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Distribution Automation and Control on the Electric Power System

Proceedings of the Distribution Automation and Control Working Group

Volume I: Executive Summary

Baltimore, Maryland
November 20-22, 1978

March 1979

Prepared for
U.S. Department of Energy
Through an agreement with
National Aeronautics and Space Administration
by
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FOREWORD

This document consists of two volumes: Volume I, the Executive Summary, and Volume II, the detailed Proceedings. Volume I was prepared from Volume II and is being more widely distributed. Copies of Volume II (or additional copies of Volume I) may be obtained from Ralph Caldwell, 507-108, DAC Project Manager, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91103 (telephone: (213) 577-9162, (FTS) 792-9162).

ACKNOWLEDGEMENT

The efforts of all of the participants before, during, and after the DAC Working Group Meeting are gratefully acknowledged. We are especially grateful to D. Mohre, W. Blair, and F. Schweppe for presentations and to the session chairmen: J. Blose, R. Ferber, O. Hill, J. Hunter, H. Kitching, K. Klein, G. Lokken, W. Prince, T. Reddoch, and F. Schweppe.

Basic documentation was provided by P. Klock, D. Evans, and M. Van Horn of ESC Energy Corporation. Arrangements for the meeting were made by M. Fowler and D. Osman of the Jet Propulsion Laboratory.

R. Caldwell of JPL was responsible for the preparation of meeting materials and the overall conduct of the meeting under the guidance and direction of P. Overholt of the Department of Energy. Other members of JPL and DOE provided valuable contributions to the preparation of materials and to the conduct of the meeting.

ABSTRACT

This document presents results of the Working Group Meeting for Distribution Automation and Control (DAC) on the Electric Power System held on November 20-22, 1978 at Baltimore, Maryland. The meeting was sponsored by the Department of Energy, Division of Electric Energy Systems. Its purpose was to bring together some members of the electric utility community so that they might reach a common understanding on (1) key issues and uncertainties to be resolved, (2) the existing state of the art, and (3) specific requirements for further RD&D in the area of DAC. The meeting consisted of several presentations and working sessions. The statements and recommendations formulated by the group on various topics are presented. The document consists of two volumes: Volume I, the Executive Summary, and Volume II, the detailed Proceedings.

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1. INTRODUCTION

The meeting of the Distribution Automation and Control (DAC) Working Group was held at Hunt Valley Inn, Baltimore, Maryland, on November 20-22, 1978. It was sponsored by the Department of Energy (DOE), Division of Electric Energy Systems, and was conducted by the Jet Propulsion Laboratory (JPL). Approximately 35 people attended, among them electric utility company representatives, manufacturer's representatives (from companies having power distribution systems experience), and representatives of the Electric Power Research Institute (EPRI), DOE, JPL, and Oak Ridge National Laboratory (ORNL) (see Section 6, Participants).

The meeting was held to provide a forum in which electric utilities could communicate with each other, with DOE, and with DOE's contractors regarding research, development, and demonstration efforts to apply DAC to the electric power system (see Section 7, Agenda). In these discussions emphasis was to be placed on identifying the priorities and needs for DAC development.

2. PURPOSE

The Distribution Automation and Control (DAC) Working Group was brought together to reach a common understanding on

(1) The key issues and uncertainties to be resolved prior to the economic application of Distribution Automation and Control Systems to Load Management, Distribution System Management, Emergency State Control*, and Unconventional Energy Resources.

(2) The existing state of the art in DAC, and current research, development, and demonstration.

(3) Specific requirements for further research, development, and demonstration in the area of DAC.

*This term was later revised by the Working Group Session.

3. APPROACH

The Working Group gathered together individuals and organizations with interest in various aspects of Distribution Automation and Control. The meeting consisted of a number of introductory presentations, panel and plenary sessions, discussions, and nine working sessions of interactive discussions. Through the use of a workshop format, the participants shared experiences, concerns, ideas, and insights, having the advantage of hearing and responding to others with similar interests. The use of a workshop structure, procedures, and materials provided a basic framework for discussions. The meeting's activites revolved around the four Technical Motivations and six Areas of Issues.

3.1 TECHNICAL MOTIVATIONS

Technical Motivations are the broad functions to which DAC can be applied to enhance operation of the electric utility system.

(1) Load Management.

(2) Distribution System Management.

(3) Preventive, Emergency, and Restorative State Control.*

(4) Unconventional Energy Resources Management.

