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November 3, 2006

William A. Bonnet
Vice President
Government & Community Affairs

The Honorable Chairman and Members of the
Hawaii Public Utilities Commission
465 South King Street, First Floor
Kekuanaoa Building
Honolulu, Hawaii 96813

FILED
2006 NOV - 3 P 3: 40
PUBLIC UTILITIES
COMMISSION

Dear Chairman Caliboso and Commissioner Cole:

Subject: Docket No. 2006-0431
October 15-16, 2006 Outage Investigation

Pursuant to Order No. 22986, filed October 27, 2006, Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc. and Maui Electric Company, Limited (collectively the "Companies") respectfully submit a summary report of the Monday, October 23, 2006 public meeting regarding the outage and restoration of the electric power systems following the October 15, 2006 earthquakes. (See Exhibit I.¹) In addition, at the public meeting, the Companies made available: (1) a claim for damage and loss form, (2) Energy Tips & Choices booklets and (3) Handbook for Emergency Preparedness booklets. (See Exhibits II, III and IV, respectively.) A videotape and DVD of the public meeting is also enclosed. (One copy each of the videotape and DVD is being provided to the Commission and the Division of Consumer Advocacy.)

Sincerely,

William A. Bonnet

Enclosures

cc: Division of Consumer Advocacy (with Enclosures)

¹ Order No. 22986 required the Companies to file all documents provided at the Commission briefing on October 19, 2006 and the public briefing on October 23, 2006. The documents from the October 19, 2006 Commission briefing were submitted by letter dated November 1, 2006.

***A Summary Report of
The Public Meeting Held by Hawaiian Electric Company, Inc., Hawaii Light
Company, & Maui Electric Company Regarding the Outage & Restoration of
Electric Power Systems Following the October 15, 2006 Earthquakes
October 23, 2006
Hawaii State Capitol Auditorium***

This report is a summary of the public meeting held by the Hawaiian Electric Company, Inc. (HECO or Hawaiian Electric), Hawaii Electric Light Company (HELCO), and Maui Electric Company (MECO) on October 23, 2006 at the Hawaii State Capitol Auditorium. It is not meant to be a verbatim transcript of the presentation or subsequent public comment period.

Based on the enclosed list of people that signed-in (see Attachment A), approximately fifty people from the general public attended the public meeting.

The meeting began at approximately 2:10 p.m. with Robbie Alm, Hawaiian Electric's Senior Vice President of Public Affairs giving the opening remarks regarding the presentation. His pertinent points were:

- Hawaiian Electric has a detailed preliminary report on what happened. Hawaiian Electric has promised the Public Utilities Commission (Commission) that it would hire an outside industry expert to assist the company in finishing a more thorough investigation, which will be submitted to the Commission by the end of the year.
- Hawaiian Electric will cooperate fully with the Commission on any report or investigation that they request.
- This presentation is meant to be an initial presentation of the facts known to date. It is the same presentation that was made to the Commission on October 19, 2006.

Catherine Awakuni, Executive Director of the Division of Consumer Advocacy offered a brief statement:

- The Consumer Advocate will request a formal, independent investigation of the outages and has asked the Commission to open an investigation docket.
- The Consumer Advocate will retain its own expert for the investigation.

Representing HECO was Tom Joaquin, Senior Vice President of Operations; Tom Simmons, Vice President of Power Supply; Chris Shirai, Vice President of Special Projects; and Dan Giovanni, Manager of Power Supply Operations & Maintenance. Representing HELCO was Warren Lee, President. Representing MECO was Ed Reinhardt, President.

Tom Joaquin provided a brief description of the events that occurred at the Kahe, Honolulu, and Waiau Power Plants during and after the earthquakes. This was followed by a detailed PowerPoint presentation by the HECO, HELCO and MECO representatives. Tom Simmons began the HECO presentation with a detailed second-by-second incident chronology. He was followed by Chris Shirai who briefly described the deployment of an Incident Command organizational structure and communications with key government agencies and the media. Dan Giovanni then walked through the steps that were taken to restore power including the measures that were taken to restart the various units at the Kahe and Waiau power plants. Chris Shirai then explained that simultaneously, steps needed to be taken on the power distribution side to ready the system to deliver the power to customers. After the conclusion of HECO's presentation, Warren Lee and Ed Reinhardt described what happened to their respective island facilities and systems. The PowerPoint presentations for HECO, HELCO and MECO are enclosed (see Attachment B).

The public was then provided the opportunity to ask questions and offer comments. The first opportunities were given to anyone who had signed up to do so. After that, anyone who wished to pose a question or make a comment was given the opportunity as well. Below is a brief summary of each person's comments and any responses from the corresponding utilities' representative.

Speaker 1. Comments/Questions:

- The natural tendency is to ascribe blame, but it seemed that Hawaiian Electric worked very well through the blackout, responders acted competently, doubts that anyone could have done better.
- Part of the problem is the current reliance on human beings and their ability to react quickly enough to make timely and accurate assessments of the situation at hand. The system losses and subsequent complete system shutdown could have been prevented if computers had been making the decisions rather than human operators. The use of microprocessors and computers could have avoided human errors. Operators may have taken action where none was required. Recommend that more computer decision-making be employed rather than relying on human reaction time, especially with respect to the timing of load shedding. Recommend that Hawaiian Electric use computer systems to help with the complexities of balancing load and generation when restoring power.
- Recommend that the utility use RF or radio frequency for communications during a blackout rather than traditional phone systems.

Response by Tom Joaquin:

- Acknowledged the speakers comments and stated that these issues would be examined.
- He also reiterated his belief that the utility's operators responded properly and as trained.

Speaker 2. Comments/Questions:

- The State's Civil Defense Plan calls for a different set of power restoration priorities than that followed by Hawaiian Electric in the wake of the blackout.
- Does not make sense to restore the entire system simply from west to east. Hawaiian Electric should have restored power to the harbor, airport and other crucial areas first, rather than neighborhoods closer to the power plants that were first brought back on line.

Response by Robbie Alm:

- The company restored power to crucial areas and facilities as they were able to—as well as to neighborhoods along the restored grid routes as they came back on line. However, the question of whether Hawaiian Electric's emergency power restoration plans and the State's Civil Defense plans are in agreement is a valid one and that will be addressed in the review.

Speaker 3. Comments/Questions:

- The speaker noted that he is in the communications field and worked with most of the utility's presenters at one time or another when he worked at Hawaiian Electric.
- The speaker expressed strongly his belief that Hawaiian Electric failed to communicate in a timely manner with the public and that it was approximately four hours before the general public had a thorough update from the utility regarding the situation.
- What has Hawaiian Electric done in the week since the blackout to improve the communications system and process to assure that Hawaiian Electric would be able to communicate more effectively with the media should another emergency event occur?
- The communications problem was not caused by telecommunication equipment, but rather by people and lack of people-to-people communications.
- Hawaiian Electric should have had private phone numbers for media contacts. This would have enabled Hawaiian Electric to provide information more quickly to the media. Recommend that this "unpublished" media contact list be in place so that Hawaiian Electric does not have to rely on standard media contact numbers and lines that will already be clogged due to an emergency situation.

Response by Robbie Alm:

- Hawaiian Electric is looking at the telecommunications infrastructure issues as one area for improvement.
- He also stated that the other issues raised; on content, phone numbers and speed would also be examined.

Speaker 4. Comments/Questions:

- What happened to the hydraulic systems at Kahe (the turbines whose hydraulic systems automatically shut off)?

Response by Tom Simmons:

- The “lock out” protections automatically took the pumps out of service. Hawaiian Electric is investigating the cause.

Speaker 5. Comments/Questions:

- The vibration sensors and the automatic “trip” may have been designed to detect individual machine problems and not an earthquake. The sensors are not sensitive enough to distinguish between vibrations caused by an earthquake and those caused by machine problems. If they were, then the generators would not have tripped off and forced the eventual shut-down of the entire system.

Response by Tom Joaquin:

- Clarified that the generators did not automatically trip off as a result of the vibrations, but that the operators took the generators off-line in response to the alarms and indicators. This action did not cause the blackout.
- Some phenomenon caused the hydraulic pump to shut down and Hawaiian Electric is investigating this matter. The loss of these units did lead to the blackout.

Speaker 6. Comments/Questions:

- The automatic shut down of the hydraulic pumps was not needed.
- It appears that the load shedding system was severely inadequate. The system should have been able to shed load quickly enough to stabilize the system to prevent an entire blackout.
- Everyone makes mistakes and Hawaiian Electric needs to learn from them.

Response by Tom Joaquin:

- The investigation is meant to show whether the load shedding system was adequate.

Response by Robbie Alm:

- Acknowledged that there are lessons to be learned. That is why Hawaiian Electric is having an investigation done by independent parties.

