

Discussion

Norton Savage (U.S. Department of Energy, Washington, DC): These comments express the views of the writer, and do not necessarily reflect the views of the Department of Energy. The statement in the introduction, that increased usage of the (U.S., presumably) transmission system has not been off-set by additional transmission capacity, appears to be supported by an exploratory study referred to in a recent Department of Energy report (1). Although that report is based on nation-wide data and therefore reflects only the "average" condition, a tentative conclusion is that close attention to the economics of additional transmission capacity, in some areas, may be advisable. This paper provides an economic analysis of the benefits that may be available from additions to the transmission system. The work described deals with the MAPP area, but the techniques could be applied to any system.

In principle, the approach appears to be simple enough. As I understand it, a contingency event is applied to an economically dispatched load flow pattern and the system is examined for overloads. Then, the system generators are re-dispatched to obtain another economic pattern that reduces the number of overloads. The difference in generating cost between the two dispatch arrangements is multiplied by the probability of the contingency and the duration of the chosen load level, to obtain the dollar cost associated with the chosen contingency. It is then assumed that this dollar cost could be used for additional transmission facilities that would prevent the contingency. Several such studies are combined to obtain the total annual cost. If the procedure is as I have summarized it, there are several things not clear to me.

For one, it would seem that the procedure would have to extend over some 30 to 40 years, with the appropriate leveling or present worth techniques being applied, if the savings (avoided costs) are to be applied to install new facilities that have the usual life of transmission installations. The paper does not refer to this aspect of balancing avoided costs against investment.

Another aspect that I do not find mentioned in the paper is the probability that even with an augmented transmission system, contingent events will occur, even though they may be different from those initially selected for the original system. If these occurrences are met by redispatch of the new system, the associated cost should be deducted from the money available for system augmentation. Could the authors discuss this?

The authors appear to be of two minds about the inclusion of scheduled maintenance in the dispatch of load. One of their assumptions (see A in the paper) is that it is prohibitively difficult to accurately project and incorporate future maintenance schedules. However, in the paragraph preceding "Conclusions" they state that generation maintenance *can* be modeled. I would agree with their statement as to difficulty of exact prediction of maintenance, but it would seem that a sufficient data base, with associated judgement, exists for the use of probabilistic prediction of maintenance of the larger units. Has any assessment been made of the effect on dispatch economics of ignoring maintenance?

Again, with respect to maintenance, it is usual to attempt to schedule that activity for periods of low load. If this effect is ignored, the results are not apt to be realistic. And, if generating units are kept on line for the purpose of selling capacity and energy during low load periods, the "maintenance window" becomes indeed small.

Under Section C of the paper I find a sentence that I cannot at all understand: "The remedial dispatch can be considered as transfers where unit pair changes designed to alleviate (potential) transmission overloads." Has a part of this sentence been inadvertently omitted?

I would be remiss if I did not point out to the authors, and to the paper referees, that "indice" is not a word to be found in Webster. The proper singular of "indices" is "index". And the singular of "criteria" is "criterion".

In a study of the nature undertaken in this paper, many assumptions are of course necessary, and the authors have listed their principal ones. How the results would be affected by different assumptions, for instance with respect to losses, load center shifting, voltage considerations, to name a few, would be interesting to pursue but would not doubt require as much effort as has gone into the study described in this paper. It is evident that much work has gone into the study, and a useful approach has been outlined.

REFERENCE

[1] Staff Report--Electric Power Supply and Demand for the Contiguous

United States--1958-1994. May 1985. U. S. Department of Energy DOE/IE-0003/1. (pp. 20-23)

Manuscript received August 5, 1985.

M. G. Lauby, D. A. Jepsen, H. V. Nguyen, C. J. Spargo, A. D. Burbach, and L. D. Rose III: The authors appreciate Mr. Savage's comments. He correctly summarizes the procedure used in the MAPP study, except that the calculated potential benefits could be used to justify additional transmission capacity, not necessarily additional facilities. Additional capacity may also be obtained by uprating existing facilities or modifying operating procedures for facilities in question.

There were several reasons for which the paper does not refer to the aspect of balancing avoided costs against investment, as described by Mr. Savage. First, the MAPP study focused on the assessment of the transmission system at different time frames, rather than on an economic evaluation of any specific additions. The latter may be the subject of a subsequent study, depending on the results found in the current study. Secondly, an extension over a period of 30-40 years as not practical for the MAPP study as models existed only for a limited number years. However, if adequate modeling was available, this time period would be possible.

As stated above, the study did not attempt to propose any new transmission facilities but, instead, address the potential problems existed on the MAPP transmission system as planned and as submitted by the utility member companies. Therefore, for a particular year and season under study, no "augmented transmission system" was considered. However, the procedure can be extended to assess "augmented transmission systems".

The authors do not see any conflicting concepts in the paper about the inclusion of scheduled maintenances in the dispatch of generating units. The assumption under Section C of ASSUMPTIONS arose from actual limitations on study time, computational capabilities and data availability at MAPP. A more general approach should include scheduled maintenances for both transmission lines and generating units. This can be done within the existing study procedure. It would, however, produce a considerable additional computational effort and a corresponding engineering effort to review the results.

During the courses of the MAPP study, it was recognized that the assumption relating to maintenance schedules, as well as to other parameters, might compromise some of the realistic results. Therefore, efforts were made to carefully examine each studied contingency based on engineering judgement, as presented in the paper. This review process mostly relied on the expertise of each member of the study group and his familiarity with the areas of his responsibility.

The sentence under Section C of GENERAL PROCEDURES can best be clarified by using the expanded version that part of the paragraph. "The system re-dispatch required in anticipation of a particular contingency may wholly or partially mask the re-dispatch required for a different contingency. The elegant solution to this problem is to use linear programming techniques to find the most economical joint re-dispatch. A less computationally intensive method which provided adequate results in the MAPP study was to eliminate any redundant remedial transfers. The remedial re-dispatch can be seen as a set of generator pair changes which would consist of raising one generator and lowering another generator. These generator pair changes create transfers which eliminate the (potential) transmission overloads for a given contingency. As costs from the generator pair changes for additional contingencies are accumulated, redundant transfers (or generator pair changes) are excluded. For the MAPP study this procedure eliminated most of the double counting of benefits."

Finally, Mr. Savage's comments pertaining to the improper use of the words "indice" and "criteria". He correctly points out this error, and changes have been incorporated into the paper for the Transactions on Power Systems. It is unfortunate that these changes could not be incorporated into the pre-print copies. Thank you for pointing out this oversight.

The authors would like to again thank Mr. Savage for his interesting and important questions pertaining to our paper. He extends the possible applications of the ideas suggested in the paper, and therefore, adds to the usefulness of these ideas.

Manuscript received December 17, 1985.