
City of Bellevue 2015 Electric System Reliability Review



Andy Swayne, Municipal Liaison Manager

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Introductions

- Andy Swayne – Municipal Liaison Manager
- Bill Foster – Distribution System Planner
- Rick Buell – Distribution System Engineering Specialist
- Carol Jaeger– Transmission System Planner
- Sunitha Kothapalli – Transmission System Planner
- Chris McVicker – Supervisor Engineering Maintenance Programs
- Laura Feinstein – Smart Grid Planning Manager
- Dennis Martin – Electric System Senior Engineer
- Keri Pravitz – Community Projects Manager
- Katherine Taylor – Local Government Affairs Representative

Workshop Purpose

- Provide an overview of PSE electrical system performance in 2015 as reported to the City
- Overall performance
 - Reliability projects completed and proposed
 - Areas addressed at past workshops
 - Maintenance
 - Automation initiatives (smart grid)
 - Information technology initiatives

2015 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
2011	86.1	281.0	0.60	1.02
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

PSE SAIDI figures for 2011 - 2015 are five year rolling average figures.

The 2011 - 2012 Bellevue SAIDI figures were calculated as single year figures.

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.

System Average Interruption Duration Index [SAIDI] SQI 320

Total customer outage minutes / average total customer count

System Average Interruption Frequency Index [SAIFI] SQI 1.3

Total customers affected / average total customer count



2015 Bellevue Reliability Overview

- Distribution system serving Bellevue in 2015

95 distribution circuits serving Bellevue

72 circuits [76%] had performance better than our system wide average

27 circuits [28%] experienced no unplanned outages

23 circuits [24%] had SAIDI or SAIFI exceeding system wide average figures
(5 circuits rolling average SAIDI resulted from prior years performance)

2015 Bellevue Reliability Overview

- Circuits Exceeding System SAIDI and/or SAIFI 2011 – 2015

CIRCUIT	Repeat Counts					Repeat Counts			
	2011	2012	2013	2014	2015	1	2	3	4
ARD-11						1			
ARD-13						1			
ARD-15							1		
BTR-14						1			
BTR-22									1
SOM-13							1		
SOM-15								1	
SOM-16							1		
SOM-17							1		
Totals	17	19	20	25	23	37	17	7	3
	2011	2012	2013	2014	2015	58%	27%	11%	5%

- 64 circuits exceeded system wide average performance ...
 - 37 (58%) once in five years
 - 17 (27%) twice in five years
 - 7 (11%) three times in five years
 - 3 (5%) four times in five years

