EXHIBIT B

BESS Testing Specifications

DNV – 23 Dec 2022

Table of contents

List of figures

1 SCOPE OF CONTRACTOR TESTING

1.1 General

(a) This Exhibit B – BESS Testing Specification to the VINLEC Energy Storage Technical Specification describes the minimum requirements for testing the facility and includes:
  (i) Descriptions of the required tests and test acceptance criteria;
  (ii) Contractor and equipment supplier roles and responsibilities with respect to facility testing and data analysis; and
  (iii) Reporting and documentation requirements and timelines for tests.

(b) In addition to the tests in this specification, Contractor shall also be responsible for any additional testing required to satisfy Laws and Regulations, including but not limited to applicable Codes and Standards, and requirements of VINLEC.

(c) Contractor shall provide all labor, supervision, materials, tools, equipment, and services required to complete testing of the facility, including but not limited to the following:
  (i) Contractor shall furnish acceptable evidence that the technicians and inspectors, or inspecting and technical organization(s), have experience inspecting and testing similar equipment/work, e.g., circuit breakers, wiring/conductors, junction boxes (combiner box is considered a junction box), transformers, mechanical/structural steel assemblies, foundations, soil compaction, etc. For testing to be performed to meet International Electrical Testing Association (NETA) requirements, the testing organization shall be an independent, third party entity, with a "NETA Accredited Company" designation issued by the International Electrical Testing Association.
  (ii) Technicians performing tests from NETA ATS shall be certified in accordance with ANSI/NETA ETT-2000, Standard for Certification of Electrical Testing Personnel. Each on-site crew leader shall hold a current certification, Level III or higher, or equivalent certification.
  (iii) Prior to startup, Contractor shall provide cleaning and preparation as required for each piece of Equipment.
  (iv) Temporary devices, cables/conductors, hoses, valves, jumpers, etc., not furnished by an Equipment manufacturer, but required for Contractor testing, shall be furnished by Contractor and removed after testing is completed.
  (v) All equipment safety labelling including, warning, danger and arc flash labels shall be applied to all equipment prior to start up testing.

(d) Testing shall meet the requirements of this specification and referenced industry standards, and be conducted in accordance with any instructions provided by the equipment manufacturers. Any conflict between these requirements shall be brought to the Employer's attention for resolution.

2 GENERAL REQUIREMENTS

2.1 Testing Program

(a) Within thirty (30) days prior to scheduled "Notice to Proceed" date, Contractor shall provide for VINLEC approval a "Testing Program" for the Facility, detailing testing procedures and schedule for

the Tests in accordance with the minimum requirements of this Exhibit B – BESS Testing Specifications. VINLEC shall review and return to Contractor comments to the Testing Program, and Contractor shall revise and resubmit to address such comments. The Testing Program shall be approved by VINLEC prior to commencing any Test.

(a) For each of the Tests described herein, Contractor shall provide, as a minimum, test procedures containing the following information as part of the draft manual:
    (i) Test purpose (including equipment/materials to be tested);
    (ii) Safety precautions/requirements;
    (iii) Tools, test equipment, and consumables required as applicable;
    (iv) Any prerequisites for test commencement;
    (v) Procedure steps for performing the test;
    (vi) Blank and/or sample test results sheet(s) to demonstrate the format of test documentation, containing (at minimum) the following fields:
        A Test organization name;
        B Equipment ID noun name and unique identifier;
        C Test description;
        D Test performance date;
        E Identification of person performing the test;
        F Conditions that may affect the test results, e.g., temperature;
        G Maintenance & Test Equipment (M&TE) serial #, calibration date, and next calibration due date; and
        H Test data (include as found results if applicable);
        I Acceptance criteria (and calculations if applicable);
        J Observations (as applicable), analysis, and recommendation; and
        K Engineer approval/justification for accepting results not meeting acceptance criteria NETA required inspections and tests.

(b) Contractor shall provide within the Testing Program, a high-level testing strategy with respect to scheduling and logistics of Circuit-level testing that contains all on-site activities associated with the Contractor Tests. The Testing Program shall demonstrate a logical schedule showing prerequisites for testing, anticipated durations, witness points, and data/document submittal that meets the overall Project Schedule. Details provided should include:
    (i) Anticipated start and duration of each test, highlighting Circuit-level test phases (if applicable);
    (ii) Test prerequisites and dependencies;
    (iii) Witness points; and
    (iv) Anticipated dates of submission of test data and reports to VINLEC.
        A Test reports for Contractor Tests shall be submitted to VINLEC within three (3) Business Days of completion of data collection, unless a different submission schedule is approved by VINLEC.
        B Contractor shall promptly conduct tests on any Circuit ready for testing and shall not delay commencement of such testing due to the construction status of other Circuits.

2.2 General Test Requirements

(a) The BESS shall be delivered with a System Integration Test, which at least covers the following equipment:
    (i) one Power Conversion System;
    (ii) one battery system consisting of at least four battery racks;
    (iii) and the control system.

If applicable, the System Integration Test shall be carried out in accordance with IEC 62933-2-1.

(b) Contractor shall provide at least twenty (20) Business Days advance written notice to VINLEC prior to conducting any inspections or tests to provide VINLEC an opportunity to witness such inspections and tests. Mutually agreed upon composite testing schedule and periodic meeting minutes shall be accepted as written notice.

(c) Upon completion of inspections and tests, Contractor shall provide written certification to VINLEC stating that such inspections or tests have been conducted in accordance with this Exhibit B – BESS Testing Specifications. Contractor's written certification shall be approved by VINLEC precedent to Contractor's achievement of the associated completion stage, unless otherwise mutually agreed between VINLEC and Contractor in writing.

(d) Testing shall comply with all pre-operational testing and commissioning requirements specified by VINLEC.

