

City of Bellevue 2016 Electric System Reliability Review



Andy Swayne, Senior Municipal Liaison Manager

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Introductions

- Andy Swayne – Senior Municipal Liaison Manager
- Bill Foster – Distribution System Reliability Planner
- Tammie – Bechtel – Distribution System Operations Planner
- Rick Buell – Distribution System Regional Planning
- Sunitha Kothapalli – Transmission System Planner
- Kevin Gowan – Asset Management Supervisor
- Laura Feinstein – Smart Grid Planning Manager
- Dennis Martin – Electric System Senior Engineer
- Keri Pravitz – Community Projects Manager
- Sharmila Swenson – Manager Local Government Affairs

Workshop Purpose

- Provide an overview of PSE electrical system performance in 2016 as reported to the City
 - Overall performance
 - Reliability projects completed and proposed
 - Automation initiatives (Smart Grid)
 - Information technology initiatives

2016 Bellevue Reliability Overview

Bellevue is served by 96 distribution circuits from 23 substations

74 circuits (77%) had performance better than our system wide average

14 circuits (15%) experienced no unplanned outages

22 circuits (23%) had SAIDI or SAIFI exceeding system wide average figures

2016 Bellevue Reliability Overview

24 circuits from 4 substations serve customers downtown

- 7 reliability circuits provide redundancy for downtown customers
- There was two unplanned outage events which affected downtown customers in 2016:
 - A squirrel made electrical contact at Center Substation bank 2
 - A feeder cable fault along NE 8th ST caused a circuit outage on Lochleven 35

2016 Bellevue Reliability Overview

- Bellevue Performance & Comparison

**SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI) &
SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI)
FIVE YEAR HISTORY**

SAIDI figures in minutes, all outages including storm
SAIFI figures in outage events, all non-storm outages

	SAIDI		SAIFI	
	BELLEVUE	PSE	BELLEVUE	PSE
2012	52.4	245.0	0.40	0.92
2013	100.7	247.0	0.41	0.86
2014	160.2	312.0	0.60	1.04
2015	186.9	361.0	0.71	1.11
2016	107.0	148.0	0.74	1.06

PSE SAIDI figures for 2012 - 2015 are five year rolling average figures.

The 2012 Bellevue SAIDI figure was calculated as a single year figure.

The 2013 Bellevue SAIDI figure was calculated as a four year rolling average for years 2010 - 2013.

The 2014 - 2015 Bellevue SAIDI figures were calculated as a five year rolling average figures.

2016 SAIDI figures were calculated using the IEEE 1366 method for the single year 2016.

System Average Interruption Duration Index [SAIDI] SQI 155

Total customer outage minutes / average total customer count

System Average Interruption Frequency Index [SAIFI] SQI 1.3

Total customers affected / average total customer count



2016 Bellevue Reliability Overview

SAIDI IEEE 1366 calculation – why did we switch?

- PSE's prior method of calculating SAIDI was based on estimated outage size reported in a legacy system (CLX).
- PSE's 2013 implementation of GIS and OMS allows calculation of outage event duration with more precise customer counts capturing and reporting outage minutes more accurately.
- PSE's outage reporting is now in line with industry standard IEEE 1366 used by most utilities.
- IEEE 1366 characteristics:
 - A sustained outage event is defined as 5 minutes or greater
 - Outage events occurring during Major Event Days are excluded
 - Calculation provides single calendar year figures
- The WUTC agreed that the IEEE 1366 methodology would provide improved understanding and reporting of outage events affecting PSE customers.

