OFFICE COPY

REPORT OF THE
NATIONAL PETROLEUM COUNCIL'S
COMMITTEE ON THE USE OF RADIO AND RADAR

MAY 28, 1953

CHAIRMAN: F. W. LITTELL

HEADQUARTERS OFFICE

601 Commonwealth Building
1625 K Street, N. W.
Washington 6, D. C.

Telephone:

EXecutive 3-5167

INDEX

C
O
P
Y

Mr. Walter S. Hallanan, Chairman
National Petroleum Council
1625 K Street, N. W.
Washington, D. C.

Dear Mr. Hallanan:

Under date of July 16, 1952, Mr. H. A. Stewart, Acting Director of the Oil and Gas Division of the Department of the Interior, addressed a letter to you regarding the radio and radar usage being made by the petroleum industry and requesting the National Petroleum Council to appoint a Committee to make an authoritative, comprehensive and up-to-date study and report on such usage, with such comments and recommendations as are appropriate.

As provided in the Articles of Organization of the Council, this letter was considered at a meeting of the Agenda Committee on July 28, 1952 in Washington, D. C. at which meeting it was unanimously agreed to recommend to the Council the appointment of a Committee to make a study as requested by Mr. Stewart and to report to the Council.

Thereafter, on October 6, 1952, you appointed me as Chairman of the National Petroleum Council's Committee on the Use of Radio and Radar. The other members of the Committee are listed in the recommendations to the report made by this Committee.

The first meeting of this Committee was held at Chicago, Illinois on November 13, 1952. Periodic meetings of the Committee have been held from time to time and progress reports have been made to the Council at its meetings on December 9, 1952 and February 26, 1953. The Committee has now completed its study and recommendations and I am pleased to enclose herewith the report of the Committee.

Very sincerely yours,

/S/ F. W. Littell

F. W. Littell
Chairman, Committee on the Use of Radio and Radar
National Petroleum Council

FOREWORD

On July 1, 1949 the Federal Communications Commission released new rules and regulations governing the Industrial Radio Services and established thereunder, as Sub Part "G", the Petroleum Radio Service. Eligibility for licensing in the Petroleum Radio Service is limited to those "engaged in prospecting for, producing, collecting, refining, or transporting by means of pipe lines, petroleum or petroleum products, including natural gas". Under the new rules and regulations, certain radio frequencies were allocated by the Commission for the exclusive use of licensees in the Petroleum Radio Service and additional frequencies were allocated on a shared basis with other industries.

In addition to the Petroleum Radio Service, the industry is making extensive use of frequencies within the Maritime, Aeronautical, Radiolocation, Special Industrial, Highway, Power Utility, Low Power Industrial, Experimental and Special Emergency Services of the Federal Communications Commission.

The petroleum industry, and in turn, the national security and defense would be disastrously affected if the industry's use of radio channels were impaired in any way. The essentiality of the petroleum industry's use of radio was recognized and confirmed by the National Communications Conference held in Washington by the Federal Civil Defense Administration. At that time it was clearly established that present petroleum industry radio communications facilities were not to be disturbed in any way and that they would be permitted to continue to operate under industry control even in a national emergency.

There has been some concern as to the extent to which the oil and gas industries are presently using radio facilities basically reserved to the military. The facts are that except for the limited use of three Shoran frequencies, all of the radio frequencies now used by the industry are non-military frequencies. At the present time, the military recognizes the essentiality of petroleum industry use of radio to such an important degree that it is unlikely that this use would be disturbed by the military even in a national emergency.

From its early usage in geophysical operations, where radio is not only used for voice communication but to transmit and record the shot-instant in seismic prospecting, its use has grown phenomenally until today the latest development in the radio art, microwave, is utilized on long haul pipe lines for remote control of pumps and motors, telemetering of various pressures and other data, teletype operation and the myriad communications functions required in present day pipe line operations. It is significant to note that pipe line microwave relay facilities far exceed all other present uses of microwave.

Pipe lines also inaugurated radio communication between patrol planes, pump stations and repair crews to expedite the reporting and repair of leaks or other conditions requiring immediate attention.

Radio is employed in production and drilling operations from the time the rig is moved in until final completion of the well and then becomes a valuable operating tool in the daily activities of a producing field.

Refineries have found the use of radio a great asset in improving the efficiency and safety of their operations, particularly in routine maintenance and repair.

In marketing operations, radio is a tremendous benefit and is being used increasingly as conditions warrant. Fuel delivery trucks are dispatched by radio on emergency service calls from a central control station. This results in improved service to the customer with fewer tank-trucks in use by the oil company.

Radio-telephony plays an important role in the movement of petroleum products on the inland waterways and Great Lakes of the United States as well as an ocean-going tankers. In these services, radar serves as a navigational aid which provides a degree of safety heretofore impossible to realize.

Radar is also useful in detecting the presence of a line-squall or hurricane and determining the speed and direction of a storm's movement. Its value to the safety of personnel on isolated drilling platforms in the open sea is readily apparent.

In geophysical prospecting for possible oil bearing structures offshore in the Gulf of Mexico and other waters, the techniques of radiolocation have proved to be invaluable as surveying aids. Radar, Shoran and phase-comparison systems have all given very good results.

The following report contains detailed and specific information pertaining to the history of the use of radio and radar in the petroleum industry and treats radio usage of each branch of the industry as a separate subject as indicated on the index page. There is also a section devoted to the National Petroleum Radio Frequency Coordinating Association which describes the function of that association in recommending radio frequencies to be used by licensees in the Petroleum Radio Service.

The industry has, with its characteristic foresight, organized a Central Committee on Radio Facilities within the framework of the Division of Transportation of the American Petroleum Institute. This Committee includes broad representation of all phases of the use of radio and radar and has accomplished significant results in its handling of industry radio problems.

The Committee desires to point out at this time the fine cooperation of the Federal Communications Commission and its Bureau of Safety and Special Radio Services in providing radio frequencies for petroleum and natural gas industry use. The Commission has shown wise and intelligent appreciation of the industry's problems in the past and continued cooperative effort through the industry's Committee organization can be expected to assure sound solution of future problems.

This short foreword summarizes the high spots of the report.

RECOMMENDATIONS

The physical limitations of the radio spectrum and the ever-growing demand for frequencies to serve the communication needs of an expanding economy, make competition for spectrum space ever keener and more pressing. Radio is a dynamic, rather than a static, field. Protection of the petroleum industry's stake in radio demands constant vigilance. The use of radio and radar by the petroleum and natural gas industry has become so comprehensive that it is no exaggeration to state that the industry is dependent upon these facilities to a critical degree in all of its operations.

This Report outlines, somewhat in detail, the use being made in many important fields of petroleum industry operation. The frequencies now available for use are listed and a detailed description of the uses being made of them is included. Based upon the careful study and consideration given this subject by the Committee, we desire to submit herewith the following pertinent recommendations:

1. The National Petroleum Council should continue to give careful study and consideration to the industry's radio and radar uses and to make further reports on this matter from time to time as significant radio developments affecting the industry's operations occur.
2. The appropriate governmental agencies having an important interest in these matters should be fully informed of the industry's needs in this field and of the manner in which radio enables this industry to provide for the national defense and to serve the public welfare.

3. All radio matters of industry-wide concern should be left in the capable hands of the American Petroleum Institute's Central Committee on Radio Facilities, whose record of accomplishment in this field cannot be surpassed.

4. All companies using or contemplating using radio in their operations should participate in the work of the Central Committee on Radio Facilities, through representation on that Committee.

5. The National Petroleum Radio Frequency Coordinating Association is in need of competent engineering personnel to assist in frequency coordination work and all companies should make personnel who have the qualifications for such work available for this purpose.

6. It is important that the industry itself be fully apprised of the extensive use being made of radio facilities within the industry and that all levels of the industry comprehend the essentiality of such usage.

Respectfully submitted,

F. W. Littell
Chairman, Committee on the Use of Radio and Radar

J. A. Polhemus, Jr., Vice Chairman

Joseph E. Keller, Secretary

Committee Members:

Weldon Brigance
Rowan Drilling Company
Fort Worth, Texas

W. T. Bulla
Natural Gas Pipeline Company of America
20 N. Wacker Drive
Chicago 6, Illinois

Robert Gray
Ashland Oil & Refining Company
Ashland, Kentucky

Carl L. Lathrop
Standard Oil Development Corporation
Box 121
Linden, New Jersey

W. M. Rust, Jr.
Humble Oil & Refining Company
Houston, Texas

Chet F. Whaley
Chet F. Whaley Well Servicing Co.
Houston, Texas

C. B. Lester
Mid-Valley Pipe Line Co.
Bramlette Building
Longview, Texas

H. L. Cornell
Esso Shipping Company
115 Broadway, Room 301
New York 6, New York

H. G. Pegues
United Pipe Line Company
Shreveport, Louisiana

H. A. Rhodes
Transcontinental Gas Pipe Line Corporation
Houston, Texas

R. D. Wyckoff
Gulf Research & Development Company
Pittsburgh 30, Pennsylvania

HISTORY OF THE USE OF RADIO IN THE PETROLEUM INDUSTRY

The first recorded use of radio in the petroleum industry was on board tank ships and was concerned primarily with safety of life at sea.