Speaker 7. Comments/Questions:

- The speaker expressed frustration with Hawaiian Electric because of how late their messages were in coming and that they weren't simple and to the point. The public's primary concern is, "When will my electric power be restored?" Hawaiian Electric failed to engage in simple, straightforward communication with the public. The following sample public statement could have been used:

"In the event of an earthquake there may be a blackout of eight to 24 hours. Power will be restored generally from west to east across the island. Hospitals, military installations, airports and other important facilities will be restored earlier. There will be pocket outages that persist; your patience is necessary."

Response by Robbie Alm:

- Acknowledged that Hawaiian Electric did not do a good enough job communicating with the public.

Speaker 8. Comments/Questions:

- Appears that the system was not designed to handle an earthquake of this magnitude. What level of earthquake is the system designed to handle? Can the system be designed and tested to handle this level of earthquake or greater? The Neighbor Islands have a larger number of smaller units; would this make for a more reliable system?

Response by Tom Joaquin:

- Oahu has a bigger system and bigger units primarily because larger units are much more efficient.

Response by Robbie Alm:

- Smaller generating systems will be looked into.

Speaker 9. Comments/Questions:

- Was a tsunami generated? As a Windward resident, the speaker was concerned that she did not hear a siren. The speaker recognized that Hawaiian Electric was probably not the entity to ask, nor were they responsible for the alarm system.

Response by Robbie Alm:

- He believes he heard that a very small one was generated, but it did not lead to an alarm being sounded.

Speaker 10. Comments/Questions:

- Appears that the hydraulic pumps caused the problems.
- The HELCO and MECO presentations were very good; the HECO presentation was not good at all. It was too complicated and difficult to follow for laymen. The speaker questioned how many in the audience understood the presentation and approximately 10 individuals raised their hands.
- Was there excessive salinity in the hydraulic system? Frank Montgomery built the sensor system at Kahe Power Plant and the speaker was responsible for monitoring the system about 25 years ago.
- It is an unusual system because it uses circulating water.
- Request that the final report from Power Engineers be made available in the public libraries.
- Recommend that Hawaiian Electric get permission to build more transmission lines and power production units to better avert future island wide blackouts.

Response from Robbie Alm:

- Assured the speaker that Hawaiian Electric will make the report available to him and to the public.

Speaker 11. Comments/Questions:

- Hawaiian Electric is doing a great job.
- The problems were with hydraulic pressure and steam, etc. Was all the equipment maintained and inspected properly?

Response by Tom Joaquin:

- Hawaiian Electric looks at industry best practices. This is part of the investigation. The initial assessment is that Hawaiian Electric was conforming to industry standards and not in violation of any criteria.

Speaker 12. Comments/Questions:

- Is there a difference in the design of systems due to areas having higher or lower earthquake probability ratings?

Response by Tom Joaquin:

- Oahu's system was built to conform to Hawaii's building codes and he believes that it is basically more demanding than others across the United States. However, he is not sure if there are differences in system designs due to higher levels of earthquake probability.

Response by Robbie Alm:

- As an "essential facility," power plants are constructed to higher standards.

At this point there were no more questions from the public. Robbie Alm thanked the attendees and stated that Hawaiian Electric plans to have the final report completed and available to the public by the end of the year. The meeting closed at approximately 4:10 p.m.

In addition to the list of people that signed-in at the public meeting, Attachment A includes a list of people that signed up to speak at the meeting and a list of people that would like to receive the final report.

10-23-06 HECO Public Briefing on Earthquake Event
Attendance Sign-In

First Name	Last Name	Organization	Mailing Address Optional	City	Postal Code	Email Address
Barbara	Guss	Adecco	1001 Bishop St., ASB Tower, Ste 2370	Honolulu	96813	
Don	Marshall	Brinderson Corp.				
Doug	Carlson	Carlson Communication	1516 Halekua Drive	Honolulu	96821	yourchore.blogspot.com
Gail	Myers	City Council				
Brysen	Poulsen	Consumer Advocate	335 Merchant St., Rm 326	Honolulu	96813	
Catherine	Awakuni	Division of Consumer Advocacy				Catherine.P.Awakuni@DCCA.hawaii.gov
Don	Ho	DOT	869 Punchbowl St.			
Mike	Fitzgerald	Enterprise Honolulu	737 Bishop St.	Honolulu	96701	
Alex	McGehee	Enterprise Honolulu	737 Bishop St.	Honolulu	96701	
Sophia	Tang	FAA HNL District Office	760 Worcester Ave	Honolulu	96818	
Stuart	Sakai	Fed. Aviation Administration	760 Worcester Ave.	Honolulu	96818	
Gail	Nishimura	Ferguson Enterprise	801 Moowaa St.	Honolulu	96817	
Sumner	Howard	GET, INC.				
Malia	Zimmerman	Hawaii Reporter	1314 S. King St., #1163	Honolulu	96813	
JoAnn	Schindler	Hawaii State Public Library System	44 Merchant St.	Honolulu	96813	
Danielle	Douglas	House of Representatives				
Jim	Harwood	Manoa Neighborhood Board	1928 McKinley St.	Honolulu	96822	
Stefanie	Sakamoto	Office of Rep. Blake Oshiro				
Janis	Higaki	Office of Rep. Chong				
Tommie	Suganuma	Office of Rep. Cindy Evans	State Capitol, Rm 311	Honolulu	96813	
Blayne	Higa	Office of Rep. Sylvia Luke				
Chris	Lee	Office of Rep. Sylvia Luke				
Michelle	Ching	Office of Sen. Espero				
Allison	Yanagi	Office of Sen. Ige				
Mel	Ah Ching	Office of Sen. Stom				
Cherry	Torres	Office of Senator Norman Sakamoto	State Capitol, Rm 230	Honolulu	96813	
Daniel	Barzhill	Pacific Rim Energy Partner	1001 Bishop St., Ste 2225, Pauahi Tower	Honolulu	96813	
Alan	Lloyd	Private Citizen	303B Kaelepulu Dr	Kailua	96734	
Stacey	Djou	PUC				
Hank	Schmall	Retired	180 Karsten Ave	Wahiawa	96797	
Harry	Blanchette	SMRG				h.blanchette@capito.hawaii.gov
Gail	Gilman	The Gas Co.	PO Box 3000	Honolulu	96802	
J.M.	Comcowich	UH/SOEST				comco@hawaii.edu
Courtney	Brown		1164 Bishop St, Ste 124-1	Honolulu	96813	
Ted	Chinn					
Pamela	Clegg		45-003 Holowai St.	Kaneohe	96744	
Bevna	Dates					
Marian	Grey		243 Alinahau St.	Honolulu	96825	
Al	Hoffman		686 Hakaka St.			
Charles	Jones					
Rick	McQuain		1212 Nuuanu Ave., #605	Honolulu	96817	

10-23-06 HECO Public Briefing on Earthquake Event
Attendance Sign-In

First Name	Last Name	Organization	Mailing Address Optional	City	Postal Code	Email Address
Mureen	Muraoka					hkaimima@hotmail.com
F. William	Pelzer		1420 Victoria St., #1304	Honolulu	96822	
Greg	Robinson		POB 240173	Honolulu	96824	
Martha	Shirai		2717 S. King St., #201	Honolulu	96821	
Allen	Shiroma					
Judy	Tanouye					
Roger	Wickenden		974 Apokula Pace	Kailua	96734	
Media who signed in:						
Mark	Nesse	AP				
Richard	Walker	Honolulu Star-Bulletin				
Greg	Wiles	Honolulu Advertiser				
BJ	Reyes	Honolulu Star-Bulletin				

10-23-06 HECO Public Briefing on Earthquake Event
Speakers/Comments

First Name	Last Name	Organization	Mailing Address Optional	City	Postal Code	Email Address
F. William	Pelzer		1420 Victoria St., #1304	Honolulu	96822	
Courtney	Brown		1164 Bishop St, Ste 124-1	Honolulu	96813	
Doug	Carlson	Carlson Communication	1516 Halekoa Drive	Honolulu	96821	yourchore.blogspot.com
Jim	Harwood	Manoa Neighborhood Board	1928 McKinley St.	Honolulu	96822	
Roger	Wickenden		974 Apokula Pace	Kailua	96734	
Martha	Shirai		2717 S. King St., #201	Honolulu	96821	
Charles	Jones					
Judy	Tanouye					
Hank	Schmall	Retired	180 Karsten Ave	Wahiawa	96797	
Allen	Shiroma					
Charles	Jones					

10-23-06 HECO Public Briefing on Earthquake Event
Report Request

First Name	Last Name	Organization	Mailing Address	Optional	City	Postal Code	Email Address
Hank	Schmall	Retired	180 Karsten Ave		Wahiawa	96797	



