

Federal Power Commission.

National Power survey

Interim Report, Power series no. 1

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FEDERAL POWER COMMISSION

NATIONAL POWER SURVEY
INTERIM REPORT

POWER SERIES No. 1

1935



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**NATIONAL POWER SURVEY
INTERIM REPORT**

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LETTER OF TRANSMITTAL

MARCH 22, 1935.

The PRESIDENT,
White House, Washington, D. C.

SIR: We submit herewith the first report of the National Power Survey which has been conducted by the Federal Power Commission under the provisions of Executive Order No. 6251 of August 19, 1933.

The facts developed in this interim report have an important bearing not only upon conditions in the electric light and power industry but also upon the problems of unemployment, industrial recovery, and national defense. This report presents for the first time an analysis of the relation between the Nation's power requirements and the generating capacity of existing power plants. It shows by districts the shortages and surpluses of power that will exist upon a resumption of normal industrial activity.

This information is essential to sound planning for the future development of the Nation's power resources.

Respectfully submitted.

FRANK R. MCNINCH,
Chairman.

BASIL MANLY,
Vice Chairman.

HERBERT J. DRANE,
Commissioner.

CLAUDE L. DRAPER,
Commissioner.

CLYDE L. SEAVEY,
Commissioner.

LETTER OF SUBMITTAL

MARCH 15, 1935.

To the FEDERAL POWER COMMISSION:

Pursuant to the instructions of the Commission and the provisions of the President's Executive Order authorizing the National Power Survey, there is submitted herewith the first of a series of reports on the Nation's power resources and power requirements. This is in the nature of an interim report.

The results and summaries contained in this report, as well as the tentative conclusions, are based largely on an analysis of the returns of 215 electric utility systems, comprising 391 privately owned major electric operating properties and 21 major municipally owned electric operating systems. The installed generating capacity of these 215 systems is 91 percent of the total installed generating capacity of electric utilities in the United States. Their output represents 93 percent of the electrical output of the publicly and privately owned utilities of the entire country.

The staff of the National Power Survey takes this opportunity to express its appreciation of the cooperation of the municipal plants and private companies in supplying detailed information concerning their generating plants and transmission systems, characteristics of their load, and other pertinent information; also of the information furnished in published and unpublished form by the Corps of Engineers, United States Army; the United States Geological Survey; the Bureau of Reclamation; the Department of Agriculture; the Bureau of Mines; the Bureau of the Census; and the Federal Emergency Administration of Public Works.

In the conduct of the survey valuable assistance has also been received from the regular staff of the Federal Power Commission, particularly its Chief Engineer and Chief Accountant, and from the staff of the Electric Rate Survey whose field forces assisted in collecting returns from municipalities and companies in the field. Without the cooperation of all of the above, it would not have been possible to present this report.

Respectfully submitted.

THOMAS R. TATE,
Director, National Power Survey.

FOREWORD

By BASIL MANLY, Commissioner in Charge, National Power Survey

This is a preliminary report on the results of the first engineering study of the electric light and power industry that has ever been made on a national scale in the United States.

Other nations have made elaborate surveys of their power resources and requirements extending over a period of years and involving large expenditures. Regional surveys have been made in this country and have proved their value both to the Government and to industry. Individual utility systems have made detailed studies of their available resources and probable demands for power at an expense exceeding the appropriation made for this nation-wide survey. But hitherto no attempt has been made in this country, either by the Government or by any private agency, to determine from a national standpoint the relation between present and future requirements for electrical energy and the capacity necessary to meet such demand. Nor has there been an appraisal of the efficiency of the generating plants of the major public and private utility systems. The water power resources of the country have been studied by various public and private agencies and a vast amount of more or less valuable data has been accumulated. But no attempt has been made on a national scale to evaluate these data and coordinate them with information regarding present and future markets for power.