(e) Requirements for test instruments:
    (i) The Contractor shall have a calibration program, traceable to the National Institute of Standards and Technology (NIST).
    (ii) Calibration records shall be maintained and shall be made available to the Contractor upon request.
    (iii) Dated calibration labels shall be affixed to all test equipment. Instruments shall have been calibrated within the 12 months or more recent if applicable testing standards require prior to the work.
    (iv) Test equipment shall be maintained within rated accuracy.
    (v) Test equipment shall be in good mechanical and electrical condition and shall be inspected prior to use.
    (vi) Procedures and result reporting shall include make, model, software updates, accuracy, calibration and maintenance information specific to the instrumentation used to perform the test.

(f) For each Test, the Contractor shall provide to VINLEC Data Reports using measurements recorded by the SCADA system. The Data Reports shall include the following data points for the facility on a minute-by-minute basis using the units below (Data Points):
    (i) date (MM/DD/YY);
    (ii) time (HH:MM);
    (iii) revenue meter kWh at POI;
    (iv) revenue meter kWh at circuit metering
    (v) power factor at circuit metering and POI meter (as measured by revenue meter);
    (vi) voltage at circuit metering and POI meter (as measured by revenue meter);
    (vii) for each inverter:
        A inverter input voltage (V dc);
        B inverter input current (A dc);

C inverter output voltage (V for each phase);
D Inverter output current (A for each phase)
E inverter output power (AC-kW, for each phase and total);
F certain performance related inverter fault codes (Contractor to provide a list of such for approval by VINLEC prior to tests);
G Inverter power factor; and
H Internal temperature measurements.

(viii) For each battery energy storage system (BESS) container:

A battery dc voltage, charge and discharge (V dc);
B battery current, charge and discharge (A);
C battery power, charge and discharge (kW);
D battery state of charge (%);
E maximum cell temperature in (°C);
F minimum cell temperature in (°C);
G Operating mode;
H battery status and fault codes; and
I Auxiliary power consumption.

(g) Each Data Report may be provided as an Excel .CSV file

(h) The Data Point categories shall be represented as column headers with each Data Point category being one (1) column, in the form contained in the Excel file, with additional columns being added, as applicable, to accommodate all BESS and balance of plant components.

(i) Test Reports

(i) Reports shall be prepared documenting the results of each of the tests listed herein. For each test, Contractor shall submit for VINLEC review results of the tests and verifications within ten (10) Business Days following the completion of such tests, unless otherwise mutually agreed upon by Contractor and VINLEC in the composite testing schedule provided in the Testing Program. Test reports shall include at a minimum:

A Identification of Circuit(s) under test;
B Any mutually agreed upon deviations from the test manual procedures;
C Instrument calibration sheets and certificates;
D Completed test results sheets, as described in the Testing Program;
E Test data (manual and Data Reports using data acquisition);
F Corrected test data (as applicable);
G Field notes (observations, Site and weather conditions, etc.);
H Calculations;
I Post-test uncertainty analysis in line with ASME PTC 19.1;
J Any deficiencies discovered and corrective actions taken, and documentation of repeated tests, as applicable;
K Conclusions; and
L Signatures of testing agent and Contractor witness.

3 COMMISSIONING AND ACCEPTANCE

(a) The Contractor shall provide a composite schedule for the Factory Acceptance Tests, Commissioning Tests, and Site Acceptance Tests for VINLEC approval prior to Contract Execution; detailing the timeline and plan from design to delivery and commissioning. The composite schedule shall include:
    (i) Overall time frame, including key milestones
    (ii) Plans for factory testing, both component parts and as a whole, including detailed schedule, testing criteria, and acceptance criteria

(b) The Contractor shall submit Commissioning and Site Acceptance Test plans at least one (1) month prior to commissioning. The test plans shall meet the requirements of this Exhibit B – BESS Testing Specifications, and shall include:
    (i) Detailed schedule, procedures, necessary tools required on Site, testing criteria, and acceptance criteria
    (ii) Progress reports if any delays are identified
    (iii) Remediation plans in the event of a component or system failure

3.1 Factory Acceptance Test

(a) The Contractor shall coordinate Factory Acceptance Tests with VINLEC.

(b) The Contractor shall allow VINLEC to appoint an independent engineer for FAT witnessing if VINLEC wishes to do so.

(c) The Contractor shall allow VINLEC to witness the factory acceptance testing of the batteries and related equipment produced for VINLEC, through an independent engineer.

(d) The Contractor shall provide all Factory Acceptance Testing reports, demonstrating that the BESS and all associated equipment have passed all applicable tests. FAT reports shall have pass/fail criteria for each main testing procedure. Test reports shall be provided at least 30 days prior to planned installation.

(e) The Factory Acceptance Testing reports shall demonstrate:
    (i) BESS operational performance in compliance with requirements described in the Technical Specifications.
    (ii) Proper functionality of critical subsystem components such as:
        A Protection and disconnect devices
        B Battery cell/module/rack monitoring and protection provided by battery monitoring system
        C Inverters
        D Transformers
        E Thermal management systems
        F Communication interfaces
        G BESS Plant Controller
        H Safety System including, but not limited to, Fire Suppression and Fire Detection systems

3.2 BESS Commissioning Test

(a) The "BESS Commissioning Test" is intended to verify proper BESS performance per manufacturer's specifications, and per BESS performance requirements.

(b) Battery manufacturers may require a representative present to witness or conduct commissioning. The test should be conducted under environmental conditions included in the design specifications and deemed to be appropriate by battery manufacturer, and in accordance with IEC 62933-1.

(c) Contractor shall submit a BESS Commissioning Test procedure for VINLEC approval.

  (i) The BESS Commissioning Test procedure shall include the procedures described in this Exhibit B – BESS Testing Specifications.

(d) The BESS Commissioning Test shall follow BESS manufacturer commissioning procedures for all activities. This should include at least:

  (i) Verification of interconnected battery rack or string functionality.

  (ii) Auxiliary equipment testing, including standard operational lighting, emergency lighting, and HVAC or other thermal management system functionality.

  (iii) Safety system verification, including smoke, gas, fire, heat, and other sensors and alarms, as well as automatic emergency shut down.

