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MODULE : 4

INTERCHANGE OF POWER AND ENERGY

OVERVIEW

- POWER POOL
- MULTIPLE UTILITY INTERCHANGE TRANSACTIONS
- OTHER TYPES OF TRANSACTIONS

POWER POOL

- When a system is interconnected with many neighbours the process of setting up one transactions at a time with each neighbour can become very time consuming and result in optimum production cost
- To overcome the burden several utilities may form a power pool that incorporates a central dispatch office
- ***Power pooling is used to balance electrical load over a larger network* (electrical grid) *than a single utility.***
- It is a mechanism for interchange of power between two and more utilities which provide or generate electricity
- For exchange of power between two utilities there is an interchange agreement which is signed by pool member, but signing up an interchange agreement between each pair of utilities within a system can be a difficult task where several large utilities are interconnected.
- Thus, it is more advantageous to form a power pool with a single agreement that all join. That agreement provides established terms and conditions for pool members and is generally more complex than a bilateral agreement.
- In one model, the power pool, formed by the utilities, has a control dispatch office from where the pool is administered.
- All the tasks regarding interchange of power and the settlement of disputes are assigned to the pool administrator.

Advantage of Power Pool and Constraints

- **The formation of power pools provide the following potential advantages:**
  - Decrease in operating costs
  - Saving in reserve capacity requirements
  - Help from pool in unit commitment
  - Minimization of costs of maintenance scheduling
  - More reliable operation
- **The formation of a power pool is associated with a number of problems and constraints. These include:**
  - Pool agreement may be very complex
  - Costs associated with establishing central dispatch office and the needed communication and computational facilities
  - The opposition of pool members to give up their rights to engage in independent transactions outside the pool.
  - The complexity towards dealing with regulatory authorities, if pool operates in more than one state.
  - The effort by each member of the pool to maximize its savings.
  - Power pooling is very important for extending energy control over a large area served by multiple utilities.

Economy interchange between interconnected utilities

Unit data $F_i(P_i)=f_i(a_i+b_iP_i+c_iP_i^2)$

UNIT NO	FUEL COST fi	Cost Coefficients			Unit Limits	
		ai	bi	ci	Pimin (MW)	Pimax(MW)
1	2.0	561	7.92	0.001562	150	600
2	2.0	310	7.85	0.00194	100	400
3	2.0	78	7.97	0.00482	50	200
4	1.9	500	7.06	0.00139	140	590
5	1.9	295	7.46	0.00184	110	440
6	1.9	295	7.46	0.00184	110	440

Area 1 Load= 700 MW
Max total generation=1200MW
Min total generation= 300MW

Area 2 Load= 1100MW
Max total generation=1470MW
Min total generation= 360MW

Multiple utility interchange transactions

- **Regional interconnectivity**
- Most of the power systems are interconnected with all their immediate neighbouring systems
- One system may buy and sell interchange power simultaneously with several neighbours
- The price for interchange must be set while taking account of the other interchanges
- Prices are derived from the incremental costs of the various utility systems
- A group of utility power systems may form a power pool
- The price might be set by the power and energy pricing policies and must be established by a centralized pool control centre
- When there is no centralized centre, the order in which transaction

agreements are executed is very important in costing the interchange

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Multiple utility interchange transactions

- Multiple neighbouring utilities may engage in "wheeling" simply stated, wheeling is the transmission of power from one utility, through one or more intermediate utility systems, to a third utility system
- The intermediate systems AGCs keep the net interchange to specified values, regardless of the power being passed through the transmitted power changes the transmission losses incurred
- In the intermediate systems the increased losses represent an unfair burden on the intermediate systems, if the utilities are not part of the interchange agreement
- Therefore the increased losses are supplied by the intermediate systems
- Generation utilities may impose a wheeling access charge for such power

OTHER TYPES OF TRANSACTIONS

- CAPACITY INTERCHANGE
- DIVERSITY INTERCHANGE
- ENERGY BANKING
- EMERGENCY POWER INTERCHANGE
- INADVERENT POWER EXCHANGE

CAPACITY INTERCHANGE

- Normally , a power system will add generation to make sure that the available capacity of units has equal amount of capacity as it is predicted for peak load as well as for reserve to cover unit outages
- If for some reasons this criterion cannot be met the system may enter into a capacity agreement with the neighbouring system, provided that the neighbouring system has surplus capacity beyond what it needs to supply its own peak load and maintain its own reserve
- In selling capacity the system that has a surplus agrees to cover the reserve needs of the other system
- This may require running an extra unit during certain hours which represents cost to the selling system

DIVERSITY INTERCHANGE

- Daily diversity interchange arrangements may be made between two large systems covering operating areas that span different time zones
- Under such circumstances one system may experience its peak load at a different time of the day than the other system simply second system is behind 1 hour
- If the two system experience such phenomenon they can help each other by interchanging power demand during the peak
- The that peaked first would buy power from the other and then pay it back when the other system reached its peak load

ENERGY BANKING

- Energy banking agreements usually occur when a predominantly hydro system

is interconnected to a predominantly thermal system

- During high water runoff periods the hydro system may have energy to spare and will sell it to the thermal system
- Conversely the hydro system may also need to import energy during periods of low runoff
- The prices for such arrangements are usually set by negotiations between the specific systems involved in the agreement

EMERGENCY POWER INTERCHANGE

- It is very likely that at some future time a power system will have a series of generation failures that require it to import power or shed load
- Under such emergency it is useful to have agreements with neighbouring systems that commit them to supply power so that there will be time to shed load
- This may occur at a times where it is not feasibly economical from an incremental cost point of view
- Therefore such agreements often stipulate that emergency power be priced high

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INADVERENT POWER EXCHANGE

- The AGC systems of utilities are not perfect devices with the result that they are regularly occurring instances where the error in controlling interchange results in a significant accumulated amount of energy This is known as inadvertent interchange
- Under normal circumstances system operators will “pay back” the accumulated inadvertent interchange energy megawatt-hour for mega watt usually during similar time periods in the next week period
- Differences in the cost during these periods are ignored