A Pioneer Undertaking

The National Power Survey is, therefore, a pioneer undertaking. Congress had clearly indicated in the Federal Water Power Act of 1920 its intention that such an inquiry should be made, but until the President issued his Executive Order of August 19, 1933, the Commission had neither the authority nor the funds to carry it out. When the work was begun not even a complete and accurate list of private utilities and municipal plants was available. Months had to be spent in making preliminary inquiries and analyzing such fragmentary information as was available before sound and effective plans could be devised for the conduct of the survey.

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Whatever valuable results the Power Survey has been able to accomplish may be attributed primarily to three principal factors:

1. The solid foundation established in the early stages of the undertaking through conferences with the best informed public and private authorities connected with the electric light and power industry.

2. Careful selection of the staff, in the course of which 3,000 applications for engineering positions and 2,000 applications for other employment were reviewed, the majority being personally interviewed by two or more persons experienced in the choice of personnel. As a result of this careful selection from the large number of exceptionally qualified men rendered idle by the depression, the National Power Survey has assembled a staff that ranks high in technical training, practical experience and other qualifications.

3. Whole-hearted cooperation of the officials of municipal plants and the executive officers of the private companies. Recognizing the great practical value of such a survey they have, almost without exception, not only compiled and furnished the required data but in many cases have also made available the results of special investigations which had been conducted for their private information.

Its Practical Value

The National Power Survey is not an academic inquiry but a practical undertaking of great immediate and future value not only to the Government but to every branch of the electrical industry. "It should have been made 10 years ago," one of the leading engineering authorities of the country recently declared. "If it had been, the industry would have been saved many of its most serious blunders and the Government would have been able to plan its public-works program on a solid foundation of established facts." Such a survey of the Nation's power resources and power requirements is an essential factor of national defense. The War Department, acutely realizing this fact as a result of the critical shortage which occurred during the World

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War, has sought to compile certain essential information annually through the district offices of the Corps of Engineers. But there has never been available hitherto even a fraction of the comprehensive and accurate information that has been assembled and is now being analyzed by the National Power Survey.

This Interim Report presents a birdseye view of certain major aspects of the electric light and power industry. It is not a microscopically accurate picture such as might be obtained if it were possible to make a thorough study of the conditions in each separate district. The possible margins of error are, however, small and the results are not likely to be materially affected by the refinements which will be employed in the preparation of subsequent reports. It is significant that the results reached by the National Power Survey in estimating the demand that will exist upon the resumption of normal industrial activity coincide almost exactly with the forecasts for the same districts prepared by private companies and municipal plants for their own purposes.

This information is of great public value not only in its bearing upon conditions in the electric light and power industry but also in relation to the problems of unemployment and industrial recovery. Much has been said during the past 5 years about the supposed surplus of electric generating capacity in the United States. Until quite recently this has been true enough if the situation was viewed from the short-range standpoint of the relation between existing capacity and the immediate demand during a period of depression. In recent months, however, the use of power has been rapidly increasing until in many districts the demand is nearing the limit of available efficient generating capacity.

It takes 2 years to plan and construct a large modern steam plant and from 2 to 7 years to plan and build a large water-power project. It is the part of wisdom, therefore, to determine at this time what new generating plants and transmission lines will be required to meet the demands that will be created by a resumption of normal industrial activity and where they should be located to supply the demand most efficiently and economically. It is time also to take stock of the existing private and public plants and ascertain which of them are inefficient or have become obsolete. Finally, the

national interest requires the most accurate possible inventory of the Nation's undeveloped water-power resources in their relation to present and future markets for power.

Outstanding Results

These are the principal lines of inquiry that have been pursued by the National Power Survey during its initial stages. The first tentative but significant results are presented in this Interim Report. They may be summarized as follows:

1. The use of electricity for domestic purposes as well as in certain branches of industry has grown at such a rate during the depression that, upon a resumption of normal industrial activity, the demand for power will be at least 4,000,000 kilowatts in excess of that which existed in 1929. This is equivalent to the capacity of some 50 large generating stations.

