peco®
AN EXELON COMPANY

7/22/2025

Emergency Response Practices to Meter Alarms

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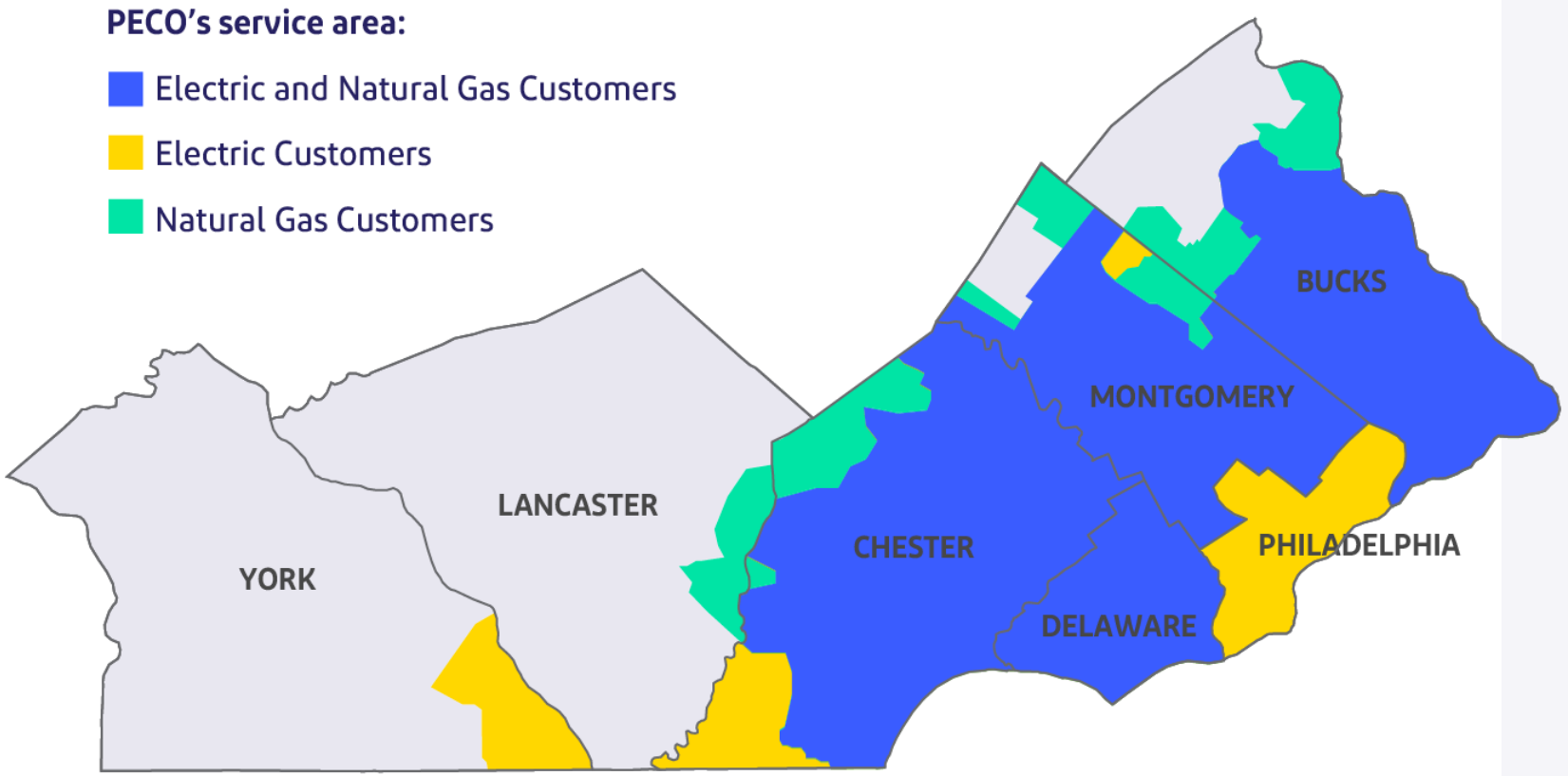
TESCO's Meter School
TESCOOL
July 20-23, 2025

PECO



22,659
distribution miles

1.7 million
electric customers

553,000
natural gas customers

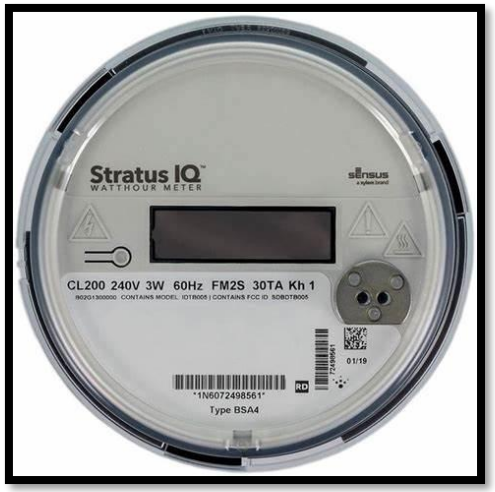
10%
commercial/industrial

90%
residential

PECO’s Electric Meter Landscape

PECO’s Electric Meter Breakdown:

- Total electric meter count: ≈1.8 million
  - Residential customers ≈91%
  - Commercial/Industrial customers ≈9%
- Original AMI meters were the L&G Focus.
  - Mass deployment 2012-2016
- The form 2S meter: Most common form used for residential customers.
  - 200A, 120V/240V Service
  - ≈88% of total electric meters
- PECO utilizes a mix of meter vendors that leverage the Sensus FlexNet communication network.
  - Sister operating companies within Exelon use the Itron Network.



Form 2S Meters

Footnote

Electric Meter Alarms

- Legacy Electromechanical meters could only measure energy consumption (kWh)
- Smart meters introduced additional sensor and measurement components that allowed meters to not only measure energy consumption but also introduced the ability to generate new alarms.
  - Power Alarms
  - Voltage/ Current Events
  - High Temperature Alarms
  - Tamper Alarms
  - Meter Failure/ Communication Alarms
- Alarms are categorized into different priority levels.
  - Critical, Major, Minor, Informational
- Meters can be configured to handle alarm messages differently.
  - Alarms that send message immediately
  - Events recorded and sent during normal communication
  - Events recorded and logged on meter but not sent over the air

Power Fail / Power Restore Alarms

- AMI meters generate power fail alarms when they detect a loss of voltage.
  - Events are logged within the meter
- Meters will send a last gasp event.
  - Meters have battery or super capacitors that allows meters to communicate when they detect an outage.
- When power is restored to a meter, it will send a power restore event.

Alert	Alert Category	Alert Severity	Start Time (EDT)	End Time (EDT)	Status	Duration	Actions
Power Fail	Service	Cr	07/01/2025 1:09:43 AM	07/01/2025 3:16:55 AM	Inactive	2 Hrs 7 Min 12 Secs	Detail

Alerts Detail

	Alert Type	Alert Name	Alert Message Received
+	Cr Critical	Power Fail	07/01/2025 3:16:55 AM **End Time**
+	Cr Critical	Power Fail	07/01/2025 1:09:43 AM **Start Time**

Showing 1 - 2 of 2 | 5 Per page

Outage Management Systems

- Utilities will incorporate the power alarms and the 2-way communication capabilities of smart meters into an Outage Management System (OMS).
- OMS will sync with outage events head-end systems, customer info systems and work management systems.
- Outage events are received and collated by time and location.
  - OMS logic can group disparate outage events into a single outage and help determine the location of the outage.
  - Helps utilities prioritize restoration work.
- After repairs are made, OMS can ping meters to confirm power has been restored.
  - OMS can close events faster and reduce the number of truck rolls.

Voltage Alarms

- Meters can be configured to generate alarms when meters experience voltages above or below a predefined threshold.
- Notifies the utility of a potential grid issue or equipment malfunction.
- Allows utilities to respond to and resolve issues before a customer reports.
- Supports regulatory compliance on power quality metrics.
- For Voltage events, meters will record:
  - Start and End time
  - Peak Voltage
  - Phase affected
  - Duration

Alerts Detail

	Alert Type	Alert Name	Alert Message Received
+	Ma Major	Over Voltage	07/06/2025 7:33:29 AM **End Time**
–	Ma Major	Over Voltage	07/01/2025 11:45:01 PM **Start Time**

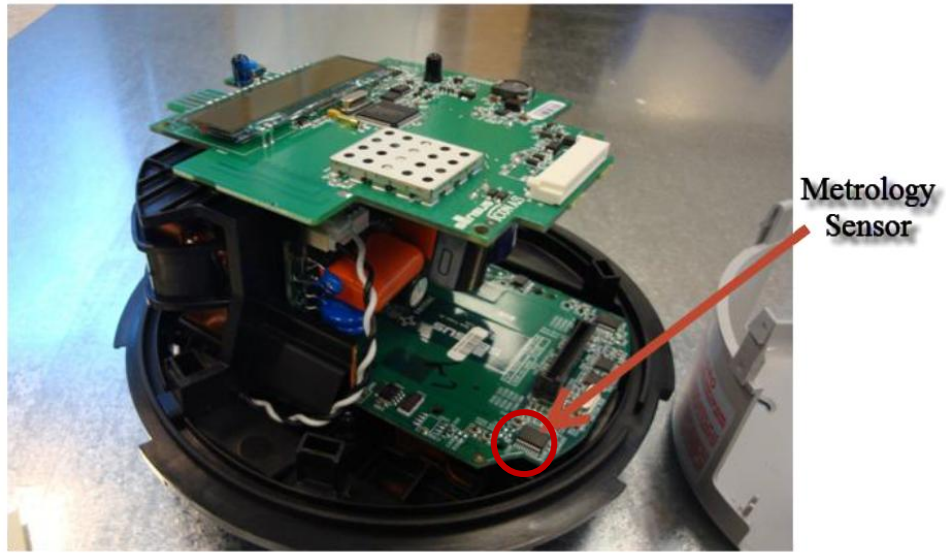
Measurement	Value
VOLTAGE, INDICATING, NA, MAXIMUM, SEG: PHASE C - Vrms	258
VOLTAGE, VALUE, NA, HIGH_THRESHOLD, SEG: NA - Vrms	256

Alert	Alert Category	Alert Severity	Start Time (EDT)	End Time (EDT)	Status	Duration	Actions
Over Voltage	Service	Ma	07/01/2025 11:45:01 PM	07/06/2025 7:33:29 AM	Inactive	4 Days 7 Hrs 48 Min	Detail

Tamper Alarms

- Meter Inversion
  - Upside-down position is detected using an accelerometer
  - Reverse Energy Alarms can also determine that
- Tilt
  - Meters experiencing excessive physical movement after installation
  - Angles are measured from vertical using an integrated accelerometer
  - Can be incorporated with meter switch to issue disconnect if an extreme angle is reached.
- Theft Bypass Detection
  - Occurs when disconnect switch in meter is opened and customer tampers with socket and connects line side terminal to load side terminal bypassing the meter.
- Magnetic Tamper
  - Identifies attempts to interfere with meter accuracy using strong magnetic fields

