Pros and Cons of Tamper Detection with AMR
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Theft is a costly problem for utilities in the USA. A study conducted by EPRI estimates losses at 1% annually, and surveys by the Edison Electric Institute peg lost revenue between $1 billion and $2 billion annually. Tamper detection features rate very high in business cases to justify AMR, and utilities report they are the most popular benefit of AMR. But, do they really work???

**Types of meter tampering and tamper detection**
This paper will discuss the most common types of tampering and theft encountered by utilities. One-time tampers as well as recurring tampering activities will be described. Fairly detailed discussions on tamper detection features included in today’s meters, with a talk on each one’s effectiveness in ferreting out theft, will provide the audience with a good understanding of what works and what leaves something to be desired. Capabilities by vendor will be discussed.

**Systems for filtering tamper data**
The details of filtering tamper flags, establishing trends, and making realistic comparisons will provide insights into how to make most effective use of tamper data from AMR systems. Flags taken alone can often lead to an excessive number of false alarms. Filters, trends, and comparisons transform raw data into useful leads, with good hit rates. Examples will be provided.

**Revenue Assurance**
Through the years, current diversion groups have been transformed to revenue protection groups, to revenue assurance groups. Revenue assurance is much more than theft detection, as it includes a wide range of activities, from finding metering malfunctions to consumption on inactive accounts.

**Conclusions on AMR and tamper detection**
AMR provides a wealth of information to help utilities reduce lost revenue. It is very effective in some areas and less effective in others. A good understanding of these areas is crucial to properly setting expectation levels correctly, both for the up-front business case, and for getting the biggest bang for the buck with system deployment.
Pros and Cons of Tamper Detection with AMR

Ed Malemezian
consulting inc.
Theft is a costly problem

- Recent EPRI study
  - Estimates 1% lost revenue annually
  - Average medium sized utility may lose $5 to $20 million annually
- Edison Electric Institute survey
  - Estimates electric industry losses between $1 billion and $2 billion annually
  - Average utility spends $700K on theft and theft investigations
  - Average utility uncovers $2.6 million in theft and related losses

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Utility Reports on Theft

- NE: 0.5%–1.0% of revenue w/$950 K recovered in 2001
- South: 1025 confirmed cases per 100K customers = 1% customers
- Mid-Atlantic: 0.5% of revenue = $20 million lost revenue annually
- West Coast: 0.25% of revenue = $7.5 million lost annually
- Southeast: $7 million billed
- West Coast: $100 million lost annually
No matter how you slice it, theft is a costly problem for all utilities unless...
Reasons to do AMR

- Tamper Detection usually rates very high in business cases to justify AMR
- From Chartwell’s 2002 Report on AMR
  - 20% of utilities use or plan to use AMR for tamper detection
  - 35% of utilities are considering using AMR for tamper detection
  - Tamper detection is the most popular benefit of AMR
Types of Meter Tampering

- **Internal to the meter**
  - Adjustment screws - One Time (OT)
  - Register tampering - OT
  - Magnetic circuit alteration - OT
  - Electrical alteration - OT
  - Dial tampering - Recurring (RC)

- **External to the meter**
  - Magnets - RC
  - Hole in cover / disk "pinning" - RC
  - Upside-down meter - RC
  - Stolen meter - OT
Installation Tampering

- Line-side taps
  - Weather-head - OT
  - Service entrance conductors - OT
  - Underground - OT
  - Switchgear / buswork / troughs - OT
- Bypass
  - Jumpers in meter socket - OT
  - Close bypass device - OT
- Instrument transformer installations
  - "Re-wiring" - OT
  - Shorting of current transformers - OT
AMR Tamper Detection

- Reverse energy flag
- Reverse energy register
- Tilt switch
- Meter inversion
- Blink counter - no power to meter
- Magnetic sensor
- Site & meter diagnostics
- Other ...
- System - Trends and comparisons
Reverse Energy

- Reverse energy flags do a very good job in detecting meters that have been turned upside down.
- In addition to the flag, some meters capture the reverse energy in a separate register.
- Other meters simply add reverse energy to forward energy, thereby accumulating total consumed - no longer matches meter dials.
Tilt Switches

- Tilt switches detect when the meter is tilted some amount from its normal position - usually around 50° to 70°
- Early tilt switches contained mercury
- Today’s tilt switches are mercury-free
- Tilt switches alone are notorious for false indications from vibrations
- Meter removal is inferred when:
  - Tilt switch closes and
  - Power outage detected (short time delay)
Tilt switches (w/outage) provide a reliable indication of meter removal. Meter removal does not directly translate to tampering. Need to be able to “back out”

- Regular meter work
- Emergency work, i.e., trouble calls
- Acceptable customer work - electrician or homeowner
- Need a "system" solution or this kills you
- ??? value in finding one-time tampers
Meter Inversion

- Meter inversion is inferred when:
  - Meter removal has been detected
  - Tilt switch stays closed and
  - Power is restored
- Most likely, would also get reverse energy flag
- Provides a reliable indication that the meter is running upside down
Blink Counter

- Blink counter increments for each interruption detected
  - May or may not conform to industry standard definitions
    - Momentary - ITIC (CBEMA) curve
    - Outage - zero voltage for >5 minutes
- Need a “system” solution to “back-out” normal power outages, i.e. storms, regular meter work, trouble work, etc.
- Need to compare against neighbors
- ??? value in finding one-time tampers
Magnetic Sensor & Diagnostics

- Magnet sensors - provided in a few meters - limited effectiveness
- Meter diagnostic flags
  - Solid-state meters only
  - Detect internal problems with meters - meter malfunctions and tampering
- Site diagnostic flags
  - Solid-state meters only
  - Detect meter wiring, instrument tx, voltage and current balance problems
- Diagnostic flags are very effective
Other - RFID

- Other high-tech solutions are beginning to appear to better tackle the meter installation integrity issue.

