THE IMPACT OF FUTURE POWER MONITORING SYSTEMS ON ELECTRICAL UTILITY CUSTOMER SATISFACTION

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Power Quality

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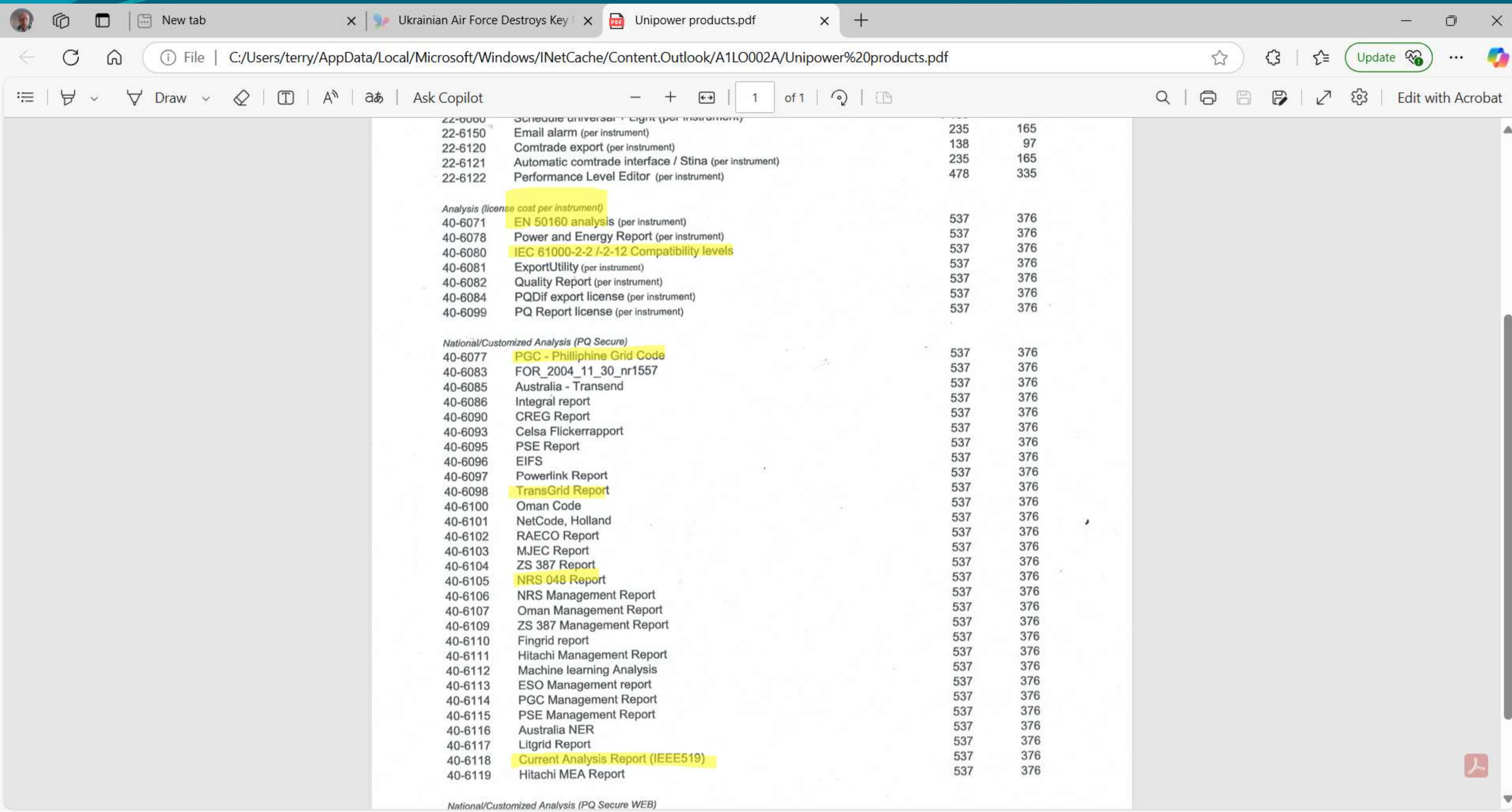
3 Business models for Electrical supplier customer satisfaction