2. Very little new generating capacity has been constructed by the privately owned utilities since 1930. As a result, the capacity of existing plants is 2,325,000 kilowatts less than the demand that will exist for power upon a resumption of pre-depression industrial activity, assuming maintenance of normal reserve capacity.

3. This shortage is being rapidly accentuated by the obsolescence of plants which would have been replaced under normal conditions. As of January 1, 1935, 56 percent of the total installed steam-electric capacity of the United States was at least 10 years old, 11 percent was 20 years old or older, and about 1 percent at least 30 years old. Inefficient and obsolete plants with a capacity of at least 2,000,000 kilowatts should be scrapped and replaced within the near future.

4. Analysis by districts of the relation between the capacity of existing plants and the demand that will be created with the resumption of normal industrial activity shows that critical shortages will exist in almost every section of the United States. The only regions in which substantial surpluses of capacity now exist to meet normal demand are Florida, part of Michigan, an area along the lower Mississippi, North Dakota, Idaho, Utah, and New Mexico and parts of Texas, Minnesota, Montana, Washington, and Oregon.

5. Government plants provided for or under construction will meet these shortages in cer-

tain limited areas. Only one major private power development and one major municipal plant are now under construction. Many of the regions where the greatest power markets now exist and where the shortage will be most acute when industrial activity is renewed do not have projects under construction at the present time sufficient to carry the loads that will develop upon resumption of normal industrial activity.

6. In view of the time required to plan and construct large generating plants, whether hydro or steam, early construction of new plants with an aggregate capacity of between 3,000,000 and 4,000,000 kilowatts is imperative. This would involve capital expenditures of at least \$300,000,000.

7. The critical shortage of existing generating capacity most seriously affects the great industrial districts of the East and Middle West. It would, therefore, be disastrous in case the United States should become involved in war. The situation might be even more acute than that which existed during the World War when, in many districts, electric service had to be denied to domestic and commercial customers and nonessential industries to meet war needs for power.

8. Careful planning under Federal supervision of new power plants and facilities for transmission is required to promote the safety and welfare of the Nation. Selection of sites for hydro or steam plants, to be developed either by public or private agencies, should take into consideration not only the pertinent engineering and economic factors but also essential considerations of broad national policy.

A Chart for the Future

Control of power is a social as well as an engineering and economic problem. If the flow of electricity should suddenly cease, it would be a national catastrophe of unimagin-

able magnitude. Our homes, streets, and highways would be in darkness. Street cars, subways, elevators, and conveyors would suddenly stop and even railroad transportation would be impossible at night without electric signals. Radios would cease to function and the ships on the high seas would be immediately endangered. Factories would be forced to shut down, modern bakeries would cease to produce bread, the water supply of cities would be interrupted by the failure of the electric pumps and perishable food would rapidly deteriorate for lack of refrigeration. There would be no fire alarm, no burglar alarm, no telegraph, no telephone, and few newspapers. Electric light and power has come to be almost as essential an element in our daily lives as the bread we eat and the water we drink. Modern civilization would collapse with the failure of the sources of electric light and power.

The national safety and welfare, the productivity of our industries and the comfort and convenience of our homes are thus dependent upon the maintenance at all times of an abundance of electricity available at rates which will permit its use wherever it is needed. We must, therefore, not only provide for our immediate requirements but we must also plan for continued improvement and expansion of the Nation's electrical systems to meet the demand that may be reasonably anticipated for the future.

Complete engineering knowledge of the existing electric industry, our probable future requirements for power and our available resources are necessary to sound planning either by the Government or private industry. The National Power Survey has been conducted with a view to supplying this essential information. It is in this spirit of fact-finding, rather than of prophesy, that this, its first report, is presented. It is, in effect, a chart for the future development of the electrical resources of the United States.

