Input File Formats for the June 2018 Version of the RTS3 Program.

RTS3 now includes pumped storage and individual VER source storage:

1) Integer generator capacities can now be entered as decimal values.
2) Only one hourly historical data file is needed for the demand and VER profiles.
3) Pumped energy storage and individual VER energy storage has been added.
4) An additional report PS.txt file shows how energy storage is used for all hours.
5) A target LOLE feature automatically seeks a demand giving that precise LOLE.
6) The generator data file can now include extensive comments for generators.
7) All data other than VER profiles is in the generator data file for easy tracking.
8) The program source is in Matlab format and also in Fortran 77 format coding.
9) An F77 .exe file is included which may set off alarms at your work office.

Here is the format of the hourly file H2020.txt:

```
55,2020 IEEE RTS hourly demand wind hydro and solar profiles...
YYYYMMDDHH,D, DEMAND, HYDRO,    WIND,   SOLAR,  SOLARR,
2020010101,4,0.40740,0.1842,0.850074,0.000000,0.000000,
2020010102,4,0.39809,0.1990,0.909606,0.000000,0.000000,
2020010103,4,0.39639,0.1638,0.843176,0.000000,0.000000,
2020010104,4,0.39852,0.1678,0.819610,0.000000,0.000000,
2020010105,4,0.41540,0.1626,0.796922,0.000000,0.000000,
2020010106,4,0.44828,0.1410,0.773835,0.000000,0.000000,
2020010107,4,0.48201,0.1506,0.681646,0.000000,0.000000,
2020010108,4,0.48668,0.2886,0.541848,0.416726,0.145686,
2020010109,4,0.48862,0.2514,0.464612,0.600515,0.365249,
2020010110,4,0.49224,0.3386,0.309143,0.671727,0.531686,
2020010111,4,0.49111,0.3506,0.169146,0.703056,0.635784,
2020010112,4,0.49001,0.3498,0.093345,0.700032,0.667040,
  :        :     :      :        :       :        :
end,,,,,
```

The first line is a title following the user decided number 55 which means read only the first 55 characters on each line. Comments beyond 55 will be ignored by RTS3. The first three spaces of the title line are reserved for the length of the line to read which is 55 in this instance. The maximum value is a line length of 220 for data.

The next line is a header for the time stamp, day of the week, the demand profile, and VER (variable energy resources) profiles. There are four VERs, hydro, wind, solar, and rooftop solar. D is the day of the week with 1 being a Sunday. The D = 4 means the first day is a Wednesday in 2020. The hourly file can contain any number of historical years. RTS3 is usually run with a large number of historical years concatenated together. No hours can be skipped although you can use DST daylight savings time hours which duplicates an hour and omits an hour in the year. The date

time stamp is stored as a 32 bit integer and cannot be used beyond the year 2147 without overflow of the integer. We will all be dead by then anyway.
The names Demand, Hydro, Wind, Solar, SolarR, should be left in the header as shown because this header file description is rewritten as a header in file OPH.csv. You may want to add PS, VER Stoage, also to the end of that description since these hourly values will also be listed in OPH.csv although you don't have to do this.

This hourly file contains per unitized MW's of demand and VERs. The hourly demand column has at its greatest value 1.00000000 per unit demand for each historical year. The H2020 file only has one year because that is the way NREL created the data files. However you should have several years because you get to see the year to year variations if you use many historical years. It's best not to create an average year. Just enter all the historical years and the the random variations are already in the data, such as wet and dry years of hydro for example. The hourly profile data file must end with the "end" line shown above.

Here is the format of the generator data file G2020C.txt:

```
26,2020 IEEE RTS  8192 MW load  8076 MW conventional generation with. . .
H2020.txt                 hourly sequential demand and VR data for this . . .
9999,0.000,1.E-4,         peak demand, %LFU (load forecast uncertainty) for .
4,  90, 500,   4, 100,    4 VERs (20 max), 90% PS efficiency, 500 MW PS..
76.6, 9.3, 43.1, 37.6,    VER capacity credits used in reserve margin calcs
0,0,0,0,                  VER extra MW used to charge up storage only ...
1000,810,250,250,         VER nameplate capacities used to serve load
PMAX ,RM%, FOR, DER,DMW,  BU#,GENERATORNAM,TP,
  20.,100,.100,.000, 0.,  101,ABEL___Oil_1,CT,
  20.,100,.100,.000, 0.,  101,ABEL___Oil_2,CT,
  76.,100,.020,.000, 0.,  101,ABEL___Coal3,ST,
  76.,100,.020,.000, 0.,  101,ABEL___Coal4,ST,
```

The first line is a title following the number 26 which tells RTS3 how many columns to read of data on each line following the title. Comments after column 26 are not read by the program. The first three spaces on the first line are reserved for your number which can range from 1 – 220 characters each line being read in.