3.2 AREAS OF ISSUES

Areas of Issues are groups of interrelated questions or problems that must be resolved before DAC can be applied to the Technical Motivations.

(1) Economic and Institutional Issues.

(2) DAC Control Hierarchy.

(3) Communication System Alternatives.

(4) DAC Impact on System Design.

(5) DAC Functional Requirements.

(6) New Source Integration.

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*As renamed and redefined by the Working Group Session.

This Executive Summary presents a brief account of the DAC Working Group Meeting. It is important in the interpretation of the results presented in this Executive Summary to understand how the document was prepared.

Information was collected in the form of written notes, tape recordings, and submittals from participants for preparation of the Proceedings. The proceedings document was assembled by condensing this raw data into a statement of the issues and recommendations made by the Working Group participants. The documentation of each of the individual sessions was reviewed with the session's chairman. The work of compiling the Proceedings documents was performed by ESC Energy Corporation, a contractor to JPL.

It is important to recognize that the Working Group activities led to statements of issues, uncertainties, and needed actions which may or may not be consistent with the views of each of the organizations represented. These statements are included in the final documentation as presented; no attempt is made to point out or reconcile inconsistencies.

At the conclusion of the workshop the participants convened to summarize what the DAC Working Group had accomplished, where it could have been improved and what the next steps should be in the ongoing development of DAC. Most of the participants believed that the DAC Working Group Meeting had produced a generally beneficial exchange of information and opinions and met the stated objectives. They felt that such a forum was necessary for updating and transferring information among the utilities, and the R&D and manufacturing communities. The DAC Working Group Meeting should therefore be regarded as a useful step in the development of DAC.

4. PERSPECTIVES ON DAC DEVELOPMENT

Distribution Automation and Control (DAC) systems of the future will fill needs that come out of the four Technical Motivations. The purpose of the present section is to introduce these Technical Motivations and discuss perceived priorities for developing DAC systems. The viewpoints of people in government and in the utility industry are also presented here along with a description of the DOE/JPL role in developing and assessing DAC technology.

4.1 TECHNICAL MOTIVATIONS

DAC components and systems will be developed to meet needs in the electric utility industry. In planning a program for developing DAC technology, the needs must be described in enough detail to give

direction to development efforts. In the marketplace, successful application depends on both technical and economic justification. The Technical Motivations discussed in this section comprise the technical justification for increased monitoring and control of electric distribution systems.

4.1.1 Load Management

Load management was defined as the systems concept of altering the real or apparent pattern of electricity use in order to

(1) Improve system efficiency.

(2) Shift fuel dependency from limited to more abundant energy resources.

(3) Reduce reserve requirements while maintaining reliable service to essential loads.

The Working Group formulated the following statements:

(1) Regulatory requirements are not a necessary precursor to the implementation of load management. Utilities are going ahead with load management development without regulatory motivations, and regulation would probably not significantly alter current efforts.

(2) More work should be done in preparing customers for load management and its potential effects on electric service. Improved public awareness does not require detailed results from engineering studies.

(3) Customers probably are willing to entertain the idea of alternate forms of service, if they are adequately prepared and educated as to the needs and ramifications, including costs.

(4) It must be determined whether the utility customer is willing to accept possible reductions in quality of service, selective load control, or other changes in the historical level of quality of service.

(5) Current development efforts are primarily being directed towards lowering daily peak demand levels. Additional efforts must be started to address potential load management effects on monthly, seasonal, and annual load factors.

4.1.2 Distribution System Management

Distribution system management is defined as the management of the planning, design, construction, operation, and maintenance of the distribution system to provide safe, economical, and high quality service to the customer. This definition clearly encompasses a broad scope of activities in utility operations. DAC technology will provide advanced techniques and new capabilities to permit improved operations in various areas of distribution system management. Consequently, the comments developed during this session relate to the entirety of DAC development, not simply to a single "Technical Motivation."

The session members discussed applications, economics, and DAC technology related to distribution systems management. A number of major statements and questions were formulated with near unanimity of the group in each area.

Applications:

(1) The utility companies should be responsible for defining what needs to be done in the area of system applications, as they will eventually be responsible for the system's performance.

(2) How and when should DAC systems for advanced distribution system management be implemented and at what level of complexity and function within the distribution system?

(3) What functions will dominate and determine the control hierarchy?

Economics:

(1) Nearly all projects must be justified on the basis of economics, with a proper understanding of both near and long term cost benefits from the expenditure.