2016 Bellevue Reliability Overview

Bellevue circuits with SAIDI or SAIFI exceeding system wide figures

CIRCUITS THAT EXCEED 2016 PSE SYSTEM SAIDI AND/OR SAIFI					
SQR: SAIDI = 155 SAIFI = 1.30		Notes: SAIDI figures reflect all non-major event day outages, scheduled & unscheduled; SAIFI figures reflect all non-5% exclusion major event day outages, scheduled & unscheduled			
PSE: SAIDI = 148 SAIFI = 1.06		SAIDI (IEEE 1366 method) & SAIFI figures are calculated single year figures for 2016.			
Bellevue: SAIDI = 107 SAIFI = 0.74					
CIRCUIT	SAIDI	SAIFI	2016 Events Comments	Actions & Projects Completed in 2016	Planned Actions & Projects
Circuits with planned actions or investigations					
SOM-16	405.7	3.18	Three circuit outages resulted from trees in the overhead feeder along Coal Creek Parkway.		PSE Planning is reviewing options to improve this system infrastructure.
KWH-25	368.6	1.29	A circuit outage occurred when several spans of overhead feeder along NE 24th ST came down (believed to be caused by a tree fall, but cause not recorded in the outage event log).	Overhead feeder was reinstalled on poles.	PSE Planning is reviewing options to sectionalize an overhead segment of this circuit to reduce impact from future extended outage events.
HAZ-12	268.8	2.55	Hazelwood substation was taken off line for equipment replacement/upgrades with temporary circuit configuration impacting circuit performance during the Summer of 2016.	Substation and feeder construction were completed and the system switched to normal.	PSE Planning is reviewing options to improve this system infrastructure.
EGT-25	225.2	1.05	An underground feeder cable failed causing a circuit outage.	Underground feeder cables were replaced.	Additional feeder cables will be replaced in the near future (2017).
SBE-22	166.2	1.35	A circuit outage resulted from trees in the overhead feeder along Bellevue Way SE.	PSE tree crews did 'hot spot' trimming to restore required vegetation clearance.	This area is scheduled for an underground conversion in 2017 in association with Sound Transit East Link project construction.
Circuits with completed 2016 actions - no additional corrective action needed					
CEN-11	841.1	2.07	Several outages were scheduled outages supporting relocation work for the Sound Transit East Link project.	Switch US37 was replaced with a SCADA enabled switch.	
SOM-17	392.3	2.66	Two circuit outages resulted from trees in the overhead feeder along Coal Creek Parkway. A third circuit outage resulted from a failed underground feeder cable.		
COL-23	345.4	2.00	An animal contact tripped the substation transformer resulting in a circuit outage. One circuit outage resulted from a failed pad-mount switch.	Switch U2527 and cable connections were replaced.	
MED-36	281.8	2.40	A car-pole accident caused a circuit outage. A tree limb fell into overhead feeder during trimming work causing a circuit outage.		
OVE-15	266.5	2.34	An animal contact tripped the substation transformer resulting in a circuit outage. A car-pole accident caused an extended large outage.		
HOU-25	224.0	2.18	A tree in overhead feeder caused a circuit outage with the resulting fault causing damage to an overhead disconnect switch. The damage switch failed causing a second circuit outage.	The failed switch and associated equipment and cable connections were replaced.	
NRU-27	204.8	0.85	Failed distribution junction boxes resulted in two extended large outages. A scheduled outage to replace distribution cables resulted in an extended outage to a local area.	Failed and suspect junction boxes and cable elbows were replaced.	
EGT-28	199.0	1.05	A failed feeder cable splice caused a circuit outage (including extended investigation to find and isolate the problem).	The underground feeder cables were repaired.	
COL-26	193.3	1.39	An animal contact tripped the substation transformer resulting in a circuit outage.		
NRU-23	169.3	0.59	Failed distribution cables caused an extended to a local area outage. A scheduled outage to replace distribution cables resulted in an extended outage to a local area.	Distribution cables were repaired and replaced.	
FAC-24	177.5	0.78	A failed distribution junction box resulted in an extended outage to a local area. A car-transformer accident caused an extended outage to a local area.	Failed and suspect junction boxes and cable elbows were replaced.	
CEN-13	173.7	0.35	A SCADA equipped switch operated (unexpectedly) causing a large outage.	The switch was configured to operate in local control pending communications verification.	
EGT-26	156.1	0.89	A failed distribution cable elbow resulted in an extended outage to a local area.	The failed elbow was replaced.	
PHA-17	148.2	1.16	A car-pole accident required dropping the circuit to make the area safe and replace the pole.	The broken pole was replaced.	
PHA-16	100.9	1.15	An equipment problem in the substation caused an unsafe condition requiring the substation inspector to open the circuit. Customers were temporarily switched to PHA-17 while repairs were completed.	Failed and suspect equipment was replaced.	
EVE-23	124.5	1.09	Failed switches along West Lake Sammamish Parkway resulted in a circuit outage. Servicemen isolated the failed switches and restored feeder operation.	All three switches and the arrestors on this pole were replaced.	
Circuits for which no corrective action is needed					
ARD-11	230.0	0.79	A scheduled outage to replace a three phase underground cable run along Bel-Red Road resulted in an extended large outage.		