- Contractual with Quality of Supply contracts
  - France, South Africa, USA (very few)
- Cooperative effort between utility and customer (most utilities)
- Legislative by the government or regulator
  - Meet standards set by legislation
    - Norway , Philippines, Columbia, India (2018) harmonic regulation

QOS contracts examples

Quality assurance of electricity deliveries	EDF (France)	Escom (South Africa)	Detroit Edison (Michigan)	San Diego Gas & Electric (California)
Benchmarking				
against own network	Yes	Yes	Yes	Yes
against regional level	Yes	Yes	Yes	Yes
against national level	Yes	Yes	Yes	Yes
methodology	Own	EPRI RBM	EPRI RBM	EPRI RBM
Index	Interuptions, dips	Interuptions, dips	Interuptions, dips	Interuptions, dips
Measurement				
Systematic	Yes	Yes	when necessary	when necessary
Ad hoc	No	No	No	No
interruptions, at PCC	Yes	Yes	Yes	Yes
interruptions, at customer	Emeraude	On request	Acc. to agreement SMC	Acc. to agreement
Voltage dips	Emeraude	NRS 048	Acc. to agreement SMC	Yes
Harmonics	EN / IEC	Yes	IEEE	IEEE
Flicker	IEC	IEC	IEEE	IEEE
Guarantees				
Restore time	Yes	Yes	Yes	Yes
number of interruptions	Yes	Yes	Yes	Yes
number of voltage dips	Yes	Yes	Yes	Yes
Acc. tot PQ standard	No	NRS 048	No	No
Acc. tot PQ agreement	Emeraude	Yes	SMC	Yes

PQ Secure automatic report writer "custom"



22-6060	Schedule universal + Light (per instrument)		
22-6150	Email alarm (per instrument)	235	165
22-6120	Comtrade export (per instrument)	138	97
22-6121	Automatic comtrade interface / Stina (per instrument)	235	165
22-6122	Performance Level Editor (per instrument)	478	335
Analysis (license cost per instrument)			
40-6071	EN 50160 analysis (per instrument)	537	376
40-6078	Power and Energy Report (per instrument)	537	376
40-6080	IEC 61000-2-2 /-2-12 Compatibility levels	537	376
40-6081	ExportUtility (per instrument)	537	376
40-6082	Quality Report (per instrument)	537	376
40-6084	PQDif export license (per instrument)	537	376
40-6099	PQ Report license (per instrument)	537	376
National/Customized Analysis (PQ Secure)			
40-6077	PGC - Phillipine Grid Code	537	376
40-6083	FOR_2004_11_30_nr1557	537	376
40-6085	Australia - Transend	537	376
40-6086	Integral report	537	376
40-6090	CREG Report	537	376
40-6093	Celsa Flickerrapport	537	376
40-6095	PSE Report	537	376
40-6096	EIFS	537	376
40-6097	Powerlink Report	537	376
40-6098	TransGrid Report	537	376
40-6100	Oman Code	537	376
40-6101	NetCode, Holland	537	376
40-6102	RAECO Report	537	376
40-6103	MJEC Report	537	376
40-6104	ZS 387 Report	537	376
40-6105	NRS 048 Report	537	376
40-6106	NRS Management Report	537	376
40-6107	Oman Management Report	537	376
40-6109	ZS 387 Management Report	537	376
40-6110	Fingrid report	537	376
40-6111	Hitachi Management Report	537	376
40-6112	Machine learning Analysis	537	376
40-6113	ESO Management report	537	376
40-6114	PGC Management Report	537	376
40-6115	PSE Management Report	537	376
40-6116	Australia NER	537	376
40-6117	Litgrid Report	537	376
40-6118	Current Analysis Report (IEEE519)	537	376
40-6119	Hitachi MEA Report	537	376

National/Customized Analysis (PQ Secure WEB)

