Battery Test Suite

**About**

The battery test suite contains tests written to validate that features within the SAM battery modules are behaving as expected. The tests are not comprehensive but should be updated and added to as possible to ensure robust behavior and reduced maintenance time as the module gains complexity.

**Instructions to run test**

1. Open the latest version of SAM
2. Open project file: “SAMnt\tests\Battery\Test.sam”
3. Within project, open script: “SAMnt\tests\Battery\main.lk”
4. Run the script.

**Instructions to add tests**

1. Currently tests are written in “main.lk”. Add to the tests in these.
2. If a test fails, return false from the function and output a message.
3. Within “main.lk”, output results from the tests.
4. If any simulation settings were changed during a test, initiate a call to “reset\_default”, ensuring that you update the defaults if you change a variable not listed.

**Combinatorial process**

The test script uses a combinatorial process to change options and test the model under a variety of conditions. The battery is tested in all combinations of:

1. Sending PV to load or battery first
2. Hourly weather or sub-hourly weather
3. Hourly load or sub-hourly load
4. Single year or lifetime mode
5. Lead acid (4 types) or Lithium Ion (7 types)

Note that some of the below tests are skipped depending on which combination is being test due to some outputs not being supported for lifetime simulations

**Test Descriptions**

1. **Battery bank sizing test**

This test retrieves the desired bank capacity and voltage and the computed bank capacity and voltage. The number of cells in series and the number of strings in parallel are calculated. The computed voltage and computed bank capacity are recalculated and checked against the inputs.

1. **Chemistry test**

A check is conducted to test whether the specific battery chemistry fits appropriately within lithium ion or lead acid.

1. **Voltage test**

This test does not explicitly test the voltage, but rather ensures the input voltage curve makes sense. This is done by checking whether the exponential and nominal cell capacities are less that the full capacity, and that all capacities are greater than zero.

1. **Current test**

This test checks whether the maximum charge and discharge currents are greater than zero and checks whether the current at any time step is within these limits.

1. **Efficiencies test**

This test checks whether the battery efficiencies input and output are greater than 0% and less than 100%. A more detailed check occurs over every time-step to see if the output battery power correctly accounts for the charging/discharge efficiency.

1. **Charge test**

This test checks whether the total charge at any time step is less than zero or greater than the maximum allowed charge.

1. **Power to load test**

This test checks whether the power to the load from the battery, grid, and pv are greater than 0 and add up to the total electric load.

1. **Power to battery test**

This test checks whether the power to battery from PV and the grid are greater than 0 and add up to the total power charged.

1. **Charge state test**

This test checks whether the state-of-charge and depth-of-discharge at each time-step are greater than 0% and less than 100%. The state-of-charge is also computed from the total charge and maximum charge and checked.

1. **Cycle degradation test**

This test ensures that the output cycles are increasing in order and that the battery capacity is decreasing with cycling.

1. **Peak shaving test**

This test ensures that the demand charge with the system is less than the demand charge without the system. Another test ensures that the peak grid demand is less than the peak electric load.

1. **Replacements test**

This test is run as a lifetime simulation. The first test checks if a battery bank replacement has occurred for the case where no replacements are allowed. The second check reruns the simulation, forcing a replacement at 98% capacity. The final battery capacity is checked to see if it is less than 98%.

1. **Target power test**

This test checks the target power controller. First, the automated peak shaving controller output is examined to get the peak grid power for each month. The target power is set as this peak grid power for each month and the target power controller is run. The new peak grid power each month is extracted and checked to ensure it is within 2% of the setpoint.

1. **Manual dispatch test**

This test checks that the battery simulation outputs don’t violate the constraints set in the manual dispatch controller. For every timestep, the profile is extracted. It is checked whether the battery was allowed to charge from pv, charge from the grid, and/or discharge, as well as whether the battery actually did charge or discharge. If the battery charged from a component it wasn’t allowed to or discharged when it wasn’t supposed to, the test fails. Furthermore, if the battery charged more from the grid or discharged more than it was allowed to, the test fails. Note, currently the battery model is implemented to make up any difference in charge with the grid, such that small amounts of grid charging may occur even when disallowed. This causes the test to fail, but is not catastrophic when actually running the model.

1. **PV to battery priority test**

This test sets PV to charge the battery first. The test then checks whether or not the model properly uses PV power to charge the battery before meeting the electric load.