2015 Bellevue Reliability Overview

CIRCUITS THAT EXCEED 2015 PSE SYSTEM SAIDI AND/OR SAIFI			Notes: SAIDI figures reflect all outages, scheduled & unscheduled, including storm; SAIFI figures reflect all non-storm outages, scheduled & unscheduled. PSE & Bellevue SAIDI are five year rolling average figures for the period 2011 - 2015.		
CIRCUIT	SAIDI	SAIFI	2015 Events Comments	Actions & Projects Completed in 2016	Planned Actions & Projects
Circuits with planned actions or investigations					
EGT-16	91.2	3.56	Three circuit outages resulted from 1) failed underground feeder cables, 2) failed overhead transformer fuse and 3) a contact fault between overhead feeder conductors.	Faulted feeder cables were isolated, failed fuse cut-out was replaced and spacers were installed in the overhead lines.	PSE has developed a project to replace failed feeder cables crossing under I-90 to restore the tie to a second circuit. PSE plans to replace the circuit breaker at the substation.
Circuits with completed 2015 actions - no additional corrective action needed					
BTR-22	670.6	0.34	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value. 2015 outage events resulted from tree limb contacts with overhead distribution lines.	Distribution lines were reenergized follow removal of tree limbs and minor repairs.	PSE has developed a project to underground the segment of feeder with the worst reliability exposure and place tree wire on the remaining segment.
SOM-16	534.1	2.27	A tree fell into the radial transmission line feeding Somerset Substation deenergizing the substation. Trees and tree limbs fell into distribution lines causing two circuit outages. An equipment failure caused one circuit outage.	Transmission and distribution lines were reenergized following removal of trees/tree limbs, minor repairs and equipment replacement.	
KWH-25	521.9	0.29	A tree fell into the transmission line feeding Kenilworth Substation deenergizing the substation. A tree fell into distribution lines causing one circuit outage.	The substation was reenergized following removal of the tree limb from the transmission line. Distribution lines were reenergized following removal of a tree and minor repairs.	
MED-35	429.6	0.52	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value. A 2015 circuit outage resulted from a tree limb contact with the distribution bus at Medina Substation.	The substation was reenergized following removal of the tree limb from the distribution bus at the substation.	
SOM-17	376.6	3.17	A tree fell into the radial transmission line feeding Somerset Substation deenergizing the substation. A tree fell into distribution lines causing one circuit outage. A failed distribution cross-arm caused a large outage.	Transmission and distribution lines were reenergized following removal of trees/tree limbs, minor repairs and equipment replacement.	
NRU-25	369.2	1.79	Feeder and distribution cables failed causing a circuit outage with additional customers affected due to temporary switching for system work to accommodate a city public improvement project along 120th AVE NE.	Cable and equipment were replaced in conjunction with system relocation allowing circuits to be restored to normal configuration.	
LHL-22	369.0	1.66	An equipment failure during a construction of a system improvement project resulted in one circuit outage. A tree fell into distribution lines, broke a cross-arm and resulted in one circuit outage.	Distribution lines were reenergized following replacement of failed equipment and removal of a tree.	PSE is currently permitting a new transmission line between Lake Hills and Phantom Lake substations. Two feeder tree wire projects are expected to be completed by year end 2016.
EGT-11	344.7	0.72	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value. A 2015 circuit outage resulted when a tree fell into distribution lines and broke a distribution pole.	Distribution lines were reenergized following removal of a tree limbs and replacement of a distribution pole.	
SOM-15	285.3	1.33	A tree fell into the radial transmission line feeding Somerset Substation deenergizing the substation.	The substation was reenergized following removal of the tree limb from the distribution bus at the substation.	
HOU-25	189.7	2.49	A tree limb fell into the transmission line feeding Houghton Substation deenergizing the substation. A tree fell into distribution lines causing one circuit outage.	The substation was reenergized following removal of the tree limb from the transmission line. Distribution lines were reenergized following removal of a tree and minor repairs.	
ARD-15	173.6	1.20	A car left the road, crossed a sidewalk and struck a pad-mount switch resulting in a circuit outage.	The pad-mount switch was replaced.	
NOB-12	172.8	1.77	Switching for system work including switch and cable replacement to accommodate a city public improvement project along 120th AVE NE required multiple scheduled large outages.	System relocation work was completed and circuits restored to normal configuration.	
CLY-23	159.3	1.59	A tree fell into distribution lines causing one circuit outage.	Distribution lines were reenergized following removal of a tree and minor repairs.	
EGT-12	77.5	2.16	Tree limbs fell into distribution lines resulting in two circuit outage with one occurring during system improvement work with the circuit breaker set not to reenergize for crew safety.	Distribution lines were reenergized following removal of tree limbs and completion of system improvement work.	
HOU-23	51.5	1.13	A tree limb fell into the transmission line feeding Houghton Substation deenergizing the substation.	The substation was reenergized following removal of the tree limb from the transmission line.	
LOC-25	0.9	6.96	System work including switch and cable replacement for Lincoln Square Expansion required scheduled circuit switching and outages.	System improvement work was completed and circuits restored to normal configuration.	
Circuits for which no corrective action is needed					
OVE-15	628.9	1.18	A lightning strike on distribution lines resulting in a circuit outage during system improvement work with the circuit breaker set not to reenergize for crew safety. A majority of outage minutes resulted from multiple outages occurring during a 2015 storm event.		An overhead tree wire project along Overlake drive is planned for 2016 construction.
NRU-23	492.9	0.47	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value.		PSE plans to engage the Bridle Trails neighborhood and City to develop a new landscape plan to remove danger trees from around Northrup Substation.
NRU-27	401.9	0.29	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value.		PSE plans to engage the Bridle Trails neighborhood and City to develop a new landscape plan to remove danger trees from around Northrup Substation.
NRU-26	331.4	1.09	This circuit appears here based on 2014 SAIDI performance elevating the 5 year average SAIDI value.		
EGT-13	325.6	0.00	This circuit appears here based on 2013 SAIDI performance elevating the 5 year average SAIDI value.		
EVE-23	108.4	1.10	A large circuit outage resulted from deenergizing most of this circuit for a brush fire along Lake Sammamish Parkway for fire crew and public safety.		

