Business Practice
GRID FORMING BATTERY ENERGY STORAGE SPECIFICATION AND SIMULATION TEST PROCEDURE

1. Background

With the rapid growth of inverter-based resources and the impact this may have on the performance and reliability of the SRP System, SRP is adopting grid forming (GFM) technology for battery energy storage systems (BESS) on a case-by-case basis. GFM is a type of inverter control philosophy that brings additional grid-stabilizing benefits and is a low-cost commercially available option in BESS technology.

2. Purpose

This Business Practice defines the functional specifications (i.e., performance requirements) for GFM BESS and defines a simulation test procedure used to ensure that the proposed GFM BESS facility by an interconnection customer (IC) complies with the functional specification.

3. Applicability

This Business Practice applies to any standalone BESS or the BESS component of a co-located facility where SRP specifies that the BESS shall operate in GFM mode. This Business Practices does not apply to the BESS components of hybrid power plants at this time, although SRP may extend applicability to these resources in the future.

GFM BESS shall comply with all other applicable requirements in SRP's Facility Connection Requirements (FCRs)[1] in addition to the requirements listed here. Any exemptions requested by the interconnection customer shall be reviewed and approved by SRP prior to commercial operation.

4. Definitions

No additional terms are defined here. Capitalized terms hold the same meaning as those in the applicable Generation Interconnection Procedures (GIP).

5. General Policies

All applicable GFM BESS where SRP has specified that the BESS shall operate in GFM mode shall meet the following functional specification as defined in Section 5.1 and shall provide SRP with a simulation test report (see Section 5.2) confirming that the proposed GFM BESS meets the requirements. All applicable GFM BESS shall operate in GFM mode at all times while connected to the SRP system, unless exceptions are specified by SRP.

[1] http://www.oasis.oati.com/SRP/index.html

5.1. GFM Functional Specification (Performance Requirement)

- GFM BESS shall maintain a nearly constant internal voltage phasor in the sub-transient time frame that resists near-instantaneous voltage magnitude and phase angle changes and stably regulates active and reactive power appropriately.
- GFM BESS shall be able to stably operate through and following the disconnection of the last synchronous machine in its portion of the power grid.
- GFM BESS shall exhibit acceptable performance to the GFM BESS simulation test procedures defined below.

5.2. GFM BESS Simulation Test Procedure

An accurate, validated electromagnetic transient (EMT) model shall be provided for all GFM BESS by the IC. The EMT model must comply with SRP EMT modeling requirements in the FCR and EMT Models Business Practice and will be used for conducting the SRP GFM BESS simulation test procedures.

GFM BESS simulation test procedures shall be conducted once final equipment selections are made (including specific inverter OEM, make, model, and parameterization) prior to signing the generator interconnection agreement (GIA). Any modifications to the IBR plant after the GIA is signed that alter the facility's electrical behavior and lead to performance deviations from the EMT model representing the GFM BESS site will require the IC to reconduct the GFM BESS simulation test procedures, along with any other necessary model quality or performance tests, before commercial operation. Changes made after signing the GIA may require additional studies and could delay SRP approval for commercial operation.

The GFM BESS model shall demonstrate a stable and reliable response to the specified simulation test procedure. The IC shall test the performance of the GFM BESS and provide SRP with a simulation test report confirming that the proposed site meets the requirements. Additional test scenarios may be required on a case-by-case basis, depending on the specific characteristics of the BESS site.

Simulation Test: Loss of Last Synchronous Machine

The GFM BESS testbed system is shown in Figure 1. The GFM BESS under test is added to the test case at the nameplate rating of the proposed interconnection request. This should be a site-specific representation of the actual configuration, equipment, controls, protections, and parameterization of the proposed facility. A duplicate GFM BESS with half the nameplate capacity is also added to the test case.

Testbed Setup and Initial Conditions:

- An ideal voltage source can be used to represent the system equivalent,[2] and its voltage setpoint is set to the expected voltage schedule for the proposed IBR plant point of interconnection (POI) (i.e., the nominal operating voltage specified by SRP).

[2] An ideal voltage source is sufficient since this generator will be tripped as part of the simulation test procedure.

- The load active power demand should match the active power capacity of the GFM BESS under test, with a power factor of 0.9 (consuming reactive power).
- The GFM BESS under test is dispatched to 50% of its nameplate charging active power capacity; the duplicate GFM BESS is dispatched to 100% of its nameplate discharging active power capacity.

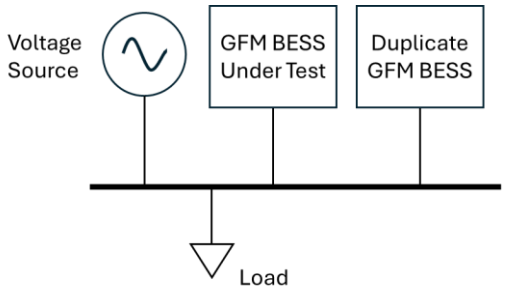

Figure 1: GFM BESS Testbed Setup

Simulation Test:

- The simulation must reach a steady-state operating condition within 5 seconds.
- At 10 seconds, the voltage source is tripped.
- The simulation continues for 30 seconds, and the results will be analyzed against the Pass/Fail criteria.

Pass/Fail Criteria

- The GFM BESS under test must go from charging to discharging, as required by the change in power flow conditions.
- The duplicate GFM BESS should remain at maximum power (Pmax) and shall not exceed any expected operating limits or equipment capabilities.
- After the loss of the voltage source, both GFM BESS sites shall stably reach a new operating point, respond in a well-damped manner, and maintain system parameters within expected limits – voltage within ±10% and frequency between 59.5 and 60.5 Hz.

SRP will review the submitted GFM model and accompanying simulation test report to ensure all pass/fail criteria are met. SRP will inform the interconnection customer of any deficiencies that must be addressed, if needed. The interconnection customer shall address and resubmit a GFM BESS model and simulation test procedure report that describes the changes made and how they will be implemented in the field.

This Business Practice describes general conditions and practices. There may be specific circumstances that require some variation from or are not addressed by this Business Practice.

Please address any questions to $TGOMGMT@srpnet.com for general questions or $IBR_Unit_Managers@srpnet.com for site-specific questions.

BUSINESS PRACTICE
GFM BESS SPECIFICATION AND SIMULATION TEST PROCEDURE
SALT RIVER PROJECT AGRICULTURAL IMPROVEMENT AND POWER DISTRICT
EFFECTIVE DATE: FEBRUARY 14, 2025 VERSION 1.0

Revision History

Document	Version	Date	Comments
Business Practice – GFM BESS Specification and Simulation Test Procedure	1.0	2/14/2025	Initial Release

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