Powering Uganda

DEMAND PREPAYMENT METERING, TAMPERING AND LOSS REDUCTION SARPA CONVENTION 2017

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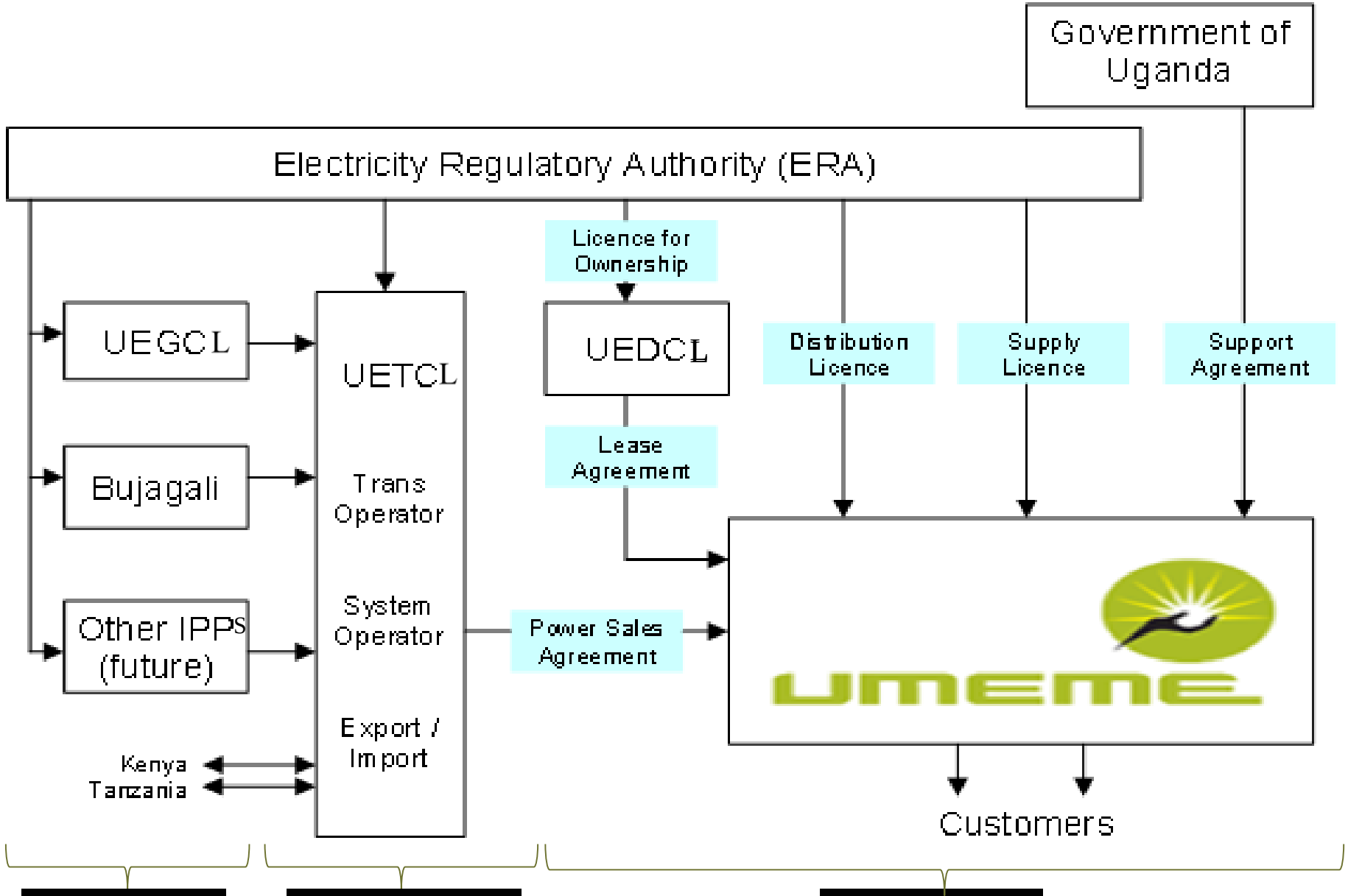
Outline

1) About Umeme
   - Uganda's energy sector
   - Quick statistics
   - Regulatory targets
   - Losses Trajectory
2) Tampering Techniques
3) Loss Reduction Initiatives
4) Demand Prepayment Metering

About Umeme

Umeme:

- ⇨ Largest distribution Power company in Uganda
- ⇨ Distributes 98% of the electricity up to 33kV
- ⇨ Operates a 20 year Concession via a single-buyer model (2005-2025)
- ⇨ Cross-listed on two stock exchanges (Kenya, Uganda)
- ⇨ Regulated Company


Government of Uganda
Electricity Regulatory Authority (ERA)
Licence for Ownership
UEGCL
Bujagali
Other IPPs (future)
UETCL
Trans Operator
System Operator
Export / Import
Kenya
Tanzania
UEDCL
Lease Agreement
Power Sales Agreement
Distribution Licence
Supply Licence
Support Agreement
UMEME
Customers
GENERATION
TRANSMISSION
DISTRIBUTION

Umeme Statistics

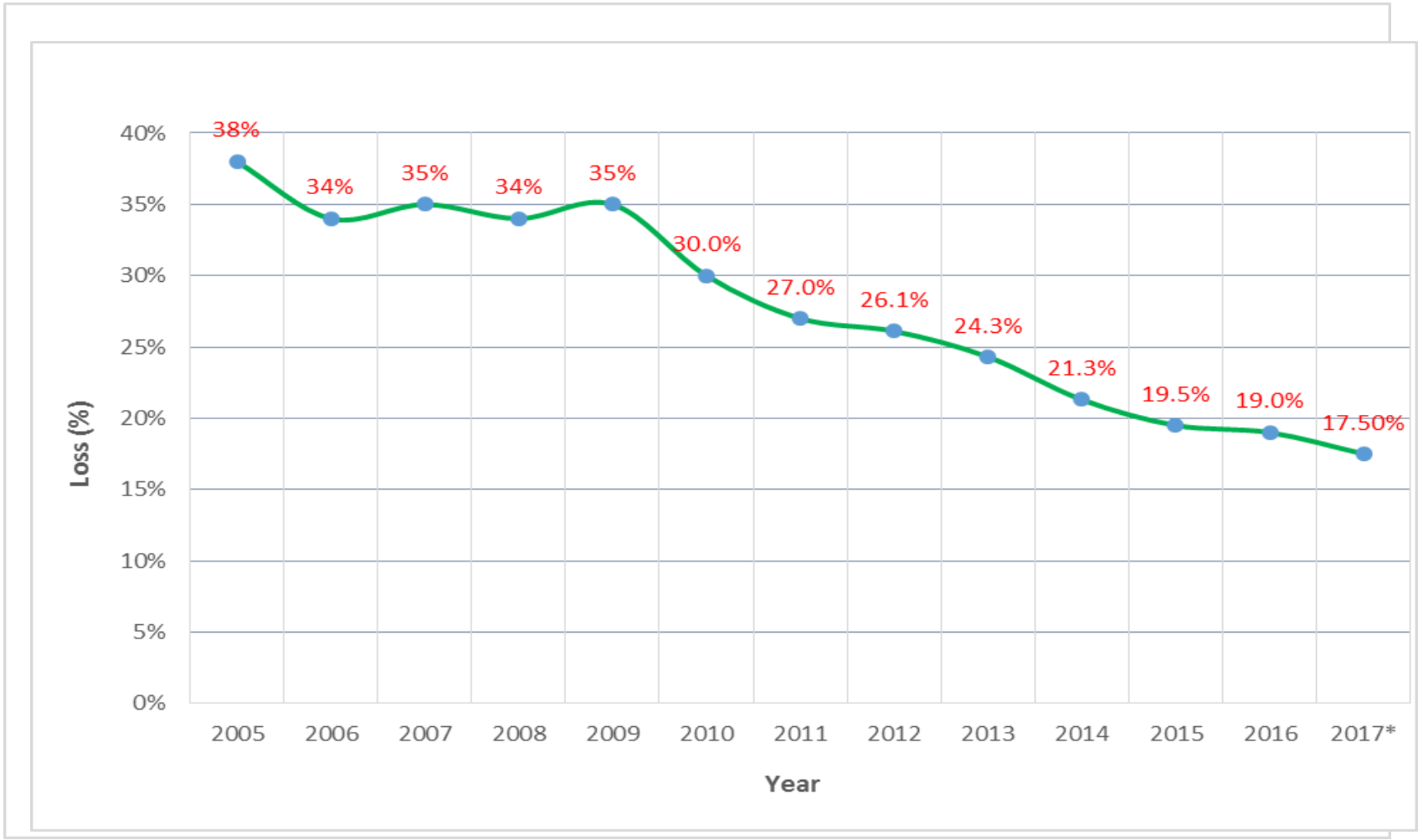
Parameter	UoM	Details
Customer Base (avg)	No.	1,000,000
Purchases (avg) per month	GWh	271.8
Sales (avg) per month	GWh	224.2
Loss (2017 as at end of July)	**(%)**	17.5*
Loss (YTD 2016)	**(%)**	**19.0**
Revenue Collection	(%)	98.2%

