DISTRIBUTION AUTOMATION
AND
CONTROL SUPPORT

ANALYSIS AND INTERPRETATION
OF
DAC WORKING GROUP RESULTS
FOR USE IN
PROJECT PLANNING

Prepared for
JET PROPULSION LABORATORY

by

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April 1979

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1.0 Background and Introduction

The meeting of the Distribution Automation and Control (DAC) Working Group was held at the Hunt Valley Inn, Baltimore, Maryland, on November 20-22, 1978. Following the meeting, ESC Energy Corporation prepared the Proceedings and the Executive Summary which include statements and recommendations made by the Working Group concerning DAC RD&D topics.

ESC's goal, in providing support under this task, is to express these Working Group statements and recommendations in a form directly useable in the preparation of a DAC Project Development Plan.

To accomplish this result, ESC identified each RD&D topic discussed at the Working Group Meeting which was critical to DAC technology development. ESC also identified topics which are not critical but are desirable. These topics were ultimately compiled under categories of work selected by ESC. Perhaps the most important result, produced by ESC, is the description of projects in Section 2.2. Another result that may prove valuable in the DAC program is the information compiled in the Tables in Section 3.0, Appendix. The following information is contained in these tables:

- A listing of critical and desirable RD&D topics
- The page number of the Executive Summary and Proceedings which contains a discussion of the RD&D topics
- A dot chart indicating the program management area (selected by ESC) in which the RD&D topic should be handled
- References to the six major elements of activities recommended in the DOE Program Plan for Research, Development and Demonstration of DAC on the Electric Power System
- Identification of categories of work which where not addressed in the DOE Program Plan

2.0 Analysis and Interpretation of DAC Working Group Results

The utilities are being faced with many new business challenges and need to consider DAC technology in specific applications on the electric system. The utility industry has been sponsoring private RD&D for DAC technology for several years and is planning to continue programs in the future.

The government interest in DAC stems from wanting to bring about efficient utilization of facilities and energy resources and save barrels of oil. The DOE objectives include development of DAC technology to support commercialization and integration of dispersed alternative energy resources, such as solar, wind and cogeneration on the electric system.

The Working Group Meeting showed that the utility industry will support the DOE DAC development program. However, the technology developed should meet specific needs and be cost effective over its operational life time. The DOE needs to establish a close working relationship with the utility industry to produce the desired result and maintain industry support.

The utility industry wants to continue independent DAC RD&D and be responsible for projects that deal directly with customers. Therefore customer education and surveys to determine levels of customer acceptance regarding service should not be part of the government DAC program.

2.1 Description of DAC RD&D Projects

DAC RD&D projects can be classified under the following broad categories of work:

(1) Customer load management
(2) Legislation and regulation
(3) Inter-program communications
(4) DAC requirements analysis
(5) Communication system development
(6) Utility operations and control system development
(7) Economic evaluations
(8) Special studies
(9) Full system demonstration

The utility industry will probably want to assume responsibility for categories (1) and (2). The other categories include work that the utility industry perhaps does not want to support directly with funding. This work should be funded and managed by the government with as much utility industry interaction as possible. Category (3) creates a focal point for utility industry interaction. Category (4) develops the requirements for DAC systems developed in categories (5) and (6). Categories (5) and (6) are communication system and overall utility operations and control systems development. The latter category includes the specification, design and testing of DAC hardware and software for all applications including dispersed storage and generation. Categories (7) and (8) include tasks to support development work in categories (5) and (6). A full system demonstration on a utility owned electric system is category (9).

The following paragraphs include, for each category, descriptions for projects discussed at the Working Group meeting. The scope-of-work described for each category should be used as an aid or checklist in DAC program and project development planning.

(1) Customer Load Management

Load Management is complex and is probably not understood by the majority of utility customers. As a result, the customer may not be willing to accept service based on load management practices of the 1980's.

This category of work should include tasks to educate the customer and get feedback on the quality of service necessary to gain customer acceptance. Customer information should be acquired and used to assess the customer's response to load management. Field tests should be conducted to determine the level of acceptance for various load control strategies. The goal should be to use DAC effectively and efficiently to meet the public's electric energy needs without forcing alterations in life styles.

(2) Legislation and Regulation

Legislation and regulation can drastically affect DAC technology development. Therefore, the utility industry needs to actively contribute to the legislative and regulatory process.

This category of work should include projects that will enable the utility industry to gain more certainty regarding the extent of government influence over DAC development and regulation. A listing of DAC government sponsored programs and activities should be compiled and continuously updated. Public Utilities Commission work on rate structures should be monitored. Issues should be identified which may force some installations of DAC equipment on the electric power system, which are not clearly justified by economics. The efforts initiated and pursued by the Utility Telecommunications Council to obtain additional frequency allocations should be supported. Electric utility experts should actively communicate the utility point of view to government groups who are funding and managing the development of DAC technology. Ad hoc working groups should be organized as special utility issues surface.

