

Resilience Working Group (RWG) Meeting Notes

November 22, 2019

8:30 am - 12:30 pm

Honolulu Club

Attendees

Name	Organization	In Person	WebEx
Chris Yunker	Hawai'i State Department of Business, Economic Development and Tourism, Energy Office	X	
Thomas Travis	Hawai'i State Department of Defense, Hawai'i Emergency Management Agency	X	
Gary Yokoyama	Hawai'i State Department of Transportation, Airports Division	X	
Judy Kern	Hawai'i State Department of Health	X	
Chris Crabtree	Healthcare Association of Hawai'i	X	
Carilyn Shon	Hawai'i State Department of Business, Economic Development and Tourism, Energy Office	X	
Mark Want	Hawai'i State Department of Business, Economic Development and Tourism, Energy Office	X	
Alexander de Roode	County of Maui, Energy Commissioner		X
Lori Kahikina	Honolulu Department of Environmental Services	X	
Gina Yi	Hawai'i Public Utilities Commission	X	
Samantha Ruiz	Hawai'i Public Utilities Commission	X	
Jay-Paul Lenker	Hawai'i Public Utilities Commission	X	
Keith Yamanaka	United States Army		
Casey Ann Hiraiwa	United States Army	X	
Sonny Rasay	United States Marine Corps	X	
Leigh Anne Eaton	United States Department of Commerce, National Oceanic and Atmospheric Administration	X	
Crystal Van Beelen	City and County of Honolulu Emergency Management	X	
Jennifer Walter	City and County of Honolulu Emergency Management	X	
Shereen Wachi	United States Navy	X	
Peter Yuen	United States Navy	X	
Aaron Lau	Hawai'i National Guard	X	

Name	Organization	In Person	WebEx
Jonathan Choi	Par Hawai'i	X	
Noelani Kalipi	Progression Energy	X	
Wren Wescoatt	Progression Energy	X	
Francis Alueta	Hawaiian Telcom	X	
Corey Shaffer	Verizon Wireless	X	
Henry Curtis	Life of the Land	X	
Murray Clay	Ulupono Initiative	X	
Will Rolston	Energy Island		X

Hawaiian Electric Companies Attendees

- | | | |
|----------------|-----------------|------------------|
| Karina Abenoja | Ronald Cox | Lydia Mertyris |
| Ken Aramaki | Brandi Crabbe | Darcy Endo Omoto |
| Marc Asano | Darren Ishimura | Rick Pinkerton |
| Riley Ceria | Christopher Lau | Scott Seu |
| Colton Ching | Earlynne Maile | Jack Shriver |
| Stewart Chong | Mahina Martin | Donna Stinefelt |
| Karen Chung | Todd Mayeshiro | Christine Tasato |
| Edine Clemente | Mathew McNeff | Lena Young |

Meeting Facilitators

- | | | |
|--------------|---------------|---------------|
| Gerry Cauley | Linda Colburn | Nicole Brodie |
| Gary Vicinus | | |

Opening Remarks (Colton Ching) (8:30AM)

Purpose

- Identify threat impacts to grid and key customers
- Develop inputs to Integrated Grid Planning
- Identify grid resilience planning criteria

Lessons Learned

- Utilities moving toward acquiring clean energy
- Resilience criteria may include recovery time for key customers and other customers
- Consider rain bombs as another serious threat

Process Overview

- Raise awareness
- Define resilience
- Define priorities
- Identify potential impacts
- Identify/assess options
- Put it all together

Topics Covered

- Mapping of customers to threats and grid
- Assumptions regarding threat impacts and outages
- Inputs to IGP: objectives, assumptions, threat scenarios, resilience criteria, and solution options

Resiliency Working Group Overview (Stewart Chong)

Meeting Objectives

- Review and comment on draft outline of RWG report
 - Definition of resilience
 - Resilience threats and impacts to grid and customers
 - Key customer/sector capabilities and needs
- Review and comment on Integrated Grid Planning inputs
 - Resilience objectives and measurement criteria
 - Assumptions and threat scenarios
 - Resilience strategies