Regulatory Targets

Parameter	Target (%)
Loss (2018)	14.7
Loss (2017)	16.2
Collection Rate	99

- ⇨ **Targets set for seven (7) year period up to 2018**
- ⇨ **Company incentivized to reduce losses**
- ⇨ **1% point of losses = USD 3.5m (p.a.)**

Losses Trajectory



Tampering Techniques in Three Phase Installations

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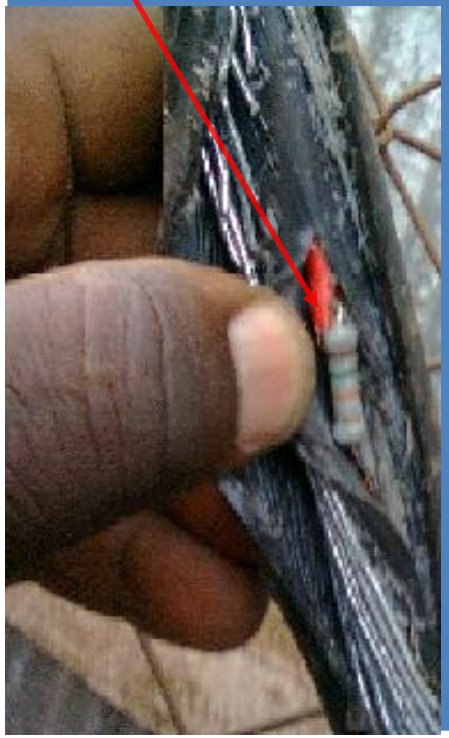
Resister in cable connecting CTPT unit and meter



Foreign circuit controlling energy registers to limit energy measurement

Foreign Relay connected to energy registers to limit energy measurement

Tampering Techniques In Three Phase Installations _ Cont'd

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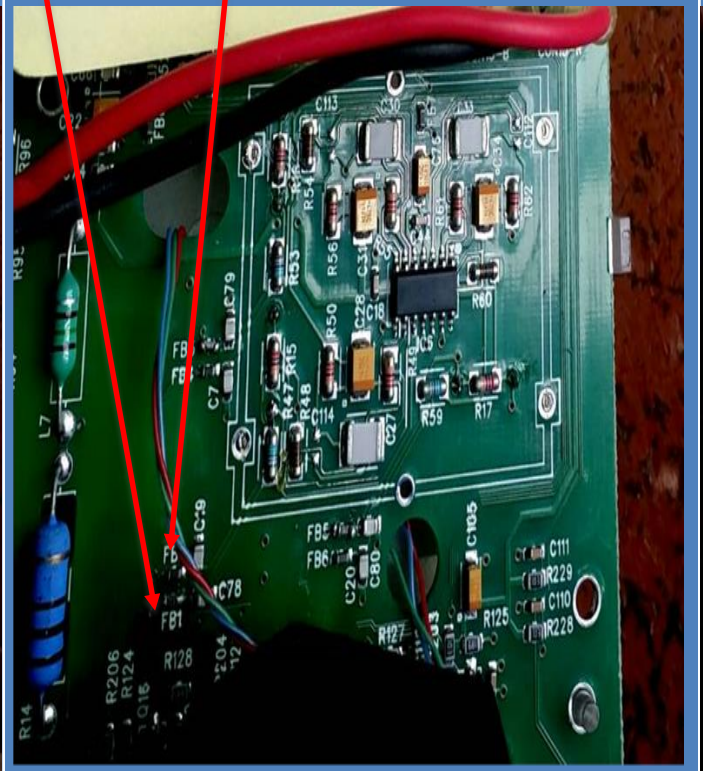
Cut Current Transformers in three phase meters to cut off energy measurement

Replacement of Ferrite Beads with resistors in three phase meters



Four resistors installed in series on the circuit board to limit current flow and insulated not to cause short circuits