(2) Political or institutional issues may force some installations which are not clearly justified by economics.

(3) Economic benefits must be broadly based on the total system, not just the distribution level.

Technology:

Hardware performance characteristics must be specified for the system function and the system environment.

4.1.3 Preventive, Emergency, and Restorative State Control

Preventive, emergency, and restorative state control (PERSC) refers to the ability of a DAC system to remotely and/or automatically provide preemptive action in anticipation of an emergency state, state detection, and corrective and restorative control.

Present supervisory control systems do not provide a method of accomplishing PERSC at the distribution level. Therefore, DAC may provide control

(1) To the depth, or to the level of discrete elements contemplated for further systems control.

(2) For all aspects of PERSC, e.g., anticipation of the emergency state in portions of the electric system or its components.

(3) For systems that include dispersed generation and storage, when such systems are connected to the distribution system.

Further, DAC may provide a means of response to two kinds of emergency conditions requiring corrective action:

(1) Loss of, or imminent loss of bulk supply facilities, requiring load shedding, start-up or increase in output from dispersed storage and generation.

(2) Loss of, or imminent loss of portions of the distribution system, including loads and dispersed storage and generation.

The group formulated the following major statements:

(1) "Emergency state control" can be discussed in the context of the bulk power system. Thus, "emergency state control" does not relate to restoration in the distribution system, but to shortfalls in supply.

(2) DAC systems capabilities for actions related to control under emergency conditions shown above will differ from those capabilities required for actions related to restorative control.

(3) Utilization of DAC equipment and PERSC methods will provide more options for utility system operators under "emergency" situations.

(4) When load shedding under "emergency" conditions, societal priorities can be recognized by DAC systems selectivity.

(5) The cost effective analysis for PERSC, relative to other ways of responding to supply deficiencies, needs to focus on DAC equipment applied to specific systems.

(6) Control of loads by DAC systems may result in spinning reserve credits.

(7) Since customers may ultimately determine standards for reliability, the question may be, "How much additional cost will the customer tolerate for PERSC implementation?"

(8) All communication links fail at one time or another; therefore, does DAC equipment need to be more or less reliable than the distribution system itself? What is the needed reliability level for each DAC function and for DAC equipment?

(9) The cost of connecting customer-owned dispersed generation to the utility grid should be borne by the owner, not the general utility customer.

(10) Predictive control will not be implemented until far in the future.

(11) In the bulk system, emergency control can be accomplished through selective load shedding via DAC in the distribution system.

(12) Currently there are no national standards for reliability, and the group's apparent conclusion was that such standards are not necessary.

4.1.4 Unconventional Energy Resources

Unconventional energy resources are energy storage or generating systems using devices or renewable resources to complement conventional methods of power generation. A common characteristic of these systems is that they are small in unit size and may be located in random patterns throughout the system. Sites may be selected on the basis of requirements for waste heat, the presence of favorable meteorological conditions, access to roof or other unused space, etc. Thus, the definition of unconventional energy resources for the purpose of DAC discussions implies remote control and remote monitoring of the status and capacity of such units.

The session formulated the following major statements:

(1) Bidirectional power flow from dispersed units will be acceptable to most utilities. However, this acceptance must be preceded by establishment of special rate structures, adequate safety provisions, etc.

(2) Solar thermal space and water heating will have the most significant near-term impact of all unconventional energy resources on the displacement of energy from conventional sources.

(3) Significant effects on the operation of utility distribution systems may come from the near-term application of wind turbine generators and eventually from solar, or other types of dispersed generation and storage, requiring new control means.

4.2 DEVELOPMENT PRIORITIES

Pressures for the development of DAC systems originate from the four Technical Motivations, although initial implementation will be in response to those specific functions deemed necessary at local levels.

The participants felt that load management needs should be given a top priority when assessing requirements for DAC systems. Further, these DAC systems should be designed with preventive, emergency, and restorative response as a chief concern. This impacts hierarchy and functional priorities.

Participants also felt that the DAC systems development priority related to unconventional energy resources was high, as pertains to establishing near-term standards and policies for interfacing dispersed generation and storage with established utility systems. However, many utility representatives felt that a need to actually control unconventional energy resources will not significantly motivate the development of DAC systems until penetration of these unconventional energy resources has increased substantially.

DAC systems availability is dependent on development of DAC technology as well as on other activities that support the implementation of DAC technology. Some near-term activities are

(1) Determine system and component cost effectiveness.