Data dependent

- All three situations are dependent on accurate, timely, continuous and reliable data on the quality and reliability of the voltage supplied to the customer.
- Continuous data is required because the customer loads are constantly changing and the utility is constantly changing the network

Power Quality Monitoring Challenges

- No single international standard covers all aspects of PQ and Power Reliability.
- Customers have varying requirements for PQ levels and different internal investment rules
- Very different from Kwatt hours revenue metering
- Customers have limited understanding of PQ issues and which are from utility and which are generated internally
- Many variables, simplistic approach doesn't work
- Metering to a Power contract is unique to each customer and utility situation

PQ (PR) parameters (2008)

utility /

- Outage
- Voltage Stability
- **Voltage sags (#1 issue)**
- Voltage distortion
- Flicker
- Current distortion from users
- Lightning damage or sags

/user

- Outage
- Voltage sags
- Voltage distortion
- Voltage Stability
- Flicker
- Voltage transients
- Grounding issues
- Current distortion
- Apparent PQ issues

Measurement to standards IEC 61000-4-30

- Class A. ED 3 Required for contractual applications

- Class B not recognized for use in Contractual applications but suitable for troubleshooting.
- Note: Class B removed in 20xx , Now Class A edition 3

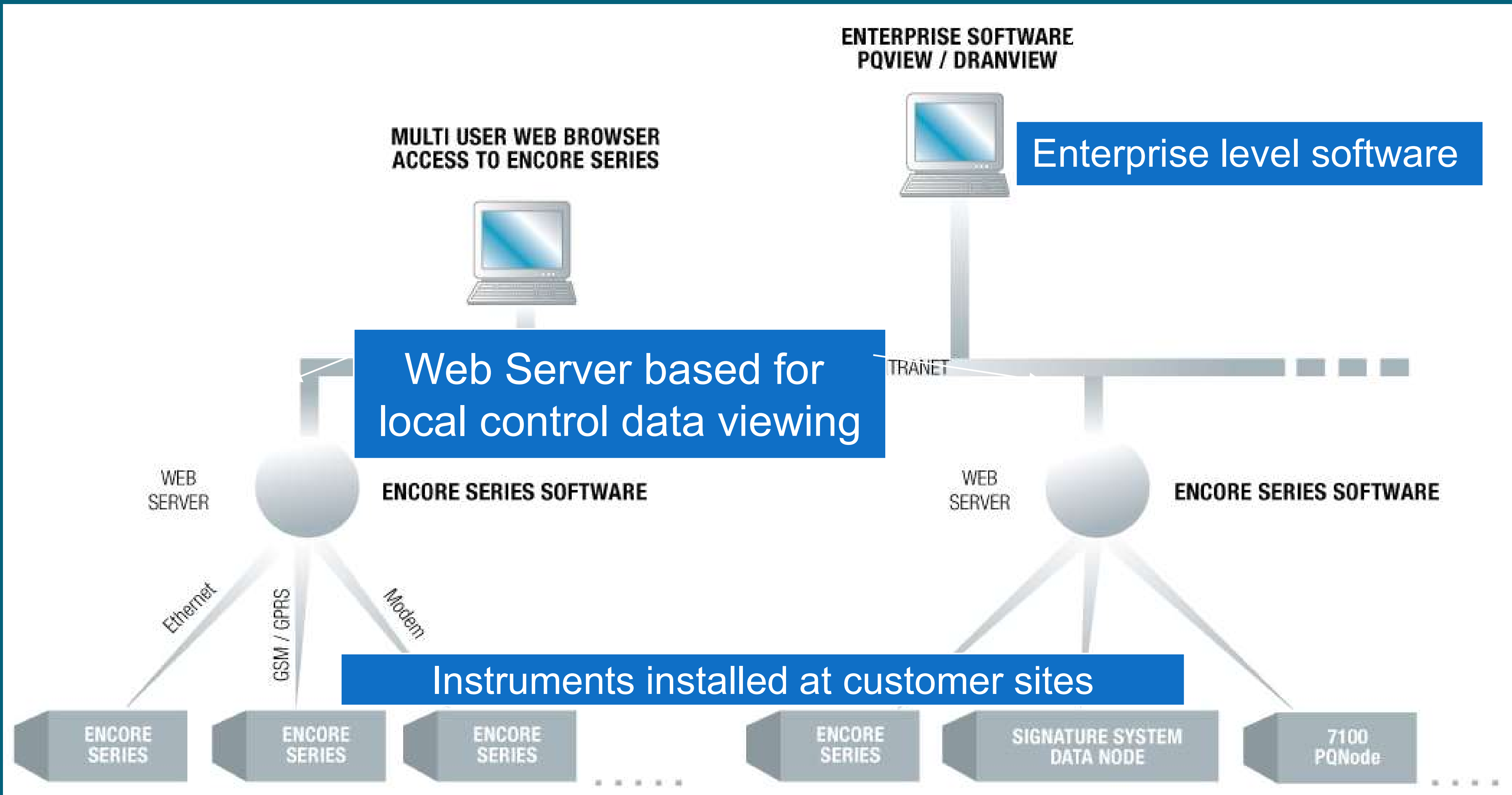
Voltage dips/sag classification Guidelines and Standards