- Figure exceeded PSE system wide average figure
- Figure exceeding system wide average and Service Quality Index
- SAIDI & SAIFI figure results in part from circuit outages due to 2010 substation outage

- 22 circuits had SAIDI or SAIFI in 2016 exceeding system wide figures. 17 of these circuits have been addressed or require no corrective action. The remaining 5 circuits have improvement actions identified or under review.



2016 Bellevue Reliability Overview

Circuits Exceeding System SAIDI and/or SAIFI 2012 – 2016

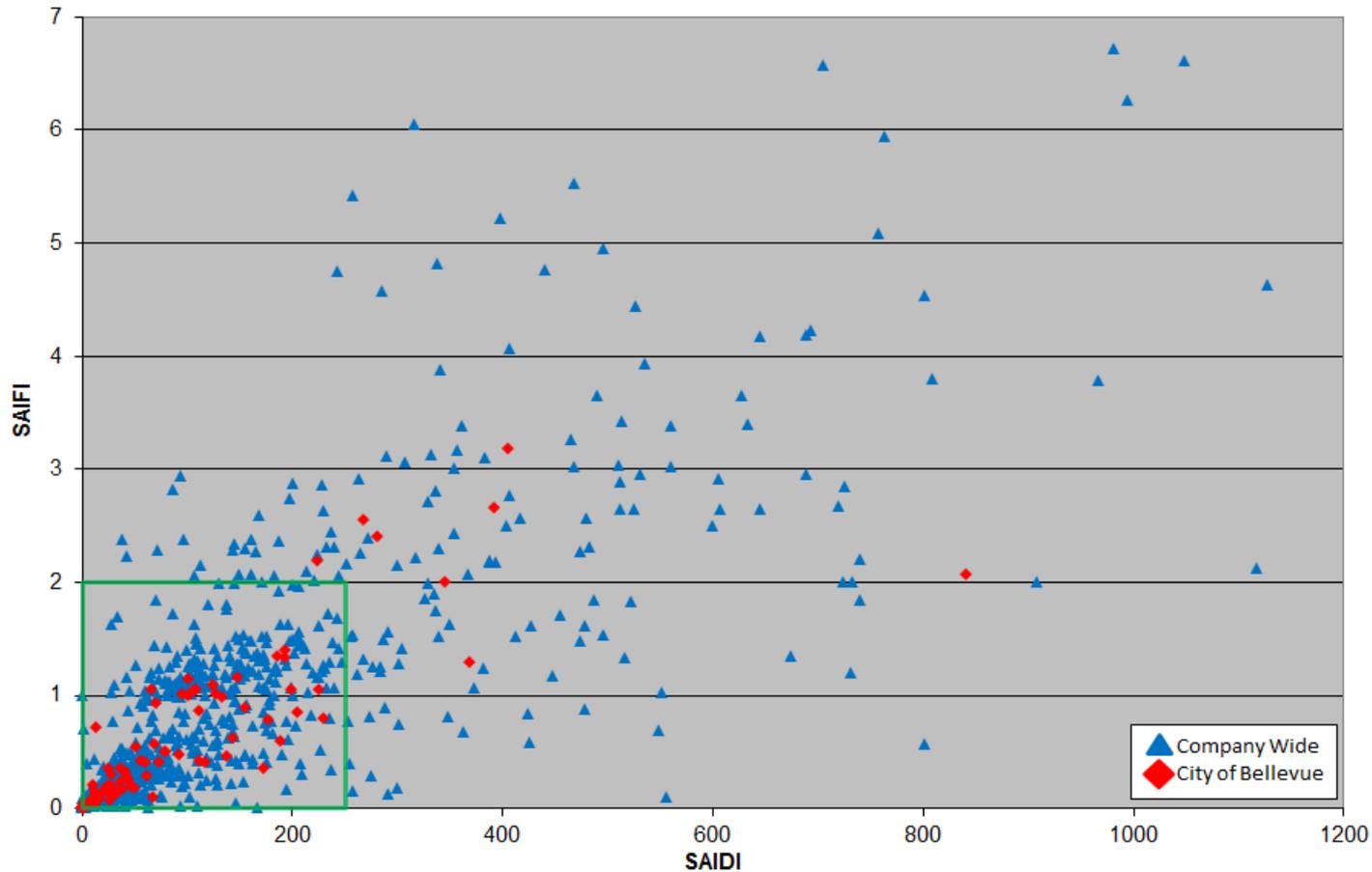
CIRCUIT	Repeat Counts					Repeat Counts			
	2012	2013	2014	2015	2016	1	2	3	4
ARD-11							1		
ARD-13						1			
ARD-15							1		
BTR-22									1
SBE-22							1		
SBE-23						1			
SOM-13							1		
SOM-15								1	
SOM-16								1	
SOM-17								1	
Totals	19	20	25	23	22	35	15	12	2
	2012	2013	2014	2015	2016	55%	23%	19%	3%

- 64 circuits have exceeded system wide average performance during this period ...