High Temperature Alarms



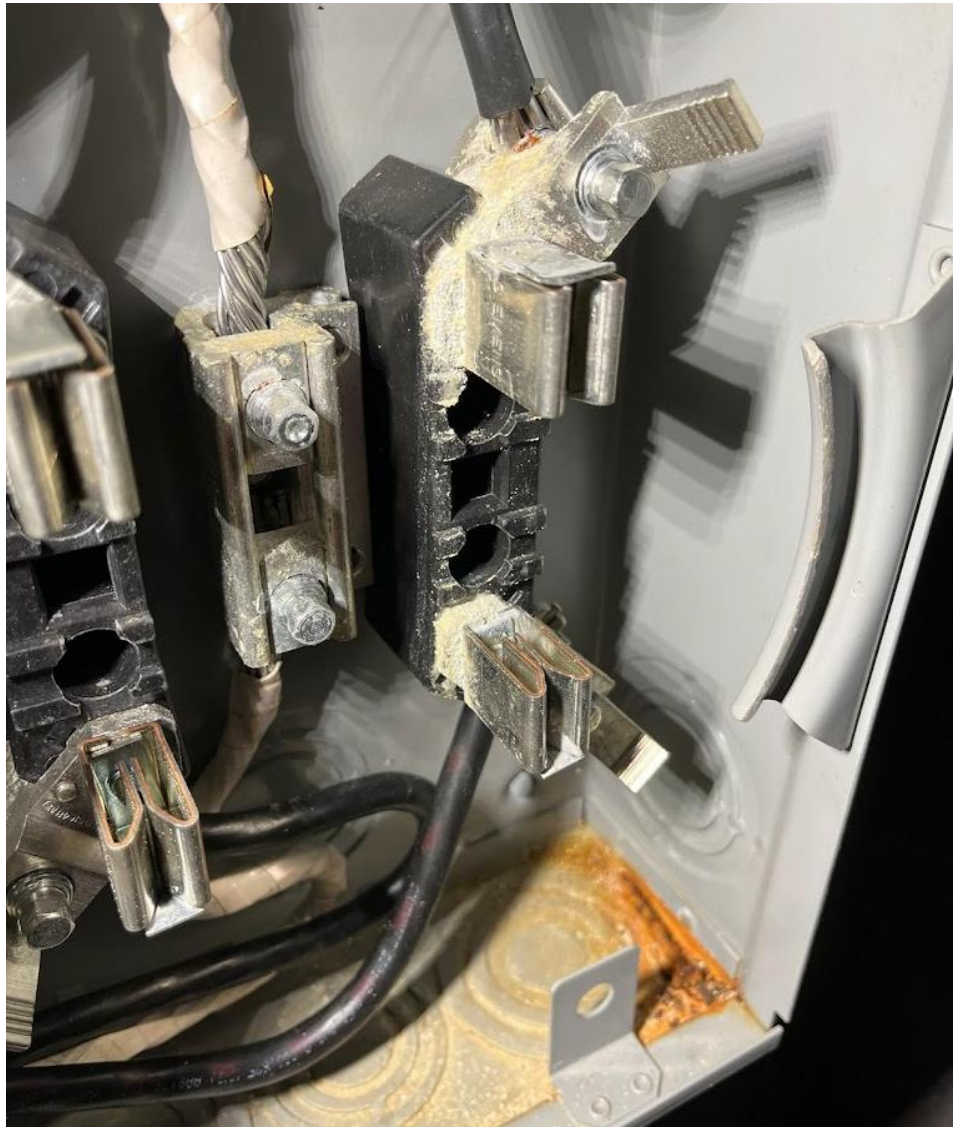
- High temperature events for meters can occur due to several reasons
  - Loose meter socket connection
  - Under rated/ Damaged equipment
  - Tampering
  - External factors (i.e. environment, meter location, building fire)
- Measuring temperature at the meter can alert utilities to one of these potential hazardous situations before a serious fire event can occur
- AMI meters have a temperature sensor built into the metrology that provides temperature readings.
- PECO established business process with alarms triggering at 85°C threshold
- Meter have been tested by UL to meet minimum standards that far exceed these thresholds

Additional Alarms

- **Reverse Energy Alarm:**
  - Triggers when meters detect flow from customer home onto the grid.
  - Indicates a tamper situation or an improperly connected generator
  - Identifies unreported solar customers
- **Meter Error Alarm**: Signals internal faults such as memory corruption, clock failure, or firmware issues.
- **Demand Threshold Exceeded**: Triggers when energy demand surpasses a preset limit, useful for demand-side management.
- **Phase Loss or Imbalance**: Detects missing or unbalanced phases in three-phase systems, which can damage equipment.

Meter Examples

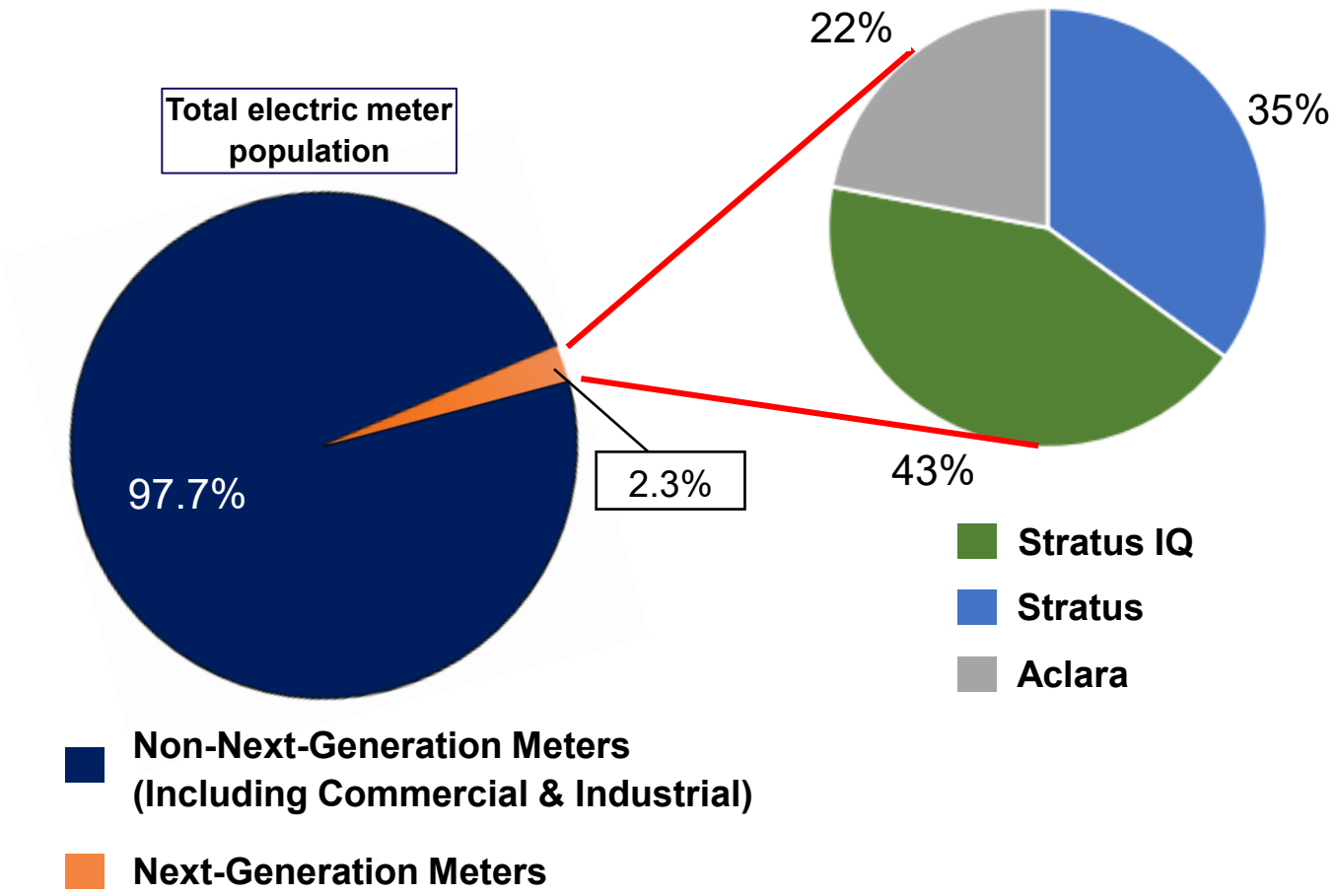
Meter Examples



Next Generation Meters

What is a Next Generation Meter?

- Replacement for current meters on system.
- Next-gen at PECO is the Stratus, Stratus IQ & Aclara.
- Next-gen meters introduced on system in 2021.
- Experimenting with advanced features mainly on Stratus IQ.
  - Loss of neutral & Generation Detection
  - Focusing on voltage channel
  - Looking to expand to Aclara

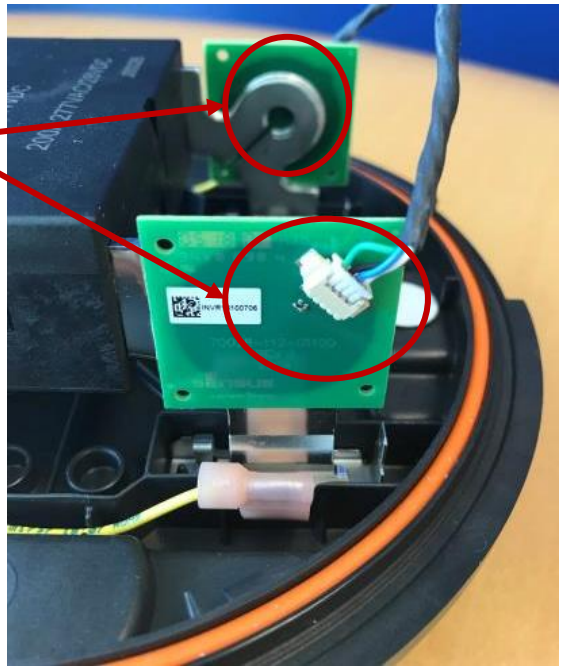


Next Gen Alarms

- Loss of Neutral
  - Feature allows notification for the electrical characteristics of intermittent or sustained loss of the neutral connection for several meter forms (2S, 12S/25S)
  - Unusual electrical phase balance within any 15-minute interval in order to trigger an alarm
- Arc Detection
  - The Arc Detection alarm feature allows notification if conditions indicate arcing at the meter bus bar connections to the socket, due to a loose connection.
- Total Harmonics Distortion/ Total Demand Distortion
  - Measures distortion in voltage or current waveforms caused by harmonics
- Load Side Sensing
  - Occurs in situations when the meter switch open.
  - Identifies a load side voltage in the meter and will not allow meter switch to close.

SENSUS Next Gen Meter Temperature Alarm Evolution

- SENSUS improved temperature sensing for next generation meters
  - 2 additional temperature sensors
    - Located directly on meter busbar A and busbar C
    - Directly connected to meter blades
      - Sensors are closer to potential heat sources
      - Allows for faster heat event detection.



- Added logic how meter handles temperature sensing
  - There are 5 potential triggers for High Temperature alarms on Stratus IQ meters
    - Metrology
    - Busbar A
    - Busbar C
    - Rapid Rise
    - Temperature Differential

Temperature Auto Open

- Temperature Auto Open (TAO) is a new feature on next gen meters
  - algorithm controls the alarms and actions of the remote disconnect as a result of increased temperature.
  - Meter will trigger a high temperature alarm at a defined threshold.
  - If meter temperature continues rising to higher set threshold, meter switch will open disconnecting the customer load.
- Mitigates a potentially dangerous situation before a catastrophic event.
- Removing the load from a meter will remove the primary heat source for high temperature events.
- Provides additional benefit to “Orphan” meter high temperature alarms.
  - Meters with incorrect or no location data.

