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The NRRI appreciates the cooperation of the Arizona Corporation Commission in preparing this study.

THE DEVELOPMENT OF A COMPUTERIZED REGULATORY INFORMATION AND ANALYSIS SYSTEM FOR THE ARIZONA CORPORATION COMMISSION

prepared by

THE NATIONAL REGULATORY RESEARCH INSTITUTE
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FOREWORD

The National Regulatory Research Institute (NRRI) was established at the Ohio State University in 1977 by the National Association of Regulatory Utility Commissioners to provide state regulatory commissions with technical assistance and timely, high level policy research on regulatory issues.

This report is one of a series of publications resulting from on-site technical assistance projects supported by the U. S. Department of Energy (DOE) and directed by the NRRI. The purpose of these technical assistance projects is to provide in-depth studies in specific areas of utility regulation as requested by various state regulatory agencies. A concern of the DOE is for the prudent management and conservation of our national energy resources. Accordingly, it is believed that assistance should be provided to state regulatory agencies in husbanding the energy resources within their state boundaries. Funding availability has limited these efforts such that not all state agencies requesting assistance could be served at first. One criterion for selecting a particular state assistance project was the potential for that project to possibly provide guidance to other regulatory agencies with similar or related problems. It is with that thought in mind that the results of several of the individual state technical assistance projects are being published and made available to others.

EXECUTIVE SUMMARY

This report presents a general guide for the Arizona Corporation Commission to follow during the development of a computerized regulatory information and analysis system. As such, it fulfills one of three objectives of technical assistance to the Commission provided through The National Regulatory Research Institute as part of the Regulatory Assistance Program.

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INTRODUCTION AND BACKGROUND

The on-site technical assistance provided to the Arizona Corporation Commission had three objectives. The first is the delivery and implementation of a fully operational computer program; second, a report to use as a map for establishing data processing at the Commission; and third, any additional support necessary to procure available data bases and programs.

The purpose of this report is to satisfy the second objective and to present a general guide for the Arizona Corporation Commission to follow during the development of a computerized regulatory information and analysis system.

An increasing workload, particularly in the utilities area, led the Arizona Corporation Commission to seek more efficient means of collecting, processing, and analyzing the large volume of information associated with the utilities' regulatory function. A decision was made to meet this objective using computer technology. The Commission then sought and obtained a legislative appropriation sufficient to fund the development of computer programs and data bases to support regulatory functions.

Having made the commitment to automate and having procured the necessary funding, the Arizona Corporation Commission realized a need for outside expertise to help the staff plan the entry into electronic data processing. Consequently, the Commission applied for on-site technical assistance from The National Regulatory Research Institute (NRRI) to plan the orderly development and implementation of a computerized Regulatory Information and Analysis System. The NRRI was able to offer on-site technical assistance as part of the Regulatory Assistance Program with funding provided by the U.S. Department of Energy.

In order to provide the technical assistance appropriate for the requirements of the Commission, NRRI assigned John C. Cuddy to be Project Manager. For additional technical support, NRRI acquired the consulting assistance of J.W. Wilson & Associates, Inc., of Washington, D.C., and Dewey E. Ray, Director of Systems Development for the Florida Public Service Commission. Dewey Ray is the author of the main body of this report to the Arizona Corporation Commission.

DETERMINING COMMISSION NEEDS

The on-site technical assistance project team made up of John Cuddy and Dewey Ray made a visit to the Arizona Corporation Commission, September 20-22, 1978. During the visit, the team conducted a series of "in-depth" interviews with the Arizona Corporation Commission Commissioners, utilities staff, the Data Processing Manager, representatives of the supporting state data center, the Executive Secretary of the Commission, and other key staff persons. The objective of the interviews was to obtain differing viewpoints and perspectives of personnel with various levels of responsibility about the areas in which computerized information and analysis would be of benefit. During these interviews, the Commission staff was provided with descriptions and examples from a wide range of analytical and data base programs being used by the utility regulatory community. As a result of the three days of interviews, a set of "needs" for the development of computer programs and data bases was identified for the Arizona Corporation Commission.

The next step in the project involved producing a list of computer program and data base development needs determined to be high priority by Commission staff. This approach produced a priority list of computer programs and data bases that met most of the critical needs of the Commission and offered the greatest potential for a cost-effective investment in electronic data processing.

In contrast to the "priority of needs" approach taken for this project, it is possible to pursue the total systems approach. The total systems approach generally involves an expensive, time-consuming study that may result in development of one or more very large data bases designed to meet the total information needs of the regulatory commission. Serious drawbacks to this approach are that months of analysis may be required to determine the total information needs and, because of unavailability of needed data coupled with the complexity of systems design and development, three to four years of time and several hundred thousand dollars may be required.

Another major factor to consider in the total systems approach involves the learning capability of a state regulatory commission that is not presently making substantial use of computers. Experience with state commissions presently using computers indicates that several years may be required to train commission staff to utilize data bases and the other capabilities of the computer efficiently. In addition, once such a total system is completed, needs within the regulatory commission may change; and the existing data bases may become partially or totally obsolete. These are practical realities encountered by numerous regulatory commissions and were given careful consideration by the project team in recommending the approach to be taken by the Arizona corporation Commission. Therefore, total system approach was rejected by the NRRI project team as inappropriate for the commission at this time.