Meeting Handouts

- Agenda/Chatham House Rules
- Topical outline of final report
- List of organizations and individuals on RWG for inclusion in final report

Overview of Integrated Grid Planning (Chris Lau)

- This group is developing the inputs that we need in order to determine our future needs.
 - Identifying the system needs is expected to happen 6 months from May 2020, so near the end of 2020 Hawaiian Electric will start to draft the RFPs
- Those future needs will determine the procurements and programs.
- Those will then be evaluated to determine the best set of resources.
- The final stage is regulatory approval.

Stakeholder Engagement in Integrated Planning (8:50am)

(These three categories continue to rise to the top when utility customers have been asked about their concerns. There are multiple working groups under each of these categories.)

1. Affordability
 - Standard Contract
 - Competitive Procurement
2. Reliability
 - Forecasts and Assumptions
 - Distribution Planning
 - Resilience
3. Energy Choice
 - Grid Services
 - Solution Evaluation and Optimization

Resiliency Working Group Role (Steward Chong)

- **Support the development of resilience planning criteria for Hawaii's power system including resource, transmission and distribution, in relation to potential societal and economic impacts.**
- Identify and prioritize resilience threat scenarios and potential grid impacts
- Identify key customer/infrastructure sector capabilities and needs following a severe event and loss of power
- Identify gaps and priorities in grid and customer capabilities following a severe event and loss of power
- Provide recommendations and inputs for integrated grid planning to address resilience needs
- Recommend additional grid and customer actions to close gaps in capabilities following severe events

Resilience Working Group Meetings

- **July 22, 2019** - Introduce Resilience Working Group topics and get initial input/thoughts
- **August 29, 2019** - Review needs and existing capabilities of critical infrastructure/customer segments under a severe hurricane scenario. Get preliminary consensus on resilience process
- **September 17, 2019** - Define severe event priorities. Identify/map potential impacts of all hazards. Identify/assess/discuss mitigation options
- **October 28, 2019** - Mapping of threats, vulnerabilities, key customer needs and capabilities as compared to grid. Review planning criteria/scenarios
- **November 22, 2019** - Review outline of final report
- **December 16, 2019** - Review final written report. There will be a 4-week RWG review and comment period through January 10. Consensus/acceptance by RWG. Consider minority views

Resilience Working Group Membership

- [insert list here]

Defining Resilience (Gerry Cauley) (Slide 14)

“Resilience is the ability of a system or its components to adapt to changing conditions and withstand and rapidly recover from disruptions. “ – PUC Staff, PBR Docket

Key elements

- Ability to minimize impacts of severe events
- Ability to sustain mission critical functions under severe conditions
- Ability to rapidly recover from a severe event
- Ability to learn from severe events and continuously adapt

Gerry reviewed a graph to illustrate how the severity of consequences and frequency of events challenge our ability to be resilient.

Comments from the group:

- Does the definition of resiliency include the changing conditions (such as solar and wind)?
 - Resilient today is different from resilient tomorrow with rising sea levels, energy sources, and frequency of storms.
 - What do you need to do to achieve a certain level of resilience when the construction of the grid is different? We are going to change our distribution and resources. We need to incorporate the changing environment.
- Also consider the price environment. Changing conditions and resources affect prices. Cost is an important objective and factor we’re trying to achieve in our plan. (9:12am)
- This process allows us to make smart decisions about trade-offs.
- We want to build resiliency for today and tomorrow. This plan is trying to consider all of these angles and how they’re changing.

Discussion Questions: Role of RWG and Definition of Resilience

1. Is the Integrated Planning Process sufficiently understood, particularly stakeholder and RWG roles?
2. Are the goals and objectives of the Resilience Working Group understood and acceptable to the RWG?
3. Are there any concerns with the final report review and acceptance process or outline of the final report?
4. Are the definition of grid resilience and description of the elements of resilience acceptable to the group?