Tampering of Single Phase Prepaid Meters

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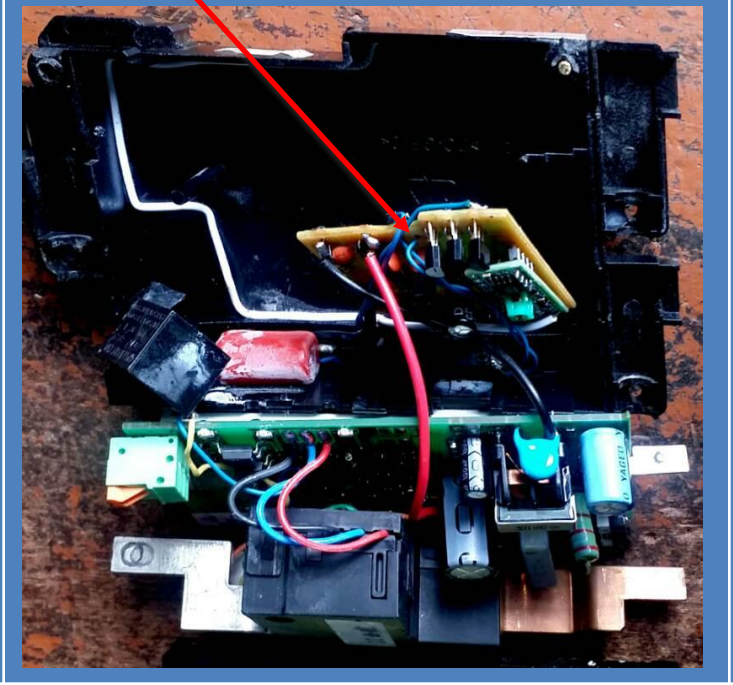
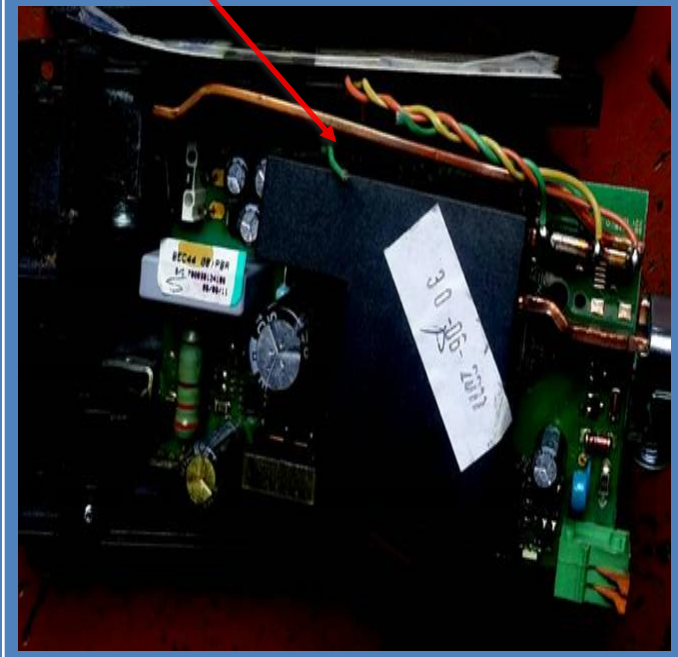
Resistor inserted in green coded signal cable through comm port without opening meter

Foreign circuit controlling energy registers using a remote device to limit energy measurement in single phase meters



Current signal cable cut through comm port using a spoke. Meter pulsing not decrementing credit in 1 phase prepaid meters



Tampering of Single Phase Prepaid Meters

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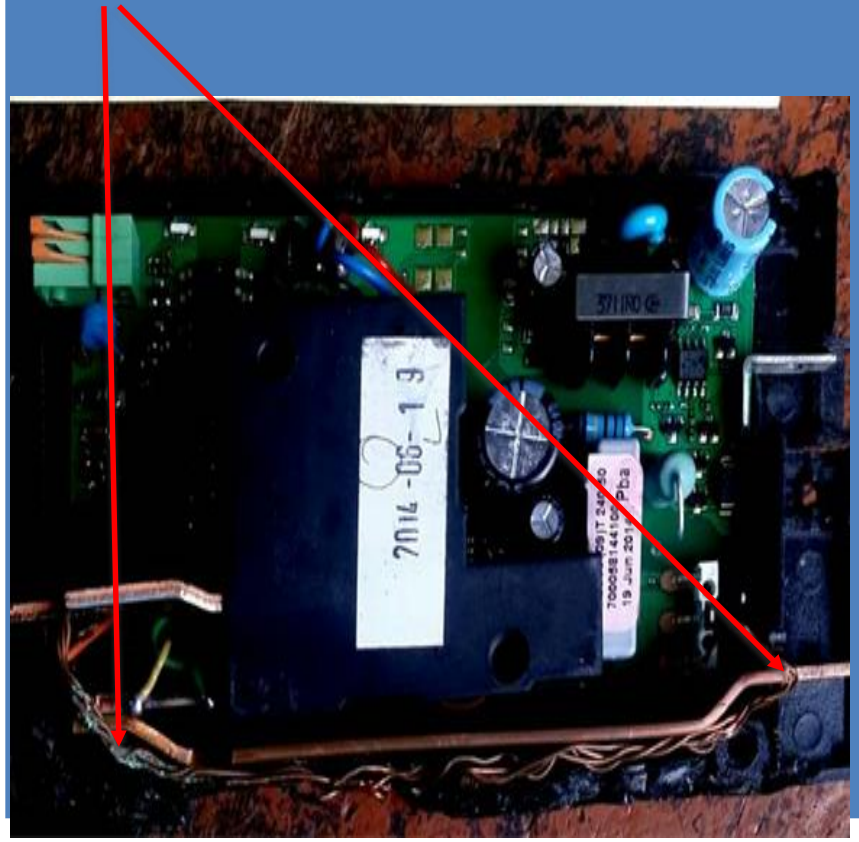
Internal meter bypass by connecting a copper cable across the input and output bus-bars in prepaid meters



Foreign switch inserted in the current path and operated through comm port using the communication cable

Tampering of Single Phase Prepaid Meters

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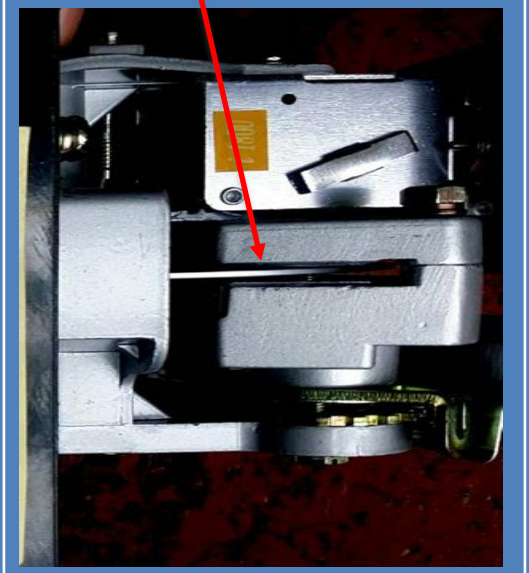
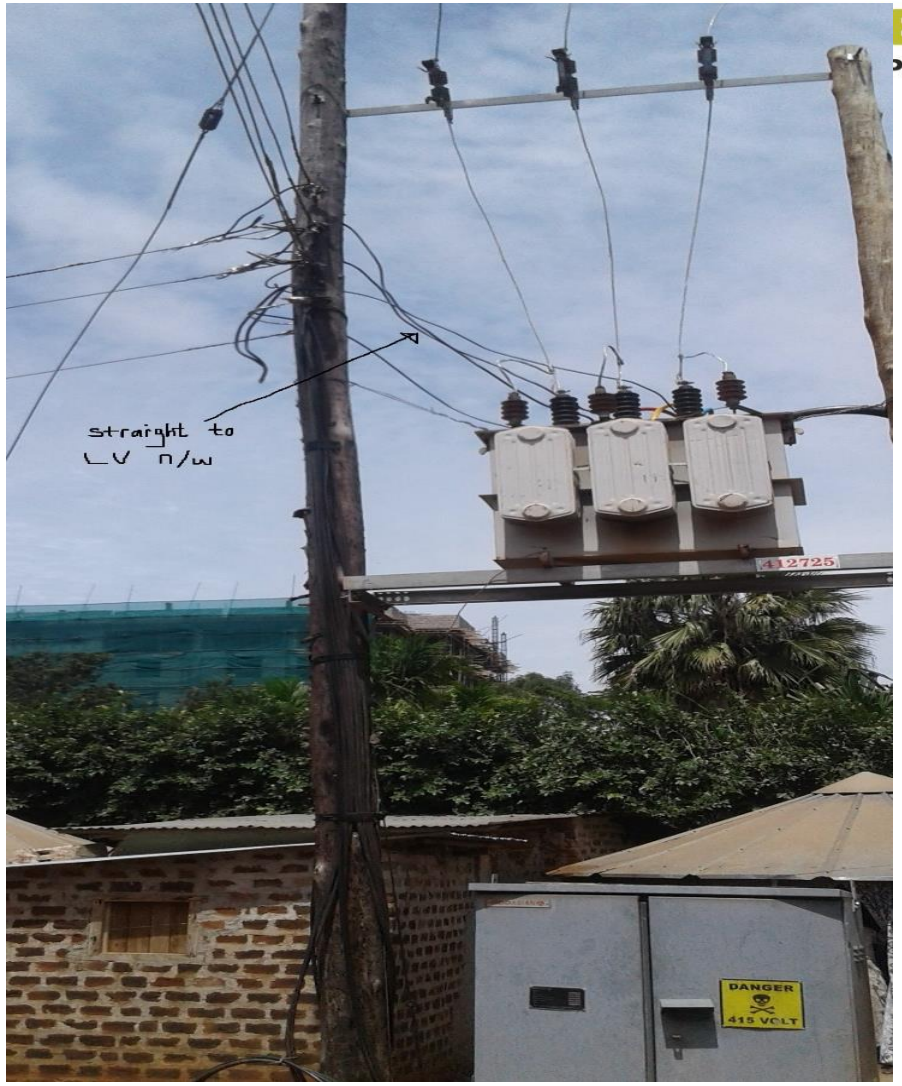
Four Resistors Installed in series to limit current flow	Foreign resistor inserted by cutting a hole in the meter case back	Disc adjusted to rub against the permanent magnet	Three Yellow wires inserted in the current path
			