Based on this investigation of the needs and requirements for information and analysis, the project team developed a three-phase program designed to meet the short-term objectives of the Commission. Phase One is designed to outline preliminary tasks and suggest certain in-house procedures for placing into operation two simple utility analysis programs. At the end of the six month start-up period for Phase One, the Commission should be in a position to implement Phase Two that calls for two additional analytic computer programs. The final section of the plan is Phase Three that recommends the implementation of two higher level analytic programs to assist electric rate case and revenue requirements analysis. Thus, at the end of an eighteen-month period, the Arizona Corporation Commission would have achieved a basic computerized regulatory information and analysis system for the utility staff.

PHASE ONE - DATA BASE DEVELOPMENT AND START-UP PROGRAMS

The purpose of Phase One is to enable the Commission to begin developing computer capability to use in its operations. Phase One objectives are:

1. To acquire access to competent systems analysis and FORTRAN programming support.
2. To design, develop, document, and implement two relatively uncomplicated utility analysis computer programs.
3. To select and install a suitable computer terminal within the Utilities Division.
4. To train the Utilities Division staff in the efficient utilization of these programs and generally familiarize the Commission with the capabilities of the computer.
5. To establish in-house procedures that will ensure the overall long-term integrity of the programs and data bases that are developed. These in-house procedures should include, but not be limited to, the following:
    a. A Computer Program Library, consisting of a magnetic tape or disk file containing source-code copies of all existing programs, along with a suitable catalog describing the contents of the library.
    b. Formalized written procedures for maintaining the Computer Program Library.
    c. A suitable number of magnetic tapes reserved exclusively for permanent backups of all existing binary programs and data files/data bases.
    d. Computer program/data base documentation for <u>every</u> operational application. Documentation should consist of a <u>User's Guide</u> with straightforward instructions for executing each application, along with a comprehensive <u>Technical Guide</u> that details all technical specifications pertinent to each application. Each operational program/data base should have both the <u>User's Guide</u> and <u>Technical Guide</u>.

e. Organize, within the Arizona Corporation Commission, an EDP Steering Committee. The Steering Committee should consist of the Executive Secretary, the Data Processing Manager, all Division Directors, and other key staff as deemed appropriate. The Executive Secretary should serve as Chairman, and each member should have one vote. Representatives from the supporting data center should be included as nonvoting members. The Steering Committee should meet on a regular basis for the purpose of defining overall objectives, setting priorities for program/data base development, resolving complaints and problems, and otherwise coordinating the Commission's EDP activities.

Phase One should span a period of approximately six months and involve development of programs and data bases described below.

Utility Ratio Analysis Program

Since the Commission does not currently have the staff required to maintain a thorough audit and surveillance capability for utility operations, the utilities staff need a small data base containing selected financial and operational data taken from the Annual Financial Reports of approximately thirty selected utilities. This data base will provide the Commission with the capability of establishing a "utility financial/operational profile," which will provide, via output from a set of ratios, the optimum performance levels of an electric utility. Once the optimum profile is established, all annual financial reports can be compared against the profile to identify those utilities that, because of unusual performance, need to be more closely examined. The data base, and its associated program, allow Commission staff to maintain surveillance of these utilities and audit those companies that merit such action.

The design of this data base and program can be approached in two different ways. First, a small data base, utilizing a generalized data base management system, can be developed to store the data and to produce reports and ad hoc retrievals. The data entry program for the data base should be interactive so that the user can enter the data directly from the computer terminal to the data base. Reports will be generated by the same program used for data entry.

An alternate approach involves the creation of an indexed sequential file containing the data. The data entry program, which is similar to the previous data entry program, will create the indexed sequential file and allow for random updating. The program will also produce the necessary reports. An estimated four months will be required to develop, document, and implement this program.

Appendix A describes some of the data and ratios that should be included in this program. Appendix B describes in detail the input variables and computational procedures for this program.

Fuel Adjustment Program

This program will calculate the monthly fuel adjustment factor for the seventeen electric utilities under the regulatory authority of the Arizona Corporation Commission and will allow for the creation and maintenance of a data file containing the accumulated totals for the reserve "bank accounts" for the seventeen electric utilities. The program should be written in FORTRAN and execute interactively via a computer terminal located within the Utilities Division. The program design should consist of a user-oriented set of file processing commands to accomplish all file manipulations prior to program execution. The program should make extensive use of prompting statements that request the specific inputs (i.e., billing period, total fuel cost, cost of purchased power, etc.), for the program. The program should allow for the "opening" of the data file containing "reserve on account" data and allow for the entry of a new amount for the preceding month for each company. The program should then adjust the "reserve on account" and replace the preceding "reserve on account" with the new value. Following this operation, the program should proceed to calculate the fuel adjustment factor and print the "adjustment factor" and "reserve-on-account" values at the terminal. The program should then loop back to the first input-prompting statement and allow for continuation of the program until all companies have been computed. An estimated two months will be required to develop, document and implement this program.