Figure exceeded PSE system wide average figure
 Figure exceeding system wide average and Service Quality Index
 SAIFI figure results in part from circuit outages due to 2015 transmission or substation outage

- 23 circuit had SAIDI or SAIFI exceeding system wide figures. 18 of these circuits have been addressed or require no corrective action. The remaining 5 circuits have improvement actions identified.



2015 Bellevue Reliability Overview

- 5 circuits rolling average SAIDI resulted from prior years performance

CIRCUITS THAT EXCEED 2015 PSE SYSTEM SAIDI RESULTING FROM PRIOR YEAR PERFORMANCE

PSE SYSTEM SAIDI = 361 Bellevue: SAIDI = 187

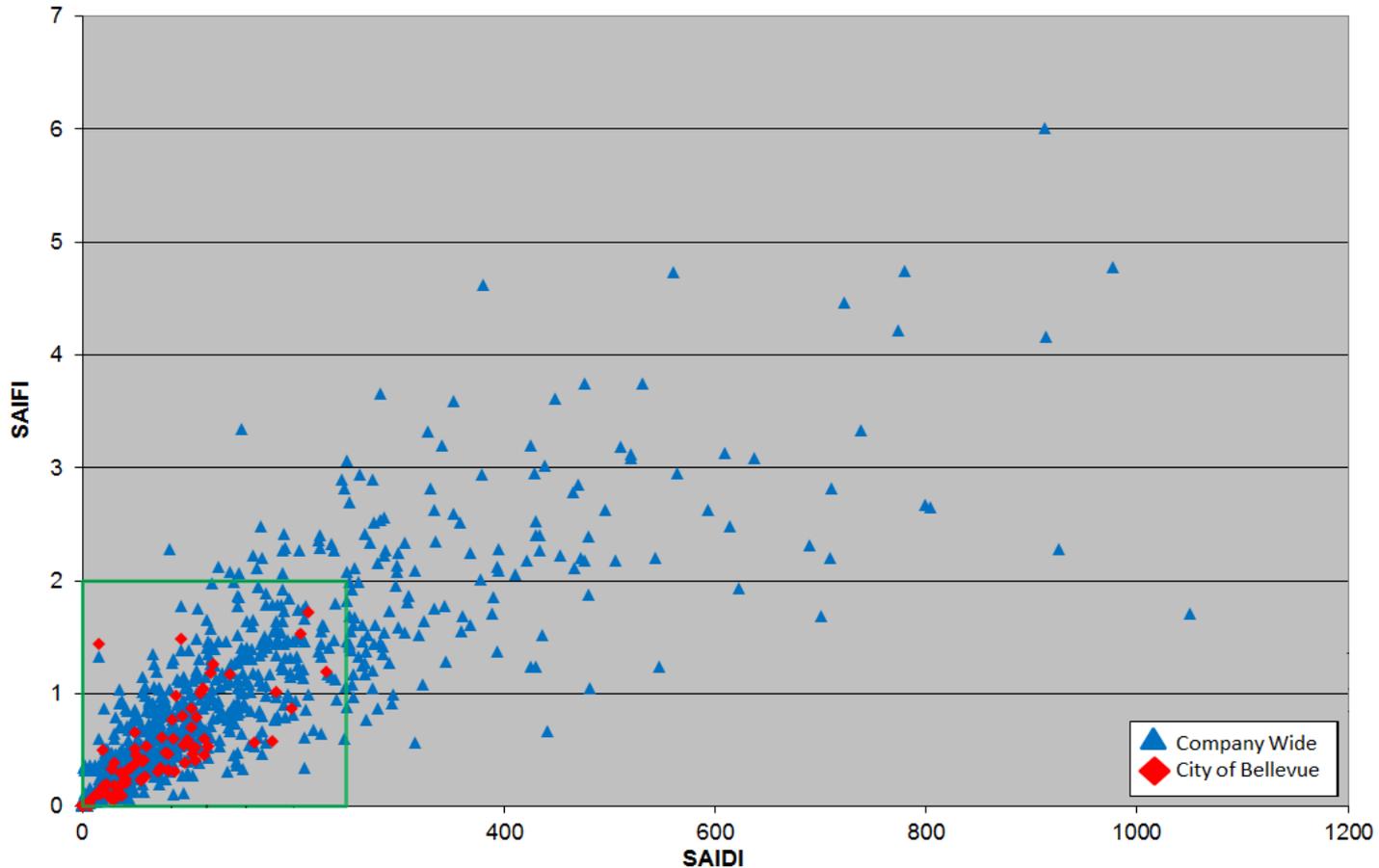
Circuit	2015 5 Year		
	Rolling Average	2014 Single Year SAIDI	2015 Single Year SAIDI
MED-35	429.6	1334.0	602.6
NRU-23	492.9	2024.0	99.9
NRU-27	401.9	1572.0	248.0
NRU-26	331.4	1320.0	202.6
EGT-13 ¹	325.6	1123.0	0.0