(2) Perform a full scale demonstration of DAC systems.

(3) Specify component and system functional requirements.

(4) Define terms and develop standard evaluation methods.

(5) Develop a process for getting executive and technical management support from the utility industry.

(6) Develop a process for allowing utilities to contribute to research, development, and demonstration (RD&D) planning and regulatory policy-making.

(7) Integrate current activities, and develop a comprehensive, coordinated overall plan.

(8) Develop public awareness and education programs.

4.3 DEPARTMENT OF ENERGY AND UTILITY VIEWPOINTS

The purpose of the national program for DAC RD&D is to provide control and data acquisition techniques for

(1) The emerging distribution functions of load management including dispersed storage and generation.

(2) Improved management of electric distribution operations.

DOE has generated program plans for Load Management on the Electric Power System, DOE/ET-0004, and Distribution Automation and Control on the Electric Power System, DOE/ET-0005.

The DOE involvement in load management and distribution automation and control is directed at four major objectives:

(1) Improve overall system efficiency in the use of both capital and energy.

(2) Shift fuel dependency from limited to more abundant energy sources.

(3) Reduce reserve requirements in both transmission and generation.

(4) Increase reliability of service to essential loads.

The basic objective of the DAC program in the Load Management Section of DOE's Division of Electric Energy Systems (EES) is to evaluate needs and support the RD&D necessary to produce DAC systems and to demonstrate their feasibility. This RD&D involves systems engineering and analysis.

DOE is encouraging new and expanded approaches to power systems planning incorporating DAC. For example, load management, by means of DAC systems, extends the planning process past production and delivery to include energy use. The components of control, communications, and energy storage in the delivery stage of power production gives new system options.

In contrast to the DOE's national perspective, the individual utility's viewpoint tends to be focused on near-term solutions to specific electric utility system needs. As a result, the utility industry supports near-term engineering solutions which can be cost effective on electric utility systems.


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4.4 THE ROLES OF DOE, JPL, AND ORNL

The DAC Working Group Meeting was sponsored by the Load Management and Storage Application Section of the Division of Electric Energy Systems of the Department of Energy. Its task is basically research, development, and demonstration of advanced power systems, not regulation or policy formation. A small amount of research is performed "in-house" by government laboratories. Oak Ridge National Laboratory is responsible for power systems studies in load management and dispersed storage and generation, as well as for several demonstration projects.

The Jet Propulsion Laboratory is also contributing to the Distribution Automation and Control Program. JPL's Office of Energy and Technology Applications, Utility Systems Office has been supporting the efforts of the Load Management and Storage Application Section with the technical management of two DOE communication projects and is supporting the communication and control aspects of electric power distribution technology development.

5. STATEMENTS OF THE WORKING GROUP

The most valuable of the DAC Working Group's activities took place in the nine Working Sessions. In these sessions the four Technical Motivations and six Areas of Issues related to DAC development were discussed. Each group met for two to three hours to identify and discuss the definition and priority of pertinent issues. This section presents the results of the discussions. Table 1 summarizes the overall conclusions of the Working Group.

5.1 KEY ISSUES AND UNCERTAINTIES

During the course of the interactive Working Group meetings, it became clear that there were a number of recurrent issues, questions, recommendations, and general statements. Certain concerns were being voiced over and over again. This section summarizes the issues and uncertainties of most concern to the workshop participants.

Economics

The cost effectiveness of each DAC component and the overall system must be demonstrated credibly. A full system field demonstration would be quite helpful in this endeavor. Economic justification is almost always a prerequisite for implementation. Exceptions may be applications that are forced by absolute functional necessity or regulation.

Table 1. Key Issues and Uncertainties

Technical Motivation	Key Issues and Uncertainties	Recommended Near-Term Activities	Unresolved Issues
Load Management	Public acceptance	Customer load control demonstrations	Energy theft
	Changes in energy use patterns	Customer acceptance surveys	Public awareness and education
	Reserve requirements		DAC specification by utilities
	Reliability		Identification of controllable loads
Distribution System Management	Applications	Communication systems demonstrations	Frequency bands
	Economics	DAC system functional specifications	Standard means for assessing economic feasibility
	Technology		Control hierarchy
	Communications		Demonstration of DAC component cost effectiveness

Table 1. Key Issues and Uncertainties (Continuation 1)