Resilience Threat Scenarios (Gerry Cauley)

Gerry reviewed the work conducted by this Resilience Working Group and explained how it will be included in the final report.

The group provided feedback on a few of the slides.

Slide 20 - comments from group

- Include Oahu in the effects from Iniki as the Waianae Coast was also affected.
- Include Hurricane Lane with a statement that the circumstances that caused the dissipation of Lane are not necessarily repeatable. Had it hit us, it would have caused 5 times the damage as the other hurricanes.
- Check spelling of Iwa.
- Philippines experienced 7 feet of rain in 3 days in 1911.

Slide 23

- Findings that will be included in the report:
 - 12 threat scenarios for study, 4 per county
 - Moderate + severe conditions for each; volcano requires 1 scenario (23 total)
 - High impact scenarios capturing damage to electric and key customer infrastructure
 - Fuel supply is an issue for all scenarios with extended outage times
 - Combined cyber and physical security into one hybrid threat

Comments from Group:

- What explains the change from cyber and physical attack on Hawaii Island from September Meeting to October Meeting?
 - Considering the potential threat and difficulty of restoration if a physical attack were to take out a grid, it made sense to include it for all three of the major islands. (9:25am)

Slide 26 - Questions from Group

- Why would 25-30% of transmission lines take the same amount of time--four months--to be restored as the 50-75% of distribution lines?
 - There are many more distribution lines, which explains why it is likely that more will be disrupted, and they are more easy to replace.
 - These numbers are our best guesses and estimations. We cannot really know what the effects will be, though, we do know that they'll be very location specific. This is only a scenario starter.
 - These numbers will be reviewed and critiqued further.
- Why would we plan for a Category 2 storm? Why not simply plan for a Category 4 and assume all bases are covered? Looking at the worst cast is sufficient to ensure our

resilience. Discussions of lower probability of a Cat 4 makes the argument that we don't really need to plan for that one, yet we do. Even the legislature is planning for Cat. 3.

- The moderate cases (that we present for each of the 5 threats) are much more likely to hit and with more frequency than the severe threats. Looking at the associated costs, it's important to consider the probability or frequency of the event when deciding on investments. Resiliency for Cat. 2 is going to come at a far lower cost than a Cat 4. So it makes sense to optimize the limited costs. We look at options for portfolios. Successful solutions go in one direction and solve a lot of problems. This is not target setting or benchmark setting. this will help us make sure that our solutions are going to work for a range of scenarios.
- The consequences are so similar between these two Categories that parsing them doesn't necessarily make sense.
- We are not going to set the standard for what kind of magnitude storm we are going to survive. How does one solution set improve resilience as compared with another as a relative statement. Value gained versus the cost spend. It seems like it's valuable to set pegs in the ground. This is just a stress test to give us an income.
- To make it more relevant to the customer, you may want to say substations rather than distribution lines.
- In the moderate, we may be underestimating the effects--for example, roads being cleared in 3 to 4 days is not likely even for major arteries. These issues have cascading consequences.
 - A former Honolulu C&C Arborist was contacted to find out if this estimate was accurate, he said that with the State, C&C, and HECO all having the equipment and crews to clear roads, that 3 to 4 days is reasonable for most major arteries. Likelike and Pali may be different because of the amount of trees that line those roads.
- The flood damage will affect fuel storage, piping and loading racks, which will affect fuel supply and create a hazardous materials situation. It will take more than 3 to 4 days to be ready to supply fuel as shown in Cat. 2.
- Effects on harbors need to be considered for all islands.
- Add loss of generation to the list of effects - Windmills and solar panels tend not to survive storms very well.
- This report will be used by the greater IGP.

Slide 32 - Cyber

- Mark will provide comments re: 24 hours

Discussion Questions: Selection of Threat Scenarios for IGP

1. Are the 12 threat scenarios (4 per county) a good set of events to challenge the grid and key customers?
2. Do the descriptions of the potential impacts of the severe events appear to reasonably describe future expectations?
3. Are the scenarios described sufficient and reasonable for evaluating grid resilience performance for the future?
4. What other comments do you have on what you heard?

