0	26.3	4.0
2020	4.5	1.2	23.8	4.5

Table 7 shows the reserve capacity surpluses or shortfalls corresponding to the calculated reliability shown in Table 6. Reserve capacity shortfall is the approximate amount of additional firm capacity needed to restore the generating system LOLP to be greater than the 4.5 years per day reliability guideline. A positive number indicates the amount of capacity over and above that amount needed to satisfy the 4.5 years per day reliability guideline. A negative number indicates the amount of capacity below the amount needed to satisfy the 4.5 years per day reliability guideline. For example, in the reference scenario for 2018, the number -90 would indicate that about 90 MW of firm generating capacity would have to be added, in order for the expectation of not being able to satisfy demand due to insufficient generation occurs no more than once every 4.5 years.

Table 7: Reserve Capacity Shortfall for reference and planning scenarios (MW)

		Alternate Scenarios		
Year	Reference Scenario	Higher Load (Add 60 MW)	No W3 & W4 Deactivations	10 yrs/day reliability scenario
2016	10	-50	10	-20
2017	40	-20	40	0
2018	-90	-150	-10	-120
2019	-10	-70	70	-40
2020	0	-60	70	-40

(Note: Negative values indicate a shortfall of generating capacity; positive values indicate a surplus of generating capacity)

The forecasts and analysis for 2016 and 2017 appear to indicate that there will be sufficient generation available for reasonable emergencies and reserve capacity. In 2018, a reserve capacity shortfall may occur based on the assumptions analyzed, such as the anticipated deactivation of Waiau generating units 3 and 4.

The results indicated for the 2018-2020 timeframe are based on present day assumptions, and will change as the Hawaiian Electric system transforms into the future. The lower reserve capacity shortfalls in 2018 through 2020 are largely influenced by forward-looking maintenance schedules that will be revised in the years ahead.

The analysis shows that the reserve capacity shortfall is sensitive to the load forecast. In the case of the Higher Load Scenario, a nominal 60 MW increase in the forecasted load resulted in a 60 MW change to the results, indicating a projected capacity shortfall to occur earlier, for all years 2016-2020. Expectations regarding future loads can change quickly, and Hawaiian Electric may not be able to respond quickly to increases in demand. This illustrates the importance of using scenario analysis as a planning tool.

Table 7 further projects that approximately 120 MW of firm capacity would have to be added to the Hawaiian Electric system by 2018 to achieve a higher reliability guideline of 10 years/day in the near term. The approximate 30 MW difference between the 4.5 years/day reference scenario and the 10 years/day Scenario to achieve higher levels of reliability is a non-linear relationship between MW capacity added and improvement in LOLP.

Delaying the deactivation of Waiau Unit 3 and/or Waiau Unit 4 may help to mitigate short term reserve capacity shortfall risk and help Hawaiian Electric to meet its reliability guideline of 4.5 years per day.

5.3 Additional Capacity Planning Criteria

As indicated in Section 5.1.4, Hawaiian Electric's Power Supply Improvement Plan, Chapter 5 of the PSIP included reserve margin planning analysis based on the criteria further described in Appendix M of the PSIP.

Table A1 in Appendix 1 indicates that Hawaiian Electric's reserve margin calculation is greater than 30% based on the planning assumptions utilized.

8. Conclusion

Under the reference scenario, Hawaiian Electric's reserve capacity for the next five years (2016-2020) at times may not be sufficient to meet the Company's generating system reliability guideline of 4.5 years per day, assuming Waiau Units 3 and 4 are deactivated at the end of 2017. Deferring the deactivation of Waiau Units 3 and 4 until additional firm capacity is acquired may mitigate the capacity shortfall risk and help Hawaiian Electric to meet its reliability guideline.