1 EGT-13 single year SAIDI is from 2013

- 5 year rolling average SAIDI is calculated using single year figures for the performance year and the previous 4 years

2015 Bellevue Reliability Overview

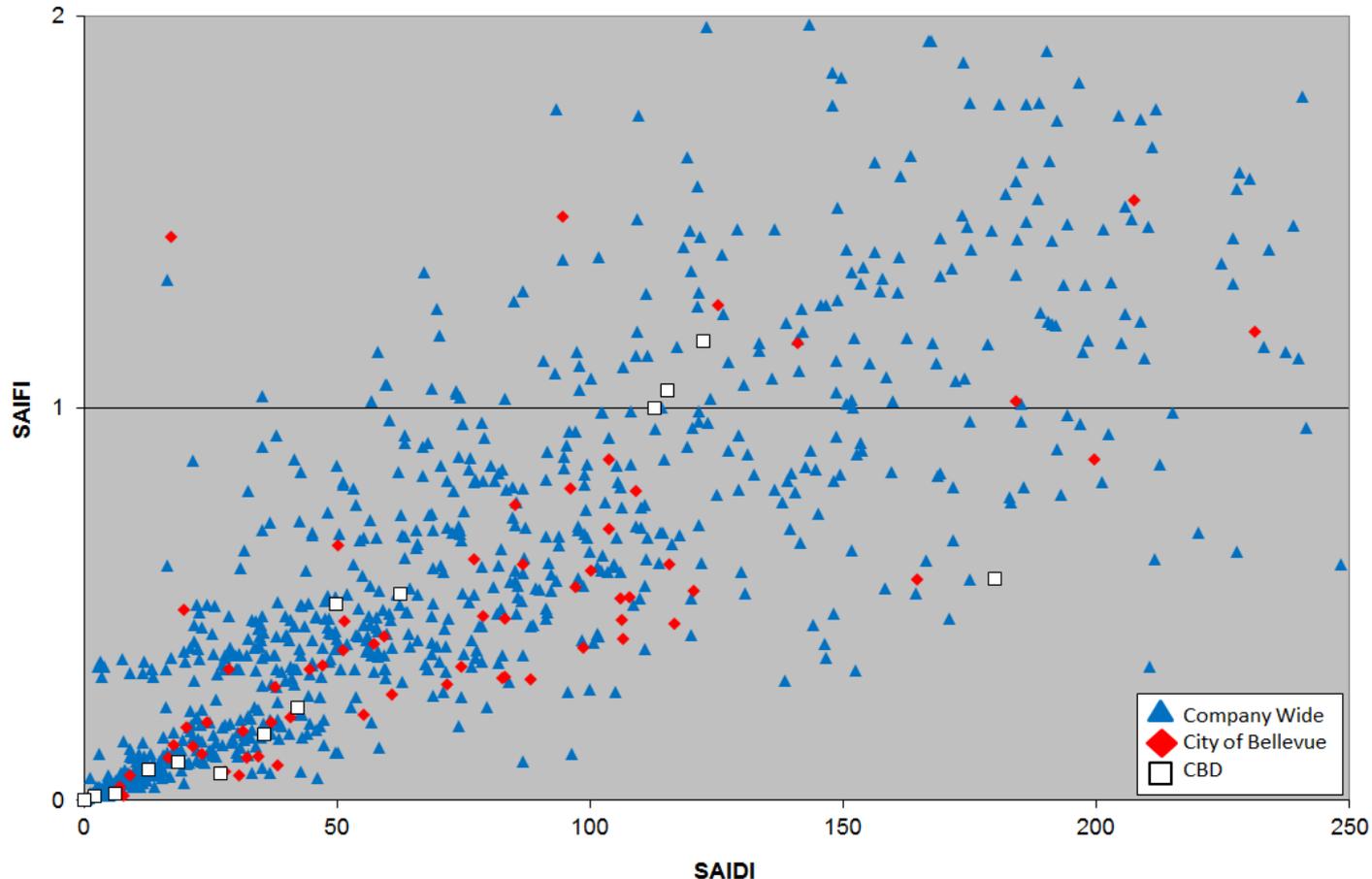
Three Year Average SAIDI/SAIFI (IEEE) Scatterplot
(2013-2015 unplanned non-storm including substation and transmission line)