35 (55%) once in five years
 15 (23%) twice in five years
 12 (19%) three times in five years
 2 (3%) four times in five years

2016 Bellevue Reliability Overview

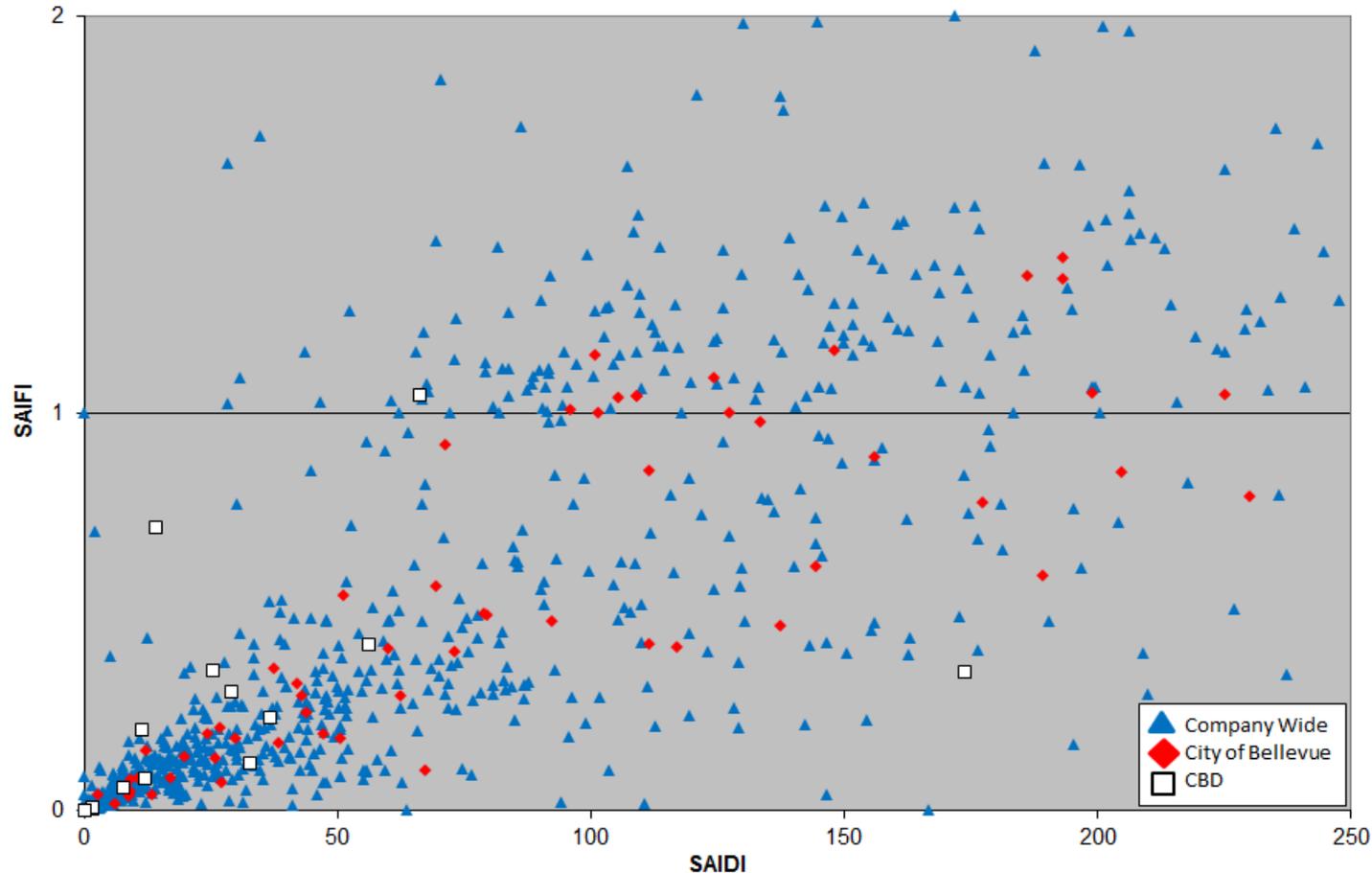
2016 IEEE SAIDI/SAIFI Scatterplot
(Excludes Major Event Day Events)



