

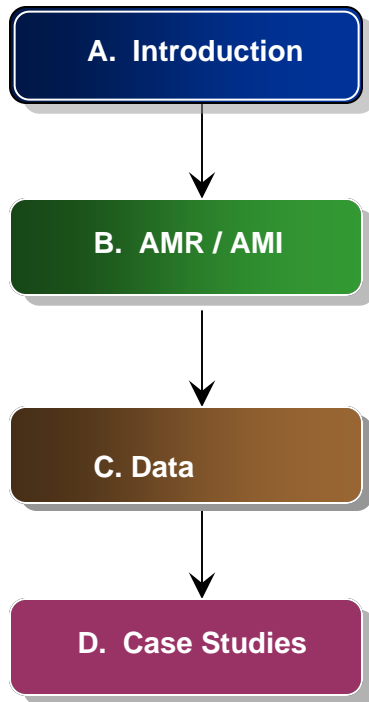


# ***Meter Data Management for Revenue Protection Informational Review & Case Study Application***

***George Balsamo  
Meter Security Manager***



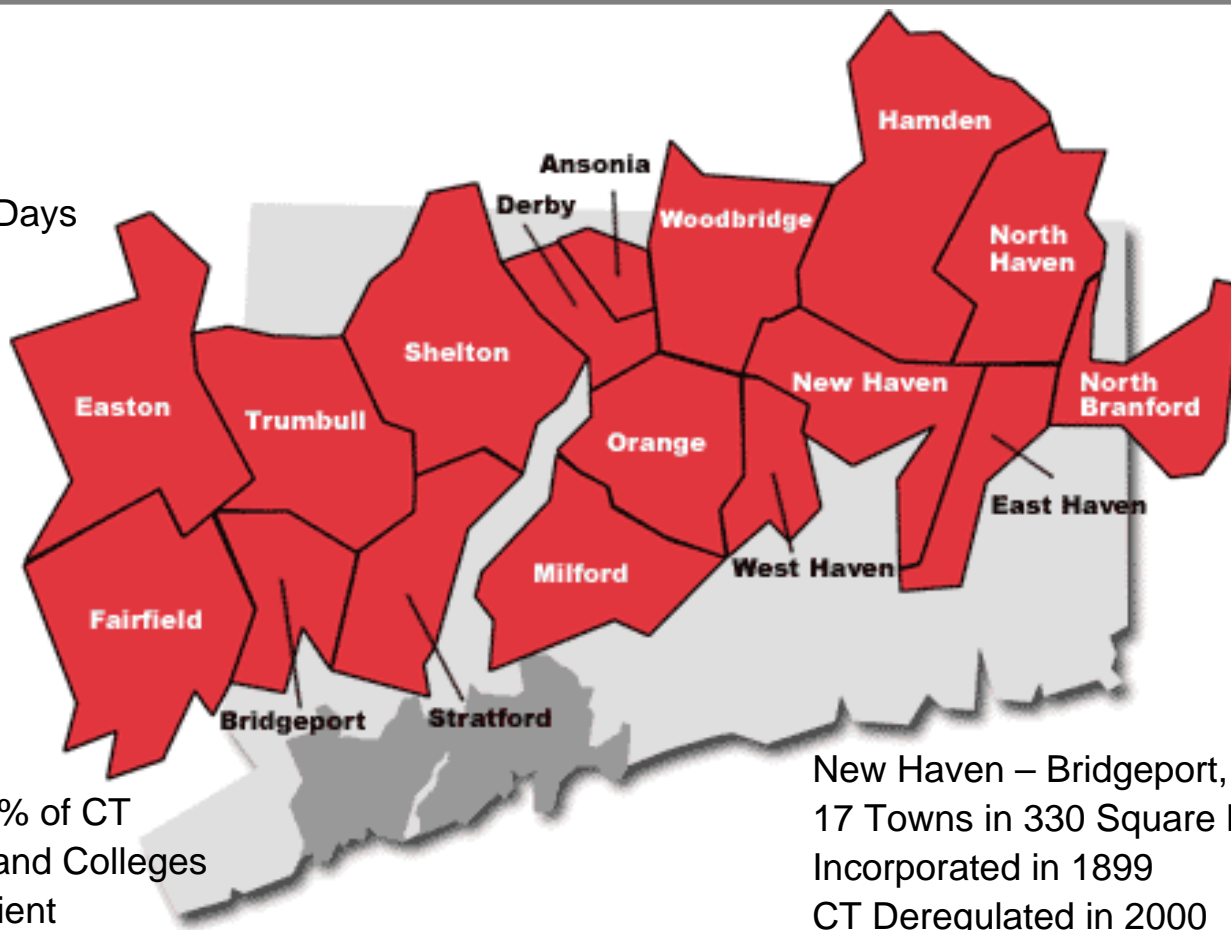
# Agenda



- A. Introduction and Company Profile
  - Background
- B. AMR / AMI
  - Tamper Programs (out of the box sort of)
  - Things to Look out For
    - What the Data Won't Tell You
- C. Utilizing Data
  - Creating Reports for Revenue Loss
- D. Case Studies (Not Included)
  - Intermittent Usage
    - Pinned Disc / Potential Switch
  - “The Blue Plate Special”
    - Meter removal
    - Line Side Tap
    - Removal of Line Side tap

# Company Profile

324,000 Accounts  
 293,000 Residential,  
 31,000 Comm./Indus.  
 33% Delinquent > 60 Days  
 40% Indoor Meters



726,000 People – 21% of CT  
 7 Major Universities and Colleges  
 1/3 Population Transient

New Haven – Bridgeport, CT  
 17 Towns in 330 Square Miles  
 Incorporated in 1899  
 CT Deregulated in 2000  
 Wires Only Co. - No Generation



# Background

- **1975 - Revenue Protection Program Began**
  - All Meters & Associated Equipment Were Sealed
- **Early 1980's - A Commercial Inspection Program Began**
  - All C & I Applications Were Inspected & Secured With HD Locking Devices
  - All Electric Space Heating and Water Heating Accounts Were Inspected Sealed With HD Locking Devices
- **1996 - Two Field Investigators Were Added**
- **1999 - AMR Deployment Began**
  - Fixed Base Cellular Network System
  - Reading is Sent Every 2.5 Minutes & can be Viewed for the Past 45 Minutes
  - Midnight Reads occur Daily & are Downloaded into a Database
- **2006 - Another C & I Audit was Performed by an Outside Concern**
- **2006 - Revenue Protection Business Case Approved**
  - 1 Investigator & 1 Analyst Added
  - 2007 – 2 Investigator's Added
  - 2008 – 1 Investigator Added



# Tamper Programs

- **Programs may be Developed from Daily Data to Flag:**
  - **Illegal Reconnects:**
    - Review DNP orders that have not been reconnected
      - **Approx 10% of these locations have self reconnected in some manner**
  - **(Pinned Meters)/Potential Switches:**
    - Some AMR Systems Have the Ability to Examine Daily Real-Time Consumption. AMI Systems will provide this information
      - **This Will Give Intermittent Usage Data Indicating the use of a shunt switch.**
- **Unaccounted for Power Outages:**
  - Filters may be Developed to “Weed Out” Known Occurrences Leaving a Highly Questionable Population
  - These flags can be effective when used in tandem with disconnects
- **Reverse Rotation:**
  - Will Provide Information on Inverted Meters and Inverted Wiring
- **Loss of Phase on Commercial Metering**
  - Next Day Reporting Allows for Prompt Action



## Things to Look Out For

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**Check Metering Within Smaller Groups  
of Population Points is Needed to  
Determine System wide Revenue Loss or  
Indicate Meter Circumvention.**

**This Approach is Currently Cost  
Prohibitive.**



B. AMR / AMI

# Cooling Model

## NETWORK SYSTEM

## AVERAGE KWHRS

## MORE TYPICAL CONSUMPTION

500 Metering Points per Feeder

Avg.. KWHRS/month per Acct

667

1,500

Total KWHRS in Population

335,500

750,000

Line Losses		Variance Txf./Sec. & Svs. Losses (@7.5%)	Line Losses		Variance: Txf./Sec. & Svs. Losses (@7.5%)
4% @333,500 =	13,340	<u>1,001+/- (kwhrs)</u>	4% @ 750,000 =	30,000	<u>2,250+/- (kwhrs)</u>
6% @333,500 =	20,010	<u>1,501+/- (kwhrs)</u>	6% @ 750,000 =	45,000	<u>3,375+/- (kwhrs)</u>
8% @333,500 =	26,680	<u>2,001+/- (kwhrs)</u>	8% @ 750,000 =	60,000	<u>4,500+/- (kwhrs)</u>

**Avg... KWHR Cooling Load 881 Kwhrs**

Average July & August Degree Days – last 3 years

New Haven, CT

(2000 sq. ft Res. ASHREA 90.1)



