COORDINATION OF POWER IN THE WESTERN HEMISPHERE IN A FUTURE EMERGENCY

21 January 1948

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MR. SWAREN: Colonel Hornor gave me an introduction to read and in the excitement of the moment I forgot it.

All that I can say is that we have brought here this morning a man who is known throughout the industry for two things: first, his willingness to try something new, and, second, his ability to get cooperation, not only in his own organization but throughout the entire electric power industry.

I take great pleasure, in fact, I feel it an honor to be permitted to introduce Mr. Philip Sporn, President, American Gas and Electric Corporation.

MR. SPORN: The subject chosen for this address is so broad and ambitious a subject that if it is to be encompassed within the limits of time available, it most certainly needs to be delimited; there are other reasons also why such delimitation is desirable. For one thing, I should like to delimit it geographically and confine myself to one portion of the Western Hemisphere, that is, the U.S.A. Even more important to submit to delimitation is the definition of an emergency, and while we are about the business of defining, and again delimiting the emergency, I would like to alter the title of the subject of the talk to something like the following:

COORDINATION AND INTEGRATION OF POWER IN THE U.S.A. FOR FORESTALLING A FUTURE EMERGENCY

All of these proposed changes I believe need to be explained and might be expanded to advantage.

It is somewhat difficult to discuss coordination of power supply facilities without the benefit of fairly extensive and full knowledge of the existing power systems. Thus, the data on the power systems of the U.S.A. are not only available but are known to a considerable number of people, among whom your speaker might perhaps be included. The information on the Canadian power systems is generally known to a much lesser extent, and, certainly, well, to a smaller number of people in the United States. So far as the balance of North America and Central and South America, the authentic available information on the power resources available in these countries is still even less, and the number of people

who are informed on the subject is likewise much less. Hence my suggestion that we confine our discussion to the power systems of the U.S.A. and the power situation in this country.

This is not to say that I am in any way attempting to minimize the importance of extending the discussion to cover the power situation in the entire Western Hemisphere or to shirk the job. For example, if after this discussion has been completed and the results obtained are measured and are found to have been fruitful enough, it would be logical to give someone an assignment to cover the balance of the Western Hemisphere area to be presented at another session.

As to the scope of the emergency to be discussed, it seems to me fairly obvious that from the standpoint of national defense the word "emergency" has acquired an entirely new meaning since the occurrence of 6 August 1945. In my own thinking I have assumed that an emergency might mean an occurrence calling for the mobilization of national resources something along the pattern that was initiated in the summer of 1940, but might go as far as to include preparation for an attack by an enemy force using atomic bombs or the coping with the results of an actual atomic bombing entirely unforeseen and unexpected.

It is because of this factor, that is, because the results of atomic bombing are likely to be so destructive, that I have suggested that we re-orient our thinking and direct our discussion to cover the handling of the power situation to prevent or forestall an emergency, at least, so far as power is concerned. It is obvious that in all the emergencies that we have had to meet heretofore, the time factor and the ability to not only utilize existing facilities but to extend and improve them had always been in favor of the United States; these things have made possible the situation that we are the beneficiaries of today with a record of this country never having lost an armed conflict in which it was engaged. But with the advent of the atomic bomb, and this is certainly the case if it is assumed that atomic bombs might perhaps be concentrated on areas where large power facilities are located, it is no longer safe to assume that the time factor will be available to work in our favor. To the extent that power availability is a determining factor, the probability of it even being partially available is much too remote, unless we take the proper precautionary measures.

I would like to state certain other assumptions that I am forced to make:

1. That a considerable amount of decentralization of industry will have taken place by the time the emergency occurs, but that relatively little of that decentralization will be autarchic decentralization. Decentralization has been going on for several decades and is going on at the present time. The trend to autarchy, however, is nowhere observable and would involve a major revolution in thinking and planning of our industrial economic system.

2. That no substantial relocation of industry underground has taken place.

I have already pointed out as to (a) that decentralization has been going on for some time in the United States. I am assuming that that process will continue. But I doubt that the country is ready to pay the price of splitting the U. S. A. into a series of autarchic regions. However, if any indications should appear that the contrary is true, then the entire situation with regard to power would certainly need to be reexamined. As to (b), here again I doubt whether the country is ready, or whether it could even successfully pay the price of carrying through such a program. I have seen some figures quoted that indicate the cost of such a program might be one hundred billion dollars and that it might be carried out over a period of five years. In these analyses it has always been assumed that if this were carried out the industrial economic system would be safe from atom bomb attack. I doubt, however, the validity of the estimate both as to the cost and as to the time factor involved to complete the program. On both scores it seems to me that grave underestimates have been made. But if the time ever comes where such proposals appear likely of adoption, then here again it would be in order to re-examine the entire power problem.