Earthquake Event

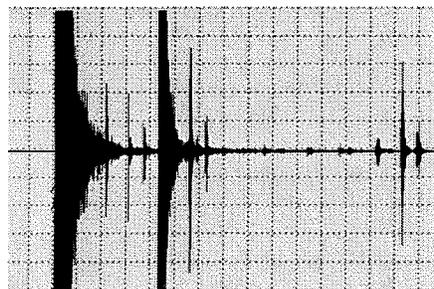
October 15 and 16, 2006

1



October 15, 2006 – Two Major Earthquakes West of Big Island

- 6.7 Quake (Actual Origin Time at Epicenter: 07:07:49.25)
– Arrival at Oahu Station: 07:08:23.75



2



Incident Chronology

- 7:08:23 6.7 magnitude quake arrives at Honolulu
- 7:08:23+ Quake triggers automatic shutdown of hydraulic fluid pumps on Kahe 5 and Kahe 6, setting in motion eventual loss of output on these units.
- 7:08:58 Kahe 3 operator feels building trembling, sees and hears many alarms. Operator responds as trained to initiate a trip of the unit. **See Slide 25**
- 7:09:06 Koolau-Wailupe #1 46 kV line trips due to insulator failure caused by the quake. **See Slide 30**
- 7:09:08 Honolulu 8 operator feels building trembling, sees and hears many alarms. Operator responds as trained to initiate a trip of the unit. **See Slide 28**



Incident Chronology

(continued)

- 7:09+ Kahe 5 and 6 and other units pick up load lost by Kahe 3 and Honolulu 8. System stabilizes.
- 7:11+ Kahe 5 output declining rapidly due to loss of hydraulic pressure resulting from earlier automatic shutdown of pumps due to the quake. System frequency declining.
- 7:11:51 Automatic load shedding removes about 13,100 customers from the system and stabilizes system frequency
- 7:12:48 Kahe 5 trips automatically to protect generator.
- 7:13+ Kahe 6 output declining rapidly due to loss of hydraulic pressure resulting from earlier automatic shutdown of pumps due to the quake. System frequency declining even further.



Incident Chronology

(continued)

- 7:14:02 Automatic load shedding removes about an additional 32,200 customers from the system to try to stop declining frequency
- 7:14:04 Kalaeloa steam turbine trips automatically on low frequency.
- 7:14:13 Automatic load shedding removes about an additional 29,700 customers from the system to try to stop declining frequency
- 7:14:21 H-Power trips automatically due to low frequency.
- 7:14:23 Automatic load shedding removes about an additional 59,000 customers from the system to try to stop declining frequency

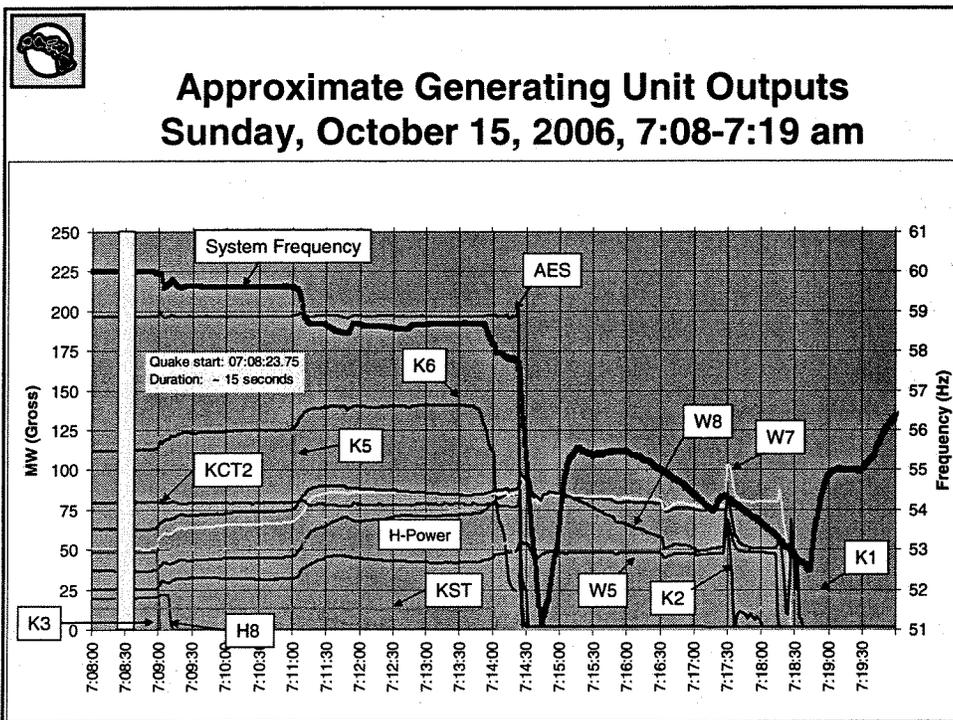
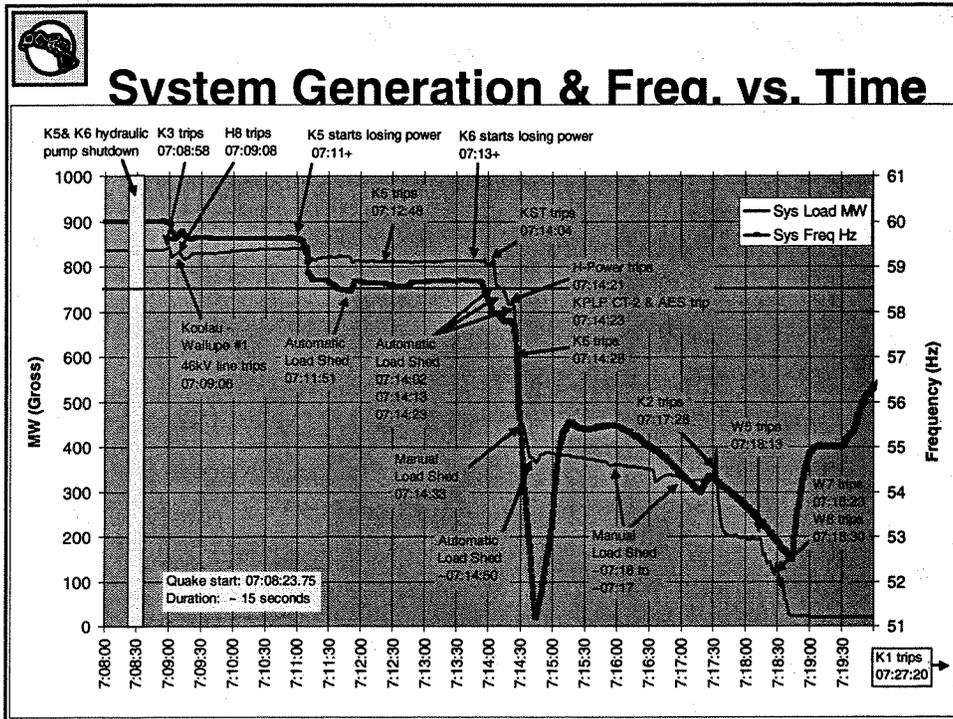
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Incident Chronology

(continued)

- 7:14:23 Kalaeloa CT2 and AES trip automatically due to low frequency.
- 7:14:28 Kahe 6 trip initiated by operator at near zero output.
- 7:14:30+ Kahe 1, Kahe 2, Waiau 5, Waiau 7 and Waiau 8 continue operating despite severely depressed system frequency (< 56 Hz).
- 7:14:33 Operators initiate manual load shedding to try to raise frequency and prevent total system outage
- 7:14:50 About an additional 4,700 customers automatically shed from the system on low voltage
- 7:17:28 to 7:18:30 Kahe 2, Waiau 5, Waiau 7 and Waiau 8 all lost on automatic boiler trip
- 7:27:20 Last remaining unit, Kahe 1, lost on automatic boiler trip
- 7:27:20 Island-wide blackout, less than nineteen minutes since the quake hit Honolulu





Preparing the System for Restoration

- Shortly after outage, black start units started up
- Began configuring the system for restoration
- Began mobilizing field crews
- Began inspections and damage assessments

9



Strategic Objectives

- Safety of public, employees and assets
- Restoration of generators
- Orderly restoration of system
- Verify integrity of transmission and distribution system
- Verify integrity of substation/switchyard
- ***Our actions shall be to operate for the long run***

10



Coordination with Government Agencies

- State of Hawaii
 - Governor's Office
 - Energy Council
 - State Civil Defense
 - Public Utilities Commission
 - Department of Transportation
 - Department of Commerce and Consumer Affairs
 - Department of Education
- City and County of Honolulu
 - Oahu Civil Defense
 - Honolulu Police Department
 - Honolulu Fire Department



11



Communications with Media

- Started trying to call the media as soon as island-wide blackout occurred
- Continued to update media throughout the day
- Press release – some hand delivered

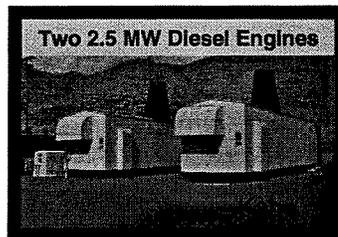
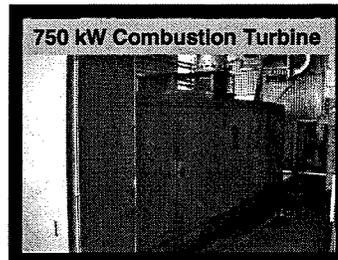
12



Waiau and Kahe Black Start Generators

Black starting energizes the grid at 60 Hz by connecting the first unit to a de-energized grid.

