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Smart Inverter Grid Support Functions *and* *Potential Impact on Reliability*

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Smart Inverters

WEIL Western Electric Industry Leaders

"There is an immediate need for new solar to be fitted with "smart inverters" to provide necessary voltage support to integrate effectively and prevent costly renovations and reliability impacts"

– *Western Electric Industry Leaders, Aug 2013*

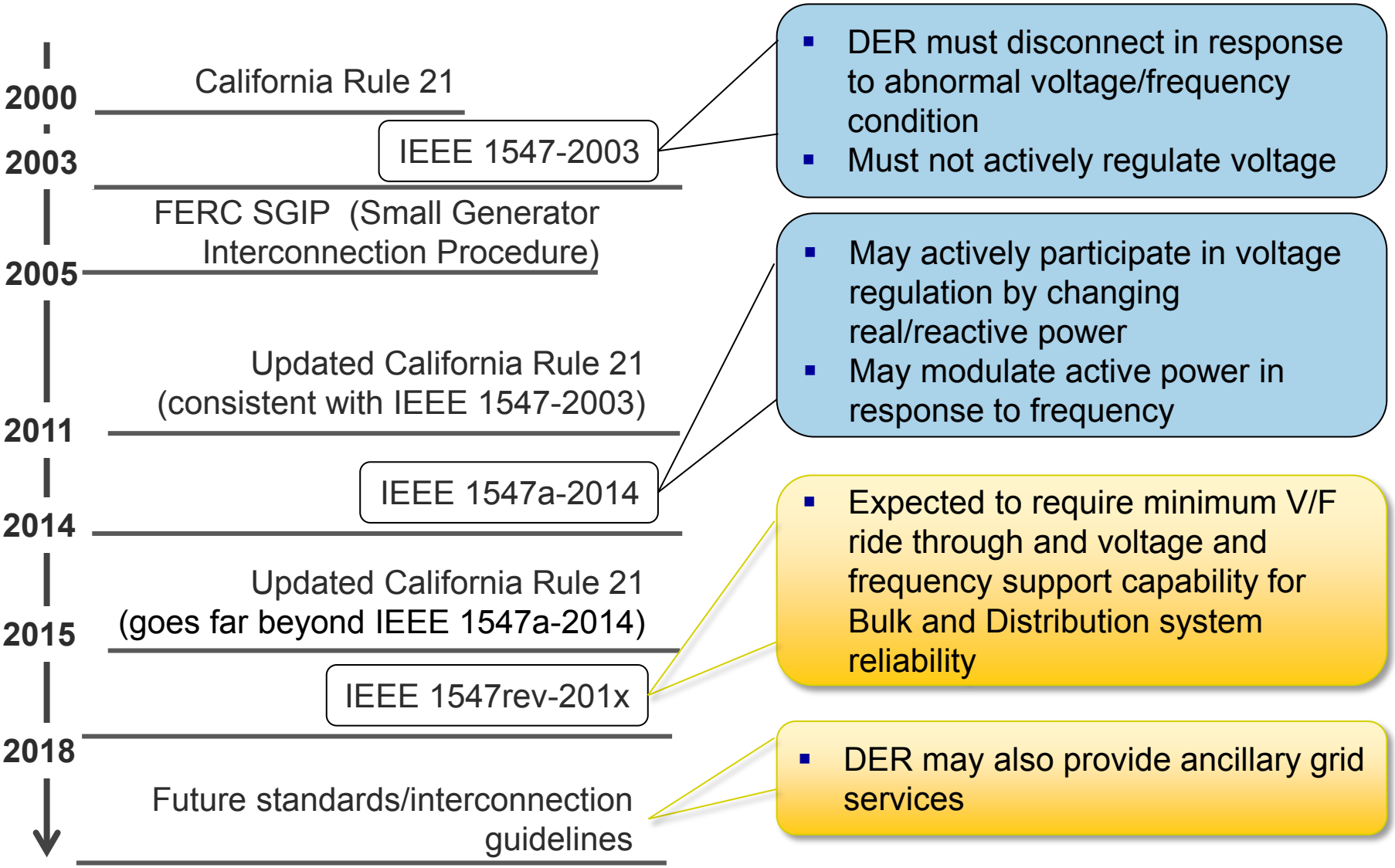
What is a Smart Inverter?