PHASE TWO - RECONSTRUCTION COST NOW AND GROSS RECEIPTS TAX PROGRAM

Phase Two is the intermediate phase and spans a six-month period during which two additional computer programs should be developed, documented and implemented.

RCN Indices Program

Major utility rate cases require an extensive amount of man-hours performing computations that are necessary for establishing the utility's rate base. In order to calculate the rate base, the utility staff must first calculate the total utility plant value. Total utility plant value is calculated by multiplying the original cost for each plant account/vintage by an appropriate index. A computer program is required that will perform the total utility plant value calculation for each plant account in a given rate case and display these values. The program should be designed to allow for the input and storage of the appropriate indices, in this instance, the Handy-Whitman RCN indices. It should also allow for the input of original cost of each plant account. The program should, based upon these two inputs, calculate the reconstruction cost new for each plant account. Upon completion of these calculations, the program should be able to aggregate or sum the reconstruction cost new for the entire utility plant, thereby providing the total utility plant value needed for calculating the utility's rate base.

In terms of design, the program should store all of the appropriate RCN indices and access those indices that are applicable during each program run. The program should also be interactive; that is, executable from a computer terminal.

Gross Receipts Tax Program

The Arizona Commission, like most state regulatory commissions, assesses and collects a gross receipts tax levied against the adjusted gross revenue of each of the regulated utilities. This task involves calculating adjusted gross revenue, calculating the amount of gross receipts tax, and monitoring collections for each of the more than 500 utilities under its authority. This task is complicated due to deadlines for notification and collection of the tax and consumes many man-hours to complete. A computer program is needed to automate this process. This program is called the Gross Receipts Tax Program.

The Gross Receipts Tax Program should consist of a small data base containing one record for each utility. Each record should contain the utility mailing address, the previous year's adjusted total revenue, and the gross receipts tax amount. Once the data base containing all of the addresses is completed, the staff will input the utility total revenue amount into the associated program. The program will compute the adjusted gross revenue and gross receipt tax and print these amounts for each utility. Since all addresses will be stored, the computer terminal should have printer capability in order to print address labels for each of the utilities. This feature will expedite mailing of notices. Upon payment of the gross receipts tax, each amount paid is entered into the program, the program checks for accuracy of each amount paid, and flags any that are over or under amount. Following the final deadline for tax payment, the utility staff will be able to query the data base and flag delinquent companies and generate address labels for notices of delinquency. The program will also maintain a cash receipts journal. This program and data base should be interactive and executable from a computer terminal.

PHASE THREE - ELECTRIC UTILITY RATE ANALYSIS AND UTILITY TOTAL REVENUE PROGRAMS

Phase Three consists of a six-month period during which two additional programs should be developed and implemented.

Electric Utility Rate Analysis Program

One of the most important functions of the utility regulatory commission is to conduct rate analysis during major utility rate cases. For the electric utility this involves rate making based essentially upon kWh usage and kWh rates for the various classes of customers. Typically, the utility staff is responsible for distributing a total revenue requirement over several classes of customers.

The Electric Utility Rate Analysis Program should be designed to allow for inputting user-defined kWh usage blocks and assigning a rate(s) for each of the usage blocks. The program will then calculate the estimated total revenue generated from the given usage and rates. Additional features should include the capability of entering a total revenue requirement into the program and generating rates for each of the usage blocks, based upon some set of user-defined criteria. By assigning kWh cost factors (i.e., marginal kWh cost) to the program, rates can be computed based upon estimated usage and the cost-of-service concept. This program should be interactive and thus able to be executed from a computer terminal.

Utility Total Revenue Requirements Program

During the resolution of utility rate cases, the staff must, at some point, calculate the total revenue requirement that is to be recommended to the Commissioners. This is a straightforward calculation that is well suited for the computer. Basically, this program will allow the Commission's utility financial analyst to enter such variables as the cost of equity; cost of debt; lower, middle, and upper points of the zone of reasonableness; rate base; and net operating income. The program will then calculate the cost of capital and the total revenue requirement. This program should also be interactive.

Given the proper design considerations, this program can serve as a prototype for a more generalized utility rate case model. Such a model would allow for input of all rate case variables and incorporate essential calculations. With appropriate parameters for each calculation, the program could serve as a modeling tool. The Commission should plan to examine a similar model being developed by the California Public Utilities Commission.

SUMMARY

The purpose of this report is to describe the combined efforts of J.W. Wilson and Associates, Inc., Dewey Ray, and NRRI for the development and implementation of a three-phase program for introducing electronic data processing to the Arizona Corporation Commission.