- Waiau
 - 750 kW Combustion Turbine
 - Black start W5 or W6
- Kahe
 - Two 2.5 MW Diesel Engines
 - Black start two 90 MW units (Kahe 1 or 2 and Kahe 3 or 4)



Starting a Black System

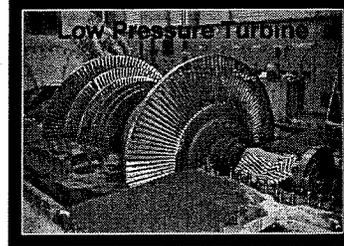
	<u>Approximate Time (hours)</u>
1 Generating units off line and secured. Conduct visual damage assessment.	0.5 - 1.0
2 Reconfigure auxiliary power systems and start black start diesel engine (Kahe)	2.0 - 3.0
3 Start up generating unit boiler and build steam pressure up to 600-800 psi; place turbine-generator on turning gear	0.5 - 2.0
4 Admit steam to turbine and roll turbine to 3,600 rpm	0.3 - 1.0
5 Synchronize main auxiliary transformer to auxiliary bus and unload black start diesel engine	0.4 - 0.8
6 Synchronize generating unit to de-energized grid	0.4 - 0.8
TOTAL	4.1 - 8.6

Actual time on Oct. 15, 2006 to start Waiau 6: 4.5 hours



Steam Units – Process for Starting and Loading

1. Start auxiliaries and purge boiler
2. Fires in, build steam pressure to 600 – 800 psi (turbine/generator on turning gear)
3. Pull condenser vacuum and roll turbine to 3600 rpm; verify acceptable vibration
4. Synchronize to system and stabilize at initial load
5. Increase firing to 20-30% capability; stabilize water chemistry and combustion conditions
6. Increase firing to 50-60% capability; stabilize water chemistry and combustion conditions
7. Unit good for 100% capability (“firm”); transfer to EMS control

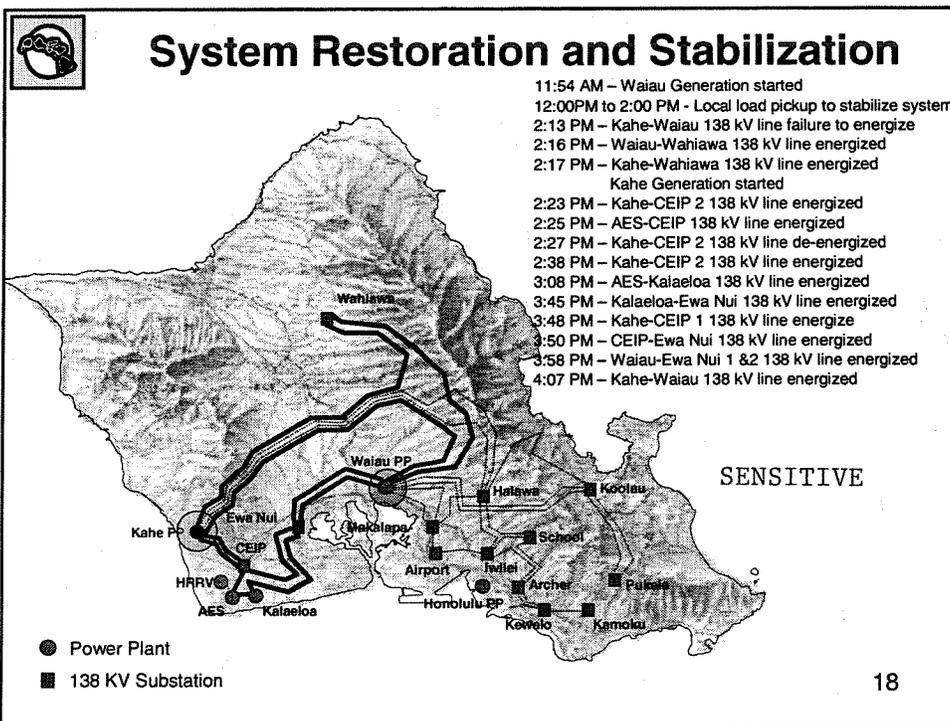
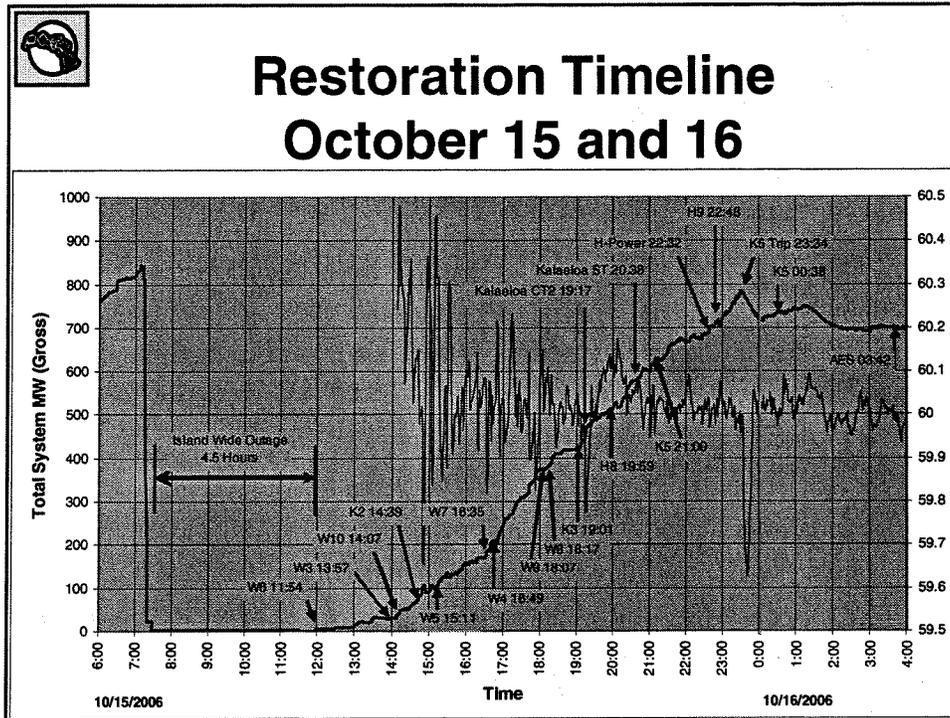


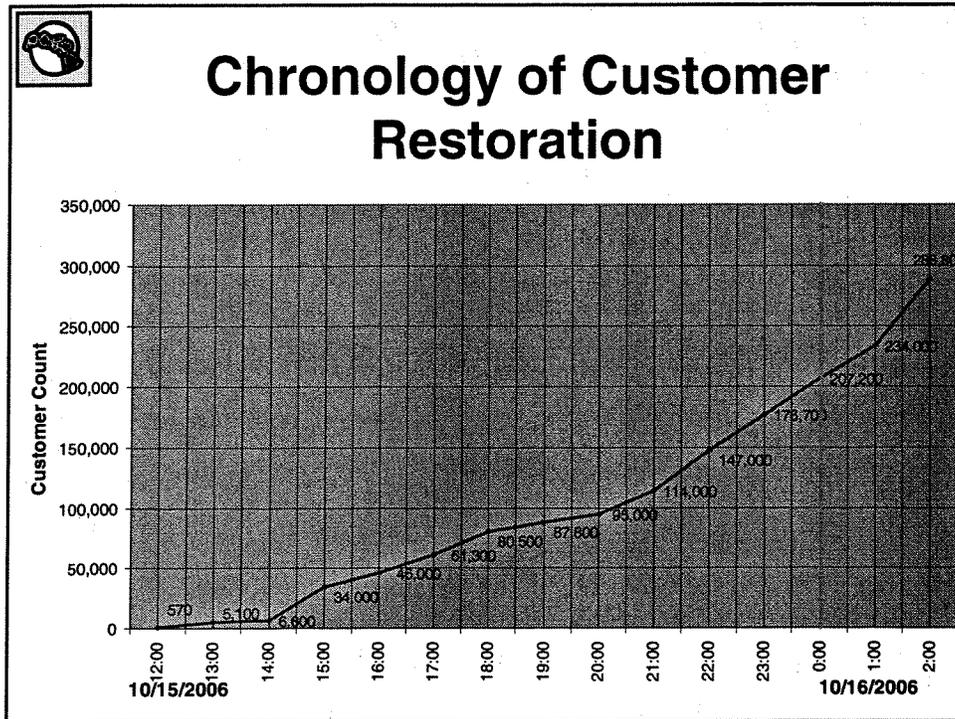
Factors Affecting Steam Unit Starting and Loading Times