TESCO METERING

Socket Arc-Detect Update

AGENDA

- What is Micro-Arc Detection?
  - Location and Purpose of Arc Sense in Meter Base
  - Description of Operation
  - Block Diagram
  - Circuit Diagram
  - Important Parameters and Take Aways
- Your Data & You
  - How is Micro-Arc Data Captured
  - How do I make use of it?
- Micro-Arc Detection in the Wild
  - PSEG LI Micro-Arc Case Study
  - AvanGrid Case Study Preliminary Findings

Location and Purpose of Detector

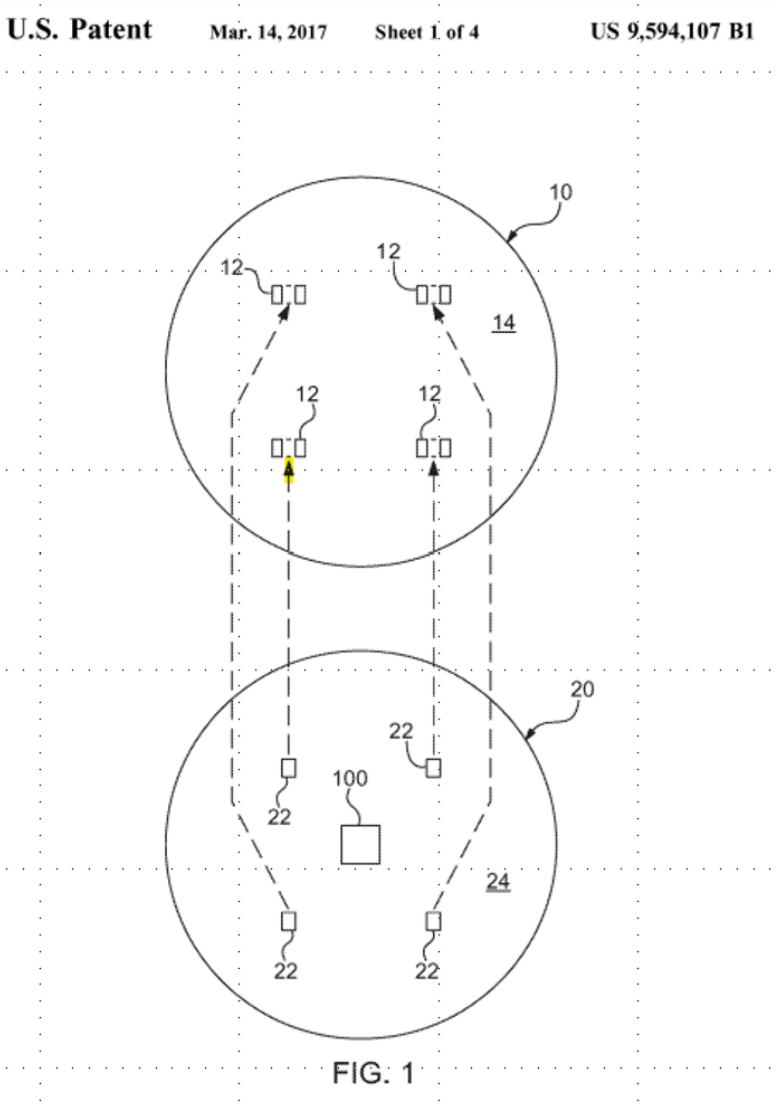


FIG. 1

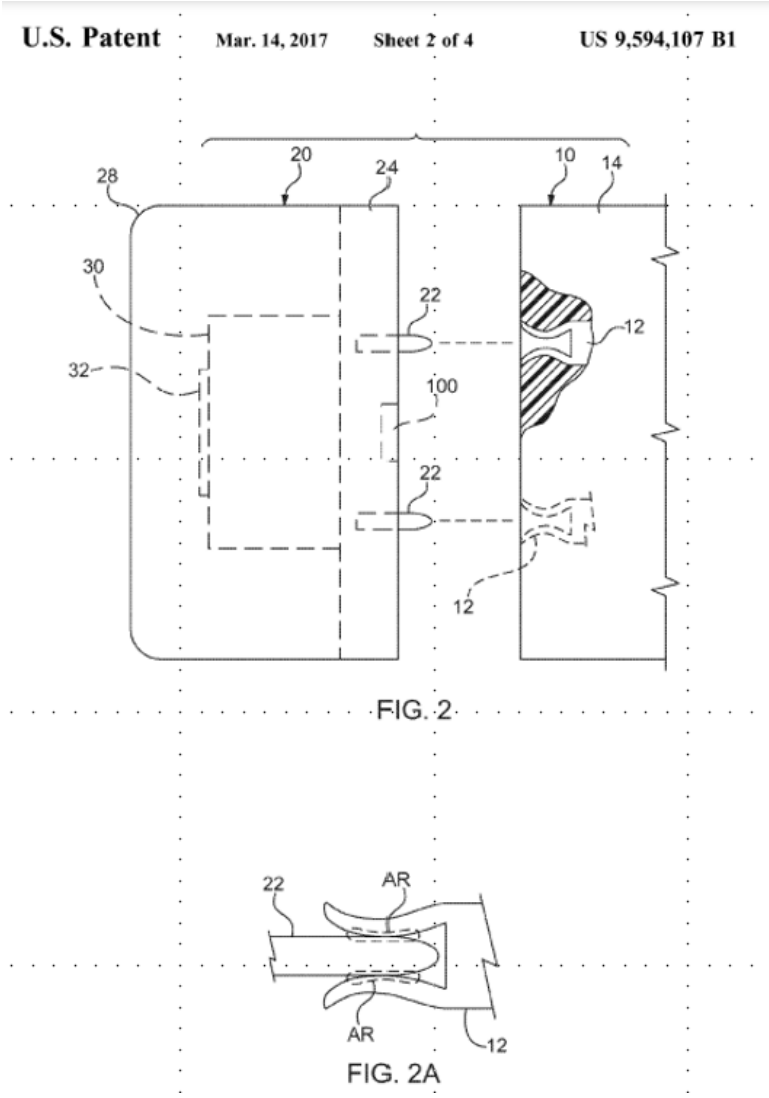


FIG. 2

FIG. 2A

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BLOCK DIAGRAM

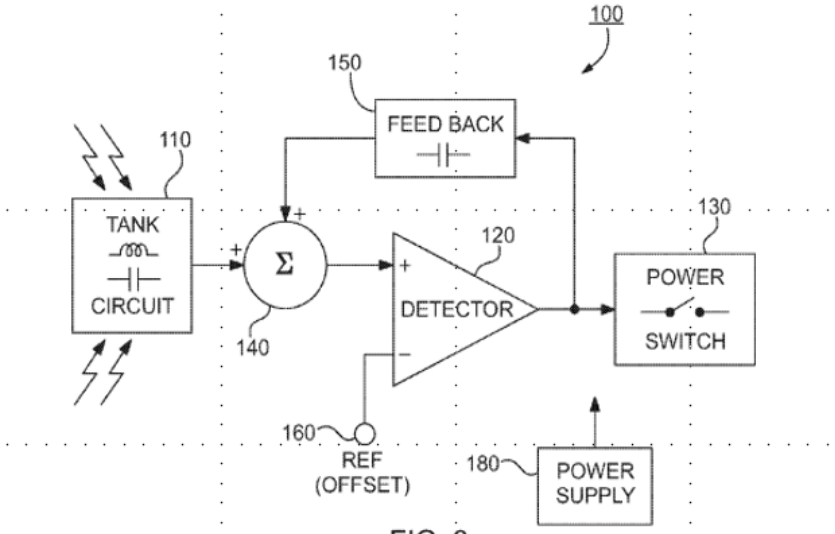

FIG. 3

THEORY OF OPERATION TAKE AWAYS

- Sensor (100) embedded in meter base (24) within 4 inches of Stabs (22)
- FIG 2A. Arc will occur when Contact Surface Area (22,12) Compromised
- AND Vibration Occurs to Stimulate Arcing
- Arcing Produces EMF (~ 500 kHz) (low energy – UHF high frequency)
- Arc Detector (110): Tank Circuit (110) De-Tuned Resonant R,L,C Circuit*
- Electric Detector(120): Latches Occurrence High (~ one second)
- Arc Count = One Second Resolution (f(RC Time Constant) (150))
- Output (130) Logic High for One Second

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CIRCUIT DIAGRAM

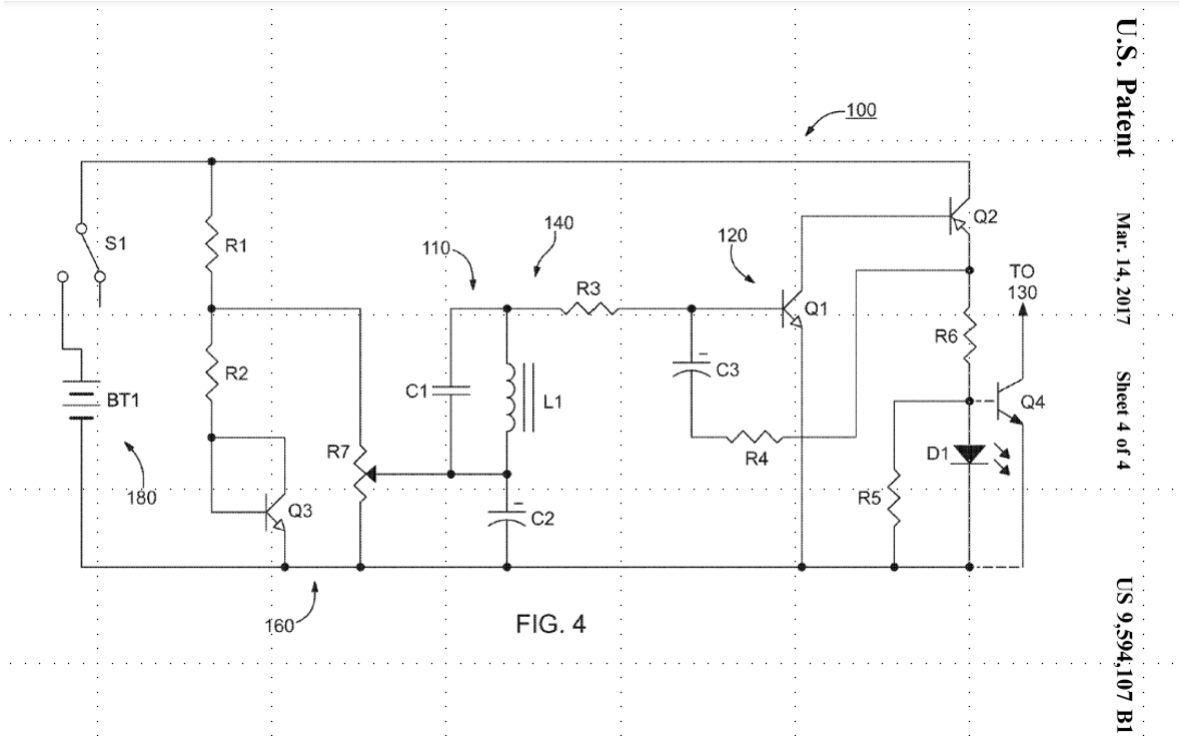


FIG. 4

U.S. Patent Mar. 14, 2017 Sheet 4 of 4 US 9,594,107 B1

Arc Properties: Type One and Two

- Type One:
  - “Jittering” type “intermittent” arcing (lower energy “heat” content)
  - Incipient Information… Contact Area Compromise Early Stages
- Type Two:
  - “Welding” type “longer duration” arcing (high energy “heat” content)
  - Significant Compromise of Contact Area and High Impedance
  - Later Stages, Thermal Runaway Condition

TESCO METERING

Your Data & You

Micro-Arc Detection as Part of Your AMI System

YOUR DATA & YOU

- Reporting and data is the lifeblood of a healthy Micro-arc detection ecosystem
- Alarms are good, but not enough
- High temp and vibration alarms
- What should my settings be

YOUR DATA & YOU: YOUR SETTINGS

- What should my settings be?
  - Depends on the utility
    - Each utility will have their own sweet spot when it comes to their problem sets; this can take a bit of time to dial in
    - Variables like:
      - Age of meter population
      - Type of meter sockets (lever bypass vs ring etc)
      - Climate (inland vs coastal)
  - Depends on the meter manufacturer
    - Itron and L+G implemented different data capture methods and provide disparate reporting formats and granularity of data capture

Your Data & You: L+G Settings

- L+G Settings
  - Captures raw arcs in Load Profile
  - Can capture 4-5 arcs/second
  - Can capture “highest rise”, “temp”, and other important co-variables
- Basic set-up is easy: select the number of arcs/day required to trigger an Arc Alarm*
  - *Currently tied to High Temp alarm

PSEG Long Island Case Study

PSEG Long Island, TESCO, L+G

Project Background

- PSEG LI
  - 1.2 million connected customers (electric)
  - Fully AMI deployed, L+G Gridstream
    - Deployment commenced: 2018
    - Deployment completed: Spring 2022
- TESCO
  - Developed ArcSense® technology in-house
  - Worked with L+G to provide as a formal offering
  - PSEG LI offered to run a pilot program of ~4,500 meters
  - Pilot launched in Fall 2021
- L+G
  - Provided platform and access to load profile data for arc reads
  - Incorporating the technology into their next gen, Revelo® meter