- *Inverter that can modify it's output to better integrate into the grid*

- *Autonomous response to V/F or responding to communicated signal*

DER Interconnection Standards and Guidelines

IEEE 1547 and others are recognizing the importance of DER providing grid support …



Smart Inverter Grid Support functions

- Remote ON/OFF
- Power Factor Control
- Volt / var
- Volt / Watt
- Frequency /Watt
- Reactive Power Control
- Low/ High Voltage and Frequency Ride Through
- Power Curtailment

Go to www.epri.com and search **3002002233**

IEC

IEC 61850-90-7

IEC 61850 Object Models for Photovoltaic, Storage, and Other DER inverters

Draft Version 10a

dnp Distributed Network Protocol

DNP Application Note AN2013-001
Version 2013-01-14

DNP3 Profile for Advanced Photovoltaic Generation and Storage

1 Introduction

This document describes a standard data point configuration, set of protocol services and settings – also known as a *profile* – for communicating with photovoltaic (PV) generation and storage systems using

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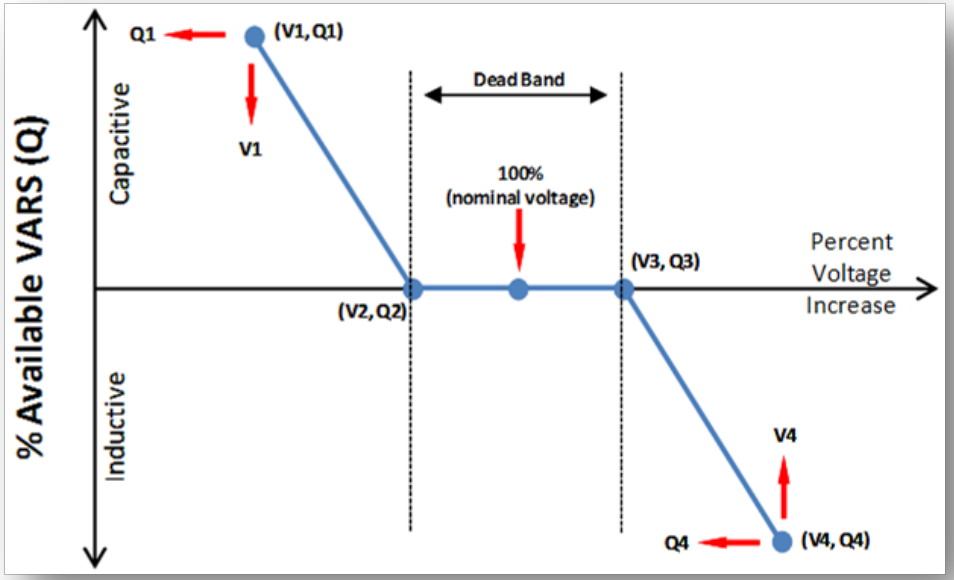
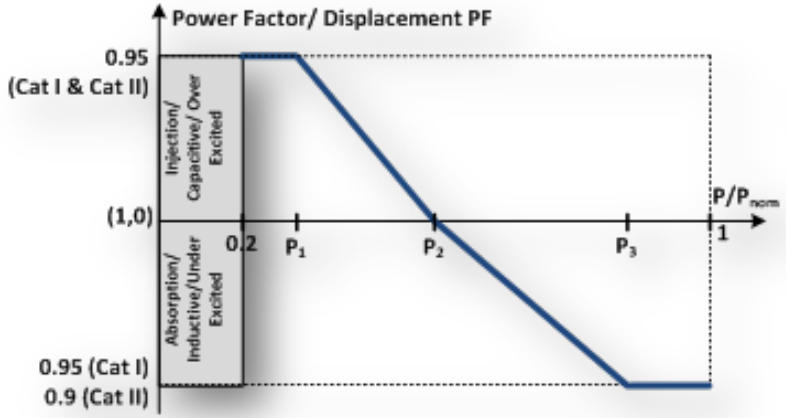
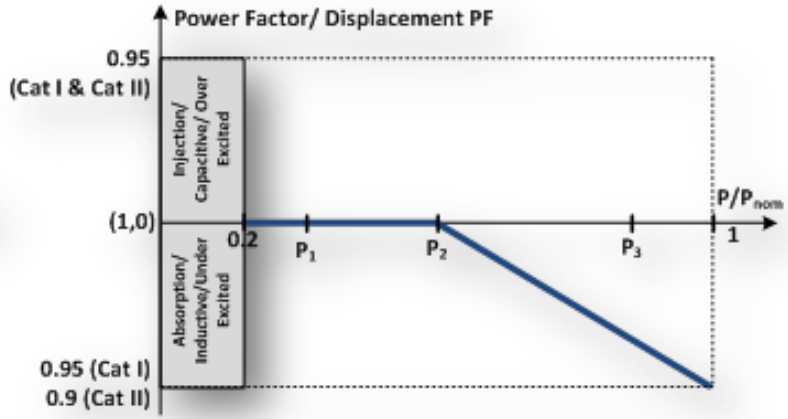
Voltage Regulation by Reactive Power Support