Technical Motivation	Key Issues and Uncertainties	Recommended Near-Term Activities	Unresolved Issues
Preventive, Emergency, and Restorative State Control	Societal priorities Quality of service Dispersed generation Reliability	Fault location demonstration in conjunction with communication system demonstrations Reliability requirements studies	Functional definition Demonstration of real benefits and communication reliability during outages
Unconventional Energy Resources	Bidirectional power flow Control Safety Rates	Advanced system demonstrations New rate structures developed by utilities & PUC's	Safety & reliability Ownership & control
General Consideration	Terminology RD+D information Total system assessment	Continuing forum	Common terminology, assessment methods Exchange of RD+D Status

Table 1. Key Issues and Uncertainties (Continuation 2)

Technical Motivation	Key Issues and Uncertainties	Recommended Near-Term Activities	Unresolved Issues
	Total system demonstration Systems approach		Total demonstration, all motivations, total system Mechanism for system approach Extent of regulation

Public Awareness and Education

The public sector is not well informed about the advent of DAC technology and its potential effects, especially in load management. Each utility should accept responsibility for educating its customers and preparing them for any changes.

Communications and Reliability

The communication system is perhaps the most vital element of the DAC system. Since it transfers all of the metering information, data, equipment commands, etc., it must be extremely reliable. Work in developing improved communication alternatives must continue. One need is readily identifiable: more frequency bands should be allocated to electric utilities for use in load management and distribution automation.

DAC Specification by Utilities

DAC systems must be specifically designed on a case-by-case, utility-by-utility basis to meet individual needs. Therefore, there must be a free exchange of system requirements between utilities and researchers and manufacturers, to assure that systems developed for the "general case" are appropriate for the specific case. Clearer identification of DAC functions is required.

Regulation With Utility Input

Regulations can drastically affect new technology developments, such as DAC technology, especially when applied in the utility industry. Utilities therefore need to assume a more active role in communicating needs to regulators and in monitoring new legislation.

Emergency Conditions - A Top Priority

Much discussion time was spent on what a DAC system should do in certain preventive, emergency, and restoration situations. DAC systems should be designed with emergency response as a chief concern.

New Challenges from Dispersed Storage and Generation

As new energy technologies, cogeneration, and dispersed storage begin to represent a signficant total power source, the utilities must find ways of accommodating these dispersed sources. Many issues are involved in a successful implementation, including interface designs and control hierarchies for the dispersed units. The ownership of dispersed generation units is a significant concern, and must be taken into consideration in power and control systems designs. Thus, well defined role statements for privately owned units are needed for both normal and emergency operations.

Minimization of Social Impacts

DAC development should be aimed at minimizing forced social changes by the consumer. The goal should be to use DAC to more effectively and efficiently meet all of the public's electric energy needs without requiring alterations in life styles. At the least, a choice of service options should be offered to the customer.

New Effects on Reserve Requirements

How DAC will affect reserve requirements is not known and should be established.

Standard Means of Evaluation and Definitions

The industry needs a set of standards, including standardized methodologies, for economic and engineering feasibility analyses of DAC. There is also a need for standardization of the new, specialized terms accompanying the growth of this new technology. Specifically, terms such as "load management" and "distribution automation and control" appear to mean different things to different persons in the industry.

Relationship of DAC Systems to Distribution System Management

As a result of the Working Group's efforts, the relationship of DAC to overall management and operation of distribution systems was clarified. If distribution system management is defined as the control and direction of the planning, design, construction, operation, and maintenance of the distribution system to provide safe, economical, high quality service to the customer, then DAC systems are those systems which provide for communications and control in support of distribution system management. Thus, a DAC system monitors and controls the total distribution system, including any dispersed storage and generation, and load control devices or subsystems, under all power system states.

Data Needs

More data on customer's reactions to load control, and on the real consequences of load deferral, etc., is needed before load management and related DAC systems can be adequately designed.

Independent RD&D

There is a great deal of activity in DAC and related technology within the industry,* but implications from these numerous

*See Volume II, Appendix A, Current Projects and Activities; see also Survey of Utility Load Management and Energy Conservation Project, 1st Revised Report, ORNL/SUB-77/13509/4, Oak Ridge National Laboratory.

activities are not usually considered in an overall, comprehensive fashion.

5.2 RECOMMENDED NEAR-TERM ACTIVITIES

The major recommendations made by the participants regarding near-term activities are summarized in this section.