B. AMR / AMI

# Heating Model

## NETWORK SYSTEM

## AVERAGE KWHRS

## MORE TYPICAL CONSUMPTION

500 Metering Points per Feeder

Avg.. KWHRS/month per Acct

667

1,500

Total KWHRS in Population

333,500

750,000

Line Losses	Variance Txf./Sec. & Svs. Losses (@7.5%)	Line Losses	Variance: Txf./Sec. & Svs. Losses (@7.5%)
4% @333,500 = 13,340	<u>1,001+/-</u> (kwhrs)	4% @ 750,000 = 30,000	<u>2,250+/-</u> (kwhrs)
6% @333,500 = 20,010	<u>1,501+/-</u> (kwhrs)	6% @ 750,000 = 45,000	<u>3,375+/-</u> (kwhrs)
8% @333,500 = 26,680	<u>2,001+/-</u> (kwhrs)	8% @ 750,000 = 60,000	<u>4,500+/-</u> (kwhrs)

**Avg... KWHR Heating Load 3068 Kwhrs**

Average January Degree Days – last 3 years

New Haven, CT

(2000 sq. ft Res. ASHREA 90.1)





**OK.... Let Me Get This Straight.....**

**You're Gonna Come To My House...**

**And You're Gonna Put This Meter In...**

**And You're Never-Ever-Ever Gonna Come  
Back Again.....**

**Right?**



# Do the Math

• 2,000 sq ft @ 20 BTU/sq ft (Ashrea 90.1) = 40,000 BTU	
• 3,412 BTU / Kwhr	
• 8 – 1,500 watt heating units	
• 1,500 watts = 1.5kw x 8 = 12kw x 3,412 = 40,944 BTU	
• 600 gals oil @ \$2.40/gal =	\$1,440
• 1,000 gals oil w/ domestic hot water	\$2,400
• 125 Amp Breaker Panel 24 Position	\$ 35
• 125 amp main	\$ 75
• 8 - 20 amp double pole Breakers	\$ 100
• 300' 12/3	\$ 250
• 8 – 1,500 watt Baseboard Units	\$ 425
• 20' Service Entrance (@\$2.22)	\$ 44
• Misc Connectors, etc.	<u>\$ 100</u>
• <u>Total Cost</u>	\$1,029 (plus tax)
• 80 gal water heater	<u>\$ 528</u>
• <u>Total Cost</u>	\$1,557 (plus tax)



# Things to Look Out For

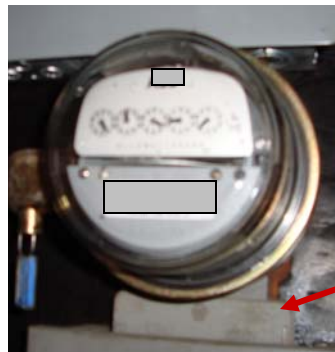
**Absent a Field Force to Regularly Examine Meter Installations the Risk of Undetected Theft Activity Will Increase.**

## Theft Scenarios to be Aware of:

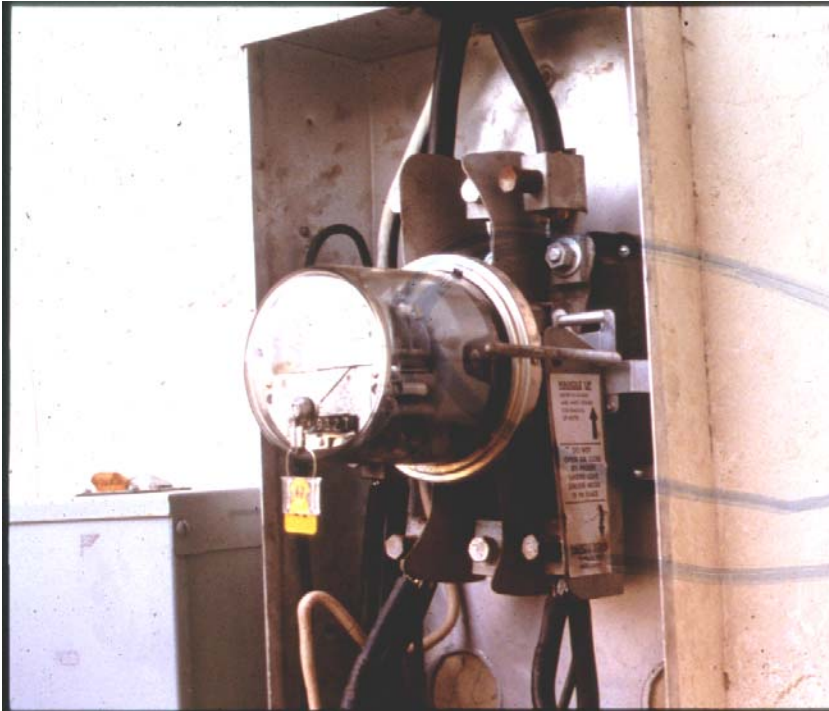
- **Line Side Taps or Jumpers Across Line & Load Terminals May Occur Without Removal of the Meter and Without Triggering a Tampering Flag**
  - Ringless Meter Provisions
  - Bottom Connected Metering
  - Split Meter Enclosures
  - Troughs, Main Disconnects, Weatherheads
- **Taps Installed for Purposes of Increased Load Will not be Reflected by any Change in the Load Curve**

# More Scenarios to be Aware of:

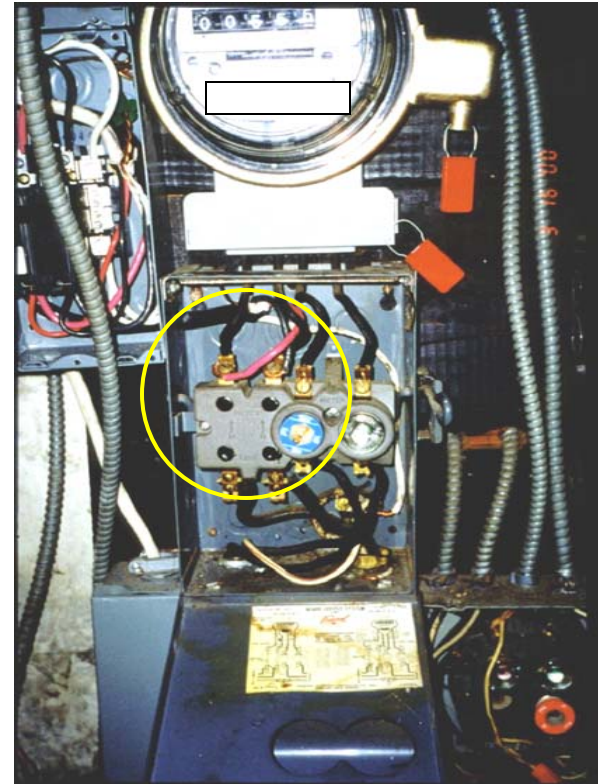
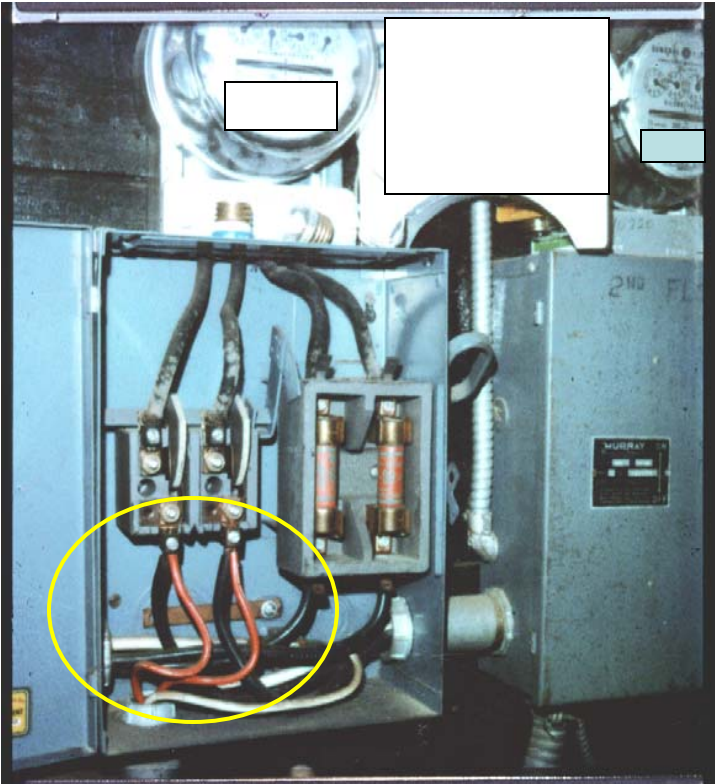
- Removal of the Meter Cover May not Trigger a Tampering Flag
  - **Electronic Meter Tampering**
    - Requires Potential and Current sensing within the Metrology
    - Internal Jumpers can be Installed
    - Partial Registration of Phases
- Jumpers Across Line / Load Terminals in Bottom Connected Metering
  - **Inside Meter Provision Itself – No Contact to Meter**
  - **Tests Show That Connections Across Terminal Screws may Affect Metering as Much as 10%**