  (iv) Verification of proper and reliable electrical performance given environmental conditions.

  (v) Verification of proper communication and reporting to the controller:

    A Confirm communications between cell, module, rack, and system BMS.

    B Confirm communication between meters/monitors/sensors and BMS.

    C Confirm communication between BMS and Plant Controller.

  (vi) Verification of BESS response to charge and discharge setpoints set by Plant Controller/ SCADA systems, and response to commands from VINLEC operations.

3.3 Site Acceptance Test

(a) The Contractor shall provide a Site Acceptance Test Plan for VINLEC approval.

  (i) The Site Acceptance Test Plan shall include the BESS Tests described in Section 7 of this Exhibit B – BESS Testing Specifications.

(b) The Site Acceptance Test Plan shall be used to verify that:

  (i) All components of the Project meet or exceed the minimum target capacities, ramp rates, and response times for the BESS.

  (ii) The Plant Controller can communicate with the inverters, meters, and battery system.

  (iii) The BESS can be commanded to charge and discharge, and does so without faults.

  (iv) The BESS can meet all functional requirements described in the Technical Specifications.

  (v) The components of the project can meet ride-through and fault requirements, as identified in the Technical Specifications.

  (vi) BESS operation is in compliance with Performance Guarantees.

(c) Testing shall comply with Good Industry Practices, Applicable Laws, and Applicable Standards.

(d) VINLEC has final approval of the testing procedures identified by the Contractor.

(e) VINLEC shall have the right to request specific tests, if necessary, provided such test do not delay the production process or cause significant cost increase to agreed test plan. These tests may include Battery System factory testing with the Plant controller.

(f) VINLEC shall have the right to witness all tests. As such, the Contractor will notify VINLEC of test dates no less than 2 weeks prior to each test. Any delays due to scheduling these tests will be accommodated on a case by case basis.
(g) The Contractor shall provide all necessary facilities and equipment for all tests.
(h) A draft Test Report shall be submitted to VINLEC by the Contractor within ten (10) Business Days following the end of the Site Acceptance Test. VINLEC shall have ten (10) Business Days to accept or reject the results of the draft Test Report, and provide in writing any comments of VINLEC on such draft Test Report. In the event that VINLEC rejects all or any part of the draft Test Report, Contractor shall, within ten (10) Business Days thereafter address any comments of VINLEC and re-submit the draft Test Report to VINLEC. This procedure shall continue until VINLEC accepts the draft Test Report.

3.4 Final Acceptance and Completion

(a) Contractor shall complete all activities related to Commissioning and Acceptance testing, and submit to VINLEC a Final Acceptance Certificate.
(b) The Contractor shall be fully responsible for the sufficiency of the work and ensuring all work is completed in compliance with applicable laws, standards, permits, equipment manufacturer requirements, industry practices, and these technical specifications. Any departure from referenced codes must be fully described and submitted for VINLEC's review.

3.5 Training

(a) Because VINLEC will be responsible for operating the Site functions, the Contractor shall provide comprehensive training and training material to ensure optimal safety and performance through installation, O&M, first responders, and emergency response procedures. The training will further go into detail about, Battery technology, Plant Controller, inverters, SCADA system and all related components. This will ensure that the trained staff has the appropriate competencies to safely perform system assessments, for both standard operations and maintenance and failure maintenance and response.
(b) As applicable, instruction shall include:
    (i) Identification of any specialized test equipment required/supplied
    (ii) Description of the electrical system layout including details of high-voltage (HV), medium-voltage (MV), and low-voltage (LV) data cable routes
    (iii) Location of plant and equipment including points of isolation and grounding
    (iv) Operation of the switchgear/breakers
    (v) Operation of inverter systems
    (vi) Operation of battery systems
    (vii) Operation of battery management system (BMS)
    (viii) Operation of safety system including fire detection/suppression, HVAC and interlocks
    (ix) Identification of protection relays and equipment
    (x) Review of protection relay settings

(xi) Safe operation, safe access, maintenance of nominal and safe performance where special procedures are required which would not be familiar to experienced, qualified, or registered personnel.

(xii) A simple assessment to demonstrate comprehension.

(xiii) Documentation (hard copies, electronic files, video as appropriate) of all training materials.

(c) Training shall also include first responders, and emergency response procedures, including but not limited to:

(i) Procedures for using the installed safety features, such as alarms, to identify potential hazards

(ii) Procedures for using available safety equipment to mitigate any hazards or abuse conditions. Methods of identifying

(iii) Procedures for discharging, de-energizing, and removing battery modules/strings/rack from the container; separately for both damaged and undamaged components

(iv) Procedures for storing and disposing of damaged and undamaged components

(v) Emergency action procedures for first responders

(a) Training of O&M Operators

(i) No later than two weeks prior to commissioning, Contractor shall provide hands-on operations and maintenance training to the operations and maintenance personnel designated by VINLEC in writing. Training shall be accomplished using audio and visual aids, textbooks, the Facility operations and maintenance manuals, etc. Contractor's training schedule and procedures shall be included in the project schedule and submitted for VINLEC's written approval ten (10) days prior to Contractor's expected date of training.

(ii) Contractor shall be responsible for providing up to two (2) days of on-site training in the use and operation of the generating facility, including all Equipment included therein. The training program shall include the following:

A Hands-on training including mechanical, electrical and control equipment and systems of the Facility

B Hands-on training for the local and remote BESS operators

C Hands-on training for the SCADA system and HMI

3.6 O&M

(a) Contractor shall provide a comprehensive O&M manual, and training as necessary to enact the tasks therein. This manual shall describe in detail all relevant operational and maintenance procedures required to keep each component at optimum performance throughout the design life of each item of equipment supplied. The manuals will address, at minimum:

(i) Equipment specification and description

(ii) Operational procedures

(iii) Maintenance procedures

(iv) Test certification

(v) As built drawings

(vi) Performance criteria

(vii) Testing requirements and limitations

(viii) Specialized equipment

(ix) Operational hazards

(x) Safety protocols for service and maintenance
(xi) Procedures for de-commissioning and proper disposal of BESS components
(xii) Instructions for recycling BESS components

(b) Contractor shall provide a comprehensive list of components that need maintenance, what that maintenance entails, and a schedule of how frequently each task should be attended to. Further, the testing and performance criteria by which it can be determined that the system continues to operate as originally claimed, or to identify any issues.