Distribution circuits serving Bellevue relative to all PSE circuits

2016 Bellevue Reliability Overview

2016 IEEE SAIDI/SAIFI Scatterplot
(Excludes Major Event Day Events)



Enlargement focusing on distribution of circuits serving Bellevue

Distribution Reliability Projects Completed in 2016

- Installation of a new Reclosers on Northrup 23
- Distribution System reconfiguration on South Bellevue 25 in the Surrey Downs Neighborhood
- Distribution cable replacement projects in the Crossroads area (programmatic replacements planned to continue into 2018 and beyond)
- 25 cable replacement projects (various circuits – 49,000 circuit feet) including proactive replacements
- Vegetation management trimming of 12 distribution circuits and 1 transmission line

Proposed Distribution Reliability Projects

- Mark 1 switch replacement in the Cherry Crest Neighborhood
- Installation of Reclosers on Eastgate 28 and South Bellevue 22 feeder circuits
- Tree wire retrofit projects on Eastgate 12, Kenilworth 23 and Overlake 15
- Bridle Trails 22 feeder undergrounding west of 140th AVE NE
- CBD SCADA switch installation (continuing). 7 installed in 2016. 7 & 10 switches are planned for 2017 & 2018 respectively
- Distribution cable replacements in Crossroads area (continuing) via the CRP in locations where new conduit is needed
- 13 cable replacement projects engineered for future construction (30,000 circuit feet)
- 22 cable replacement projects scoped for future engineering (41,000 circuit feet)

Smart Grid Initiatives Including Automation

- AMI (Advanced Meter Infrastructure) -- Network installation is complete in Bellevue and is in verification testing. Meter installations are planned to begin in 2018.
- Distribution Automation (formerly referred to as Fault Location, Isolation, Service Restoration) – Initial projects commissioning is complete; expansion to Bellevue CBD planned in the future.
- Distribution SCADA Switchgear – 66 switches in the CBD area get SCADA and EMS integration to allow system operators to see the distribution system configuration and respond to events in real time. 31 switches completed. 7 switches expected to be retrofit in 2017. 10 switches proposed for retrofit in 2018. Precursor to CBD DA.
- Bellevue Urban Smart – PSE is supporting downtown businesses in managing building energy use including combinations of behavioral and technology solutions to achieve energy savings.
- Scoping and planning for Spring District & Bel-Red corridor Smart Grid development environment is underway

Distribution Automation

- Distribution Automation (DA) can provide a level of self-healing response to distribution system outage events using SCADA equipped devices and automated control software.
- DA isolates faults through switching, then attempts to restore power outside of the faulted (isolated) area. Fewer customers experience a sustained outage while more customers can see their power restored in under five minutes.
- Pilot projects are underway in PSE service territory areas of lowest reliability and locations with customer funded projects. Intent is to validate efficacy of various approaches and implementations.
- To be effective DA requires a robust and redundant transmission system to keep power flowing to distribution substations

CIS, GIS & OMS

- PSE implemented three integrated systems in April 2013
 - Customer Information System
 - Geospacial Information System
 - Outage Management System
- These systems work together to improve company response to outage events
- In 2017 AMR meter status data has been integrated into OMS to provide system operator real time status display and support customer notification functions

Transmission System Improvements

- In Progress ...
 - Lake Hills – Phantom Lake 115kV – New transmission line between existing substations to provide redundant (looped) transmission connection for three substations – project expected to begin construction in 2018.
 - Lakeside 115 kV Switching Station Rebuild – Multi-year phased replacement and upgrade of control and operating equipment in the substation for enhanced automation and reliability – planned completion in 2017.
 - Energize Eastside 230kV – Upgrading existing transmission lines and build a new transmission substation in Bellevue to provide increased system capacity and reliability for Bellevue and the greater Eastside – currently in permitting with planned construction in 2018-2019.
- On the Near Horizon ...
 - Vernell Substation – New 115kV transmission switching station with local distribution substation for improved transmission system flexibility/reliability and new distribution system capacity to support Sound Transit and Spring District development in 2022, in coordination with the City and Spring District Developers.

Wrapping Up

Questions & Discussion