APPENDIX A—ROSTER OF STAFF

A LIST OF PRINCIPAL EMPLOYEES OF THE NATIONAL POWER SURVEY, THEIR EDUCATION, TECHNICAL TRAINING, EXPERIENCE, AND MEMBERSHIP IN PROFESSIONAL SOCIETIES

ADMINISTRATIVE DIVISION

Thomas R. Tate, Director; B. S. in-E. E., U. of Missouri.

Twenty-seven years' experience in design, construction, and operation of steam electric, hydroelectric, and internal-combustion generating stations, transmission lines and substations; electric, telephone, and gas valuation; power and transportation surveys and general consulting work. Registered Professional Engineer, New York; member A. I. E. E., S. A. M. E. and A. S. M. E.

Lester S. Ready, Chief Consulting Engineer; B. S. in E. E., U. of California.

Consultant on public-utility operation and regulation; 23 years' experience in operation and regulation of public and privately owned utilities; formerly chief engineer of California Railroad Commission and specialist on rates, valuations, water-power resources, and transportation problems; member A. I. E. E.

Ralph W. Martin, Executive Assistant; University of Chicago, National Institute, Northwestern University.

Ten years' experience in commercial organization, personnel management, public accounting, industrial development and executive administration.

Leshar S. Wing, Chief Engineer; B. S. in Mech. and E. E., South Dakota State College.

Nineteen years' experience in electrical design and general construction work; electric, gas, water, telephone, and transportation valuation and rate cases; special reports on power development, irrigation, and power applications. Registered Civil Engineer, California; member A. S. A. E. and associate A. I. E. E.

Emmett G. Craig, Chief Power Engineer and Asst. to Director; B. S. in C. E., C. E., Rutgers University.

Fourteen years' experience on construction, power studies, system design, economics of utility operating, utility finance, and securities; associate member A. S. C. E.

Claude E. Puffer, Economist and Asst. to Director; B. B. A., M. A., U. of Washington.

Seven years' experience in railroad traffic and rates, statistical and financial studies, and special research in public-utility regulation.

POWER REQUIREMENTS DIVISION

Percy H. Thomas, Chief of Division; S. B. in E. E., Massachusetts Institute of Technology.

Forty years' experience in design of electrical equipment for manufacturing companies; consulting engineer for American and foreign power and mining properties; and specialist on transmission lines. Registered Professional Engineer, New York; Registered Professional Engineer, N. J.; Fellow A. I. E. E.; member A. S. M. E.

Robert E. Moore, Chief Industrial Engineer; Pratt Institute.

Twenty-five years' experience in general industrial applications of power apparatus; power consultant in private engineering practice and in application of electric power to industries. Registered Professional Engineer, New York; Registered Professional Engineer, Michigan; associate member A. S. M. E.

Howard M. Van Gelder, Chief Electrification Engineer; M. E., Brown University.

Thirty-five years' experience in design and construction of power plants, industrial manufacturing plants, railroad electrification, and subway electrification, including supervision and inspection of contracts and placing of equipment in operation; member A. I. E. E.

Joseph P. Schaezner, Agricultural and Irrigation Engineer; B. S. in Agriculture, U. of Wisconsin.

Thirteen years' experience in project direction, rural electrification, vocational agricultural instruction, and community agricultural activities; member A. S. A. E.

James V. Alfriend, Jr., Electro-Chemical Engineer; B. E., Johns Hopkins University.

Eleven years' experience in application of electrical equipment to electro-chemical and electro-metallurgical industries; associate member A. I. E. E.

Richard L. Kimball, General Engineer; B. S. in E. E., Worcester Polytechnic Institute.

Eleven years' experience in railway electrifications.

Stanley W. Roland, Statistician; B. S. in E. E., U. of Wisconsin, M. S. in E. E., Harvard Engineering School.

Four years' experience as instructor in electrical engineering, four years in construction of power plants, and power sales engineering.