- Collaboration between PSEG Long Island, TESCO, and Landis + Gyr
- Pilot project included a total of ~4,500 meters in the field at various locations
- New technology developed by TESCO is integrated into an L+G Focus Meter
- The board detects the RF signature of a micro-arc
- Micro-arc data is captured and relayed within the load-profile data
  - Load-profile reporting was an open channel to provide the additional micro-arc data for reporting analysis

Additional Load Profile Data in Daily Report

Meter with LP Data

L+G Head End System

Landis Gyr+

- Max arc count
- Sum of arc count
- Maximum temperature and timestamp
- Estimated blade temperature

Automated Report

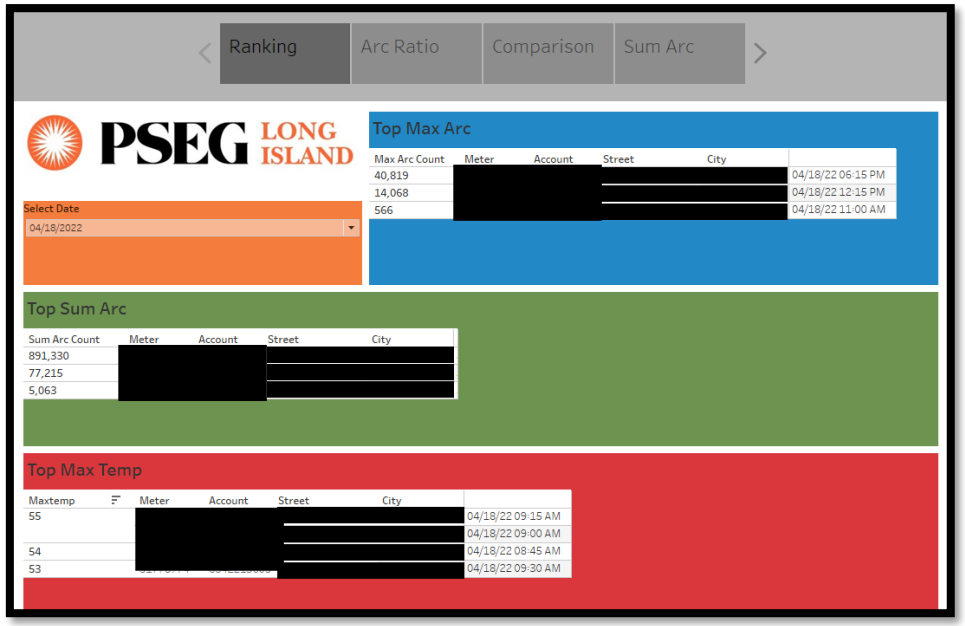
Analysts / Engineers

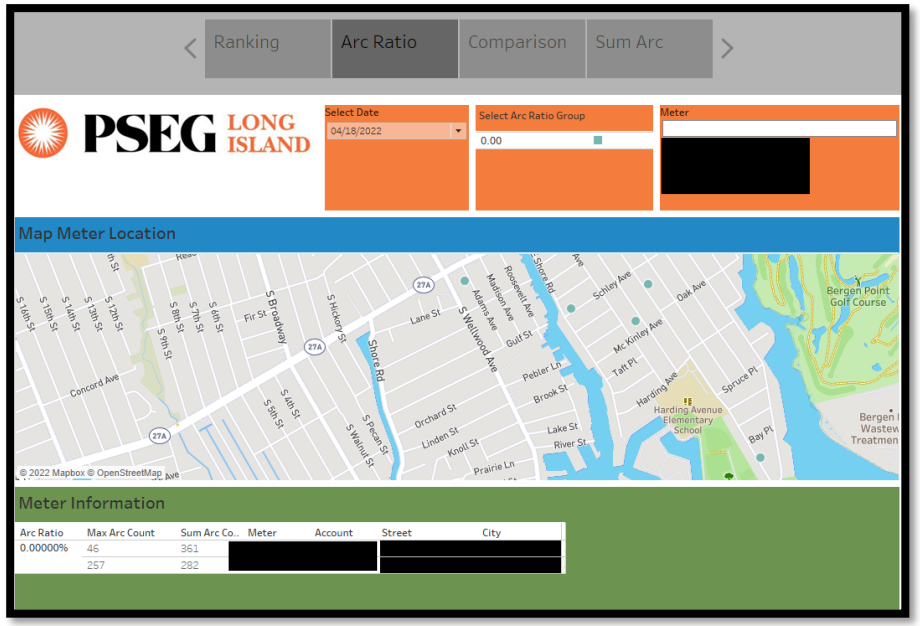
Field Investigation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	RUN_DATE	CONFIGURATION_GROUP	METER	MAX_RISE	MAX_RISE_TIME	MAX_ARCCOUNT	KWH_ATMAXARCTM	MAX_ARCCOUNT_TIME	SUM_ARC_COUNT	MAXTEMP	MAXTEMP_TIME	MAX_KWH	MAXKWH_TIME	LATITUDE
2	7/4/2022	Arc_Sense	51775736	2	7/4/2022 11:45	7	0.3768	7/4/2022 11:45	7	40	7/4/2022 15:15	2.2746	7/4/2022 16:15	40.841446
3	7/4/2022	Arc_Sense	51775738	2	7/4/2022 19:15	6	1.3734	7/4/2022 19:15	6	40	7/4/2022 12:00	1.7136	7/4/2022 19:00	40.907032
4	7/4/2022	Arc_Sense	51775739	2	7/4/2022 19:15	6	0.5376	7/4/2022 19:15	6	51	7/4/2022 17:45	0.582	7/4/2022 15:30	40.911827
5	7/4/2022	Arc_Sense	51775741	2	7/4/2022 23:30	7	0.4872	7/4/2022 23:30	72	56	7/4/2022 8:00	1.119	7/4/2022 22:00	40.85447
6	7/4/2022	Arc_Sense	51775742	7	7/4/2022 16:30	20	1.0806	7/4/2022 16:30	40	66	7/4/2022 11:30	1.251	7/4/2022 15:15	40.854065

TESCO METERING

TABLEAU DATA





TESCO METERING

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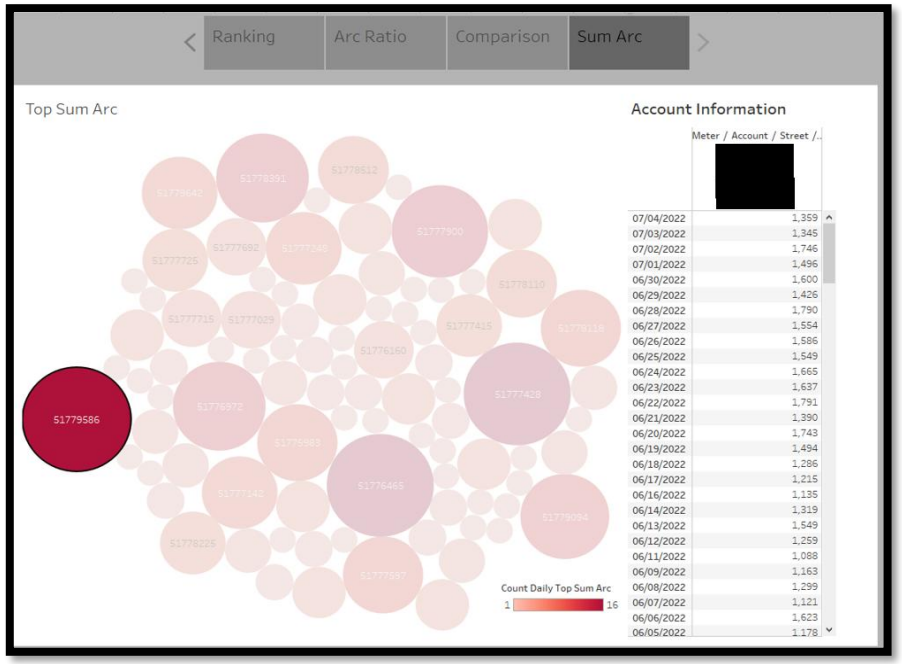

Arc Sense Priority List

- Meters were selected based on below criteria:
  - High arc count: >100 arcs
  - Days of high arc: >=14 days
- Meters prioritized by number of days they appeared on Arc Sense Report
  - Priority 1 = 40-95 days of high arc
  - Priority 2 = 20-39 days of high arc
  - Priority 3 = 14-19 days of high arc
- Some meters with anomalous data profiles (high average arc counts or abnormal temp readings) were moved up in priority level

	Meter Number	Priority	Division	Date of Visit
3	[redacted]	1	Western Suffolk	4/29/2022
4		2	Western Suffolk	5/9/2022
5		3	Western Suffolk	5/9/2022
6		1	Western Suffolk	5/23/2022
7		1	Western Suffolk	5/23/2022
8		1	Central Nassau	5/24/2022
9		1	Central Nassau	5/24/2022
10		1	Central Nassau	5/24/2022
11		3	Western Suffolk	6/2/2022
12		1	Eastern Suffolk	6/22/2022
13		2	Eastern Suffolk	6/22/2022

TESCO METERING

PRIORITY CLASSIFICATIONS

- Priority 1 – 15 sites, 13 investigations showed issues at the site, 7 hot-socket compromised
- Priority 2 – 23 sites, 18 investigations showed issues at the site, 5 hot-socket compromised
- Priority 3 – 19 sites, 8 investigations showed issues at the site, 2 hot-socket compromised

Mete Numb	Prior	Date of Visit	Note	Meter Pan Brand	Meter Pan Type
[redacted]	1	5/23/2022	Pan Damaged at Top Conduit Entry, 2 repair points on neutral	Murray	Bypass Lever
	1	4/22/2022	None	Milbank - Ring Type	Ring
	1	4/22/2022	Generator Present at house, dielectric grease found on meter	Milbank - Bypass Lever	Bypass Lever
	1	4/22/2022	found Open neutral at Next House	Murray-Bypass Lever	Bypass Lever
	1	4/22/2022	Damaged Weather head, Repairs to Neutral and Hot legs for feed across the street. Corrosion/oxidation on Phase A line	Anchor- Ring Type	Ring
	1	4/29/2022	none	Murray	Bypass Lever
	1	4/29/2022	part of ceramic broken on inside of pan	Anchor	Ring
	1	5/23/2022	none	Milbank	Ring
	1	5/23/2022	brand new pan and new service wires, some pitting on meter	Milbank	Bypass Lever
	1	5/26/2022	near window AC Unit	Anchor	Ring
	1	5/24/2022	open to elements and had been allowing water to drain into pan; meter pan jaws had dielectric grease. Meter Arced when re installed.	Not legible	Ring
	1	5/24/2022	Linkets at weatherhead instead of fuzzy boxes, discoloration on phase A load side of meter blade	Murray	Bypass
	1	5/24/2022	Burn Marks on Meter Pan Jaws	Milbank	Bypass Lever
	1	6/22/2022	corrosion inside meter pan	milbank	bypass
	1	6/24/2022	repair point on service drop. 1 block away from transmission line	murray	bypass

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Mete Numb	Prior	Date of Visit	Note	Meter Pan Brand	Meter Pan Type
[redacted]	2	4/22/2022	repairs to wires at weathehead	Crouse Hinds – Ring Type	Ring
	2	4/29/2022	Meter located in Vicinity of Water Tower with Cell Antennas	murray	ring type
	2	4/29/2022	House Behind LIE Barrier, near Road Noise	Anchor	ring type
	2	4/29/2022	Meter located in Vicinity of Water Tower with Cell Antennas, RF detector reads 1.0 in vicinity of meter	Milbank	Bypass Lever
	2	5/23/2022	2 repair points in neutral wire to weather head, meter is 1 mile from cell tower	Milbank	Bypass Lever
	2	5/9/2022	of A Phase. Meter is in direct sunlight. Meter has illegal holes drilled and is being used as a raceway for Romex which is not properly insulated. Weatherhead has flexible insulation to meter pan.	Milbank	Bypass Lever
	2	5/26/2022	Rusted conduit, Service wire Deteriorating	Murray	A Base
	2	5/26/2022	None	?	Circular Style Socket
	2	5/26/2022	meter within 40 feet of transmission lines	Anchor	Ring
	2	6/2/2022		Milbank	Ring
	2	5/23/2022	none	Murray	Bypass Lever
	2	6/2/2022	Improper connection at weatherhead	Milbank	Bypass
	2	6/2/2022	None, installed at meter bank	Delta	
	2	6/2/2022	Repair Point, weatherhead has signs of wear	?	Socket
	2	6/2/2022	conduit at meter pan is separated	Murray	Ring
	2	6/22/2022	near several AC Units	anchor	socket
	2	0			
	2	6/22/2022	neutral wire shows signs of heating up inside pan	milbank	bypass
	2	6/24/2022	RF Readings 10-19	murray	bypass
	2	6/24/2022	none	milbank	bypass
	2	6/24/2022	not pulled, pan installed in siding	unknown	ring socket
	2	6/24/2022	corrosion on weather head conduit	anchor	ring socket
	2				