The second line is the hourly data file name followed by blanks through col 26.

The third line is the peak demand 9999 and in this case, we will ask the program to find a demand target automatically to achieve an LOLE = 0.1 d/y. Start the demand out too high and it will come down to the exact value using half interval searches and upper and lower bounds.

The LFU load forecast uncertainty is in percent and uses the Billington's 7 step Normal distribution. The next number of 1.e-4 means do not list days that have all hours with LOLPs less than .0001. Days LOLP>.0001 are listed in file OPH.csv.

The fourth line shows there are 4 VERs in the hourly H2020C.txt file. The 90 means pumped energy storage is 90% efficient. The 500 is the MW of pumped storage charging followed by the number 4 which is the hours max energy at the 500 MW level of charging. The last 100 means to give pumped storage 100% capacity credit in the reserve margin calculation.

The fifth line shows the percentage capacity credits to be given to the VERs in the reserve margin calculation. These numbers are not used in the LOLP calculations.

The sixth line is the amount of VER capacity in MW that is installed and is not connected directly to the grid but charges up storage that is then used in the following 24 hours to shave off the peak demand after pumped storage energy. You put this kind of VER into the model to prevent too much dumping of energy because there is too much renewable power at the wrong times. It has to go to storage. You can split the VERs between going directly to the grid and going to their own storages. This feature will be needed if you want to study going to 100% non fossil fuel systems.

The seventh line is each VER MW corresponding to the hourly H2020C file profiles and this creates hourly VER MW's which are subtracted from the demand each hour. What you are doing on this line is telling the program how many MWs you want to apply to each profile column in the hourly file. In this manner you can run many different generation scenarios that use different amounts of VER capacities without having to change the hourly data file. Even though the V ER capacities go into the generator file they are never treated like generators. They are always treated like hourly load reducers. VERs are never to be put into the COPT if you want correct answers to your simulation.

The eighth line is a header that is used as a header in the .csv output file reports.

The ninth line and all the rest of the lines are generator data. The first generator is a 20 MW (oil burner?) given 100% capacity credit in the reserve margin and has a forced outage rate of 10%. The modernized RTS has probably changed this to a natural gas peaker. I need to change the fuel types in the new files.

RTS3 writes out a PS.txt file which shows hourly operation of pumped storage:

```
2020010101     -378.21         0.00      3579.04
2020010102     -500.00         0.00      3544.72
2020010103     -462.31         0.00      3579.04
2020010104     -425.92         0.00      3579.04
2020010105     -233.56         0.00      3579.04
              -2000.00  <- pumped storage charging is limited to 500 MW at 4 hours or 2000 MWh
max energy.
2020010106        0.00         0.00      3714.55
2020010107        0.00         0.00      4116.88
2020010114        0.00         0.00      4153.73
2020010115        0.00         0.00      4236.92
2020010116        0.00         0.00      4247.25
2020010117      136.52         0.00      4444.55  <- notice the daily peak net demand is lopped
off so it's constant with PS.
2020010118      579.08         0.00      4444.55     see the bottom of this file for more stats.
2020010119      588.92         0.00      4444.55
2020010120      383.46         0.00      4444.55
2020010121      112.01         0.00      4444.55
              1799.99  <- pumped storage discharging is not capacity limited but is limited
to 90% of the stored energy.
2020010122        0.00         0.00      4175.21
2020010123        0.00         0.00      3745.17
2020010124        0.00         0.00      3595.01     1800. MWh      589. MW
```

Setting up RTS3 in a directory to do a study.

Copy the files in RTS3S.zip to your working directory. Run RTS3.m or RTS3.exe and give it the name of one of the generator files which start with a G. You can choose to have the program auto seek a target demand level to specific LOLE or you can just hit return and it will not seek a new demand level.

I recommend you run RTS3.exe which is a compiled Fortran version that runs quite a lot faster than the Matlab version. It was compiled from the defunct Compaq Fortran of many years ago but executes fine in all versions of windows. Many computer centers will not allow .exe files to be imported. If you would like to test a way to compile the Fortran on the fly as a temporary file contact me at g.preston@ieee.org and I will tell you how to get set up to do this. This on the fly Fortran uses Watcom 77 which is now in the public domain and executes fine for all versions of windows. It's more powerful and has better error reporting than the Compaq Fortran. You can download the Watcom 77 program from their web site or I can show you an even easier way to get it running. Just let me know if you are interested.

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