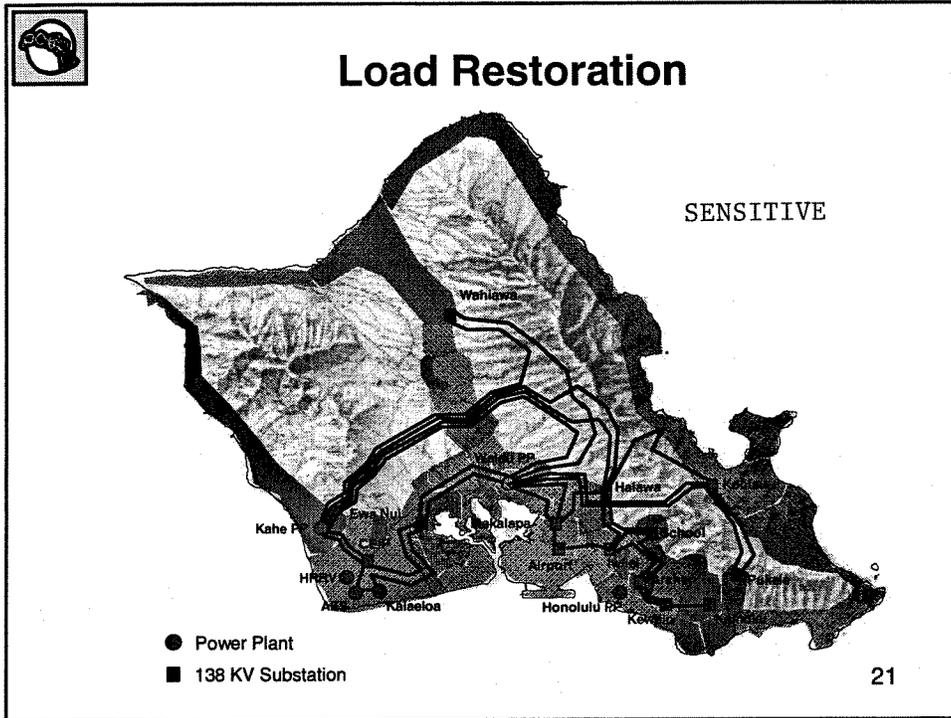
(Typically 2-24 hours total from cold start to firm status)

- Initial boiler drum level and pressure
- Cold, warm or hot condition of the turbine at the time of startup
- Boiler water chemistry determines permissible drum pressure and attemperation source
- Fuel oil temperature and viscosity prior to light-off
- Atomizing steam conditions for steam atomized burners
- Boiler purge sequence prior to ignition
- Number of burner guns in service
- Boiler combustion conditions
- Boiler steam conditions (pressure and temperature) before admitting steam to the turbine
- Boiler, turbine and voltage regulator controls on auto or manual
- Turbine eccentricity, differential expansion and vibration during the roll up to sync speed on startup

16

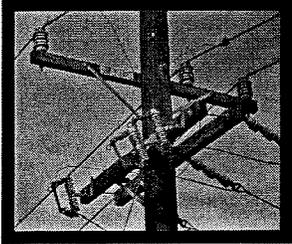






Pocket Outages

- At 1:55 am October 16th, all distribution circuits were energized
- More than 100 crew members worked through the rest of October 16th to get the approximately 2,200 customers affected by known pocket outages back in service



22



Next Steps

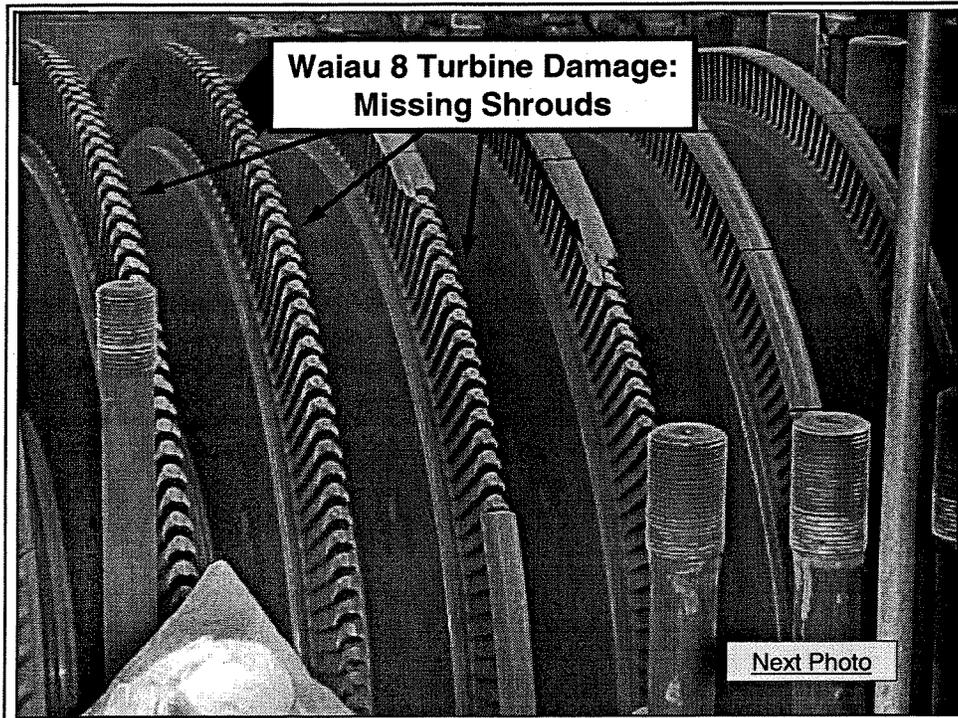
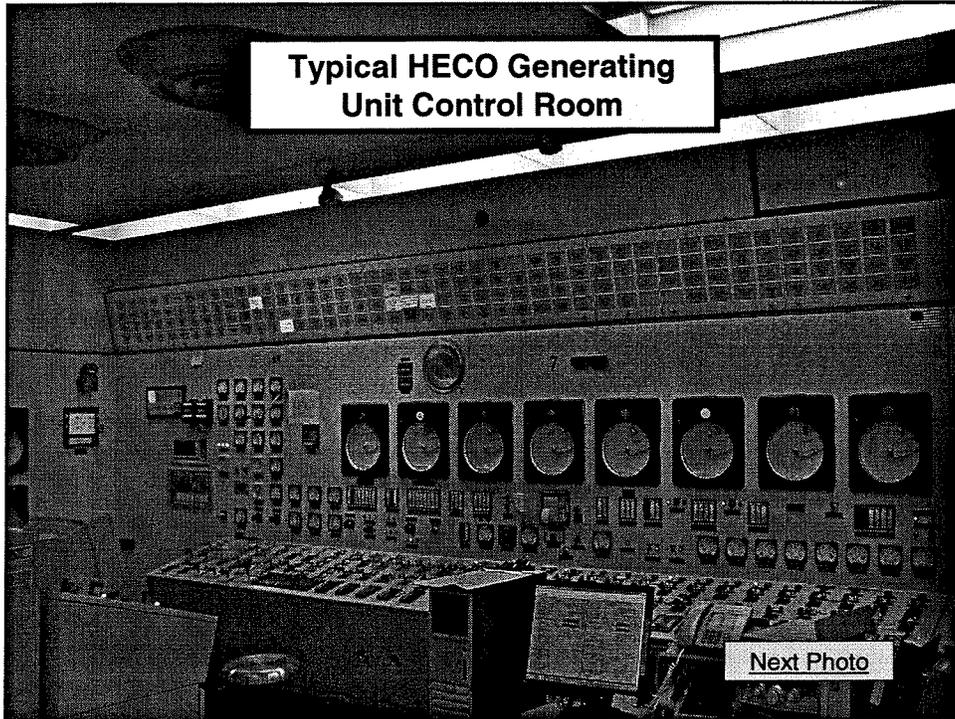
- Retain an industry expert organization to assist with our investigation
- Complete investigation and file report with PUC in December 2006