# Ringless Meter Sockets

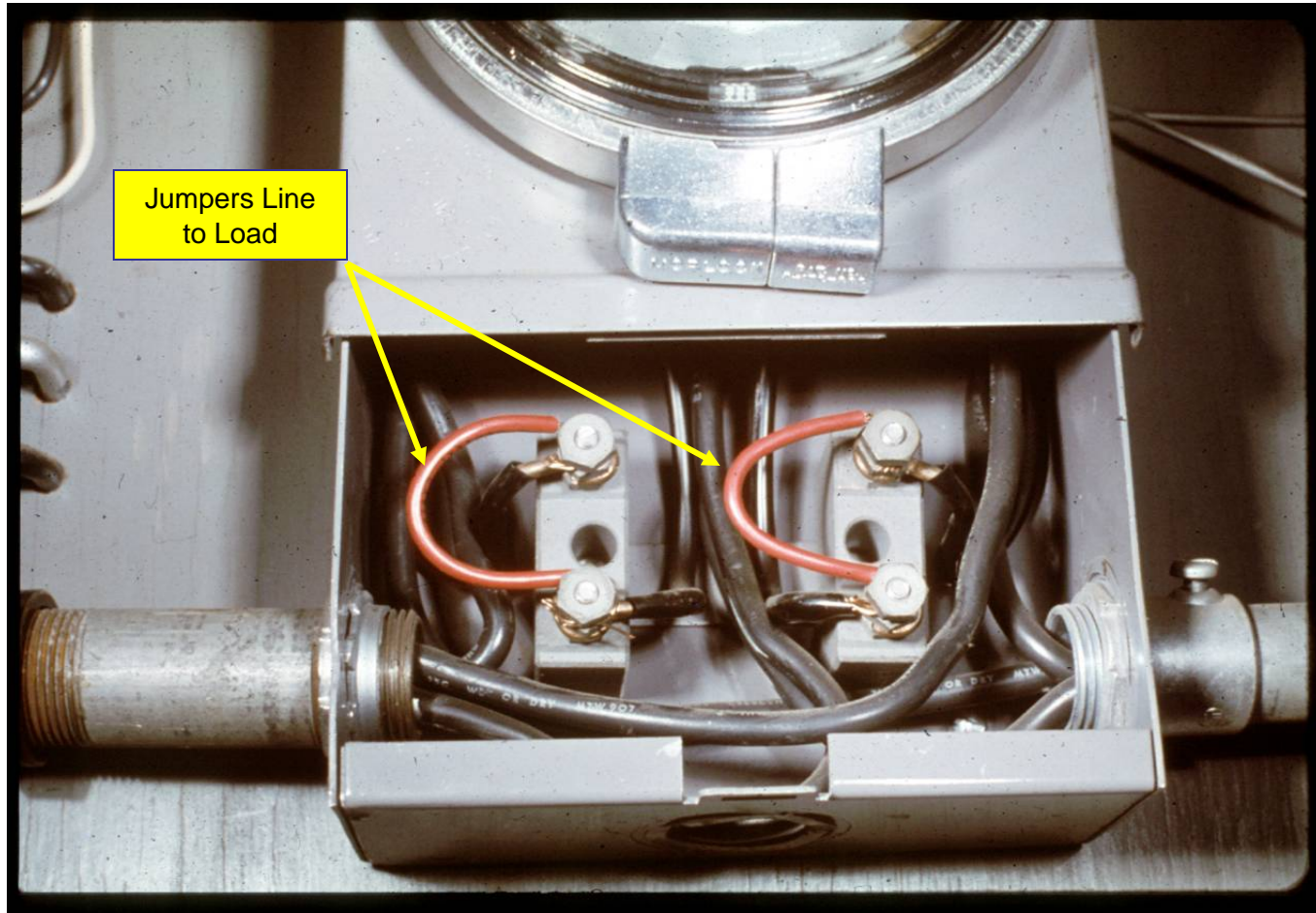


# Bottom Connected Metering

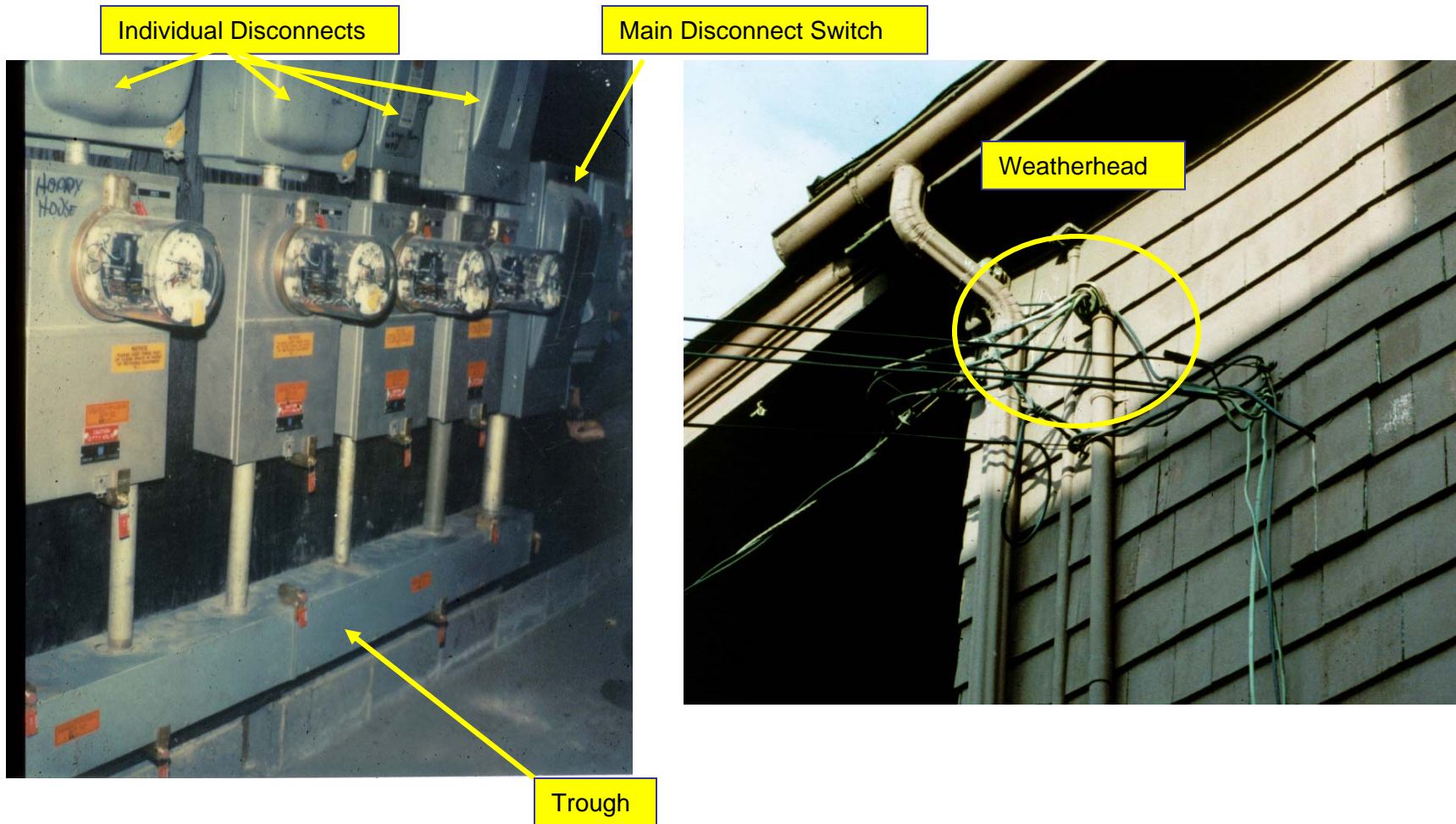




# Split Boxes with By-Pass Section

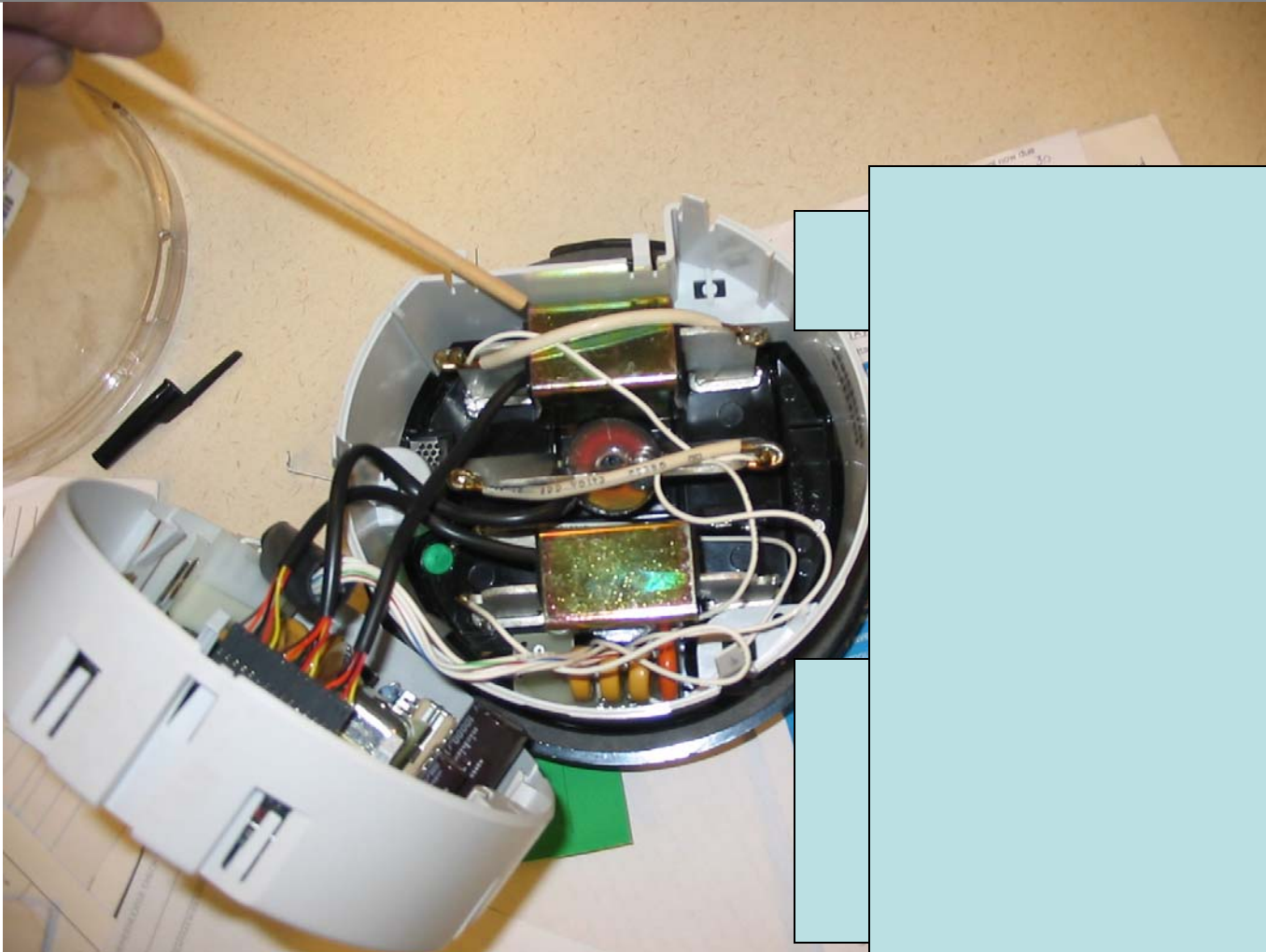


