IPC-E-20-30
Staff Workshop

November 10, 2020

Introduction

Idaho Power Company

Jared Ellsworth	Transmission, Distribution & Resource Planning Director
Marc Patterson	Senior Engineer, Planning, Engineering and Construction
Connie Aschenbrenner	Rate Design Senior Manager

Agenda

1. Smart Inverters
   - Voltage control
   - IEEE 1547
2. Non-Export Option
   - Proposed interconnection requirements
   - Non-export control system
3. Energy Storage Devices
   - Proposed interconnection requirements

Key Objective

- Address the technical aspects surrounding:
  1) Smart Inverters and IEEE 1547 for distributed energy resources (“DERs”)
  2) The proposed Schedule 68 interconnection requirements for customer’s installing DERs
- Open to questions and discussion throughout

IEEE 1547 and 1547.1

IEEE 1547 Standard

IEEE 1547 was the first of a series of standards developed by Standards Coordinating Committee 21 on Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage (SCC21) concerning distributed resources interconnection

Voltage Regulation

IEEE 1547 has been amended in response to a widely expressed need to make changes to subclauses related to voltage regulation, voltage response to Area EPS abnormal conditions, and frequency response to Area Electric Power System ("EPS") abnormal conditions

Test Procedures

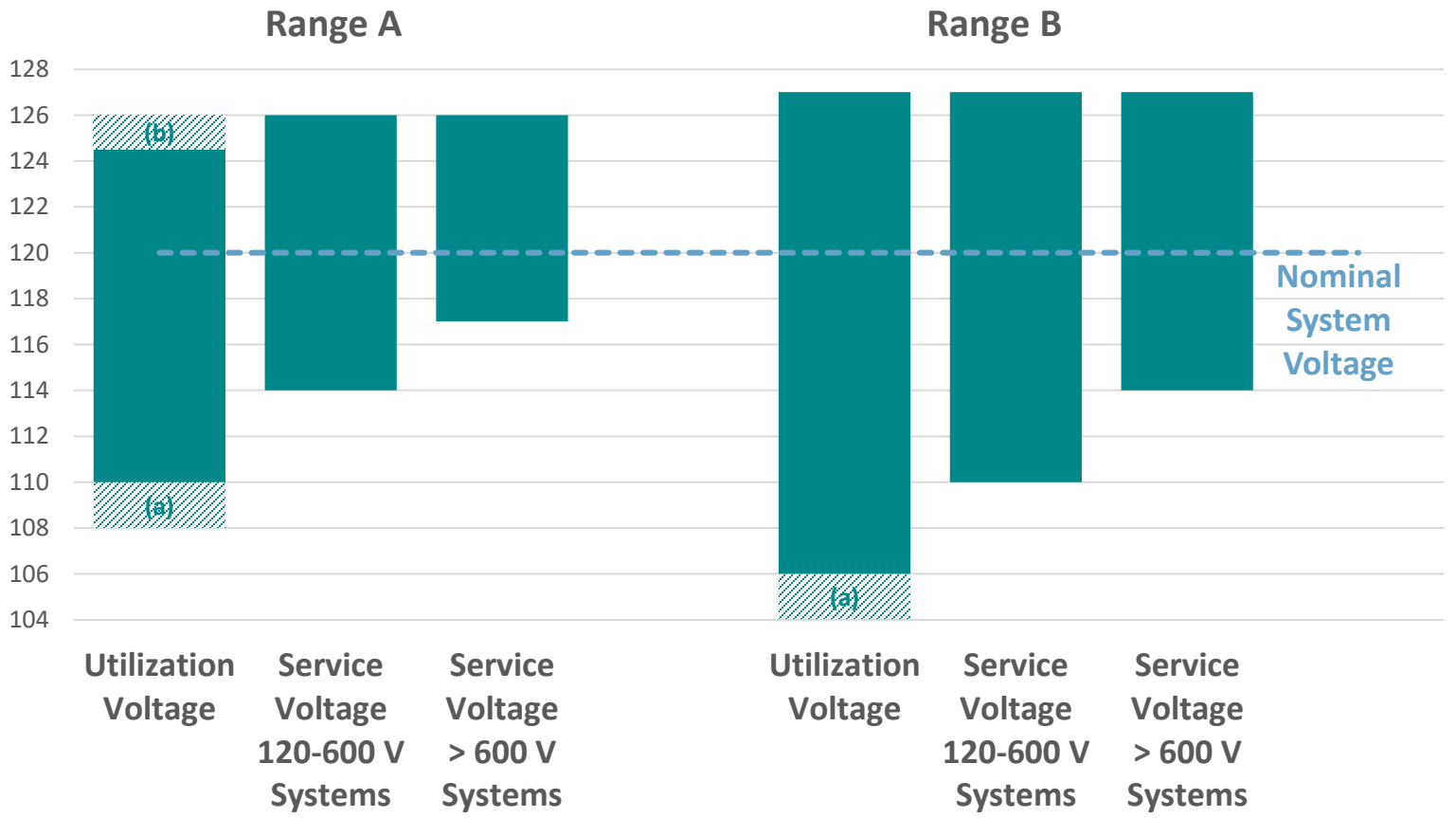
IEEE 1547.1 provides conformance test procedures for equipment interconnecting DERs with the Area EPS.