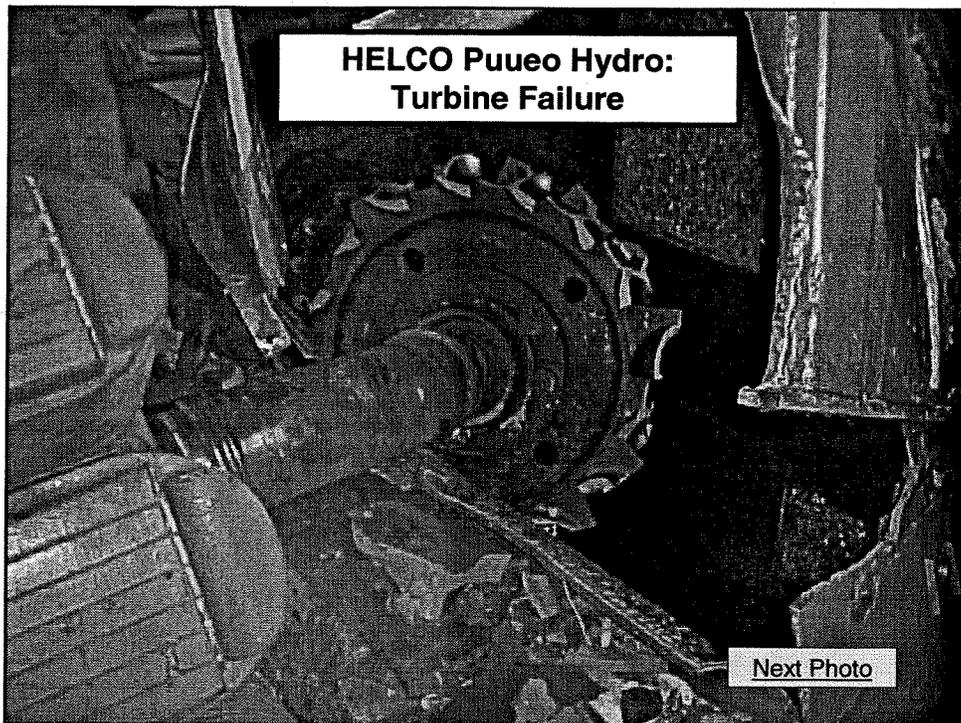
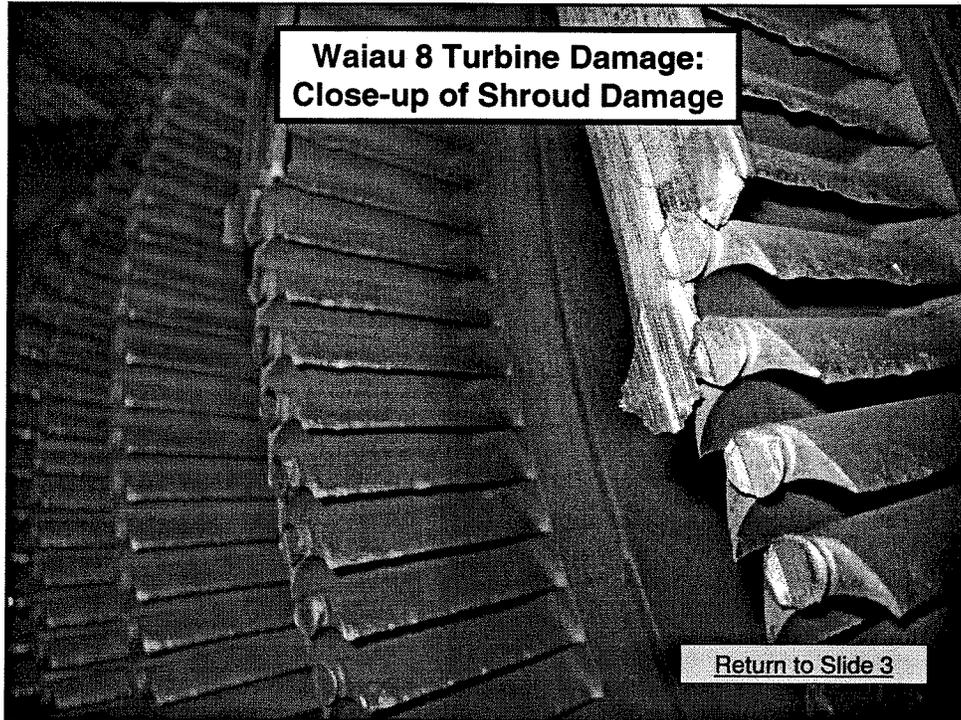
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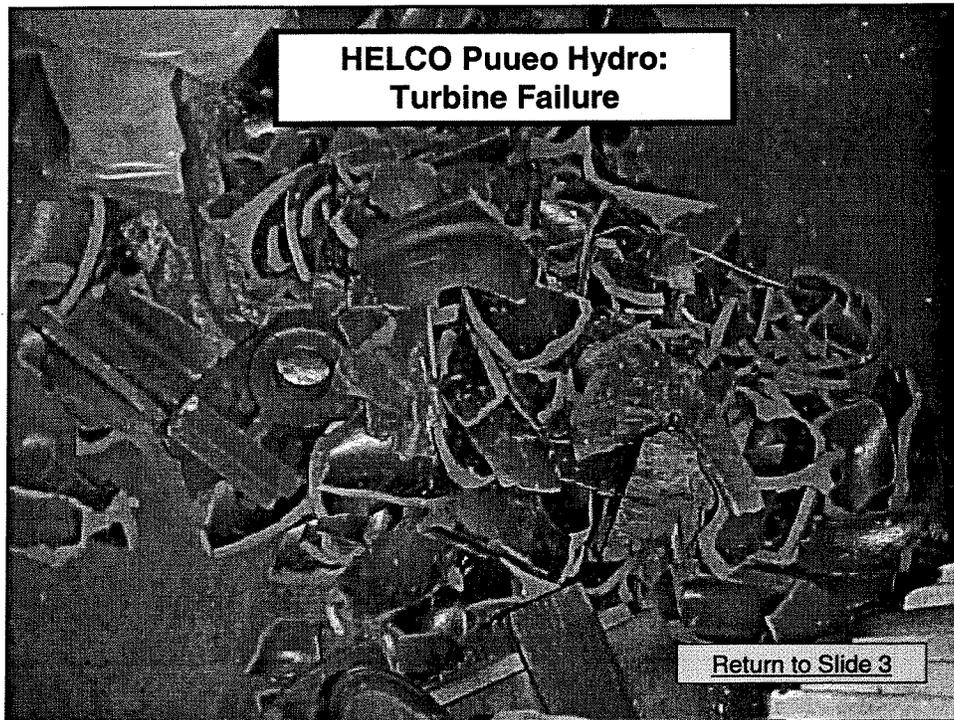


Thank You

24







Earthquake Damage

10/15/2006 07:09:06 46KV OCB 4467 (K001) TRIP

- The earthquake causes damage to the Koolau-Wailupe #1 46kV circuit causing it to trip off-line at 7:09 am



Return to Slide 3

30

The slide features a title "Earthquake Damage" and a list item describing a power line trip. A photograph shows a worker on a power line tower. A timestamp and event name are displayed above the list. A return button and the number 30 are at the bottom.

