For Discussion Purposes Only (September 28, 2018)

Introduction

ERCOT’s long term objective is to change software systems to take into account the unique characteristics of storage resources.

In order to minimize trial and error cycles (cause churn in data requirements – not good for ERCOT and the Resource Entities with storage), we are implementing in phases with the intention to learn and refine the requirements for subsequent phases based on the experience obtained in prior phases.

ERCOT’s first step is in requiring additional (new) telemetry from storage resources. The objective of this phase is for ERCOT to develop situational awareness tools for the ERCOT Operators. As an example, develop displays that show how many MW at the Point Of Interconnection (POI) can be sustained (charge or discharge) by a storage resource for 15 min, 30 min, 1 hour,., etc. taking into account its current state of charge (energy in MWh) and its minimum and maximum energy limits.

Time

60min

45min

30min

15min

Discharge MW

Charge MW

Max. Oper. Discharge MW

Max. Oper. Charge MW

# High Level Schematic diagram of a Battery System

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**-**

Xfmr

AuxLoad

Cooling & Control

Battery

Power Electronics

Point of Interconnection (POI) or

Point of Common Coupling (PCC)

**-**

**~**

meter

grid

RBattery

RPwerElec

RXfmr

AuxLoad

Cooling & Control

**+**

**-**

meter

grid

Point of Interconnection (POI) or

Point of Common Coupling (PCC)

Losses considered for Charging and Discharging efficiency calculations

MWdischarging@pcc

MWcharging@pcc

# Losses in a Battery System

# Charging Efficiency Curve

The charging efficiency curve is represented as a function of the charging power (MW).

# Discharging Efficiency Curve

The discharging efficiency curve is represented as a function of the discharging power (MW).

# The State of Charge (SOC) inside battery in MWh for a constant charging power ()

# The State of Charge (SOC) inside battery in MWh for a constant discharging power ()

# Example of Charge Efficiency Curve for a Li-Ion Battery

*Ceff*

# Example of Discharge Efficiency Curve for a Li-Ion Battery

# ERCOT Use of New Telemetry – Example calculations

## Assumption

The charging and discharging efficiencies are fairly constant across operating range.

Using the assumption stated above, Let the single number *Ceff* and *Deff* represent the single charging and single discharging efficiencies respectively across the whole operating range.

The round trip efficiency (*RTE*) is defined as

## Round Trip Efficiency (*RTE*)

The source of Round Trip Efficiency (*RTE*) will not be telemetry. For the first phase, *RTE* will be obtained from Resource Entity via a RFI initially and will be user enterable into the system for modifications. The default value will be 0.8

## The State of Charge (SOC) at PCC or POI in MWh for a constant charging power ()

## The State of Charge (SOC) at PCC or POI in MWh for a constant discharging power ()

## The constant discharge power that can be sustained from time t1 to t2

## The constant charge power that can be sustained from time t1 to t2

**New Telemetry (ICCP) Points for Electric Storage Resources**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Unit** | **Telemetry** | **Description** |
| Maximum Operating State of Charge [SOC\_OperMax] | MWh | X | For the current operating condition of the Storage Resource, represents the maximum amount of stored energy capability in MWh that should not be exceeded. This energy value is calculated at the Point Of Interconnection (POI) or Service Delivery Point (SDP). (FERC 841 Item: “Maximum State of Charge”).  For example, if the Storage Resource currently has the capability of storing a maximum of 10 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC\_OperMax) = 0.94\*10=9.4 MWh  Note: The Resource Entity can provide this telemetry using other techniques/calculations as long as the telemetered value represents the “not to exceed” maximum stored energy capability as measured at the POI/SDP. |
| Minimum Operating State of Charge [SOC\_OperMin] | MWh | X | For the current operating condition of the Storage Resource, represents the required minimum amount of stored energy in MWh that should not be discharged below. This energy value is calculated at the POI/SDP. (FERC 841 Item: “Minimum State of Charge”)  For example, if the Storage Resource is required to store a minimum of 2 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC\_OperMin) = 0.94\*2=1.88 MWh  Note: The Resource Entity can derive this telemetry using other techniques/calculations as long as the telemetered value represents the “not to go below” required minimum stored energy as measured at the POI/SDP. |
| State of Charge  [SOC\_Telem] | MWh | X | For the current operating condition of the Storage Resource, represents the amount of energy in MWh that is being stored. This energy value is calculated at the POI/SDP. (FERC 841 Item: “State of Charge”)  For example, if the Storage Resource is currently storing 6 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC\_Telem) = 0.94\*6=5.64 MWh  Note: The Resource Entity can derive this telemetry using other techniques/calculations as long as the telemetered value represents the current stored energy as measured at the POI/SDP. |
| Maximum Operating Discharge Power Limit  [MaxOperDischargeMW] | MW | X | For the current operating condition of the Storage Resource, represents the maximum discharge power (MW) capability measured at the POI/SDP. (FERC 841 Item: “Maximum Discharge Limit”) |
| Maximum Operating Charge Power Limit  [MaxOperChargeMW] | MW | X | For the current operating condition of the Storage Resource, represents the maximum charge power (MW) capability measured at the POI/SDP. (FERC 841 Item: “Maximum Charge Limit”) |