As indicated in Section 4.5, Hawaiian Electric is anticipating the addition of approximately 50 MW of utility owned and operated, firm, dispatchable, generation (SGS Project) in 2018. Hawaiian Electric anticipates that the acquisition of this new firm generation capacity in 2018 may alleviate the projected reserve capacity shortfall in that year and beyond.

The scenario analysis indicates that depending on system conditions, Hawaiian Electric may experience anywhere from a 90 MW reserve capacity shortfall under the reference scenario to a 150 MW reserve capacity shortfall in the Higher Load Scenario in the timeframe analyzed. Hawaiian Electric may seek to mitigate future capacity needs in 2018 and beyond by deferring future deactivation of units, increasing Demand Response Programs, optimizing maintenance schedules, reactivating units that are currently deactivated, or acquiring additional firm capacity.

Hawaiian Electric will continue its portfolio approach to meet its obligation to serve, which includes increased renewable energy contributions, demand-side management programs, energy storage resources and the pursuit of firm capacity supply side options. Hawaiian Electric also recognizes that the environment for resource planning has increased in complexity and uncertainty.

Very truly yours,

Joseph P. Viola
Vice President
Regulatory Affairs

Attachments

c: Division of Consumer Advocacy (with Attachments)

Table A1:
Projected Reserve Margins

Year	System Capability at Annual Peak Load (net MW) [A] (I)	System Peak (net MW) [B] (II)	Interruptible Load (net MW) [C] (III)	Reserve Margin (%) [A-(B-C)] / (B-C)
2015	1,671	1,232	26	38%
2016	1,679	1,163	26	48%
2017	1,679	1,177	26	46%
2018	1,642	1,191	26	41%
2019	1,642	1,187	26	41%
2020	1,642	1,171	26	43%

Notes:

I. System Capability includes:
- Hawaiian Electric central station units at total normal capability in 2015 was 1,214.3 MW-net.
- Firm power purchase contracts with a combined net total of 456.5 MW in 2015 from Kalaeloa (208 MW), AES Hawaii (180 MW), and H-POWER (68.5 MW).
- Expected addition of Airport DSG in 2016 (8 MW)
- Honolulu Units 8 and 9 were deactivated in 2014 (-107.3 MW)
- Kalaeloa assumed to continue in service after 2016
- Waiau Units 3 and 4 are deactivated from 2018 (-92.6 MW)
- Expected addition of Schofield Generating Station in 2018 (48.8 MW)

II. System Peaks
- The 2016-2020 annual forecasted system peaks are based on Hawaiian Electric's May 2015 S & P Forecast.
- The forecasted System Peaks for 2016-2020 include the estimated peak reduction benefits of third-party energy efficiency DSM programs.
- The peak for 2016-2020 includes approximately 27 MW of stand-by load
- The Hawaiian Electric annual forecasted system peak is expected to occur in the month of October.

III. Interruptible Load:
- Interruptible Load impacts are at the net-to system level, and are approximate impacts at the system peak.

Equivalent Demand Forced Outage Rate Definition and Formula

As defined in IEEE Std-762-2006,[12] Section 3.8:

Equivalent Demand Forced Outage Rate ($EFOR_d$): A measure of the probability that a generating unit will not be available due to forced outages or forced deratings when there is demand on the unit to generate.

$EFOR_d$ is defined in the NERC GADS Data Reporting Instructions,[13] Appendix F as:

$$EFORd = \frac{[FOHd + (EFDHd)]}{[SH + FOHd]} \times 100\%$$

where

FOHd = f x FOH

EFDHd = (EFDH – EFDHRS) if reserve shutdown events reported, or
= (fp x EFDH) if no reserve shutdown events reported – an approximation.

fp = (SH/AH)

$$f = \left(\frac{1}{r} + \frac{1}{T}\right) \Big/ \left(\frac{1}{r} + \frac{1}{T} + \frac{1}{D}\right)$$

r=Average Forced outage deration = (FOH) / (# of FO occurrences)
D=Average demand time = (SH) / (# of unit actual starts)
T=Average reserve shutdown time = (RSH) / (# of unit attempted starts)