(3) Inter-Program Communications

The DAC development program includes work at many levels and by many government and private sector organizations. This category of work should include tasks to create lines of communication between the various private and government organizations and an exchange of information.

Events, such as the Working Group Meeting held at the Hunt Valley Inn on November 20-22, 1978, should be conducted periodically to assist the utility industry:

- o Maintain an ongoing dialogue with the govenment and others in industry on DAC development
- o Learn about standardized approaches for assessing DAC system economics
- o Update information on regulations, legislation or other issues that may affect the utility business

A set of standard terminology and methods should be developed for use in DAC economic and engineering feasibility studies.

(4) DAC Requirements Analysis

This category of work supports communication systems and utility control and operations system development. Requirements analysis projects should be in a separate category, independent of system development projects, to encourage results based on total system analysis. From a systems point of view, the DAC system can potentially monitor and control the total distribution system, including any dispersed storage and generation and selected customer loads. The DAC system can also be integrated with electric system operations in the utility control center.

Tasks or projects should be formulated in this category to:

- o Define the needs for DAC systems in specific utility applications
- o Determine how and when DAC systems should be implemented and at what level of complexity
- o Determine what DAC functions will dominate and determine the control hierarchy
- o Determine the reliability necessary for DAC components and systems
- o Evaluate the effect of DAC load control on the quality and quantity of spinning reserves.

(5) Communication System Development

A great deal of communication systems development including demonstrations and tests has already been completed. The results should be compiled and disseminated to avoid duplication of effort. Detailed requirements for

communication systems should be developed. They should be based on acknowledgement of electric system interfaces of the 1980s including customer owned dispersed storage and generation. Demostrations of DAC communications systems for reading meters for customers on time-of-use rates should be conducted.

(6) Utility Operation and Control Systems Development

DAC technology development, in this category, supports distribution system management and refers to:

(1) Systems that monitor and control the distribution system including dispersed storage and generation
(2) Systems that monitor and control customer load on the electric system
(3) Systems that integrate the above systems with the utility control center
(4) Systems that provide preventative, emergency and restorative state control.

This category of work should be supported by results from categories (4) DAC Requirements Analysis (7) Economic Evaluations and (8) Special Studies. This is a large and complex category as it includes the specification, design and testing of the various DAC devices.

The manager of this category of work should consider the following objectives:

- Understand the functions of all systems in this category and the relationships and dependence of one system to another
- Develop a management plan that acknowledges development sequences and priorities coming out of the understanding of relationships and dependence among systems
- Prepare project scopes-of-work that can be adjusted at major milestones to incorporate the results and discoveries made along the way.

The management plan in this category should allow for fast start-up work on several tasks or projects simultaneously, thereby producing results quickly and allowing the flexibility for redirecting work at critical milestone project reviews.

The following tasks should be included in this work category:

- o Development of standard methods for performing DAC technical feasibility evaluations
- o Development of control techniques and technology for dispersed storage and generation.

(7) Economic Evaluations

The projects in this category should demonstrate that the DAC components and systems recommended for implementation are cost effective. This category supports projects in category (5) Communications Systems Development and (6) Utility Operations and Control Systems Development.

Projects should include:

- o Development of standard methods for assessing economic feasibility
- o Consideration of various ownership arrangements, when determining the component or system life-cycle costs
- o Consideration and quantification of benefits based on the total systems rather than just the distribution system
- o Quantification of spinning reserve credits.

(8) Special Studies

This category of work contains special studies related to implementation of DAC components and systems on the electric system. Some of these studies may involve limited testing.

Special studies should include:

- o Projection of component and system reliability levels as they relate to quality of service and DAC acceptability
- o Verification of DAC load control capabilities related to potential benefits of reducing reserve requirements
- o Demonstration of communication systems
- o Assessment of the effect of dispersed storage and

generation on the operation of a utility electric system and the quality of customer service

- o Assessment of the impact on DAC of new equipment such as transformers, switches, fuses, etc.

(9) Full System Demonstration

A full system field demonstration should be conducted on a non-government electric system. The demonstration should be designed so that the cost effectiveness of each DAC component and the overall system can be quantified.

2.2 DAC Program Management

The objective of this Section is to look at management from the broadest perspective and recommend areas of program responsibility appropriate for the government and the utility industry.