In terms of the overall goal of establishing an operational data-processing function within the Arizona Corporation Commission, primary emphasis has been placed upon accomplishing the following objectives as part of the on-site technical assistance being provided by NRRI:

a. Delivery and implementation of a fully operational computer program by mid-November 1978. This program, which produces nineteen (19) utility ratios based upon forty-one (41) data input items, was developed and delivered by Dewey Ray. The program has been successfully converted and is fully operational at the Commission in Time Sharing FORTRAN to be executed on the Honeywell model H-6068 main from computers located at the appropriate data center.

b. Formal delivery of this report that will serve as a guide for establishing the data-processing function and describe the general design for future programs and data bases.

c. Follow-up activities that include providing evaluations regarding the suitability, in items of conversion, of programs and data bases in existence at other state regulatory commissions. Additional support has been provided to procure those programs and data bases requested by the Corporation Commission.

During the process of preparing this report, substantial progress has been realized at the Commission. Specifically, the supporting state data center has hired a computer programmer with an extensive background in engineering and the FORTRAN language. This person has been given the assignment of performing systems design and programming exclusively for the Corporation Commission. A terminal was installed in the Utilities Division on January 12, 1979. In addition, systems design for the fuel adjustment program was completed and operational.

At this time it appears that the on-site technical assistance has been of value. In addition to the tangible progress that has been made, considerable enthusiasm for computer technology has been observed throughout the Commission. The Commission's Executive Secretary, Comptroller, Data Processing Manager, Utilities Division Director, and other key staff members have demonstrated a genuine commitment to follow through with the development of a computerized regulatory information and analysis system.

In time, the Arizona Corporation Commission will no doubt join the growing ranks of utility regulatory commissions that utilize electronic data processing to improve the regulatory process.

APPENDIX A

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This report is comprised of three sections. The first section discusses performance indicators of the utilities regulated by the Arizona Corporation Commission. These indicators can be computed from data collected on the annual report of the utility to the Commission. The study of the performance indicators described can be done whether they are calculated by hand or by computer. The sheer number of possible indicators and the large number of utilities realistically preclude the possibility of performing all of the computations by hand for all utilities and then being able to analyze them adequately. Computerization of such systems is discussed in the second section. Some of the precautions one should take in implementing a computer system of this nature are mentioned. This section also discusses how an analyst could utilize a computerized annual report data base and also presents information on time-sharing computer systems, which could be used by the staff, and some relative advantages and disadvantages of each for various types of applications. Section three lists some software packages that may be of use to the Commission staff, and a brief description of each.

Performance Indicators

As a part of the oversight function performed by the Utilities Division of the Arizona Corporation Commission, data are collected on all electric, gas, telephone, water and sewer utilities through the submission of annual reports. The data contained in these reports provide the Commission staff with the information necessary to evaluate the performance of each utility in a number of areas. The use of various ratios as performance indicators enables the staff to identify out-of-line performance that serves as a point of departure for additional analysis.

Because there are so many aspects to the operation of a utility, there necessarily also are numerous performance indicators that can be examined. Obviously, each entry in the Annual Report can itself be used as a performance indicator. Any significant change in an item from year to year should be justified. General measures of efficiency can be constructed by examining expenses or revenues per customer or per unit sold. Beyond that, there are some more specialized ratios that should be examined for aberrations from the norm.

Two methods of analysis exist for the identification of such out-of-line performance. One method is to study the pattern of changes for a company from year to year to detect significant trends in the utility's operation. A rising trend in the percentage of capacity utilization for an electric utility, for example, may indicate the smoothing of seasonal sales, the purchase of peak-load requirements from another utility, or some other adjustment permitting more efficient use of available generating capacity. Similarly, the direction of movement of fuel costs per million Btu is a key determinant of changes in the production cost, while kWh consumption per residential customer is an important indicator of success in conservation promotion or perhaps changes in customer characteristics.

A second analytical method is to make intercompany comparisons. The validity of such comparisons, however, depends upon whether the companies being compared are reasonably homogeneous from the standpoint of the particular aspect of performance being examined. Within an individual state, there is generally an insufficient number of major utilities to be able to make extensive intercompany comparisons. It thus is necessary to cross state boundaries to be able to perform this type of analysis. Additionally, it is more complicated to derive reliable statistical measures for intercompany performance comparisons than for analyzing the changes in an individual company's performance over a period of years. For the first purpose, the companies must be classified and grouped according to similarities in key aspects of their operations (e.g., size, power sources, fuel costs, market characteristics, etc.). The composite experience of an appropriately constructed group may provide performance benchmarks for the individual members of the group. For the other purpose, that is, individual company testing against its own past record, it is only necessary to identify any changing circumstances affecting the particular company since these may account for the observed trends and the performance results during the period under study. Furthermore, the user of the data should examine a comprehensive display of interrelated classification and cost data before drawing any conclusions about the performance of one company relative to the performance of others. For example, lower fuel costs are sometimes achieved at the expense of higher investment in transmission lines; similarly, generating costs may appear to be out of line because the generating facilities are used primarily for peaking purposes instead of for base load power. There are many similar pitfalls in focusing on a single performance indicator without regard for the interrelationships.