Radio Frequency ID is a good example of high-tech
- Ties to AMR
- Positive indication, not inferential
To be effective, tamper indicators need to be filtered, to spot trends and provide for reliable comparisons.

Blink counts and outage flags need to be compared against neighbors.

Normal meter and trouble work need to be backed out of meter tilts, removals, and power outages.
Custom algorithms and a formal process is required to look at trends.
Energy consumption needs to be compared - by individual & by groups.
Combine AMR data with:
- Class of customer
- Geographical information
- Customer's past history - family, too
- Other utilities - cable, gas, water ...
Experience ... knowing where to look is extremely valuable ... listen to your people.
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Vendor Capabilities

The Connected Home

AE MX - Advanced Energy
AS MX - Advanced Systems
BE MX - Basic Energy
BS MX - Basic Systems
CE MX - Complete Energy
CS MX - Complete Systems
DS MX - Direct Systems
EE MX - Enhanced Energy
ES MX - Enhanced Systems
FE MX - Future Energy
FS MX - Future Systems
In the 70’s and 80’s, these activities were called Current Diversion.
In the 90’s, they were called Revenue Protection.
Today, they are called Revenue Assurance.
Revenue assurance reflects the much bigger issue, assuring that all the revenue owed the utility is collected.
Revenue Assurance

- Revenue assurance includes
  - Theft detection and follow-up
  - Metering mistakes - malfunctions, meter constants, billing errors, etc.
  - Consumption on inactive accounts
  - Collections

- AMR provides a wonderful tool to help utilities reduce lost revenue in each one of these areas

- But ... AMR is only a tool - it must be coupled with systems and people
How Did We Do ???

**AMR Does a Good Job**
- Recurring tampers
- Upside-down meters
- Dial tampering
- Site and installation diagnostic problems
- Consumption on inactive accounts
- Detailed data for trends and comparisons
  - ... plus ...
- Provides opportunity for 100% clean sweep !!!

**AMR Provides Little or No Help**
- One-time tampers
- Adjustment screws
- Register tampering
- Magnetic ckt alteration
- Electrical ckt alteration
- External to the meter
- Magnets
- Disk “pinning”
- Stolen meters
- Taps and jumpers
Conclusions

- AMR provides great information for detecting certain kinds of losses
- AMR provides little help with others
- To be truly effective, systems to filter, trend, and compare are required
- Utilities need active Revenue Assurance programs & systems, staffed by knowledgeable people ...
  - Work will not go down
  - Activities will shift to new areas
  - Recovery and “assurance” will improve
Questions ???

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Biography

Speaker: Ed Malemezian
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Country: United States

Ed Malemezian is the president and principal of Ed Malemezian Consulting, Inc., where he serves the needs of clients requiring an in-depth understanding of the metering industry. Ed provides Meter Consulting services to those needing customer focused, practical solutions to the metering problems facing utilities, equipment suppliers, and system developers, in order to help improve their profitability and competitiveness. In 2000, Ed retired from EDMpro.com, the unregulated Energy Data Management business of Florida Power & Light (FPL) Energy Services. Prior to joining FPL Energy Services, Mr. Malemezian directed meter engineering at FPL, with responsibility for metering standards, specifications, policies, evaluations and development of related systems required to meter $6 billion in annual revenue. His 20+ years of metering experience cover all facets of the discipline from competitive services, to field metering, to meter shop, to meter laboratory / standardization, to meter engineering, including effective interfacing with virtually all departments within FPL. Author of a number of metering articles in publications such as T&D Magazine, Electrical World, and Metering International, Mr. Malemezian is a respected member of the metering community. Mr. Malemezian's contributions to the American National Standards Institute (ANSI) working committees resulted in a number of significant changes in the ANSI C12 meter standards. Mr. Malemezian is a registered Professional Engineer in the state of Florida and a 1970 graduate of the University of Florida.
Ed Malemezian Consulting is committed to providing Meter Consulting services to utilities, equipment suppliers, and system developers needing customer focused, practical solutions to the metering challenges presented in today’s utility marketplace, in order to help improve company profitability and competitiveness. Ed Malemezian Consulting will: analyze your current situation, provide the best, customer focused solutions, and make recommendations on how to effectively implement the solutions. Core competencies include: Meter Practices, Smart Meters, Load Control / DSM Programs, AMR, Real Time Monitoring / Control, Prepayment Systems, Load Profile Services, Energy Data Mgt. Services, ANSI C12, Product Design, Market Research, Benchmarking, and Expert Witness.

Ed Malemezian brings more than 30 years management experience in utility operations, 20+ of them directing all aspects of utility metering activities: field and shop operations, meter engineering, project management, and competitive metering services. Ed has extensive experience delivering results in multi-million dollar projects and active participation and leadership in regional, national, and international industry organizations, conferences, and standards making groups. He has been published or interviewed 15-20 times by trade publications, newspapers, and Public Broadcasting in the past few years. He is a respected member of the metering community with an extensive network of industry contacts.