COO-5014-6

AN ASSESSMENT OF RESEARCH DIRECTIONS FOR HIGH VOLTAGE DIRECT CURRENT POWER SYSTEMS

Quarterly Technical Progress Report
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DISCLAIMER

ABSTRACT

The two Priority One activities have continued to receive major attention during this reporting period. "Application credits" for HVDC systems imbedded in ac links are expected to evolve out of a system study wherein dc is introduced into a system where the breakeven criterion is not satisfied. Alternative benefits of the dc link will be quantified in an attempt to develop an expanded economic basis for HVDC systems. Discussions have been initiated with system planners at American Electric Power Service Corporation to see if this type of study could be of benefit to them. Discussions will also be explored with system planners from other utilities.

HVDC circuit breaker development is being examined. There is a clearly definable relationship between the exploration acceptance of multiterminal dc systems and the availability of a dc breaker. Further investigation of dc interruption techniques is recommended, together with the establishment of operating criteria and design specifications. Additionally, a definitive system study wherein the operating parameters of the breaker are examined should be undertaken. It is believed that the key relationship exists between breaker speed of operation, control coordination among terminals, and ac system stability.

QUARTERLY REPORT

This is the second quarterly report under Contract No. ET-78-S-02-5014.A000, "An Assessment of Research Directions for High Voltage Direct Current Power Systems." The objective of the study, as quoted from the statement of work in the original proposal, is "to identify hardware developments and, where appropriate, system applications which can exemplify cost and operational advantages of integrated ac/dc power systems."

APPLICATION CREDITS

The concept of "application credits" was outlined in the final report for Contract ET-78-X-01-2836, "HVDC Power Transmission Technology Assessment Study." At this time, discussions have been initiated with system planners at American Electric Power Service Corporation. The scope of the proposed study was outlined, and a comparison was made with the study previously done by Philadelphia Electric. In this latter study, an injection problem was investigated; a large block of power being injected into an urban area. The AEP study would be much more diverse in accordance with the nature of their system. The key to the problem is the short circuit duty at various stations in the system. Load flow, stability, and economics would also be examined. Conversion of existing ac lines to dc will be considered. An estimate of five-six man-years, plus computer time, was conjectured for this study.

AEP indicated concern over an internal manpower constraint --how to identify the people to conduct the study and where to obtain outside help. ASEA's new transient stability program was mentioned as a possible aid to the study.

It was proposed by AEP that they spend three months on an initial scoping study in an attempt to set boundaries on the costs and benefits of a full study. This was agreed to; Dr. Phadke will provide interim verbal reporting to Dr. Long on the progress of this study. Prior to July 31, 1979, a decision will be made whether to instigate a full investigation.

Pursuant to the AEP study, a meeting was held with representatives of ASEA regarding their new transient stability program. In addition to an accurate representation of electromechanical phenomena, it enables dynamic representation of multiterminal HVDC systems. This might be an ideal tool to use in the AEP study, especially if an ASEA representative could be arranged for as a participant in the study.

HVDC CIRCUIT BREAKER

A substantial amount of time has been devoted to the investigation of direct current circuit breaking. The principal sources of information have been:

1. "Ultra High Voltage Direct Current Circuit Breaker (Part 1), Performance Requirements and Basic Design," Report No. 175048 of the Electric Power Control Research Institute of Japan, May, 1976, and
2. A series of CIGRE study committe reports.

A condensation and compilation of this information will comprise the next quarterly report, COO-5014-9.

Several preliminary conclusions can be stated at this time:

1. There is considerable doubt, in this investigator's opinion that a satisfactory interruption technique has been demonstrated.

2. No system studies have as yet demonstrated the need for a fast dc circuit breaker.

3. HVDC system controls must be designed to both ease breaker duty and minimize system disturbances, and

4. Both in-line (across the breaker) and line-to-ground surge arresters will be needed for energy absorption and overvoltage limiting.

If research and development activity in HVDC circuit interruption is to be undertaken, the above four conclusions must be addressed as part of the statement of work.

CONFERENCE FOR SYSTEM PLANNERS

Agreement has been reached to hold a conference March 24-28, 1980, at the Ramada Inn Phoenix East Resort. The intent of this conference is to bring utility system planners together with utility "users", equipment suppliers, and other persons knowledgeable about HVDC power systems. Six topics would be explored:

1. What constitutes an HVDC system
2. Present-day operating experience
3. Ongoing research activities
4. Environmental and electrical field effects
5. System studies
6. Future directions and applications.

A call for papers is being issued, with abstracts due by October 1, 1979. Special emphasis will be placed on inviting system planners so as to effect an interchange of information and questions. International participation is envisioned, and CIGRE Study Committee 14 (HVDC Links) assistance will be requested.

All requirements of this contract have been complied with to date. Dr. Long has been devoting 40% of his time to this contract, has engaged the services of one graduate student, and will shortly be engaging another. Travel expenditures are slightly below projections in the contract. No computer simulation has yet been initiated.