POWER RESOURCES DIVISION

Erich A. Mees, Chief of Division; B. S. in C. E., Rose Polytechnic Institute.

Twenty-four years' experience in design, superintendence, and supervision of construction of hydroelectric and steam power plants, water filtration plants, bridges, and industrial buildings; member A. S. M. E.

William G. Mervine, Chief Mechanical Engineer; Drexel Institute.

Seventeen years' experience in design, construction, and operation of steam electric power plants. Coauthor with Joel D. Justin of "Power Supply Economics." Registered Professional Engineer, Pennsylvania; member A. S. M. E.

Francis L. Adams, Civil Engineer; B. S. in C. E., U. of North Carolina, Mass. Institute of Technology.

Eight years' experience in hydroelectric, railway, and highway design and construction, valuation of public utilities, structural design and drafting, specification writing, and inspection; junior member A. S. C. E.

John D. Fitch, Hydraulic Engineer; S. B. in C. E., Mass. Institute of Technology.

Nine years' experience in field and office work in connection with the study, design, construction, maintenance, and testing of hydroelectric projects; associate member A. S. C. E.

Olcott L. Hooper, Hydraulic Engineer; S. B. in C. E., Mass. Institute of Technology, Northwestern U.

Twelve years' experience in design of water-supply and hydroelectric projects, construction supervision, and engineering management of public-utility properties, associate member A. S. C. E.

Carl O. Berglund, Hydroelectric Engineer; B. S. and B. A., State College, Sweden, Columbia Univ. Teachers College.

Twenty-three years' experience in general industrial engineering, design of hydroelectric and steam electric power stations, preliminary investigations, and research work.

D. N. Showalter, Hydroelectric Engineer; C. E., Lehigh University.

Eleven years' experience in design of dams and power plants; field survey of hydroelectric power plant sites.

Peter von Weymarn, Power Engineer; C. E. College of Civil Engineers in Petrograd, Russia.

Twenty-six years' experience in design, construction, and survey of water power, navigation, and irrigation projects, and power development; member A. S. C. E. and S. A. M. E.

RESEARCH DIVISION

Fayette S. Warner, Chief of Division; C. E., M. B. A., Rensselaer Polytechnic Institute; Ph. D., U. of Pennsylvania.

Sixteen years' experience in Industrial Research, instructor in the fields of Manufacturing Industries, American Government, Business and Government, and Regulation of Public Utilities at University of Pennsylvania; consulting engineer in valuation of public utilities; associate member A. S. C. E.

Joseph T. Silver, Chief Cartographic Engineer; B. S. Cooper Union.

Twenty-four years' experience in design of steam-electric and hydroelectric stations, substations, and transmission lines; and valuation engineering; member S. A. M. E. and associate member A. I. E. E.

Frederick Haag, Jr., Editor; B. S. in C. E., U. of Penn.

Sixteen years' experience in exploration and development of iron and coal properties, surveying, triangulation, mapmaking; rate investigations; surveys and publications; member A. M. S.

William L. Fairbanks, Economist; Eastman College.

Twenty-seven years' experience in U. S. Foreign Service, foreign trading, port development, rail and water transportation, commercial relations, and economic surveys.

L. B. Woll, Electrical Engineer; B. S. in E. E., E. E., Columbia U.

Five years' experience in electric motor design, testing, and power-plant operation; industrial engineering production and management problems; and statistical, economic, and financial research; associate member A. I. E. E. and S. A. M. E.

W. B. Moore, Civil Engineer; B. S. in C. E., Mass. Institute of Technology; M. S. in Transportation; Yale University.

Five years' experience in railroad design, economic studies, business management, and geodetic surveying; junior member A. S. C. E.

E. H. Dimmitt, Engineering Draftsman, B. in Arch., M. S. in C. E., Ala. Polytechnic Institute, Purdue.

Three months' experience in surveying and instrument work; member S. A. M. E.