(c) Critical and Recommended Operating Spare Parts list
  (i) Contractor shall submit to VINLEC, not later than 45 days following Limited Notice to Proceed Date, a priced list of Critical Spare Parts and recommended Operating Spare Parts, for the operation of the Project.
  (ii) The recommended Operating Spare Parts list shall incorporate manufacturer-recommended components for all Project Equipment.
  (iii) The recommended Operating Spare Parts list shall incorporate consumable items required to perform the manufacturer-recommended preventative maintenance for Project Equipment.
  (iv) If Operating Spare Parts require special storage requirements, special tools, vehicles or other non-standard equipment in order to replace such Operating Spare Parts, these conditions shall be noted on the Operating Spare Parts list.
  (v) If Operating Spare Parts require calibration while in storage, the calibration requirements shall be noted on the Operating Spare Parts list.
  (vi) Operating Spare Parts quantities shall be based on the quantity required for the first 2 years of operation, and based on the quantity of associated equipment installed at the Project.

(d) Contractor shall provide BESS warranty related operational and storage requirements (including temperate and humidity control) and recommendations.

4 HIGH VOLTAGE MECHANICAL COMPLETION TESTS

4.1 Visual and Mechanical Inspections

(a) Inspections of power cables for physical damage, and proper connections where accessible, shall be performed and documented by Contractor. Proper tightness of accessible bolted connections shall be verified by calibrated torque wrench in accordance with the manufacturers published data. Inspection shall apply to Contractor installed power cables and preassembled equipment and include inspecting for visual match marks on each lug. Care should be taken to not void the Warranty on any Equipment.
  (i) A general visual inspection of the BESS major equipment shall be performed by Contractor, which shall include, but is not limited to:
    A inspection for missing ground wires to equipment;
    B verification that proper phasing is labeled on structures and equipment where there may be phase rolling;
    C inspection of foundations to ensure no damage from settling;
    D inspection for oxidation or corrosion issues;
    E inspection of welded assemblies;
    F inspection of cabinets and locks; and

G inspection of circuit breaker, switch, bus, surge arrestor, and transformer installation for compliance with project design drawings.

(b) Any issues identified in the general visual inspection shall be reported in writing to VINLEC and rectified immediately by Contractor. In the event of deficiencies, VINLEC, Contractor, and Supplier to work together towards resolution. The general visual inspection shall be repeated until all issues are resolved.

(c) All control cabinets and their associated mounting structures, wires, and surroundings shall be visually inspected to include verification of:

(i) Equipment free of damage or defect;
(ii) structural integrity of enclosures, mounts, bolts, wiring, and connectors;
(iii) positioning of boxes enables appropriate access;
(iv) wiring is neat and appropriately routed;
(v) wiring does not bend excessively or bend across sharp edges or fittings;
(vi) labeling is installed, appropriately marked and complete.
(vii) Wiring raceways in the substation field and in the control building shall be verified for protective relays and control equipment.

5 CIRCUIT MECHANICAL COMPLETION TESTS

5.1 Visual and Mechanical Inspections

(a) Inspections of power cables for physical damage, and proper connections where accessible, shall be performed and documented by Contractor. Proper tightness of accessible bolted connections shall be verified by calibrated torque wrench in accordance with the manufacturers published data. Inspection shall apply to Contractor installed power cables and preassembled equipment and include inspecting for visual match marks on each lug. Care should be taken to not void the Warranty on any Equipment.

(b) Any issues identified in the general visual inspection shall be reported in writing to VINLEC and rectified immediately by Contractor.

(c) All combiner and recombiner boxes and their associated mounting structures, wires, and surroundings shall be visually inspected to include verification of:

(i) Equipment free of damage or defect;
(ii) structural integrity of enclosures, mounts, bolts, wiring, and connectors;
(iii) positioning of boxes enables appropriate access;
(iv) wiring is neat and appropriately routed;
(v) wiring does not bend excessively or bend across sharp edges or fittings;
(vi) labeling is installed, appropriately marked and complete.

5.2 Switchgear and Switchboard Tests

(a) Contractor shall perform the following switchgear and switchboard tests :

(i) Inspect and test each switchgear and switchboard assembly in accordance with NETA-ATS section 7.1. Optional testing is not required unless warranted by special design considerations.

(ii) As per NETA-ATS section 7.1.2.11, perform system function tests in accordance with NETA-ATS section 8, which requires interlock system testing.
(iii) Perform the insulation resistance tests on control wiring as per NETA-ATS section 7.1.2.4.
(iv) Switchgear and switchboard test values shall be in accordance with NETA-ATS section 7.1.3.Transformers (Liquid Filled) Tests

(b) Contractor shall perform the following transformer tests on liquid filled transformers:
(i) Inspect and test the transformer in accordance with NETA-ATS section 7.2.2.
(ii) Perform the optional core insulation resistance test (if accessible).
(iii) Measure the percentage of oxygen in the nitrogen blanket.
(iv) Perform the optional oil tests for water content, and power-factor.
(v) Inspect and test the sudden pressure relay.
(vi) Transformer test values shall be in accordance with NETA-ATS section 7.2.2.3.

5.3 Cables – Low and Medium Voltage Tests

(a) Contractor shall perform the following tests on low voltage cables (600-Volt - 1500-Volt-DC Maximum if applicable):
(i) Inspect and test each low voltage cable in accordance with NETA-ATS, section 7.3.2.
(ii) Field-applied test voltages shall not exceed the maximum test voltage of NETA-ATS, Table 100.1.
(iii) Verify uniform resistance for all parallel conductors
(iv) Low voltage cable test values shall be in accordance with NETA-ATS, section 7.3.2.3.