About 30 years ago (in 1925) another use was found for radio in the petroleum industry by geophysical crews engaged in prospecting for petroleum deposits. Frequencies in the 1600-1700 mc band were used both for communications and for transmitting and recording information pertinent to the operations as described in the "Geophysical" section of this report.

Early in 1928 other needs for radio communication in the industry led to the submission of applications to the Federal Radio Commission (the predecessor to the Federal Communications Commission) for radio licenses by several oil companies. The Commission ruled at that time that radio channels could not be assigned for private use but suggested that it would be in order for the companies interested to pool their resources and form a public service corporation to accomplish the desired result.

Accordingly, in January 1929, the Petroleum Communications Corporation was formed and the consolidated applications of the interested oil companies were filed with the Federal Radio Commission on January 26, 1929. The name of the new corporation was changed to Western Radio Telegraph Company on March 28, 1929.

On June 10, 1929, the Federal Radio Commission assigned certain frequencies to Western Radio Telegraph Company. However, because channels were not assigned to several other companies, the decision was appealed and licenses were temporarily withheld, pending action on the appeal.

On January 19, 1931, the Federal Radio Commission granted to Western Radio Telegraph Company the frequencies previously authorized: namely, two exclusive United States frequencies, 5075 and 5085 kc; three Canadian frequencies for daytime use only in the southern part of the United States, 5780, 5795 and 5810 kc; and also granted four low frequencies for point to point service, 182, 186, 188 and 193 kc.

Stations were authorized at the following points: Tulsa, Bartlesville and Ponca City, Oklahoma; Jal, New Mexico; Eldorado, Kansas; and Skellytown, Borger, Breckenridge, Kingsville, Burkburnett, McCamey, Crane and Wink, Texas.

Due to the general business recession between 1931 and 1933, oil industry development was retarded to some extent and lack of interest in this new venture caused many of the participants to withdraw leaving Phillips Petroleum Company as the principal stockholder.

During 1933, Western Radio Telegraph Company lost the frequencies 5075, 5085, 5780, 5795 and 5810 kc because of non-use.

Subsequent development of this company resulted in the establishment of radio-telegraph stations at Bartlesville and Oklahoma City in Oklahoma; at Breckenridge, Judkins and League City in Texas; Smackover, Arkansas, and Cahokia, Illinois. The system operated on 182, 2252, 3045, 4530, 4805, 6745 and 7775 kc.

As an indication of the volume of business transacted over this radio-telegraph system, a total of 10,000,000 words were transmitted during 1941.

This system operated until June 30, 1942, when, because of wartime restrictions, it was closed by the Defense Communications Board Order No. 8 issued May 28, 1942.

In 1932 a few oil companies began to use radio in the Special Emergency Radio Service on a very limited basis in the swamps of Louisiana for communications between drilling rigs and base offices. As drilling operations began to move offshore it became a necessity to maintain communications by means of radio. Some of this service was rendered by communications common-carriers and the rest by a few individual oil companies with extensive holdings in that area.

In 1938 a new class of station, "Provisional," was established by the Federal Communications Commission under their rules governing "Miscellaneous Radio Services". By interpretation, a number of petroleum operators qualified for this service because its primary use was for operations involving the safety of life and property.

However, technical problems, as well as a general lethargy toward the use of radio, retarded its general acceptance by the industry as an everyday operating tool.

By 1941 considerable interest was being evidenced in the possibilities of radio usage throughout the industry, but World War II prevented any expansion of radio installations.

Because of the technical advances made in the radio art encouraged under pressure of military necessity during the war, particularly the development and perfection of frequency modulation in the High Frequency and Very High Frequency bands, entire new portions of the frequency spectrum became usable, and the whole concept of radio usage changed overnight.

Frequency modulated signals at very high frequencies are limited to line-of-sight transmission with very little interference from natural or man-made sources. This meant that the same frequencies could be used simultaneously by stations in different geographical areas without seriously interfering with one another which would allow the establishment of short range systems on a scale never before possible.

In recognition of these new developments, the Federal Communications Commission, in keeping with its statutory obligations to study new uses of radio, decided to broaden the field of users to include several categories heretofore denied the use of radio.

The Federal Communications Commission embarked on a comprehensive study of its frequency allocations in 1942 when the Chairman of the F.C.C. suggested that the Radio Industry set up an organization which might be effective in resolving the problems of radio frequency allocations and might set up standards for new equipment.

Since the problem involved all past, present and future users of radio, it was readily apparent that the radio industry would not be able to handle the job without outside assistance.

Early in 1943 a committee composed of representatives of the Radio Manufacturer's Association and the Institute of Radio Engineers undertook the development of a plan to carry out the proposal made by the F.C.C. This resulted in the formation of the Radio Technical Planning Board with headquarters in Chicago. Any individual or organization having either a direct or indirect interest in any of the services or problems to be considered was invited to participate in the Radio Technical Planning Board's activities.

This activity received the serious attention of a few members of the Petroleum Industry Electrical Association, an organization then composed principally of communications superintendents of most of the major oil and pipe line companies in the Midwest and Southwest.

Because these men were vitally interested in all methods of communications, particularly those within and for the oil industry, they started a movement within the association to become affiliated with the Radio Technical Planning Board in order to further the petroleum industry's interest in obtaining usable frequencies for its use in day-to-day operations.

As a result of their efforts, the Petroleum Industry Electrical Association became a contributing sponsor in R.T.P.B., and the President of P.I.E.A. appointed a committee to formulate the oil industry's radio requirements. This committee was composed of R. M. Bayless, Humble Pipe Line Company, Houston, Texas; J. F. Collerain, Houston Pipe Line Company, Houston, Texas; O. V. Summers, Texas Pipe Line Company, Houston, Texas; C. C. Sampson, Gulf Refining Company, Houston, Texas; A. H. Riney, Phillips Petroleum Company, Bartlesville, Oklahoma; C. R. Hepler, Pan American Pipe Line Company, Houston, Texas; R. M. Slough, Ohio Oil Company, Findlay, Ohio; with F. W. Littell, Shell Pipe Line Corporation, Houston, Texas, as Chairman.

This committee then became known as Committee #9, Provisional and Special Emergency Oil Industry Services, Panel 13, R.T.P.B. It prepared a very comprehensive statement outlining in minute detail the petroleum industry's radio requirements.

The Petroleum Industry Electrical Association also retained the services of Dow, Lohnes and Albertson in Washington, D. C., to represent them in Docket #6651, the initial hearing before the F.C.C. in the matter of the new frequency allocations. This hearing was held in Washington in October, 1944 and was the first at which the oil industry had any semblance of united action in support of their claim for a share of the frequency spectrum. Joseph E. Keller of this law firm acted as the Association's attorney in this hearing.

The Commission's report in this Docket was released in May, 1945. It permitted new uses of radio under experimental grants which were not entirely satisfactory from an operating standpoint.

In August, 1946, the Commission established the Utility Radio Service which included among others, the petroleum pipe line class of station which permitted radio to be used on a regular basis in connection with the operation and maintenance of crude, products and natural gas long distance pipe lines. However, other petroleum industry radio operations, with the exception of geophysics, were still classified as Experimental, which was not a desirable condition.

Realizing the importance of radio as an operating tool for all branches of the industry, the P.I.E.A. group attacked the problem realistically, and on behalf of the industry petitioned the F.C.C. for the establishment of a "New Radio Service Governing Radio Stations Used in Petroleum Industry Production and Pipe Line Operations and Promulgation of Rules and Regulations Therefor." This petition was filed on January 20, 1947, "not only on behalf of the P.I.E.A., but in the interest of all companies desiring to use radio in order to improve the safety and efficiency of petroleum production and pipe line activities and to aid in increasing and conserving this nation's oil supply and reserves." The petition also requested that pipe line usage be transferred from the Utility Radio Service to the proposed new Petroleum Radio Service.

For its historic value as the very beginning of the establishment of Petroleum Radio Service as such, a copy of the original petition is appended to this report. (It is worth noting that the suggested "Rules and Regulations" attached to the petition were, with few minor exceptions, incorporated into the final F.C.C. Rules and Regulations applying to the Petroleum Radio Service.)

