EC473 CONTROL OF POWER SYSTEMS

Lab # 2 - Introduction to Unit Commitment Software

This lab will use the **UNITCOM** software, which in the **POWERGEN** folder. It is similar to the economic dispatch program that was run in lab 1. To run the program, double-click on the UNITCOM.EXE icon. An input data file has to be ready and the following describes the structure of the input file.

***INPUT DATA FILE FORMAT

The unit commitment input data file starts with two header lines of up to 80 characters each. This is followed by a line with a single number equal to the number of generating units represented.

Each generating unit has exactly four lines of data. The first is a dummy line of characters much like the header (it is ignored by the program and just serves as a label in the data file). The second line contains the unit low limit in MW, the unit high limit in MW and the unit incremental heat rate in Btu/kWh. The third line contains the unit no load cost in $/h, the unit start up cost in $ and the unit fuel cost in $/MBtu. The fourth line contains three integers: the unit minimum up time in hours, the unit minimum down time in hours and the initial unit status in hours (positive being hours up and negative being hours down at the start of the schedule).

This is followed by another line with two entries containing the number of periods in the load schedule and the length in hours for each period. This is followed by a line with MW load values one for each period in the schedule.

Example: This example is for file UNITCOM1.DAT on your disk. The arrow <---- will denote comments and is not on the file.

```
UNIT COMMITMENT DATA FILE - 8 PERIODS/4 UNITS ( Chapter 5 example )
-----------------------------------------------------------------
4                       <---- number of units
unit 1 data             <---- dummy "comment line for first unit
25.0  80.0  10440.0 <---- unit 1 min MW, max MW, inc heat rate (Btu/kWh).
213.0  350.0 1.0        <---- unit 1 no load cost, start up cost, fuel cost
4  2  -5                <---- unit 1 min up time, min down time, initial status
unit 2 data             <---- dummy line for second unit
60.0  250.0  9000.0
585.62 400.0  2.0
5  3  8
unit 3 data
75.0  300.0  8730.0
684.74 1100.0 1.0
5  4  8
unit 4 data
20.0  60.0  11900.0
252.0  0.02 1.0
1  1  -6
8  1.0                  <---- number of periods and length period in hours
450.0  530.0  600.0  540.0  400.0  280.0  290.0  500.0 <---- load MW values
```

The term “inc heat rate” refers to the linearization of the cost curve by taking the full-load running cost minus the no-load running cost and dividing by the unit rating. The result needs to be multiplied by 1000 to convert to Btu/kWh.

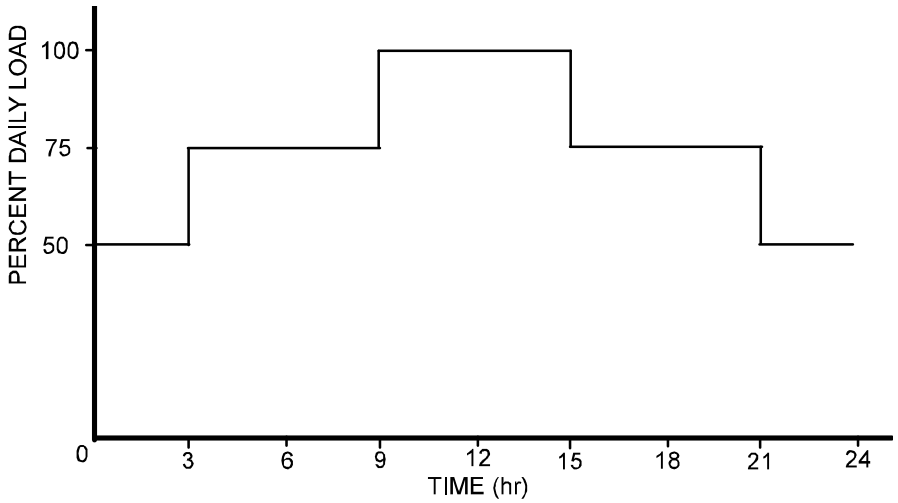
To run the software:

i) Double-click on the **POWERGEN** icon.
ii) Double-click on the **UNITCOM.EXE** icon.
iii) You will be asked if you want to output to a file (this is your choice and its not a big deal either way).
iv) You will be asked for an input file.
v) Once the file is loaded you will be given the option of priority order or complete enumeration. select “2” for complete enumeration.
vi) You will be asked for the number of search states and you can enter any number up to $2^n - 1$. The larger the better provided computation does not become excessive. This number is repeated for both previous and present periods.
vii) Answer “y” to include up/down time constraints.
viii) The final table in the output will tell you the optimum ON/OFF combination for each time period.
ix) You will need to run EDC for each combination in (viii) to determine the incremental running cost for each time period and the total operationg cost.

You are now ready to analyze your assigned utility. Work in groups of three as follows:

Group #	Names
1	Jesse, Andy & Jiaqi
2	Doug, Nikki & Charlie
3	Megan, Brandon & Nathan
4	Joel, Zach & Andrew

This part of the lab will simulate the operation of four power utilities with the generators shown on the next page. The lab groups have the peak loads with the load profile shown below. Model it as 8 x 3 hr. periods.



Group #

1	units 1, 3, 4, 5 & 6	Max. load = 2250 MW
2	units 2, 7, 8, 9 & 10	Max. load = 4000 MW
3	units 6, 7, 8, 9, & 10	Max. load = 4250 MW
4	units 1, 3, 4, 5 & 8	Max. load = 2250 MW

Assume that the utilities operate as separate entities and are free to commit units to minimize cost, but are unable to trade with each other. Each person runs their own unit commitment for their utilities and arrives at a dispatch schedule that will minimize the cost of supplying their own loads. Determine the total annual generating cost and hence the daily average energy cost for each utility; then determine the overall average energy cost for the whole interconnection, under these conditions.

To run the unit commitment program apply the following assumptions:

- Min. up and down times, in hours, are equal to (3 x unit rating in GW).
- Neglect transmission losses and ignore operating reserve requirements.
- Base initial up-down pattern on the priority list for 24:00hr i.e. run the program once and see which units are left on after 24 hrs.
- Start-up costs are as follows:

UNIT #	START-UP COST ($)
1	15000
2	6875
3	12000
4	14000
5	7500
6	22000
7	11875
8	10000
9	30000
10	28750

The generating units are as shown. They are similar to those used in lab 1, but #s 4 & 9 have been changed.

Unit #	Min MW	Max MW	F(P)
1	400	1000	$500 + 3P + 0.003P^2$
2	100	550	$600 + 4P + 0.006P^2$
3	300	750	$200 + 2P + 0.002P^2$
4	150	850	$400 + 3P + 0.001P^2$
5	50	350	$100 + 5P + 0.005P^2$
6	150	1050	$600 + 4P + 0.003P^2$
7	65	475	$250 + 6P + 0.008P^2$
8	125	650	$800 + 4P + 0.004P^2$
9	450	1250	$900 + 7P + 0.002P^2$
10	400	1150	$450 + 8P + 0.002P^2$