# Mains, Troughs & Weatherheads

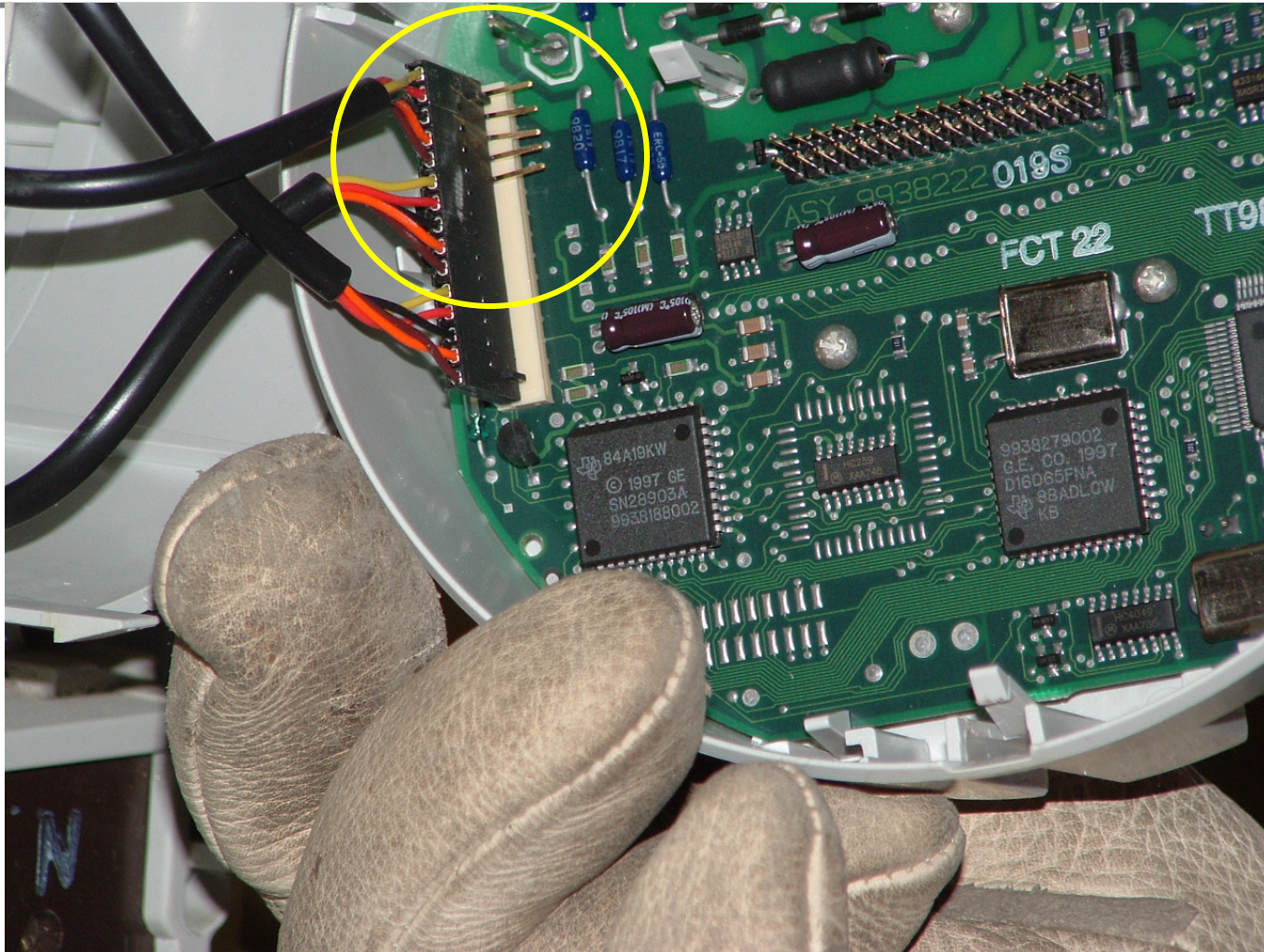




# Electronic Meter Tampering Jumper Wires Line to Load

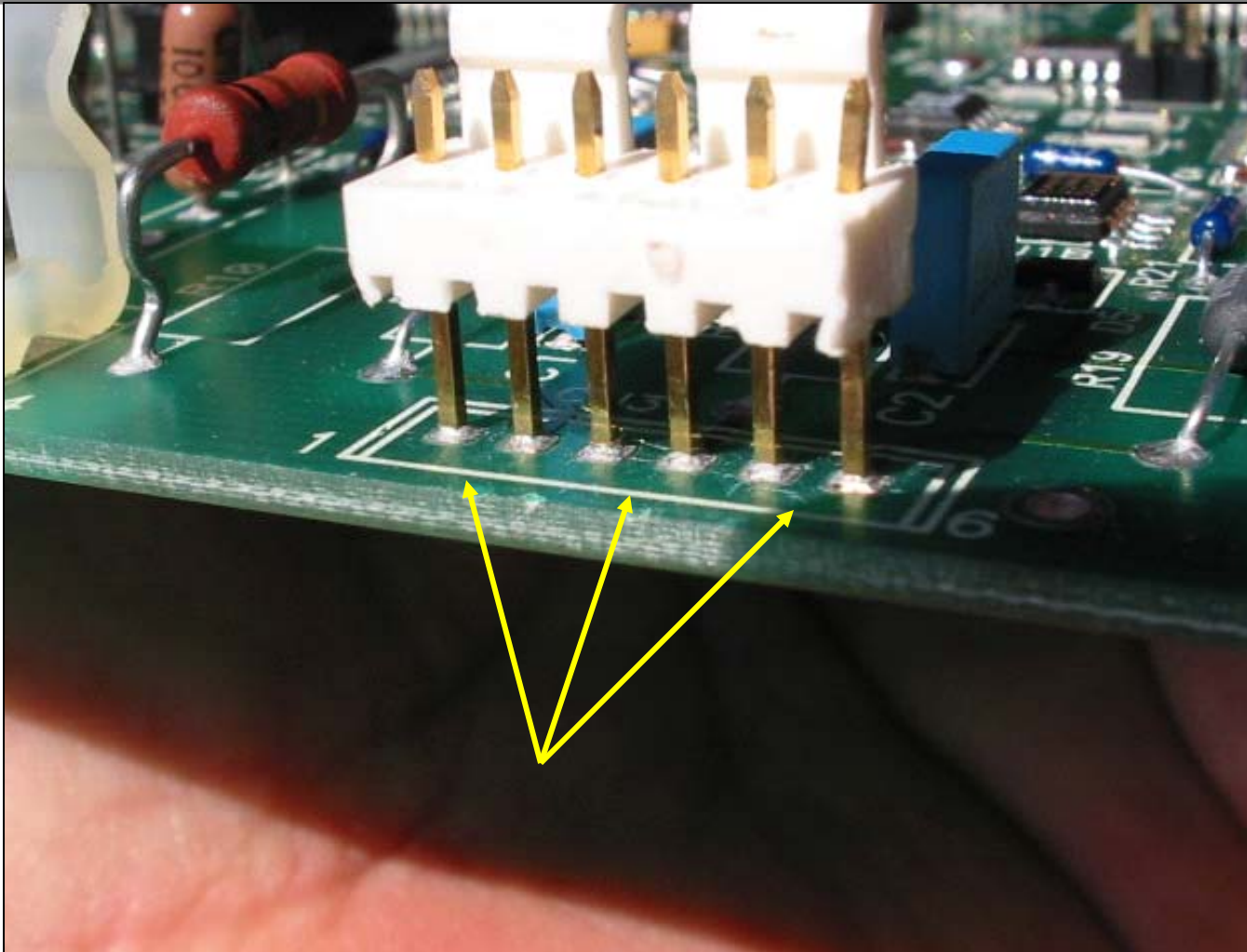