(b) Contractor shall perform the following tests on medium voltage cables
(i) Inspect and test each medium voltage cable in accordance with NETA-ATS section 7.3.3.
(ii) Inspection and testing shall be performed after all splices and cable terminations have been installed by others.
(iii) Field-applied test voltages shall not exceed 80% of the factory test value, and shall not exceed the maximum test voltage of NETA-ATS Table 100.6.
(iv) Verify the proper installation of 13kV faulted-cable indicators as per the project design drawings.

(c) Contractor shall verify that all cables comply with VINLEC requirements.

5.4 Switches – Low and Medium Voltage Tests

(a) Contractor shall perform the following low voltage DC and AC Switch tests:
(i) Inspect and test each switch in accordance with NETA-ATS, section 7.5.1.1.
(ii) Confirm proper electrically-bonded equipment ground.
(iii) Confirm that metal-enclosed switches are clean and debris has been removed.
(iv) Verify that switches used in DC applications are rated and installed accordingly.
(v) Verify that warning signs where provided are in accordance with NEC.
(vi) Low voltage DC and AC switch test values shall be in accordance with NETA-ATS, section 7.5.1.1.3.

(b) Contractor shall perform the following medium voltage metal-enclosed switch tests:
(i) Inspect and test each air break switch in accordance with NETA-ATS section 7.5.1.2.

(ii) Include testing of the motorized switch operator mechanism (if applicable) in accordance with NETA-ATS section 7.5.1.2.

(iii) Medium voltage metal-enclosed switch test values shall be in accordance with NETA-ATS section 7.5.1.2.3.

(c) Contractor shall perform the following medium voltage air break switch tests:

(i) Inspect and test each air break switch in accordance with NETA-ATS section 7.5.1.3.

(ii) Include testing of the motorized switch operator mechanism (if applicable) in accordance with NETA-ATS section 7.5.1.3.

(iii) Medium voltage air break switch test values shall be in accordance with NETA-ATS section 7.5.1.3.3.

5.5 Circuit Breaker Tests

(a) Contractor shall perform the following tests for low-voltage insulated-case/molded case air circuit breakers:

(i) Inspect and test circuit breakers in accordance with applicable NETA-ATS sections:

A. With the exception of a field installed molded case circuit breaker installed between the inverter and the inverter step-up transformer perform, NETA-ATS, sections 7.6.1.1.1 (as applicable) and 7.6.1.1.2.4

B. For field installed molded case circuit breakers installed between the inverter and the inverter step up transformer perform NETA-ATS, section 7.6.1.1.

(ii) Confirm that if the breaker is back-fed, it is rated accordingly.

(iii) Low-voltage air breakers – insulated-case/molded-case test values shall be in accordance with NETA-ATS, section 7.6.1.1.3.

(b) Contractor shall perform the following low-voltage air power breakers test:

(i) Inspect and test circuit breakers in accordance with NETA-ATS, section 7.6.1.2.

(ii) Confirm that if the breaker is back-fed, it is rated accordingly.

(iii) Perform NETA-ATS, section 7.6.1.2.

(iv) Test values are to be in accordance with NETA-ATS, section 7.6.1.2.3.

(c) Contractor shall perform the following medium-voltage vacuum breakers test:

(i) Inspect and test circuit breakers in accordance with NETA-ATS, section 7.6.3.

(ii) Perform optional power factor tests on each pole and bushing.

(iii) Medium-voltage vacuum breakers test values shall be in accordance with NETA-ATS, section 7.6.3.3.

5.6 Microprocessor Based Protective Relay Tests

(a) Perform NETA-ATS, section 7.9.2 for microprocessor based protective relays.

(b) Commissioning tests for protection relays shall be coordinated with VINLEC, and shall meet VINLEC requirements.

5.7 Instrument Transformer Tests

(a) Perform NETA-ATS, section 7.10 for medium voltage instrument transformers, including capacitive coupled voltage transformers (CCVT), when a CCVT is installed.

5.8 Medium Voltage Surge Arrester Tests

(a) Perform NETA-ATS, section 7.19.1 and 7.19.2 for medium voltage surge arresters.

5.9 UPS Battery Tests

(a) Perform testing in accordance with NETA-ATS, section 7.18.1.1 for flooded lead acid batteries or 7.18.1.2 for vented nickel-cadmium batteries, or as applicable to the battery type of the UPS.

5.10 UPS Battery Charger Tests

(a) Perform NETA-ATS, section 7.18.2 for battery chargers, excluding optional testing.

5.11 Battery Energy Storage System Tests

(a) BESS Grounding Test
    (i) Contractor shall perform grounding checks between the following equipment:
        A BESS cabinets/racks/cable trays to earth;
        B Container earthing lug to earth; and
        C HVAC duct (if applicable) to earth during HVAC operation.

    The test procedure and acceptance criteria shall be in accordance with the industry best practices.

(b) BESS Open Circuit Voltage Test
    (i) The Contractor shall perform the "BESS Open Circuit Voltage Test" is to determine if all BESS sub-components (battery modules connected in strings or racks) are properly connected and are holding at an appropriate voltage level.
    (ii) The test scope includes all BESS battery module strings or racks.
    (iii) The test should be conducted under environmental conditions deemed appropriate by the battery manufacturer, typically temperatures within 23°C±5°C. If required by the battery manufacturers, Contractor shall conduct the test with the presence of the manufacturer representative.
    (iv) BESS Open Circuit Voltage Test procedure:
        A Given the current state of charge (SOC) based on manufacturer input for each battery module, calculate the expected Voc for the battery string or rack under test.
        B Independently test each battery string at the combining location (a DC bus or inverter).
        C Record the voltage of each battery string.
    (v) BESS Open Circuit Voltage Test acceptance criteria:
        A Battery string voltages shall conform to within 5% of the expected voltage as calculated in the procedure in the previous section.

