FAQ on NREL 118-bus test system

1)      What are 'escalators'?

Escalators are simple multipliers of certain generator characteristics. We

use them to adjust a certain generation profile to seasons or other time

slices.

In our case, we create escalators to adjust minimum stable level, load

point and rating, per month. Thus, each of these generator characteristics

will be scaled based on the escalator for each month of the year. We apply

escalators to all the generators, except wind, solar and hydro.

2) Some of the hydro power data might be missing.

The article reads

“The model includes 15 dispatchable and 28 non-dispatchable hydro

generators. Four of the 28 non-dispatchable units have a fixed load (MW)

defined per month, and the other 24 non-dispatchable units have a fixed

load defined with a time series file. This means that the dispatch level

of 15 hydro units is estimated according to the optimal system operation.

On the other side, 28 hydro generators are constrained to a fixed

generation. The database includes the time series data of the fixed

generation of the non-dispatchable units 16-43 except 36-39.”

The fixed load data of hydro generators 36-39 is not in the

database. The Plexos database exported as an excel file show more details, although the input files should be enough now if you are going to build your own optimization algorithm.

Some background on hydro modeling in Plexos, in case it is useful:

Plexos uses two schedules, Medium-term (MT) and Short-term (ST).

Both MT and ST schedules can be defined for the models that include

generators for which such representation make sense (hydro in this case).

Medium-term decomposes monthly hydro energy budgets into daily budgets.

Short-term (ST) schedule is used to model system operation within one day.

In our system, day-ahead (DA) and real time (RT) models have both

schedules (a MT and ST). This means, that Plexos runs a DA model

considering a MT schedule that passes a daily budget to the ST schedule.

The same is true for the RT. Information from MT flows to ST in DA model,

and separately, information from MT flows to ST in the RT.

For the DA model, Plexos will run automatically first a MT schedule using

as inputs the variables defined over months. In the hydro case, this means

that dispatchable hydro (Hydro 1-15), which has a monthly generation limit

or “Maximum energy per month", will have a daily budget defined by the MT

schedule. This is true both for DA and RT runs. Now, all the other hydro

is non-dispatchable, I.e. There is no a damn that can tell us the

available amount we have.

Hydro 16-35 (rating and fixed load are defined with a time series file,

that you can access in Input files/Hydro/\*.csv): this means that the

generation of these units is already passed to the system.

Hydro 40-43 (maximum capacity per month is defined, rating and fixed load

passed by time series file as well): Non-dispatchable units. The fixed

load file is the important one, which defines the load that each of these

units will meet.

Hydro 36-39 (fixed load per month and maximum capacity per month are

defined): Non-dispatchable units. The fixed load per month is the variable

of importance (defined inside Plexos, and attached in the excel file –not

included before. Thanks for the heads-up!). We are defining with this

variable the fixed load that the generator will meet over a month, for

each month.

**3) The dataset (Input files/Hydro/\*.csv), however, includes time series data**

**for 32 hydro generators, not 28. Could you explain this?**

It includes data for 28, Hydro 16-35 and Hydro 40-43. But it

should be for 32 (see above the mention of the data of Hydro 36-39).

Also some of the file names do not correspond to generator names in

Generators.csv (in the form of HY\_\*\_2014.csv), but others do (like 'Hydro

\*.csv'). However, in the table Generators.csv, there are total 43 hydro

generators, which corresponds to 15 + 28.

The generators Hydro 01-15 are dispatchable. All the other are

non-dispatchable.

The files in generators.xlsx include all Hydro generators, I.e. Hydro

01-Hydro 43. This file contains all the characteristics of the hydro

generators, such as rating, maximum capacity, etc. The time series data

are data only for the hydro generators Hydro 16-35 and Hydro 40-43 because

these are non-dispatchable with fixed load defined as a time series (24

non-dispatchable hydro generators with time series data, 4 with monthly

fixed load).