POWER IN THE LATE WAR

The peak in demand for electric power in the late world war was reached in the year 1944. In that year the power demand reached a figure of 31.8 percent above the 1940 figure and the expansion in energy produced, that is in kilowatt-hours, reached a figure of 59 percent above 1940. I shall not go into further details of the job that was accomplished in bringing about this expansion: in having available substantially all power needed, wherever needed for war production, and without any curtailment of a substantial nature being imposed upon the civilian population of the country.

But it is worth while to make an analysis of the reasons why this job was done as effectively as it was. Primarily it was the result of these factors:

1. The conditions of the electric supply systems, when the national emergency arose, and the margin above the then existing requirements that was available in generation, transmission and distribution plant;

2. The limited but strategically chosen expansions that were not only permitted but that were aided in every way by the War Production Board;

3. The highly competent job of placing of new war industry so as to obtain substantially all the other benefits needed from any particular location, without throwing an impossible burden on the power supply situation;

4. The effective job of coordination of the power facilities through the organization and operation of a group of regional power committees supervising regional power pools which were thoroughly interconnected and all of which were under the general direction of the War Production Board;

5. The complete elimination of sabotage or other disruptive effects from the operation of power system facilities.

It may be worthwhile to dwell a few moments longer on each of these basic contributions to the superb job that was done in the power field in the United States during the war.

1. Margins--The vital role played by the existing margins in the power supply facilities of the United States when the national emergency arose has received altogether too little attention; yet this item was perhaps the most important single contribution to the skillful organizing of the job and to carrying it out with the success that was done. The reason for that is obvious. It was the existing margins that made possible immediate expansion of war production and war loads and that gave the necessary time for such additional expansion of facilities as were indicate to be necessary to carry on, on a much higher scale of production than even those margins could possibly hope to supply. Data bearing on the question of margins are available and have been published. Projections have been made also for the years ahead up to and including 1952.

Thus the margin of generating capacity reserve, which was over 26 percent in the year 1939, declined sharply during the war to the point where in the year 1943 it reached a low figure of 13.2 percent. Had the margin in 1939 been no greater than it was, for example in the year 1947, when it was below 5 percent it is quite obvious that a totally different history of war production might have been written in 1940, 1941, and 1942.

2. Strategic expansion.--The element here that was of greatest significance was the organization of the Office of War Utilities in the War Production Board, manned primarily by a group of people trained in the electric power industry and utilizing, besides, to the full, all the skills and know-how in the power industry in the solution of every major problem as it occurred in power supply.

3. Location of new war material plants.--Actually the proper location of new plants flowed naturally out of the existence of an organization of the type indicated in the preceding paragraph. It was the existence of

such an organization that was largely responsible for having the vital power supply question tackled and answered in the very early stages of any discussion of war industry, projection or expansion, and working out an optimum solution so as to put the mimimum amount of drain on the country's resources at a time when demands in excess of their capability were being placed on these resources.

4. Regional organizations.--The regional organizations supervising a group of regional power pools were perhaps second in importance in achieving the job carried out. The starting point or base for these was the existence of highly developed interconnected major power pools in the United States. There were eight such great power pools in the country and they were as follows:

New England-New York Area
New Jersey-Pennsylvania-Baltimore Area,
North Central Area,
Southeastern Area,
Illinois-Wisconsin Area,
Southwest Area,
Pacific Southwest Area, and
Pacific Northwest Area.

Actually during the war four of these groups, namely, the North Central, the Illinois-Wisconsin, the Southeastern and the Southwestern areas, all operated in parallel with an interconnected load of over 16,000,000 kw. Likewise, there was coordination between the New England-New York group and the Pennsylvania-New Jersey group. Each of these areas was supervised by a coordinating committee representative of all the utilities forming the area group. The coordinating committees functioned quite differently in various sections of the country, but in general they accomplished the same results.

As representative of the variety in functioning, it might be well to briefly describe two widely differing organizations.

The Pacific Northwest Area pool consisted of practically all of the private, municipal and Federal systems in the States of Washington, northern Oregon, Montana, Idaho, and Utah, including the Bonneville Power Administration, the municipal systems of Seattle and Tacoma, as well as many other small municipals. The coordinated pool involved some 13,000 miles of high voltage transmission lines and 150 power plants having a total capacity of almost 3,250,000 kw. The power sources of this pool are predominantly hydro since it includes only about 420,000 kw of steam generation out of the total of three-and-a quarter million. Prior to the war six associated utilities in Utah, Idaho, Montana, and Washington were operated on an inter-connected and coordinated basis.

During 1941 this coordination was further strengthened by setting up a small coordinating group consisting of four engineers who were located in Portland, Oregon. In 1942 this same coordinating group took on the job of coordinating all of the utilities in the area.