T. C. Evans, Jr., Engineering Draftsman; B. S. in E. E., U. of North Carolina.

Two years' experience in maintenance of switches, relays, and transformers, and power surveys.

R. R. Sabine, Engineering Draftsman.

Eighteen years' experience as engineering draftsman.

Raymond B. Breinig, Engineering Draftsman; B. S. in E. E., Armour Institute of Technology.

Six years' experience in map drafting, statistical studies, transmission line design, and power-plant engineering.

Richard M. Kane, Engineering Draftsman; Mechanics Institute of Architecture.

Six years of experience in drafting including architectural, electrical, and map drafting, and illustrating.

DISTRIBUTION COSTS STUDY DIVISION

George H. Morse, Chief of Division; B. E. E., E. E., U. of Minnesota.

Forty-two years' experience, including Professorship of Electrical Engineering at U. of Nebraska; designer and consultant for electrical manufacturing companies; power specialist; consulting engineer on electrical work; and power survey for public service commission; fellow A. I. E. E.

Claudius E. Bennett, Distribution Engineer; B. S. in E. E., U. of Nebraska; M. S. in E. E., E. E., U. of Illinois.

Twenty-one years' experience in operation, design, and construction of hydroelectric plants, transmission lines, and distribution systems. Registered Professional Engineer in Illinois; member A. I. E. E.

Edgar S. Coffman, Distribution Engineer; Purdue University.

Six years' experience on appraisals of public-utility properties and valuations, participation in rate cases, and specialization in unit costs of electric distribution systems. Registered Professional Engineer in Indiana; associate member A. I. E. E.

William K. Hackmann, Distribution Engineer; B. S. in E. E., U. of Nebraska.

Six years' experience in requisition design on standard and special designs, particularly transformers and mercury arc rectifiers; associate member A. I. E. E.

Ellsworth F. Miner, Distribution Engineer; B. S. in E. E., Yale University.

Twenty-seven years' experience in testing and design of electrical equipment, construction, operation, and management of electric utilities, electric utility valuation and independent rate cases; member A. I. E. E.

Francis P. Quigley, Distribution Engineer; B. S. in E. E., U. of Pennsylvania.

Nine years' experience in design and construction of transmission lines distribution systems, lighting systems, and substations; industrial plant development; electrical appraisal work; member A. I. E. E.

Leon C. Shaver, Distribution Engineer; B. S. in M. E., Tri-State College of Engineering.

Eleven years' experience in rate structures, valuation of electric utilities, load dispatching, and operation of electric stations.

Samuel H. Thompson, Distribution Engineer; C. E., Reed College, Rensselaer Polytechnic Institute.

Thirteen years' experience in design and construction of bridges, buildings, equipment; installation, marketing, housing, advertising, domestic heating, technical and specification writing.

REVIEWING AND TABULATING SECTION

Robert H. Barclay, Chief of Section; Washington University.

Twenty-five years' experience as a consulting electrical engineer specializing in steam and hydroelectric-plant design and construction. Registered Professional Engineer in New York; fellow A. I. E. E.

Andrew H. Grimsley, Power Engineer.

Nineteen years' executive experience in the operation of electric and gas properties; the design and construction of hydroelectric and steam electric power plants, high-tension transmission lines, substations, and distribution systems; purchase and sale of electric and railway properties; studies of corporate structure and financing of public utilities; member A. I. E. E.

H. H. Houston, Electrical Engineer, A. B., Reed College, B. S. in E. E., M. S. in E. E., Mass. Institute of Technology.

Ten years' experience in design, construction, and valuation of power plants and transmission systems; associate member A. I. E. E.

George S. Green, Hydraulic Engineer.

Fifteen years' experience in field surveys, design, supervision, and management of construction of hydroelectric and steam electric power plants, dams, water supply systems, pipe lines, transmission lines, and pumping stations.

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