General Utility Performance Indicators

Two fundamental kinds of performance indicators are recommended, with some additional miscellaneous indicators. The first kind is a measure per customer. The unit of output varies between utility types, and is straightforward for some (e.g., Mcf for gas utilities), and not as straightforward for others (measures of telephone company output, for example). Performance per customer can be misleading if it is not properly used. An electric utility that serves primarily residential customers will have much different ratios from one that has a large industrial base. Additional indicators must be considered--in this case, percentages of customers that fall into the various classes would indicate that the two electric utilities are not comparable in that respect, so that their outputs per customer would not be directly comparable. Some indicators only make sense in terms of the total output or total number of customers, while for others the ratio can be examined by customer class. These data on output and number of customers are obtained from pages 15 and 16 of the Annual Report. For each of the areas in the Annual Report--assets, liabilities, operating expenses, capital expenses, revenues, operation and maintenance expenses--performance indicators can be constructed for the totals and for several levels of detail. For example, expenses for operation per customer can be computed at one level and, at a lower level of detail, distribution expenses per customer can be computed. Operation expenses per customer might be similar for two utilities, while a rural utility would be expected to have greater distance between customers and, consequently, higher distribution expenses per customer.

Each of the utility types provides the same information on assets and liabilities, and the computation of performance indicators is the same in these two areas. For them, the discussion is contained in this section and will not be repeated for each utility type.

To single out some indicators that should be considered:

- Assets - each of these should be computed with respect to total output and total number of customers: plant in service, net plant in service, net other plant, cash special deposits, temporary investments, doubtful accounts, receivables, and material and supplies. These are to be obtained from pages 3 and 4 of the Annual Report. An increase in, or consistently high ratios of, receivables, doubtful accounts, or material and supplies may indicate continued poor management in these areas and should be a signal to the analyst to examine the company more closely. A decline in plant-in-service per customer may indicate greater efficiency and improved management, or it may be indicative of operation closer to the margin of the company's capability. At a lower level of detail, indicators on plant (e.g., distribution plant) can be constructed from information on page 7. These are discussed in the section for each utility type.

- Liabilities - these are computed with respect to total output and total customers: total proprietary capital, total long-term debt, and total current and accrued liabilities that appear on page 5. For a given utility, these should not change greatly from year to year.

Electric Utilities

The measure of output for electric utilities is total kWh sold, and total customers is to be used as the denominator for the other ratios. Many of the indicators will reflect the differences between companies that generate most of their energy and those that purchase it. More complete information on the amount of purchased power must come from another source, as the only item related to that in the Annual Report is expense for purchased power. Any company which is using its generation plant inefficiently and purchasing power unnecessarily will have that reflected in another of its performance indicators (e.g., cost per kWh sold). In addition to the general indicators, listed in Section 1, electric utilities can be compared by examining:

- Assets - at a lower level of detail than was listed in Section 1, information on page 7 provides indicators on: intangible plant, production plant, transmission plant, distribution plant, general plant, other tangible plant, plant held for future use, construction work in progress, and total utility plant.

- Operating expenses - these are computed with respect to total kWh and total number of customers. Operating expense, maintenance expense, depreciation expense, total expense, and net revenue all appear on page 8 of the Annual Report. At a lower level of detail, operating expenses and maintenance expenses can provide additional performance indicators. These would be for operation expenses, production expenses, purchased power, transmission expenses, distribution expenses, customer accounts expenses, sales expenses, and administrative and general expenses. For maintenance, there would be production expenses, transmission expenses, distribution expenses, and administrative expenses. All of these are to be found on page 11 of the Annual Report.

- Revenues - these are provided by customer class, and the performance indicator should be constructed by using the total number of customers within that class or the total kWh consumed by that class. For example, residential sales would be computed both with respect to number of residents, providing sales per customer, and with respect to total number of kWh that would provide sales per kWh within the class.

- Miscellaneous - indicators of interest can be constructed by taking the ratio of net income, which appears on page 9, to several variables. First would be income per kWh and per customer. Additional indicators can be computed by taking income per proprietary capital that appears on page 5.

Information on pages 15 and 16 can be used to construct indicators of what proportion of the total each customer class represents. This would provide the percentage of total customers who are residential, commercial, industrial, etc., and what percentage of sales were residential, commercial, industrial, etc.

Several indicators of employee efficiency can be constructed from the data on page 17. Total number of employees per kWh and per customer can be used as well as total payroll divided by the number of employees.

Telephone Utilities

The measure of output for a telephone company is much more uncertain than for most other utilities. Utilization of the plant is not something that is easy to define. It is not at all clear what compares to kWh for an electric company, and such information is not available in the Annual Report. Therefore, indirect measures of output must be used, with the resulting lack of precision that accompanies the use of indirect measures. In order to attempt to regain some of that precision, it is necessary to examine a greater number of ratios. In this case, we compute all of the ratios with respect to the following four parameters: total telephones in service, number of main stations, number of subscribers, and number of route miles of line.

- Assets - these include the ratios of construction work in progress and plant held for future use with respect to the four denominations mentioned above. Data for these two ratios are found on page 7.

- Operating expenses - data for these indicators appear on page 8. Ratios of the following can be computed: maintenance expense, depreciation expense, traffic expense, commercial expense, general office expense.

