APEC

SmartMeters – Beyond Billing

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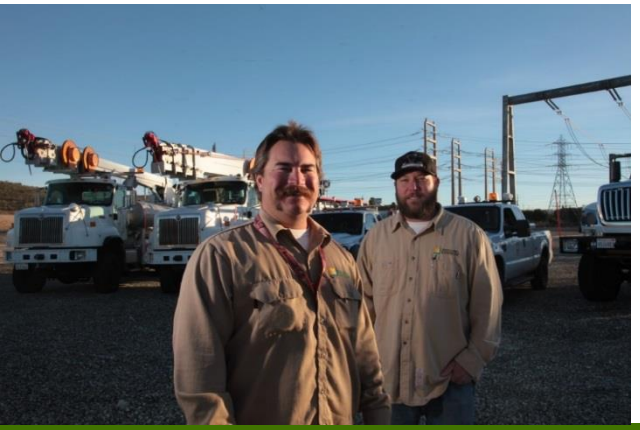
March, 2016



Smart Meter - Beyond Billing

Billing

ESC AMI Backhaul

Historic Data

SAIDI calculation automation/ accuracy improvement

Proactive Storm Analysis Demonstration

Real Time Data

Outage Restoration

PON/PRN Exceptions

Meter Events

Service Connect/ Disconnect switch

ESC AMI Backhaul

Outage Notifications

Hi Impedance fault Detection

Voltage

Home Energy Displays

ZigBee HAN

Real Time/Historic Data

Rule 2 compliance

Power quality Low/High voltage

Voltage

ZigBee HAN

Demand Response with Pool Pumps / PCTs / Smart Appliances, etc.

Voltage

Conservation Voltage Reduction CVR

Voltage

Voltage

Historic Data

Service Phase identification

Waveform signature

Aggregated Customer Loads (KWh)

Voltage

Historic Data

Optimize Capacitor Bank placement

SCADA Voltage (eDNA)

Transformer Failure Detection

Historic Data

Transformer Load Monitoring

Historic Data

Voltage Analytics & Visualization

Asset Management Transformer Loss of Life Calc.

GIS/SCE's Electrical Network

Home Area Network:
What We Thought Would Happen

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- Retail Market for ZigBee Smart Energy Profile (SEP) HAN devices
- Customers purchase Home Area Network (HAN) devices that can be leveraged by utility programs
- Meter connection required for access to energy information and to signal Demand Response Events
- SEP 2.0 would improve functionality, security, etc.
- Smart meters would be upgraded to SEP 2.0
- Customers would purchase devices that showed energy consumption information

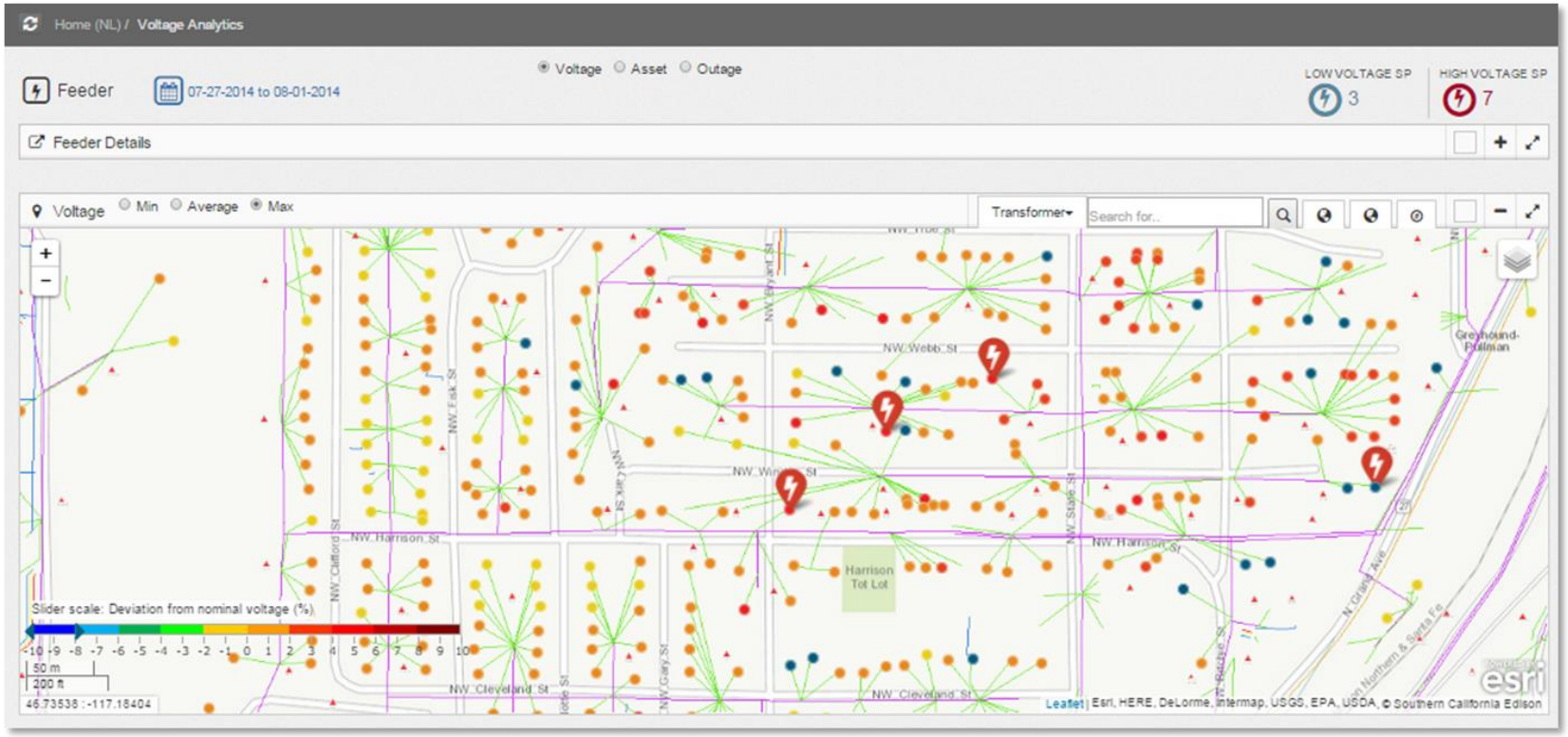
Home Area Network: What Actually Happened