Administration of all matters pertaining to pool operation was in the hands of an operating committee composed of one authorized representative from each of the pool members. Meetings of the operating committee were held once per month and rotated throughout the territory. One member of the coordinating group acted as chairman of the committee. In addition to the monthly meetings of the operating committee there was a weekly Bell telephone conference presided over by a member of the coordinating committee.

The coordinating group did not attempt to follow hour to hour operation but, based upon load and capacity data furnished by the members of the operating committee, operating programs for reservoir operation, interchange between companies, and maintenance schedules were set up. By means of the weekly reports and the weekly telephone conferences they were able to check the carrying out of the operating schedules. Because of the preponderance of hydro and the importance of saving fuel oil and coal in the steam plants, the first job of the coordinating groups was to make resource studies for the pool from data supplied in the main from long years of records of the individual pool members. Each system's resources and load data were used to make a master resource and load study for the pool as a whole. From this study the most critical water-year for the pool as a whole was determined and based on this a two-year operating program was set up. This program, of course, was under constant review and revised at least annually. Rule curves were set up for reservoirs and the operation of many of the reservoirs was changed considerably based on pool operation.

The coordinating group and the operating committee were constantly making studies of the situation in order to make recommendations on the elimination of transmission bottlenecks, on voltage levels, communication, load frequency control, relaying, accounting, all other phases of operating practice, and necessity for new capacity.

It is estimated that the resources of the area were increased by over 100,000 kw as a result of the coordination of reservoirs and maintenance.

A totally different organization existed in the case of the North Central Area. This was the name given to the interconnected group of power companies covering Indiana, Ohio, Western Pennsylvania, Eastern Kentucky, and the Western Appalachian region, which included parts of West Virginia, Virginia, and a small area in Tennessee. The close coordination in the operation of this group of power systems and the actual physical tying-in

of all of these systems, came about long before the war quite largely as a result, if I may say it, of the development of the integrated Central System of the American Gas and Electric Company and the efforts which this company made in establishing interconnections with adjoining systems. Along with other regional organizations, which I have already described, an organization, known as the General Committee for the Coordination of Power Supply, North Central Area, was set up to study the load and capacity requirements of this region; this General Committee was also to furnish for the guidance both of the companies themselves and the Office of War Utilities reliable estimates of load and capacity requirements for succeeding periods of one to two years ahead. The entire area was divided into four smaller areas, known as Indiana, Ohio, Western Pennsylvania and Western Appalachian areas, and local area committees, comprising a representative of each of the operating companies within the area, were set up and the respective chairmen of these local area committees were constituted into the so-called General Committee, which I have mentioned. Perhaps because of the fact that the American Gas and Electric Company Central System was in a sense the central integrating core of the entire interconnecting area, operating in all of the states with the exception of Pennsylvania, I was asked to take the chairmanship of this General Committee.

Through the medium of this organization, the companies in this area put together every three months throughout the war period from 1942 to the end of the war in 1945 a complete forecast of expected loads by months, and along with it a schedule of generating capacity, which would be available month by month to supply these loads, taking into account, of course, the bringing in of new capacity under construction. Maintenance schedules were also put together in these reports and, I might add, were frequently revised when preliminary setups showed up unsatisfactory margins between capacity and load, so that we were able to come up with the estimated margins of capacity that would be available after taking care of loads and maintenance and to bring about wherever possible satisfactory margins both for individual areas and for the North Central Area as a whole.

Early in the schedule of activities of this committee a technical study committee was set up to explore the actual capacity of interconnections between systems and between the areas to determine the limitations, if any, on the availability of capacity margins from one area to another. Network analyzer studies were made and decidedly valuable information was obtained.

As illustrative of the type of work carried out by this study committee, I might cite the series of plant loss studies carried out in 1943. These studies were made by complete miniature scale representation of the interconnected power systems by means of the A. C. Network Analyzer at Massachusetts Institute of Technology, and cover the assumed loss of

the entire generating capacity of each of the larger generating stations in the Indiana, Ohio, Western Pennsylvania, and Western Appalachian areas. In all of these studies, one or more representatives from the system on which a plant outage was being studied was made available to cooperate in making the study to be sure that his own system was carefully represented and all operating conditions fully taken into account.

All of these plant outage studies were made on the assumption that necessary transmission lines were restored to service with temporary connections if necessary but that generating capacity would be out of service for a prolonged period. These studies showed that we would be able to replace the loss of the entire generating capacity of any one of these major generating plants with few exceptions. In each of these cases the inability to replace plant outage was due to inadequate interconnection facilities and the inherent layout of the local system by which the major part of the normal output of the generating plant was supplied through lower voltage distribution systems directly to the load. In some of these cases, the full capacity of such high voltage interconnections, as did exist, could not be used to the full extent because of lack of voltage corrective equipment to hold up the voltage.