Under date of March 27, 1947, notification was received from the F.C.C. that the petition had been denied without prejudice to the resubmission of such petition following the release of the Commission's proposed Rules Governing the Industrial Radio Service. It was further stated that the Commission was then engaged in a study of the communications needs of all industries, including the petroleum industry, with a view to revising Part II of its Rules Governing the Miscellaneous Services so as to provide for the establishment of a new Industrial Radio Service, and that the information submitted in the petition would be extremely helpful to the Commission's staff in completing its studies of the communications needs of the petroleum industry.

After R.T.P.B. went out of existence, the petroleum industry's only representative group concerned with protecting their overall stake in radio was the original P.I.E.A. Committee. Because of the fact that membership in the P.I.E.A. could not by any stretch of the imagination be considered representative of the entire industry, steps were taken to interest the American Petroleum Institute in the formation of a radio committee which could encompass all phases of the industry's varied operations in a recognized association which would be truly representative of the industry as a whole.

Mr. T. E. Swigart, President of Shell Pipe Line Corporation in Houston, Texas, became interested in the possibilities of the use of radio, and he recommended the establishment of a radio committee to the General Committee of the Division of Transportation of the A.P.I. The General Committee approved the recommendation and so reported to the Board of Directors. The Board authorized the formation of the Central Committee on Radio Facilities on April 23, 1947, and a temporary committee was appointed a few days later. The first permanent committee was appointed on November 9, 1947, in Chicago. The Society of Exploration Geophysicists has given continued support and cooperation to and with this Committee.

The newly created Central Committee on Radio Facilities of the A.P.I. immediately concerned itself with the most pressing problem, that of finalizing the establishment of the Petroleum Radio Service.

In close cooperation with the original P.I.E.A. group this project was followed diligently with the F.C.C. Several informal meetings were held with the F.C.C. staff engaged in writing rules and regulations for the proposed Industrial Radio Service. Members of the Committee appeared before the F.C.C. in numerous hearings in support of the industry's radio needs.

Finally, on May 3, 1949, the Commission announced the adoption of its Industrial Radio Service Rules in final form to become effective July 1, 1949. Sub-part "G" of Part II, Rules Governing Industrial Radio Services covered "Petroleum Radio Service" and included all of the major target goals contained in the original petition for the service.

Upon establishment of this new service, another problem, that of coordination of frequencies assigned to the service, became of paramount importance.

After several meetings it was decided that because of the very nature of the problem, involving the use of all frequencies allocated to this service, it was of primary concern to the individual users, and that the users should form an association independent of the American Petroleum Institute through which frequency assignments should be cleared.

The direct result was the formation of the National Petroleum Radio Frequency Coordinating Association whose history and accomplishments are described in another section of this report.

In addition to coordinating radio problems among petroleum users, this association maintains close contact with other radio users in the Industrial Radio Services and cooperates with them on all matters of mutual interest.

The volume of work performed by the Central Committee on Radio Facilities increased to such a point that on October 1, 1949, it became necessary to appoint and retain a Special Representative of the Committee. Joseph E. Keller of the firm of Dow, Lohnes and Albertson in Washington was appointed to this position and as of this date is still very actively carrying on this assignment, both for the

Central Committee and the National Petroleum Radio Frequency Coordinating Association.

Members of the Central Committee on Radio Facilities, the Petroleum Industry Electrical Association, National Petroleum Radio Frequency Coordinating Association and others interested in the problem took part in the Communications conference held by the Federal Civil Defense Administration at Olney, Maryland, during the week of December 10, 1951.

In addition to formulating recommendations for civil defense communication needs, consideration was given to the continued operation of existing radio systems providing essential services during extreme emergencies.

It was recognized that the Petroleum Radio Service is indispensable in the exploration for, production, transportation, and refining of this vital resource and that the industry would require the exclusive use of its facilities for operations in time of emergency under attack conditions.

In the Federal Civil Defense Administration Manual M25-1 dated October 15, 1952, under Chapter 9, Annex 9-A, Communications Plans, appears the following statement:

"Radio Facilities operated by agencies providing essential public services, such as police, fire, power companies, petroleum companies, natural gas companies, common carriers and other public utilities, will not be diverted to provide channels of communications for civil defense agencies except on a voluntary basis and at such times as channels can be made available without impairing the efficiency of the service."

In a letter dated July 16, 1952 from the Oil and Gas Division of the Department of the Interior to the National Petroleum Council requesting the appointment of a Committee to study the use of radar and radio in the petroleum industry, mention was made of the fact that "frequencies allocated for the use of the oil and gas industries are basically reserved for the military and are licensed under such reservation". Except for the limited use of three Shoran frequencies, none of the radio frequencies now used by the industry are basically reserved for the military, nor licensed under such reservations.

We feel confident that the Petroleum Radio Service, because of its vital role in the everyday operations of the industry and particularly in time of emergency, will be permitted to continue to function during such times in the interest of the national welfare.

While the history of the industry's use of radio is a relatively short one, the progress which has been made has been spectacular indeed. We need only to point out that since the creation of the Petroleum Radio Service in 1949, over 600 users have been authorized by the Federal Communications Commission to operate over 22,000 transmitters.

It is pertinent also at this point to enumerate the relatively small number of frequencies allocated for use in this service. The Commission has allocated the following frequencies to the Petroleum Radio Service:

FREQUENCY BAND	NO. CHANNELS EXCLUSIVE FREQUENCIES	TYPE OF STATION
25.02 - 25.30 mc	8	Base, mobile
33.18 - 33.38 mc	6	" "
48.58 - 49.18 mc	16	" "

FREQUENCY BAND	NO CHANNELS	TYPE OF STATION
	SHARED FREQUENCIES	
1614 - 1700 kc	5	Base, mobile
2292 kc	1	" "
2398 kc	1	" "
4637.5 kc	1	" "
30.66 - 30.82 mc	5	" "
72.02 - 74.58 mc	65**	Fixed
75.62 - 75.98 mc	15**	"
153.05 - 153.43 mc	9	Base, mobile
	SHARED FREQUENCIES DEVELOPMENT ONLY	
456.05 - 457.95 mc	20	Base, mobile
952 - 960 mc	*	Fixed
1850 - 1990 mc	*	"
2110 - 2200 mc	*	"
2450 - 2500 mc	*	Fixed, base, mobile
2500 - 2700 mc	*	Fixed
3500 - 3700 mc	*	Base, mobile
6425 - 6475 mc	*	" "
6575 - 6875 mc	*	Fixed
11700 - 12200 mc	*	Base, mobile
12200 - 12700 mc	*	Fixed
16000 - 18000 mc	*	"
26000 - 30000 mc	*	"

**These channels available only on condition that no interference results to television channels 4 and 5. Continued use of this entire band now under consideration in Docket number 10315.

*Number of channels available to Petroleum Radio Service not yet determined.

Separate sections of this report which follow deal with each application of radio and radar to the various segments of the petroleum industry.

NATIONAL PETROLEUM RADIO FREQUENCY COORDINATING ASSOCIATION

I. INTRODUCTION

New rules and regulations of the Federal Communications Commission released May 6, 1949 allocated certain radio frequencies to the Petroleum Radio Service. Petroleum companies who are prospecting for, producing, collecting, refining, or transporting by means of pipe lines, petroleum or petroleum products (including natural gas), are eligible for licenses in this service.

Part II - Industrial Radio Services, paragraph 11.57 (a), stated that "All applicants for, and licensees of, stations in these services shall cooperate in the selection and use of the frequencies assigned in order to minimize interference and thereby obtain the most effective use of the authorized facilities. Each frequency, or band of frequencies, available for assignment to stations in these services is available on a shared basis only, and will not be assigned for the exclusive use of any one applicant; such use may also be restricted to one or more specified geographical areas." This rule clearly indicated the petroleum industry's obligation to submit to the Federal Communications Commission a workable plan of frequency coordination.

II. ORGANIZATION

In view of the urgency for prompt action in coordinating the use of frequencies allocated to the Petroleum Radio Service, the National Petroleum Radio Frequency Coordinating Committee was organized in Washington, D. C. on May 16, 1949, primarily for the guidance of the petroleum industry organizations, in coordinating frequencies for their mutual benefit. This temporary committee was asked to function until such time as permanent arrangements could be made for a national organization representing the petroleum industry. The membership of this temporary committee was open to all persons or organizations eligible in the Petroleum Radio Service.

H. A. Rhodes of Humble Pipe Line Company, Houston, Texas, was elected temporary chairman and W. G. McLarry of Magnolia Petroleum Company, Dallas, Texas, was elected temporary secretary. Seven temporary regional chairmen were appointed to initiate the organization of a permanent national committee and to prepare basic frequency coordination plans which would be acceptable to the petroleum industry and to the Federal Communications Commission.

The United States was divided into seven administrative regions and a temporary chairman appointed for each region. These temporary regional chairmen were requested to return to their respective regions, call a meeting of all parties interested in the new Petroleum Radio Service and organize Regional Petroleum Radio Frequency Coordinating Associations. After the regional associations had been formed, each temporary chairman was asked to submit a report to a national meeting on June 13, 1949 in Kansas City, Missouri.