Tampering Techniques

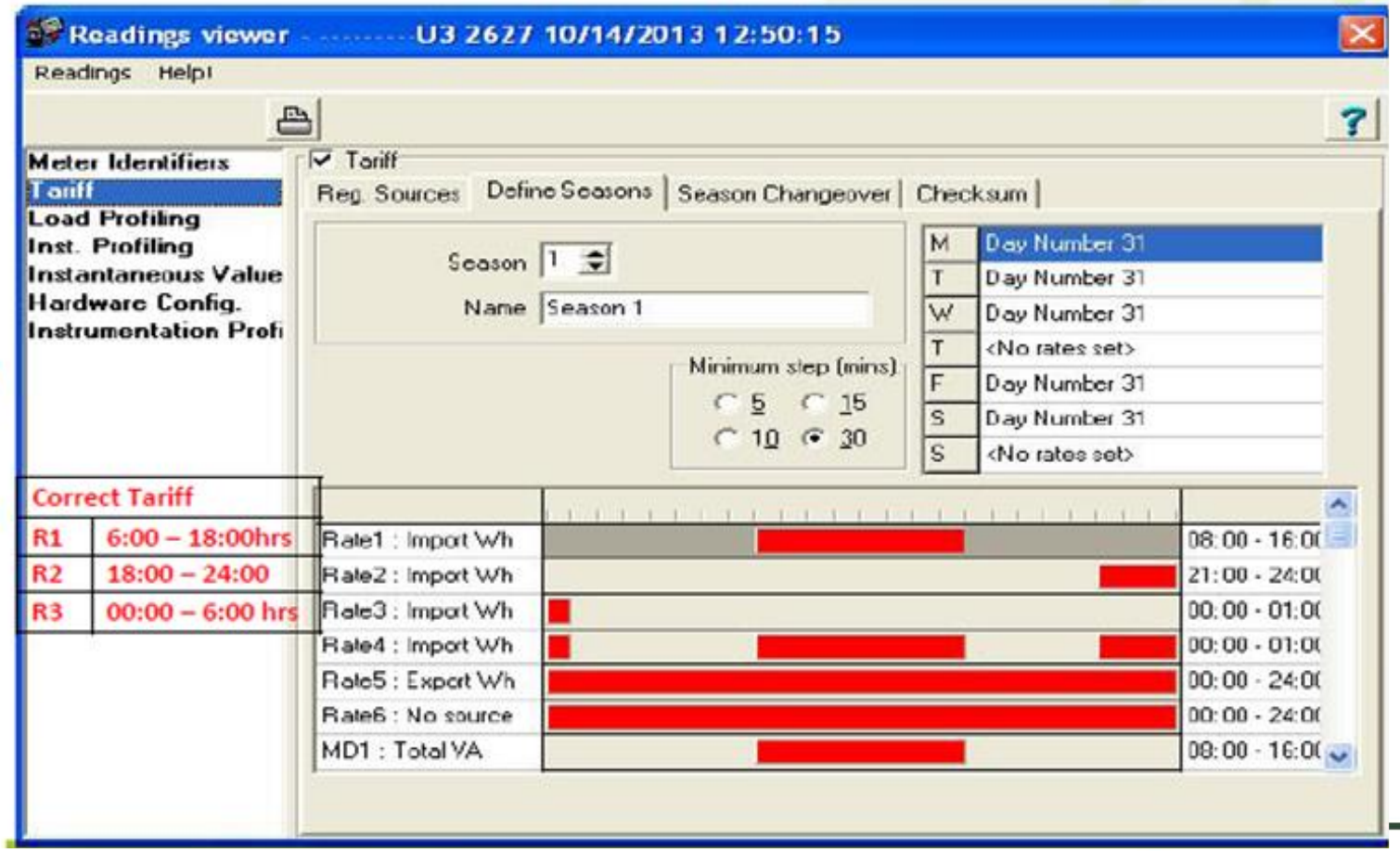


Software Tampering of Demand Meters

most sophisticated

Meter accuracy is unaffected

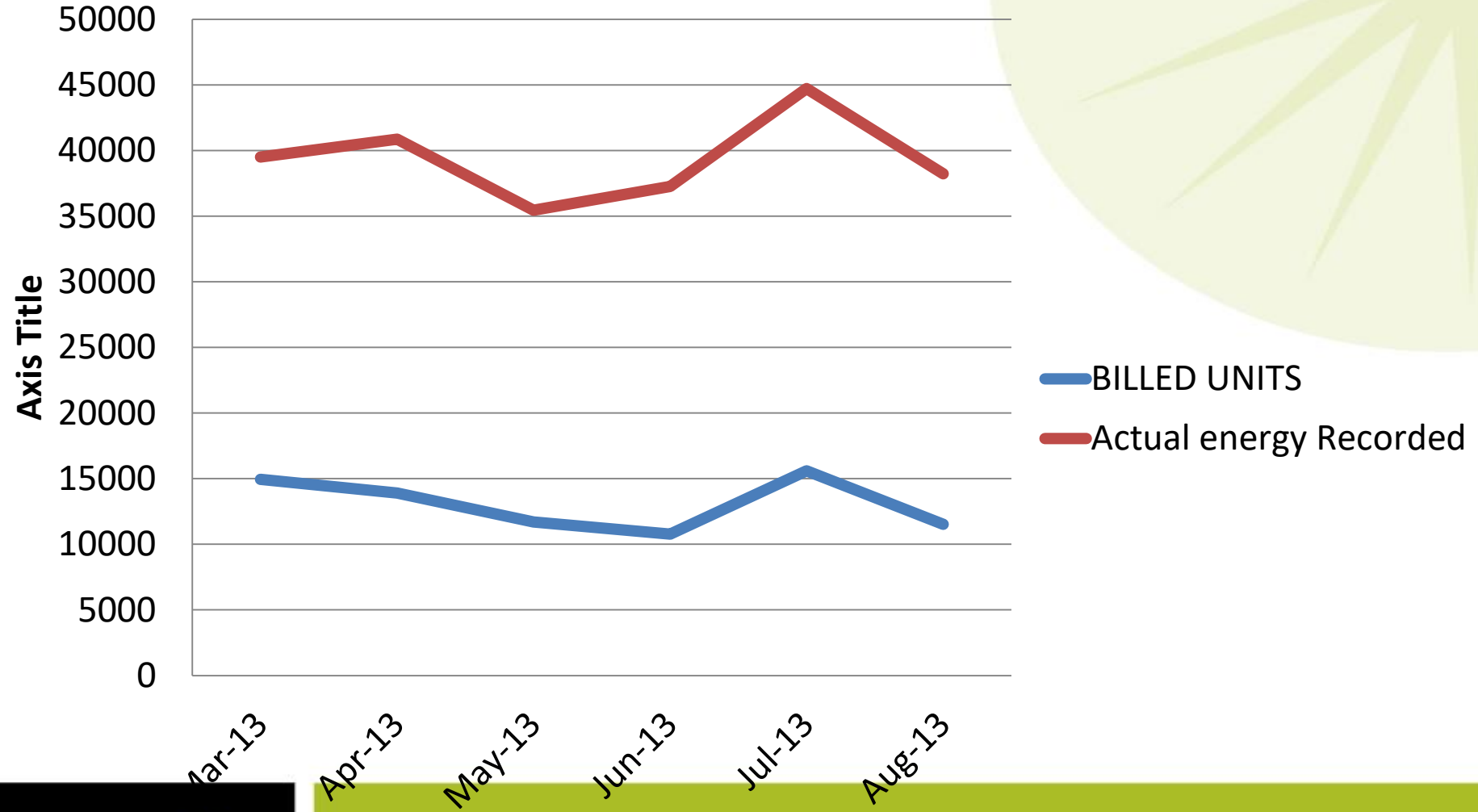
Access through optical port



Load profile Analysis

1946	8/19/2013	12:00:00 AM	12:30:00 A	37.312	0	13.939			39.847			
1947	8/19/2013	12:30:00 AM	1:00:00 AI	40.371	0	13.965			42.732			
1948	8/19/2013	1:00:00 AM	1:30:00 AI	38.982	0	13.843			41.383			
1949	8/19/2013	1:30:00 AM	2:00:00 AI	8.9862	0	3.1302			9.517	Write access		
1950	8/19/2013	1:40:00 AM	2:00:00 AI	23.987	0	8.7872			25.555	Partial demand	Clock change	
1951	8/19/2013	2:00:00 AM	2:40:00 PI	0.7488	0	0.2752			0.7936	Write access	Partial de	Clock chan
1952	8/19/2013	2:00:00 AM	2:30:00 AI	35.251	0	14.31			38.054			
1953	8/19/2013	2:30:00 AM	3:00:00 AI	34.938	0	13.85			37.607			

Comparison of Billed and Actual consumption



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Loss Reduction Plans

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Feeder Loss Matrix

	HIGH LOSS	LOW LOSS
HIGH CUSTOMER RESISTANCE	Feeders with monthly Losses > 0.4 Gwh & High customer resistance against Loss Reduction initiatives	Feeders with monthly Losses < 0.4 Gwh & High Customer resistance against Loss Reduction initiatives