Home Area Network: What Actually Happened

- HAN retail market did not develop as anticipated
- A retail market of Internet connected thermostats and home automation systems developed
- Although a connection to the meter is required for energy information, there are alternatives such as the Internet for signalling DR events
- SEP 2.0 took longer than anticipated to be finalized and has yet to gain traction in the consumer market
- SCE smart meters will not be upgraded to SEP 2.0
- Energy only devices don't seem to be compelling to customers, but energy may be a potential add-on

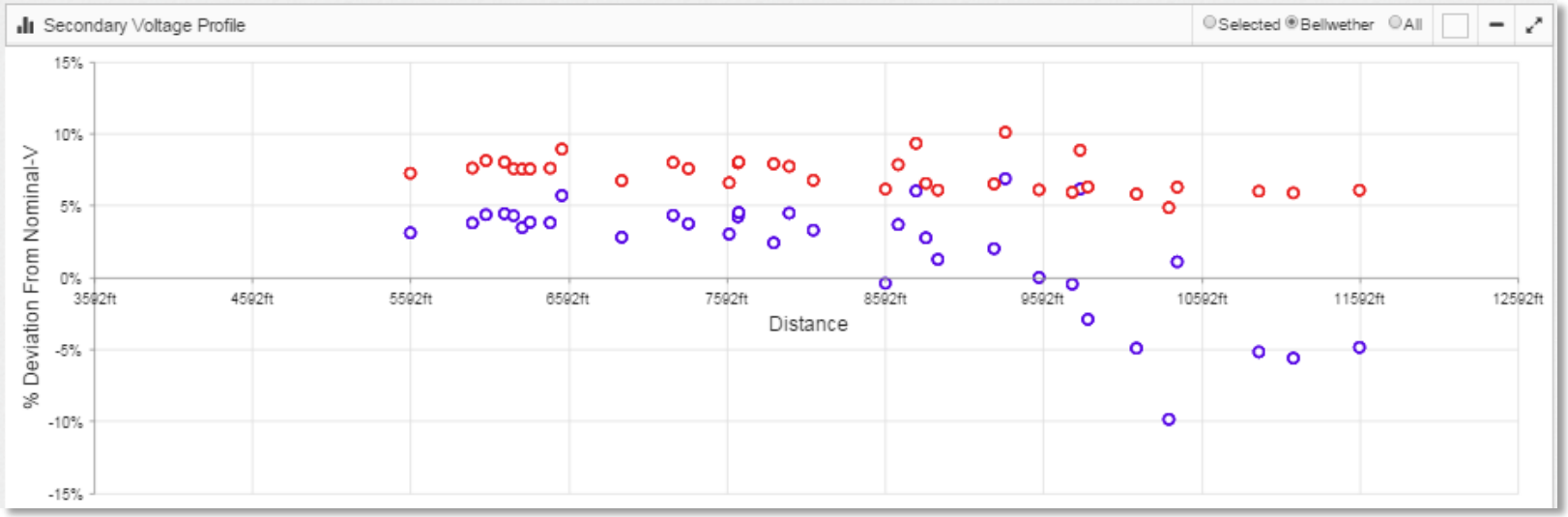
Voltage Management

View of system voltage fluctuations and assets outside of voltage limits

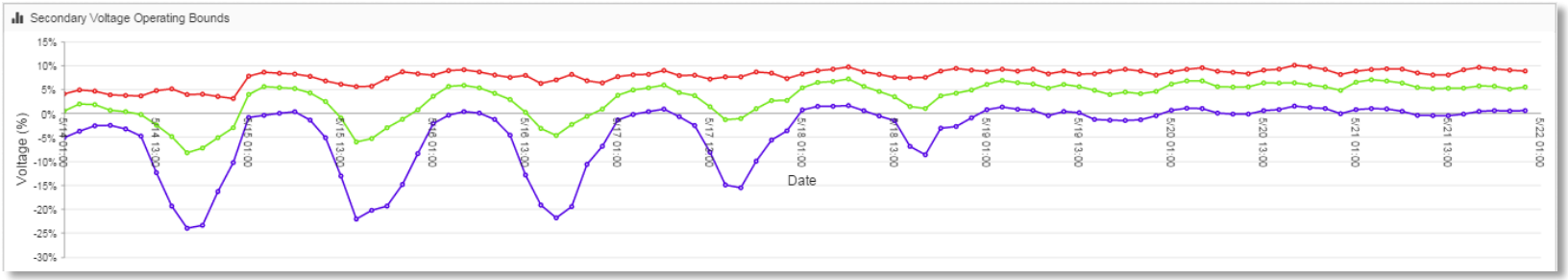


Secondary Voltage Profiles

- View voltage profile along distribution circuit



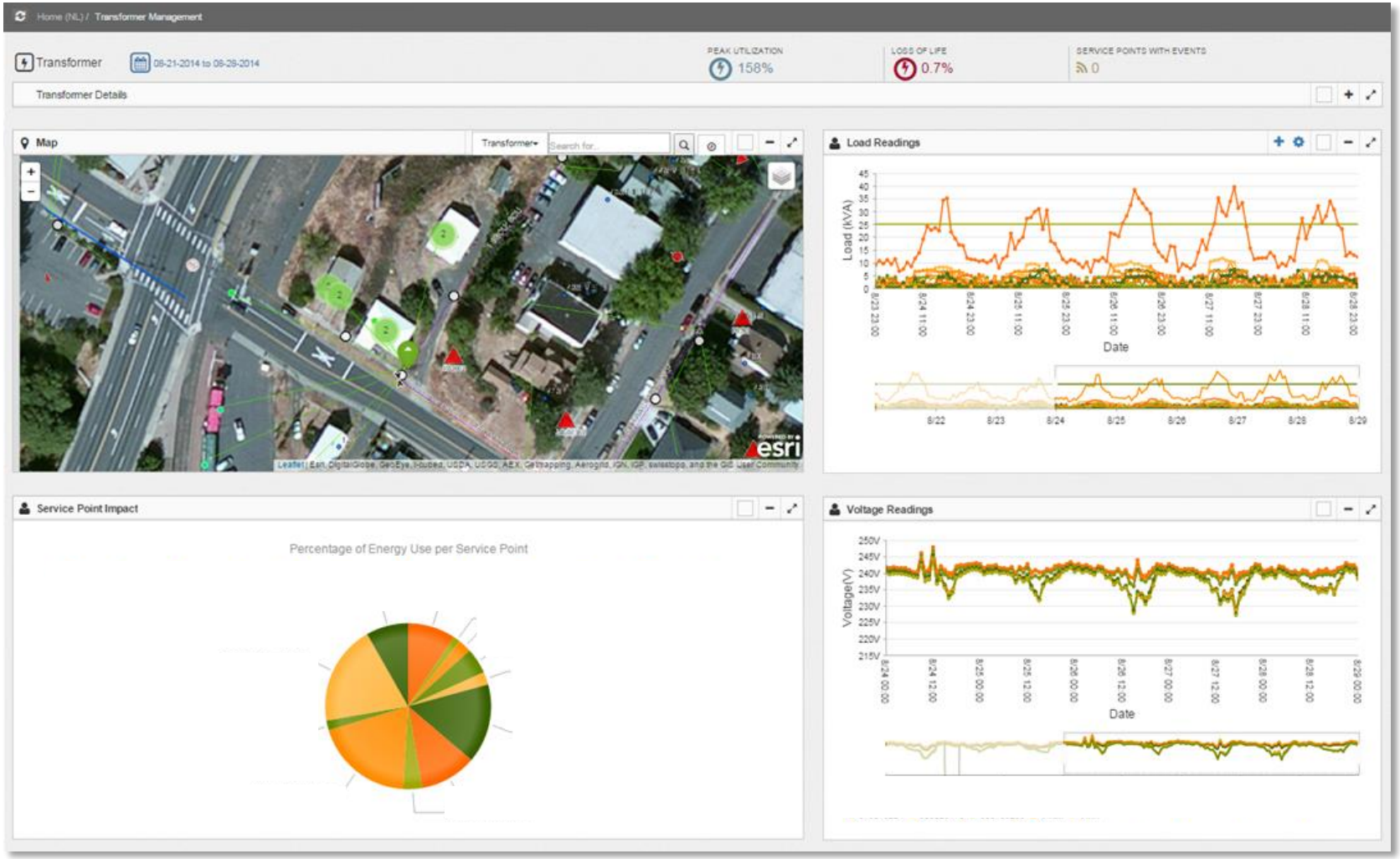
Voltage drop vs. circuit distance from substation