Besides indicating the value of the interconnected transmission facilities which already existed, these studies pointed out some weak links in the existing facilities which could be strengthened at reasonable expense to bring about greatly improved area protection. Some of these weak links were accordingly taken care of.

The quarterly forecasts of load and capacity, including maintenance schedules prepared by the General Committee for the North Central Area, were made available to the Office of War Utilities and frequent discussions were held with representatives of that Office, particularly with the regional sponsors. Not only did these reports serve as a precise and reliable guide to the Office of War Utilities in the scheduling of new generating plant units, as well as in the determination of suitable locations for vital war industries, but the contacts within the local area committees, as well as within the North Central Area General Committee, provided the necessary opportunities for exchanging information, ideas, and the adoption of principles and practices in connection with the problem of expanding, operating and coordinating power supply facilities under the strenuous war conditions.

The benefits obtained during the war by this coordinating organization were so great that by unanimous agreement among companies and individuals concerned, it was decided to continue the organization and the preparation of load and capacity forecasts for an indefinite period following the war.

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5. Elimination of sabotage.--There is no need to comment in detail on the easing of the entire power situation and the numerous problems associated with maintaining an adequate power supply that resulted from the elimination of the factor of sabotage in the calculations of what was necessary to bring about the desired result from a power standpoint.

COORDINATION AND INTEGRATION OF POWER TO FORESTALL A FUTURE EMERGENCY

Let us examine the problem of coordination of power in the light of the results achieved in the late war, the lessons learned in doing that job, and under the assumptions as to what emergency conditions may have to be confronted. I have thought deeply on this problem and about the experience obtained in solving the power problem in the late war, I have studied everything relating to it that has been published by anyone who has given the subject thought and study--for example, such an excellent discussion of the problem as that given by Major Swaren in his "Electric Power and Its Relation to the National Defense," presented before the 1947 Midwest Power Conference--and I believe that the following constitute the most important steps to be taken to make possible coordination of power in the United States to prevent a national emergency:

1. Organization of a committee--not too large, but carefully chosen--of power people to intimately keep in touch with, to keep itself fully acquainted with the thinking of, and to be consulted by, those planning the industrial and military measures for preparing to meet a national emergency.--The power situation in the United States today is in a highly fluid condition. Expansion of facilities has been taking place at a pace unprecedented in the history of the industry. On the other hand, ideas with regard to national defense are not only in the stage of serious and continuous discussion at the present time, but in many phases are perhaps crystallizing and in directions not to have been thought likely as recently as two years ago. All of these ideas about defense will, sooner or later, impinge on the power supply situation and are going to be affected by power supply and its availability. If national defense and mobilization are to be provided for with a minimum waste of national resources--the stipulation is definitely made that no waste can be afforded--then it is inconceivable that a proper job can be done without the organization of some such committee.

But it needs to be remembered that for the committee to be effective, a number of important criteria will have to be observed:

a. The committee will not only have to be carefully selected as to character, ability, the standing of each of the individuals in his own company or bureau, and in the industry, but very importantly also, as to the willingness and ability of each individual to devote the necessary time to the job.

b. The committee having been carefully selected, it would be highly desirable that it be cleared so far as national security is concerned to the utmost degree, and perhaps to the same degree as if every member of it were to take an executive position of responsibility with the Atomic Energy Commission. It does not look as if under the present stage of developments in the field of national defense and security anything constructive could be accomplished by the functioning of a committee of that type that did not have substantially complete access to the vast amount of material and discussions of a restricted nature that is being made available continually.

c. Finally, the committee having been appointed and cleared, it should be put to work on two fronts: First, to get itself informed on all thinking going on with regard to both industrial and war mobilization and, second, to act as a liaison group with the power industry to see that the industry is in turn informed of those things that it needs to know in order to properly plan and develop its expanding power facilities.

That such a group is desirable and almost necessary, in even the early stages of planning of defense and preparation for emergency, can be demonstrated from this, and I am certain by no means isolated, occurrence that has taken place within the last six months:

For some time the Aeronautics Committee of the Joint Research and Development Board and the Armed Forces have been discussing airplane and missile test centers. The Air Engineering Development Center discussed in connection with that program called for an estimated power requirement up to a figure of 1,000,000 HP and more. Some of this has been discussed in the public press. Mr. Hanson W. Baldwin, critic of "The New York Times," discussed it in an article of that journal of 4 July 1947.