B If results fall outside of parameters, notify Employer within 48 hours.

(c) BESS battery racking and installation Test

(i) The Contractor shall perform the BESS battery racking and installation Test to determine if all battery modules are properly connected and physically installed

(ii) The test scope includes all battery racks and containers

(iii) Test procedure:

A If the battery system was shipped with electric charge, follow manufacturer's instructions for safe handling of equipment.

B Verify that systems have been installed as required by manufacturer, including at least anchor bolts, appropriate pad and site grading to account for system stability, proper grounding, and drainage. The BESS container and interior components should be confirmed to be plumb and level.

C Confirm all disconnect switches are functional.

D Ensure that system is installed and area is cleared such that access can be allowed as appropriate for maintenance, operation, and access for VINLEC, Governmental Authorities, and first responders.

E Confirm no physical scratches, marks, or other visible signs of damage.

F Confirm that all container doors or openings can be fully and securely closed, to prevent ingress to level designed for and appropriate for installation location.

G Ensure no signs of water are present within the BESS container.

H Confirm all field-installed wires are properly torqued, per manufacturer specifications. Verify all connections which were made off-site remain correctly connected. Confirm proper installation by "tug testing" all wires.

I Confirm all wiring is completed as outlined in manufacturer drawings, and as appropriate to ensure safe handling of battery modules, within specified conditions, prior to commissioning.

J Confirm all internal communication devices are operational.

K Confirm signage as required by Governmental Authorities is installed.

(d) BESS DC-DC Converter Cold Commissioning Test

(i) The Contractor shall perform the BESS DC-DC Converter Cold Commissioning Test to verify proper installation of any DC-DC converter(s) per manufacturer's specification, and that the DC-DC converter(s) is ready for commissioning

(ii) The test scope includes all BESS utilizing DC-DC converters

(iii) Test procedure and acceptance criteria are described below. If the BESS utilizes a DC-DC converter and the DC-DC converter requires installation, ensure converter is installed per manufacturer's specifications, including, as applicable:

A Confirm the converter is grounded and the wire is secure.

B Confirm the converter is plumb and level.

C Confirm that all entry doors have water tight barrier strip installed.

D Ensure no signs of water are present within the converter.

E Confirm all wires are properly torqued, per manufacturer specifications. Confirm proper installation by "tug testing" all wires.

F Confirm all wiring is completed as outlined in manufacturer drawing.

5.12 Fiber Optic Cable Tests

(a) Perform NETA-ATS, section 7.25 for fiber optic cables.

5.13 Grounding System Tests

(a) Inspect and test grounding system in accordance with NETA-ATS, section 7.13.
(a) Test values are to be in accordance with NETA-ATS, section 7.13.3

5.14 Inverter Inspection

(a) Inverter manufacturer or approved technician shall perform inverter pre-energization checks; including polarity verification for each DC feeder pair landed on the inverter DC bus prior to installing inverter DC bus fuses.

5.15 Skids

(a) All skids shall have visual and mechanical inspections per applicable sections of this Exhibit B – BESS Testing Specifications, where the associated equipment is installed.
(b) Factory Test procedures to be agreed upon by VINLEC and Skid Supplier.

6 CIRCUIT SUBSTANTIAL COMPLETION TESTS

6.1 Current Check

(a) The operating current of all BESS AC sub circuits shall be measured when their associated inverter is operating to verify current flow is as expected, e.g., no open circuits/missing or blown fuses, etc. Each circuit's current shall be measured and recorded. If the measured operating current of an individual circuit differs by more than 10% from the expected value, the test segment wiring should be carefully examined and repaired as necessary.

6.2 Phase Rotation Test

(a) Proper AC phase rotation at the 11 kV bus shall be physically inspected and documented. Phase rotation at tie-in point shall be compared to the expected phase rotation from the inverter.
(b) Proper AC phase rotation at 33 kV POI shall be physically inspected and documented. Phase rotation at tie-in point shall be compared to the expected phase rotation from the inverter.
(c) Measurements shall be verified and documented.

6.3 Inverter Commissioning Tests

(a) Inverter commissioning shall be performed by the inverter manufacturer or approved technician. As a precondition of Circuit Substantial Completion, the inverters shall be fully operational and meet the

following requirements: (1) all software updates and data acquisition (DAQ) communication tested and in operation; (2) all torque wrench marks recorded; (3) all fuses and air filters checked; and (4) packing materials removed.

(b) The inverter commissioning test shall follow the requirements described in IEEE 1547.1 clause 7. Select requirements are included below:

(i) Verifications and Inspections - A list of nine inspections to verify the inverter is ready for operation:

A Confirm that the equipment and its installation comply with the interconnection installation evaluation in IEEE Std 1547.

B Record applicable settings.

C Visually inspect system grounding implementation according to the requirements of IEEE Std 1547.

D Visually inspect and verify operability of isolation devices, if required.

E Verify that polarities, burdens, and ratios of field-wired CTs and VTs are correct and in accordance with the design.

F Through visual inspection, continuity test or insulation resistance test, verify that field -installed power and control wiring is in compliance with drawings and manufacturer requirements.

G Interconnection protective devices that have not previously been tested as part of the interconnection system (ICS) - the collection of all equipment and functions, taken as a group, used to interconnect a distributed resource (DR) to an area electric power system (EPS) – with their associated interrupting devices (e.g., contactor or circuit breakers) shall be tested to verify that the associated interrupting devices open when the protective device operate. Interlocking circuits between protective and interrupting devices shall be similarly tested unless they have been tested during production tests.

H On three-phase systems, check the phase rotation of both area EPS and DR and verify that they are compatible as installed.

I Verify functionality of all monitoring provisions required by IEEE Std 1547.

(ii) Cease-to-energize functionality test - The inverter is disconnected from the grid during operation to verify that it ceases in operation and recovers once re-energized without component failure. See IEEE 1547.1 for detailed instructions.