DAC program management, when viewed in the broadest context, includes at least three basic areas of responsibility:

(1) Public acceptance and DAC program support
(2) Technology development including field tests and demonstrations
(3) Cost/benefit analysis

The first area, public acceptance and DAC program support is really both a utility function and a government function; therefore, it may be considered two distinct areas of responsibility. The utility function is to study customer needs and preferences, potential DAC impacts and the customer response to DAC implementation. This includes education of the public regarding the consequences of DAC technology. The government function is to develop a cooperative government, industry and public program for supporting all phases of DAC RD&D. The second and third areas can be considered government functions, although it should be acknowledged that organizations such as the Electric Power Research Institute have comprehensive programs in DAC technology development and cost/benefit analysis. Technology development deals with development of DAC components and systems that meet the needs and will be capable of penetrating the desired market. The area of cost/benefit analysis supports the DAC program by providing economic, social and other impact analysis as required.

Therefore, it appears that a feasible government management plan would focus on the three areas of responsibility:

- o Program support
- o Technology development
- o Cost/benefit analysis

The fourth area of public acceptance and the customer interface would be managed in the private sector.

An attractive feature of this plan is that the three government management functions can be carried out independently, interfacing and coordinating by way of project results from one area to another. All three can be started immediately and can begin producing results quickly. The government management area of program support should coordinate with the utility industry area of public acceptance and the customer interface.

2.3 Conclusions and Recommendations

The results produced and presented in this report represent a level-of-effort. The feeling is that there are gaps in the results and this is not unexpected.

If this report was to be used as a primary source document in the preparation of a Project Development Plan, the recommendations would be:

(1) Review the results identifying areas where gaps or uncertainties exist

(2) Acquire information necessary to fill the gaps, particularly as they relate to definition of critical projects and schedules

(3) Decribe the projects in detail specifying interim and final results

(4) Develop a management plan that will result in satisfactory project definition, contractor selection and completion of projects on time and within budget, with interim and final results passed to other projects in the program

It appears; however, that this report will be used along with other information to support a Project Development Plan, which is in development. If this is the case, this report can be used as a check list to identify specific projects that may need to be added to the Plan. It also can be used, as the DAC Program continues, as a reference source and trail back to the Executive Summary or Proceedings of the DAC Working Group.

In either case, the results reported here are complete in the sense that the Working Group topics were reviewed from A to Z. The gaps that exist are due to the lack of detail in the analysis, due to the limited level-of-effort.

3.0 Appendix

3.1 Supporting Information

This appendix contains information obtained from the Proceedings and Executive Summary of the DAC Working Group. The information is presented in formats useful for project planning.

The formats include:

- Table 3.0-1, presenting RD&D topics categorized under RD&D program functions, selected by ESC, with specific reference to the Proceedings and Executive Summary
- Table 3.0-2, presenting specific categories of work, selected by ESC, (rather than RD&D functions) referenced to the RD&D topics in Table 3.0-1 and the DOE/ET 0005 Elements.

The evolution which led to the development of Table 3.0-2 stems from recognition that, for the purpose of ESC's work, projects are best organized under categories of work (Customer Load Management, Communication System Development, Inter-program Communication, etc.) rather than typical RD&D functions (data-base development, technology development, etc.).

3.2 Approach Used in Developing the Supportive Information

The approach used included the following activities:

(1) Review of the Executive Summary and Proceedings
(2) Select typical RD&D program functional areas, (e.g. methodology development, feasibility studies, etc.)
(3) List RD&D topics within each functional areas, with reference to sources in the Executive Summary and Proceedings.
(4) Select broad specific RD&D program functional areas (e.g. technology development, cost/benefit analysis, etc.)

(5) Interpret the Working Group results to determine first, which topics are included in which broad RD&D program functional areas and second, if the topic represents an activity which is critical to the development of DAC.

(6) Identification of general categories of work from the listing of RD&D topics.

(7) Preparation of Section 2.0 using the information in Table 3.0-1 and Table 3.0-2 as a guide.

For example, in preparing Section 2.0, Table 3.0-2 provided a check list of program topics which was used in developing the projects or tasks in each category of work. Table 3.0-1 provided a reference back to the Proceedings and Executive Summary so that the context in which the program topic was discussed at the Working Group Meeting could be clarified. Table 3.0-1 also served to record ESC's interpretation regarding topics that are critical to the successful development of DAC technology.