- Revenues - major revenue items that provide useful performance indicators are found on page 10 and include the following: subscribers' station revenues, message tolls, directory advertising, rent revenues, uncollectibles, and total revenue. In addition, net revenue is found on page 9 and should have the four ratios computed. One additional indicator can be constructed by taking the ratio of public telephone revenue to number of pay stations.

- Miscellaneous - there are a larger number of miscellaneous indicators than for other utilities since the output is not a single measurable entity. Mostly, they are related to the data on pages 14 and 15 about subscribers and facilities of the company.

  total telephone/central offices
  total telephones/total subscribers
  route miles/total subscribers
  route miles/central offices
  subscribers/central offices
  main stations/central offices
  main stations/total subscribers
  one party business/total business
  one party residential/total residential
  employees/total subscribers
  employees/total telephones
  employees/route miles

Gas Utilities

The two basic kinds of performance indicators for gas utilities are similar to those for electric utilities--one being performance per customer, and the second being taken relative to Mcf of gas. And, as with electric utilities, there are some additional miscellaneous performance indicators. In addition to the indicators on assets and liabilities in Section 1, the assets at a lower level of detail are only slightly different from those for electric plant.

- Assets - these are computed with respect to total number of Mcf and with respect to total number of customers: gas stored (from page 3), and intangible plant, production plant, storage plant, transmission plant, distribution plant, general plant, other tangible plant, plant held for future use, construction work in progress, and total utility plant (from page 9).

- Operating expenses - the ratios of operating expenses to Mcf and number of customers are obtained from the data on page 11 and are broken down into the following: production, purchases, storage, transmission, distribution, sales, administrative and general.

- Revenues - these are provided by customer class and the performance indicator should be constructed by using the total number of customers within that class or the total Mcf consumed by that class. For example, residential sales revenue ratios would be computed both with respect to revenues per customer and with respect to revenues per Mcf.

- Miscellaneous - indicators of interest can be constructed by taking the ratio of net income, which appears on page 9, to several variables. First would be income per Mcf and per customer. Additional indicators can be computed by taking income per total plant that appears on page 7, and income per proprietary capital that appears on page 5.

Information on pages 15 and 16 can be used to construct indicators of what proportion of the total each customer class represents. This would provide the percentage of total customers who are residential, commercial, industrial, etc.

Several indicators of employee efficiency can be constructed from the data on page 17. Total number of employees per Mcf and per customer can be used as well as total payroll divided by the number of employees.

Water Utilities

The obvious measure of output is millions of gallons sold and can be computed for the total as well as for several customer classes. Some indicators can be computed relative to customer class, but most are only of value when taken with respect to total millions of gallons.

- Assets - in addition to those general assets listed in Section 1, water utilities have the following breakdown of plant in service: intangible, source of supply, pumping, water treatment, transmission, and general. Ratios of these with respect to M gallons and to number of customers provide performance indicators of the distribution of costs among kind of plant. Other water plant for which ratios ought to be computed are: held for future use, and construction work in progress.

- Operating expenses - as for electric and gas utilities, ratios for operating expenses can be computed at several levels of detail and should be computed with respect to M gallons and total number of customers. Data for the higher level appear on page 8, and these ratios should then be taken for: total operating, and total maintenance. At the second level, data appear on page 11, and ratios should be taken for expenses for: pumping, purchase and source, treatment, transmission and distribution, customer accounts, sales, and general and administrative.

- Revenues - these data are provided by customer class, and useful indicators can be calculated for the company on a class basis. For each class, the revenue contribution from that class is divided by each of the number of customers in the class and the millions of gallons of water sold to each class. Additional indicators of interest are net income from page 9 divided by total plant (page 7) and by proprietary capital (page 5), as well as number of customers and gallons sold.

- Miscellaneous - several additional ratios are of interest:

  unmetered revenue/total revenue
  unmetered customers/total customers
  unmetered gallons/total gallons
  employees/gallons
  employees/customers

Computerized Systems

Hand computation of the performance indicators that have been discussed requires a large amount of time, and since there are a great many comparisons an analyst might want to examine, fixed output is both difficult to produce and difficult to use. If the need for the comparisons is great, and the resources exist with which to develop and implement a computer system for the Annual Report data, examination of the performance indicators discussed previously can be facilitated with an interactive computer system.

Implementation of a system is an expensive and time-consuming process. Results should not be expected quickly. The Regulatory Information System (RIS) was initiated in 1972 by the Federal Power Commission and is not expected to be fully operational until 1980. Of course, there is an immense amount of time required for rule making, and there is lag time for approval of forms by various governmental entities. Additionally, RIS is a large and very complex system. It will provide much of the capability for intercompany comparison of gas and electric utilities since it covers the entire United States. The contractor for this project, Planning Research Corporation, has visited Arizona within the past year and has provided information on RIS to the Corporation Commission. The designated point of contact within the Arizona Corporation Commission is Robert Kircher, Director of the Utilities Division, and he can provide the most current information on schedules and accessibility of RIS.

