MAIN
Engineers

CHAS. T. MAIN, INC.
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Gentlemen:

This brochure describes the Economic Services of Chas.T. Main, Inc. MAIN is a major Architect-Engineer firm with its main offices in Boston, Massachusetts. Regional offices are maintained in Charlotte, North Carolina; Denver, Colorado; Portland, Oregon and in several foreign countries.

Included in this presentation are a description of the firm, a brief outline of our capabilities and some examples of representative projects. Resumes of key and back-up personnel are available upon request.

We feel that this material demonstrates our capability to implement any assignment in the economic area that you may require. We would be pleased to discuss with you, at your convenience, your needs and objectives and to provide additional detail on those of our capabilities that could be specifically of value to you.

Looking forward to the pleasure of hearing from you, I remain,

Sincerely yours,

CHAS. T. MAIN, INC.

Howard C Barnes

Howard C. Barnes
Vice President

DESCRIPTION OF MAIN

Chas. T. Main, Inc., a completely independent organization, provides comprehensive professional engineering, technical and managerial services to its clients. Being free of any financial interests with construction firms, manufacturers, suppliers or other commercial entities, MAIN is in a position to serve its clients with complete objectivity.

Chas. T. Main, Inc. was founded in 1893. Through the years, it has experienced a gradual and steady growth to its present stature – a well-balanced organization composed of men and women with varied backgrounds in the principal branches of engineering. The staff also includes architects, management consultants, environmentalists, economists, utility rate specialists, procurement specialists and construction managers.

MAIN is an employee-owned organization in which all officers and principals are engaged in the operation of the firm. The President of the firm is its Chief Operating Officer, exercising control in a broad sense over all activities of the firm. The activities in turn are carried out by autonomous divisions segregated along industrial lines each under the direction of a Vice President. Each of the diverse projects undertaken by MAIN is assigned to one of the divisions, which is responsible for the general supervision of all phases of work and for involving other divisions as required. A group of key specialists working directly on the project in liaison with the client, draws upon the complete range of talent within the corporate organization as necessary to meet the specific project requirements. This operating flexibility assures that the combined judgement and experience of a group of management and engineering specialists, directly concerned with the successful and economical achievement of the client's objectives, is concentrated on every assignment.

MAIN is constituted of the parent organization, Chas. T. Main, Inc., an affiliated partnership, Uhl, Hall & Rich, and MAIN's wholly owned subsidiaries, which include Chas. T. Main International, Inc., Chas. T. Main of Michigan, Inc., Chas. T. Main of New York, Inc., Chas. T. Main of Virginia, Inc., and Buerkel and Company, Inc., headquartered in Boston, Massachusetts. MAIN also maintains district offices in Charlotte, North Carolina; Portland, Oregon; and Denver, Colorado. On the international scene, MAIN has regional offices in Buenos Aires, Argentina; Jakarta, Indonesia; Lagos, Nigeria; Panama City, Panama; and Tehran, Iran, plus project offices as required. Presently, MAIN employs approximately 1700 professional and support personnel in its worldwide activities. Approximately 1300 of these are in Boston.

The firm is organized into two basic groups: Power and Industrial. Each is staffed with personnel whose expertise lies in their respective areas.

The Power Group is structured to serve clients in the utility industry and consists of the Hydro, Thermal, Nuclear, and the Power and Environmental Systems Divisions. The responsibility of the Hydro, Thermal and Nuclear Divisions is to provide clients with engineering, design and construction management services related to the construction of electric generating plants and associated facilities. The Power and Environmental Systems Division is responsible for all aspects of utility system planning including load forecasting, economic and system planning, rate structuring, environmental impact statements, expert testimony and the subsequent engineering, design and construction management of facilities required in the transmission and distribution of electrical energy.

The services provided by the Power and Environmental Systems Division are tailored to meet the requirements of individual clients – both large and small – located in all parts of the United States and throughout the world.

These services are performed by professionals who are highly qualified by accumulated knowledge and mature judgement acquired through many years of experience in their respective fields, including practical operating experience with planning, analysis and operation of high-voltage transmission lines, distribution systems, substations, switching stations, communications and microwave systems as well as environmental planning and rate structures. They fully understand the importance of a properly structured utility network in providing the reliability, flexibility, and economic operation essential to successful utility performance.

CAPABILITIES

Rapid advances in economic theory and computer technology facilitate creative approaches to today's problems. MAIN's Economics Department is involved in a continuous program to apply econometrics, input-output analysis, probability methods, and Markov techniques to the practical problems facing private businesses, public agencies, and national governments.

MAIN provides professional economic services based upon the practical application of modern theory and methodology to a variety of problems and projects including:

1. Forecasting and Marketing Studies

   a. to project local, regional and national economic trends . . .
   b. to determine current and future demand for energy, goods and services, recreational facilities, specific products . . .
   c. to project population, employment, per capita income, consumption patterns, social service, and educational requirements . . .

2. Impact Studies

   a. to determine project impact upon the economic, social, and environmental structure of communities.