ANSI C84.1

Overview

- ANSI C84.1 establishes the nominal voltage ratings and operating tolerances for 60-Hz electric power systems above 100 volts up to a maximum system voltage of 1,200 kV (steady state voltage levels only)
  - Range A: Normal operation
  - Range B: Abnormal operation

Range A & Range B Utilization and Service Voltage



Notes:
(a) The shaded portions of the ranges do not apply to circuits supplying lighting load.
(b) The shaded portion of the range does not apply to 120 V – 600 V systems

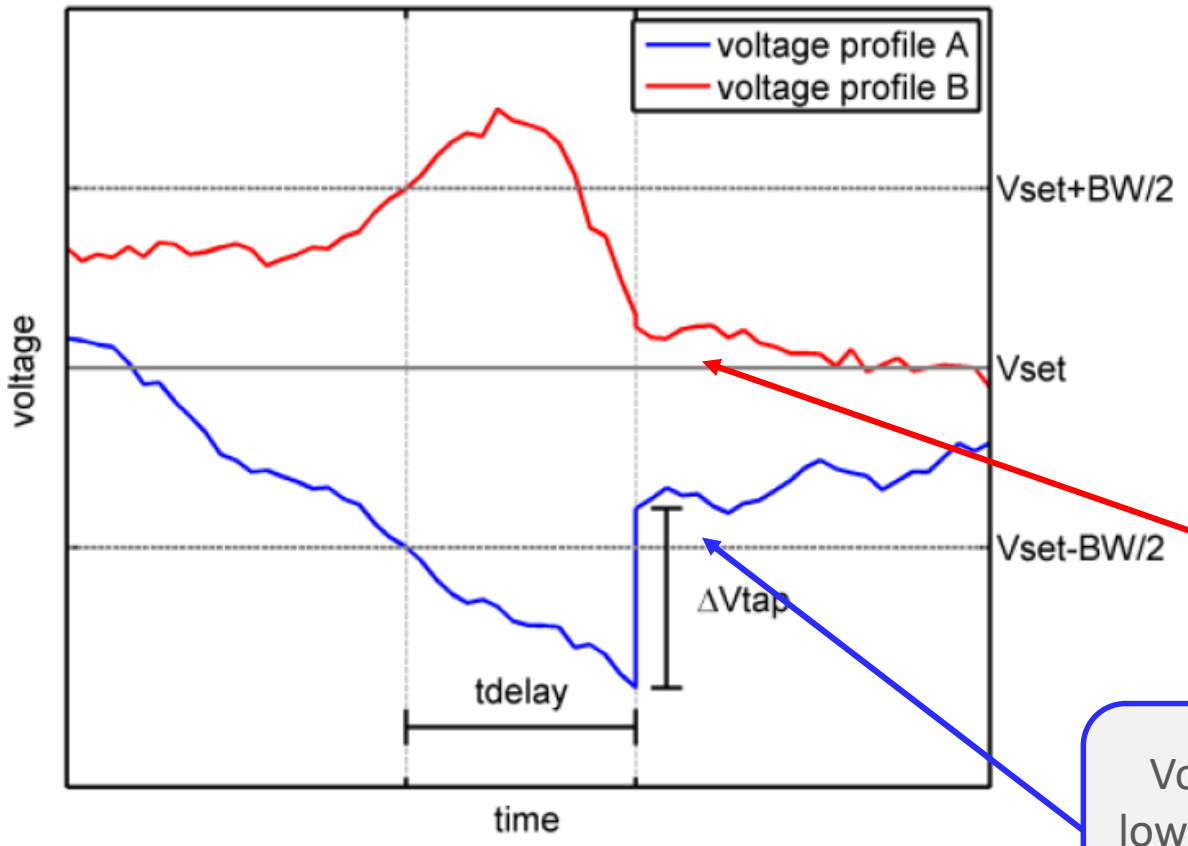
Voltage Deviation & DER

Voltage Deviation and DER Mitigation Overview

- In most cases, it is the customer with DER that creates the voltage deviation, especially in locations with high levels of penetration