## Close up of 3 Phase Meter with Bent Pins on One Phase

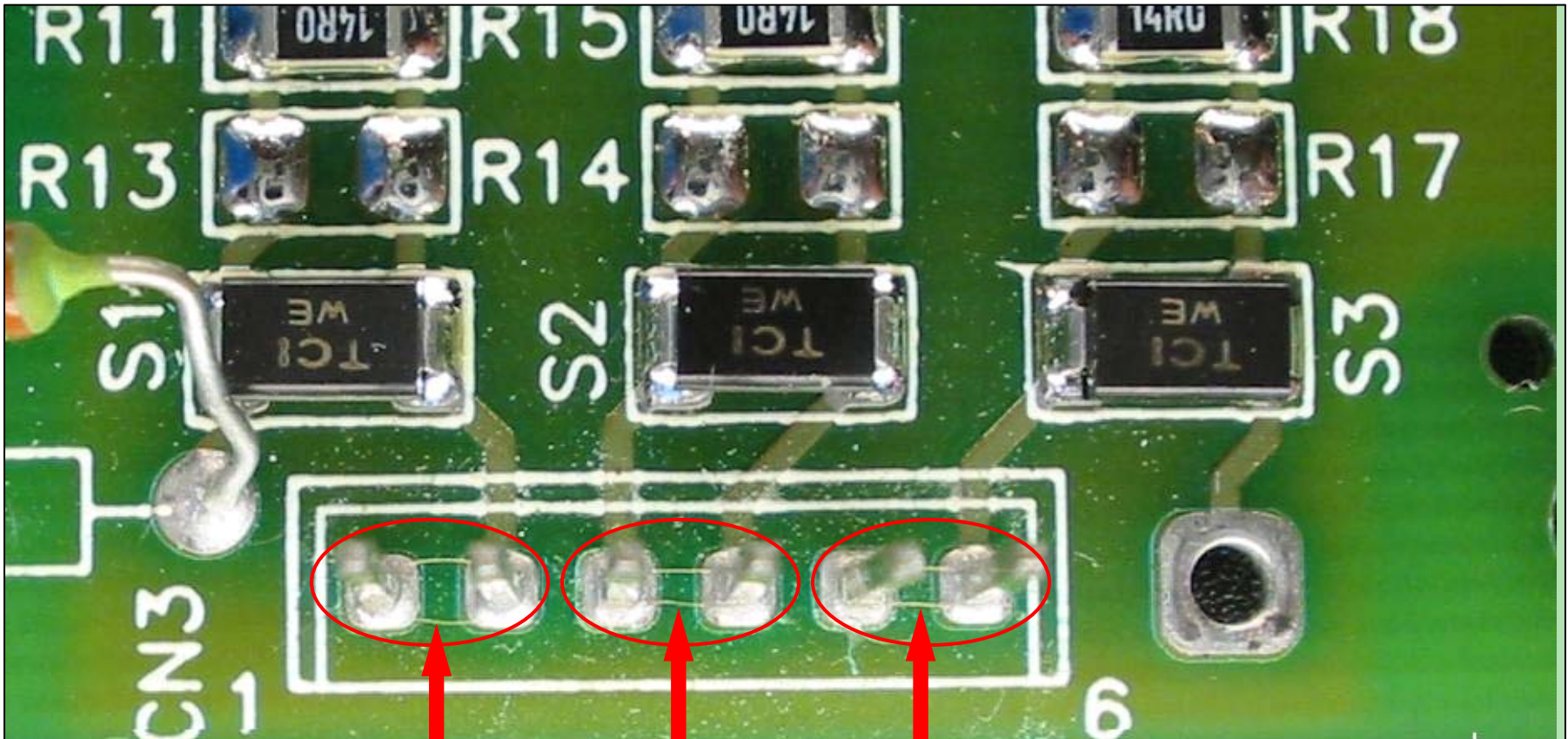




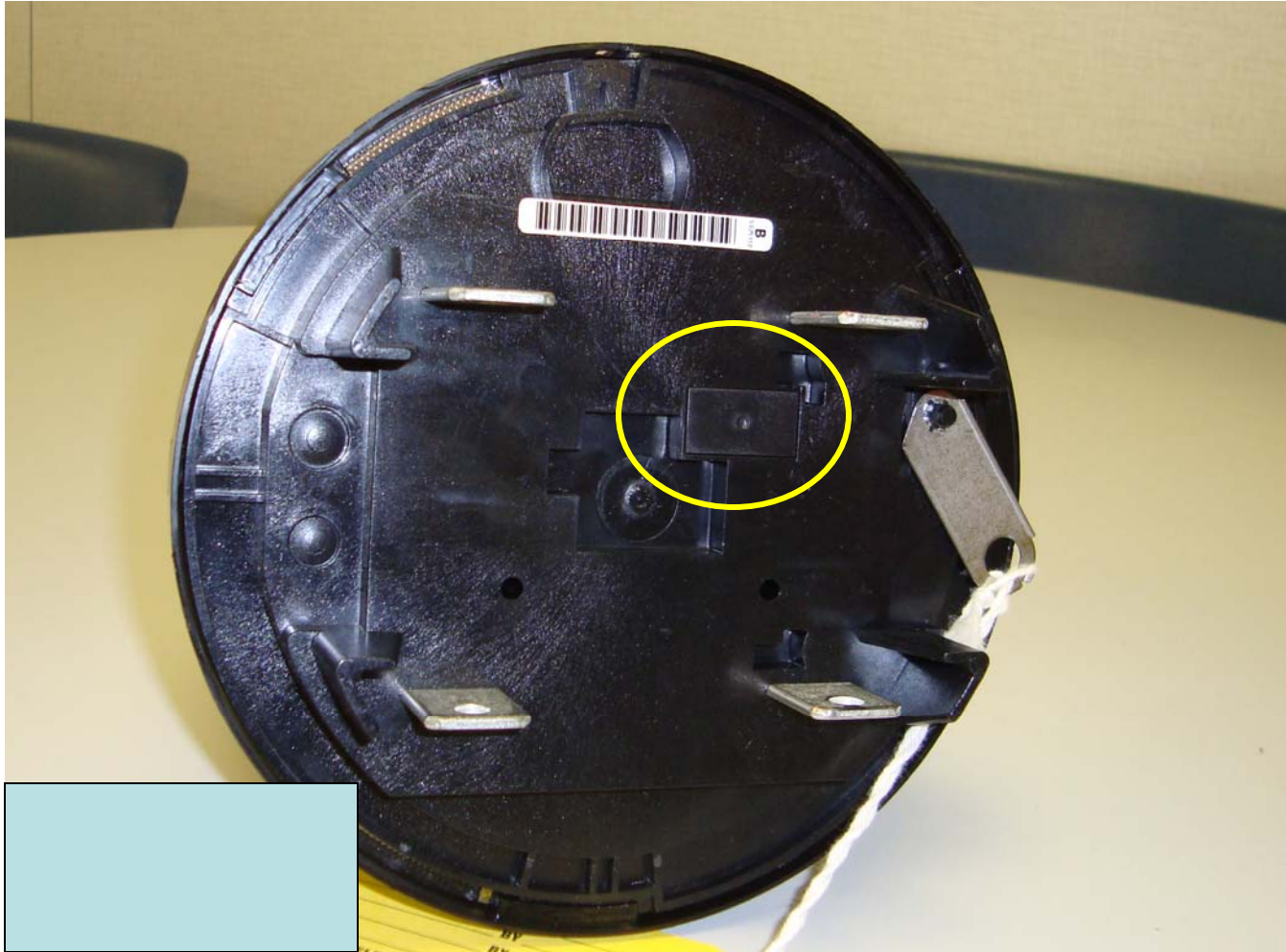
## Internal Circuitry Showing Currents Entering Meter From Current Transformers