At the Kansas City meeting, a thorough review was made of the Washington proposals, particularly with reference to the coordination of frequencies within the industry. Considerable thought was given to the protection of the industry's geophysical operations and it was deemed advisable to designate certain frequencies for their exclusive use. A final plan and an assignment pattern were adopted by the assembly, which consisted of approximately 60 members representing all phases of the petroleum industry in the United States. Each regional chairman presented the views of the users from his region and these were carefully considered in the deliberations of this body. Permanent officers of the new Association were elected, as provided for in the bylaws adopted at the meeting.

III. ANNUAL MEETINGS

The first annual meeting was held in Washington on June 26, 1950 to review the work of the NPRFCA during its first year of operation. A number of minor procedural changes were made in recommendations that improved efficiency of the organization. At this meeting, emphasis was placed on using narrow band equipment, which appeared inevitable if expansion of usage continued in this service. Microwave usage was becoming important. Steps were taken to initiate coordination of these frequencies.

In 1950, forty-seven percent of the petroleum radio stations were concentrated in Region IV, comprising the states of Texas, Louisiana, Arkansas and Mississippi. A belt approximately 75 miles deep along the Texas and Louisiana Gulf Coast contains the major portion of this concentration. The rapid increase in activity in petroleum radio usage centering about Snyder, Texas created a problem comparable to that encountered in the Coastal area.

New systems and expansion of older systems were making severe demands on the limited frequency spectrum allocated to the petroleum industry. Industry cooperation made possible almost immediately adjacent channel operation in many areas; but even with these measures, the rate of increase in usage demonstrated the serious inadequacy of available frequency space. The major portion of users in Texas and Louisiana were accommodated in the 48-50 megacycle band. Concentration in this band revealed that saturation was approached.

The Association was confronted with the necessity of making more recommendations in the less desirable 30 and 33 megacycle bands, where sharing with other services and skip interference prevail. The Association also faced the necessity of making co-channel recommendations in certain areas, contrary to the desires of the users.

At the annual meeting in June, 1951, problems were reviewed and recommendations made. Congestion continued to be the major problem. A special engineering committee, with Dr. W. M. Rust, Jr. as Chairman, was appointed to make a thorough study of the possibility of reducing channel separation from 40 kc to 20 kc.

Statistical data for Region IV indicated a 40% increase in the number of stations, and a 20% increase in the number of users. Since the inception of the Association, recommendations had been processed for more than 7000 stations in Region IV, alone.

Recommendations of frequencies were made initially on an assignment pattern designed to minimize adjacent channel and skip interference. During the first year of the Association's activities, it became necessary to amend this method in Region IV, where it was necessary to abandon primary frequency assignments in order to accommodate the large number of requests for frequency recommendations. Other regions were also forced to abandon initial assignment plans.

In many areas of Region IV, as many as sixteen users were operating co-channels, with four of these within the same immediate area. This situation was not confined to any one band of frequencies.

Technical improvements in equipment design made practical adjacent channel installations within the same area. Otherwise, the limited number of frequencies in the Petroleum Radio Service would not have accommodated the large number of users.

In the June 11, 1952 annual meeting, reports of progress were reviewed. Dr. Rust made a report on 20 kc spacing, in which it was concluded that equipment was commercially available in the 25 to 50 megacycle band, which would give satisfactory operation with 20 kc channel widths. This equipment would give adjacent band operation with practical separation of adjacent channel systems. It would have essentially the same service range as broad band equipment. In order to permit adjacent channel operation with minimum geographical separation, proper maintenance of center frequency and maximum deviation would be somewhat more important than in the case of 40 kc equipment.

While this special Committee was not charged with the problem of considering the economic aspects of conversion from 40 kc channels to 20 kc channels, it did ascertain that much of the equipment supplied during the past several years could be converted to 20 kc operation at a moderate cost. In view of the increased demands for radio service, it would seem desirable for all new installations to employ equipment designed for narrow band operation.

IV. <u>GROWTH</u>

A tabulation of radio stations in the Petroleum Radio Service, as of June, 1949, disclosed a total of approximately 5000 stations. All of these stations had to be relicensed under the Petroleum Radio Service. During the year June 1949 to June 1950, 483 recommendations covering 10,450 transmitters were issued to 362 users.

By June, 1951, the number of recommendations had increased to 824, the number of transmitters to 15,603 and the number of users to 438.

By June, 1952, the number of recommendations had increased to 1,269, the number of transmitters to 21,400 and the number of users to 553.

In 1949, when formal frequency coordination was begun, the petroleum industry had licenses for approximately 5,000 stations. Each succeeding year showed a steady increase of slightly more than 5,000 units, reaching the total of more than 22,000 to date. The first two years' growth was anticipated and predicted. The coordinating groups, as well as members of the Federal Communications Commission Staff, thought the rate of growth would have passed its peak before this time. The records do not reflect any trend in that direction.

V. CONCLUSION

Continued expansion of existing petroleum systems, as well as installation of new systems can be expected. In order to accommodate these, particularly in the oil producing areas of the Gulf Coast, both channel-splitting and time-sharing must be utilized. Many of the larger systems have equipment predominantly wide-band; consequently, assignments of channels 20 kc from these is not immediately feasible. However, this condition will gradually be corrected by installing narrow band units to replace obsolete units, which will eventually permit the full implementation of a 20 kc program.

During the past three years, coordination has been primarily concerned with those frequencies below 160 mc. With the tremendous increase in mocrowave activities, it was decided some coordination was mandatory there. Consequently, all users were asked to obtain recommendations from Regional Chairmen before applying for microwave construction permits. Records from Regional Chairmen indicate twenty-three users have systems operating or under construction in or above the 900 mc bands, with a total length in excess of 16,000 miles. As contrasted with the petroleum installations, all other sources combined show a total of slightly in excess of 10,000 miles. If all factors are analyzed before a firm policy is established in the microwave bands, coordination will be a smaller problem than exists in the mobile bands.

The petroleum group has pioneered both microwave development and 20 kc usage, which is entirely in keeping with the best traditions of our industry.

The work pertaining to frequency coordination is carried on by engineering personnel of many companies. These men are familiar with the field problems involved, the types of equipment used by the various companies and the vagaries of propagation peculiar to the region. The frequency recommendations are made on the basis of factual data and the interests of all users of radio in the petroleum industry have been well served.

RADIO IN GEOPHYSICS

I. INTRODUCTION

The nation's supply of petroleum can be maintained only by a vigorous exploration program. A vital phase of this program is exploration geophysics.

Radio facilities are essential auxiliaries in exploration geophysics as they are in any operation where the transmission of information of any kind is of vital importance. While, in general, they are but one link in the rather diverse instrumentation that makes up a geophysical exploration unit, in certain cases they are a primary link. In any case, such facilities contribute directly to the operational efficiency, and the practicability of geophysical exploration is in direct proportion to the economy of such operations.

Even to great depths, the pore spaces of rocks are filled with water or other fluids. In a petroliferous area, this fluid may be oil or gas. In the basins of which we speak, the deeper strata contain a residue of original sea water together with that squeezed out of the adjacent compacting shales but usually with an added concentration of salt and other minerals.

Oil or gas is lighter than water and if present in such a water horizon, will float on top of the water. Just as oil or gas might be collected and held trapped in an inverted bowl held over water, so the oil and gas content of a permeable rock stratum will gravitationally segregate and be trapped at the top of a closed fold in the strata, provided, of course, that the overlying rock is effectively impermeable. This, then is the basic feature of the petroleum reservoirs, and any configuration of the permeable strata that will provide a trap for the gravitationally segregated oil or gas in the geological subsurface feature we are attempting to locate. The location and delineation of such features is the ultimate goal of geophysical exploration.

II. PHYSICAL PRINCIPLES OF GEOPHYSICS

It is self-evident that any geophysical technique must be based on distinguishable variations in the physical characteristics or properties of the subsurface rocks. They vary in: (1) density, (2) magnetic properties, (3) elastic characteristics, and (4) electrical properties. Of these four physical characteristics, techniques based on the first three comprise the primary methods of petroleum geophysics. Electrical methods are of considerable importance in mineral exploration but have very limited application to date in petroleum exploration.

The operational procedures involved in gravimetric surveys, which determine the gravitational effects resulting from the variations in the densities of subsurface rocks, comprise nothing more than the transportation of a suitable gravity meter from point to point over the area to be investigated. A suitable survey to define the geographical position and the topographic elevation of these points is a necessary auxiliary.

Prior to the introduction of the modern gravity meter about 1936, pendulum equipment was sometimes used for the gravity measurement. This involved the precise comparison of the periods of several pendulums separated by distances that might be as much as 75 miles or more. These techniques required the transmission of radio timing-signals, and 100-watt equipment in the 1600-1700 kc geophysical channels was used.