- Rule K, Section 4: “The customer is solely responsible for the selection, installation, and maintenance of all electrical equipment and wiring (other than the Company’s meters and apparatus) on the load side of the Point of Delivery.”
- The customer with a DER can most cost effectively mitigate the deviation through the installation of a smart inverter
- The alternative would be more costly distribution system upgrades required to allow continued or expanded operation of the customer-generators

Load Tap Changer ("LTC")

Illustration of LTC Control



LTC Operation

- The LTC Control has a voltage set point, a voltage bandwidth, and a time delay
- Comparative study of LTC algorithms CIRED2014 – simulated for high penetration distribution feeder

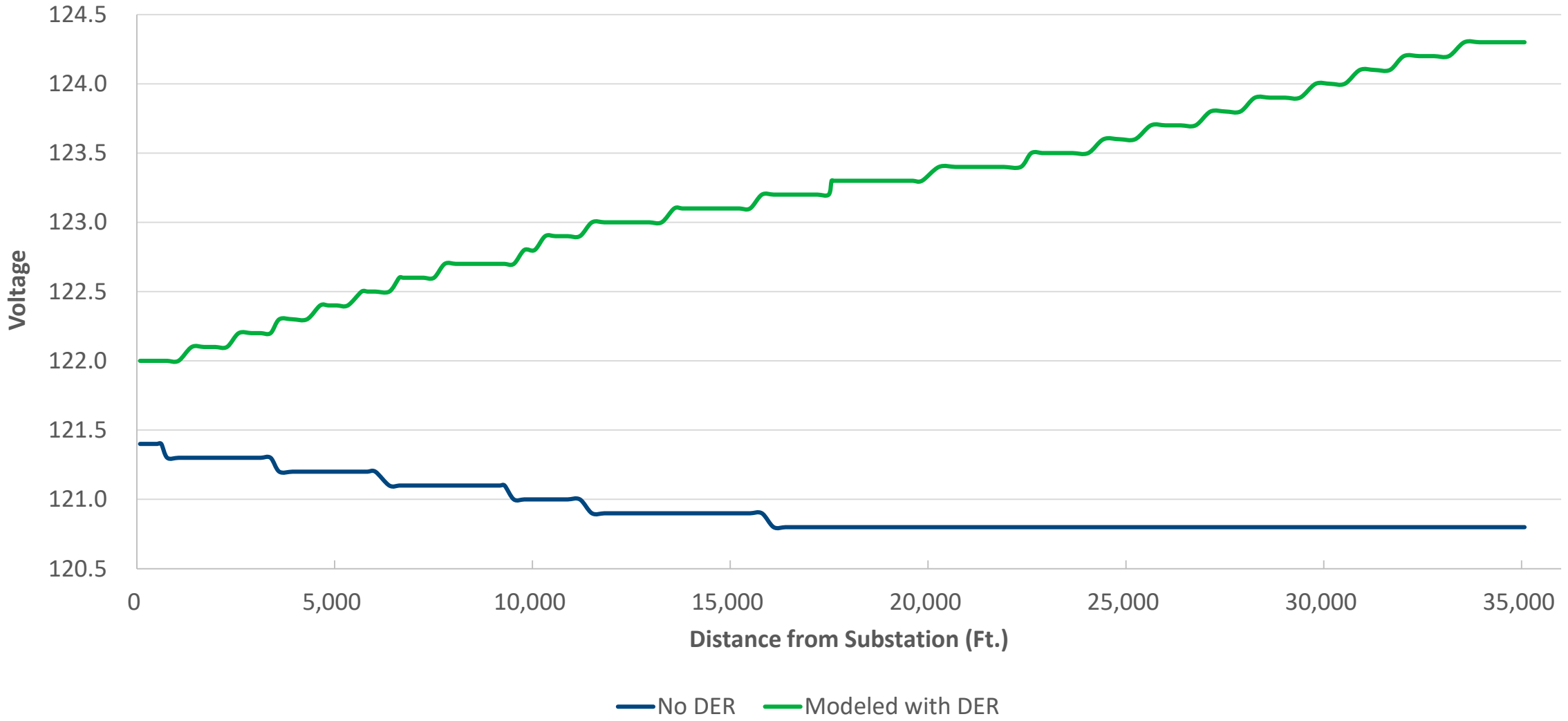
Voltage profile B is above the upper limit, but returns before the time delay – no LTC operation