LOW CUSTOMER RESISTANCE	Feeders with monthly Losses > 0.4 Gwh & Minimal customer resistance against Loss Reduction initiatives	Feeders with monthly Losses < 0.4 Gwh & Minimal Customer resistance against Loss Reduction initiatives

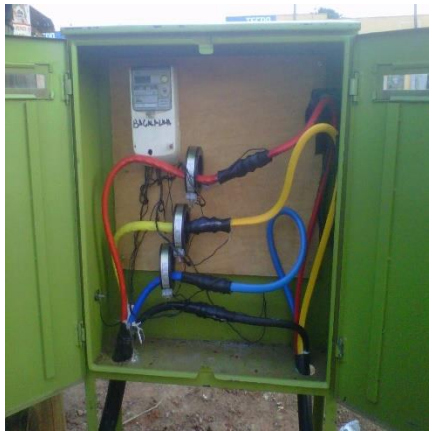
Strategy Matrix

	HIGH LOSS	LOW LOSS
HIGH CUSTOMER RESISTANCE	• NO - 19 feeders • TOT feeder Length: • TOT Loss – 13.5 Gwh (5.4%) **PROPOSED STRATEGIES:** • MV distribution system with PPM & AMR/AMI • ABC with LV network above the MV • Transformer Loss Analysis • Remote Load management (LV)	• NO - 8 feeders • TOT feeder Length: • TOT Loss – 1.5 Gwh (0.6%) **PROPOSED STRATEGIES:** • Prepayment with LV ABC conductors • Localized LR projects • Remote monitoring (AMR/AMI) • Consumption analysis • Targeted & Regular Audits
LOW CUSTOMER RESISTANCE	• NO - 26 feeders • TOT feeder Length: • TOT Loss – 14.9 Gwh (6.0%) **PROPOSED STRATEGIES:** • Prepayment (with LV ABC for Max benefit) • AMR/AMI • Transformer Loss Analysis	• NO - 78 feeders • TOT feeder Length: • TOT Loss – 15.7 Gwh (6.3%) **PROPOSED STRATEGIES:** • Prepayment on Bare conductor • Transformer Loss Analysis • Targeted Localized LR projects