Future meetings such as the DAC Workshop would be helpful. Such meetings would be especially valuable as a continuing source of information on what other companies are doing in DAC development. Specific questions should be taken up at future meetings, such as

(1) Regulations: What will they be and how should utilities influence their formation?

(2) Controllable loads: What are the most effective types of DAC applications, especially those related to load management?

(3) What are viable standardized approaches for assessing economic feasibility of these systems?

(4) What are DOE contractors (other than JPL and ORNL) doing in DAC, and what input should they receive from the utility community?

(5) How will utilities deal with new forms of energy theft and system tampering that use advanced electronics? What is the potential impact of such thievery?

(6) Should DAC systems be integrated with control of other utilities such as gas and water? Perhaps a joint meeting would be appropriate.

Formal or informal working groups (ad hoc, EEI, IEEE, etc.) should be formed to establish industry-wide definitions of terms in the DAC field. Particularly important definitions include

(1) Load management.

(2) Dispersed storage and generation.

(3) Emergency conditions, as they pertain to the distribution system.

(4) DAC.

(5) DAC communications.

A common catchall term should be agreed upon which embraces the entire field so as to avoid the use, interchangeably, of the terms automatic meter reading, load management, or DAC as the appropriate title.

Since the task of developing DAC is immense, development must be carried out in a number of areas in parallel. One possible way of organizing DAC development work would be to divide it into three areas:

(1) Technology development (hardware and component design and costs).

(2) Economics (cost/benefit analysis)

(3) Public acceptance (surveying, educating, and preparing customers for DAC).

Some organization should be designated to oversee the formation of multidisciplinary working groups for each of the above areas. (It was noted that some technical organizations have standing committees on load management, for example, EEI and IEEE.)

More frequencies for utility system communications are needed. The efforts initiated and pursued by the Utility Telecommunications Council to obtain additional frequency allocations should receive additional support.

More system demonstrations are needed. Particularly needed are demonstrations of a totally integrated DAC system for meter reading (including implementation of time-of-day rates), load management, emergency control, integration of dispersed storage and generation, etc.

DOE, JPL, and ORNL should contact the DAC Working Group, especially the chairmen, at regular intervals to provide them with information on future developments in the government's research program.

5.3 NEEDS AND REQUIREMENTS FOR COORDINATED DAC TECHNOLOGY DEVELOPMENT

DAC technology should be developed to fill needs in each of the four Technical Motivations:

(1) Load management.

(2) Distribution systems management.

(3) Unconventional energy resources operation.

(4) Preventive, emergency, and restorative state control.

DAC technology development will be influenced by economics, regulation, and public acceptance. The participants in the Working Group believe that DAC requirements must be defined utilizing a systems approach. That is, the technology development requirements must be based on integrated applications in the four Technical Motivations, and the needs of future utility systems, as well as on the constraints imposed by economics, regulations, and public acceptance. In this way, a total perspective of need will be developed. The participants felt that the systems approach must also include the following components:

(1) Preparation of a clear statement of what is known and what is not known about DAC technology and potential applications.

(2) Development of a method for coordinating the various programs of utilities, researchers, manufacturers, and government.

(3) Performance of several research, development, and demonstration (RD&D) projects at the same time in order to produce near-term results and minimize the overall time of development.

(4) Assessment of the costs and benefits of DAC systems.

(5) Development of multidisciplinary task forces to comment on the RD&D action plan and to recommend development priorities.

(6) Continued dialogue, and dissemination of information among utilities, regulators, manufacturers, consultants, and the state and federal governments.

6. PARTICIPANTS - DAC WORKING GROUP MEETING

American Electric Power Service Corporation
Verlin Warnock
Head, Distribution Engineering Section
2 Broadway
New York, New York 10004
(212) 422-4800, ext. 8359

Baltimore Gas & Electric
Ernest C. Dawson
Supervisor, Forecasting
Post Office Box 1475
Baltimore, Maryland 21203
(301) 234-6409

Baltimore Gas & Electric
Bill Prince
Chief of System Operations
Gas & Electric Building
Baltimore, Maryland 21203
(301) 234-5000

Department of Energy
Kenneth W. Klein
Technical Assistant to Director
Division of Electric Energy Systems
20 Massachusetts Avenue
Washington, D. C. 20545
(202) 376-4596

Department of Energy
David Mohre
Chief, Load Management Branch
Division of Electric Energy Systems
20 Massachusetts Avenue
Washington, D. C. 20545
(202) 376-4732