Voltage profile A is below the lower limit, longer than the time delay – LTC operation occurs

Source: CIRED Workshop – Rome, June 11-12, 2014, Paper 0376

DER Feeder Voltage Rise

1 Smart Inverters



Normal & Abnormal Operating Performance Categories

Normal Performance Categories

- Categories A and B for voltage regulation performance and reactive power capability requirements

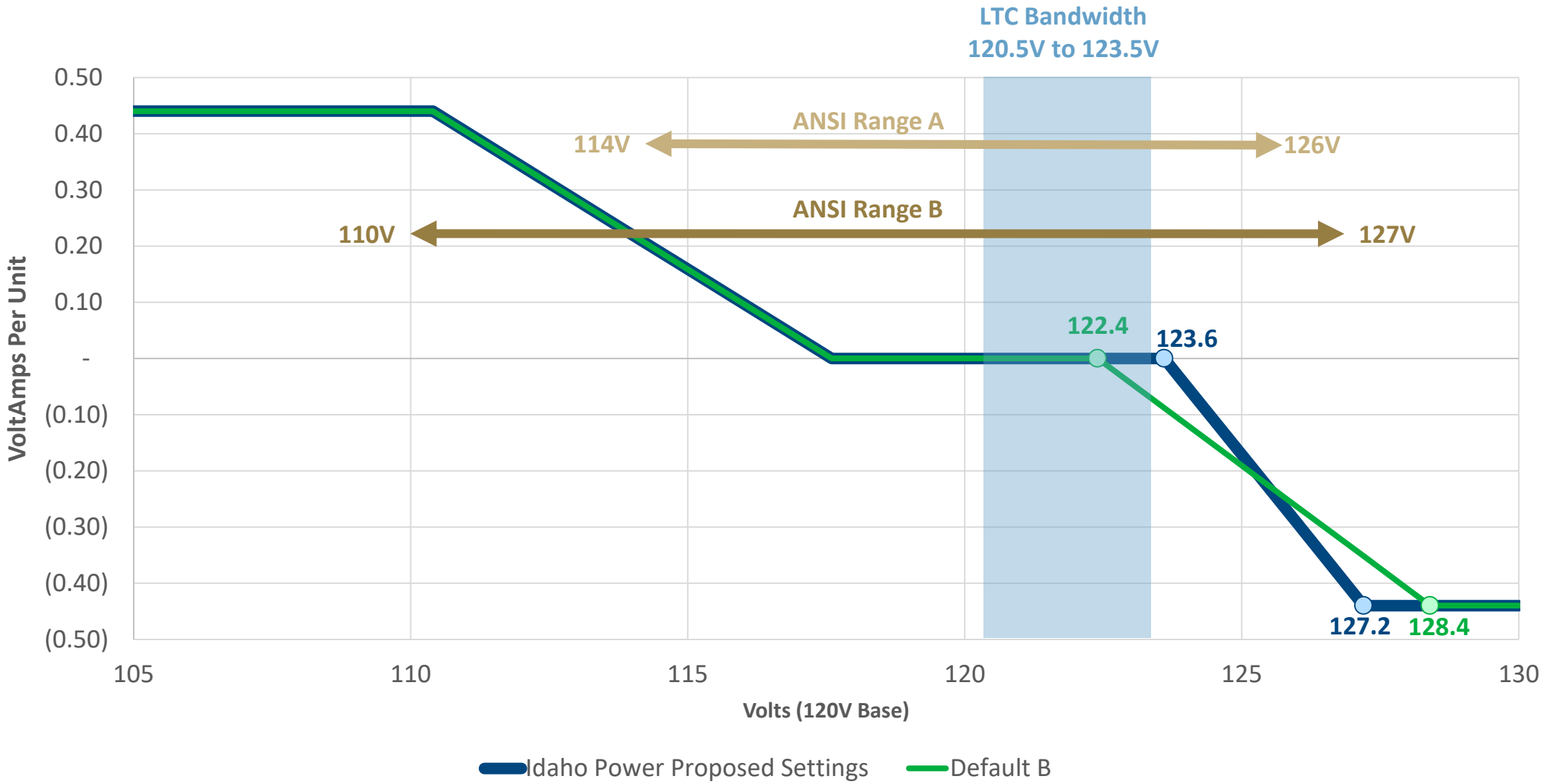
Category B

- Reactive power requirements to regulate voltage for DERs that are inverter based with inherent power output variability (e.g., solar)