- Power factor mode
- Volt-var mode
- Active power-power factor mode (Volt/Watt)
- Reactive power mode

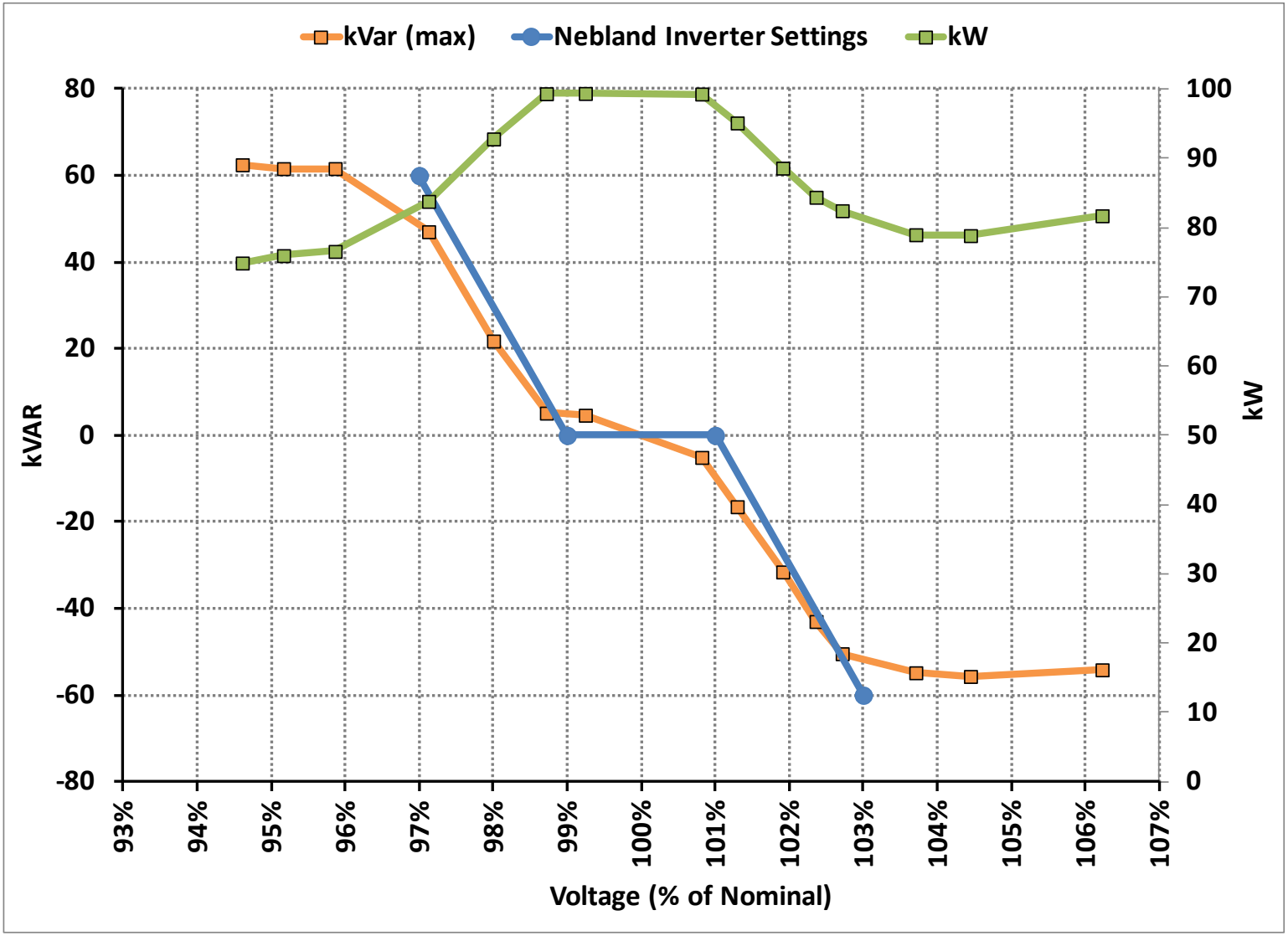