(iii) Revised settings - If the settings for inverter responses to grid abnormal behavior have been changed, this section describes how to verify functionality at the new setting. See IEEE 1547.1 for detailed instructions.

(c) The Inverter Commissioning Test shall demonstrate functionality required in the Technical Specifications, including operation throughout the full reactive power range.

6.4 Monitoring Systems Verification

(a) Prior to Circuit Substantial Completion, Contractor shall perform the following verification tests:

(i) Confirm operation of the SCADA system, and verify that all monitored facility components, including, but not limited to, weather station, inverter, Safety System, and battery measurement and monitoring points are wired to the correct SCADA system channels.

(ii) Verify all meter data scaling factors are correct.

(iii) Ensure that all SCADA system channels are sampling and logging correctly.

(b) Confirm that collected data is properly received at servers and/or data repositories such that the SCADA system can be used to produce any required operational reports.

(c) Contractor shall submit all verification results with respect to this Section 6.4 of Exhibit B – BESS Testing Specifications to VINLEC within three (3) calendar days of completing the verification.

6.5 Skids

(a) All skids shall have substantial completion tests per all applicable sections of this Exhibit B – BESS Testing Specifications, where the associated equipment is installed.

7 BESS TESTS

(a) Contractor shall coordinate all BESS operational tests with VINLEC transmission operations.

(b) Testing procedures for the BESS Tests are described in this section, which include:
   (i) BESS Capacity Test
   (ii) Response time Test
   (iii) Signal Following Accuracy Test

(c) Contractor shall perform the additional following tests, which are not detailed in this section.
   (i) Active Power Test
   (ii) Reactive Power

(d) Contractor shall perform all Tests in accordance with IEC 62933, and the industry best practices.

(e) Prior to any BESS Test, the Contractor shall inspect and verify all safety aspects of the BESS. For this purpose, Contractor shall provide a check list for VINLEC approval. The inspected items shall include, but are not limited to:
   (i) Emergency Response Plan
   (ii) Fire and smoke detection, fire suppression, and fire and smoke containment systems
   (iii) Ventilation and thermal management systems
   (iv) Egress, access, and physical security illumination
   (v) Electrical safety and emergency shutoff devices
   (vi) Signage

(f) BESS performance tests are described in this Section. Contractor shall be responsible for coordinating with VINLEC as well as performing all tests required for compliance with local Grid Code.

7.1 Metering Point

(a) Facility metering shall be as described in the Technical Specifications.

(b) BESS charge and discharge power shall be evaluated at point of interconnection (POI) Metering Point.

(c) BESS discharge duration and energy capacity shall be evaluated at the POI metering point.

(d) BESS round-trip efficiency (RTE) shall be evaluated at the POI Metering Point, with adjustments separate auxiliary metering.

(e) BESS response time shall be evaluated at the POI Metering Point.

(f) Auxiliary loads shall be measured separately and shall be accounted for in RTE evaluation, as applicable.

(g) Contractor shall verify that BESS equipment measurements, at the battery and inverter interfaces, and corresponding values recorded by the SCADA system are in line with measurements at the POI Metering Point when adjusted for efficiency losses, ohmic losses, transformer losses, parasitic loads, and power factor impacts.

7.2 BESS Capacity Test

(a) The "BESS Capacity Test" is a performance test to demonstrate that the BESS energy capacity, maximum charge and discharge power, and roundtrip efficiency are in compliance with operating requirements and contractual obligations.

(b) The procedure for the BESS Capacity Test is described below. The test scope includes all BESS components, including batteries, battery management system (BMS), Plant Controller, DC/DC converters, inverters, transformers, revenue meters, and the interconnection to the Utility.

(c) The BESS Capacity Test should be conducted under environmental conditions included in the design specifications, and deemed to be appropriate by battery manufacturer. If required by the battery manufacturer, Contractor shall conduct the test with the presence of a manufacturer representative.

(d) The BESS Capacity Test shall be completed according to the following procedure:

(i) Turn on datalogging, record all parameters at 1 second intervals (or faster), and confirm data is being saved in an appropriate location.

(ii) Execute the following Cycle Steps:

A Command BESS to discharge at the maximum rated power until it reaches 0% rated SOC or as limited by the BMS to prepare for the first full charge-discharge cycle.

B Command BESS to idle (zero power set point) for 2 hours, or time adjusted by Contractor based on battery technology.

C Command BESS to charge at the maximum rated power until it reaches 100% SOC. If BMS protections prevent fully charging battery at maximum power, allow battery to reach 100% SOC at a current/voltage limited by the BMS.

- The SOC value, cumulative energy, and time at the beginning and end of the charge cycle shall be recorded.
- The maximum AC power at the POI Metering Point during this charge cycle shall be recorded as the “Maximum Charging Rate”.
- The cumulative energy of this charging step shall be the “Charged Energy”.

D At 100% SOC, command BESS to idle (zero power set point) at 100% SOC for 2 hours, or time adjusted by Contractor based on battery technology.

- The SOC value, cumulative energy at POI Metering Point, and time shall be recorded.

E Command BESS to discharge at the continuous maximum rated power until it reaches 0% rated SOC or as limited by the BMS.

- The SOC value, cumulative energy at POI Metering Point, and time at the beginning of the discharge cycle shall be recorded.
- The maximum AC power at POI Metering Point during this discharge cycle shall be recorded as the “Maximum Discharging Rate”.
- The cumulative energy during the discharge cycle shall be recorded as the BESS “Discharged Energy”.

(e) BESS Capacity Test acceptance criteria and performance indicators

(i) No critical warning/alarm thresholds shall be exceeded for the entirety of the test, including voltages, currents, and temperature limits per component specifications, communication failures, and safety-related alarms.

(ii) BESS charging capability is found as the Maximum Charging Rate, and BESS discharging capability is found as the Maximum Discharging Rate. Verify that the BESS power capability is within operating requirements, Guaranteed Power Capability, and contractual obligations, as applicable.