3. Allocation Planning

   a. to maximize the achievement of economic goals while minimizing resource usage and environmental damage,
   b. to establish development policies consistent with local environmental, social, and economic objectives.

4. Feasibility Studies and Economic Evaluation of Alternatives

   a. to compare alternatives,
   b. to evaluate the economic feasibility of projects, based upon discounted cash flow, present worth, benefit-cost, and internal rate of return methods,

c. to assess the technological feasibility of project implementation,
d. to schedule the development of multi-phase projects.

5. Investment Planning

a. to maximize long-term profit objectives and return on invested capital,
b. to develop financial programs for future growth and expansion,
c. to maximize social and environmental objectives.

In addition, MAIN's management and rate specialists provide services in the fields of:

6. Management Consulting

a. to provide a multi-disciplined approach for corporate model building,
b. to develop long-range planning programs and to evaluate corporate objectives.

7. Pricing and Rate Setting Policies

a. to completely evaluate the need for additional revenues,
b. to develop pricing policies in accordance with revenue requirements based upon supply and demand studies,
c. to present pricing policy recommendations before company staffs, regulatory agencies, and community leaders.

PERSONNEL

MAIN's Economics Department is a flexible group that is capable of adopting new organizational forms in order to provide the necessary experience and climate of innovation which a specific task requires. The basic staff is composed of economists, market and financial analysts, mathematicians, pricing and management specialists, and programmers. However, in response to the needs of different projects, the staff may be increased to include in-house engineers, architects, environmentalists, geologists, accountants, personnel advisors, rate specialists, and systems analysts.

In addition to the work in the United States, MAIN's Economics Department has been involved in projects in Africa, Asia, Latin America, and the Middle East, and has conducted studies for such agencies as the World Bank, Asian Development Bank, and Agency for International Development.

COMPUTER SERVICES

MAIN provides complete computer services to clients, including:

1. An in-house Data Processing Center with an IBM 370/145 and several time-sharing terminals connected to a GE 635 computer.

2. An extensive library of public and private programs and data files.

3. A staff of computer systems analysts, programmers, mathematicians and operations personnel employed in the Data Processing Center.

4. Analysts and programmers who specialize in various disciplines throughout the company and who work closely with the Data Processing Center to develop computer applications which meet the specific needs of individual clients and projects.

The Economics Department makes extensive use of the latest techniques in computer applications. Members of the department have developed several techniques and models which have recently been described in national magazines and endorsed by professional organizations and international agencies. These include a land-use model for quantifying the economic, environmental, and physiographic impacts of projects; a model for determining the direct and indirect interrelationships between the economy and the environment; and a Modified Markov method which utilizes aspects of econometrics, input-output analysis, and stochastic processes in solving problems related to allocation planning, forecasting, and investment planning.

ENVIRONMENTAL SERVICES

The Economics Department works closely with MAIN's Environmental Planning Department. The Environmental Planning Department is an interdisciplinary team of scientists supported by photogrammetric and water

quality laboratories as well as sophisticated computer methodologies. Facing the practical problems of private businesses and public agencies, the staff is dedicated to the dual goal of environmental preservation and project implementation. Professional services offered by the department include:

1. Environmental Impact Studies
2. Plant Siting Studies
3. Power Transmission Planning and Design
4. Land Planning
5. Wastewater, Air Quality, and Solid Waste Engineering

Common to all of these studies is a thorough assessment of the probable physical, ecological, economic and social impacts of a project and advice on measures to mitigate negative impacts so as to protect or enhance the resources affected. The Environmental Planning Department is experienced in the formal preparation of its findings to conform to the requirements of regulatory agencies.

REPRESENTATIVE PROJECTS

Examples of recent projects conducted by MAIN's Economics Department for specific clients are listed below and presented in the following pages. This selection includes sample projects for each of the categories outlined in the preceding "Capabilities" section.

	Project	Client
1.	Forecasting and Marketing Studies	South Carolina Electric & Gas Co. Inter-American Development Bank
2.	Impact Studies	Power Authority of the State of New York
3.	Allocation Planning	Government of Kuwait
4.	Feasibility Studies	International Bank for Reconstruction and Development Planning Ministry of Ecuador
5.	Economic Evaluation of Alternatives	General Electric Corporation Cities Service Company
6.	Investment Planning	Technical Association of the Pulp and Paper Industry Washington Post
7.	Management Consulting	Virginia Electric and Power Company

PROJECT: **Forecast of Economic Potentials and Energy Demand**

CLIENT: **Inter-American Development Bank**

LOCATION: **Colombia**

MAIN prepared studies analyzing economic potentials in the twelve component sectors of the economies of seven provinces located along the Caribbean coast of Colombia. Special attention was given to future perspectives in agriculture, industry, mining, exports, population migration tendencies, the growth of tourism and the energy demand. Working closely with local planners, MAIN prepared financial, economic, and market studies for public utilities in the region.