Abnormal Performance Categories

- Categories I, II, and III for disturbance ride-through requirements

Distribution Voltage Operation

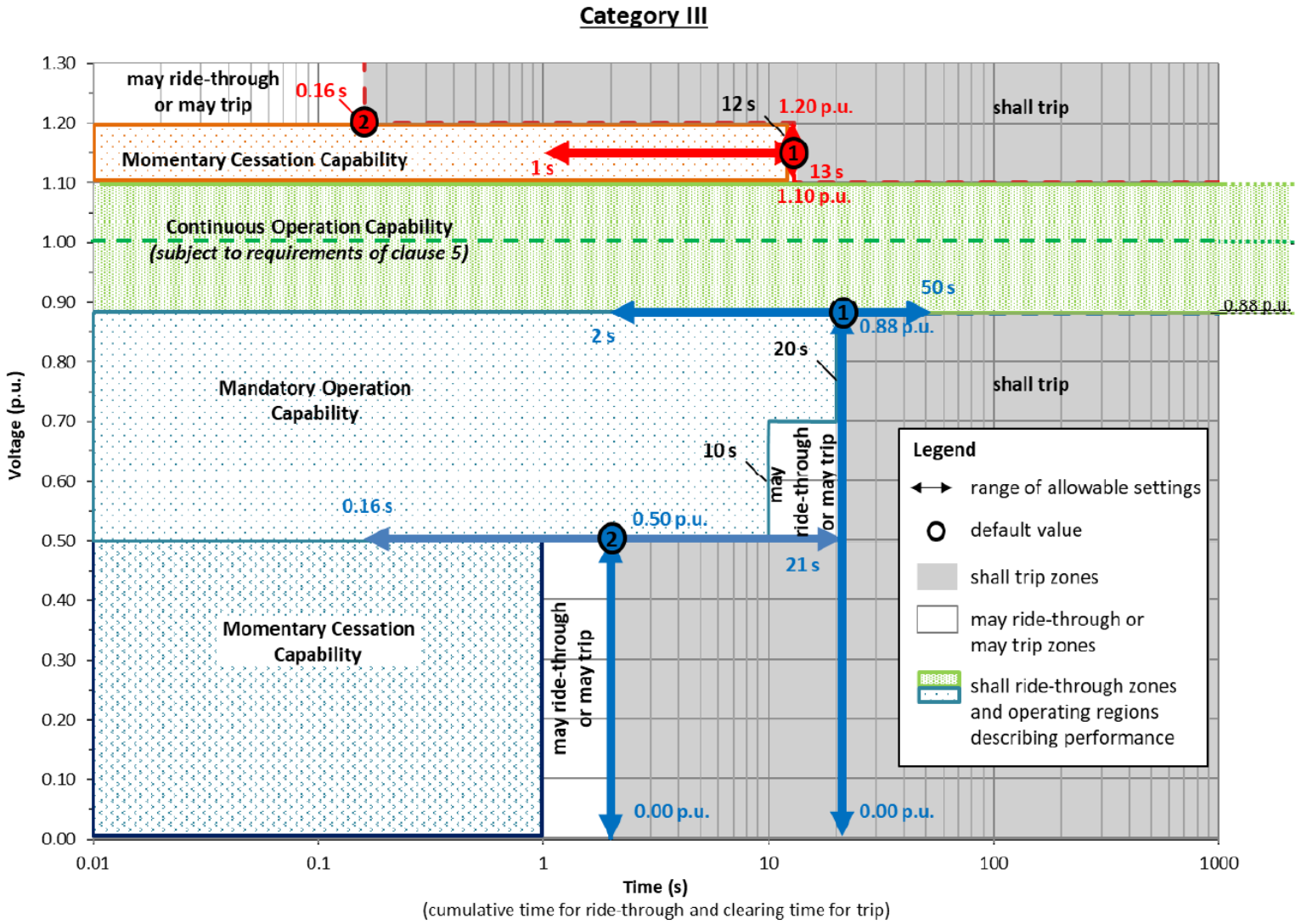


Abnormal Operating Performance Categories

- **Category I**
  - Based on minimal bulk power system (BPS) reliability needs
  - Reasonably attainable by all DER technologies that are in common use today
- **Category II**
  - Performance covers all BPS reliability needs
  - Coordinates with the existing BPS reliability standard, NERC PRC-024-2 [B26]
  - Developed to avoid adverse tripping of bulk system generators during system disturbances
- **Category III**
  - Provides the highest disturbance ride-through capabilities
  - Intended to address integration issues such as power quality and system overloads caused by DER tripping in local Area EPS with high levels of DER penetration
  - Provides increased bulk power system security by further reduction potential loss of DER during bulk system events

Category III

- Smart Inverters
- 0.88 – 1.10 per unit (“p.u.”) continuous operating range
- High-voltage & low-voltage “ride-through” requirements
- Disconnection “trip” requirements



Non-Export Option

General Requirements

- Submit a completed application to the Company to interconnect non-exporting system
- Feasibility Review to determine the capability of the Company's electrical system to incorporate the DER
- All DER would be subject to applicable provisions of Schedule 68
  - Construction and operation of interconnection facilities and disconnection equipment
  - Inverter settings, metering equipment, protection equipment, and non-export control system

Non-Export Application Process

Less than 3 MVA	3 MVA or Greater
Submit Application	Submit Application
Feasibility Review	Study Agreements
Submit System Verification Form	Customer Generator Interconnection Agreement
Complete Interconnection	Complete Interconnection

Non-Export Technical Requirements

2 Non-Export Option

The Non-Export generation facility must utilize one or more of the following:

1. **Advanced Functionality**: Prevent unpermitted export
   - Internal transfer relay, energy management system, or other customer facility hardware or software system(s) is required.