The basic argument or theses in connection with power requirements advanced in all the articles or discussions I have read is that because of the large scale of the power requirements, such an engineering center or centers will, of necessity, have to be restricted in location to an area where large hydroelectric projects have been or can be developed. But this is a fallacious idea. It should be clear that if, as I understand is the case, a large part of the power requirements called for in the establishing of an Air Engineering Development Center can be used in off-peak periods, that no power system wholly dependent upon hydroelectric-power resources, and particularly run-of-river hydroelectric power, is suitable for developing off-peak power without jeopardizing the value of the power facilities during peak periods.

But if we are to enter upon a period, as seems likely to be the case, of where all our raw material, our productive facilities, and manpower resources are to be taxed to the limit to meet (a) all our obligations and commitments to our domestic peacetime economy, (b) our

commitments abroad to help rehabilitate Europe, and (c) our preparations for national defense and against possible future attack, then it follows that we must make maximum use of what we already possess.

In one area, in Chio for example, it would be a relatively simple matter to provide at some point a block of electric capacity of as much as 1,500,000kw, if 1,000,000 kw of that block were used off-peak. What is more, none of that 1,000,000 kw of capacity will involve any additional expenditure for power plant, nor any appreciable additional personnel to operate. True, it will require some additional transmission facilities to gather the capacity from the various sources and concentrate it, but such expenditures would have other major, and perhaps even more important, benefits from the standpoint of national defense and preparedness.

For example, the transmission facilities referred to above might very well, if properly planned, provide not only the off-peak capacity for a major Air Engineering Development Center, but might also at the same time be the answer to assuring continuity of power supply to the whole area if we ever seriously undertake a program of basic industry decentralization and dispersion, including the placing of certain key units underground.

It is quite possible that what I have suggested above goes further than merely providing for power as part of an aeronautical program but, after all, the only sound way of handling the vital problem of aeronautical development is part of the broader and the whole problem of national defense. The concomitant power problem can also best be handled that way.

The committee of the type I have suggested is obviously badly needed and the logical agency to help solve properly a problem of this kind.

2. The further development of the idea of regional organizations.--The regional coordinating organizations that existed prior to the war are being continued and many organized during the war continue to function. Most certainly the practice is more widespread now than prior to the war. But it is imperative that this plan be continued and this may require definite encouragement, stimulation, and in some cases aid in developing proper coordination. One obstacle in many cases to complete coordination is the interstate problem.

To obtain optimum results it may be necessary to stimulate certain developments relative to transmission and interconnection, possibly generating plants and in setting up efficient smooth-functioning organizations. The working out of this phase of the problem could well be one of the functions of the industry committee that I have proposed.

3. The development or restorations of margins of reserve.--The margin of reserve in generation capacity or capability which was above 26 percent in 1939 was down to around 5 percent in 1947, and but for some favorable factors would have been much lower. Even if nothing happens to interfere with the carrying out of a program of expansion in the generation facilities of close to 5,000,000 kw per year for the next six years, that margin, on the basis of the best present estimates, will by the end of 1952 still be only slightly above 12 percent. It is true that this is based upon an assumption of a differential between installed capacity and capability of 2.5 million kw. On the other hand, it gives no consideration to retirement of existing capacity. It is estimated that as of 31 December 1945 there was in service plant comprising some 6,200,000 kw of capacity which had been installed prior to 31 December 1920. This capacity will obviously be 32 years old or more by 1952 and it is reasonable to suppose that at least a substantial percentage of that will have been retired by 1952 and greater percentages are bound to meet the same fate with each year that elapses after 1952. Thus, taking into consideration both the factors of unavailable capacity and retirement of old capacity, it is likely that the percentage of margin of reserve in 1952 will actually be less than 12 percent. It is therefore all the more imperative that the program for the restoration of necessary margins now under way be given the benefit of every aid, stimulation and encouragement so that it be brought to fruition at the earliest date possible.

The situation on margins discussed above with regard to generation isn't materially different in the field of transmission and in the field of interconnection facilities. Here, too, margins that have been developed over a period of perhaps a decade or more have been severely infringed upon and the restoration to proper values is most essential if proper coordination of facilities to prevent emergencies is to be carried out.

This may call for some special steps and some special organization It may be that special aids may have to be given to make possible the restoration of margins of reserve, particularly in transmission and in interconnection facilities. And, here again, a committee of the type that I have indicated is bound to be of great and perhaps indispensable help in working out the problem. It has been argued in some quarters that the existence of this situation of loss of margin is adequate reason for the development of parallel facilities. But the true answer is, and it needs to be pointed out again and again, that duplication is in most cases not the equivalent of enlargement: The duplication of facilities involving nothing more than superposition of new transmission lines and new networks over existing adequate networks may be the very thing that national economy and national defense can least afford if the degree of protection against emergency needed by the country is to be attained in the minimum of time.