TESCO METERING

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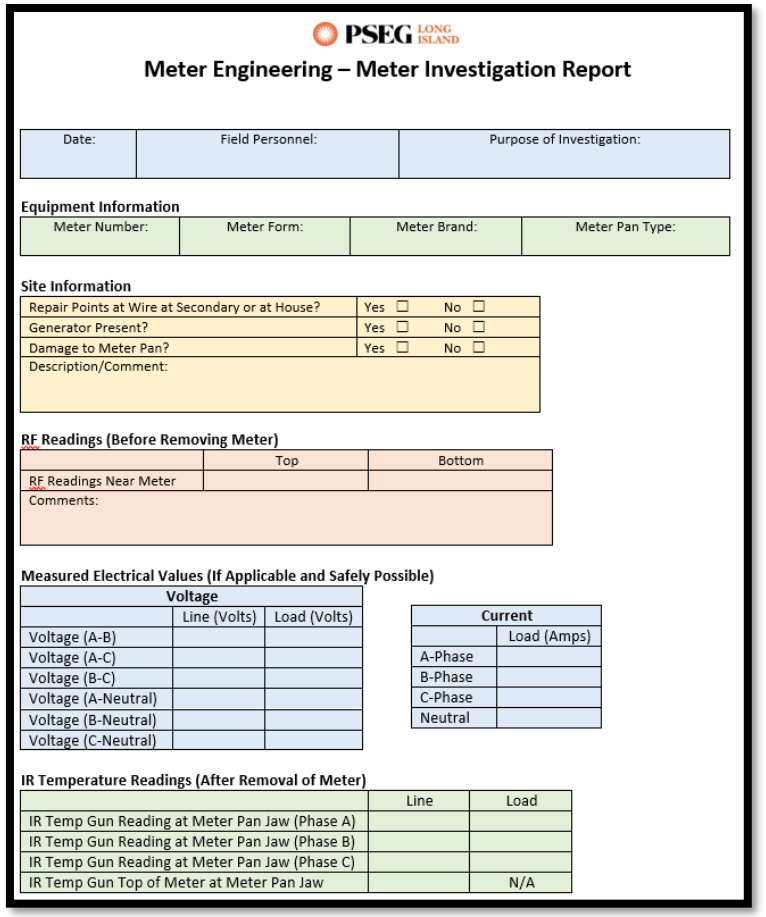
- Priority 3 – 19 sites, 8 investigations showed issues at the site, 2 hot-socket compromised

Mete Numb	Prior	Date of Visit	Note	Meter Pan Brand	Meter Pan Type
	3	4/22/2022	Found Burned/damaged insulation on line side of A Phase	Murray Bypass Lever	Bypass Lever
	3	4/22/2022	oxidation on 2nd phase, busy roadway	Crouse Hinds - Ring Type	Ring
	3	4/29/2022	Meter located in Vicinity of Water Tower with Cell Antennas	not visible	Ring Type
	3	4/29/2022	none	not visible	RING TYPE
	3	AA			
	3	5/23/2022	none	Murray	Ring
	3	5/9/2022	none	Anchor	Ring
	3	5/9/2022	Found Pan Jaws recessed due to meter installation, Found signs of Arcing. Found open insulation cover on "fuzzy box" at	Anchor	Ring
	3	5/23/2022	RF read 3.3 mw/m2 in area of meter. Meter is at busy roadway. Linkets installed at wire to house instead of fuzzy boxes	Anchor	Ring
	3	6/2/2022	None	Murray	Bypass
	3	CC			
	3	6/2/2022	Pitting on A Blade of meter	Murray	Bypass
	3	6/22/2022	No customer not disconnected	nr	nr
	3	6/22/2022	None	"POT Type"	
	3	F			
	3	5/24/2022	none	Not legible	Ring
	3	6/24/2022	not pulled		ring socket
	3	N			
	3	6/24/2022	near AC Units, waterfront property	durham	ring socket

Field Investigations

- PSEG Long Island Technicians and Engineers performed site visits
- Recorded various site conditions and measurements from each meter:
  - Condition of meter pan, conduit, weather-head, and secondary wires
  - Voltage and amperage
  - IR temperature reading on face of meter and on jaws
  - RF reading in area of meter
- Field Tools:
  - IR temperature laser
  - TESCO jaw tester
  - Multimeter
  - RF meter



PSEG LONG ISLAND

Meter Engineering – Meter Investigation Report

Date:	Field Personnel:	Purpose of Investigation:

Equipment Information

Meter Number:	Meter Form:	Meter Brand:	Meter Pan Type:

Site Information

Repair Points at Wire at Secondary or at House?	Yes ☐	No ☐
Generator Present?	Yes ☐	No ☐
Damage to Meter Pan?	Yes ☐	No ☐
Description/Comment:		

RF Readings (Before Removing Meter)

	Top	Bottom
RF Readings Near Meter		
Comments:		

Measured Electrical Values (If Applicable and Safely Possible)

Voltage		
	Line (Volts)	Load (Volts)
Voltage (A-B)		
Voltage (A-C)		
Voltage (B-C)		
Voltage (A-Neutral)		
Voltage (B-Neutral)		
Voltage (C-Neutral)		

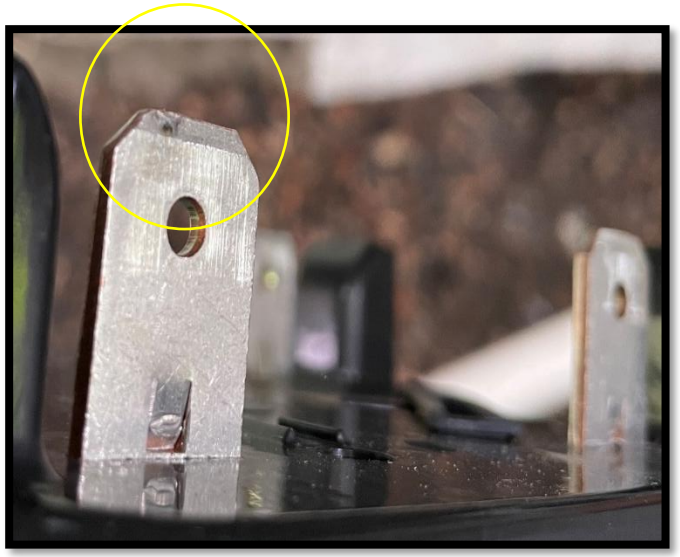
Current	
	Load (Amps)
A-Phase	
B-Phase	
C-Phase	
Neutral	

IR Temperature Readings (After Removal of Meter)

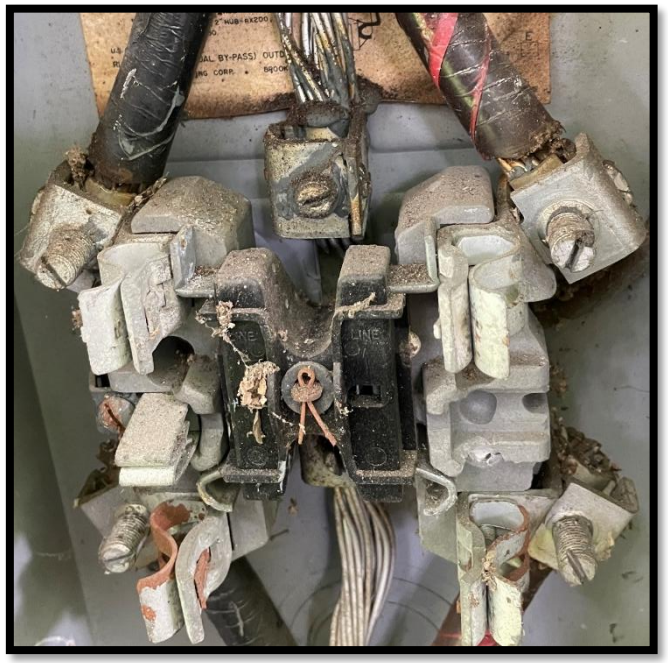
	Line	Load
IR Temp Gun Reading at Meter Pan Jaw (Phase A)		
IR Temp Gun Reading at Meter Pan Jaw (Phase B)		
IR Temp Gun Reading at Meter Pan Jaw (Phase C)		
IR Temp Gun Top of Meter at Meter Pan Jaw		N/A

Meter 51****48 – Discoloration on Meter Blade

- Days on report with >100 Max Arc Count: 16
- Average arc count: 160
- Max Arc Count: 320
- Arc Sense Priority Level 3

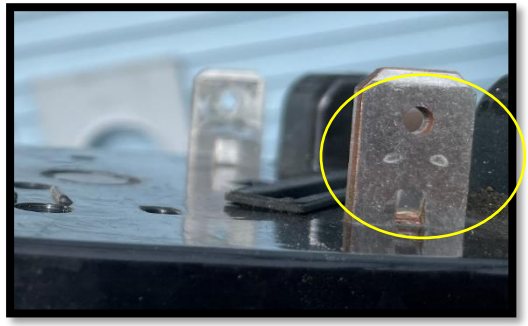


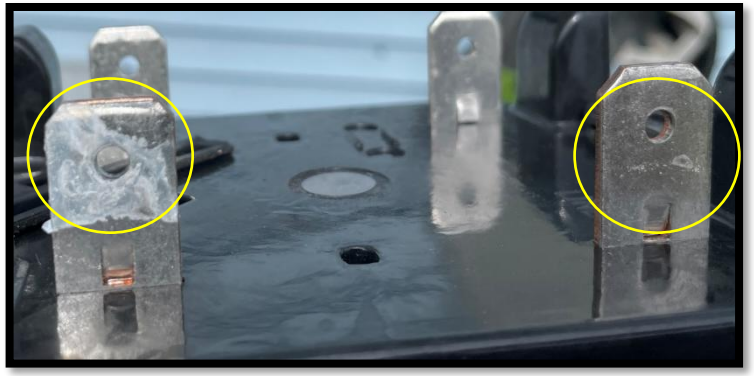
- **No previous reports of overheating or rise in temperature**
- **Pitting on meter blade**
- **Meter pan did not show any signs of damage or excessive weathering**

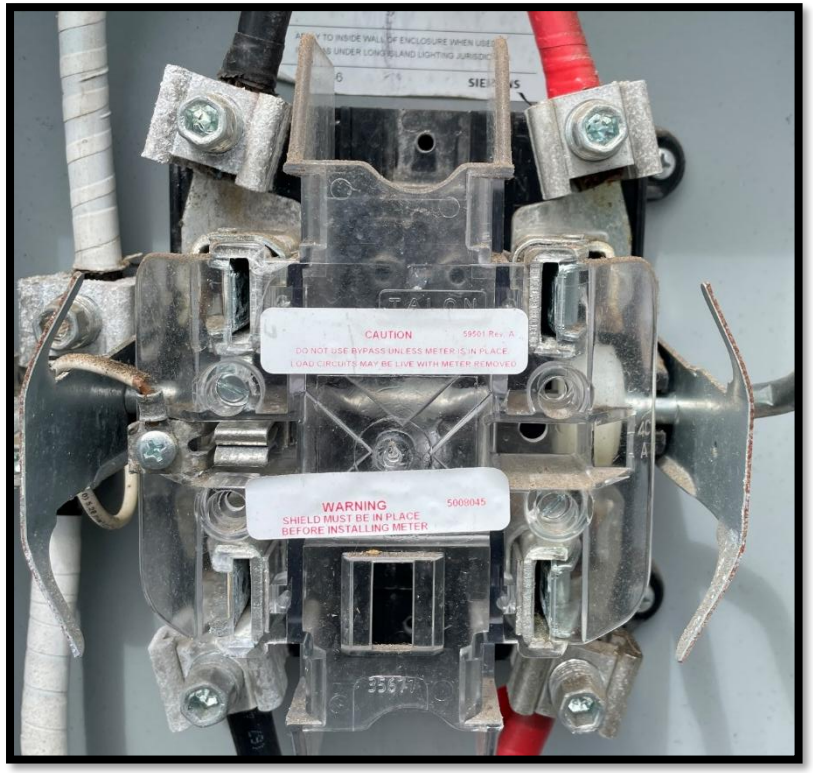


Meter 51****35 – Discoloration on Meter Blade

- Days on report with >100 Max Arc Count: 43
- Average arc count: 305
- Max Arc Count: 534
- Arc Sense Priority Level 1
- No previous reports of overheating or rise in temperature