2. **Reverse Power Protection**: Ensure export power is limited
   - Default setting for protective function is 0.1% (export) of DERs total nameplate capacity, with maximum 2.0 second time delay

3. **Minimum Power Protection**: Ensure a minimum amount of power is imported at all times
   - Default setting shall be 5% (import) of DERs total nameplate capacity, with maximum 2.0 second time delay

System Protection

2 Non-Export Option

Rotating Machines

500 kVA or less

May not require additional system protection

500 kVA – 3 MVA+

System protection will be required

Inverter-Based*

Less than 3 MVA

May not require additional system protection

3 MVA+

System protection will be required

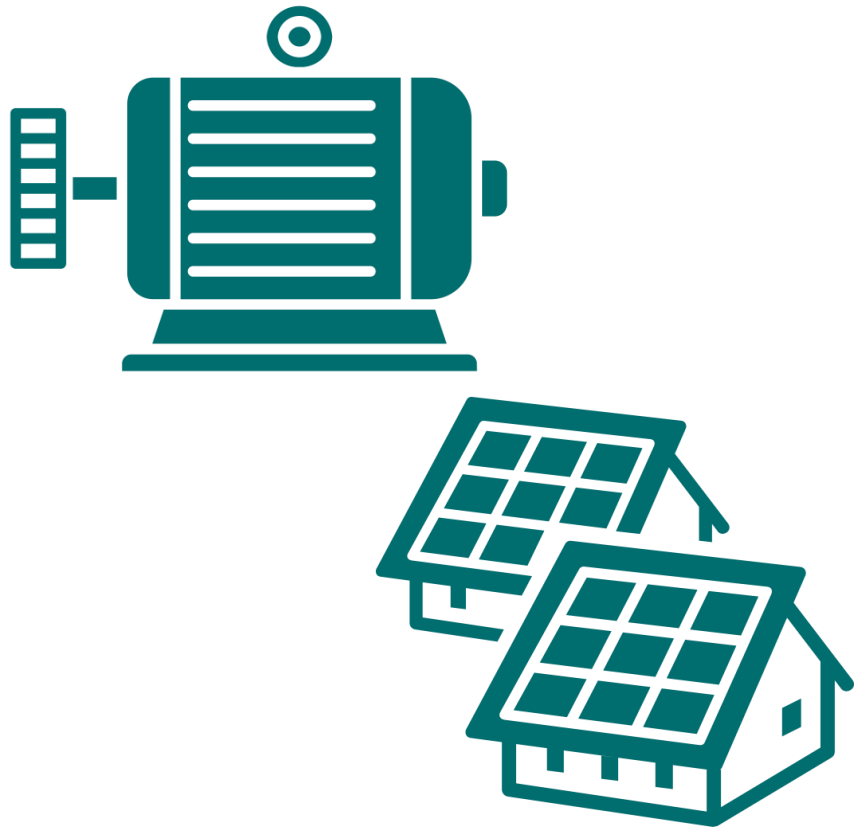
**UL-1741 and IEEE 1547 compliant inverter required*