In normal land operations using present-day equipment, it will be evident that radio facilities have no essential place in the techniques involved. However, in unmapped areas or terrain of every difficult access, radiolocation methods might be required. Moreover, as with any exploratory operation in wilderness areas, relatively long-range radio communications may be required between the base camp and the roving field units for reasons of personnel safety alone. In marine operations such as the Gulf of Mexico, radiolocation techniques are the only practical means of extending the observations to the required distances of 50 miles or more offshore. Supplementary communications facilities are, of course, an additional requirement.

Analogously to the case of gravity measurements, the magnetometric field procedure comprises nothing more than the taking of precise magnetic measurements from point to point over the area under investigation. The separation of the stations may be on the order of a half to one mile in a regular grid, depending on the density of control desired.

The ground magnetometer commonly used comprises a very portable device which may be carried about and set up on a tripod for observational purposes like a surveyor's transit. The field operations with this type of instrument require no special facilities other than may be associated with camp and transportation requirements in a sparsely-settled or wilderness area. Radio facilities are, therefore, very unusual equipment for a ground magnetometer crew. However, such areas are amenable to extremely rapid reconnaissance by the airborne magnetometer.

Airborne magnetometer operations are unique in geophysical operations in that the necessary measurements are made in transit. Herein, of course, lies the particular advantage of this reconnaissance method, since the required magnetic data are collected at a speed determined only by the practical limitations on the speed of the aircraft and with no limitations imposed by the nature of the terrain. This is possible because the intensity of the magnetic field being measured is unaffected by motions of the measuring equipment, and the equipment is itself designed to be immune to motional accelerations. To be of any practical value, these data must be mapped, so that a continuous and accurate correlation with ground position is essential. In fact, this problem of obtaining a precise record of the ground track flown proves to be more difficult than the magnetic measurement itself.

The above considerations, and, in particular, the early use of the airborne magnetometer in over-water areas where photographic positioning was wholly impossible, led to the use of radiolocation techniques. Fortunately, Shoran equipment particularly suitable for such work was already available and was immediately put to use. Similarly, extensive operations over jungle country, involving both magnetic observations and photo-reconnaissance mapping, were made possible through the use of Shoran radiolocation methods.

The seismic method, making use of differences in elastic properties rocks, actually involves two rather distinct methods. This distinction in methods arises from the phonomena characteristic of all wave propagation, refraction and reflection, which are associated with elastic or seismic waves in their transmission through the stratified layers characterizing a sedimentary basin. The instruments and equipment required in conducting either refraction or reflection surveys are essentially the same.

First of all, the seismic wave must be generated. This comprises the initiation of a shockwave at or near the surface of the ground by the use of a suitable explosive charge. The loading and firing of the dynamite charge is handled by a shooter whose truck is necessarily in communication with the main recording truck. In addition to voice communications, a primary function of such equipment is the transmission of the shot-instant, accurate to a thousandth of a second, so that it may be recorded on the same record as the seismic events. A further detail is the need in the final calculations to correct recorded times for the over-all travel time in the surface materials, that is, in the low-velocity material between the shot depth and the surface of the ground. In many cases, this time interval is recorded by transmitting to the recorder both the shot moment and the instant of time the disturbance reaches the top of the shothole--the so-called "uphole" time. The shooter's equipment includes these facilities.

Finally, the recording truck carries all of the instruments required for the recording of the seismic events picked up by suitable geophones or seismic detectors comprising the receiving array. Supplementing this equipment is, of course, the necessary communication facilities already mentioned.

Communication equipment is necessary, especially for the transmission of the shot moment since the useful information on any seismic record is the time interval between the shot and the arrival of reflected or refracted events. The desired timing accuracy is on the order of one thousandth of a second; hence, good recording reliability is essential. Voice communication is also necessary to coordinate operations between recorder and shooter, which may involve distances of a few thousand feet up to ten or twelve miles, depending upon the seismic technique in use. Frequently the recording truck is equipped with both wire and radio facilities, wire communication being used when practical.

III. RADIO FACILITIES

The foregoing outline of geophysical methods and the operational techniques involved provide a background for an appreciation of the importance of radio facilities in petroleum exploration. Radio facilities are required for geophysical operations primarily for three purposes. The first is the coordination of activities, including safety measures. The second is the transmission of special data. The third is the determination of position by radiolocation methods. The extent to which a specific geophysical crew utilizes radio varies widely with the nature of the geophysical technique employed and with the type of terrain covered. A gravity crew operating on land in an area reasonably close to a town will be very unlikely to use radio for any purpose. A seismic crew operating in offshore waters may use ship-to-ship radios on four or more ships and ship-to-shore radios on two or more ships for coordination purposes. Another radio link, ship-to-ship, will be required for data transmission. Three or four shore-based transmitters, supplemented by one or more ship-based radars, may be used for radiolocation purposes. Any situation between these extremes may well exist.

The use of radio for coordinating geophysical activities differs little from the similar use in other services. The primary use of radio for coordination is between the individual components of the crew, which must exactly synchronize their activities in order to make a measurement. The distances involved may range from a fraction of a mile up to ten miles or more. In such applications, the actual position of each transmitter and receiver is dictated by geophysical considerations and cannot be varied any substantial distance in order to provide a location more favorable from the point of view of radio transmission and reception. This may result in a substantial reduction of signal or increase of noise.

Unfortunately, radio becomes most essential for coordination in the situations where the terrain is most unfavorable. It can readily be appreciated that the life and safety of the men working under such conditions might well be dependent on satisfactory communication. It is equally evident that existing communication systems cannot serve the purpose; indeed in most instances there are no available existing communications. Likewise, the nature of the terrain and the speed of the operations usually make the use of a wire line instead of radio totally impracticable.

A secondary use of radio for coordinating geophysical activities is between the crew in the field and a local base camp. Here the distances may be as great as one hundred miles. Such use of radio is necessitated by conditions which make it impossible to locate the crew headquarters at, or near, the site of operations. Examples are offshore operations, where the base must obviously be kept on shore. Another example is airborne work, where the speed of operations is so great that the distance from the base to the plane cannot be kept small. Other examples are the opposite extremes of swamp and desert. Here again the base must remain near established travel and communication routes. In each of these cases radio communication is the only answer, and in each case there are seldom adequate existing facilities. In the past, the 1600-1700 kc channels have been used for such purposes, although because of the 100-watt power requirements, recommendations have been made to use the newly available 2292 and, particularly, 4637.5 kc Petroleum Radio Service channels.

The second use of radio facilities, the transmission of geophysical data, was discussed in the preceding. In the pendulum method of gravity prospecting, the motion of two pendulums at points many miles apart must be recorded on a single record. The only practical solution is radio. In seismic prospecting, it is necessary to show on a single record the ground motion at several points and the instant at which the explosion occurred which produced the ground motion. If the shot and pickup points are all close together, the data are transmitted by wire line. However, in many applications of seismic techniques, these distances are great and the use of wire lines may be impracticable and, in some instances, actually impossible. Under these circumstances, the use of radio for transmitting the data is essential. The audio characteristics of conventional radio transmitters and receivers are inadequate for this purpose. The basic datum for the time of the explosion is the interruption of the current used to ignite the electric blasting cap which initiates the explosion. This current break must be transmitted in such manner that it can be detected, in the presence of severe static flicks, with an accuracy of one millisecond. The measured ground motion has important frequency components well below ten cycles per second. Moreover, the equipment must provide adequate safeguard against premature detonation of the explosive.

These problems are usually solved by some combination of two techniques. One is to design special radio transmitters and receivers with audio response adequate for these requirements. The other technique is to employ a carrier system--the carrier frequency being in the audio range. With such a system, conventional transmitters and receivers can be used with minor modifications.

The contribution of radio to efficient seismic operation can be more readily appreciated when it is realized that a crew can occupy as many as 10 to 24 different locations a day. Even if the use of wire line for communication were possible, the stringing and removal of these lines would reduce the operational speed very materially.

IV. RADIOLOCATION

The third purpose for which radio facilities are used in geophysical prospecting--namely, radiolocation--is the newest but by no means the least important. It is fair to say that airborne and offshore operations are practical only when radiolocation techniques are employed. The characteristics of radiolocation systems for geophysical operations are quite similar to those of other users. The systems fall into two categories, the line-of-sight systems and the nonline-of-sight systems. The first are limited to either short ranges or high altitude airborne operations.

The second are less limited in application. However, the second require the use of low or medium radio frequencies and hence are practically limited to phase comparison methods.

It is not our purpose here to detail the equipment and operational techniques involved in the use of radiolocation equipment, since they are discussed fully in the section of this report dealing with Radiolocation. That section should be read in connection with this section.