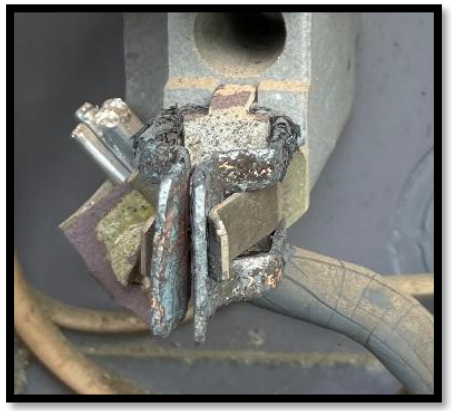






METER 51****18 – HIGH TEMPERATURE ALERTS

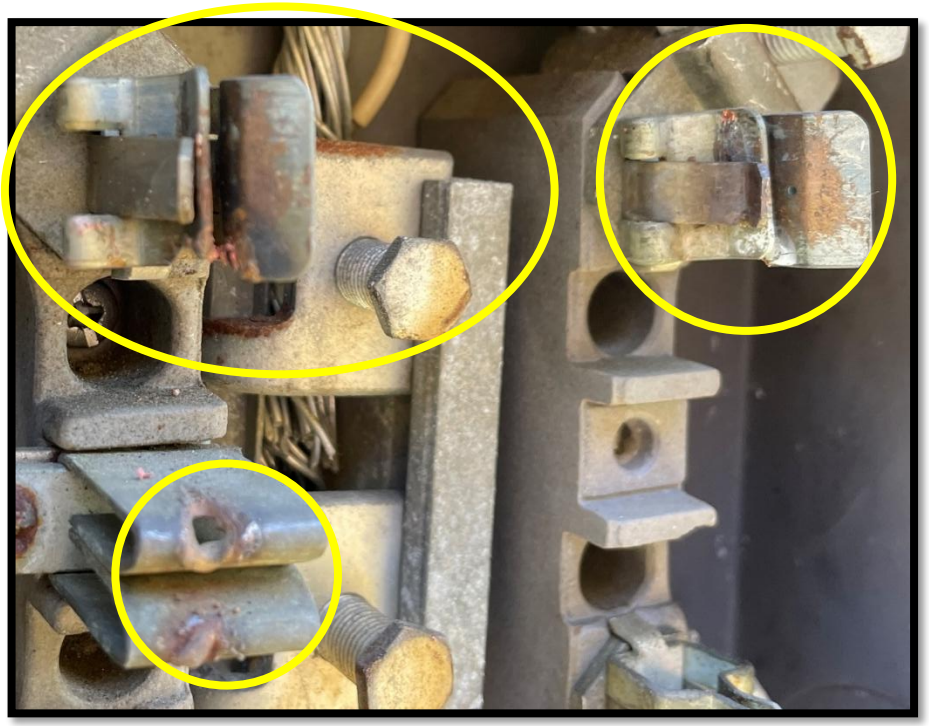
- Originally a non-Arc Sense meter was at property
- Meter was reported by Analyst to indicate high temperature alerts
- Arc Sense meter was installed in Spring 2022 after high temperature alerts
- Arc count and temperature readings were high enough to warrant investigation
- Found brittle jaws inside meter pan; meter pan was replaced as a result



Meter 51****26 – Meter Pan with Recessed Jaws

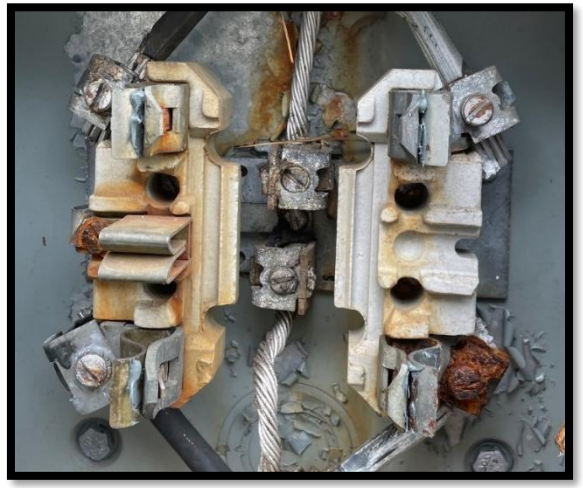
- Days on report with >100 Max Arc Count: 18
- Average arc count: 278
- Max Arc Count: 539
- Arc Sense Priority Level 3

- **No previous reports of overheating or rise in temperature**
- **Recessed springs and discoloration on the jaws**
- **Damaged neutral (as if someone tried to fix the jaws and an uninsulated screwdriver made contact between phase/neutral)**



METER 51****14 – CONDUIT ALLOWING WATER

- Days on report with >100 Max Arc Count: 43
- Average arc count: 233
- Max Arc Count: 473
- Arc Sense Priority Level 1



- **No previous reports of overheating or rise in temperature**
- **Conduit allowed water to enter into the meter pan**
- **Screw terminal at C-phase load side was rusted and deteriorating**
- **Meter produced arcs when reinstalled**

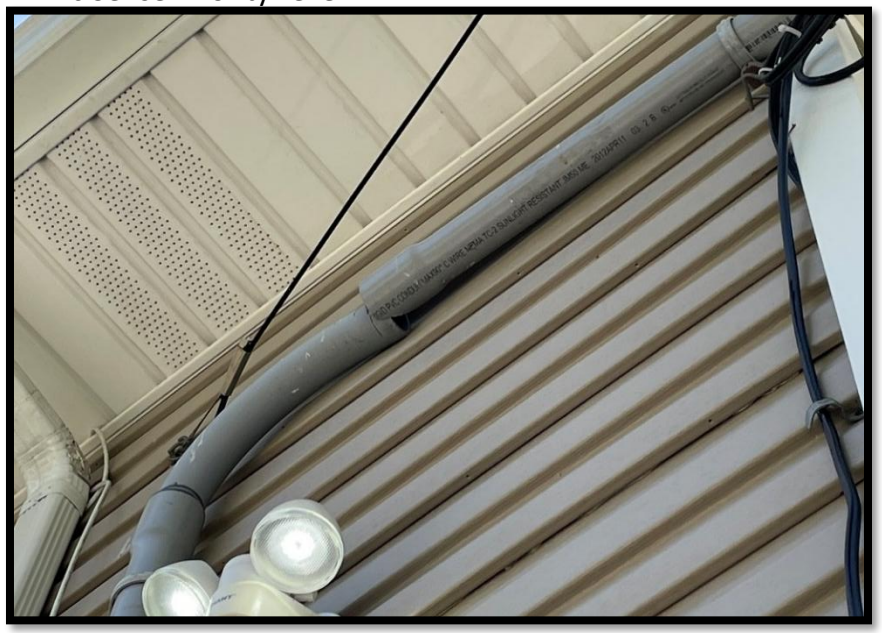
Meter 51****55 – Weather-head Conduit Damage

- Days on report with >100 Max Arc Count: 35
- Average arc count: 355
- Max Arc Count: 1601
- Investigation Priority Level: 2*
  - Moved to priority 1 based on recent top arc counts

- No previous reports of overheating or rise in temperature
- Meter not removed because customer was not home and it was a non-bypass pan
- Technician found damage to weather-head conduit

Meter 51****25 – Weather-head + Wire Repair Points

- Days on report with >100 Max Arc Count: 56
- Average arc count: 247
- Max Arc Count: 625
- Arc Sense Priority Level 1

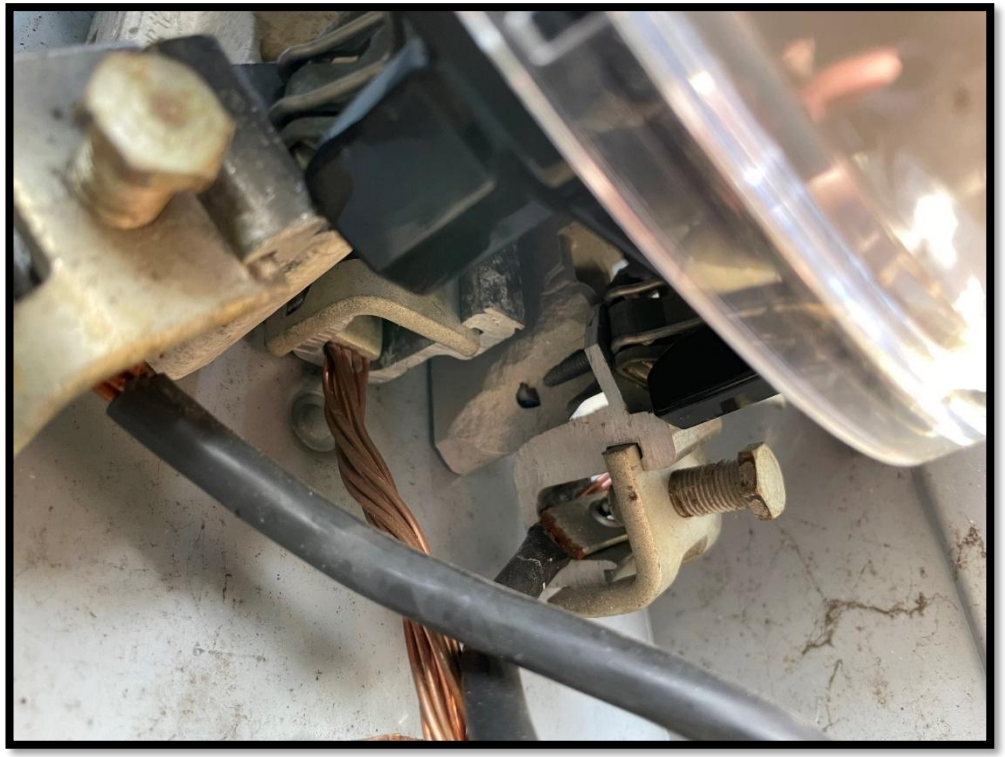


- **No previous reports of overheating or rise in temperature**
- **Damage at weather-head conduit**
- **Found repair points on neutral at triplex to house**

Meter 51****25 – Broken Ceramic Inside Meter Pan

- Days on report with >100 Max Arc Count: 93
- Average arc count: 236
- Max Arc Count: 349
- Arc Sense Priority Level 1

- No previous reports of overheating or rise in temperature
- Technician found broken ceramic on the foundation inside the meter pan



Key Pilot Insights

- Value in Arc Detection, Data, and Manpower
  - Arc Detection: helps to identify meters that may have safety issues
    - Uses load-profile channel to push as **data**
  - Data: allows for analytics to identify trends and identify quality issues
    - Pushed as daily report via L+G head-end to be interpreted by **manpower**
  - Manpower: Analyzes data, informs field force, provides investigation and response to potentially unsafe situations
- Specific problems that were identified in this study:
  - Brittle jaws & recessed jaws
  - Water damage
  - Hot socket situations
    - Current & future
- In the short duration of this project, customers have been notified and pan was replaced, thereby avoiding a dangerous situation in the field

Looking Forward

- Continuing to evolve
  - Prioritization Process
  - Tableau Dashboard
  - Field Force Checklist
    - Meter Manager Field Client
  - Round table results with additional Arc Sense deployments

