BESS General Equipment Requirements

- The BESS control, management system, batteries, inverter(s), data monitoring and communication system must be compatible with the Comap InteliNeo controller and approved by TCC & the local utility before purchasing for reimbursement.
- The BESS must be designed for a minimum operational life 6,000 cycles.
- A site specific O&M manual and onsite training for local operators is required before final payment is issued.
- Electrical components shall be within weatherproof enclosures marked with the environmental rating suitable for the type of environment they will be installed in compliance with, or exceeds, NFPA 70.
- Balance of Systems (wiring, switches, disconnects, conduits and connections, communications, etc.) shall be installed in an appropriate location that meets the following criteria:
    - Professional and permanent with appropriate conduit/connectors/etc.
    - Ease of maintenance access and monitoring
    - Efficient operation
    - Low operating losses
    - Secured location and hardware
    - Emergency stop located inside or outside
- All components shall be new. Used, reconditioned, after-market, or grey-market products or equipment are not acceptable.
- All equipment warranties must be transferred to the Owner at commissioning.

Codes and Standards Compliance

The BESS enclosure and internal components must be constructed in accordance with the following standards:

- AAC current version
- 2021 IBC
- 2020 NEC

- NFPA 70, 70E and 855
- UL 1547, 1741, 1741SA, 1973, 9540, 9540A
- IEC 62909, 62619, 62933-5-2, 62477-1
- IEEEE 519, 1547
- IFC § 1207

Environmental

All major components intended for outdoor installation must meet or exceed the following requirements for local environmental conditions. If installed in a conditioned space, the BESS unit must comply with these local environmental standards.

- Minimum Outdoor Temperature: -40F
- Wind Speed: 120 mph
- Snow Load: 60 psf

Transportation Constraints

Each BESS container must have a maximum weight of 20,000 lbs. per container. This weight restriction is determined by the limitations of local heavy equipment. To meet this requirement battery racks may be transported separately, however, it is the sole responsibility of the contractor to ensure the batteries can be safely and efficiently installed by a local contractor using local equipment.

Additionally, the BESS enclosure must have pockets for loader forks, not forklift pockets.

Barge Delivery to (via Nenana, Alaska with barge company Ruby Marine), 20-foot Conex size limit, with max weight per modular container being 20,000 lbs. to:

1. Fort Yukon
2. Ruby
3. Grayling
4. Huslia

Fly in Only (Everts, Northern Air Cargo, etc.):

5. Venetie

Road Access (must abide by DOT weight limits and hazard transportation restrictions) :

6. Minto
7. Tok

Table 1. Battery Capacity & Inverter Sizing

Community	Capacity	Inverter Size
Ruby	450 kWh	250 kVa
Grayling	450 kWh	250 kVa
Minto	450 kWh	250 kVa
Huslia	750 kWh	500 kVa
Venetie	520 kWh	250 kVa
Fort Yukon	2 MWh	1000 kVa
Tok	1.5 MWh	1000 kVa

Table 2. Battery Specifications

Chemistry	Lithium Ion, LFP
Nominal Capacity	Refer to Table 1. Battery Capacity & Inverter Sizing
Discharge and Charge Rate	0.5 to 1.0C
Voltage Range (DC)	Coordinate with PCS Manufacturer
Round Trip Efficiency (AC:AC)	86%, minimum (includes battery, inverter, BOS)
Life Cycle	At 6000 cycles minimum 80% energy retention (year 15)
Thermal Management	Air or liquid conditioned at cell level
Warranty	1 year, minimum
Compliance	UL 1973, NFPA 70, UN 38.3

Battery Management System

The BMS must include the following:

- Full monitoring of the battery systems electrical power and related operational data, including voltage, frequency, current, SOC and system temperature.
- Visual and audible alarms, located interior and exterior of the unit, if potential safety hazard exists.
- Remote notification (email and/or text) when preventive maintenance is needed.
- Must include automatic system shutdown program logic when cell temperature exceeds (high or low end) manufacturer recommended limits.
- Modbus TCP communication protocols
- Over/Under voltage, over current, thermal protection safety features via automatic shutdown.

Inverter

Inverters can be proposed but must be approved by the TCC and utility prior to purchase and must meet the minimum requirements below.

Table 3. Inverter Specifications

AC Voltage nominal	Refer to Attachment A
AC Voltage range	Refer to Attachment A
Power rating	Ruby – 250 kVa Grayling – 250 kVa Minto– 250 kVa Huslia – 500 kVa Venetie– 250 kVa Fort Yukon– 1000 kVa Tok – 1000 kVa
CEC Efficiency	97%, minimum
Power Factor	98%, minimum
Total Harmonic Distortion	< 3% THD
Thermal Management	Liquid cooled
Warranty	5 years, minimum

Table 4. Summary of PCS Requirements (each Village)

Requirement	PCS
Nominal AC Power Capacity	250 kW +; refer to Attachment A & Table 1
Use Case	Power Conversion System between BESS and existing power generation
Max Efficiency	>99%
Useful Economic Life	20 years from date of commercial operation

Table 5. Summary of XFMR Requirements (each Village)

Requirement	Isolation XFMR
Base kVA	Refer to Attachment A
Primary Voltage	480 VAC ; refer to Attachment A
Secondary Voltage	Matched to AC output of PCS to produce maximum PCS output
Use Case	Isolating Transformer Between Existing Bus and Proposed PCS
Useful Economic Life	20 years from date of commercial operation

Controls & Communications

The BESS control system shall have Modbus TCP communications protocol for external control and monitoring from a Comap InteliNeo controller.

