Power Systems Economics: Homework #4

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Given: A company called Borduria Energy wns a nuclear power plant and a gas-fired power plant. Its trading division has entered into hte following contracts for 25 January:

- A forward contract for the sale of 50 MW at a price of 21.00 $/MWh. This contract applies to all hours.

- A long-term contract for the sale of 300 MW during off-peak hours at a price of 14.00$/MWh.

- A long-term contract for the sale of 350 MW at 20.00$/MWh during peak hours.

In addition, for the trading period from 2:00 to 3:00 pm on that day, it has entered into the following transactions:

- A future contract for the purchase of 600 MWh at 20.00$/MWh.

- A future contract for the sale of 100 MWh at 22.00$/Mwh.

- A put option for 250 MWh at an exercise price 23.50$/Mwh.

- A call option 200 MWh at an exercise price of 22.50$/Mwh.

- a put option for 100 MWh at an exercise price of 18.75$/Mwh.

- A bid in the spot market to produce 50 MW using its gas-fired plant at 19.00$/Mwh.

- A bid in the spot market to produce 100 MW using its gas-fired plant at 22.00$/Mwh.

The option fee for all call and put options is $2.00/Mwh. The peak hours are defind as being the hours between 8:00am and 8:00pm. Borduria Energy also sells electrical energy directly to small consumers through its retail division. Residential customers pay a tarrif of 25.50$/Mwh.

A) Determine Borduria Energy's profit or loss for the entire trading period

First we have to determine the outcome of all the options based on the given spot price of 21.00$/MWh:

- The Put option for selling at $23.50. would be exercised due to it being greater than $21.00.

- The call option to buy $22.50 will **not** be exercised due to the spot price being lower.

- The put option to sell at $18.75 would **not** be exercised due to the spot price being higher.

And, just to clarify, the following table will show the rest of the financial transactions for the specific hour:

Item	Energy Bought	Energy Sold	Price	Expenses	Revenue
Contracts & Purchases					
Future T4	600		20.00	12,000	
Future T5		100	22.00		2,200
Forward T1		50	21.00		1,050
Long-Term T3		350	20.00		7,000
Balancing Spot Purchase	100		21.00	2,100	
Physical Assets & Sales					
Nuclear Unit	400		16.00	6,400	
Gas-fired Unit	200		18.00	3,600	
Spot sale T9		50	21.00		1,050
Residential Customers		300	25.50		7,650
Commercial Customers		200	25.00		5,000
Options					
Exercise Put T6		250	23.50		5,875
Fee T6			2.00	500	
Fee T7			2.00	400	
Fee T8			2.00	200	
Totals	**1300**	**1300**		**$25,200**	**$29,825**

But now we must calculate the profit, of which is just Revenue - Profit orrrr:

$$Profit = Revenue - Expenses = 29,825 - 25,200 = \$4,625$$

B) What is the financial impact if the nuclear power plant fails?

If theh nuclear plant fails the, then Borduria Energy's defecit on energy increases by 400MW, making the new energy defecit 500MW. BUT, this defecit increase also increases the spot price to that of 28.00$/MWh. This then causes the following effects:

- Operating Expense for Nuclear Plant Eliminated: -$6,400

- Spot Purchase Cost increase: $+500 * 28.00 = \$14,000$ but subtract old spot purchase:

$$\$14,000 - \$2,100 = +\$11,900$$

Therefore the net change in costs is simply just $11,900 - 6,400 = \$5,500$ and of which means we must subtract from the old profit:

$$4,625 - 5,500 = -\$875$$

Net Profit being negative meaning that if the Nuclear Plant fails, Borduriia Energy will have a **loss** of $875.