- ITIC Includes transients and long duration events.
- Semi-47 Equipment standard sags only
- CBEMA Replaced by ITIC
- NRS 048-2
- KEMA guideline for most cost effective control
- IEC 61000-4-30 A.6

Overview of NRS 048-2

- The **NRS 048-2** standard is a key document used in South Africa to define and manage the **quality of electricity supply**.
- **Full Title**: *Electricity Supply — Quality of Supply Part 2: Voltage characteristics, compatibility levels, limits and assessment methods*
- **Issued By**: Technology Standardization (TSD), Eskom, on behalf of the South African Electricity Supply Industry (ESI)
- **Regulatory Role**: Used by utilities, customers, and the **National Energy Regulator of South Africa (NERSA)** to ensure consistent power quality.

Old technology Power Quality monitoring systems



Power Monitoring system advances

- IEC 61000-4-30 Class A ED3 defines the measurements and techniques in detail.
- Instruments can now monitor multiple simultaneous feeders. (lower costs)
- Network speeds allow near real time alarms and notification.
- PQ Analysis Software systems can prepare complex reports directly related to the contract automatically reducing engineering costs

Conclusions Customer Satisfaction

- Government Legislative actions are forcing more reporting of actual PQ and QOS conditions at customer site.
- Cooperative efforts appear to be the most successful when there is high quality data available
- Customers are only satisfied with QOS when they production is not impacted by electrical supply.
- Communication of actual power delivered is the most important part of improving customer satisfaction.

Next Gen Power Monitoring systems can improve Customer Satisfaction

- Automatic monthly reports showing level of PQ/QOS delivered compared to a standard or contract
- Continuous, accurate and timely data. What happened, when (exactly)it happened and will it happen again?
- Utility communicates that is responsive to customers by regular communications on corrective or preventative action
- Trends are identified, evaluated and changes to prevent unexpected events, failures etc

QOS VS PQ (Except Harmonic distortion)

- **Quality of supply** is determined by monitoring all PQ parameters of the Power Quality at the Point of Common Coupling (PCC as defined by IEEE 519 2023) compared to International standards or local regulation.
- Power Quality is determined by the impact of existing power quality at an internal node at user voltage level (VS power supplier voltage level) The impact of PQ "situations" determines the acceptability of the PQ.
- IE if a PQ situation (event) impacts production the user has the responsibility of determining the source and most cost effective method of mitigation

Does AI influence PQ/QOS monitoring systems? Should it?

- AI has had a presence in the PQ data collection for more than 30 years???
  - 1. Locating faults on electrical networks?
  - 2. Determining the location of the fault upstream or downstream? What is the accuracy/reliability?
  - How could the location information be improved?

- Other possibilities for AI
  - ??

AI contributions to automatic reports for QOS monitor reports

- Document the voltage level of the root cause fault report
- Store and report the frequency of occurrence
- Suggestions?

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