ITRON METHODOLOGY – OVERVIEW

- Itron application TESCO micro arc detection tracks arcs as they occur over periods of time, rather than individual arcs
- Users establish how much of a given time period they need to witness arcs occurring, to trigger am Arc Recognition flag
- Users establish how many consecutive Arc Recognition flags they need to trigger an alarm

Arc Detection	Enable Arc Detection	True
	Arc Recognition Time Period	60
	Arc Recognition Count Threshold	30
	Number of Consecutive Arc Recognition Time Periods to Detect/Clear	5
	Clear Arc Recognition Count Threshold	0

- In this example, a meter must experience 5 consecutive periods of arcs experienced for 30 seconds within a 60 second period

AVANGRID – ITRON DEPLOYMENT

- Avangrid is currently deploying Itron Gen 5 meters for their AMI transition.
- Installation started in November, ~30K meters in the field
- Base settings triggered no alarms
- Queried database for any arc hits; data showed 8 meters with arc counts and single blocks exceeding criteria
- Investigated two of the meters that showed the greatest number of *SingleBlocksExceeded* (meters 1 and 3)

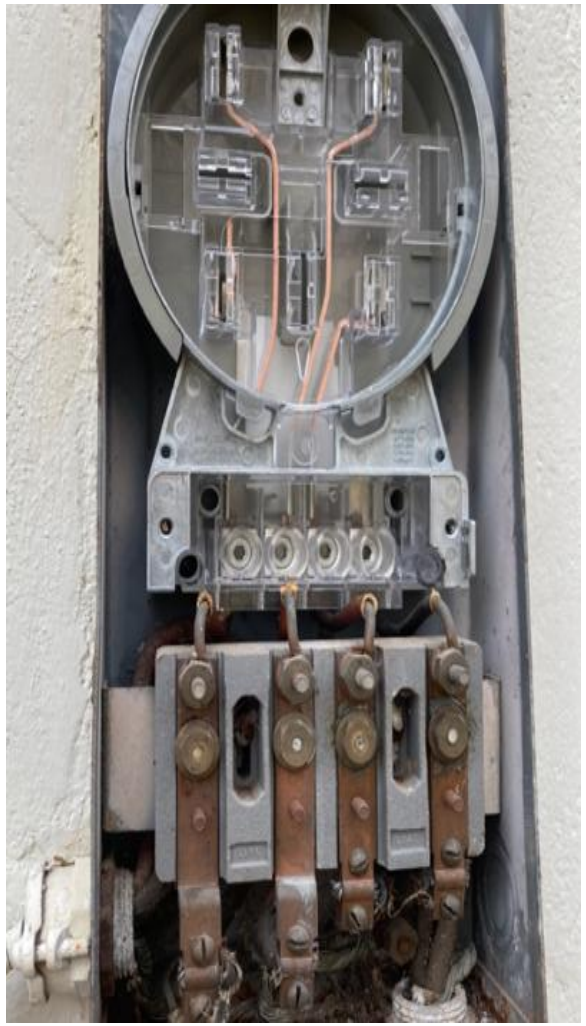
MeterName	TotalArcCoun	SingleBlocksExceededCour	AlgorithmTriggeredCou	ArcsInLastBlo	ContiguousBlocksExceededCour	ClearBlockCou	Installed Date	Latitude	Longitude	DaysInServi
Meter 1	28241	12	0	2	0	0	3/20/2023 11:10			15.02886277
~~Meter 2~~	9380	1	0	0	0	0	12/20/2022 10:32			105.0554947
Meter 3	5416	53	0	0	0	0	1/18/2023 1:00			76.45256648
~~Meter 4~~	462	6	0	0	0	0	1/12/2023 1:09			82.44664055
~~Meter 5~~	361	4	0	0	0	0	3/31/2023 11:21			4.021316477
~~Meter 6~~	271	3	0	0	0	0	11/23/2022 11:53			131.9994646
~~Meter 7~~	262	1	0	0	0	0	1/12/2023 11:23			82.01981185
~~Meter 8~~	61	1	0	0	0	0	2/6/2023 3:00			57.36904796

AVANGRID – METER 1 FIELD FINDINGS

- The meter technician confirmed the presence of small burn marks and slight discoloration on the meter blade (picture below).
- He confirmed all service terminations were tight and he tested socket jaw tension using the Tesco Hot Socket Gap Indicator tool.
  - Jaw tension was good.
- Based on photo, it appeared meter was misaligned; after field visit and reinsertion of the meter, report showed zero incremental arc counts, on all six counters.

AVANGRID – METER 2 FIELD FINDINGS

- A-Base to socket adapter
  - The adapter is new and was installed when the new AMI meter was set
- The meter technician said he used a magnifying glass to inspect the meter blades but didn't see any pit marks.
- He checked all external service connections and everything seemed to be OK (i.e. no lose connections, etc.).
- He used the TESCO Hot Socket Gap Indicator tool on the adapter and jaw tension looked good.
- Expected arcing occurring in older connection base to new socket adapter; arc passing through meter channel.
  - Additional inspection is ongoing. Meter has continued to arc and show on report after initial investigation



TESCO METERING

RECENT UPDATES

AGENDA

- Field Investigations Update
  - Investigation Summary
  - Learnings
- User's Guide Progress
  - Purpose
  - Contents
  - Examples
- SAD Roadmap

Field Investigation Update

- Total sites visited: 9
  - All sites Itron G5R, base Itron arc configuration settings
- Investigation Summary
  - Arcing at Meter: 2
  - Utility-side Arc: 3
  - Customer-side Arc: 4
- Utilized Radar Engineer's Mini RFI Locator, Model M330, to triangulate Arc source
- Items of note:
  - Customer-side: 3 instances of improper/non-existent grounding of Landline or Cable lines.
  - Utility-side: 2 instances of transformers as arc-source
- Itron base settings are inadequate for reliably identifying real-world-arcs

TESCO METERING

FIELD INVESTIGATION UPDATE

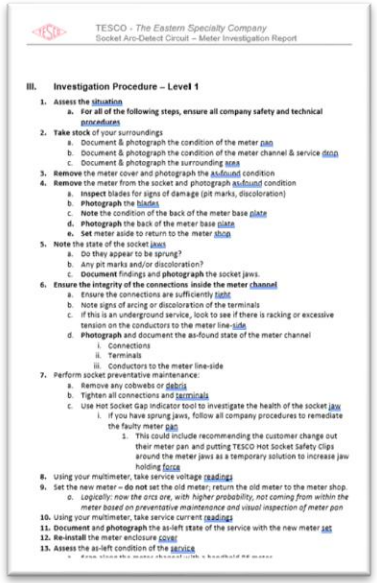
	MeterName	TotalArc Counts	SingleBlocks Exceeded Count	Algorithm Triggered Count	ArcsInLast Block	ContiguousBlocks Exceeded Count	ClearBlockCount	JobCompletionDate	Y	X	DaysIn Service	DeltaTotal ArcCounts	DeltaSingle BlocksExceededCount	DeltaAlgorithm Triggered Count	DeltaArcsIn LastBlock	DeltaContiguous BlocksExceededCount	DeltaClear BlockCount	Arcs/Day Ratio	Notes
9134	1	273448	20	0	4	0	0	4/4/2023 13:57	42.4644688	-76.52467622	55.87015717	35351	1	0	-4	0	0	4894.348143	Arc on CUSTOMER side. Meter tech gained access to the customer's panel and switched off the feeder circuit that appeared to reduce or eliminate the static pick up at the meter. I took a snapshot of the arc counters after this was done. Total Arc counts = 331,337 and Number of Blocks Exceeded count = 20. Three hours later, I read the arc counters again on this meter and they are the same (i.e. counts have not increased).
9996	2	134803	45	1	2	0	0	4/4/2023 11:36	42.49247265	-76.72950291	55.96824745	26632	45	1	1	0	0	2408.562107	RFI traced back to customer's landline. The meter technician says, this phone line was inactive. He said phone ground was not tied to the service ground so he disconnected tip and ring conductors.
6219	3	5417	53	0	0	0	0	1/18/2023 13:00	42.460004	-76.52665488	131.9097752	0	0	0	0	0	0	41.06594823	This one involves a Spectrum cable company service. According to meter techs, the spectrum cable was left ungrounded from the j-Box to the home. They suspect another grounding related issue. The cable was looped around the bottom of one pole, routed on the ground and routed up a second pole to traverse a driveway to the home and then routed down in parallel with the electric service adjacent to the electric meter pan as shown in the pictures below. This appears to be a temporary service. The meter tech contacted Spectrum and they came out and corrected the grounding. Afterwards, they reset the arc counters in the meter. All arc counters are now set to zero.
19907	4	43697	6	0	0	0	0	4/3/2023 13:32	42.61893395	-76.72739759	56.88773819	9403	4	0	0	0	0	768.1268652	The meter tech's found a floating ground on the cable company's coax cable (picture below). They grounded the cable and reset the arc counters in the meter. I will check Monday morning to see if grounding took care of the problem. A preliminary conclusion is grounding issues on Telco and Cable System services seem to affect the arc detection circuit in the Itron meter.
2524	5	20982	1	0	0	0	0	12/20/2022 10:32	42.531858	-76.63987594	161.0127035	2540	0	0	0	0	0	130.3126992	Here is another one that was investigated this afternoon. According to the Meter Technician, he approached the meter with the Radar Engineer's RFI device and verified the presence of arcing. He noted the service entrance cable entering the meter pan from the top did not have duct seal. When he opened it up, he discovered that water had been leaking inside the meter enclosure from the top cable entrance and over time, this resulted in all that corrosion seen in the pictures below. From the pictures, it appears to me that the meter jaws are also sprung. The service was repaired, including installation of a new meter pan. The meter blades did not show any signs of damage so they left the same meter in place and reset all the arc counters. After the repairs were made, the technician said the RFI receiver indicated that the arc source was no longer present. I read the arc counters (see very bottom below). The total count is now at 3. I'll see how the counters look tomorrow before we close this one.
	6																		Hot Meter! Signs of pitting on original meter as well.
	7																		Checked for RFI at meter and found higher level at the transformer. Saw primary lead laying on the tub cover. Customer said saw sparks coming from transformer. Line dept is going to look at it. I spoke with the meter technician that investigated this location this morning. He said there was RF at the meter but it was much stronger closer to the transformer. This is a pole mounted transformer and he estimates the distance between the meter and transformer to be about 40 yards. I was wondering why the circuit wasn't isolated by an upstream overcurrent device. He said it's because the source is delta connected. One of the primary conductors was coming in contact with the transformer case. The service primary was downstream to where the primary conductor was making contact.
	8/9																		Investigated the second and third meters on the my list below. They were both at the same location next to each other. This is new construction of a large home that is being fed by two, 200 amp self-contained services. The services are being supplied by 7.2 kV UG feed that connects to a single phase pad mount transformer. He used the RFI test device and isolated the arc source to the transformer. He said the arcing noise of the test unit near the transformer was very loud. The transformer is roughly 10 feet away from the meters. When he opened the pad, he saw a note inside that stated that the transformer had a bad H1 bushing and to not use it.

SOCKET ARC-DETECT USER'S GUIDE

- This document is a comprehensive guide to understanding and actioning on the TESCO Socket-Arc Detect circuit employed within Itron G5 and L+G Revelo meters.
- It provides an understanding of the technology, equipment and procedure for investigating arcing in the field and provides real-world cases to help inform what the user may encounter when they are investigating.