RIS is an interactive data base management system (DBMS). An interactive DBMS is a computer system that enables an analyst to browse through the data. This browsing consists of asking for a data item from the data base, waiting for the response from the computer and, in turn, responding to the information provided. In this way, the analyst can formulate questions based on the computer responses and thus pursue a line of questioning that otherwise would be difficult or impossible to do. Software is commercially available to be purchased or leased and installed on a computer system. The programming effort involved in establishing a data base on a DBMS is much less than building such a system from scratch, but for a complex system, can still be quite extensive. It would be possible, however, to design and implement a DBMS for each type of utility (electric, gas, water, telephone, and sewer) independently and use the implementation of the first one to provide experience on which to build the others.

Data from each Annual Report can be entered either interactively or in a batch mode. With successive years of data in the data base, it would be unnecessary to enter both current and previous year data since the previous year's data would already have been entered a year earlier. The simplest type of search would be to retrieve one parameter for one company for one year. A slightly more complex retrieval would be to compute a ratio or other function for one company for all years. Even more complex would be to list, for example, all water companies with cost per gallon of water greater than a specified amount. A final example of increasing complexity would list all electric companies with residential sales exceeding a given dollar amount, and for which the ratio of residential sales to total residential kWh is larger for the current year than the previous year. The kind of use for which this type of system can be put is limited only by the abilities and imagination of the analyst.

A second type of use of computer systems in the regulatory environment is that of applying existing programs or software packages to specific analytical situations. There are a great many such packages available and they are described below. These generally require study by the analysts and knowledge of the package's capabilities. Cost of obtaining these packages varies. Some are in the public domain and can be obtained for the cost of copying, while others are available only on a time-sharing service and can be very expensive. Additionally, costs of running the programs vary greatly as well.

Software Packages

There are three kinds of computer systems available to the Arizona Corporation Commission: The Arizona Data Service, Arizona State University, and commercial time-sharing systems.

- o Arizona Data Service - Discussed with Ben Froelich, Director of Programming, the types of services that it could provide. It is primarily a COBOL-oriented operation. While it does have some FORTRAN capability, it shies away from one-time FORTRAN operations. It does not currently have much computational-oriented software on its system but said that it could be installed it if there were a demand. If a DBMS were obtained for the purpose of implementing a system as described earlier, this system would be the appropriate one on which to install it.

- o Arizona State University Computer Center - Received information from Randy Wagner and Carol Waters at 965-5677. This system is more computational-oriented and has a number of software packages available. Some of the ones that are of interest are the following: Time-Series Processor (TSP), International Math Science Libraries (IMSL), STATPAC, BMDP (the biomedical statistics package from Stanford University), and Statistical Package for the Social Sciences (SPSS). TSP is maintained by the Business Department, and the person's name is Bob Dunikowski at 965-3961.

- Commercial time-sharing - A number of commercial time-sharing computer systems have special utility-oriented packages available. The most extensive of these is General Electric Time-Sharing that has a large number of utility-oriented programs ranging from generation planning to analysis of proposed rates. GE also had available several years ago a data base it called electricity consumption analysis data. This consisted of consumption data on sixty-three utilities across the country, a number of weather, employment, income and industry activity variables on which to perform econometric modeling. While this is no longer available on the GE time-sharing system, GE does use it internally and would make it available to an interested regulatory commission. Another type of specialized package is the utility model, marketed by Dynamics Associates, Inc., and available on the Interactive Data Corporation time-sharing network. The purpose of this model is to study regulatory scenarios and their impact on methods of obtaining capital.

APPENDIX B

AN OVERVIEW OF THE UTILITY RATIO ANALYSIS PROGRAM

The Utility Ratio Analysis Program was developed by Dewey E. Ray exclusively for the Arizona Corporation Commission. This program was written in Control Data Corporation ANSI FORTRAN IV EXTENDED to execute on the CDC CYBER 74 computer. Upon completion, the program was transmitted to Mr. Richard E. Van Allen, Systems Project Manager, for the Arizona Department of Administration's Data Center. Mr. Van Allen's staff converted the program from CDC FORTRAN to Honeywell ANSI FORTRAN IV, so that it would execute on the Honeywell 6000 series computer.

Structurally, the Utility Ratio Analysis Program consists of approximately four hundred (400) lines of FORTRAN code that reads external data file(s), each data file containing forty-one (41) data elements for a given utility company. The program then performs the calculations necessary to produce nineteen (19) operational and financial ratios, and prints the ratio name and computed ratio value for each of the nineteen (19) ratios. The external data file(s) are created through use of an on-line Text Editor program that exists on both the CDC and Honeywell computers.

Operationally, the staff of the Arizona Corporation Commission need only have a computer terminal on-line to the Honeywell computer, along with available input data, in order to run the program. With the terminal and data available, the user simply creates, using the Text Editor program, a data file for each of the utility companies being analyzed. Upon creation of the data files, the user calls the Utility Ratio Analysis Program, specifies the name of the data file to be analyzed, and the program proceeds to produce the calculated results in a very readable output format. A single data file can be created in less than thirty (30) minutes elapsed time, and the program will run in less than five (5) minutes elapsed time.

It is anticipated that this program will serve as a prototype for a more sophisticated, versatile ratio analysis program as described in the attached report. The program on the following pages describes the input data and the computational procedure for the ratios.