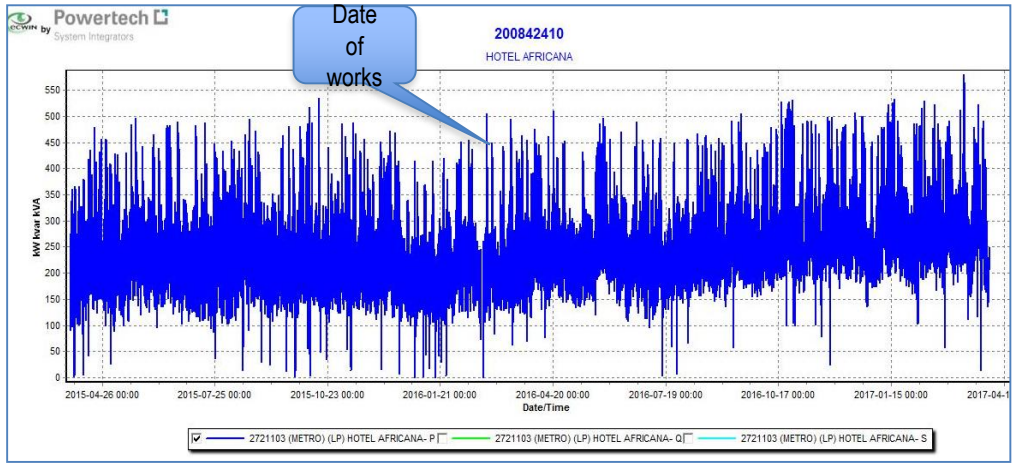
Deployed Loss Reduction Interventions

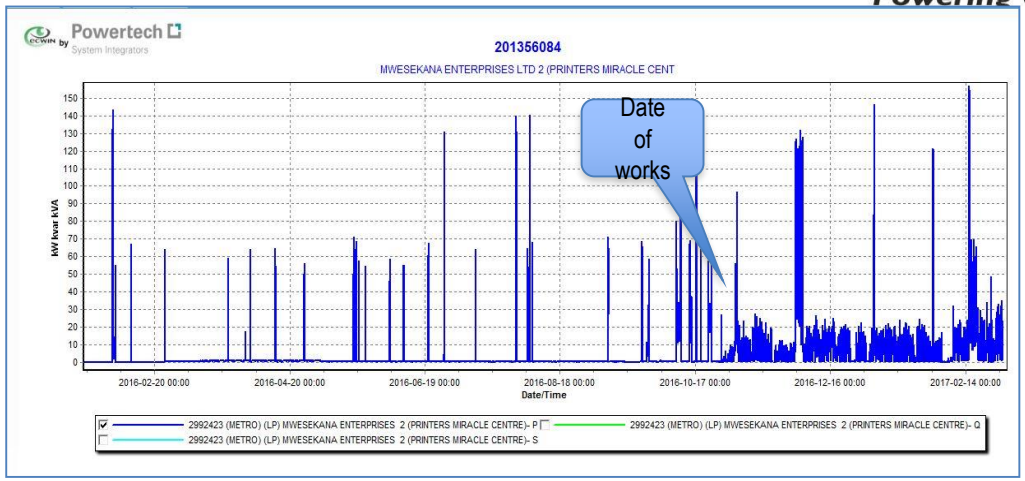
- **Non Tech Loss:** Prioritized according to: **High loss Districts, High loss feeders,**
  - ✓ Loss analysis at Service Centre and Feeder level
  - ✓ Bulk metering of commercial buildings
  - ✓ Bulk metering of maize mills
  - ✓ Relocation & securing of metering points(1Q &3Q)
  - ✓ Replacement of faulty/obsolete/tampered meters
  - ✓ Prepayment roll-out-single phase
  - ✓ AMR Roll-out
  - ✓ Robust storage system for Energy meter passwords
  - ✓ Demand prepayment metering
- **Tech Loss Reduction Projects**
  - ✓ Upgraded some industrial 11kV lines to 33KV-1
  - ✓ Shortened MV & LV lines (Injection of new S/S >7, TXs-@ yr- 200)
  - ✓ Re-conductored of MV-20 & LV lines to bigger size of conductors
  - ✓ Retrofitted LV lines to ABC (10 Fdrs)