When the study was begun, the region had a population of three million and an unemployment rate of about 30%. The plans show the need to develop two large tourist areas as well as the infrastructure and industries for serving them. The studies indicate that the tourist facilities should increase from the 313,000 capacity expected for 1976, to 1,079,000 in 1985, and 1,600,000 in 1990. It has been projected that the number of persons employed as a result of the development of tourism will increase by 17,000 in 1976; by 59,000 in 1985; and by 82,500 in 1990.

Under an Inter-American Development Bank contract, MAIN has also assisted in planning the expansion of local public utility services required to meet the growing demand. MAIN has used both micro and macroeconomic forecast techniques to project the growth of the main sectors of the economy, tourism, population and energy demand.

In addition to preparing exhaustive financial, economic, and market studies and a series of reports to be used to obtain loans from international financing agencies, MAIN began an intensive training program for teaching local planners techniques which they will be able to use to carry out similar studies in the future.

PROJECT: **Allocation Plan for Economic Development**

CLIENT: **Government of Kuwait**

LOCATION: **Kuwait**

At the request of the Government of Kuwait, MAIN evaluated the implications of a possible reallocation of resources which would result in a shift from an oil-based economy to one more dependent upon industry and services. The study included an analysis of cultural and social factors as well as economic resources.

The first phase of the study involved a complete evaluation of the nation's economic potential. Although noting the short-term advantages of oil revenues, the study concluded that rapid long-term economic expansion depends on the mobilization of available domestic capital and managerial resources. It was suggested that energy availability and geographic considerations make Kuwait an ideal location for manufacturing raw materials for re-export.

The second phase of the study was a long-range plan of the Kuwait's power system. The plan included a complete forecast of electricity requirements necessary for the country's anticipated economic diversification and expansion.

PROJECT: **Power Survey and Economic Feasibility Studies**

CLIENT: **International Bank for Reconstruction and Development**

LOCATION: **Panama**

A power survey and feasibility study was carried out for the Republic of Panama by MAIN under a contract with the International Bank for Reconstruction and Development. The purpose of this study was to provide a comprehensive plan for the integrated development of the electric power system in Panama.

This Panama survey and feasibility study program of about two years duration, comprised four major steps: the Power Market Survey, the Hydropower Survey, the Master Plan, and the Economic Feasibility Study. In this survey, MAIN screened potential hydro developments of more than 50 MW and selected the best possibilities for comparison with equivalent thermal generation and eventual inclusion in an optimized thermal-hydro development program to help meet the growing demand for power. Preliminary designs, benefit-cost estimates, and additional investigations at selected sites provided the basis for recommending developments.

Subsequently, MAIN conducted a thorough review of its 1971-1972 long-range, power survey and feasibility study for the Republic of Panama in order to re-assess the most economical, integrated system plan in light of current dramatic changes related to world-wide inflation and recession.

Based on both an extensive macro and micro analysis of the Panamanian economy, MAIN prepared a long range electric load forecast which incorporates anticipated price elasticity of demand for electricity. An economic evaluation of alternative hydro and thermal generating systems designed to meet projected demand was then conducted. The economic evaluation was done both with and without shadow prices. Sensitivity analysis was used to determine changes in the relative preferability of the alternatives. Based on the above studies, benefit-cost estimates of alternative investment schemes were made. These estimates were used in the final selection of the system plan to be implemented.

PROJECT: **Prefeasibility and Feasibility Studies for the Jubones and Paute River Development**

CLIENT: **Junta Nacional de Planificacion y Coordinacion**

LOCATION: **Ecuador**

MAIN was retained by the Government of Ecuador to perform an analysis of the power potential of the Jubones River and of the section of the Paute River known as the "Cola de San Pablo." Both rivers are located mainly in the Province of Azuay, Ecuador. The studies were financed by the U.S. Agency for International Development.

The prefeasibility part of the studies consisted of the estimation of the stream flows in both rivers making long-term projections from short-term meteorologic and stream-gaging data, selection of potential sites for hydroelectric development, preliminary designs of hydroelectric installations, and cost-benefit type evaluation of numerous alternatives. Concurrently with hydrologic, geologic and power studies, power market and transmission system studies were conducted. From these studies the projected load demands for the regions affected by the study were developed. The phase development of the proposed hydroelectric schemes was then geared to meet the growing capacity and energy requirements. The prefeasibility study was concluded by selecting from numerous alternatives the river (the Paute) and the related projects having the highest cost-benefit ratio for more detailed study in the feasibility phase.

The feasibility part of the study consisted of developing engineering features for the selected phase of the project. For this purpose the reservoir was surveyed and foundation was explored by drilling. Careful evaluation of the geologic features of the first project was essential since the plant will operate under a head of 690 meters and will have over three miles of tunnels including an underground power plant. At the same time, power market and hydrologic studies were continued to finalize load forecasts and reservoir storage requirements. The feasibility report contains all engineering information necessary for detailed project development, as well as cost estimate and cash flow requirements for financing arrangements.