# TechNote StorageController Update

From OpenDSSWiki

As of Rev 7.4.1 Build 13, there were some updates to the StorageController object to satisfy user needs. In particular, the "schedule" mode was added that produces a trapezoidal-shaped discharge schedule. Another addition was the kWThreshold property for load following mode. The purpose of this is to prevent battery discharge on days when the load is less than a specified Threshold.

The following are examples of using the StorageController in various modes.
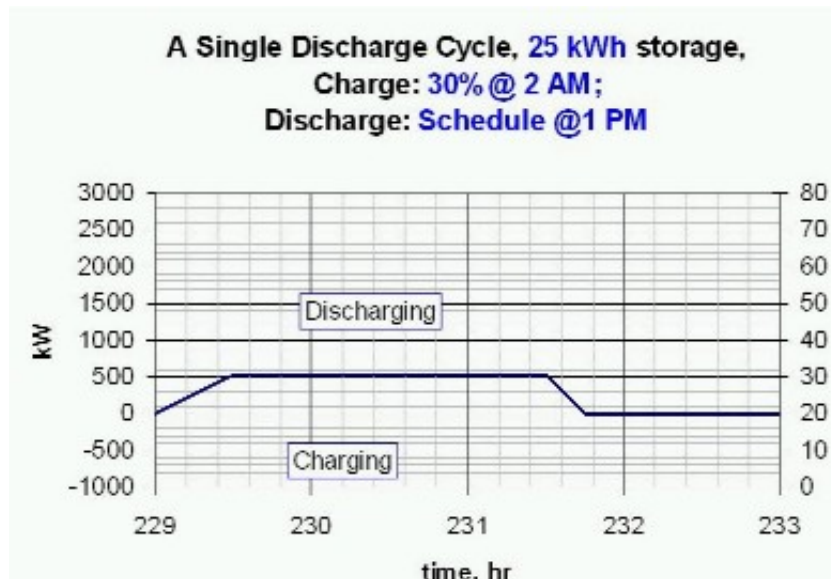
## Contents

## Trapezoidal Schedule

```
! DEFINE STORAGE CONTROLLER
! discharge = schedule (trapezoidal)  ! charge=time  @ 2AM
New StorageController.CESmain  element=line.568_4921721 terminal=1
 ~ %ratecharge=30
 ~ eventlog=y
 ~ modedischarge=schedule
 ~ Timedischargetrigger=13
 ~ %ratekW=25
 ~ Tup=0.5 Tflat=2  Tdn=0.25
```

This example discharges the storage according to a daily schedule. The characteristic is trapezoidal with an upramp time of 0.5 hr. Then it is flat for 2 hr and then a down ramp of 0.25hr. At the flat level the fleet is set to discharge at 25%.

Charging starts at the default time of 2 AM at a constant 30% of rated kW. The Eventlog is turned on so that controller actions are listed in the Eventlog.

Only the discharge part of the daily cycle is shown in the figure below. The fleet size is 2.1 MW. Therefore th 25% level is slightly over 500 kW.

A Single Discharge Cycle, 25 kWh storage, Charge: 30% @ 2 AM; Discharge: Schedule @1 PM

Results for this 2-hr schedule. You'll notice that the discharge may have been timed a little later for more effective peak reduction.

Media:StorageScheduleResults.jpg

# Load Following Time-Triggered

```
! DEFINE STORAGE CONTROLLER
! discharge = load follow @ 1PM (13:00) ! charge=time  @ 2AM
New StorageController.CESmain  element=line.568_4921721 terminal=1
 ~ kWTarget=7000
 ~ kWThreshold = 6000
 ~ PFTarget=0.98
 ~ %ratecharge=30
 ~ eventlog=y
 ~ modedischarge=follow    TimeDischargeTrigger = 13  !---> 1PM
```

In this example, the storage fleet is triggered on at 1 PM (hour = 13:00) and then attempts to dispatch the storage to hold the demand in the monitored circuit element to the kW demand at 13:00.

Charging starts at the default time of 2 AM at a constant 30% of rated kW. The Eventlog is turned on so that controller actions are listed in the Eventlog.

Example from Simulation

Media:StorageLoadFollow.jpg

# Simple Peak Shave

```
! DEFINE STORAGE CONTROLLER
! discharge = peakshave (the default)  ! charge=time @ 2AM
New StorageController.CESmain  element=line.568_4921721 terminal=1
```

```
~  kWTarget=7000   PFTarget=0.98
~  %ratecharge=30
~  eventlog=y
```

Since peakshave is the default mode, the "modedischarge" property does not need to be specified. If the load in Line.568_4921721 starts to exceed 7000 kW, the fleet is discharged to attempt keep the load lower than 7000 kW, with a +/-1% band (%kWBand property default). The storage fleet is discharged until the load drops below 7000 kW or until the energy in the fleet drops to the reserve level.

Charging starts at the default value of 2 AM at a constant 30% of rated kW. The Eventlog is turned on so that controller actions are listed in the Eventlog.

Typical results of attempt to peak shave. Note that the battery ran out of energy before the peak was reached:

Media:StoragePeakShave.jpg

# Simple Time Triggered, Constant Discharge

```
! DEFINE STORAGE CONTROLLER
! discharge = time @ 25% ! charge=time @ 2AM
New StorageController.CESmain   element=line.568_4921721 terminal=1
~  TimeDischargeTrigger=14
~  %ratekW=25
~  %ratecharge=30
~  eventlog=y
```

The controller turns the fleet on at a constant rate of 25% in this example, beginning at 2 PM. The fleet continues to discharge until the storage element reach their reserve level. Charging is prohibited during this time.

Charging starts at the default time of 2 AM at a constant 30% of rated kW. The Eventlog is turned on so that controller actions are listed in the Eventlog.

Typical results:

Media:StorageTime2PM.jpg

Note that once the storage is turned on at 25% rate, it stays on until the storage is discharged. The difference in area between the charge and discharge cycles reflects the losses in the storage element.

# LoadShape Controlled Discharge and Charge

```
! DEFINE STORAGE CONTROLLER
! discharge = loadshape  ! charge=loadshape
new StorageController.sc_battery element=line.Line1
~  %Reserve=20.0
~  ModeCharge=Loadshape
~  ModeDischarge=Loadshape
~  Yearly=ls_bat_cntrl
~  EventLog=Yes
```

The discharge of the fleet storage elements is dictated by the loadshape specified for the solution mode. In this example, the solution mode to which this applies is Yearly. The loadshape objects would typically be computed by another tool. Both charging and discharging are controlled by the loadshape. A positive value denotes discharging (producing power). A negative value denotes charging (absorbing power).

The reserve for all fleet elements is set to 20% of rated kWh.

Charging is also dispatched by the loadshape "ls_bat_cntrl". The controller attempts to dispatch charging at the level indicate when the loadahape value is negative.

The Eventlog is turned on so that controller actions are listed in the Eventlog.

The loadshape used for this example looks like this:



this Loadshape was intended to represent charging a battery with excess power and then immediately discharging to meet excess demand. When this loadahape is applied to a circuit, the result is shown in the following chart. Note that the charge cycle was insufficient to get the battery completely through the desired discharge cycle.

Media:StorageLoadShapeResults.jpg

--Rdugan 04:18, 28 January 2011 (UTC)

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- This page was last modified on 24 May 2011, at 07:06.
- This page has been accessed 459 times.