Department of Energy
Phil Overholt
Assistant Program Manager
Division of Electric Energy Systems
20 Massachusetts Avenue
Washington, D. C. 20545
(202) 376-4732

Electric Power Research Institute
Dr. William E. Blair
Project Manager, Electrical Systems Division
3412 Hillview Avenue
Post Office Box 10412
Palo Alto, California 94303
(415) 493-4800

Florida Power Corporation
Russ Schoetker
Project Engineer
3201 34th St. S. - G3B
Post Office Box 14042
St. Petersburg, Florida 33733
(813) 866-5212

General Electric Corporation
Research and Development Center
Jack Easley
Senior Engineer, Power Distribution Systems Engineering
One River Road
Post Office Box 43
Schenectady, New York 12345
(518) 385-2536

General Public Utilities Service Corporation
J. Loferski
Manager Telecommunications/ Electronics
260 Cherry Hill Road
Parsippany, New Jersey 07054
(201) 386-5700, ext. 314

Jackson Utility
John Williams
Superintendant, Electrical Department
Post Office Box 63
Jackson, Tennessee 38301
(901) 424-1911

Jet Propulsion Laboratory
Dr. Khosrow Bahrami
Technical Staff, DAC Team
4800 Oak Grove Drive
Pasadena, California 91103
(213) 577-9126
(FTS) 792-9126

Jet Propulsion Laboratory
Ralph Caldwell
Project Manager
Distribution Automation and
Control (DAC)
4800 Oak Grove Drive
Pasadena, California 91103
(213) 577-9162
(FTS) 792-9162

Jet Propulsion Laboratory
Dr. Robert R. Ferber
Technical Staff, Sec. 311
4800 Oak Grove Drive
Pasadena, California 91103
(213) 577-9396
(FTS) 792-9396

Jet Propulsion Laboratory
Dr. Elliott Framan
Manager, Utility Systems
Office of Energy and
Technology Applications
4800 Oak Grove Drive
Pasadena, California 91103
(213) 577-9265
(FTS) 792-9265

Jet Propulsion Laboratory
Kengo Kawano
Project Analysis and Engineering
Manager-DAC
4800 Oak Grove Drive
Pasadena, California 91103
(213) 577-9063
(FTS) 792-9063

Massachusetts Institute of
Technology
Dr. Fred C. Schweppe
Professor, Electric Power Systems
Laboratory
Utility Systems Program Energy Lab
Room 10-176
77 Massachusetts Avenue Tenn.
Cambridge, Massachusetts
(617) 253-4640

McGraw Edison Company
Robert Owen (Participant)
Robert M. Webler (Continuing Contact)
Power Systems Division
Post Office Box 440
Canonsburg, Pennsylvania 15317
(412) 873-2294

New England Power Service Company
Harold Kitching
Distribution Development Engineer,
TWACS Program Manager
20 Turnpike Road
Westborough, Massachusetts 01581
(617) 366-9011, ext. 3014

Niagara Mohawk Power Corporation
Dr. Roosevelt A. Fernandez
Research Engineer
Research and Development Building
C-3, 300 Erie Blvd. West
Syracuse, New York 13202
(315) 474-1511, ext. 1063

Niagara Mohawk Power Corporation
Frederick A. Rushden
Research Engineer
Research and Development Building
C-3, 300 Erie Blvd. West
Syracuse, New York 13202
(314) 474-1511, ext. 7202

Northern States Power
Dan Nordell
Supervising Research Engineer
414 Nicollott Mall
Minneapolis, Minnesota 55401
(612) 330-5822

Oak Ridge National Laboratory
Mike A. Kuliasha
Research Staff
Post Office Box Y
Oak Ridge, Tennessee 37830
(615) 574-0330
(FTS) 624-0330

Oak Ridge National Laboratory
Hugh M. Long
Program Manager
Post Office Box X
Oak Ridge, Tennessee 37830
(615) 574-5222
(FTS) 624-5222

Oak Ridge National Laboratory
John P. Stoval
Research Staff
Post Office Box X
Oak Ridge, Tennessee 37830
(615) 574-5198
(FTS) 624-5198

Omaha Public Power District
Gerald J. Krause
Manager, Customer Requirements and Rates
1623 Harney Street
Omaha, Nebraska 68102
(402) 536-4068

Ontario Hydro
Robert L. Hajas
Residential/Commercial Load Superintendent
700 University Avenue
Ontario, M5G1X6, Canada
(416) 592-3820