Hourly secondary voltage bounds on circuit (min/avg/max)

Transformer Loading

Evaluate peak load, loss of life and load allocations

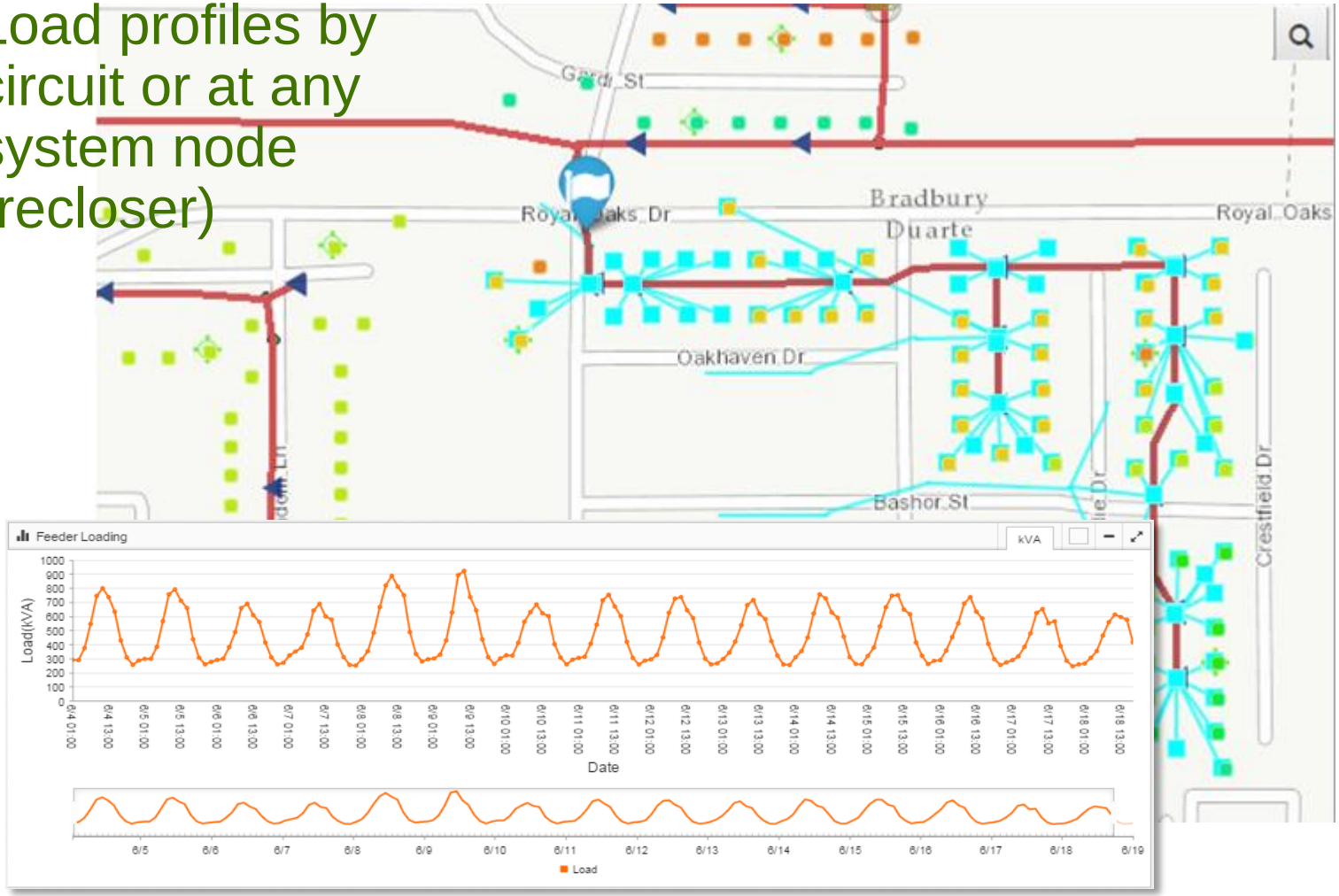


Transformer Overloads

- View area wide heat map of asset loading and at-risk transformers

Load Aggregation

- Load profiles by circuit or at any system node (recloser)



Load profile downstream of selected recloser

SAIDI/SAIFI Feasibility Study

From Wikipedia, the free encyclopedia:

The **System Average Interruption Duration Index (SAIDI)** is commonly used as a reliability indicator by electric power utilities.

SAIDI is the average outage duration for each customer served and is calculated as:

$$\text{SAIDI} = \frac{\text{sum of all customer interruption durations}}{\text{total number of customers served}}$$

Meter to Transformer connectivity

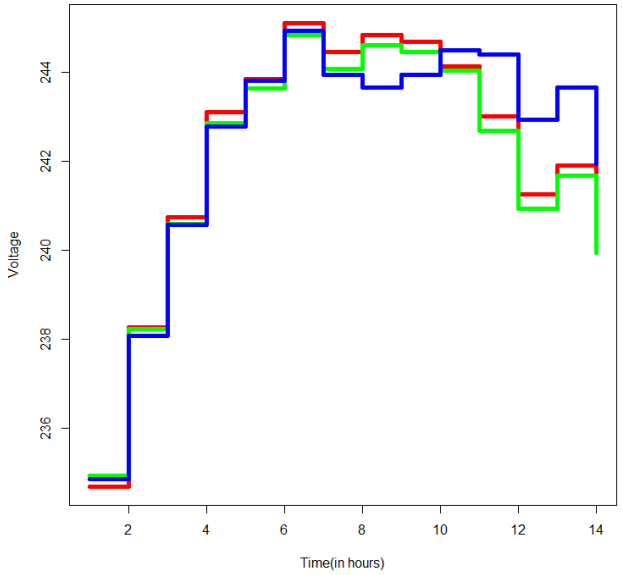
- Using Smart Meter Outage Events
- Using Voltage Signatures

Meter to Transformer connectivity

- Using Voltage Signatures