An example of the application of the EFORd formula to Hawaiian Electric's Waiau 9 generating unit in 2012 is shown below:

	Service Hours	Reserve Shutdown Hours	Available Hours				Equivalent Forced Derated Hours	Forced Outage Hours	
Capacity	SH	RSH	AH	Actual Starts	Attempted Starts	Failed Starts	EFDH	FOH	FO Events
53	67	7002.14	7069	26	27	1	0.00	1,067.26	5

=1/(1067/5)	=1/(7002/27)	=1/(67/26)		=0.021397*1067	=67/7069	=0.009416*0		=(22.84/(67+22.84))*100	=(1067/(1067+67))*100
1/r	1/T	1/D	f	fxFOH	fp	fp x EFDH	EFORd x MW	**EFORd**	**EFOR**
0.004685	0.003856	0.390625	0.021397	22.83591142	0.009416	0	1,353.87	**25.54**	**94.1**

[12] http://www.nerc.com/docs/pc/gadstf/ieee762tf/762-2006.pdf

[13] http://www.nerc.com/page.php?cid=4|43|45

Hawaiian Electric Equivalent Demand Forced Outage Rate ("EFORd") Discussion

It is extremely difficult to predict unit-specific EFORd rates, as indicated by the variation in historical data. Nonetheless, for planning purposes it is necessary to estimate forward-looking EFORd rates. This is accomplished using a blend of historical data, experience, and judgment. Hawaiian Electric has used a few different methods in determining unit specific EFORd numbers. Generating units are, at any giving time, in various stages of their maintenance plan. Different outage rates are expected following unit overhauls compared to the period prior to unit overalls. Hawaiian Electric has attempted to normalize this variation by comparing similar generating units over the previous five year period, with some exceptions. Table A2 provides recorded Hawaiian Electric EFORd data used as the basis for forward looking EFORd. The rationalization for the selection of EFORd numbers to be used in the 2016 AOS analysis is discussed below:

Table A2:
Historical EFORd

Recorded EFORd							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Honolulu 8	1.8%	17.5%	3.4%	4.0%	5.2%	7.5%	-
Honolulu 9	3.9%	9.1%	6.1%	24.5%	9.1%	36.9%	-
Waiau 3	0.8%	3.3%	11.2%	4.4%	13.7%	33.2%	37.4%
Waiau 4	5.5%	0.9%	9.0%	2.2%	1.7%	5.0%	5.5%
Waiau 5	2.7%	1.6%	0.5%	1.9%	1.4%	3.5%	6.3%
Waiau 6	0.0%	0.2%	2.2%	6.5%	2.4%	7.2%	24.2%
Waiau 7	2.4%	0.1%	7.4%	0.4%	1.6%	0.0%	1.0%
Waiau 8	1.9%	1.3%	11.2%	3.7%	4.7%	6.7%	5.0%
Waiau 9	1.3%	0.6%	8.6%	25.5%	2.1%	0.9%	12.5%
Waiau 10	3.6%	9.0%	9.8%	4.8%	7.1%	3.4%	3.1%
Kahe 1	2.4%	0.7%	2.7%	0.5%	0.6%	2.8%	5.1%
Kahe 2	7.7%	8.8%	2.4%	7.2%	3.1%	10.6%	8.4%
Kahe 3	3.8%	3.9%	2.2%	2.5%	1.3%	2.2%	9.3%
Kahe 4	7.0%	10.4%	3.0%	2.7%	2.3%	9.0%	4.1%
Kahe 5	9.0%	1.1%	6.0%	4.6%	2.3%	6.1%	14.1%
Kahe 6	3.3%	2.0%	3.0%	3.4%	12.8%	1.8%	29.1%
CIP CT-1	-	9.9%	8.4%	3.9%	0.7%	9.0%	0.6%
HECO	**3.5%**	**3.8%**	**5.0%**	**4.1%**	**3.4%**	**5.9%**	**10.2%**