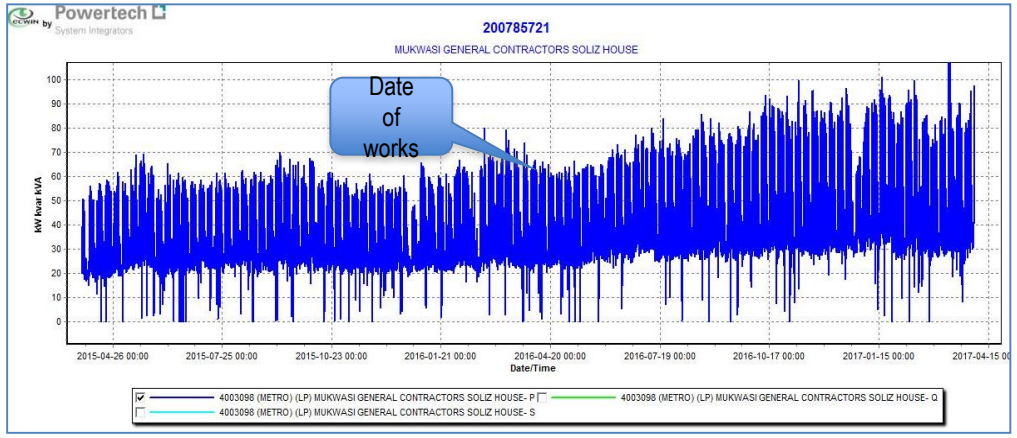
Bulk Metering of Maize Millers

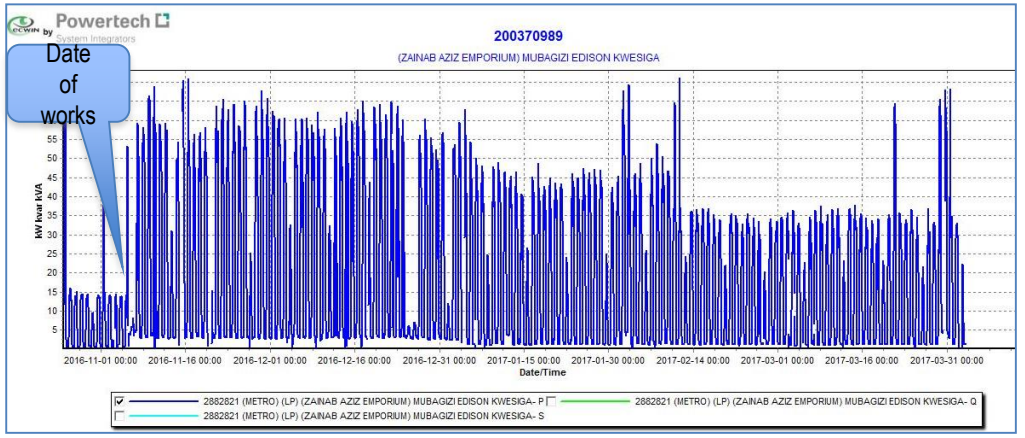


CONSUMPTION PATTERN TRENDS

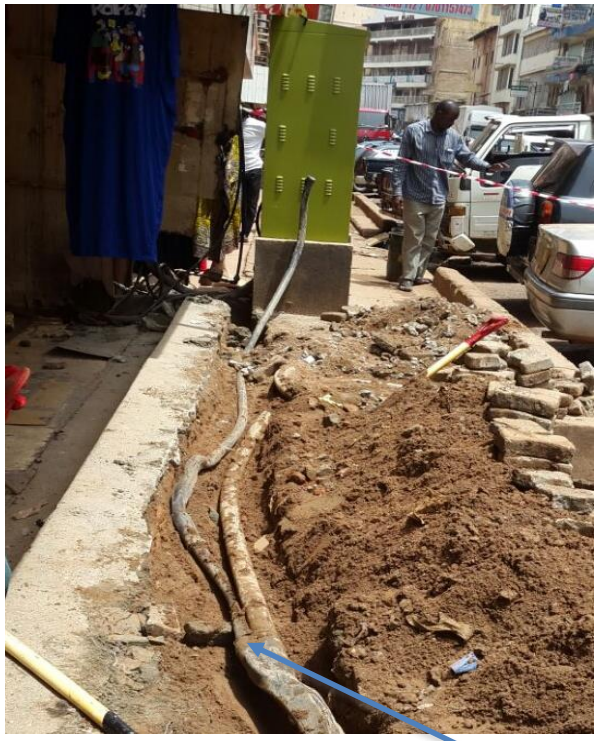


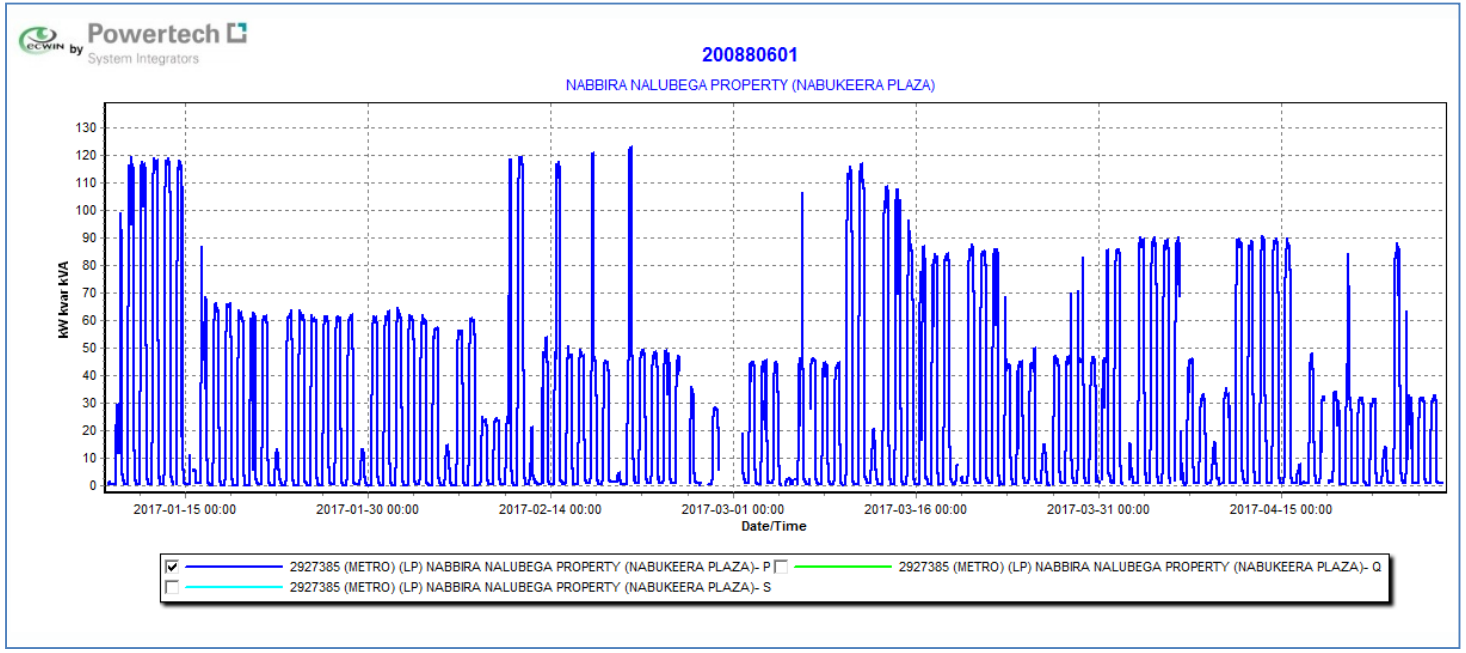






INSTALLATION BREACHES –PLAZA IN CBD





EVOLUTION OF METERING INSTALLATIONS – CODE 40&30 /HT

Legacy Boxes

Pre-wired Meter Boxes

- All key activity tracked.
- Programmable keys and tags used for access
- All events at installation monitored
- Timely discovery of power theft
- Protection of meter and its accessories

Pre-wired Meter Box re-design

EVOLUTION OF METERING INSTALLATIONS – CODE 20/CT CONNECT

Legacy Meter Boxes

Pre-wired Meter Boxes

Pre-wired Meter Box re-design

EVOLUTION OF METERING INSTALLATIONS – CODE 10.2 / TOU

Legacy Meter Boxes

Pre-wired Meter Boxes

Pre-wired Meter Box re-design

METRO MULTI-METER BOX

2-WAY BOX

4 WAY BOX

Legacy Multi- Meter Boxes

Pre-wired Multi- Meter Boxes

INSTALLATION BREACHES – HIGH SCHOOL

Incident	Timestamp	First Notification	Time Outstanding	Datasource	Serial Number	Client	District	Priority	Alerts	Incident Status	Notifications	Status Timestamp
Enclosure: Meter Side - Door Opened	2017-02-15 11:45:15	2017-02-15 11:49:38		7446670 (MUKON) (LP)	U220714	Mt.St.HenryS High School Muko	MUKONO	High	8	Resolved	30	2017-02-15 15:43:58

Alert Type	Event Comment	Timestamp	Priority
Enclosure: Breaker Side - Door Closed	Door2 Closed	2017-02-15 13:15:55	High
Enclosure: Breaker Side - Door Opened	Door2 Opened	2017-02-15 13:15:14	High
Enclosure: Meter Side - Door Closed	Door1 Closed	2017-02-15 13:15:14	High
Enclosure: Meter Side - Door Opened	Door1 Opened	2017-02-15 12:56:27	High
Enclosure: Breaker Side - Door Opened	Door2 Opened	2017-02-15 12:56:27	High
Enclosure: Meter Side - Door Opened	Door1 Opened	2017-02-15 11:45:15	High
Enclosure: Meter Side - Door Closed	Door1 Closed	2017-02-14 22:20:20	High
Enclosure: Meter Side - Door Opened	Door1 Opened	2017-02-14 22:20:11	High

DEMAND PREPAYMENT METERING

Project Objectives

- Enable GoU to Improve planning
- Enhance GoU budget control
- Provide consumption visibility
- Convenience in managing accounts