## Close-up Showing Micro Filaments Used as Shunts Across Each Phase



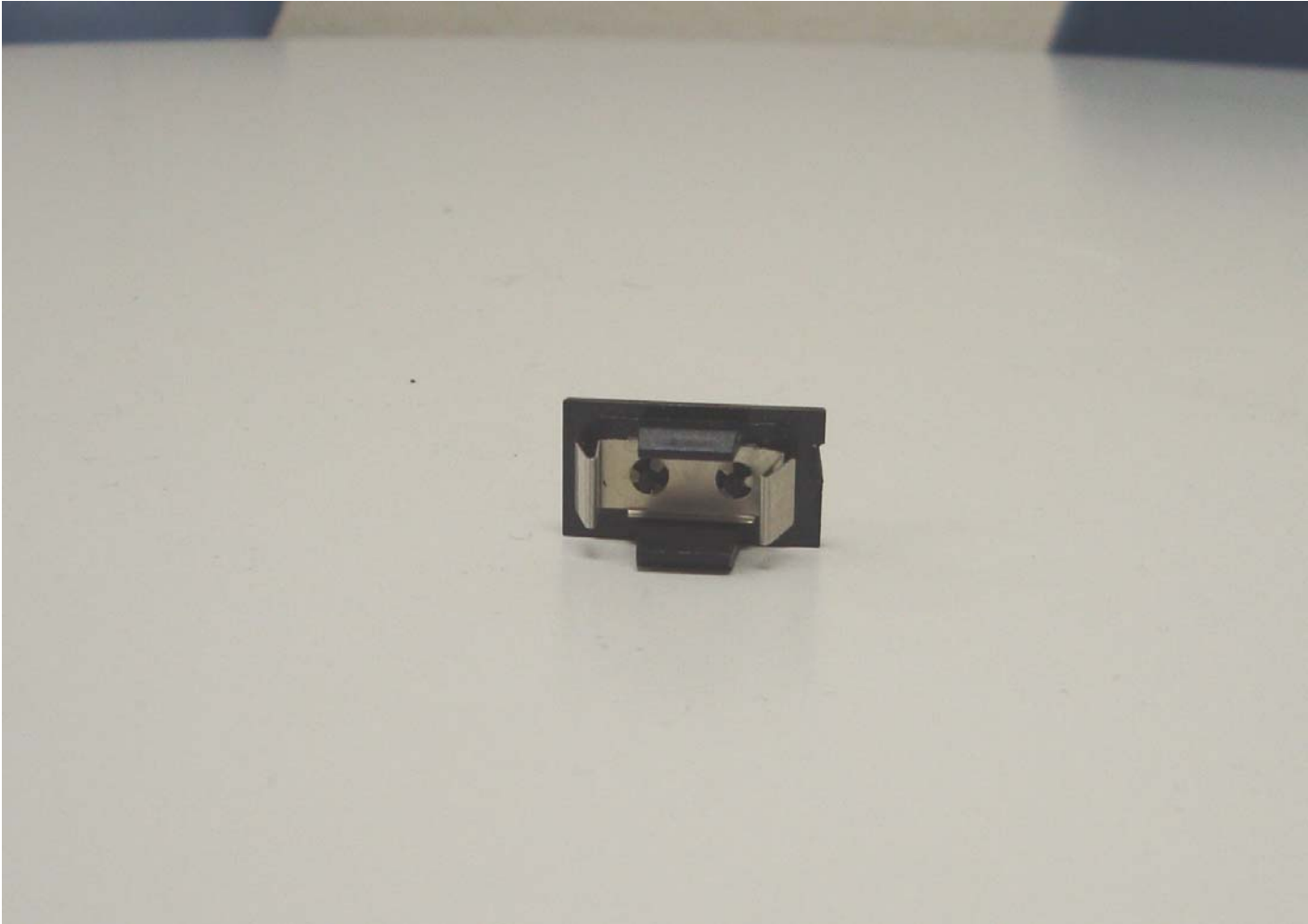
## Back of Meter Base Showing Cover Over Potential Terminals



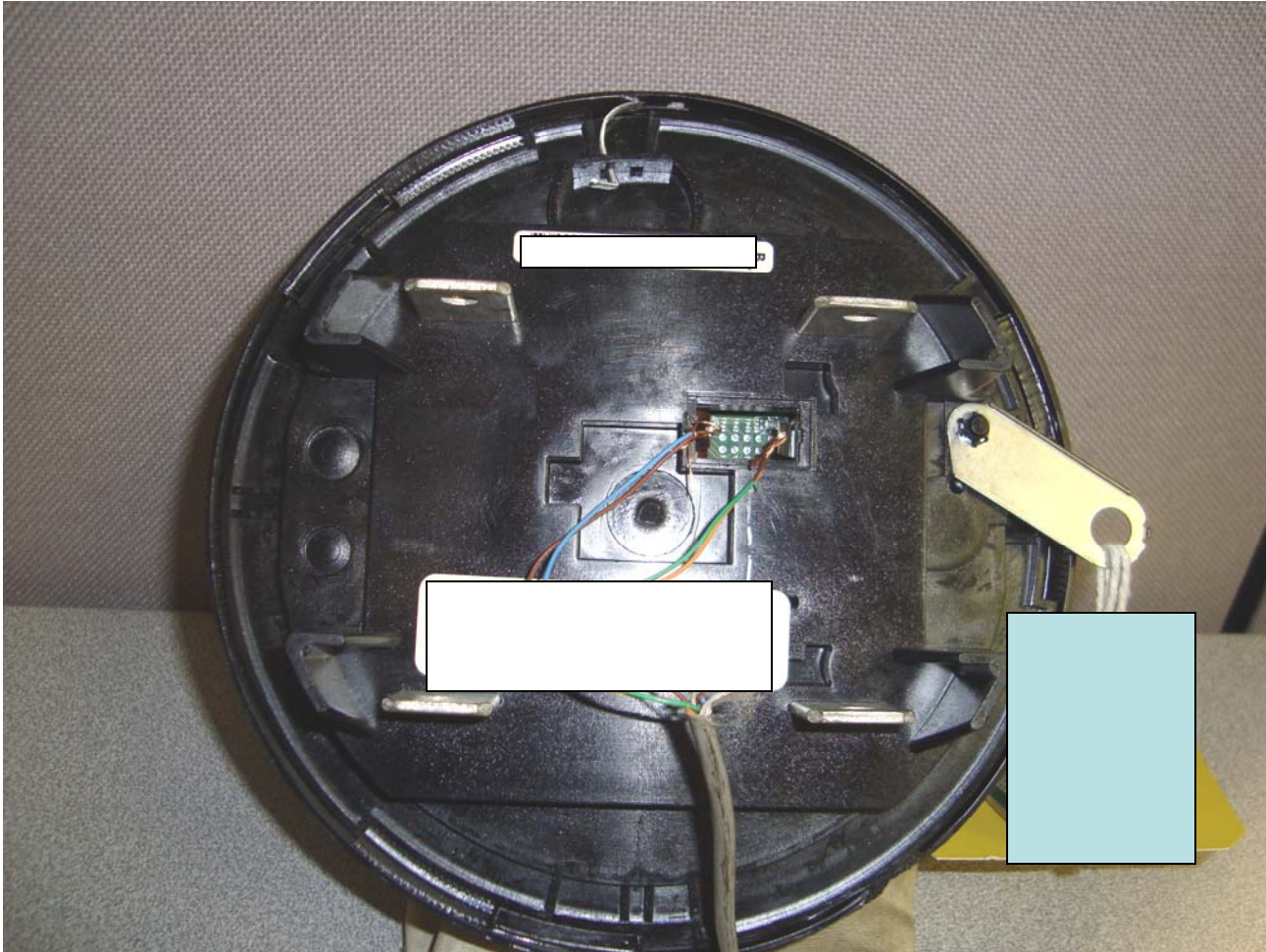


B. AMR / AMI

## Cover Removed Showing Potential Link



## Blank Cover Removed Exposing Potential Terminals Shunt Wires Attached



## New Solid State Meter for AMI Conversion







# Utilizing Data

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Understanding what information an AMI system cannot provide it is as important as knowing what it can...

Realizing what can be done with this (lack of) information is critical in the overall operation of the company...