The radiolocation equipment is not amenable to communications use. It will be evident, however, that a radiolocation network requires a certain amount of coordination via communication facilities, if it is to be operated with any practical degree of efficiency. Communication facilities are, therefore, a very necessary auxiliary, and the maximum range requirements are now on the order of 100 miles, and clearly this involves both air to ground and ground to ground contact. Since the ground to ground contacts preclude the use of VHF, to date the frequencies used have been in the 1600 to 1700 kc geophysical band. The availability of the 4637.5 kc channel in the Petroleum Radio Service will undoubtedly result in a shift to these frequencies at an early date. The power requirements, being on the order of 100 watts, fit the power limitations in this channel admirably.

V. FREQUENCY ASSIGNMENTS

The channels available to geophysical operations comprise certain exclusive channels and secondary sharing on others, which, by agreement, with other phases of the petroleum industry through the National Petroleum Radio Frequency Coordinating Association have been selected from among the channels allocated to the Petroleum Radio Service by the Federal Communications Commission.

Geophysical-Exclusive Channels

1614 kc	1676 kc
1628 kc	1700 kc
1652 kc	

Geophysical-Preferred*

25.02 mc	25.14 mc
25.06 mc	25.18 mc
25.10 mc	

*Other petroleum services already on these channels to remain there.

Geophysical-Secondary Shared Channels

25.22 mc	30.66 mc	30.78 mc
25.26 mc	30.70 mc	30.82 mc
25.30 mc	30.74 mc	
153.05 mc	153.29 mc	158.43 mc
153.11 mc	153.35 mc	
153.17 mc	158.31 mc	
153.23 mc	158.37 mc	

Special Service

2292 kc   4637.5 kc

The above channels are sufficient in number for exploration needs particularly in the high frequencies. In fact, the need for the medium frequency 1600-1700 kc channels has been questioned by those not familiar with exploration operations. In most, but not all, open country and on the Gulf of Mexico, the 25 mc channels are effective. In heavily-wooded areas frequently encountered, it has proven to be quite inadequate. Careful tests were made July, 1944, under the supervision of competent radio engineers and Federal Communications Commission representatives* in which comparative attenuation data on 1628 kc and 25.10, 35.14, and 153.11 mc were obtained. The terrain traversed was wooded but not so heavily as in many areas encountered by exploration crews. Here it was shown that the 1600-1700 kc channels were necessary to maintain adequate communication over the distances involved in normal refraction seismograph operations with mobile equipment of reasonable portability.

VI. CONCLUSION

The three major purposes of the use of radio in geophysics are integral and indispensible parts of the operations. Radio, in many areas, is not merely a convenience or a means of increasing efficiency. Without adequate radio facilities, geophysical prospecting would, in such cases, literally be impossible.

*The report of these test was submitted October 21, 1949, to the Federal Communications Commission as "Report of Field Intensity Measurements Made in Liberty County, Texas".

RADIO IN DRILLING AND PRODUCTION OPERATIONS

I. INTRODUCTION

It has long been recognized that efficient communication is essential in drilling and production operations because of the inherent hazards. Production is frequently found in remote regions, far removed from any existing communication facilities.

The first use of radio in production operations began in the early 1930's when some companies attempted to obtain licenses to use geophysical frequencies for communication with exploratory wild-cat well locations in the isolated swamp and marsh country of southern Louisiana. The Federal Communications Commission denied these requests but permitted limited use of ship-to-ship and ship-to-shore frequencies, provided no interference was caused to the regular marine radio services. Prior to that time, the only way contact was established with such locations was by boat, which entailed many hours of travel both ways. The delays occasioned by this method retarded drilling programs and added greatly to the cost of well completions. The advent of World War II stopped this usage. When the war was over, the service was restored and the use of maritime frequencies was resumed at a greatly accelerated rate.

In 1938, when the Federal Communications Commission provided the "Provisonal" class of license, a number of petroleum operators qualified for this service because the primary use was for the safety of life and property. It was not until 1949, when the "Petroleum Radio Service" was established, that full use of radio could be made by drilling and production forces without sharing the frequencies with all others who qualified for service under the old Provisional Rules.

II. DRILLING

Throughout the entire history of the oil well drilling industry, one serious problem has continuously hampered drilling operations. This problem is poor communication. Prompt and efficient communication with drilling rigs did not exist until operators began using radio as a means of keeping in constant touch with the rig on location.

Prior to that time, the only available communication with most drilling rigs was the telephone. More often than not, telephone service at the site of operations either did not exist or was so poor as to be virtually useless as a means of fast communication between the drilling site and the company's central office.

Most drilling operations are conducted in remote and isolated areas. As an example, the last few years have seen substantial developments in the marshes of Louisiana, offshore in the Gulf of Mexico and in remote sections of Montana, Wyoming, North Dakota, and elsewhere. Communication with drilling locations in these areas is possible only through the use of automobiles, boats and radio. Obviously, the use of automobiles and boats as a means of communication in these areas is so low as to be completely useless in emergencies. This leaves the driller with only one possible means of efficient communication and that is through the use of radio.

There have been numerous instances in the past where lack of efficient and fast communication with drilling rigs has seriously endangered life and property. In cases involving blowouts, fast communication might have resulted in forwarding instructions to the rig which could have either prevented the blowout or lessened the loss therefrom by getting the proper materials and services to the location earlier. In an emergency, such as a blowout, it often takes many hours for the toolpusher to drive to the nearest telephone and get a call through to his central office or to a point where help is available. During these lost hours, untold damage is done to the well and the drilling equipment. If the rig is equipped with radio, immediate contact can be established and the loss can be prevented or lessened.

The same conditions exist where drilling is being conducted offshore. In these offshore operations, the personnel on the rig can be kept advised at all times about weather conditions and, in the event of severe storms or hurricanes, warnings can be sent to the drilling site in time to allow for proper precautions to be taken before the blow strikes. This is only possible where radio communication is available.

Where drilling operations are being conducted in remote and isolated areas, there is the problem of securing medical help for employees in the event of an accident on the rig. Although many persons working on drilling rigs have some knowledge of first aid, in cases of serious injuries this first aid may not be enough to prevent permanent injury or death to rig personnel. Radio communication permits transmission of competent technical instructions to the toolpusher, which might prevent permanent crippling or death to an employee.

For example, we cite an incident in which a man's life was very likely saved through the use of radio. A switcher was dispatched from the warehouse of an oil company to light a heater on a high pressure gas line. After he had been gone a few minutes it was found that, due to the failure of a check valve and regulator, the pressure on the line had built up to several times its normal operating pressure. The switcher had a radio in his car and was warned not to go near this heater. A few minutes after the warning was given, the heater blew up from the pressure. Had this man been there at the time of the explosion there is no doubt that he would have been killed.

This is one of numerous incidents which prove the value of fast communication between the central office and field personnel. Unfortunately, in the past, most of these incidents have happened at times when communication was not available and the employee could not be reached. In those cases the results were just the opposite from the one set forth in the above example; injuries and property losses were incurred because some certain person could not be reached at a critical time.

Those companies now using radio as a means of communication report that in almost every instance, safety of personnel is enhanced, their operations became more efficient and less costly, and jobs are done in less time than before radio communication was installed. Some of these companies report that their toolpushers would be almost helpless without radio. These toolpushers have been able to reduce their driving to a minimum and consequently can spend the biggest part of their time at the location. Supplies and other materials can be ordered by the toolpusher from the rig instead of driving many miles to the nearest telephone or supply point in order to secure his daily operating materials and other items needed in the ordinary run of drilling operations. Costs have been materially reduced on automobile operation because most roads leading to drilling sites are bad and the life of an automobile used under these conditions is short. This saving is in addition to the saving on gas, oil and other automobile operating expenses.

Radio contact with drilling rigs has also proved valuable in another way. Very often it is necessary to change the drilling procedure and, in many cases, because of inadequate communication facilities, the instructions do not reach the rig until after it is too late to make the change. No doubt many oil wells have been ruined because of the failure to get proper instructions to the rig in time. The use of radio would eliminate this hazard.

There is no longer any doubt of the value to the petroleum industry of the use of radio communication between the company's offices and the drilling rigs and cars. The cost of maintaining a radio system is more than offset by the advantages gained from its use.

Based on the experience of the companies now using radio, it has been conclusively demonstrated that radio is the solution to communication problems in drilling operations.

III. PRODUCTION

After a field, whether on land or offshore, has been proven, radio becomes an indispensable operating tool for communication between operation and maintenance crews and their headquarters. Its use frequently results in a reduction in personnel required to perform a given job and greatly facilitates the quick movement of supplies and materials. Its use reduces operating time on automotive and marine equipment. It also enables supervisory and management personnel to maintain contact with all field operations at any hour of the day or night. Technical information may be requested from the well site and an immediate decision rendered by means of radio. Hurricane warnings may be received by crews on isolated platforms in off-shore waters in time to evacuate personnel before the storm strikes. In case of injury to personnel at an isolated location, valuable time is saved through radio communication in providing for medical attention.