1. Honolulu Units 8 and 9

In the 2015 AOS, the forward looking EFORd of 8.5% included the actual average of 5

years for both Honolulu Units 8 and 9. Honolulu Unit 8 and Honolulu Unit 9 are similar units at a similar juncture in their maintenance strategy. Honolulu 8 and 9 are in a deactivated state. It is assumed that if they were to be reactivated they would operate and be maintained in a similar to that of pre-deactivation. Therefore, Honolulu 8 and 9 will have an EFORd of 8.5% for forwarding looking analysis and are shown for comparison purposes.

2. Waiau Units 3 and 4

In the 2015 AOS, the forward looking EFORd for Waiau Unit 3 was 13.2%. The actual EFORd for 2015 for Waiau Unit 3 was 37.4 %. In the 2015 AOS, the forward looking EFORd for Waiau Unit 4 was 3.8%. The actual EFORd for 2015 for Waiau Unit 4 was 5.5%.

Hawaiian Electric believes that Waiau Unit 3 and Waiau Unit 4 will continue to be operated and maintained in a similar manner in the future. Although Waiau Unit 3 and Waiau Unit 4 are similar units, their maintenance plan includes deactivation in the future. Therefore the maintenance strategies on these units are different compared to other units and the units are at different stages of material condition. Yet, Waiau Unit 3 and Waiau Unit 4 will be operated and dispatched in similar manner compared to recent history. Hawaiian Electric therefore does not believe that averaging the EFORd for Waiau Unit 3 and Waiau Unit 4 together will provide accurate assumption of each unit's future performance and elect to base the Waiau Unit 3 and Waiau Unit 4 EFORd numbers on individual unit averages over the previous five years. Although, Hawaiian Electric believes using five year average as a predictor of future reliability is valid, Waiau Unit 3 had major corrective turbine work performed in 2015 which will restore the units reliability to something more comparable with operation prior to 2015. Hawaiian Electric therefore believes that an EFORd of 6.7% used in prior years is valid for Waiau Unit 3 based on current material condition and maintenance history/plans. Based on the five year EFORd average coupled with current material condition and future maintenance plans Hawaiian Electric recommends using an EFORd of 4.7% for Waiau Unit 4.

3. Waiau Units 5 and 6

In the 2015 AOS, the forward looking EFORd rate for Waiau Units 5 and 6 was 2.7% based on the average actual EFORd rates for both units for the recent 5 years. The actual EFORd for 2015 for Waiau Units 5 and 6 were 6.3% and 24.2%, respectively. For previous year AOS analysis, it was decided to use the average of the actual EFORd rates for the past 5 years. This approach recognizes that Waiau Units 5 and 6 are similar units under the same maintenance strategy yet at different stages of maintenance. However, this year Waiau Unit 6 had an extended derate that could not be corrected because of other unit outages. The unit would have been able to, and did, support short term full load operation when/if system conditions dictated. Therefore, we do not believe it is accurate or reflective of past or future operations to include Waiau Unit 6 2015 EFORd numbers in the calculation. Waiau Units 5 and 6 will be dispatched and operated similar in coming years. Averaging historic performance gives an accurate estimation of each unit's performance. The combined average of Waiau Units 5 and 6 five year

historic EFORd (excluding Waiau Unit 6 2015) is 3.6% and is recommended for the 2016 AOS forward looking EFORd for both Waiau Units 5 and 6.