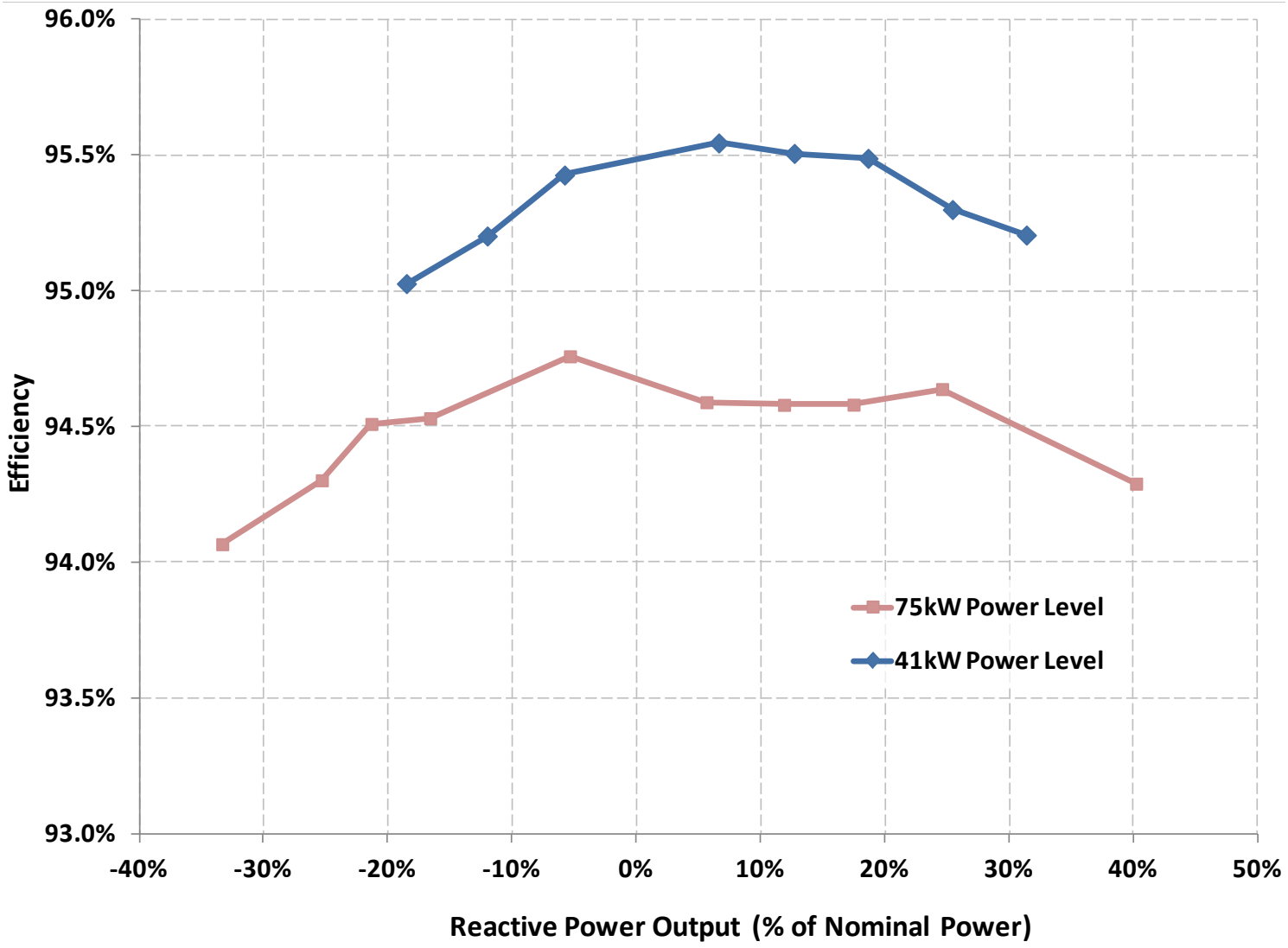


Volt-Var Function

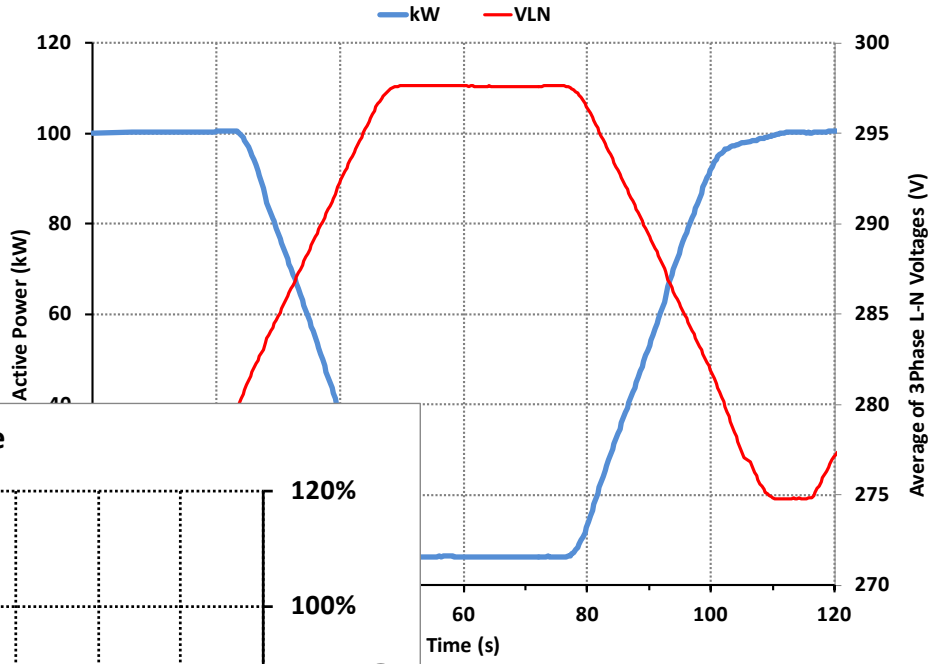
Max Var (vars before watts) Mode; Inverter was operating at rated power