Ontario Hydro
Lawrence V. McCall
Supervising Distribution Design Engineer
700 University Avenue
Toronto, Ontario, M5G1X6, Canada
(416) 592-4781

Pacific Gas & Electric Co.
Orville L. Hill
Sr. Electrical Engineer
Room 1853
77 Beale Street
San Francisco, California 94106
(415) 781-4211, ext. 2148

Philadelphia Electric Company
John B. Blose
Senior Engineer, Research and Testing Division
2301 Market Street
S10-1
Philadelphia, Pennsylvania 19101
(215) 841-4866

Public Service Company of New Mexico
Evans Spanos
Load Management Coordinator
Public Service Building
414 Silver Avenue S.W.
Post Office Box 2267
Albuquerque, New Mexico 87103
(505) 842-2863

San Diego Gas & Electric Company
James A. Hunter
Manager, Marketing Programs
Post Office Box 1831
San Diego, California 92112
(714) 232-4252

Southern Maryland Electric Coop., Inc.
Richard J. McCoy
Chief Engineer
Hughesville, Maryland 20637
(301) 274-3111

Union Electric Company
James E. Healey
Manager, T&D Operating Department
721 South 5th Street
Post Office Box 149
St. Louis, Missouri 63166
(314) 621-3222, ext. 2141

University of Tennessee
Dr. Thomas W. Reddoch
Associate Professor
Department of Electrical Engineering
Knoxville, Tennessee 37916
(615) 974-5028 (FTS) 855-5028

Westinghouse Electric Corporation
David G. Berkowitz
T&D Systems Engineer
700 Braddock Avenue
East Pittsburgh, Pennsylvania 15112
(412) 256-2609

Wisconsin Electric Company
Glen Lokken
Superintendent, Special Studies
231 West Michigan Street
Milwaukee, Wisconsin 53201
(414) 277-2560

7. AGENDA - DAC WORKING GROUP MEETING

For reference purposes for those readers who did not attend the DAC Working Group Meeting, the agenda is given here to illustrate the activities of the meeting.

Sunday, November 19, 1978

Evening:

Orientation of Working Session Discussion Chairmen with JPL and DOE Staff

Monday, November 20, 1978 (Introduction and Overview)

Morning:

- Welcome — R. Caldwell, K. Kawano - JPL
- DOE Overview of DAC — D. Mohre - DOE
- EPRI Overview of DAC — W. Blair - EPRI
- "Distribution System in the Year 2000, Homeostatic Utility Control — F. Schweppe - MIT

-Break-

- DAC Working Group Goals, Objectives, and Format — R. Caldwell - JPL
- Panel Discussion - Introduction of Technical Motivations
  - Load Management — J. Hunter - SDG&E
  - Distribution System Management — H. Kitching - NEPS
  - Unconventional Energy Resources — R. Ferber - JPL
  - Emergency State Control — W. Prince - BG&E

Afternoon:

- Working Session Discussions on Each of the Four Technical Motivations (Load Management and Unconventional Energy Resources Management were combined)

-Break-

- Plenary Session With Chairmen's Reports, Discussion and Distribution of Questionnaires

Evening:

- Dinner
- Dinner Presentation on Solar Energy — R. Ferber - JPL
- Informal Discussions

Tuesday, November 21, 1978 (The Six Areas of Issues)

Morning:

- Areas of Issues Working Sessions
  - Functional Requirements — K. Klein DOE
  - Economic and Institutional Issues — G. Lokken - Wis. Elec.

-Break-

- Areas of Issues Working Sessions
  - Impact on System Design — O. Hill - PG&E
  - DAC Control Hierarchy — F. Schweppe - MIT

Afternoon:

- Areas of Issues Working Sessions
  - Impact on System Design (cont'd)
  - DAC Control Hierarchy (cont'd)

-Break-

- Areas of Issues Working Sessions
  - Communication Alternatives — J. Blose - Phil. Elec.
  - New Source Integration — T. Reddoch - Univ. of Tenn.
- Distribution and Completion of Questionnaires

Evening:

- Dinner
- Dinner Presentation on DAC Functional Requirements — K. Klein - DOE
- Informal Discussions

Wednesday, November 22, 1978

- Summary Session
  - Recap Results of Working Sessions and Relate to Working Group Objectives
- Luncheon
- Executive Session (Working Session chairmen only)
- Adjournment