Under present day operating conditions, radio is indispensable in production operations.

IV. SERVICE COMPANIES

In addition to those companies actually engaged in the prospecting for, drilling, producing, transporting, refining and distributing of petroleum, there are many hundreds of companies engaged in supplying the petroleum industry with essential materials and services. For the most part, these companies serve the petroleum industry exclusively and are therefore considered part of the petroleum industry, even though they do not actually hold the leases or produce the oil. They are commonly referred to as "service companies".

These companies are engaged in a multitude of activities which are as necessary to the production of petroleum as the work done by the individual oil companies. The following is a partial list of the services rendered to the petroleum companies by these various organizations:

- Fire Fighting
- Drilling Mud
- Electric Logging
- Cementing
- Acidizing
- Supply
- Road Building
- Water Well Drilling
- Tank Building
- Shooting with Nitroglycerin
- Formation Testing and Core Analysis
- Rig Building
- Perforating

Of the 890 firms listed in the 1952 edition of the Permian Basin Oil Directory, which covers only West Texas and eastern New Mexico, over 350 fall into the category of "service companies" rendering services ranging from nitroglycerin shooting of a well to the supplying of tools and equipment for drilling rigs and the construction of mud pits for the rigs. This is an indication of the size of this service industry in relation to the petroleum industry.

Because these service companies are so closely interwoven into the overall petroleum operations depending on the prompt supply of needed materials or services, they began using radio almost as soon as the petroleum industry itself. The use of radio by these service companies plays as an important a role as the use by the oil companies. A drilling rig equipped with radio can call for special services. The service company, equipped with radio, can then dispatch their unit nearest to the rig.

The service companies are called upon to supply their services at any time of the day or night. During certain periods, the demand for their services may be extremely great, necessitating the use of every piece of available equipment. Because the demand for their services varies so widely, it is often difficult to have sufficient equipment available to meet peak demands. To offset this varying load factor, radio is used to make maximum utilization of available equipment.

A crew without radio might complete a job at one well, drive perhaps twenty or thirty miles to a telephone, only to find that they must return to another well in the same field. Therefore, service companies first installed radio to reduce mileage on vehicles and save time. However, soon after the first such radio installations were completed, it was found that, in addition to reducing this mileage and time, the radio was of tremendous benefit in that it permitted much closer scheduling of men and materials, thereby increasing the services rendered for a given number of units.

It is impossible to predict, more than a short time in advance, the time a particular service will be required. For this reason it has been the practice to dispatch men and equipment to the well far in advance of the time they probably would be needed. This crew then has no contact with their main office and no work can be scheduled for them until they return to the main office or reach a telephone. With radio, the drilling crew can frequently wait until a much later time before calling for the service. Moreover, the main office dispatcher is in constant communication with all crews and is able to know exactly when he can expect the equipment for another job. If there are delays encountered, either in getting to the job, or when on location, the dispatcher can be advised promptly of such delays and alter plans accordingly.

One of the first service companies to install radio was located in North Texas. They installed radio on cable tool equipment used for rod pulling, cleanout, lowering of nitroglycerin, and drilling of water wells. Shortly after the system was installed, an accident occurred on a rig wherein one man was killed and another badly injured. The radio was used to summon aid to the remote location and is credited with saving the injured man's life.

An acidizing company has installed a rather extensive radio system consisting of base stations and mobile units operating throughout West Texas and eastern New Mexico. Oil is often found in limestone formations and it was discovered several years ago that, by forcing hydrochloric acid down into the formation, the porosity, and hence oil production, could often be greatly increased. Acidizing companies operate fleets of huge tank and pump trucks which are dispatched to the well location. Quite often after treatment is started it becomes necessary to secure additional pumps to provide more pressure or additional acid to complete the treatment. The radio provides a ready means of summoning any additional equipment or personnel. Because it requires several thousand pounds of pressure to force this acid into the formation, the work is extremely dangerous and radio has been used to summon aid when accidents occur.

Prior to the establishment of the Industrial Radio Service in July, 1949, all petroleum and service companies were licensed under the Provisional Radio Service, with a very limited number of available frequencies. When the new Industrial rules were adopted by Federal Communications Commission, there was established the Petroleum Radio Service, use of which was limited to those companies actually engaged in prospecting for, drilling, producing, refining, and transporting petroleum by pipe line. The service companies are eligible to be licensed in the Special Industrial Radio Service since the work is being carried out in remote or sparsely settled areas and is of a construction nature.

Although the service companies are licensed in the Special Industrial Radio Service rather than in the Petroleum Radio Service, and therefore do not apply for frequency recommendations from the National Petroleum Radio Frequency Coordinating Association, there has been close cooperation between the Special Industrial users, their consultants and technicians and the Association. There is at present being formed a Special Industrial Radio Service Association which will be composed of licensees in the Special Industrial Radio Service. The various regional chairmen of the National Petroleum Frequency Coordinating Association will cooperate closely with this new Association, because it is recognized that a significant part of the membership of the Special Industrial Radio Service Association will be composed of service companies directly serving the petroleum industry and a large portion of the Special Industrial radio stations will be operated in the same area as petroleum radio stations. In many instances certain frequencies are shared by both services and coordination between the groups will be essential.

Indicative of the size and nature of radio operations of the service companies is the system operated by an oil well cementing company, whose two-way radio system is one of the largest privately owned two-way communication systems in the world. This system, consisting of dozens of stations and several hundred mobile units, stretches from near the Canadian border to the Mexican border. In addition to equipping the engineers' cars with mobile radio, units have been installed on the special trucks and barges used to perform various services in the oil fields. Dispatchers at the various camps thus keep in communication with all phases of the operation.

Those companies engaged in furnishing materials and supplies to the oil companies, in particular to drilling rigs, have found that two-way radio not only enables them to operate more efficiently, but also enables them to render faster service to the oil companies. The prompt communication that two-way radio provides has enabled service companies to furnish badly needed equipment at a well location many hours sooner than would be possible without radio communication. This has resulted in a substantial reduction in shut-down time on the rigs involved.

Two-way radio has become as much an integrated part of service company organization and operation as the telephone and the motor vehicle. It enables them to render better service and to operate with greater efficiency than ever before. Radio also enables these service companies to coordinate their services more closely with production and drilling needs. Of even greater importance is the protection it affords human life and public property in these hazardous undertakings.

RADIO IN PIPE LINE OPERATIONS

I. INTRODUCTION

During the year 1950, the last year for which complete statistics are available, the volume of traffic transported by oil pipe lines totaled more than 129 billion ton miles. Oil pipe lines accounted for 12.7 percent of all intercity traffic, both public and private. To handle this traffic, the pipe line companies, in the same year, operated more than 112,000 miles of crude oil trunk lines, 47,000 miles of crude oil gathering lines, and 16,000 miles of products pipe lines.

In 1951, more than 400,000 miles of gas pipe lines transported 4.25 trillion cubic feet of natural gas. Approximately 1.4 trillion cubic feet were used for domestic heating and cooking purposes in 14,742,000 residences. The remaining portion was divided among industrial loads, industrial processes, and commercial loads. Approximately 2,000,000 houses were converted to gas in 1951 and 1952, and it is anticipated another million will be added in 1953.

Most major population centers are supplied by gas, transported through large transmission mains, from the principal producing areas of the South and Southwest. Gas usage has expanded more than 500 percent in the last 15 years. The public acceptance of natural gas as a fuel, in regions far removed from the supply source, is a tribute to the advanced techniques employed by the petroleum industry in maintaining an uninterrupted flow of the consuming areas.

Coordination of these vast and widely dispersed operations requires the full time use of many types of communication facilities.

As the oil industry grew, and with the discovery of oil in Oklahoma, California, Louisiana and Texas, pipe lines reached out into sparsely settled areas, and in many of these areas the communication facilities erected by the pipe lines were the only facilities available to anyone.

Although public communications are more generally available today, it is certainly true that the locations of many pump stations on even the newest lines are remote and inaccessible. Because of these conditions and the need for reliable, full-time communication between all points on its system, pipe line companies make large expenditures to build and maintain private communications. In some cases where feasible, pipe lines lease full time circuits from public communications sources. However, where the basic system is necessarily private, and a communications staff must be maintained, there is doubtful economy in using leased public facilities.

Wire line facilities are subject to extreme weather conditions. Severe icing, windstorms, lightning and other natural hazards cause frequent interruptions to communications. Since pipe line communications must be continuous and reliable, their facilities must be constructed to higher specifications than other communication systems in order to eliminate, insofar as it may be possible to do so, any interruptions to communication service. The public carriers cannot be expected to build their systems to such high standards just to meet the needs of one of their user groups, so that the installation of privately owned communications, which can be specially built to meet these standards, becomes an operating necessity.