4. The study of the idea of a general extra high voltage backbone tie, particularly for the eastern and midwestern United States.--This is not an entirely new idea, although it has not been mentioned in the last seven years. But in 1940 and 1941 while the country was in its defense preparation stage, the idea of a high voltage grid covering the central and eastern industrial area of the United States was proposed by the National Power Policy Committee, and the job of exploring the possibilities of such a grid was undertaken by the engineering executives of the power systems in the area. On the basis of using the successful Hoover Dam-Los Angeles line transmission voltage of 287,000 volts, it was proposed to construct tie lines connecting St. Louis, Chicago, Milwaukee, Detroit, Toledo, Indianapolis, Cincinnati, Cleveland, Pittsburgh, Buffalo, Baltimore, Philadelphia, New York, Boston, and intermediate points. It was hoped that the studies of this proposal might show that, in addition to its value as a defense measure for the emergency transfer of large blocks of power from one area to another, such a grid might permit sufficient savings through interchange of economy power, pooling of reserves, interarea diversity, et cetera, to go a long way toward justifying the large expenditure of both money and materials that would be required.

In order to explore this proposal in a thorough and practical manner from the standpoint of (a) actual costs of construction including the costs of connections between grid and existing systems, (b) physical workability for handling normal and emergency power interchange, and (c) evaluation of possible economy savings, competent engineers were selected from the staffs of the power systems in the area and working groups were set up to carry out these studies, all under the general direction and auspices of the engineering executives of the various power systems involved.

One of these groups, under my direction, making an extensive study of physical workability, spent almost an entire year on network analyzer studies covering both normal and emergency power-flow conditions, as well as transient stability analyses. Other groups made exhaustive studies of the possibilities of economy interchange, inter-area diversity, pooling of reserves, et cetera, making use of operating records, production cost data, and other information freely furnished by the various companies in the area. All of these companies cooperated, along with the electrical manufacturers, in making the best possible estimate costs for constructing the over-all grid, including the necessary changes and connections for tieing-in with existing systems.

The results and conclusions from all of these studies, as summarized and interpreted by the Committee of Engineering Executives, were presented first during 1940 in the form of preliminary memoranda on progress to Mr. Leland Olds, then Chairman of the Federal Power Commission in Washington, and finally in a complete memorandum under date of

13 January 1941. Among the results of the studies, it was shown (1) that the proposed grid would cost about $400,000,000 on the basis of then-existing labor and material costs, (2) that inter-area diversity and economy flow would be considerably less than first estimates indicated, and (3) that the equivalent costs of capacity savings created by the grid would be excessive compared with new generating plant facilities. It was, therefore, concluded that from the standpoint of economy and national defense such a grid would not be justified. As an alternative, it was suggested that a substantial part of the contemplated operating and diversity savings could be made available by extensions of existing interconnections between systems which could be made more quickly and at only a small fraction of the $400,000,000 draft on national resources required to construct the grid.

It was clear then, and it is even clearer at the present time, that had a program like that been undertaken in 1941 it would have resulted in a drain on the resources of the country, and particularly on such strategic items as copper and steel and skilled shop labor that the country could not afford and that could not have been allocated to the project without some major harm resulting to other and more essential defense, and later war preparations. Nevertheless, it is well to point out that the situation today may not be the same as the one that existed in 1941. For one thing, the extent of the development of the power load that has taken place is beyond any that was visualized even as recently as 1945. The present projected peak for 1952 shows a load almost double the actual peak attained in 1940; plants, too, have grown in size.

Keeping in mind all the above, and further that there is at least the possibility of embarking on a program of relocation of industry underground, it is obvious that a new study of this problem is not only in order but is most vital. It is apparent there is a good prospect that as an alternative to placing power plants underground consideration might be given to placing none underground except those in very special situations and solving the problem by a program of further expansion of the above-ground facilities, the restoration of margins, and the supplying of sufficient interchange capacities between power centers so as to make possible the restoration in any one area of the complete loss of capacity of its major generating center. Whether that can be done, and how, whether higher voltages than those considered in 1940-1941, possibly up to 400,000 volts, might be used to advantage, will call for complete and most expert study.

But in working out a solution of this problem, to a greater extent than in any of the other problems discussed, the industry committee would be a necessary instrumentality and tool through which to align the necessary representation and the proper personnel so as to make certain that the study was not only complete but practical.

5. Finally, it would appear a part of wisdom to project, and then implement, a program of stockpiling of power plant equipment. This might very well cover turbine parts, both steam and hydroelectric, transformers, switchgear, cable, steel, insulators, welding and repair equipment, and other equipment of a more detailed nature. The exact specifications of the equipment, its exact amount and its distribution, are matters that again would involve considerable study. But that spare equipment has a part to play in any program of mobilization for an emergency, or to prevent an emergency as a result of bombing that can be as destructive as atomic bombing, there can be no question and doubt. Nor can there be any question as to the effectiveness of such equipment in so minimizing the effects of catastrophic action as to make them almost negligible.