Jupiter Intelligence - Probabilistic Forecast Modeling (Josh _____)

Who is Jupiter?

- Venture capital startup that wanted to do something about changing extremes from climate. They are focusing on multiple perils. Primarily for the private sector, but also doing some public sector work. They're projections are mainly around flooding, but there's some around extreme heat, wind, and wildfires.
- Their goal is to take the best available science and make it usable for the most people.
- They provide granular data based on location and the perils, present it probabilistically in a way that's relevant to various users. Everyone consumes this information differently.
- With HEI - Jupiter provides data that allows HEI to conduct qualitative analysis.

How Jupiter Does it Differently

- Understanding that some places will be experiencing more drought while other nearby places will experience flooding, looking at the mean is not very useful when planning for those events. Additionally, there may be fewer storms, but when they come, they're more intense.
- Jupiter provides dynamic analyses that look at sea level rise, tides, surge, and waves, and acknowledges that these all look different at different locations.
- Their wind analysis can also provide direction data.
- Jupiter has not been asked to do a compound analysis where flooding meets storm surge. Their technology can create that, but the probability is too difficult to calculate to know if it's worth it generating the scenario.

Customer Priorities and Needs

Criteria for Identifying Customers/Sectors (Slide 37)

- Tier 1
 - Essential for national security and/or public safety and health
 - Essential for power system restoration

- Power should be restored within hours up to several days (by utility or backup resource)
- Tier 2
 - Important for national security, public safety and health, and other essential services
 - Supports power system restoration
 - Power should be restored within minutes up to several hours (by utility or backup resource)
- Tier 3
 - Remaining customers

Suggested Priorities for Customers/Sectors (Slide 38)

(The items that the group suggested or asked about are in Italics.)

This conversation was and should be based on urgency rather than importance.

- Tier 1
 - Military
 - Telecommunications
 - Hospitals and critical healthcare
 - Water and wastewater
 - Emergency management and first responders
 - *Harbors & Airports*
- Tier 2
 - Transportation *and other energy infrastructure*
 - Hospitality
 - Banking and finance
- Tier 3
 - Remaining customers

Summary of Backup Power and Fuel Capabilities (Slide 39)

- *Include Other fuel facilities in the list of Summary of Backup Power and Fuel Capabilities.*

Customer Sector Need vs Capability (Slide 40)

- The number of military facilities are small in number but their capabilities vary and may be significant.
- EMAs need to shift to the left as they have higher capabilities to recover on their own.
- Installation energy water plans will be determining mission critical assets. Our ability to maintain our mission will be capable, but not all base services. DOD's military target is for 14 days functioning.

Oahu Critical Facilities (Slide 42)

- Concentrated in Honolulu and south shore
- Others distributed in central and shore areas
- Generation southwest with resources at Schofield and Honolulu
- Renewables distributed across island
- Transmission backbone west to east along south
- *At what point do we look at spatial diversity of generation and transmission? Do we want generation on other parts of the island? Pro-actively look/ask for these projects. These types of recommendations are what this process is aiming to get to.*

Hawaii Island Critical Facilities

- Concentrated in Hilo and Keahole
- Transmission ring with connectors across
- Power plants at Hilo and Keahole
- Renewables distributed in south and across island

Maui Island Critical Facilities

- Generation at Maalaea and Kahului
- Critical customers in Kahului area and resorts along west coast

Lanai Island Critical Facilities

- Central generation with radial distribution
- Limited critical customer sites

Molokai Island Critical Facilities

- Central generation with radial distribution
- Limited critical customer sites

Critical Customer/Sector Opportunities to Improve Resilience under Scenarios Identified