4. Waiau Unit 7, Waiau Unit 8, Kahe Unit 3, and Kahe Unit 4

These four units are of similar size, design, and vintage, and are dispatched as baseloaded units with similar duty cycles. They also have a similar maintenance strategy. With each unit at various stages of the maintenance plans it is recommended that averaging all four units provides the best indication of EFORd to be used for the 2016 AOS analysis. Accordingly, in the 2015 AOS, the forward looking EFORd rate of 3.8% was used for these four units. The actual EFORd for 2015 for Waiau Unit 7, Waiau Unit 8, Kahe Unit 3, and Kahe Unit 4 were 1.0%, 5.0%, 9.3%, 4.1%, respectively, with an average of 4.9%. For the 2016 AOS analysis, it was recognized Kahe Unit 4 had a long outage early in 2015. Significant work during that outage coupled with 2016 maintenance plans will improve reliability on those units. Kahe 3 completed overhaul at the end of 2015, Kahe 4 has overhaul in early 2016 and Waiau 7 has overhaul in mid 2016. With that planned work and similar operation of the four units it was decided that 3.5% is an appropriate number for 2016 AOS planning purposes.

5. Waiau Units 9 and 10

In the 2015 AOS, the forward looking EFORd rate for Waiau Units 9 and 10 was 7.2% based on the average of the actual EFORd's for both units for the recent 5 years. The actual EFORd in 2015 for Waiau Units 9 and 10 were 12.5% and 3.1%, respectively, and averaged 7.8% for the two units. For the 2016 AOS analysis, it was decided to continue to use the average of the actual EFORd rates for both units for the past 5 years. This approach also recognizes that these units will be dispatched and operated similarly in 2016 as they were in recent years and that each unit has similar maintenance strategies. As a result, an EFORd of 7.8% is recommended for the 2016 AOS forward looking EFORd for Waiau Units 9 and 10.

6. Kahe Units 1 and 2

In the 2015 AOS, the forward looking EFORd for Kahe Units 1 and 2 was 4.0% based on the average of the actual EFORd for both units for the recent 5 years. The actual EFORd in 2015 for Kahe Unit 1 and 2 were 5.1% and 8.4%, respectively, and averaged to be 6.7% for both units. For the 2016 AOS analysis, it was decided to continue to use the average of the actual EFORd for both units for the past 5 years. This approach also recognizes that these units will be dispatched and operated similarly in 2016 as they were in recent years. Additionally these similar units have similar maintenance strategies yet are at different stages of their maintenance strategy. Averaging the two units performance allows for the normalization of performance. As a result, an EFORd of 4.3% is recommended for the 2016 AOS forward looking EFORd for Kahe Units 1 and 2.

7. Kahe Unit 5 and 6

In the 2015 AOS, the forward looking EFORd for Kahe Unit 5 and 6 was 4.3% based on the average of the actual EFORd for the recent 5 years. The actual EFORd for 2015 for Kahe Unit 5 and 6 were 14.1% and 29.1% respectively, and averaged to be 21.6% for both units. Kahe Unit 5 and 6 are similar units and are operated and maintained in similar manner. For the 2016 AOS analysis we considered the events of 2015 that lead to a high EFORd. Kahe Unit 6 had two long events that were corrected. Procedures and processes were put in place to prevent similar occurrence for one and detailed mechanical corrections made for the other. Kahe Unit 5 had a long derate because of system conditions. For the 2016 AOS analysis, based on the fact that major corrections were made in 2015, it was decided to continue to use the previous EFORd projection of 4.7%.

8. CIP CT-1

On August 3, 2009, CIP CT-1 was placed in service (e.g. tied into the electrical grid and producing power). In the 2015 AOS, the forward looking EFORd for CIP CT-1 was 6.4% based on the average of CIP CT-1 actual EFORd for the recent 5 years. The actual EFORd for 2015 for CIP CT-1 was 0.6%. For the 2016 AOS analysis, it was recognized that significant work was done in 2014 that improved CIP CT-1 performance. It was recognized that CIP CT-1 is a relatively new unit and therefore should operate with better reliability. Based on the age, material condition, prior maintenance work, and current operating profile it is believed that CIP CT-1 should have forward looking EFORd of 2.5%.