## C. Data

# Utilizing Data

## Daily Consumption with disconnect Logic

Device Usage History Form

Export MS XL

Chart

Close

Enter Device Number:

Bus Partner Name:

Address:

Device ID:

BP / POD:

CA / Acct Type:

Device Constant:

Week Day	Read Date	Read	Usage	Pwr Outages	PwrOutFlag	LogPwrUsageFlag	Acct_Status
Monday	10/01/07	69577	25	0	N	YYN	Physical Disconnect
Sunday	09/30/07	69552	25	2	N	YYN	Physical Disconnect
Saturday	09/29/07	69527	26	2	N	YYN	Physical Disconnect
Friday	09/28/07	69501	23	2	N	YYN	Physical Disconnect
Thursday	09/27/07	69478	25	2	N	YYN	Physical Disconnect
Wednesday	09/26/07	69453	36	2	N	YYN	Physical Disconnect
Tuesday	09/25/07	69417	11	2	N	YYN	Physical Disconnect
Monday	09/24/07	69406	24	2	N	YYN	Physical Disconnect
Sunday	09/23/07	69382	32	2	N	YYN	Physical Disconnect
Saturday	09/22/07	69350	23	2	N	YYN	Physical Disconnect
Friday	09/21/07	69327	33	2	N	YYN	Physical Disconnect
Thursday	09/20/07	69294	10	2	N	YYN	Physical Disconnect
Wednesday	09/19/07	69284	23	2	N	YYN	Physical Disconnect
Tuesday	09/18/07	69261	28	2	N	YYN	Physical Disconnect
Monday	09/17/07	69233	13	2	N	YYN	Physical Disconnect
Sunday	09/16/07	69220	19	2	N	YYN	Physical Disconnect
Saturday	09/15/07	69201	22	2	N	YYN	Physical Disconnect
Friday	09/14/07	69179	32	2	N	YYN	Physical Disconnect
Thursday	09/13/07	69147	10	2	N	YYN	Physical Disconnect
Wednesday	09/12/07	69137	26	2	N	YYN	Physical Disconnect
Tuesday	09/11/07	69111	29	2	PWR OUTAGE	YYN	Physical Disconnect
Monday	09/10/07	69082	38	0	N	NYN	Active
Sunday	09/09/07	69044	29	0	N	NYN	Active
Saturday	09/08/07	69015	20	0	N	NYN	Active
Friday	09/07/07	68995	22	0	N	NYN	Active
Thursday	09/06/07	68973	21	0	N	NYN	Active
Wednesday	09/05/07	68952	22	0	N	NYN	Active
Tuesday	09/04/07	68930	34	0	N	NYN	Active

### Status Flags: Y-Y-N

Y – Meter Disconnected  
Y – Power to the Meter (Line side)  
N – Meter Cannot Record Usage

### Status Flags: N-Y-Y

N – Meter Not Disconnected  
Y – Power to the Meter (Line Side)  
Y – Meter Can Record Usage



## C. Data

# Utilizing Data

## Unbilled Usage with Disconnect Information

**Illegal Usage Tracking Form**

[Review Load Dates](#)[Run Physical Disconnect Report](#)[Export MSXL](#)[Close](#)

Device Lookup:

Buss Part Lookup:

POD (CIS Acct #):

Contr Acct Lookup:

**Lookups and Filters**

Status Filter:

City Filter:

Clear Filters

Account Type Filter:

Disconnect Date Filter:

Disconnect Type Filter:

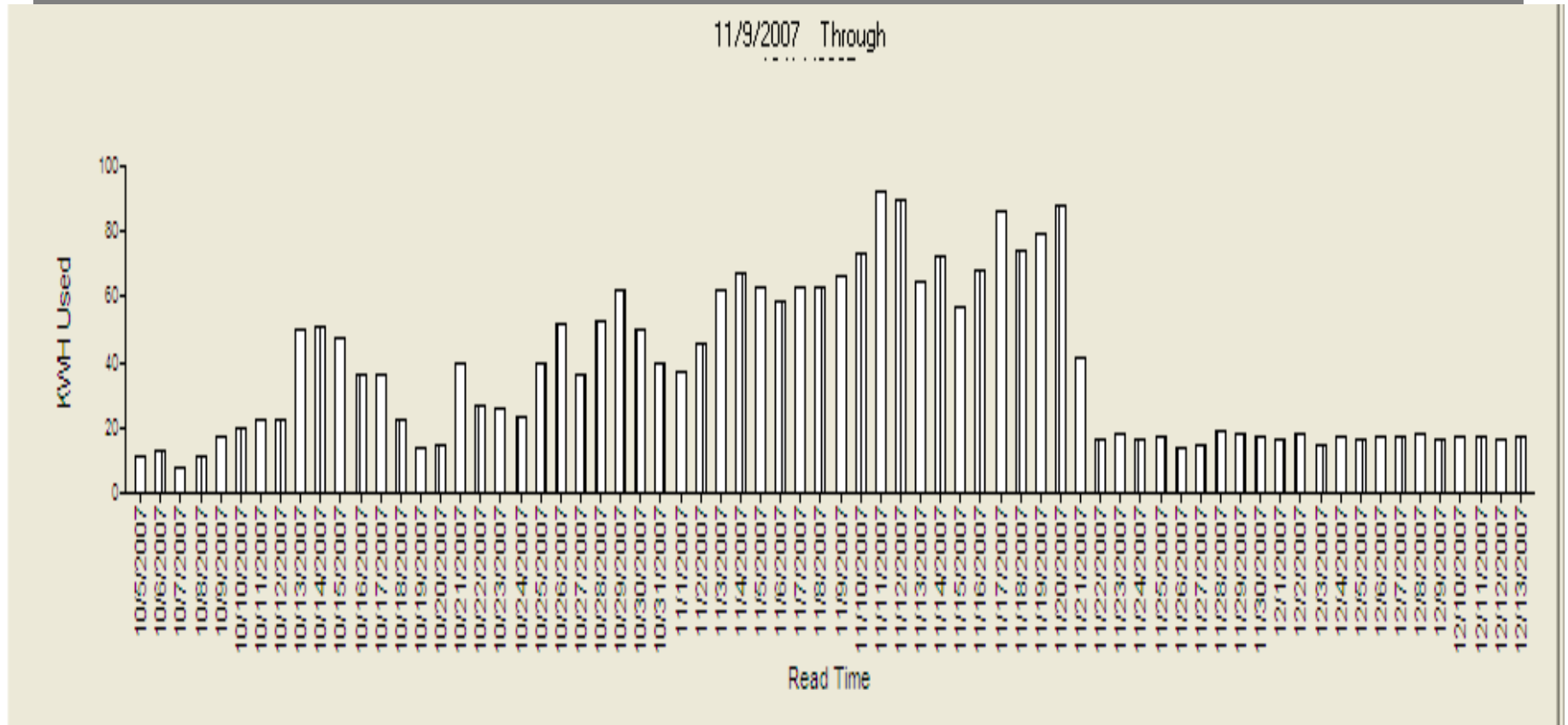
Usage Filter:

Device ID	Buss Part	POD (CIS Act #)	Contract Act	Buss Part Name	Buss Part Address	City	Service End Dt	Disco Read	Cur Read	Mtr Con	Total Usage	Type	Status	Comments
							06/11/07	34931	36337	1	1406	VIR	New	
							07/31/07	5591	6206	1	615	PHY	New	
							08/20/07	98873	99591	1	718	VIR	New	
							07/16/07	11712	12542	1	830	PHY	New	
							08/22/07	439	1296	1	857	VIR	New	
							08/01/07	86735	87767	1	1032	VIR	New	
							08/31/07	7593	8653	1	1060	VIR	New	
							09/15/07	70425	71395	1	970	VIR	New	
							07/31/07	41532	42687	1	1155	VIR	New	
							09/15/07	28332	29205	1	873	VIR	New	
							08/22/07	17438	18151	1	713	VIR	New	
							04/19/07	14377	15280	1	903	VIR	New	
							04/19/07	85143	85834	1	691	VIR	New	
							08/17/07	17093	17814	1	521	VIR	New	
							04/19/07	35439	36106	1	667	VIR	New	
							07/18/07	60105	61237	1	1132	VIR	New	
							09/26/07	75032	75833	1	801	VIR	New	
							07/31/07	39081	39642	1	581	VIR	New	
							08/24/07	2721	3251	1	530	VIR	New	
							09/16/07	41038	42257	1	1219	VIR	New	
							08/07/07	12259	14086	1	1827	VIR	New	
							04/20/07	12337	13256	1	919	VIR	New	
							08/08/07	14644	15764	1	1120	VIR	New	
							07/28/07	44112	44652	1	540	VIR	New	
							07/11/07	3426	4038	1	612	VIR	New	
							09/11/07	87066	87871	1	805	VIR	New	
							08/20/07	1247	2197	1	950	VIR	New	
							08/03/07	8001	8794	1	793	VIR	New	
							07/31/07	76626	77142	1	516	VIR	New	