THE RESULTS ATTAINABLE

In evaluating the results attainable by a power-coordination program suggested for forestalling a future emergency, it is desirable to keep in mind that an adequate program should meet the following tests:

1. It must be able to take care of any future emergency capable of being visualized. The emergency might come about as a result of an attack or a war along any of the following forms:

a. A war like the late war, but on a much larger scale.

b. The war might be a duplicate of the late one, but with the utilities, particularly the electric utilities, singled out for attack. It is now admitted by a great many people that a tactical error was made in the late war in failing to destroy systematically the power resources in Germany. Hence it is presumed that this error will not be repeated.

c. Finally, the emergency might be the development of an atomic war, again with the utilities singled out for special attack.

2. Any of the above forms of emergency might be accompanied by:

a. General destruction of industry, or

b. A condition in which industry is not generally destroyed because of either oversight, decentralization, or relocation underground.

3. Regardless of what combination of conditions might have to be met, it would seem most imperative either:

a. To be able to continue to carry on industrial production, and particularly production of war and defense materials, or

b. To be able to begin to rebuild industrial production facilities with an absolute minimum of delay.

In either of the above cases an adequate supply of power will be an indispensable prerequisite.

4. Well before the emergency outlined in 1 above may have to be met, it may be preceded by a condition that might be called a condition of urgent preparation or defense, and this condition may last several years. This may call for the maximum utilization of the country's resources--material, plant capacity, and labor--and it will undoubtedly call for increased quantities of power.

Measured by all the above criteria, how will the program recommended stack up?

It appears to me that the program proposed stands up very well. Let us examine it.

Without analyzing further the basic reason for conclusions drawn and relying on the logic of the ideas developed earlier in the course of this talk, it would appear to me that the program proposed will definitely accomplish these things:

1. It will provide a committee of outstanding people trained in power and it will give the members of this power-consulting group, representative of the industry, an unmatched opportunity to learn of the plans, ideas and program for developing national defense facilities, and for the preparation for any emergency that can be visualized. It will do this in a manner that cannot be improved upon--by continuous contact with the problems as they develop and by utilizing the opportunity this offers to absorb all the implications of the various influencing factors as they are developed.

2. This will make possible not only the taking of the maximum advantage by the consulting group of the knowledge thus gained, in planning, building, and improving the power systems, and in developing measures of protection for them, but will, at the same time, make available to the various national defense groups complete and reliable knowledge on power so necessary for each of them to carry out its particular planning and work on the problem of defense from the standpoint of calling for the minimum of national resources.

3. More specifically, this should be of incalculable aid in the establishment or restoration to proper levels, after complete exploration and planning have been carried out, of:

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a. Margins of reserves in power-system facilities. The restorations of margins of reserve in the various groups of power facilities will make possible the initial expansion of the defense load. In addition it will make possible the absorption of the first shock of the loss of capacity as a result of any damage to the industrial system of the country as a whole;

b. The regional coordinating organizations; and

c. Additional integration or interconnection facilities. Item c, it seems to me, is particularly important and I will cite one more reason for that in a moment. It may very well be that to bring this item about additional legislation might be needed and this, too, cannot be carried out in a hurry. Hence it would appear to me that in the case of this particular item it is especially important to lose no time in getting the job going.

The more complete and extensive coordination of the country's power facilities will assure the ability of marshalling from one point to the next, when and if such extensive loss of capacity takes place.

As illustrative of how a system with extensive interconnection is able to withstand without any interruption to service the complete loss of a major generating station, I can cite the experience of an incident which happened at the Philo Plant in March of 1942. With the plant carrying a load of approximately 300,000 kw, and at a time when the normal bus relay protection was cut out of service because of construction work going on, an accidental grounding of the main high voltage bus caused a short circuit which shut down the entire station. In spite of the resulting complete cut-off of power to nine 132 kw outgoing circuits, the entire load was instantly and automatically picked up by the system and its interconnections without interruption to service except for a ten-minute interruption to a relatively small load area near the Philo Plant, with a load less than 10 percent of the plant capacity. Besides the additional load picked up by other plants on the same system, contributions from other interconnected systems were received from such points as Pittsburgh, Cleveland, Toledo, Chicago, Indianapolis, and Carolina Power and Light Company.

4. A regional and complete program of stockpiling of essential parts for the country's power systems will be developed and actually acquired and stored.

