



Customer Protection and Regulation - a quality assurance framework for mini-grids

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Purpose: Provide structure and transparency for mini-grids sector, based on successful utility models, while also accounting for the broad range of service levels required to meet the needs of various segments of the off-grid consumer base

Goal: Lay the technical and business foundation for successful business models in the mini-grids space

Standards – a Mental Model



Three important elements about standards:

1. Insures safety and interoperability
2. Replicability/standardization of a product
3. The product is built around the standard

Technical Mini-Grid Standards

- Project Planning (loads assessment)
- Level of Service (power availability, quality, & reliability)
- Equipment specifications (PV, inverters, wind turbines)
- Distribution system (poles, transformers, cable)
- Metering technology (power drops and meters)
- Household wiring (wiring, lighting)
- Interconnection (mini-grid to the main grid)
- Cyber Security
- Reporting

Coordination of Standards for Mini-Grids

Isolated power systems incorporate multiple standards:

- 1) Power system equipment – Various IEC and National standards exist for most components (PV, wind, storage, generators, ...)
- 2) Mini-grids systems and deployment:
 - IEC-62257 series
 - Building on “Beyond Connections, Energy Access Redefined”, Electric Sector Management Assistance Program (ESMAP) of the World Bank, and Sustainable Energy for All (SE4All)
- 3) Distribution system – National standards or WB Guidelines
- 4) Home wiring – National standards or IEC-62257
- 5) Levels of service – the Quality Assurance Framework for minigrids
 - ANSI C84.1, IEEE 1159, & national standards
- 6) Project planning – the Quality Assurance Framework for minigrids
 - Building on “Beyond Connections, Energy Access Redefined”

Additional Efforts:

- IFC/Tanzania Bureau of Standards/NRECA – Technical standards for isolated power systems – include many of the above & cyber security
- Power system implementer certification – ISP & national programs

Elements of the QA Framework

- 1. Levels of service** tailored to different tiers of consumers, including appropriate thresholds for:
 - Power quality
 - Power availability
 - Power reliability
- 2. Accountability framework**
 - Clear process for verification of power delivery through trusted information to consumers, funders, and/or regulators
 - Provides defined assessment and reporting protocol for operators



LEVELS OF SERVICE

Levels of Service for Isolated Systems

- 1. Power Quality** – The power that is provided is of a reasonable or defined quality to safely provide the energy needs of the consumers
 - Voltage, frequency, and distortion etc.
- 2. Power Availability** – Is the power provided in the amount that meets expectations and available with the duration that has been specified
 - Hours of service, power and energy levels ...
- 3. Power Reliability** – Is the power provided with enough reliability to meet consumer needs
 - System Average Interruption Frequency Index (SAIFI)
 - System Average Interruption Duration Index (SAIDI)

Voltage Unbalance (AC)

Transients (AC & DC)

Short Duration Variations (AC & DC)

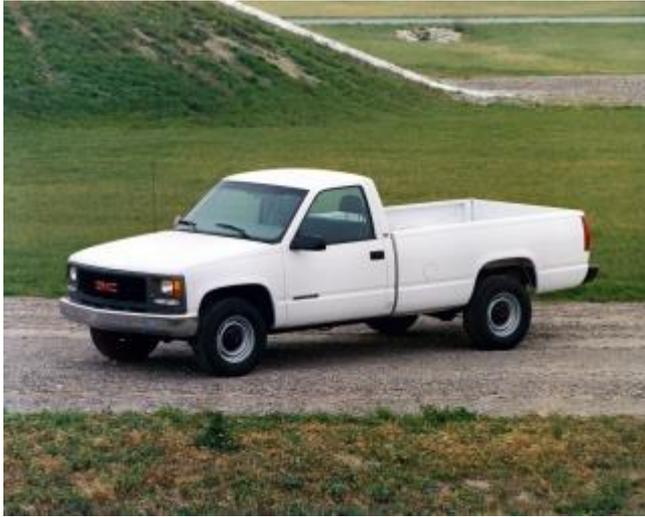
Long Duration Variations (AC & DC)

Waveform Distortion (AC & DC)

Voltage Fluctuations/Flicker (AC & DC)

Frequency Variations (AC)

Power Quality for Rural Energy – a Mental Model



- A heavy duty pick-up truck is a good mental model of “grid parity” power. It’s a great to have but expensive to own and operate.
- Most people in rural communities don’t have the need for grid parity power supply, a moped is more appropriate and much lower cost.
- Provides three levels of service quality; grid quality as a high and defined public safety as a low.

Power Availability

- The amount of energy services being provided to specific customers based on need, ability to pay, and other factors
- Availability ties together the parameters that define how much energy service is to be provided to a specific customer based on their ability and willingness to pay for that service. Expected to change over the life of the utility/customer relationship.
- **There are three main criteria driving Power Availability:**
 1. **Power:** Maximum draw in Amps or Watts
 2. **Energy:** Total energy available (kWh) over a defined time period (month, year)
 3. **Time of day service:** For what hours of the day is power available (hours per day) and then if services is provided during specific times

Represents how well the power system provides power during times when power should be provided.

- **Unplanned power outages**
 - System Average Interruption Frequency Index (SAIFI)
 - System Average Interruption Duration Index (SAIDI)
- **Planned power outages**
 - Planned System Average Interruption Frequency Index (P-SAIFI)
 - Planned System Average Interruption Duration Index (P-SAIDI)

Accountability Framework

- 1. Consumer Accountability** defines, demonstrates, and validates that a specific level of service is being provided to a customer
 - Level of Service verification
 - Service Agreement
- 2. Utility Accountability** allows funding or regulatory organizations to understand if the system is safe and providing contracted service
 - Technical reporting
 - Business reporting
 - Reporting template

Level of Service Verification

- Ability to record energy consumption
- Ability to record hours of service at service drops
- Ability to check voltage levels at service drops
- Implementation of periodic, random, and documented voltage surveys to ensure proper quality of service

Service Agreement

- Defines applicable power quality standards in place
- Identifies what type of investigation is warranted based on complaints
- Describes how to address power quality impacts caused by the customer vs. those caused by the power system (utility)

Utility Accountability Framework

Provides a defined and secure methodology for utilities to provide relevant information to regulators and project financiers, essentially the information that will allow a good understanding of the utility business

Information about the performance of the utility

- Technical Reporting: Measurements addressing system performance, energy usage, operational issues
- Business Reporting: Payment collection rates, electrification rates, customer characteristics, service calls and safety concerns, etc.

Reporting Template

- Standard document or procedure that provides performance information to the funder/regulator, providing consistency across energy platforms and projects.

A Quality Assurance Framework for Mini-Grids

Technical Report Available: <https://cleanenergysolutions.org/qaf>

Implementation guide to be published shortly

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