Total Number of Meters: **359**

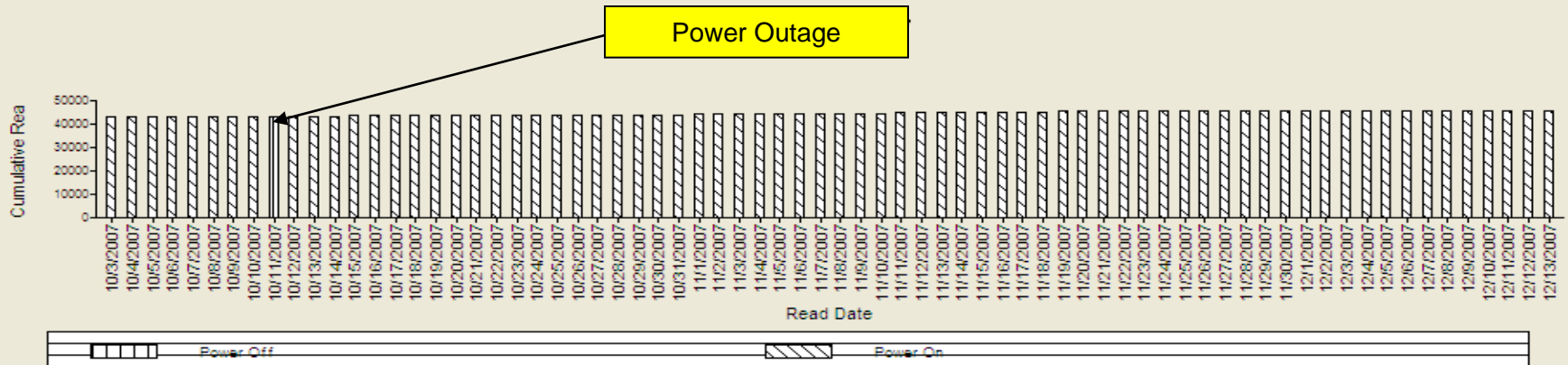
# Utilizing Data

## Daily Consumption History Graph



## C. Data

# Utilizing Data Power Outage Flag

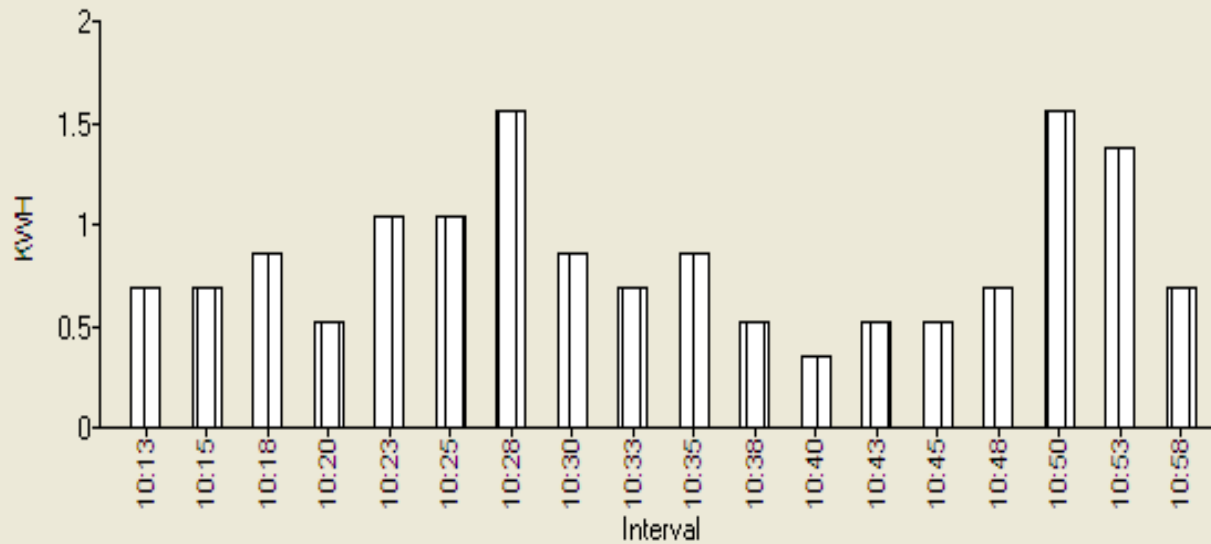


Flag Status  
☒ Power Outage Flag  
☐ Magnet Flag  
☐ Reverse Rotation Flag

# Utilizing Data

## 45 Minute Usage Profile

 Meter Header
  KWH Reading
  45 Minutes Profile



10:13:26 Through 10:58:26



C. Data

# Utilizing Data

## Program to Show Possible Pinned disc's / Shunt Switches

### Device Usage History Form

Export  
MS XL

Chart

Close

Enter Device Number:



Buss Partner Name:

Address:

Device ID:

BP / POD:

CA / Acct Type:

Device Constant:

Week Day	Read Date	Read	Usage	Pwr Outages	PwrOutFlag	LogPwrUsageFlag	Acct_Status
Monday	12/30/02	9167	26	0	N	YYY	Active
Sunday	12/29/02	9141	0	0	N	YYY	Active
Saturday	12/28/02	9141	0	0	N	YYY	Active
Friday	12/27/02	9141	40	0	N	YYY	Active
Thursday	12/26/02	9101	0	0	N	YYY	Active
Wednesday	12/25/02	9101	0	0	N	YYY	Active
Tuesday	12/24/02	9101	0	0	N	YYY	Active
Monday	12/23/02	9101	0	0	N	YYY	Active
Sunday	12/22/02	9101	0	0	N	YYY	Active
Saturday	12/21/02	9101	0	0	N	YYY	Active
Friday	12/20/02	9101	21	0	N	YYY	Active
Thursday	12/19/02	9080	22	0	N	YYY	Active
Wednesday	12/18/02	9058	23	0	N	YYY	Active
Tuesday	12/17/02	9035	29	0	N	YYY	Active
Monday	12/16/02	9006	19	0	N	YYY	Active
Sunday	12/15/02	8987	0	0	N	YYY	Active
Saturday	12/14/02	8987	0	0	N	YYY	Active
Friday	12/13/02	8987	24	0	N	YYY	Active
Thursday	12/12/02	8963	25	0	N	YYY	Active
Wednesday	12/11/02	8938	22	0	N	YYY	Active
Tuesday	12/10/02	8916	30	0	N	YYY	Active
Monday	12/09/02	8886	39	0	N	YYY	Active
Sunday	12/08/02	8847	0	0	N	YYY	Active
Saturday	12/07/02	8847	0	0	N	YYY	Active
Friday	12/06/02	8847	21	0	N	YYY	Active
Thursday	12/05/02	8826	16	0	N	YYY	Active
Wednesday	12/04/02	8810	23	0	N	YYY	Active
Tuesday	12/03/02	8787	0	0	N	YYY	Active
Monday	12/02/02	8787	21	0	N	YYY	Active
Sunday	12/01/02	8766	0	0	N	YYY	Active
Saturday	11/30/02	8766	0	0	N	YYY	Active

Zero Use  
Periods



# Utilizing Data

## Program to Show Possible Pinned disc's / Shunt Switches

C. Data

### Device Usage History Form

Export  
MS XL

Chart

Close

Enter Device Number:



Bus Partner Name:

Address:

Device ID:

BP / POD:

CA / Acct Type:

Device Constant:

Week Day	Read Date	Read	Usage	Pwr Outages	PwrOutFlag	LogPwrUsageFlag	Acct_Status
Saturday	08/25/07	32266	0	0	N	YYY	Active
Friday	08/24/07	32266	0	0	N	YYY	Active
Thursday	08/23/07	32266	0	0	N	YYY	Active
Wednesday	08/22/07	32266	0	0	N	YYY	Active
Tuesday	08/21/07	32266	32	0	N	YYY	Active
Monday	08/20/07	32234	102	0	N	YYY	Active
Sunday	08/19/07	32132	50	0	N	YYY	Active
Saturday	08/18/07	32082	0	0	N	YYY	Active
Friday	08/17/07	32082	0	0	N	YYY	Active
Thursday	08/16/07	32082	0	0	N	YYY	Active
Wednesday	08/15/07	32082	0	0	N	YYY	Active
Tuesday	08/14/07	32082	0	0	N	YYY	Active
Monday	08/13/07	32082	0	0	N	YYY	Active
Sunday	08/12/07	32082	0	0	N	YYY	Active
Saturday	08/11/07	32082	0	0	N	YYY	Active
Friday	08/10/07	32082	0	0	N	YYY	Active
Thursday	08/09/07	32082	0	0	N	YYY	Active
Wednesday	08/08/07	32082	0	0	N	YYY	Active
Tuesday	08/07/07	32082	0	0	N	YYY	Active
Monday	08/06/07	32082	0	0	N	YYY	Active
Sunday	08/05/07	32082	0	0	N	YYY	Active
Saturday	08/04/07	32082	0	0	N	YYY	Active
Friday	08/03/07	32082	0	0	N	YYY	Active
Thursday	08/02/07	32082	0	0	N	YYY	Active
Wednesday	08/01/07	32082	7	0	N	YYY	Active
Tuesday	07/31/07	32075	0	0	N	YYY	Active
Monday	07/30/07	32075	0	0	N	YYY	Active
Sunday	07/29/07	32075	0	0	N	YYY	Active
Saturday	07/28/07	32075	0	0	N	YYY	Active
Friday	07/27/07	32075	0	0	N	YYY	Active
Thursday	07/26/07	32075	0	0	N	YYY	Active

Zero Use  
Periods





# Revenue Protection & AMI Systems

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**Utilizing AMI data has assisted Revenue Protection efforts in recouping lost revenues through data interpretation and investigation.**

**It is critical to understand what data can and cannot be obtained and how to circumvent this information.**

***Thank you...***