Telemetering

2 Non-Export Option

Telemetering Requirements for Non-Export

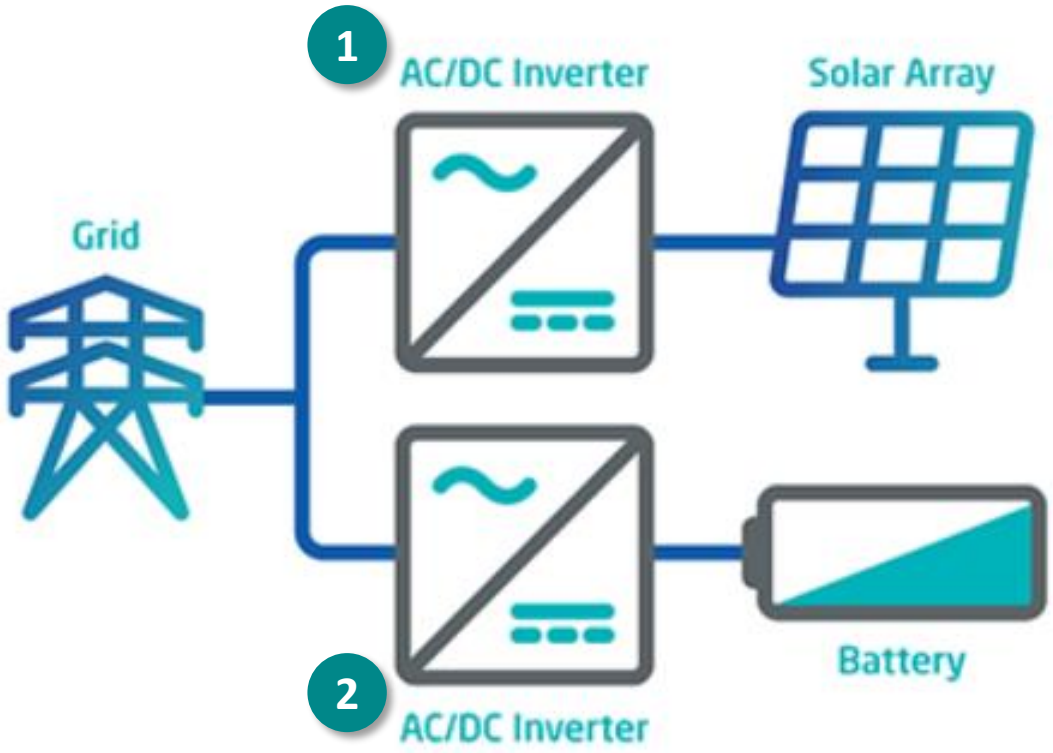
- Instantaneous bi-directional analog real-power and reactive-power flow information must be telemetered directly to the operations center specified by Idaho Power
- Idaho Power shall own and maintain the SCADA devices at the facility owner's expense
- The facility owner shall provide a telecommunications data circuit to the operations center designated by Idaho Power
  - Idaho Power shall specify the communications protocol for the data circuit



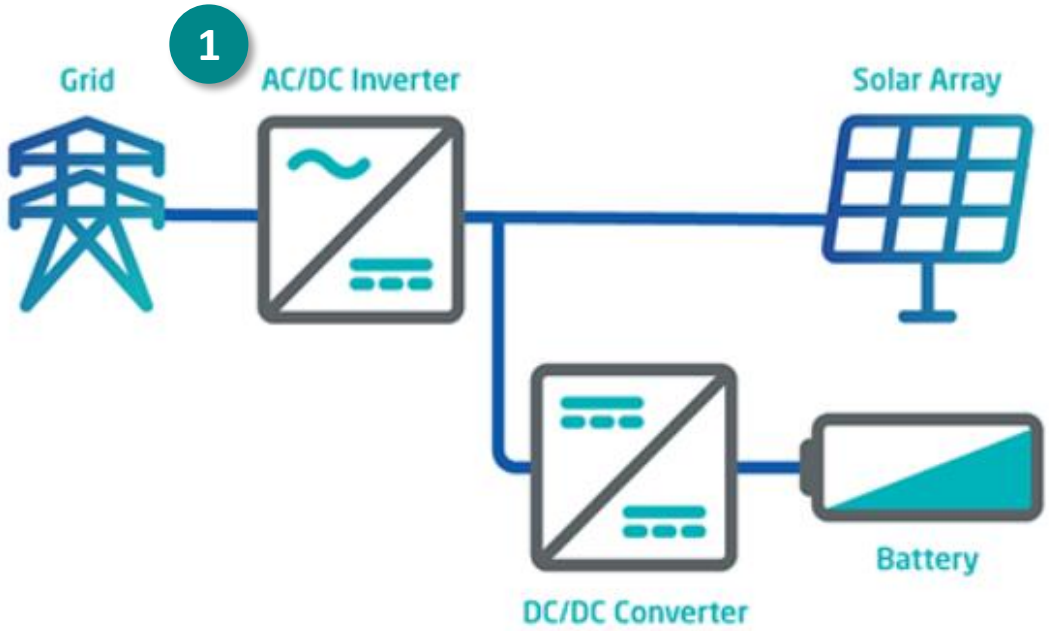
Telemetering for all non-exporting systems 3 MVA+

Energy Storage Devices

AC Coupled Storage



DC Coupled Storage



IPC-E-20-30
Staff Workshop

November 10, 2020