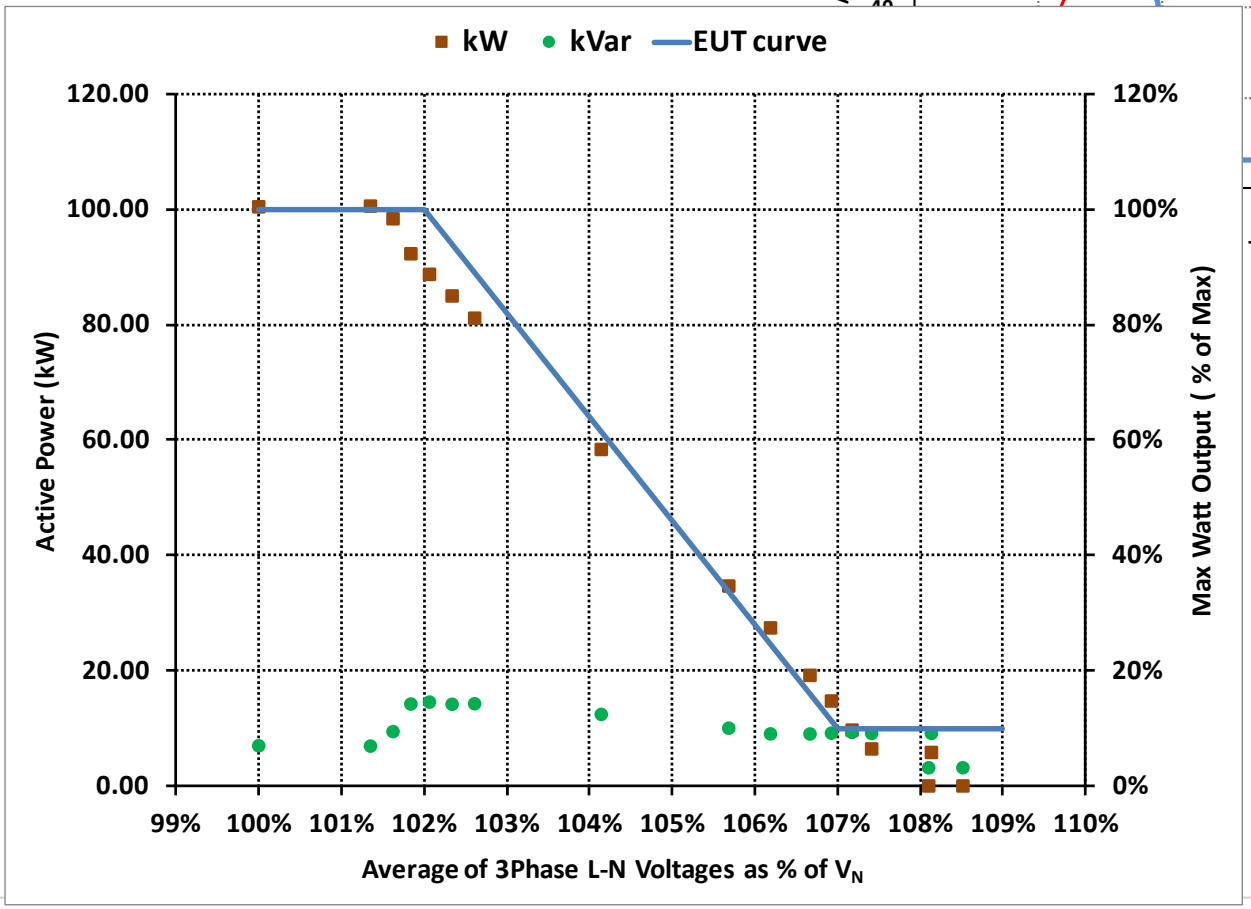


Reactive Power Support – Impact on Efficiency



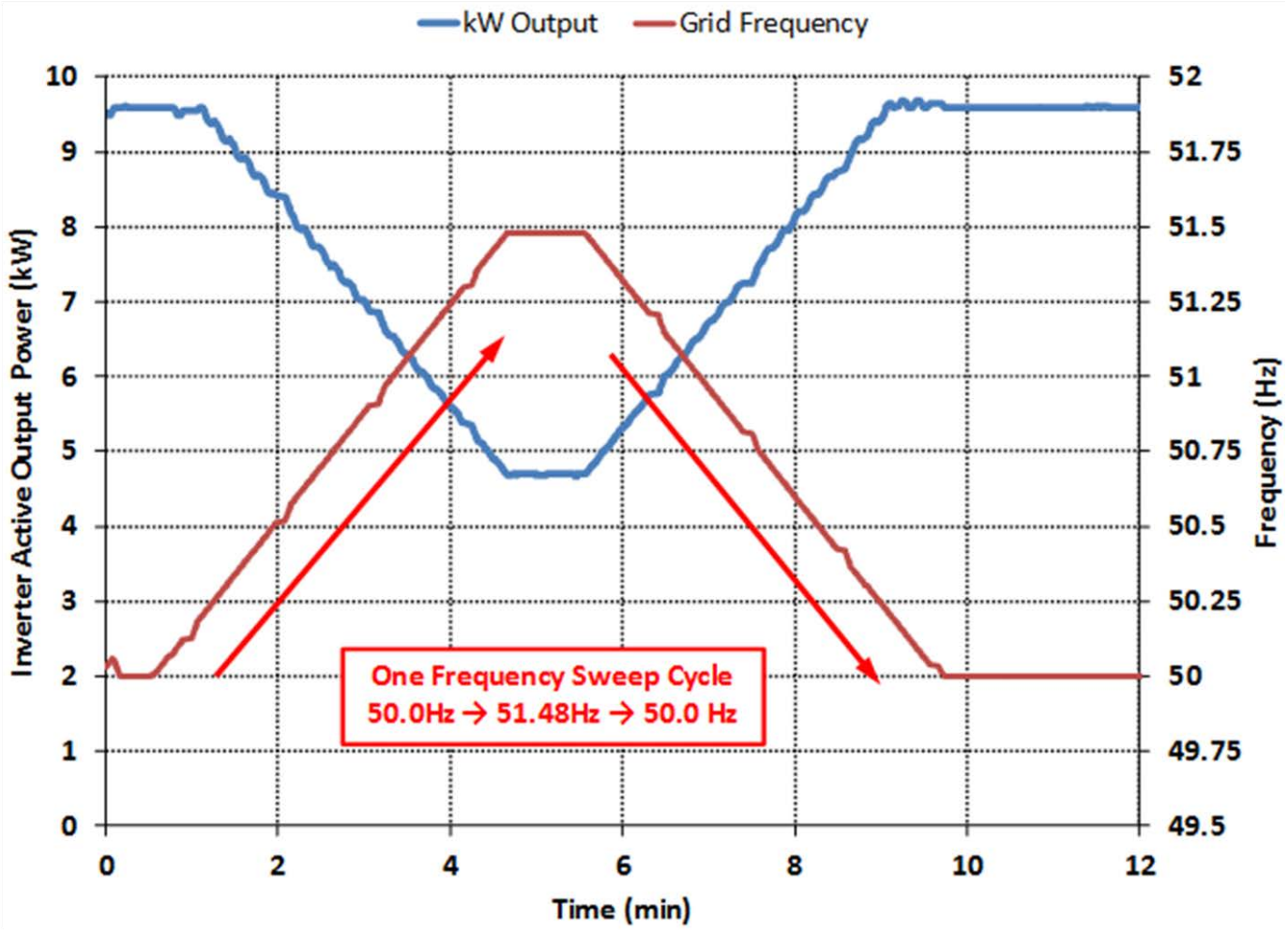
Volt-Watt Function



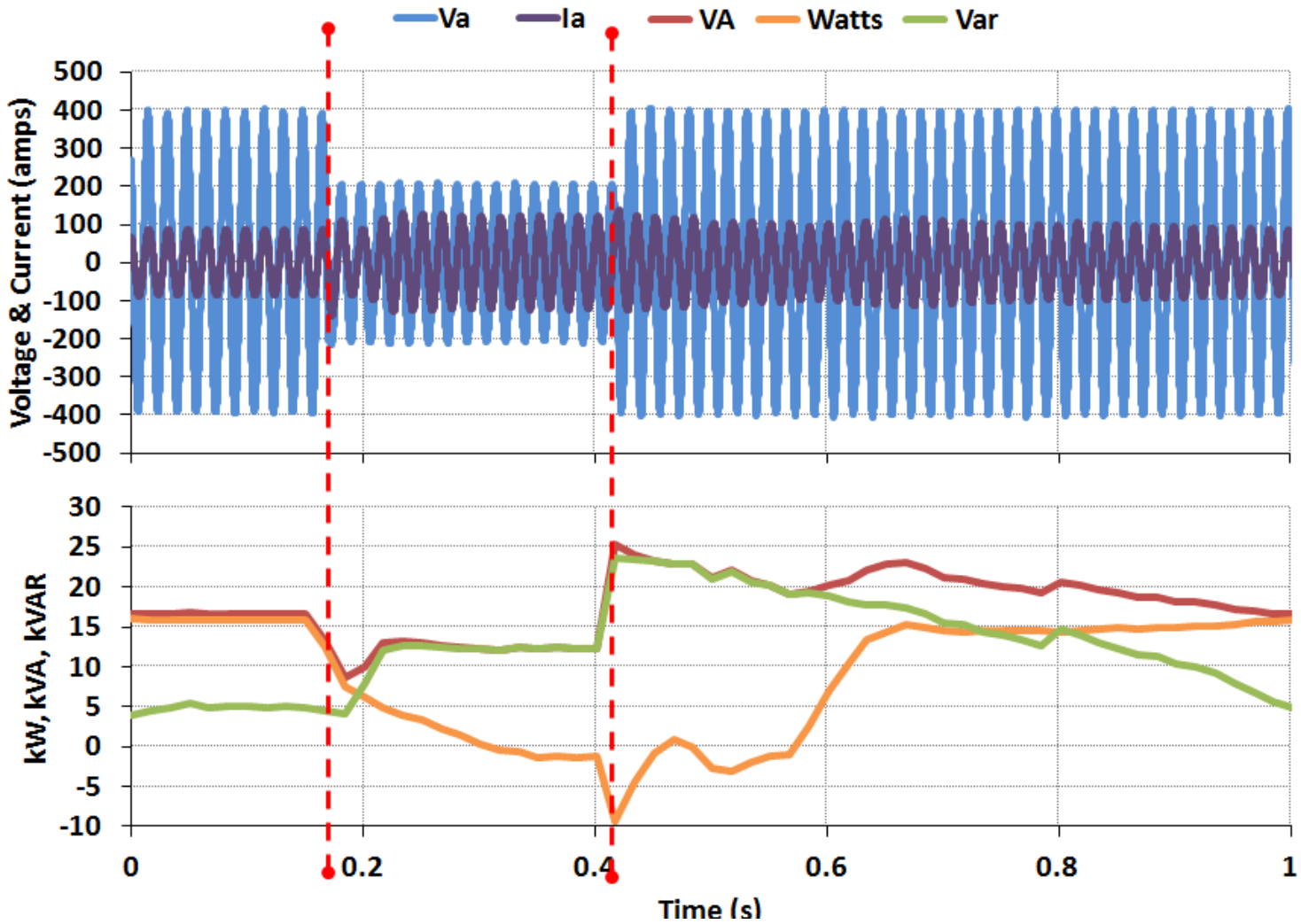


Frequency-Watt Function

Voltage Step: V_N to Target Voltage (up to 108.6% of V_N)