Legend

● Critical to DAC Development

○ Desireable for DAC Development

* Typical RD&D functions were selected by ESC as a first step in the process of organizing and structuring RD&D topics

Typical RD&D Functions* and a Listing of RD&D Topics	Page Number: Executive Summary	Page Number: Proceedings	Public Acceptance and the Customer Interface	DAC Program Support	Technology Development	Cost/Benefit Analysis
A. Data-Base Development						
1. Communication and control alternatives	15	5.8-2		●		
2. Legislation	15	5.5-2,5.5-6		○		
3. Regulations	15,17	5.5-2,5.5-6		○		
4. Life Styles	16	5.1-2	○	○		
5. Government sponsored projects	17					
6. Customer acceptance	14	5.1-2	●			
7. Exchange of information		3.0-1		○		
B. Methodology Development						
1. Economics	13,17	2.0-2				●
2. Ownership arrangements	16	2.0-2				●
3. Engineering feasibility	16	2.0-2			●	
4. Standardized terminology	16	3.0-3,2.0-2		●		
5. Near and long term benefits	7					●
6. Spinning reserve credits	8	5.3-3				●
7. Cost of reliability	8	5.3-2	○			
8. Electric rate structures	9			●	●	
9. Interfacing with dispersed generation	10	5.3-4,5.9-2			●	○
C. Feasibility Studies and Assessments						
1. Load management effects on load factors	6	5.1-4				○
2. Reliability level for each DAC function	8	5.4-7			●	
3. Energy theft and system tampering	18	3.0-2				○
D. Requirements Analysis						
1. DSM functions	16	2.0-3			●	
2. DAC systems functional specifications	7,14,15	5.4-5			●	
3. Communications and control alternatives	15	5.8-1			●	
4. Reliability	14,15	5.4-7	●		●	
5. Emergency state	15	5.3-2			●	
6. Dispersed storage and generation	15	5.9-1			●	
7. Cogeneration	15	5.9-2	○		●	
8. Control hierarchies	16	5.6-2,5.6-9			●	
9. Interface design	16	5.9-5			●	
10. Control systems	16	5.6-9			●	
11. Reserves	16				●	
12. DAC systems environment	7	5.7-4			●	
13. DAC applications related to Load Management	10,17		●		●	
14. Safety	9	5.4-7	●			
E. Technology Development						
1. DAC equipment in specific applications	8	5.4-7			●	
2. Control of DSG	10	5.9-5			○	
3. PERSC response	10	5.3-3			●	
F. Demonstrations and Tests						
1. Full DAC System	13	2.0-1		●	●	
2. Component and system cost effectiveness	13	5.4-6		○	●	
3. DAC effects on reserve requirements	16	5.1-1			●	
4. Load control	14	5.1-2	●		●	
5. Communication systems	14	5.8-2			●	
6. Fault location	14				●	
7. Advanced systems	14	5.7-4			○	
8. Meter reading	19	5.8-1	○			
9. Field test of load control acceptance		5.1-2	○			
G. Institutional Studies						
1. Life Styles	16	5.1-2	○			
2. Quality of service, acceptability	6	5.5-2	●			
3. Issues forcing installation	7	5.1-2,5.5-2	●			
H. Program Support						
1. Customer education	13,6	5.1-2	○			
2. Regulations	15	3.0-1		●		
3. New legislation	15	3.0-1		○		
4. Future meetings	17,18	3.0-1,2		●		
5. Ad hoc working groups	18	3.0-1	○	●		
6. Standards	18	2.0-2		●		
7. Frequencies for communication	19	5.8-4		○		
8. Government interaction with industry	19	3.0-1		○		

Table 3.0-1 DAC Working Group Results Diagram

TABLE 3.0-2 CATEGORIES OF WORK

	CATEGORY OF WORK	RELATED RD&D TOPIC	OOGS ELEMENTS
1.	Customer Load Management -education, acceptance, life style effects, impact or usage, field demonstration, etc.	A(4,6*), C(1), F(4*), G(1,2*), H(1)	II. Metering and Management of Customer Loads
2.	Legislation and Regulation -monitoring, lobbying	A(2,3,5), B(8), G(3*), H(2*,3,7,8)	None
3.	Inter-Program Communication -technology standardization	A(7), B(4*), H(4*,5*,6*,8)	None
4.	DAC Requirements Analysis	C(2), D(1*,2*,3,4*,5*,6,7,8*, 10,11,12,13*,14), E(1)	III, IV and V
5.	Communications Systems Development -requirements definition, design, testing, modelling, applications, regulations	A(1*), D(3*,9), F(5,8), H(7)	I. Communication Systems
6.	Utility Operations and Control System Development -specifications, design, total systems impact, compatibility, DSG	B(3*,6*,9*), C(3), D(1,5,6,7, 8,9*,10*,11*,13,14*), E(1,2,3*), F(3,6*,7)	III. Dispersed Storage and Generation IV. Distribution System Design and Control V. Integration With Utility VI. Technical and Economic Assessment Methodology
7.	Economic Evaluations, Including Criteria and Methodology Development	B(1*,2*,5*), F(1,2*)	All of the above
8.	Special Studies	C(2), F(3,5,7)	
9.	Full System Demonstration	F(1*)	V. Integration With Utility Control Center

Note: The * indicates that ESC recommends the RD&D Topic is critical to the successful development of DAC technology.