Fire Suppression

The BESS enclosure must meet UL 9540A, NFPA 855, IFC 1206, IBC codes and compliance standards. Additionally, the BESS enclosure must address the following:

- Interior and exterior audible and visual alarm/strobe are required.
- Due to potential for freezing conditions, water-based fire suppression systems, if required, must not be used.

Safety

- The BESS shall contain protective relays, circuit breakers, or fuses which self- protect the BESS and distribution system in the case of internal or external electrical faults.
- A detailed plan surrounding battery cell thermal runaway detection and mitigation systems in the BESS must be included in the submittal process.
- A visible disconnect will be installed on the exterior of the BESS unit that isolates BESS in accordance with utility interconnection requirements.
- All electrical equipment, enclosures, disconnects, and overcurrent devices shall be clearly marked and identified. Markings shall reference the same designations called out in the final design drawings.
- All electrical equipment, enclosures, disconnects, and overcurrent devices shall be installed in accordance with Professional Engineer stamped and Fire Marshal approved electrical design.
- A fire detection and suppression system shall be provided as required by NFPA 855 and UL 9540A or by manufacturer.

HVAC

The BESS enclosure shall be insulated for the environmental conditions listed above for enhanced energy efficiency, minimum R-Value of R-30. Battery module and inverter conditioning is required for thermal regulation of electrical components. Unless the BESS enclosure contains an HVAC system integrated as part of a standard package the following recommendations should be considered:

- Heating and cooling shall utilize heating systems that are code compliant (NFPA 855 & IFC 1207-2021 edition) with Battery systems & can function when ambient temperatures are down to -50F when the with the following specifications
    - Heat system appropriately sized using local design parameters and internal loads.
    - Dehumidification is required
- If economizer is not an option utilizing a separate ventilation system with individual intake/exhaust vents located high/low are required to reduce energy consumption. Fan and louvers on intake and exhaust must be thermostatically controlled.

Microgrid “IPP” Controller

Interface with the following energy resources:

1. Solar Inverters
2. Battery Energy Storage System
3. Generator Plant PLC
4. Zipp & Konen RT1 MET Station

The Microgrid Controller software will be configured for autonomous operation, prioritizing renewable energy utilization (Solar PV + BESS) to reduce diesel consumption while considering power system constraints; following recommendations from the local electric utility. At all times, the controller will prioritize the health of the resources, including generator hour balancing, minimum loading and run time, respecting high/low state of charge, minimizing generator start/stop, etc., to decrease yearly maintenance costs and increase the life of the assets. The controller will also utilize the energy storage system to operate the diesel gensets in their optimum efficiency range. This will include selectively charging the battery system if a generator operates at a lower loading than is optimal.

The controller will integrate to the Powerplant’s PLC. The PLC will continue to be the generator plant controller, providing load dependent start/stop and other generator plant control functions. The Controller will interface to the Generator Plant PLC over Modbus. There are 7 different powerplants for this project; therefore the vendor/installer of the controller must be able to work with the respective utilities to integrate the controller.

The microgrid controller must provide integrated control and coordination of distributed energy resources within a hybrid power system, specifically:

- **Battery Energy Storage System (BESS):**
  - Manage charging and discharging cycles.
  - Enforce state of charge (SOC) limits.
  - Dispatch power for load balancing, renewable integration, and diesel offset.
- **Solar PV Inverters:**
  - Real-time control of power output.
  - Provide voltage and frequency support.
  - Smoothly integrate variable renewable generation.
- **Diesel Generator Controllers:**
  - Efficient dispatch and load following.
  - Automated start/stop sequencing.
  - Spinning reserve management to minimize fuel consumption.

Compatibility Requirements:

- Support communication protocols necessary for supervisory control and data exchange with legacy assets.

Additional Features:

- Real-time monitoring and data logging of system performance.
- Automatic and manual control modes for operator flexibility.
- Remote access capability for troubleshooting, reporting, and optimization.
- Cybersecurity features appropriate for critical infrastructure.

Controller Functionality:

- Islanded/Microgrid
  - Generator-off Operation (if allowed by local electric utility)
  - Balance PV production with load
- Optimize the ESS system
  - Load smoothing for generators
  - Spinning reserves displacement
  - Reduce generator start/stop
- Monitor, control, and optimize energy storage usage, dispatch and charging
- Monitor and control the generator
  - Cycle-charging or load-following dispatch
  - Minimum loading
  - Minimum runtime
- Monitor and control the PV inverters
  - Active PV curtailment
  - Maximize PV utilization
- Monitor Health Status and Alarms
  - Auxiliary Power Supply (ARC Control Cabinet)
- Operator User Interface
- Executive Dashboard
- Data historian
- System trending
- Alarm and event logs
- Remote access - VPN Tunnel

User Interface & Monitoring:

The controller shall have a visible display at the powerplant & allow for changes to the operations of the system & monitor performance.

Microgrid Controller General Equipment Requirements:

- The microgrid controller, a Comap InteliNeo controller, must have an approved technical specification, installation process, commissioning protocol; reviewed and approved by TCC & the local utility before purchasing for reimbursement.
- A site specific O&M manual and onsite training for local operators is required before final payment will be issued.
- Electrical components shall be within weatherproof enclosures marked with the environmental rating suitable for the type of environment they will be installed in compliance with, or exceeds, NFPA 70.
- Balance of Systems (wiring, switches, disconnects, conduits and connections, communications, etc.) shall be installed in an appropriate location that meets the following criteria:
  - Professional and permanent with appropriate conduit/connectors/etc.
  - Ease of maintenance access and monitoring
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