tional approach. It is, therefore, as accurate as the conventional method but is many times faster. It is shown that gain in cpu time for a large system is approximately

$$g \approx \frac{1-f}{rf}$$

where f is the *average* number of units on planned outage per week as a fraction of the total number of units.

r depends on the ratio of average weekly peak load to the annual peak load and the capacity on maintenance per week. This factor may be typically around 1.5.

The method is illustrated by studies performed on the IEEE-RTS system and an EPRI test system.

Experience with electric utilities indicates that the speed of execution of generating capacity reliability programs is important for practical applications. First some users want to implement these programs on relatively slower computers. Secondly while doing multiyear expansion studies, the turn around time is important as the planners generally perform numerous sensitivity studies.

Discusser: P. F. Albrecht

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89 WM 195-9
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Evaluation of Transmission Network Capacity Use for Wheeling Transactions

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This paper describes the principles and the implementation of a methodology to evaluate the transmission network capacity use for firm transmission services including wheeling transactions. In this methodology transmission network capacity use for a transaction is a function of the magnitude of electric power, the length of the transmission lines and the type of facilities involved in the transaction. This capacity value provides an equitable means of allocating the cost of transmission facilities among users of the firm transmission service.

The basic concept of this methodology, referred to as MW-mile methodology, is described in the following:

"Given a transaction with the actual points and the variations of generation (delivery) and load (receipt) specified, MW-mile methodology calculates the maximum transaction-related power flow on every transmission line using a DC power flow and linear programming algorithms. The maximum transaction-related flow on every line is multiplied by the line length and a factor reflecting the cost per unit capacity (MW) of the line. These values are then summed over all the transmission lines in the network to yield the transmission network capacity use for the transaction."

Through examples the following potential benefits of using the MW-mile methodology in allocating transmission network capacity cost to the users of firm transmission service has been identified:

- It is insensitive to the order of wheeling transactions.
- It mitigates the threat of uneconomical transmission bypass by providing better cost signals to both long- and short-distance wheeling customers.
- It reflects the quality of transmission service by giving a higher cost signal to wheeling customers that reserve several delivery points and variable generation values at these points.

The production grade MWMILE program, based on this methodology, was developed at the Pacific Gas and Electric Company, and is presently being used by the Company to study the MW-mile methodology as one of its alternatives for allocating transmission network capacity cost among customers of the firm transmission service including wheeling transactions.

Discusser: L. L. Garver

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Real-Time Economic Dispatch and Reserve Allocation Using Merit Order Loading and Linear Programming Rules

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Summary

This paper presents a real-time economic dispatch algorithm suitable for on-line generation control and for study programs. The method is based on the rules of Linear Programming and the classical method of merit order loading. The basis for the algorithm is shown as a natural progression of classical optimization algorithms. Comparison with Linear Programming is included to exhibit the flexibility of the algorithm. The inclusion of a constraint for a unit or for a system wide margin (e.g., spinning reserve) is shown. The procedure is fast, in part, since the Simplex Tableau is not explicitly stored. The method is shown in pseudo-code. This method is very suitable for real-time economic dispatch on any Energy Management System. The method requires little computer resource and is appropriate for personal computer implementation as part of a back-up automatic generation control system.

The algorithm presented in this paper had been labeled the Merit Order Reduced Gradient (MORG) since it is a combination of the Merit Order Loading and the Reduced Gradient with Linear Constraints algorithms. The present implementation uses the linearized representation of the incremental heat rate curve. However, the Merit Order Reduced Gradient (MORG) algorithm can be used with any monotonically increasing incremental heat rate curve.

The implicit handling of the sparse Simplex Tableau is accomplished by accounting for the contribution of each unit to each constraint. Instead of storing the Simplex Tableau, which is very sparse, a variable for each unit representing the unit's contribution to a system constraint is maintained as the unit generation is increased. When a system constraint becomes binding, the unit contribution constraints that are binding indicate that the corresponding units can no longer be increased to reach the feasible solution. This process is continued until all units are bound, indicating the lack of a feasible solution or until a feasible solution is found. If a feasible solution is found then it is also the optimum solution.

The utility provided data included parameters for eighteen thermal units. The data was representative for the dispatchable units. The incremental heat rate curve for each unit has been divided into six linear segments. Only one reserve constraint was included to compare with the existing algorithm solutions. One of the thermal units contained a prohibited zone due to steam cavitation. The prohibited zone has prevented the present algorithm from finding a solution under a few loading conditions that do not normally occur.

The MORG algorithm found the same solutions as the present algorithm when the present algorithm found a solution. The MORG algorithm always found the optimal feasible solution, even when the prohibited zone prevented the present algorithm from finding a solution. The computer times for an 80286 microprocessor with 640 kilo-bytes memory running at 12 MHz with a math coprocessor are approximately seventy per-cent of the present algorithm.

Discusser: J. K. Delson