- Backup power supply at all critical sites
- Regular testing and operation of backup units
- Consider increasing fuel storage for backup units
- Consider alternative technologies for the most critical sites, including microgrid, renewable and storage, grid-forming inverters, other clean fuel black start units
 - *Grid-forming inverters - almost all solar and wind sites, when the substation goes down, they don't produce any power. There is a technology that allows them to maintain frequency and voltage when the main grid goes out. It's possible, more challenging and expensive just not commonly done.*
 - *In their Stage 2 RFP, the utility has asked renewable generating facilities to have the ability to have grid-forming inverter capabilities.*

- *Efficiency measures need to be considered more. Controllable curtailment as well as efficiency.*
- *Another option is to consider moving essential functions to another location.*

Resilience objectives

- Maintain critical functions
- Limit fatalities and human suffering
- Limit infrastructure damage
- Limit property damage
- Limit cost/economic impacts
- Limit environmental impacts

Grid Opportunities to Improve Resilience

Characteristics and Vulnerabilities of Existing Electricity Infrastructure – O’ahu

Characteristics

- More linear system
- Load concentration in Honolulu
- Generation concentration in one location

Major Vulnerabilities

- Transmission disruption
 - Towers and poles damaged
 - Difficult access in some areas
 - Limited spares
- Generation flooding
- Fuel disruption

Potential Options for Long-Term Plan (Slide 55)

Some Worst Case Scenarios May Have Weeks to Months for Full Restoration

Generation

- Fuel supply
- Harbor and port facilities
- Decentralized resources
- Microgrids

Transmission

- Spare material and supplies
- Access to difficult sites

- Availability of helicopter support
- Resources – personnel, equipment, tools

Distribution

- Spare material and supplies
- Access (road clearing)
- Resources – personnel, equipment and supplies

Jupiter Demo (During lunch break)

Inputs to Integrated Grid Planning Process

Overview of HECO's Integrated Planning Process (slide 60)

- HEI will decide how to take and use all these planning inputs.
- Provide Guidelines for considerations
- Quarterly updates of this group - 4 to 5 meetings over the next 18 months. When the group was asked if this was something they'd be willing to invest time in over the next 18 months, the group largely agreed.
- What are the other avenues for continuing to offer input?
 - There are other stakeholder working groups
 - Stakeholder Council - the group that looks at everything and provide strategic input to utilities.

Objectives - What do Customers Want? (slide 61)

- Affordability
- Resiliency
- Renewable Energy
- Stability
- Reliability
- Economic Development
- Sustainability
- At the end of the 18 months, there will be multiple scenarios to consider. How well do the strategies match up with the objectives?
- Resilience v. Affordability
- Resilience index measures how well a resilient grid performs under proposed severe threat scenarios. It is used to make comparisons among various strategies and options. The index is not a utility target or requirement – simply a measuring device to compare how well different solutions perform under severe circumstances.

- The group asked for a resilience metric beyond just cost. Proposed: Resilience Measures and Composite Index. Sample resilience index measurements (how to measure if survive the fall and how quickly we get back up):
 - What percentage of various Tier customers are back within a certain amount of time?
 - Many of these tiers are geographic-based, rather than classes of customers. There's the main load centers and remote load centers. We're gonna have to look at alternatives in order to be able to do this geographically.
 - If we do a resilience index, it has to be separated between those two scenarios.
 - Also consider the weight and cost of the outage.
 - Group agreed to a separate meeting to discuss how to create a logical and useful metric.
- How can we expand the portfolio of solutions and investments beyond HEI to the rest of the members present? What can HEI do by itself? What can be done with other types of investments?
- Consider both. HEI investments as well as others' contributions, such as Hybrid Microgrids with assets from HEI and other resources.
- Water critical infrastructure is all over the place, so it's very expensive to have solutions solely from the utility. As grid resources disperse, they will be in a similar situation--a need to look to the larger community for support with resilience. For example, energy efficiency is a good way for communities to participate in resiliency.

Overview of HECO's Integrated Planning Process (slide 62) (12:21pm)

This process is less about the specific numbers and more about how one portfolio compares with other options or portfolios.

Closing Remarks (Stewart Chong and Colton Ching)

Next Meeting

December 16, 2019

American Savings Bank