**4) I guess the units of measure for hydro time series data is MWh/h, i.e.**

**energy generated during the hour.**

You are right. The data is in power over time (MW powered

uniformly over the hour), I.e. MWh generated over the full hour.

**5) The fuels used by the generators are not listed in Generators.csv.**

**For most generators, it can be easily inferred from the name, but in the**

**table  Fuel prices 2014.csv there are prices (although equal) for at most**

**three  'levels' (e.q. 'Biomass R1' through 'Biomass R3'). Could you**

**explain this? Then  there are two generators called 'ST Other 01’ and 'ST**

**Other 02'. What fuel  those use?**

Since we built this model in Plexos, we needed to specify a fuel

price per region (I.e. Region 1 or R1, region 2 or R2 and region 3 or R3).

This is the reason you see several columns for each fuel. ST Other 01 uses

Oil R1 and ST Other 02 uses Natural Gas R1. It is worth mentioning also

that the escalator “TBD” corresponds to the multiplier for the geothermal

generator “Geo 01”. We have corrected this is the database, but just so you

are aware of this.

**6)      In table Generators.csv, column 'Rating', some rows have value**

**which is text (e.g. generator 'Wind 01' has rating 'Wind 01'). Maybe these**

**belong to  the next column 'Escalator of rating' and this is an error?**

Rating is a text variable when it indicates a file (the .csv name. For

example, rating=“Wind17" corresponds to Wind17.csv in the time series data

folder). Thus, text indicates that the particular generator has a time

series data of generation, I.e is non-dispatchable and cannot be committed

in the DA model.

**7) What does column 'Commit' in Generators.csv mean? Commit State of**

**the generator? Values are in {-1, 0, 1}.**

This is a categorical variable used by Plexos to understand

which generators can commit in which model/market.

Commit >=0 means a hard constraint. Commit=0 (do no commit) and Commit=1

(commit). [I assume each row in my table, I.e. Each generator, corresponds

to one unit. If you have several units, commit=1 would be commit=1\*number

of units].

Commit=-1 is the default value, I.e. That unit is left without a hard

constraint and can commit freely based on the optimization.

The most common use for commit is for baseload generators, where one would

set commit equal to the number of units i.e. commit the unit is it is

available. Another application is with intermediate type units who might

commit during certain hours e.g. peak periods, but be either off during

off-peak, or freely optimize their commitment in those other periods.

Slow generators have to commit in DA. Also a data file overwrites these

values. For example, Biomass 01 has commit=DA UC in RT, meaning that it

was optimized freely in the DA  (and so I set commit=data file in the RT

case), and very fast generators do not need to commit one day ahead of

schedule.

For your reference, here is a graph I did to better understand this (in

this case an intra-daily market is included):



The horizons are the day ahead (DA), four- hour ahead

(4HA) and real time (RT) horizons, and correspond each to one model (i.e.

one

run) in Plexos. The schedules included are the medium-term (MT) are

short-term

(ST) schedules. The medium-term (MT) is run automatically in Plexos when

performing

a ST schedule of a given model –assuming that the schedule has been

associated

with that particular model. The ST runs using the output of MT. In the

ISO-NE

and IEEE-118 models MT is used to schedule daily budget out of monthly

constraints, and the output of the MT is used automatically in Plexos when

performing the ST schedule.

**8) I suppose the input file Input files/Others/GenOut.csv defines**

**generator outages. What is the syntax here?**

The file shows the month, day and hour at which such unit

was out of operation (Units Out reports if the Generator is out-of-service

with either a Forced Outage or Maintenance.)

Value of 1 = true (I.e out of service) for that hour. You can then obviate the rows that have a 0 value.

Default value = 0.

In general, I would suggest opening the .xml file in Plexos (you can

use version 6.4 but if you have another version, you can upgrade the .xml

automatically) just to explore more each generator/model. The .xml points

to all the data. Thus, it is important that the same folder that contains

the .xml, contains the folders “Input files”. Otherwise, when running the

models in Plexos, you will get an error because it cannot find the path to

time series and fuel data.