Distribution circuits serving Bellevue relative to all PSE circuits

2015 Bellevue Reliability Overview

Three Year Average SAIDI/SAIFI (IEEE) Scatterplot
(2013-2015 unplanned non-storm including substation and transmission line)



Enlargement focusing on distribution of circuits serving Bellevue

2015 Bellevue CBD Reliability Overview

Bellevue CBD Performance continues to be very good

- 24 circuits from 4 substations serve customers downtown
- 7 reliability circuits provide redundancy for downtown customers
- There were no major unplanned outage events affected downtown customers in 2015. A major outage is a circuit level event that is greater than one minute.
- There were ...
 - 10 customer requested or scheduled outages
 - 4 smaller unplanned outages

Distribution Reliability Projects Completed in 2015

- Installation of Reclosers on Eastgate 27 and Factoria 13 & 15 feeder circuits
- Replacement of four oil-filled switches at Bellevue Square (CBD)
- Two tree wire retrofit project on Lake Hills 22 & one on Medina 36
- Extension of new feeder circuit Goodes Corner 21 west from Issaquah to east Bellevue south of I-90
- Distribution cable replacement projects in the Crossroads area (programmatic replacements planned to continue into 2017)
- 16 cable replacement projects (various circuits – 16,000 circuit feet) including proactive replacements
- Vegetation management trimming of 11 distribution circuits and 5 transmission lines

Proposed Distribution Reliability Projects

- Mark 1 switch replacement in the Cherry Crest Neighborhood
- Installation of Reclosers on Northrup 23 & South Bellevue 22 feeder circuits
- Tree wire retrofit projects on Eastgate 12, Kenilworth 23, Overlake 15 and South Bellevue 25
- Bridle Trails 22 feeder undergrounding west of 140th AVE NE
- CBD SCADA switch installation (continuing)
8 & 10 switches planned for 2016 & 2017 respectively
- Distribution cable replacements in Crossroads area (continuing)
- 40 cable replacement projects engineered for future construction (73,000 circuit feet)
- 26 cable replacement projects scoped for future engineering (42,000 circuit feet)

Distribution Areas Addressed At Prior Workshops

- Circuit Updates

- Lake Hills 25: Some underground distribution cables in the Crossroads Mall vicinity have experienced high incidents of failure. *Cable replacement in this area begun in 2014 will likely extend into 2017 as final project scope is developed. All final project phases are in private property and require outage scheduling with property owners for construction.*
- Northup 25: The Cherry Crest neighborhood north of NE 24th ST is served by direct-buried distribution cables and a mark-1 switch. *We continue to monitor the performance of this system. There were no additional cable issues in 2015, however the mark-1 switch has failed and is now slated for replacement by early 2017.*

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 – this project was rejected by the East Bellevue Community Council and is currently under appeal.
 - 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~~ **environmental review [corrected during workshop presentation]** with planned construction in 2017-2018.
- 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.

Smart Grid Initiatives Including Automation

- AMI (Advanced Meter Infrastructure) -- Planning completed in 2015 to start AMI network installation in 2016 in Bellevue. Meter installations planned post-2017.
- FLISR (Fault Location, Isolation, Service Restoration) – Implementation started in 2015; initial project currently in commissioning phase; expansion to CBD planned in the future.
- Remote Data Acquisition Devices (RDADs) – 60 units in place in Bellevue providing remote alert to detected feeder system faults.
- Distribution SCADA Switchgear – The current plan calls for retrofitting 66 switches in the CBD area to add SCADA and integrating them into the EMS so that the system operators can see the distribution system configuration and events in real time. 24 switches have been retrofitted with SCADA and integrated. 9 switches are planned for retrofit in 2016 and 10 are proposed for 2017.
- Bellevue Urban Smart – PSE is supporting downtown businesses in managing building energy use including combinations of behavioral and technology solutions to achieve energy savings.

CIS, GIS & OMS

- PSE implemented three new integrated systems in April 2013
 - Customer Information System
 - Geospacial Information System
 - Outage Management System
- All successful with ongoing assessment of best practices and potential “next step” functionality enhancements
- On-line and mobile app outage map enhanced to show approximate geographic area affected by outages and ability to check service status for home and business accounts.

Wrapping Up

Questions & Discussion