Hawaii Electric Light Company

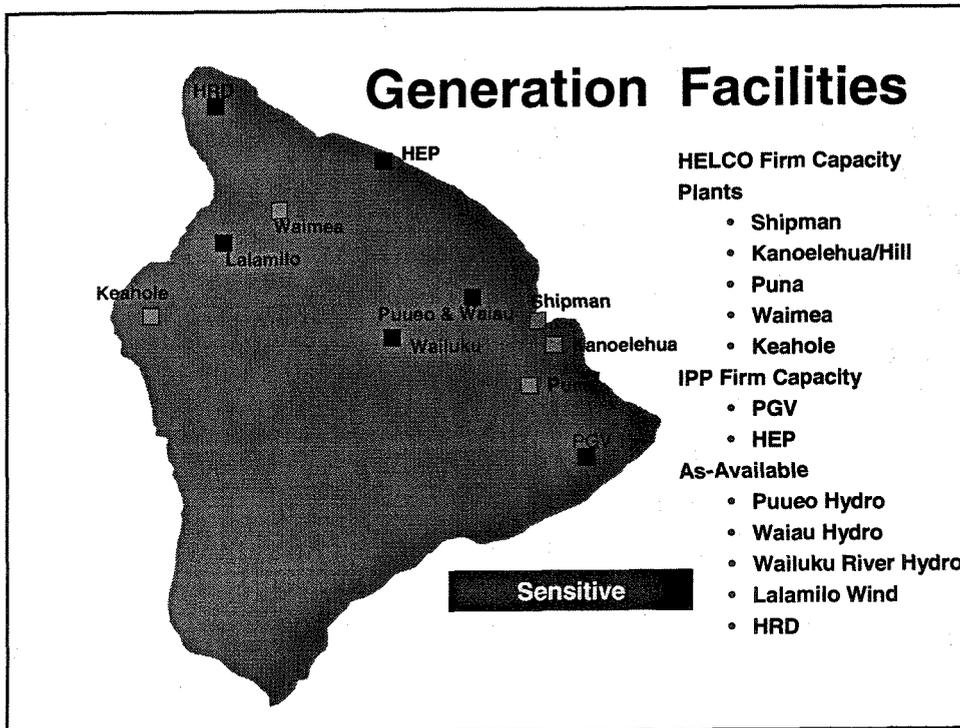
Power Interruption October 15, 2006

Status Prior to the Earthquake

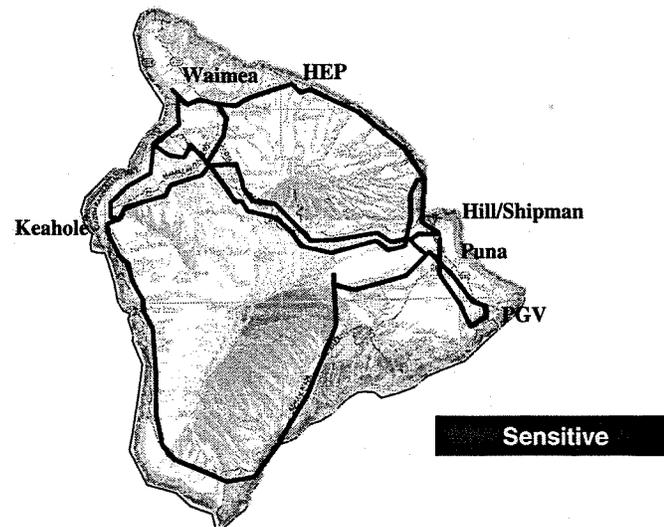
- On line at 0708 hrs - 125 MW
(approximately 76,000 Customers)
- Firm Generation Status
 - Total capability - 270 MW
 - Available capacity - 234 MW
 - Scheduled outage - 21 MW
 - De-ratings - 15 MW
- As Available Generation Status
 - Hydro Plants - 5 MW
 - Wind Farms - 0.0 MW

Status Prior to the Earthquake

- Transmission system
 - All operational & in service
- Distribution system
 - All operational & in service
- Switching station system
 - All operational & in service
- Substation system
 - All operational & in service

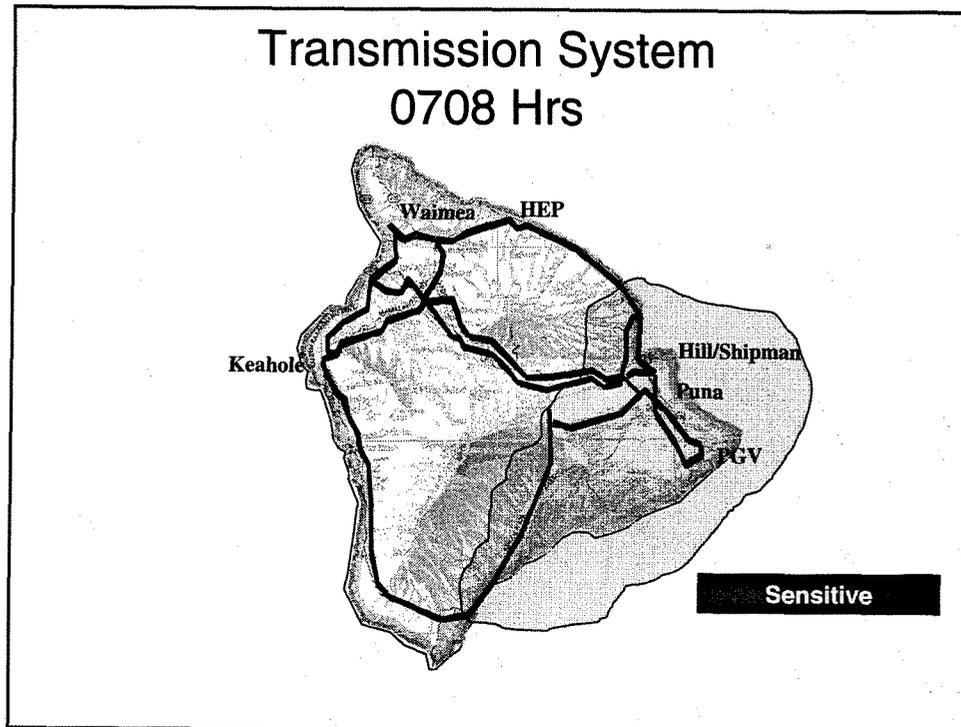


Transmission System



Incident – 0708 Hrs

- Earthquake occurs at 7:08 a.m.
- 19 transmission circuits trip open
- 60 distribution circuits to trip open
- 10 substation transformers fuses open
- Capacitor bank at Ouli Switching Station damaged
- Ten (10) spans on 3200 line (34 kv transmission line from Honokaa serving Paauilo substation) fail
- Insulator on 3300 line (34 kv transmission line from Waimea serving North Kohala) fails
- Transmission switches at Honokaa Substation damaged
- CT-5 generator locks out
- Waimea diesel generators locked out



**Incident plus 30 seconds
0708.30 Hrs**

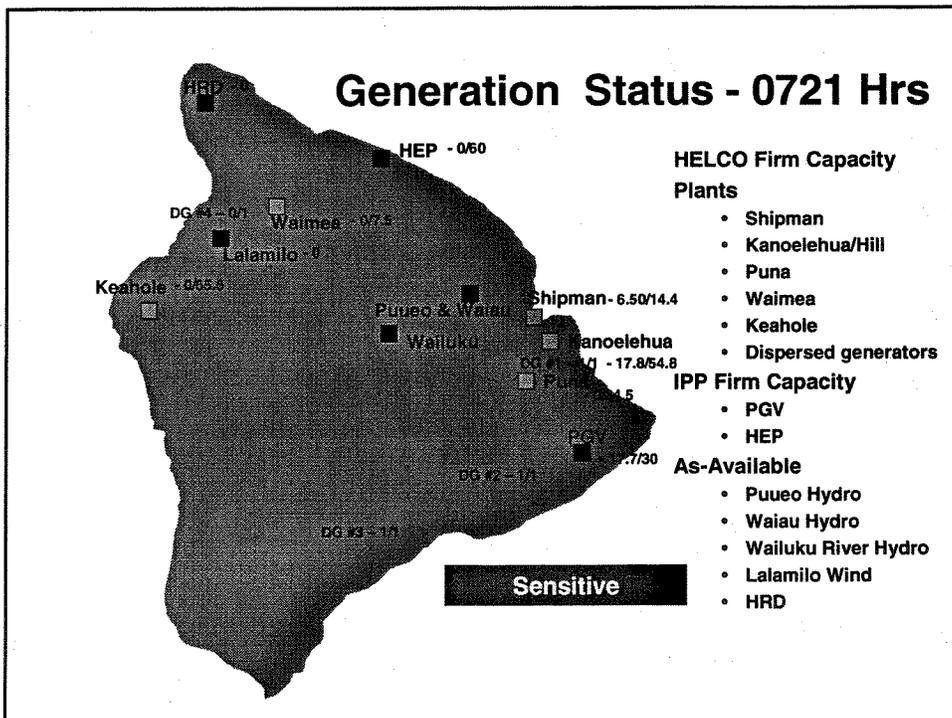
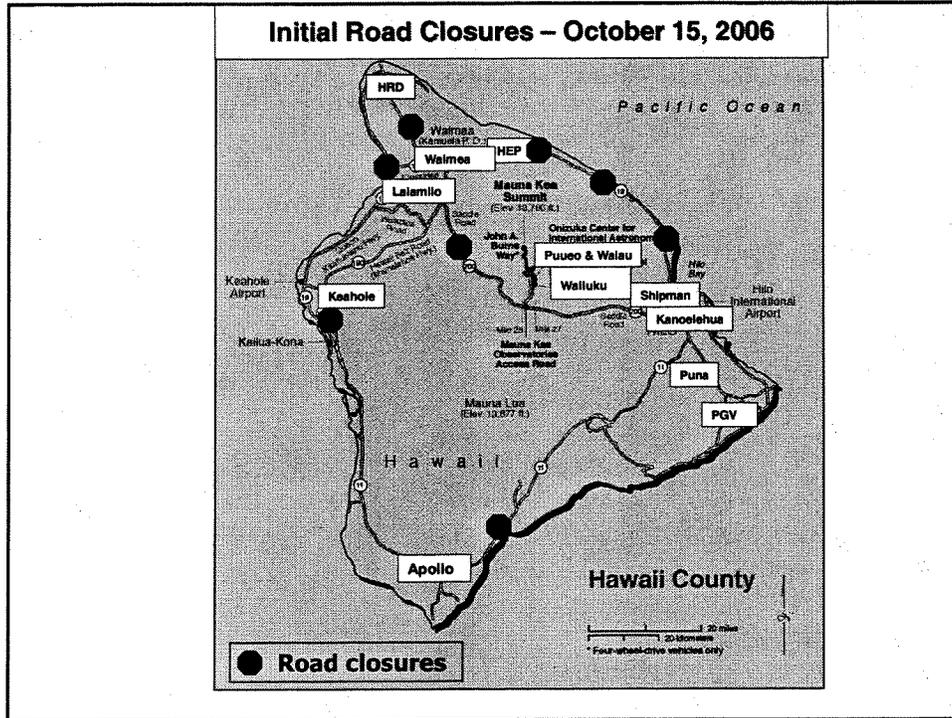
- HEP at 60 mw trips off-line due to islanding condition
- Approximately 40,000 customers without electric service
- East Hawaii Generators remain on line – Hill 5, Hill 6, PGV, Puna Steam and Shipman 3
- Generation imbalance exists – more generation on line than load