Contents

Socket Arc-Detect User's Guide


TESCO - The Eastern Specialty Company
Socket Arc-Detect Circuit – Meter Investigation Report

III. Investigation Procedure – Level 1

1. Assess the situation
   a. For all of the following steps, ensure all company safety and technical procedures
2. Take stock of your surroundings
   a. Document & photograph the condition of the meter pan
   b. Document & photograph the condition of the meter channel & service drop
   c. Document & photograph the surrounding area
3. Remove the meter cover and photograph the as-found condition
4. Remove the meter from the socket and photograph as-found condition
   a. Inspect blades for signs of damage (pit marks, discoloration)
   b. Photograph the blades
   c. Note the condition of the back of the meter base plate
   d. Photograph the back of the meter base plate
   e. Set meter aside to return to the meter shop
5. Note the state of the socket jaws
   a. Do they appear to be sprung?
   b. Any pit marks and/or discoloration?
   c. Document findings and photograph the socket jaws.
6. Ensure the integrity of the connections inside the meter channel
   a. Ensure the connections are sufficiently tight
   b. Note signs of arcing or discoloration of the terminals
   c. If this is an underground service, look to see if there is racking or excessive tension on the conductors to the meter line-side
   d. Photograph and document the as-found state of the meter channel
      i. Connections
      ii. Terminals
      iii. Conductors to the meter line-side
7. Perform socket preventative maintenance:
   a. Remove any cobwebs or debris
   b. Tighten all connections and terminals
   c. Use Hot Socket Gap indicator tool to investigate the health of the socket jaw
      i. If you have sprung jaws, follow all company procedures to remediate the faulty meter pan
         1. This could include recommending the customer change out their meter pan and putting TESCO Hot Socket Safety Clips around the meter jaws as a temporary solution to increase jaw holding force
8. Using your multimeter, take service voltage readings
9. Set the new meter – do not set the old meter; return the old meter to the meter shop.
   a. *Logically: now the arcs are, with higher probability, not coming from within the meter based on preventative maintenance and visual inspection of meter pan*
10. Using your multimeter, take service current readings
11. Document and photograph the as-left state of the service with the new meter set
12. Re-install the meter enclosure cover
13. Assess the as-left condition of the service

Explicit Investigation Procedure


Socket Arc-Detect Circuit – Meter Investigation Report

IV. Level 1 Investigation Report and Process Checklist

Date	Field Personnel	Purpose of Investigation

Equipment Information

Meter Number	Meter Form	Meter Brand	Meter Pan Type

Investigation Checklist
For all steps, ensure all company safety, policy, and technical procedures are followed.

Process Step	Yes	No
1. Assess the situation		
2. Take photographs 2 a, 2 b, 2 c, prior to removing the meter		
2.a. Meter Pan		
2.b. Meter Channel & Service Drop		
2.c. Surrounding area of the meter enclosure		
3. Remove the meter cover and photograph the as-found condition		
4. Remove the meter from the socket and photograph as-found condition		
4.a. Signs of damage to the blades (pit marks, discoloration)		
4.b. Photograph the blades		
4.c. Note the condition of the back of the meter base plate		
4.d. Photograph the back of the meter base plate		
4.e. Set meter aside to return to the meter shop		

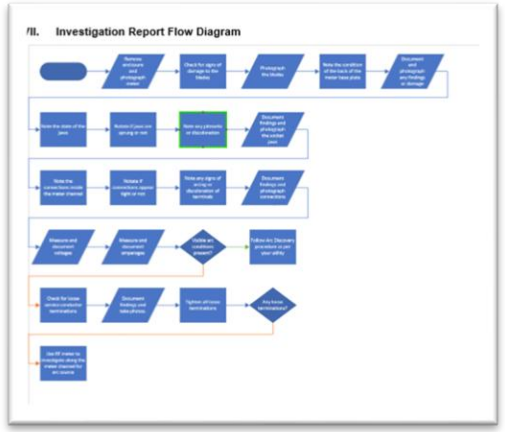
Notes:

5. Visual Inspection: Note the state of the socket jaws		
5.a. Do the socket jaws appear to be sprung?		
5.b. Are there any pit marks or discoloration on the socket jaws?		
5.c. Look for signs of corrosion or water damage		
5.d. Photograph the socket jaws		

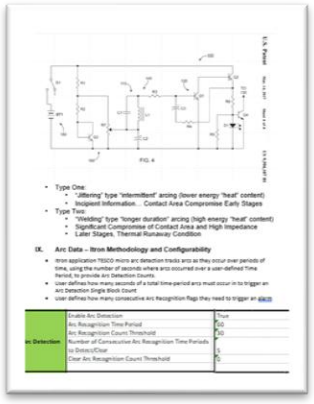
Notes:

6. Ensure the integrity of the connections inside the meter channel		
6.a. Ensure the connections are sufficiently tight		

Comprehensive Checklist

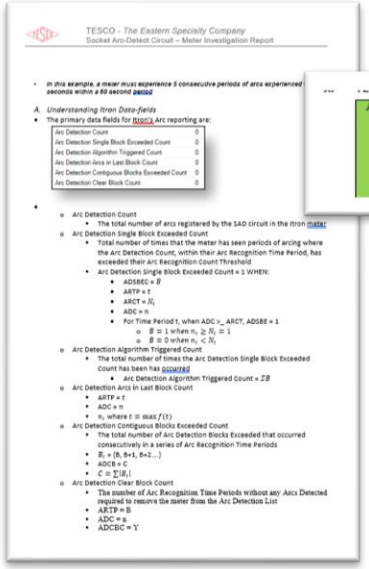

II. Investigation Report Flow Diagram

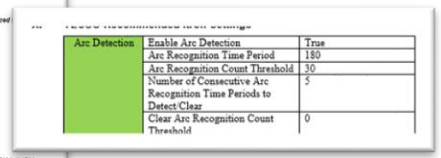
Investigation Flow


IX. Arc Data – Itron Methodology and Configurability

Arc Detection	Enable Arc Detection	True
	Arc Recognition Time Period	180
	Arc Recognition Count Threshold	30
	Number of Consecutive Arc Recognition Time Periods to Detect/Clear	5
	Clear Arc Recognition Count Threshold	0

Background and Methodology

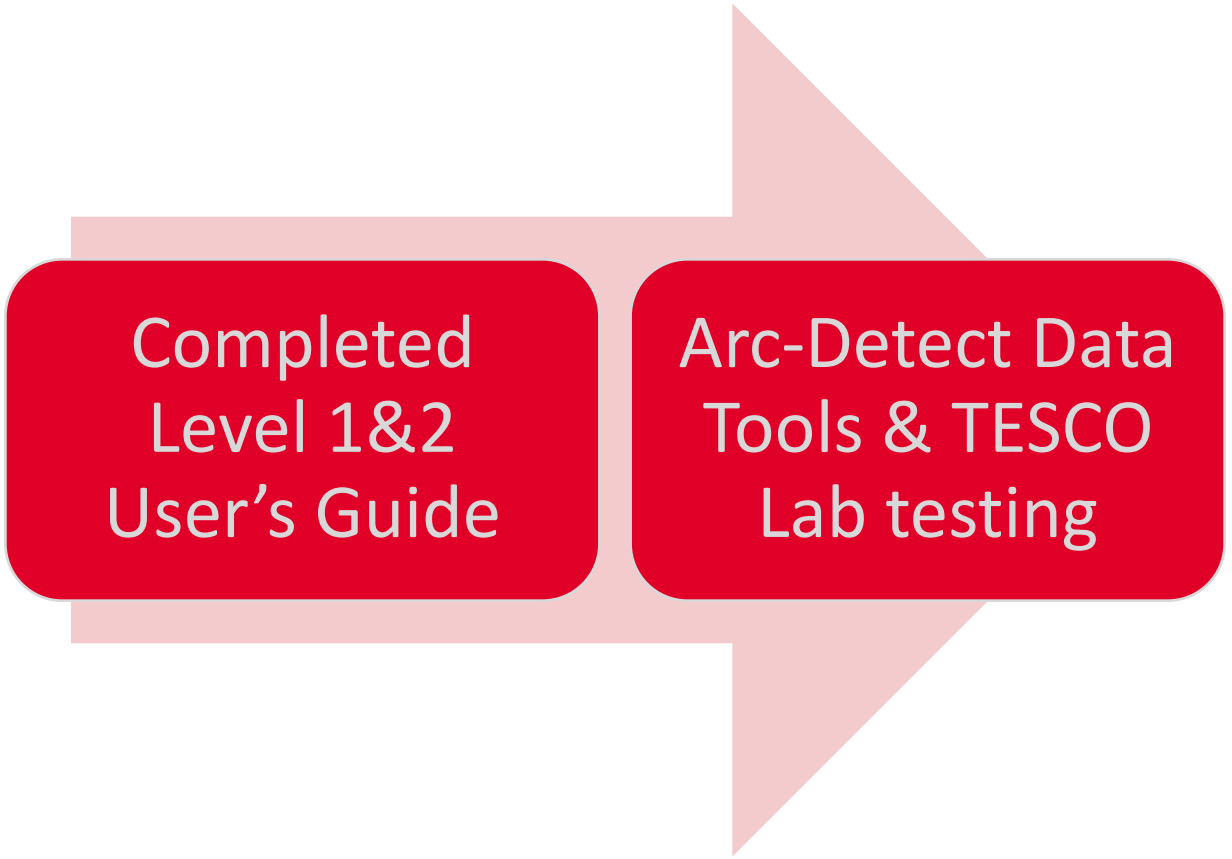

TESCO - The Eastern Specialty Company
Socket Arc-Detect Circuit – Meter Investigation Report



Arc Detection	Enable Arc Detection	True
	Arc Recognition Time Period	180
	Arc Recognition Count Threshold	30
	Number of Consecutive Arc Recognition Time Periods to Detect/Clear	5
	Clear Arc Recognition Count Threshold	0

Definitions and Recommendations

Socket Arc-Detect Road Map

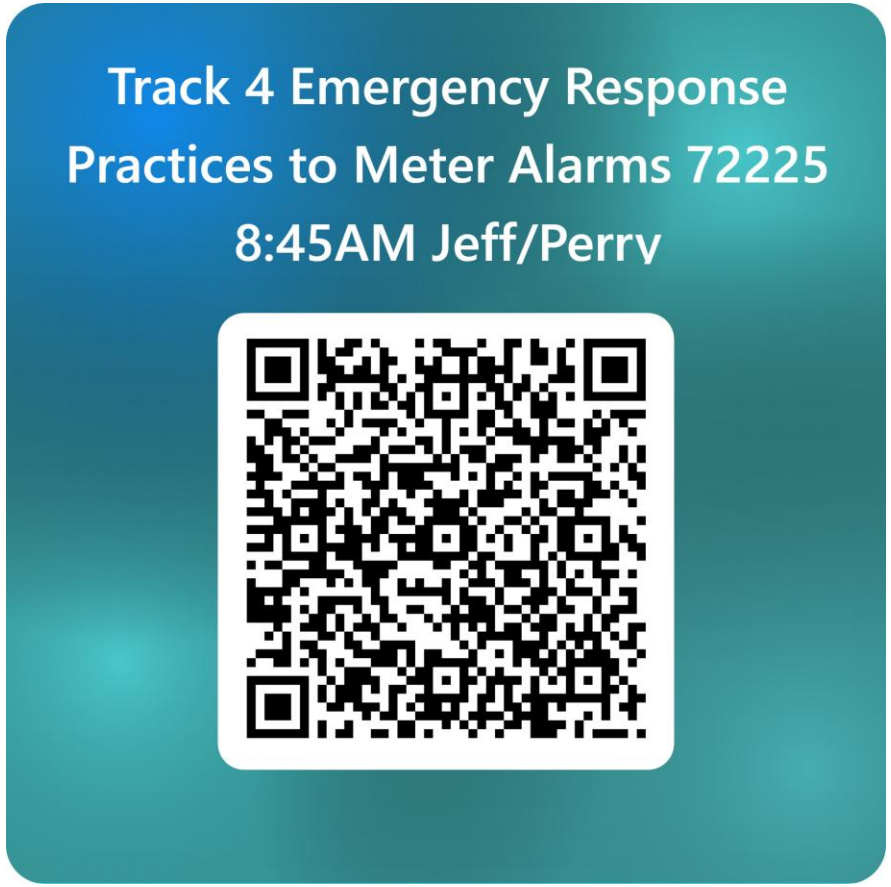


Discussion

- How are other utilities responding to meter alarms?
- Best approaches to implementation/business process changes around new metering alarms?
- What challenges have you encountered with meter alarms? False alarms?

Course Feedback

Please Take a Few Minutes To Provide Feeback About The Course & Instructor



Questions and Discussion

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This presentation can also be found under Meter Conferences and Schools on the TESCO website: tescometering.com