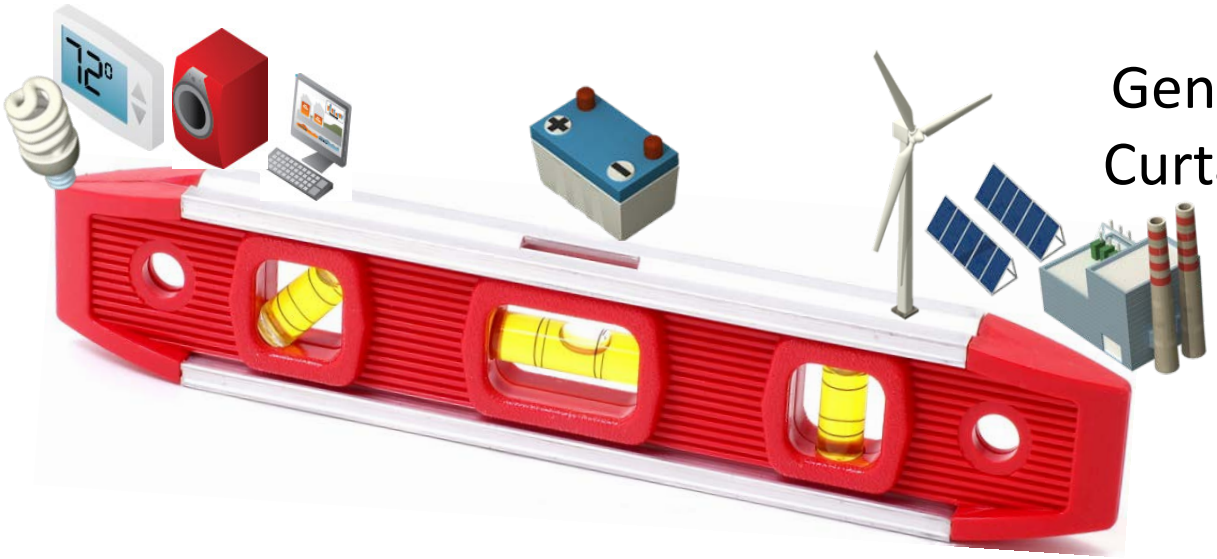
Low Voltage Ride Through



Active Power Limiting/ Curtailment

100% → In 6 seconds → 25% → In 4 seconds → 75%

Demand Response

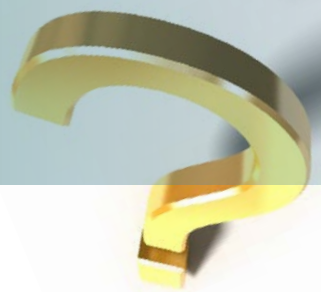


Generation Curtailment

Potential Impact on Inverter Reliability

- Reactive power support for voltage regulation – increased loss/ increased operating temperature
- Active participation in voltage regulation through volt-var mode may increase period of inverter operation at higher current magnitude – potential impact on device life span
- Providing reactive power support during night time will significantly increase the operating hours
- Industry practice of higher PV array DC to inverter AC ratio will also require the inverter to operate at higher current level for longer duration

Questions



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