Economic Operation and Control of Power System

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Lecture – 33

A very good morning. Welcome you all to the NPTEL course on Economic Operation and Control of Power Systems. Today we will be focusing on the concept power pools. Now different nations do adopt different mechanisms to cater energy to their consumers. Because of competitiveness, because of bilateral and multilateral transactions, different models have been adopted for smooth functioning of those transactions. So power pool is one of the concepts being practiced commonly in North America is one of the examples where we can understand how transactions are being carried out successfully and being implemented for smooth functioning of utilities.

Now when you talk about power pools, the power pool mainly is a central dispatch unit which maximizes many economic benefits. Now one of the main important achievements through power pools could be minimizing the operating cost, indirectly maximizing the operation or operating efficiency. Now what exactly a consumer expects from you or from a utility is to have electricity with cheaper cost. So we have to explore the competitiveness and through transparency we can make sure that the minimum cost to the energy can be achieved.

Now we can also perform a system wide unit commitment because assuming the transactions and other units status, a new unit commitment algorithm can be carried out. Now power pool can also minimize the reserves being carried through the systems. Sometimes we used to have excess reserve towards the reliability but that may certainly cost you too much for your energy price. So that is also another area that need to be optimized. It can also coordinate maintenance scheduling to minimize cost and maximize reliability by sharing reserves during maintenance period.

It can also maximize the benefits of emergency procedures. Being said that there are n number of issues that need to be improved and it is little bit of a demerit or I can say disadvantage to pool operation and we have to be careful before implementing pool model to any utilities. The complexity of the pool agreement and the continuing cost of supporting the inter-utility structure required to manage and administer the pool. The operating and investment cost associated with the central dispatch office and the needed

communication and computational facilities because that is another layer we are introducing over existing layer so certainly it is a cost issue. The relinquising of the right to engage in independent transactions outside of the pool by the individual companies to the pool office and the requirement that any outside transaction be priced on a split saving basis based on pool members cost.

The additional complexity that may result in dealing with regulatory agencies if the pool operates in more than one region or states. The feeling on the part of the management of some utilities that the pool structure is displacing some of an individual system management responsibilities and restricting some of the freedom of independent actions possible to serve the needs of its own customer strategy. Now there are few questions that I am raising here. Who will pay what to whom for all the economic transactions and special reimbursement built into the pool agreement because we need to have clarity the benefit whether it is an independent system operator or the pool mechanism can gain profit out of it so we have to be very careful before adopting any pool mechanism. No pool member should have higher generation production expenses that it could achieve by dispatching its own generation to meet its own load.

Now power is sold to and purchased from the pool and participants accounts are updated currently. After the fact competition each participant does an own load dispatch to determine how much it would have cost to just serve its load. Some participant own load cost and subtract actual pool operating cost and that is their saving. For example if I do operate my own generation to meet my own load I would have spent rupees x but going through a pool mechanism if it is 0.9x then I can say 10% of saving is certainly possible.

Now the term energy broker is a very important concept because the broker is someone who really a kind of intermediate person between the consumers and the pool manager. Doing many bilateral transactions deals between companies and market place is quite haphazard. Central broker accept quotations to sell and quotation to purchase creates an orderly market place where supply, demand and prices are known simultaneously. Now to understand one broker mechanism let us focus on one utility that is Florida Energy Group broker and what they do and how do they make profit as well as make their consumers and suppliers happy. Now if you go for hourly each member sends incremental cost in megawatt willing to sell or decremental cost in megawatt willing to buy.

That means we expect each entity to give these two offers selling buying cost. Once all the data related to selling and buying is available with the broker the broker matches lowest cost seller to the highest cost buyer. So what the broker will do try to get the energy which are available to him cheaply and engage those consumers those are ready to buy with the higher cost until all megawatts are sold or purchased. So as a seller I will be

tempted to offer a lower price so that my energy is being sold. Similarly as a consumer I will offer a higher price to make sure that I have not been left out without electricity.

Now if you do this process split so there are a lot of benefits so if you see the amount received is X and the amount spent is Y the end of the day there is a saving called X minus Y and that need to be distributed across the utility entities with a different mechanism. So the split savings model works as follows what they do FS which is incremental cost of selling utility. FB is the decremental cost of the buying utility and FC is the cost rate of the transactions and that will be FS plus half of FB minus FS that is half of FS minus FB is the cost rate for each transaction. Now let us look at a very simple example four power systems have sent their buy sell offers to the broker they are A, B, C, D. A and B are selling energy and C and D are buying energy.

In the table below these are tabulated and the maximum pool saving possible is calculated using a uniform pricing mechanism. Now if A and B are two different utilities interested to sell their energy with an incremental cost offer of 25 and 30 respectively and with a magnitude of actually 100 megawatt hour each then probably the sellers total increase in cost will be 25 into 100 that is 2500 and 3000 respectively. So indirectly the broker has to pay 5500 rupees to buy energy from both A and B. Now after that he has consumer C and D who is ready to buy this 200 megawatt in a fashion one is ready to buy 50 that is C utility and the second one is 150 such as D utility. Now the question is consumer C and D are ready to buy energy with a cost which is 35 and 45.

So the cost will be 1750 and 6750. So the pool the broker or the pool entity will have the benefit which is 1750 plus 6750 being received from the consumer C and D and being paid to A and B that is 2500 plus 3000 and net saving is going to be 3000 rupees or dollar. Now this is a very very simple example anyone can understand this matter but the important factor is it is important that this 3000 rupees profit need to be minimized because the role because if you like to encourage a competitive market then this profit has to be as minimum as possible. So probably assume that this profit is going to be zero. What does it mean that the broker has played an important role to connect two very interesting consumers as well as seller directly.

So the utility has to take care that this profit that is being created must be reasonable and should not be beyond a particular value. So how do we guarantee that's a question we need to answer. Now let's say the broker set up transactions such as A is selling 100 megawatt to D and B sells 50 to D and B sells 50 to D that means the D consumer is getting actually 200 megawatt hour from both A and B into three different ways. Now when you calculate the saving because if the purchase is 45, the selling is 25, second case purchase is 45 selling is 30, the third one is purchase is 35 selling is 30 so then each level you save some money that is 2750, 200 so indirectly 3000 that's what we calculated

earlier will become my saving. Now the rates and the total payments are easily computed under the uniform pricing arrangement at the price of the last match the highest value if you calculate the saving computation become if it is slightly higher let's say 37.5 then probably you can increase the profit from 3000 to 7500 and if that profit goes as high as possible the time may come that the system may collapse if the profit become higher and higher over time. So it has to be reasonable so that the consumers must be happy to buy as well as the sellers must be happy to sell without worrying about extremely minimum price to sell and extremely higher price to purchase. So thank you very much and we will move to one more important section so called transmission effect and issues in during our next class. So thank you very much for your attention.