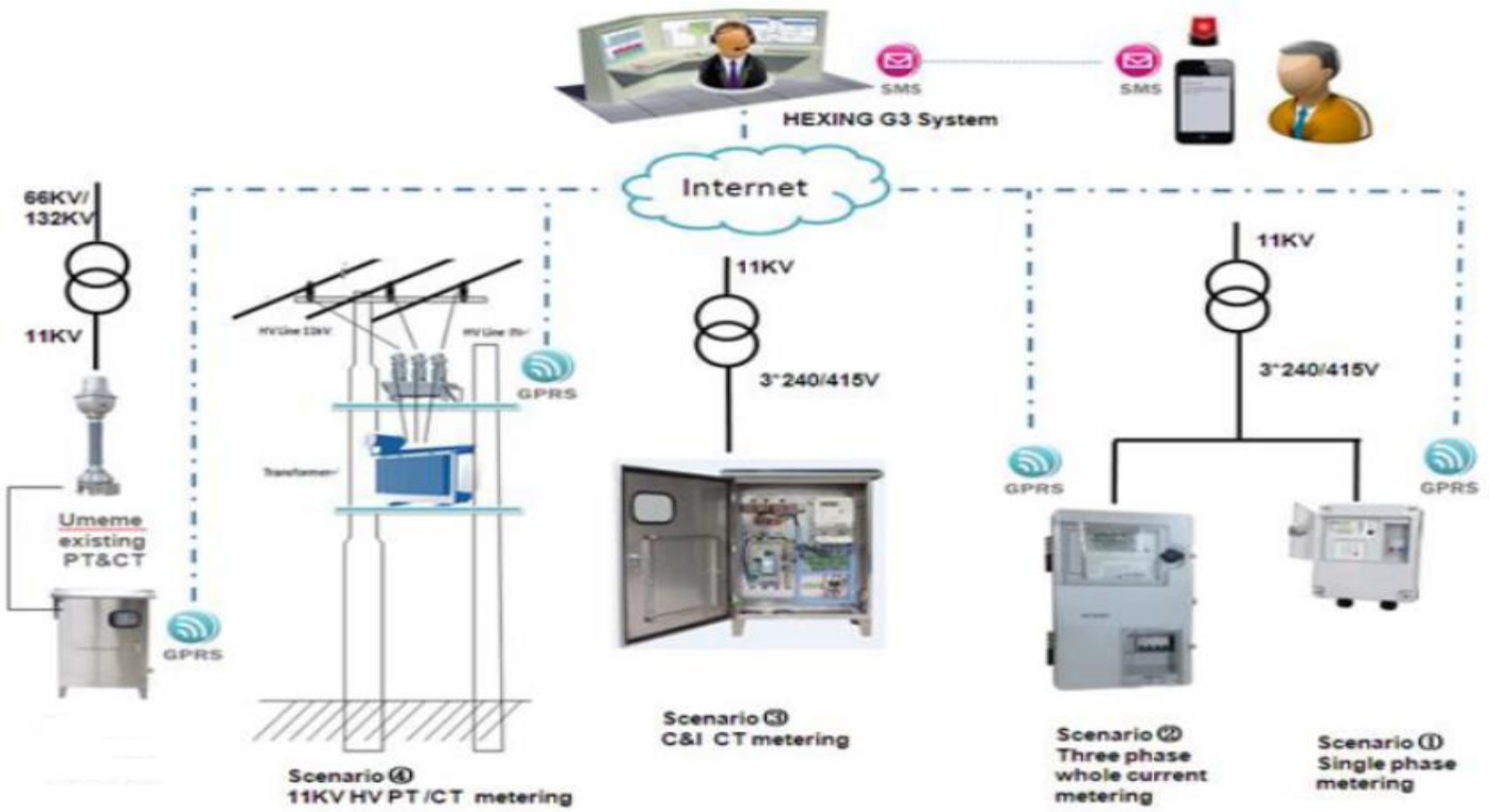
Scope

Tariff Category	No.s
Commercial (Directly Connected) – Code 10.2	239
Medium Institutions (medium industrial – CT Connected) – Code 20	207
Large Institution (Large Industrial,33kV &11kV- CTPT Connected) – Code 30	23
Total	**469**

Journey to the solution (Jan 2015 to date)

- Request for information (RFI)
- RFI Evaluation
- Solution specification development
- Request for Proposal (RFP)
- RFP evaluation
- Solutions Demonstration
- Contract Award (Hexing Electrical co. Ltd – Hangzhou China)
- Engineering Workshop with Hexing
- Project Kick off meeting with supplier
- Business Process Re-Engineering
- Functional Design Specification (FDS)
- Factory Acceptance Testing
- Mass production
- SGS inspection
- Shipment
- Network Preparation by Supplier
- Installation and commissioning
- SAT
- Go Live
- UAT & Project Closure

Technology – Solution Architecture



Technology

Item	Key Functionalities
Head End System (Hex G3)	• Tariff Management & emergency credit • Ability to support unit transfer STS • Business Intelligence Reporting Tool • Debt Management Tool • Vending as per CTS standard • Communication with meters, CB, enclosure • CTS token transfer to meters via DLMS/ COSEM • Main and DR sites to ensure availability (Fail Over to DR automated) • Enterprise Service Bus for integration with other systems • Extensive analysis and reporting support to ensure cost effective operations

Technology Ct'd

Item	Key Functionalities
Meters (HX 310 KP, HX 310 P - CT, HX 310 - CTPT)	• Programmable to take on TOU Tariff • DLMS COSEM Compliant • Support CTS • Have auxiliary output for controlling CB and inputs for indicating CB status (on or off) • Split PPM Meters with wired and PLC Comms • Pre & post paid mode switchable • Meter terminal and main cover detection & logging • Emergency credit Communication with CIU • Plug and play Comms module (GPRS, PLC, RF & Ethernet)
Circuit Breakers	• Intelligent & Controllable by Smart meter on depletion of credit • Manual and remote control functionality • HT breakers controlled via an FRTU
Enclosures	• Remote operation and event log in meter • Security features (Door open detection) • Enclosures with CIU housing

Solution Outlook – Direct Connect meter

(Disconnection/reconnection happens inside meter)

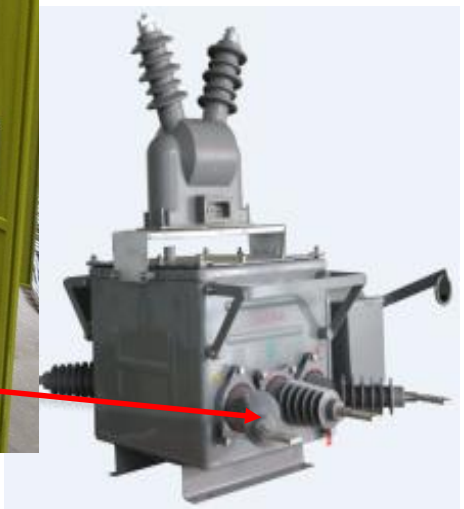
Solution Outlook– CT Low Voltage

(Disconnection/reconnection happens outside meter through circuit breaker)

Solution Outlook– High Voltage

33kV O/H CB

11kV Ground mounted CB



11kV O/H CB

(Disconnection/reconnection happens outside meter through circuit breaker

Underground 11kV Circuit Breaker

Challenges Encountered

- Drafting specifications for the new technology
- Implementation of complex tariff in prepayment mode
- Automatic disconnection of load on depletion of credit and automatic reconnection especially for HT and CT installations
- Securing buy-in from customers prior to technology deployment
- Resistance to technology by some GOU institutions for fear of insufficient funding (Ministry of Defense- 82 accounts)
- Installation of technology for sensitive entities like Hospitals, Uganda Blood Transfusion, Ministry of Defense and Prisons
- Installations bypass by Uganda Police due to low credit allocation

Milestones so far

- 300 of 469 installations converted (60%)
- Change in consumer behavior
- Clearance of government arrears
- More funding allocated to entities by Ministry of Finance
- Technical audits initiated by Top management of Entities
- Tariff sensitization requested by stakeholders
- Regional & Global Pioneering technology (Visibility at PIESA, African Utility Week, ICH conference, SARPA Convention

Thank You