# WARNING

Due to the frequency of human-bear encounters, the B.C. Fish and Wildlife Branch is advising hikers hunters, fishermen and any persons that use the out of doors in a recreational or work related function to take extra precautions while in the field.

We advise the outdoorsman to wear little noisy bells on clothing so as to give advance warning to any bears that might be close by so you don't take them by surprise.

We also advise anyone using the out-of-doors to carry "Pepper Spray" with him in case of an encounter with a bear.

Outdoorsmen should also be on the watch for fresh bear activity, and be able to tell the difference between black bear feces and grizzly bear feces. Black bear feces is smaller and contains lots of berries and squirrel fur. Grizzly bear shit has bells in it and smells like pepper.

CRIMPOROTOP



# Establishing a Baseline, Mitigating Risk & **Commissioning Methods** ALASKA ComRent LOAD BANK SOLUTIONS **Robert Hughes** August 21, 2019 **David Smidlein**

### **Most Trusted Name In Load Bank Solutions**

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### The Purpose of Commissioning

To provide documented confirmation and a baseline that the systems functions are in compliance with criteria set fourth in the Project Documents and to satisfy the operational needs.

### **Benefits of Establishing a Baseline**



pages VII and 9.

# Mitigating Risk by Project Phase



- **1.** Planning Phase (Pre-Bid)
  - Develop commissioning plan with budget
    - Ensure the plan comprehends Utility Commissioning Requirements
    - NERC Requirements if applicable
  - Clarify roles and responsibilities for each phase
  - Develop a **commissioning checklist** for the project

#### 2. Design Phase

- Develop a written commissioning plan, including utility and supplier test requirements
- Include **contingency plans** to minimize risk
- All parties involved should sign off on the commissioning plan prior to construction

# Mitigating Risk by Project Phase



### **3.** Construction Phase

- Factory acceptance testing is performed on critical subsystems such as disconnect device, inverter, HVAC, System Protection
- Avoid duplication of tests (suppliers perform design verification test)
  - Making this a witnessed test may simplify plans

#### **4.** Acceptance Phase

- The system should then be tested to ensure compliance with IEEE 1547.1a (IEEE Standard Conformance Test Procedures)
- IEEE 1547.1 Revision ('18) may require reactive power, V and F ride through
- A system can be completed under **special circumstances** that can affect timing
  - Substation is not energized
  - Need to verify system protection/settings/grounding before connecting
  - Removal from Project books before fiscal deadline

# Mitigating Risk by Project Phase

	Planning Design	Construction	Acceptance	Handoff	Decommission
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### 5. System handoff to operation

- The requirements included in the commissioning test should flow into the maintenance plans that are put in place for the system.
- The test data from the commissioning test can be used as a baseline test data for future testing of the system.

# 6. Decommissioning and Recommissioning Considerations

- Key elements include: Safety, Emergency Response Preparedness, Environment, Equipment Disposal and Site Restoration
- Special considerations may arise with energy storage systems
  - Energy storage device may reach end of life before the other components in the system
  - Need for the energy storage system at a location has changed, load profiles, generation (relocation is an opportunity)
  - Cases where decommissioning then recommissioning might be applied







### **Best Practices for Commissioning**

When load tests are needed during equipment lifecycle

Commissioning Tests	<ul> <li>Integrated Systems test ensures equipment is integrated properly and performs as designer intended</li> </ul>			
Periodic Maintenance Tests	<ul> <li>Ensures proper operation and efficiency</li> <li>Particularly important with complex systems with multiple components, devices, firmware, and software</li> <li>Allows failure prediction to occur during the test, and not during an unintended outage</li> </ul>			
Corrective Action Validation	<ul> <li>Load testing ensures validation and verification of corrective action or system design changes</li> <li>Increasing trend in critical facilities, many times referred to as "Re-commissioning"</li> </ul>			

### **Benefits of Load Bank Testing**

Uncover Random Failure Problems not diagnosed by sub system



# **Commissioning Methods**

- Equipment Testing each piece of equipment is certified and/or tested in the field (protection systems, transformers, circuit breakers)
  - Proves: each piece of equipment works as specified
  - Does not Prove: equipment works in the system (Power, Communications, Control) or that the system works as desired
- **Functional Testing** Equipment and communications working properly
  - Proves: each piece of equipment communicates properly with other pieces of equipment and reacts as desired (i.e., A pushbutton will communicate to trip a breaker)
  - Does not Prove: Equipment works in the power system and control system –or- that the system works as desired
- Comprehensive System Testing Testing using power level primary injection to a system of equipment
  - Proves The equipment works in the power system as desired including control systems and communications <u>and</u> that the system works as desired

### **Commissioning Methods**

#### **Comprehensive Electrical System Testing is the Goal Testing Power System**, **Comprehensive System** Multiple Black Boxes & Testing Communications **Functional Testing Multiple Black Boxes** & Communications (Includes Comms) Relay **Testing the Black Boxes** Board Testing / Testing inside the Black Box Component

## **Benefits of Comprehensive Testing**

#### Validation of System Performance to Specification

- Systems need to perform at rated power with underlying assumptions
  - Power Factor
  - Altitude and climate

#### Lower Maintenance costs

- As a system evolves with updated software, firmware and replacement hardware
  - Systems need to be periodically calibrated

#### **Reduced Business Risk**

- Damage to Reputation
- Brand Impact



### **Benefits of Comprehensive Testing**

#### A well run full load test can reduce project costs

- Faster setup, testing and takedown
- Reduced overall time for commissioning test (days)
- Reduced load bank setup time (hours)
- Less checking and reworking of connections by installer, faster set up of downstream tests with buss track adapters and rack mounted load banks
- Less changeover when switching tests to multiple service providers

#### Reduced labour from stakeholders involved in commissioning

- Generator, UPS Mfr.
- General Contractor, Electrical Contractor
- Consulting Engineer
- Facilities Owner/Manager

# Value of Load Testing

Save time, money and reduce the risks inherent with commissioning substations

#### Load Bank Testing

- Complete System Test
  - Power flows through high voltage system
  - o Relays, Current & Voltage
  - Transformers, Meters, etc.
  - o Sequence of operation
- System failure determined
- Component failure determined with system impact
- Ensure test conditions reflect intended operation
- Analysis more repeatable than other methodologies
- Scheduling flexibility

#### Circulating or Injected Current

- Partial test of most components
- Components not tested as a system
- Highly dependent on procedures
   taken and analysis of test results
- Undiscovered Problems incorrect analysis or procedures may not be discovered until event occurrence

# **Test and Verification Process – IEEE 1547**



# Questions