  - Based upon 1 hour average voltage readings
  - Uses the Kendall's Tau correlation

$$\tau = \frac{(\text{number of concordant pairs}) - (\text{number of discordant pairs})}{\frac{1}{2}n(n-1)}.$$

  - Applies a radial distance limit to filter outliers



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
M1	1	0.98	0.63	0.98	0.99	0.99	0.96	0.99	0.99	0.99	0.99	0.99	0.99
M2	0.98	1	0.63	1	0.99	1	0.97	0.99	1	0.99	1	0.99	0.99
M3	0.63	0.63	1	0.63	0.63	0.63	0.62	0.63	0.63	0.63	0.63	0.63	0.63
M4	0.98	1	0.63	1	0.99	0.99	0.96	0.99	0.99	0.99	0.99	0.99	0.99
M5	0.99	0.99	0.63	0.99	1	1	0.97	1	0.99	1	0.99	1	1
M6	0.99	1	0.63	0.99	1	1	0.97	1	1	1	1	1	1
M7	0.96	0.97	0.62	0.96	0.97	0.97	1	0.98	0.97	0.98	0.98	0.97	0.98
M8	0.99	0.99	0.63	0.99	1	1	0.98	1	1	1	1	1	1
M9	0.99	1	0.63	0.99	0.99	1	0.97	1	1	1	1	0.99	1
M10	0.99	0.99	0.63	0.99	1	1	0.98	1	1	1	1	1	1
M11	0.99	1	0.63	0.99	0.99	1	0.98	1	1	1	1	0.99	1
M12	0.99	0.99	0.63	0.99	1	1	0.97	1	0.99	1	0.99	1	1
M13	0.99	0.99	0.63	0.99	1	1	0.98	1	1	1	1	1	1

Transformer Monitoring (using Smart Meter technology