Incident plus 13 minutes 0721.00 Hrs

- Generation status
 - On line at 0721 hrs - 37 MW
 - Available firm capacity - 45 MW
 - Forced outage - 189 MW
- Transmission status
 - Seven (7) of nineteen (19) transmission circuits restored

Incident plus 13 minutes 0721.00 Hrs

- System upset and Generation imbalance causes Hill 5, Hill 6, and Puna Steam to trip. PGV output declines
- Underfrequency load-shedding condition results and another 18,600 customers are disconnected from the system by underfrequency relaying. 58,600 customers out
- Diesel generating units fast started
- CT-1 started and brought on line
- System stabilized at 37 mw with Shipman 3, CT-1, PGV and diesel units on-line.
- Numerous distribution circuits remain open
- Numerous highway and road closures due to earthquake damage



Restoration Action 0721 Hrs to 2400 Hrs

- System operator re-establishes transmission circuits via Supervisory Control
- Puna Steam unit brought back on line 7:35:05
- Transmission path to Keahole established. CT-4 on line at 7:41:57
- CT-3 brought on line at 7:47:49
- System Operator begins to restore underfrequency circuits
- 8:08 a.m. system stable with load at 74.2 MW but at risk
- Waimea & Keahole diesel generators started as transmission and distribution circuits are restored for service
- Numerous distribution circuits and substations to be restored

Restoration Activity 0721 Hrs to 2400 Hrs

- 8200 line (Anaehoomalu to Mauna Lani) transmission path re-established
- 8300 line (Mauna Lani to Ouli) transmission path re-established
- 7300 line (Waimea to Ouli) transmission path re-established
- Fire at Honokaa switching station disables 8800 line (Honokaa to HEP) transmission path. HEP output is limited until 1530 hrs
- 8800 line transmission path re-established after repairs at Honokaa Switching station completed
- Hill 5 returns to service
- Problem with CT-5 transformer lockout cleared. CT-5 available at 1451 hrs
- Hill 6 turbine steam leak. Unit kept off-line for repair

Restoration Activity

0720 Hrs to 2400 Hrs

- Repairs to damaged insulators on 3200 line near Honokaa completed
- Repairs to damaged insulator on 3300 line completed
- HELCO power and transmission systems restored to normal operations by 1700 hrs
- Restoration to all customers completed by 2300 hrs

Post Incident – 2400 hrs

- Evening Peak, October 15 – 179.8 MW
- Firm Generation Status
 - Total capability - 270 MW
 - Available capacity - 214 MW
 - Scheduled outage - 21 MW
 - De-ratings - 15 MW
 - Forced outage (Hill 6) - 20 MW
- As Available Generation Status
- Hydro Plants - 5 MW
 - Wind Farms - 0.0 MW

Maui Electric Company

Earthquake Event Response

October 15, 2006



Maui Electric Company, Limited

Restoration Strategic Objectives

- Maintain the safety of the public and our employees.
- Verify integrity of transmission, distribution, and power plant infrastructures on Maui, Molokai, and Lanai.
- Restoration of generators - “Black start” process.
- Verify status of substation/switchyard breakers – reestablish systems communications.
- Orderly restoration of system based on industry best practices.



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Generation Trip Sequence

07:00:00 System Load 131.9 MWs

<u>Time</u>	<u>Unit No.</u>	<u>Unit Type</u>	<u>Cause</u>	<u>Load, MW</u>
7:07:17	M16	Combustion Turbine	High vibration	18.8
7:07:20	M14	Combustion Turbine	High vibration	18.8
7:07:30	M19	Combustion Turbine	High temperature	13.0
7:07:38	M15	Steam Turbine	Loss of heat from M14 and M16	12.8
0:21	4 units dropped off line		Total MW lost =	63.4

<u>Time</u>	<u>Unit No.</u>	<u>Unit Type</u>	<u>Cause</u>	<u>Load, MW</u>
7:08:43	K4	Steam Turbine	High vibration manual trip	12.5
7:08:45	HC&S	Steam Turbines	No SCADA	6.4
7:08:45	KWP	Wind Turbines	No SCADA	17.7
7:12:10	K3	Steam Turbine	Generator trip	11.3
7:12:48	K1	Steam Turbines	Over-current relay trip	2.5
7:15:36	M12	Diesel Engine	Over-current relay trip	6.6
7:16:52	M11	Diesel Engine	Manual trip	5.3
7:16:56	M10	Diesel Engine	Manual trip	6.2
			Total MW lost after 7:08 =	68.5



Maui Electric Company, Limited

Generation Restoration Sequence

<u>Time</u>	<u>Location</u>	<u>Unit</u>	<u>Type</u>	<u>Capacity in MWs</u>
7:53	Maalaea	M1	Diesel	2.50
8:53	Puunene	HC&S	Steam Turbine	16.00
9:02	Maalaea	M6	Diesel	5.60
9:04	Maalaea	M5	Diesel	5.60
9:17	Maalaea	M4	Diesel	5.60
9:20	Maalaea	M11	Diesel	12.50
9:23	Maalaea	M10	Diesel	12.50
9:28	Maalaea	M7	Diesel	5.60
9:39	Maalaea	M8	Diesel	5.60
9:40	Maalaea	MX2	Diesel	2.50
9:48	Maalaea	MX1	Diesel	2.50
9:58	Maalaea	M17	Combustion Turbine	21.20
10:14	Kahului	K1	Steam Turbine	5.00
10:41	Maalaea	M12	Diesel	12.50
11:11	Maalaea	M14	Combustion Turbine	20.00
11:25		KWP	Wind Turbine	30.00
12:18	Maalaea	M16	Combustion Turbine	20.00
12:27	Kahului	K3	Steam Turbine	11.50
12:51	Maalaea	M19	Combustion Turbine	21.00
14:07		Makila	Hydro	0.03
			Total Capacity Restored:	217.73



Delays in Raising Generation

- Combustion turbines internally locked out on temperature due to full power shut down. Requires two to three hours before internal locks clear and they can be restarted. Lockout prevents unit damage.
- M12 fuel system required purging and refueling with Bio-diesel fuel for start-up in order to meet DOH stack emissions opacity requirements.
- M14 and M16 required two one-hour step delays to check and maintain water/fuel ratio to meet DOH emissions requirements. Added two hours from start time to full unit capacity.



Maui Electric Company, Limited

Coordination, Communications, and Cooperation with First Responders



County of Maui



Maui Civil Defense



Maui Fire Department



Maui Police Department



Maui Electric Company, Limited

Customer Restoration

09:45-10:15	9	Circuits restored, including Kaanapali – 5800 customers.
10:15-10:45	10	Circuits restored, Lahaina, Wailea, Kula – 7500 customers.
10:45-11:15	3	Circuits restored, Lahaina, Haiku, Peahi – 1700 customers.
11:15-11:45	3	Circuits restored, Haiku, Napili, Kihei – 4200 customers.
11:45-12:15	4	Circuits restored, Kihei, Waiehu, Kihei – 3900 customers.
12:15-12:45	6	Circuits restored, Mahinahina, Wailuku, Kihei – 7500 customers.
12:45-13:15	5	Circuits restored, Kihei, Kahului – 4900 customers.
13:15-13:45		
13:45-14:15		
14:15-14:45	3	Circuits restored, Kula, - 2400 customers. Last customers restored. There were two non-quake related outages occurring during this same time, one vegetation related, one equipment failed in service.



Maui Electric Company, Limited

Customer Restoration

08:57		CKT 1244 – FAA facilities
09:03		CKT 1245 – Kahului Airport facilities
09:07		CKT 1267 – Maui Memorial Hospital
09:10		CKT 1266 – Maui Civil Defense & Mayor
09:21		CKT 1264 – Maui Electric Dispatch facilities
09:25		CKT 1290 – Maui Police Department
09:30-09:45	10	Additional circuits – approximately 9000 customers.



Maui Electric Company, Limited