Many of the emergency conditions envisaged will result in considerable damage to plant, line, and substation facilities. The stock pile of essential materials available for call when the emergency occurs will make possible the relative quick restoration of what may be a case of even very bad damage.

5. Finally, it will furnish a group, with an enormous background of experience in working on this problem, that can be called upon for planning and building up an organization necessary to carry out the power program itself, when and if the emergency proper should develop.

6. All of this, and the knowledge that when the emergency develops help can be summoned, and that when summoned it will respond, will make possible the handling of the entire problem of power supply on the basis of somewhat lesser margins of reserve and, therefore, the maximum utilization of facilities and the use of a minimum amount of new facilities and resources in planning and building to be prepared to carry out the job.

I believe that the program outlined is an adequate program based upon the assumptions made and with such limited views of the future problems as are available at the present time. As the problems develop, the thinking about them can more clearly develop. As the nature of the emergency that will confront us becomes more clearly delineated, the ideas on power coordination outlined here can be expanded and modified. But here again if such change in thinking is to take place, it is advisable that it take place quickly, that is with a minimum amount of lag from the time that the change in conditions has taken place. This merely serves to point again sharply to the necessity of having a functioning advisory committee of the type that I have suggested. The time to organize such a committee is right now.

COLONEL HORNOR: We have time for about three questions.

MR. SWAREN: You spoke of this study which was made relative to the proposed large network and indicated that it was not feasible from an economic point of view. Perhaps that condition has changed; only another study can tell; but still it will take money. If a new study shows that it is not possible from an economic point of view, do you feel that it would be justified from a national defense point of view for the Department of National Defense to supply that portion of the funds beyond the amount upon which economy could be shown?

MR. SPORN: Major, I have thought about that, and I am not sure that question can be answered intelligently by a general answer. My belief is that the prerequisite to any answer of a question like that is the availability of the information as to what might be the conditions today. I might say this, that it would be an excellent idea. In fact, I think that it is almost imperative that such a study be undertaken today. It will take some time to complete that study. When it is completed, it seems to me we will be in a far better position to judge, first, whether it is economically feasible, as I brought that out, and, second, in the light of the situation with respect to national defense--our thinking about that problem at that time--to consider ideas or proposals for bringing it about independently of economic feasibility.

One of the things that I believe we ought not to do at any time is to use our resources--when we are stretching our existing resources to the limit--to do things that will not in the long run contribute so much to national defense as some other things will when done at that particular time. As an example, I think it would be tragic right now to dedicate any of our manufacturing, our manpower, and material resources to doing anything except to build up the power system of the country. I think what is being done today is economic, both in the sense that it is meeting an economic need and that it is contributing enormously to improving the national defense situation in the power field. It is impossible to think that there might be a conflict between them.

During the war, as you know--and there must be many here who know--we kept our eyes on the principal objective, which was the use of resources--dollars weren't being considered--the use of our resources, material, manpower resources, manufacturing resources, to bring about the most effective results; in other words, to use them at the point where the war would be best promoted, the prosecution of the war would be most helped. I think that on the whole that was carried out highly effectively. I think we are in a defense state right now, and I think we have no right to do anything that is not going to contribute to the building up of power systems. But a study of the type we are discussing I certainly think is in order and ought to be carried out.

QUESTION: Do you think the government restrictions on holding companies of utility companies that have been developed in the last 15 years serve to hamper the coordination of generating facilities? Do you think you might add that to your program, relaxation of restrictions on interstate holding companies?

MR. SPORN: I think I have indicated that one of the major problems that needs to be met is the question of interstate involvement which is still bothering a great many companies. Certainly that is one of the problems that needs to be cleared up, and it would help materially, I think, to bring about more extensive interconnections.

QUESTION: Mr. Sporn, your recommendation as to this committee seems to have one weakness, in that it is to be advisory. Do you have any recommendations as to how its recommendations would be carried out in an emergency?

MR. SPORN: I think so far as the advisory nature of it is concerned, that can be developed as it goes along. I don't think it is a very major point as to how we start it off. I think the important thing is to start a committee that is not merely another committee on paper.

You may recall that I dwelt at length on the make-up of the committee. I think more time needs to be devoted, more effort, on the composition of the committee, to make sure that you really have a committee that knows it has a job to do and has indicated clearly it is ready to go ahead and tackle that job. The other phases of it will follow.

It seems to me that the planning of defense and the planning to meet an emergency cannot be done properly and intelligently from the standpoint of utilization of resources in getting the most for defense perhaps in proportion to the limited resources that we have--and they are finite and limited--unless we have continuous coordination between the two.

COLONEL HORNOR: I want to thank you on behalf of the College for a most excellent discussion this morning. I think we all feel, if we didn't already feel, that certainly the power industry is one of our main considerations for national defense.

Thank you very much.

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