(iii) BESS discharge capacity is found as the Discharged Energy, see step . Verify that the discharge capacity is within operating requirements, Guaranteed Discharge Capacity, and contractual obligations, as applicable. The Discharged Energy Capacity shall be at least 5MWh and continuous maximum rated power shall be at least 5MW.

(iv) Measured Round-Trip Efficiency (RTE) is calculated using the cumulative energy across multiple cycle steps as shown in the equation below. Verify that the BESS RTE is within operating requirements, Guaranteed Roundtrip Efficiency, and contractual obligations, as applicable.

Measured RTE = (Discharged Energy)/(Charged Energy)

7.3 Response Time Test

(a) The "Response Time Test" is a performance test to measure the response time of the BESS to reach rated power during charge or discharge from initial measurements taken when the BESS is at rest, per applicable agreements.

(b) The procedure for the BESS Response Time Test is described below. The test scope includes all BESS components and interconnection to the Utility.

(c) The BESS Response Time Test should be conducted under environmental conditions included in the design specifications, and deemed to be appropriate by battery manufacturer. If required by the battery manufacturer, Contractor shall conduct the test with the presence of a manufacturer representative.

(d) The BESS Response Time Test shall be completed according to the following procedure:

(i) Turn on datalogging, record all parameters at 1/4 second intervals or faster, and confirm data is being saved in an appropriate location. Typical communication latency and response time is under several seconds; as such, manual recording of response times may not be possible and results should be evaluated from SCADA data log.

(ii) The response time shall be measured starting at T_0 when the command signal is received and continue until the BESS discharge power output reaches its rated power capacity T_2 as shown in Figure 1 below.

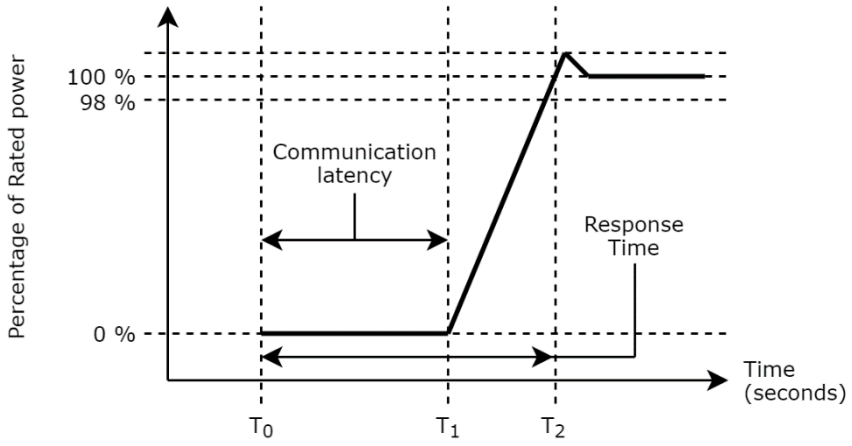

Figure 1 BESS Response Time Test

(iii) The BESS shall be resting at approximately 50% SOC and shall be prepared to receive a control command.

(iv) The SCADA shall be programed to record the time instance T_0 immediately following the initiation of the signal command requesting to change the BESS status from rest state to a discharge state.

(v) The SCADA shall be programed to record the time instance T_1 immediately following the BESS physical change in state.

(vi) The SCADA shall be programed to record the time instance T_2 immediately following the BESS reaching 100% rated power capacity.

(vii) The power capacity of the BESS at T_2 shall be recorded as P_{T2}.

(viii) The BESS shall be programed to increase/decrease its power output/input per the battery manufacturer recommendations.

(ix) The SCADA shall be used to start the response time test and shall be used to signal and record T_0, T_1, T_2, and P_{T2}.

(x) Response Time = T_2 - T_0.

(xi) Ramp Rate = Rated Power/Response Time

(e) BESS Response Time Test Acceptance Criteria

(i) No critical warning/alarm thresholds shall be exceeded for the entirety of the test; including voltages and currents, and temperature limits per component specifications, communication failures, and safety-related alarms.

(ii) Verify that the response time is within operating requirements, Guaranteed Response Time, and contractual obligations, as applicable.

7.4 Signal Following Accuracy Test

(a) The "Signal Following Accuracy Test" is a performance test to measure the accuracy of the BESS response to a specified charge or discharge command.

(b) The procedure for the Signal Following Accuracy Test is described below.

(c) The Signal Following Accuracy Test should be conducted under environmental conditions included in the design specifications, and deemed to be appropriate by battery manufacturer. If required by the battery manufacturer, Contractor shall conduct the test with the presence of the manufacturer representative.

(d) The Signal Following Accuracy Test shall be completed according to the following procedure:

(i) To commence the Signal Following Accuracy Test the BESS must be charged to 50% SOC.

(ii) The BESS shall be instructed, locally or remotely, to change the output from zero (0) MW to a specified power amount. The power amount, represented in MW AC, will be decided at VINLEC's sole discretion and will be equal to at least 10% of the BESS Rated Power.

(iii) The BESS shall ramp to the selected power amount and hold that output amount for three (3) minutes.

(iv) After three minutes, the power output of the BESS shall be returned zero.

(v) Each minute following the VINLEC issued dispatch instruction, a meter reading of power, as measured in MW AC, shall be taken at the Measurement Point.

(vi) After three minutes, the percent error between the three distinct meter readings and the power amount requested in the dispatch instruction shall be recorded.

(vii) The average of the three percent errors computed in the previous step shall be recorded as the Signal Following Accuracy

(viii) VINLEC, at its sole discretion, may elect to repeat this signal following protocol up to (3) different times to demonstrate the BESS's ability to accurately follow a dispatch instruction.

(e) Signal Following Accuracy Test Acceptance Criteria

(i) No critical warning/alarm thresholds shall be exceeded for the entirety of the test; including voltages, currents, and temperature limits per component specifications, communication failures, and safety-related alarms.

(ii) Verify that the signal following accuracy is less than or equal to the contractually required Signal Following Accuracy level.

About DNV

We are the independent expert in assurance and risk management. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.