INPUT VARIABLES FOR UTILITY RATIOS

Order of Input	Variable Label	Variable Name	Size (A or N)
	Utility Name (Cols. 1-68)	Name	68 AN
	Utility Number (Cols. 69-76)	UTNUM	5 AN
	Year (Cols. 77-80)	YEAR	4
1	Accumulated Depreciation and Amortization	ADPA	12
2	Advances In Aid of Construction	AIAC	12
3	Common Capital Stock	CCSTK	12
4	Contributions In Aid of Construction	CIAC	12
5	Capital Stock Expense	CPTSEX	12
6	Debt on Premiums and Discounts and Expense	DPTPDE	12
7	Depreciation Expense	DEPEX	12
8	Gas Stored Underground	GSUC	12
9	Income Taxes	INCTAX	12
10	Interest On Long-Term Debt	INTLTD	12
11	Materials and Supplies	MATS	12
12	Net Income	NETINC	12
13	Premium/Discounted Capital Stock	PDCSTK	12
14	Production Expenses - MT	PEXMT	12
15	Production Expenses - OP	PEXOP	12
16	Prepayments	PREPMT	12
17	Purchased Power	PURCP	12
18	Power for Pumping	PWRFPG	12
19	Quantity Sold Residential	QTRES	12
20	Quantity Sold Residential Meters	QTRESM	12
21	Residential Customers	RESC	12
22	Residential Customers Metered	RESCM	12
23	Residential Sales	RESS	12
24	Residential Sales Metered	RESSM	12
25	Retained Earnings	RTEGS	12

26	Salaries and Wages	SALWAG	12
27	Storage Expenses - MT	SEXMT	12
28	Storage Expenses - OP	SEXOP	12
29	Special Deposits	SPDPS	12
30	Transportation Expenses - MT	TEXMT	12
31	Transportation Expenses - OP	TEXOP	12
32	Total Long-Term Debt	TLTDBT	12
33	Total Maintenance Expenses	TMEX	12
34	Total Assets and Other Debits	TOAOD	12
35	Total Operating Expenses	TOEX	12
36	Total Proprietary Capital	TOPCPT	12
37	Total Operating Revenue	TOPREV	12
38	Total Quantity Sold	TOGTS	12
39	Total Customers	TOTCUS	12
40	Total Utility Plant	TOTUP	12

COMPUTATIONAL PROCEDURES FOR UTILITY RATIOS

Ratio	Procedure
RATE BASE	Total Utility Plant minus Advances In Aid Of Construction minus Contributions In Aid Of Construction minus Accum. Deprec. and Amort. plus Materials and Supplies plus Prepayments plus Special Deposits plus Working Funds
BASE 1	Rate Base plus 0.125 multiplied by (Total Operating Expenses plus Total Maintenance Expenses) minus Purchased Power minus Gas Stored Underground Currently
COMMON EQUITY	Common Capital Stock plus Prem./Disc. Capital Stock plus Retained Earnings minus Capital Stock Expense
LONG-TERM DEBT CAPITALIZATION	Total Long-Term Debt divided by Total Proprietary Capital
GROSS PLANT TO TOTAL CAPITAL	Total Utility Plant divided by Total Proprietary Capital
TOTAL ASSETS TO TOTAL CAPITAL	Total Assets and Other Debits divided by Total Proprietary Capital
NET INCOME BEFORE LONG-TERM DEBT EXPENSE (NIBLTDE)	Interest On Long-Term Debt plus Debt Prem./Disc. and Expense plus Net Income
TIMES INTEREST EARNED BEFORE TAXES	NIBLTDE plus Income Taxes divided by Interest On Long-Term Debt
TIMES INTEREST EARNED AFTER TAXES	NIBLTDE divided by Interest On Long-Term Debt
OPERATING REVENUES TO UTILITY PLANT	Total Operating Revenues divided by Total Utility Plant
DEPRECIATION EXPENSE TO UTILITY PLANT	Depreciation Expense divided by Total Utility Plant

AVERAGE RESIDENTIAL BILL	Residential Sales _plus_ Residential Sales Metered _divided by_ Residential Customers _plus_ Residential Customers _plus_ Residential Customers Metered
WATER PRODUCTION EXPENSE PER M GALLONS SOLD	Production Expense-OP _plus_ Storage Expense-OP _plus_ Transportation Expenses-OP _plus_ Production Expenses-MT _plus_ Storage Expenses-MT _plus_ Transportation Expenses-MT _divided by_ Total Quantity Sold
OPERATING EXPENSES TO OPERATING REVENUES	Total Operating Expenses _divided by_ Total Operating Revenues
INCOME TAX EXPENSE TO TOTAL OPERATING REVENUES	Income Taxes _divided by_ Total Operating Revenues
POWER FOR PUMPING TO OPERATING REVENUES	Power For Pumping Expense _divided by_ Total Operating Revenues
SALARIES AND WAGES TO OPERATING REVENUES	Salaries and Wages _divided by_ Total Operating Revenues
RESIDENTIAL TO TOTAL CUSTOMERS	Residential Customers _divided by_ Total Customers