II. CRUDE AND PRODUCTS PIPE LINE OPERATIONS

To understand the communication requirements of pipe lines, it is necessary to realize the magnitude of the shipping problem handled by a large line. A 250,000 barrel-per-day line 1000 miles long moves approximately 37,500 tons per day through the line for a total movement of 37,500,000 ton-miles per day. This is equivalent to a railroad keeping eighty 60-car trains in constant service.

The pipe line is responsible to the shipper for maintaining the quality of the oil and its safe delivery only to the extent set forth in its tariff and as defined by law. For instance, the first pipe lines were "common stream" pipe lines; if a shipper delivered a certain quantity of oil to the receiving end of the line, he was entitled to take a like amount from the delivery terminal, but the quality of the oil was not mentioned in the tariff. A shipper might tender 44-gravity green oil and receive 32-gravity black oil. The pipe line was not bound to keep various types and grades of crude separated, hence the name "common stream". Because of the substantial difference in the value of various crudes for specific refining purposes, modern lines must segregate or "batch" the various grades of crude through the line, keeping them separated insofar as possible.

The early pipe lines were "open systems", by which is meant that any given pump station pumped into a tank located at the succeeding station, and that station pumped from its tank into the tank at the next succeeding station. If one station took a pump unit off stream for some reason, the level of the oil in its tank would rise as the input stream continued at its previous rate while the output stream was reduced by the amount handled by the unit off stream. If the situation continued indefinitely, the tank would be run over, but the timing problem was generally such that the reduced rate could be maintained by the station with the unit off stream for a matter of many hours, perhaps days, without running over the tank.

A vastly different situation is encountered in the highly efficient lines operating today, which do not utilize tankage and are known as "tight" lines; one station pumps directly into the input of the next succeeding station without an intervening tank, and any change in pumping rate is immediately noticed by the station pumping into it.

On a tight line with no intervening tankage, any interruption to the flow at any point will be felt at every other point. If the flow is not reduced, the pressure in the line will continue to rise until the line is split, or pump units start breaking down.

A tight line must have a reliable communication system, flexible enough to afford instant communication between the pump station engineers at all stations. The varying flows and pressures must be known fully to all the operating personnel in order that they can keep the flow rates and pressures at their particular station set so that the lines pump at maximum efficiency, and safely, at all times.

In addition to the constant interchange of operational information between pump stations, the dispatcher must be kept informed as to the passing of the head end and tail end of the various batches in order that he can keep his dispatching orders corrected with the latest available information. The effect of temperature changes in the oil, as it travels along the line, requires an accurate reporting system of the batches, if intermixing of the various grades is to be held to a minimum.

Another communication requirement peculiar to pipe lines is the keeping of the line balance. The line fill is known, and the quantity being pumped into the line by the first station should equal the amount being delivered by the line at its terminus, theoretically. The pressure and temperature changes, mentioned above as affecting batch locations, also affect the line balance which is not apt to be zero at any given time, but will be reported as over or short. The line balance should average zero, however, over an extended period of time, and when the balance shows short for two or three checks in succession, it is reasonable to suspect a loss through leakage.

The keeping of the line balance, together with know-how of the pump station operating engineers, who interpret pressure changes almost instinctively, is sufficient to find any but small leaks in a reasonably short period of time. A large leak, or a split, will be noticed on the flowmeters and pressure gauges, and, after checking with the stations ahead and behind and making sure that the changes in pressures and flow are not caused by the actions of any of the other pump stations, this will be reported to the superintendent or the dispatcher, and the line can be shut down. Considering that a 22" line can deliver some 5000 to 10,000 gallons per minute through a split, the added safety and economy of operation afforded by good communications is readily apparent.

III. GAS PIPE LINE OPERATION

Basically, a gas transmission system consists of pipe of various sizes connecting a number of gas supply sources to delivery points. It also includes measuring, dehydrating, regulating, separator, and scrubber installations at or near the well heads, intermediate repressuring stations, additional dehydrators, separators, and scrubbers as required, and measuring, odorizing, and regulator stations at the delivery points.

Since gas is a fuel that is not readily adaptable to conventional storage methods, controlled stream flow must be utilized to accomodate varying demand. Pipe line pressures, as well as pumping rates, must be skillfully manipulated to insure deliverability consistent with public requirements. The most important factor in controlled flow is a reliable communication system. Skilled dispatchers must watch demand along the system, varying gas intake from numerous well heads to accommodate fluctuations, and in many instances, interrupting supply to less critical users in order to prevent hardships from developing in areas where rapid temperature drops suddenly increase demands. Load changes require immediate order transmittals to all stations along a gas pipe line system, since load changes in one area are quickly reflected in other sections.

To insure a maximum throughput, flow pressures are maintained at highest values consistent with safe operating practices. Very often major loads are interrupted, which requires quick reduction in pumping rate or a diversion of the load to other consumers to prevent pipe line pressures from exceeding safe operating levels.

In some gas pipe line systems, the dispatcher receives telemetered information as to pressures, flow, and input quantities into the pipe line and delivered quantities from the pipe line to consumers. With this system of operation, the dispatcher continuously observes line conditions and, when system changes are required, uses remote control devices, which function over communication facilities to effect the desired changes or utilizes voice channels to issue the required orders.

On gas pipe line systems delivering appreciable quantities over long distances, flow must be maintained by installing and operating repressuring stations. The average repressuring point is highly mechanized and kept in good operating condition so that flow can be maintained. All machinery and equipment failures are reported immediately to headquarters. These operations require adequate and reliable communications during normal operating conditions. When breakdowns and emergencies occur at these plants, the demands on communication facilities are greatly increased.

During peak load periods, which usually accompany rapid temperature drops or prolonged low-temperature periods, gas pipe lines often reach critical pressure and temperature conditions, causing the deposit of hydrates inside the pipe line, which restrict the normal flow, thus causing an expansion of the gas at the end of the restricted area, which further lowers the temperature at that point, producing additional hydrates and eventually stopping gas flow. These conditions must be detected and cleared immediately or the consuming public will suffer.

An important and ever-expanding use of radio is being made by the industry in natural gas distribution. The long-line natural gas pipe lines are all licensed within the Petroleum Radio Service, but one the gas is turned over for distribution within a municipality, radio authorizations for natural gas distribution use are made within the Power Utility Radio Service, since such service is more closely related to, and must be co-ordinated with, general power and gas utility services.

Radio is used in natural gas distribution to cover a wide range of services intended to increase safety of the public, to safeguard operating personnel, to give prompt and efficient service to the public and to cover a vast range of operational problems. Radio in natural gas distribution is controlled from one central control point, at a district headquarters from which contact is maintained with mobile units throughout the operating territory. Service and repair work on all gas appliances, repairing of gas leaks and inspection of premises for customers, sealing and unsealing meters for turning gas off and on when customers move from place to place, protecting the public during fires by cutting off gas mains and restoring service after the fire is out, construction work involving the installation, moving or repair of gas mains, inspecting premises for proper installation of gas service in connection with building permits and other similar services are examples of the use to which radio communication is put in natural gas distribution.

IV. MOBILE COMMUNICATIONS

The pipe line industry needs communication with field vehicles engaged in line maintenance and repair, particularly during emergencies such as a line break in a densely populated area or near a public highway or a river. The ability of the operating personnel to obtain answers to questions and decisions on immediate problems from supervisory personnel, who are not available to fixed communications facilities, is an operating necessity of considerable importance. The coordination of hazardous activities, through central direction of field personnel, results in such increased safety to the personnel and the plant itself that there is no large line in operation today which is not equipped with good mobile radio facilities.

Many pipe line companies operate their own aerial patrol. Communication between the patrol planes and pump stations or repair crews is effected by means of radio, which greatly expedites the reporting and repair of leaks or other conditions requiring immediate attention. Such communications are conducted on mobile frequencies allocated to the Petroleum Radio Service. The patrol planes are also equipped with customary radio facilities operating on aeronautical frequencies.

Pipe line contractors have found that the use of mobile radio has materially added to the efficiency of their operations and to the service they render in constructing and reconditioning pipe lines. Because they are not engaged in the transportation of petroleum products or natural gas, they are not eligible for frequencies in the Petroleum Radio Service. Since they are engaged in construction activities, which are carried on in the most part in remote or sparsely settled areas, they are eligible for the use of frequencies within the Special Industrial Radio Service.

It is important to realize that the far flung activities of a pipe line create communication problems that cannot be handled satisfactorily without supplementing the relatively short range of the mobile equipment with other auxiliary radio communication facilities.

Activities of maintenance crews a hundred miles or more apart must be coordinated for maximum efficiency and safety. For example, in order to cut in a gate valve, safety demands having the line full of water instead of oil at the point of the operation; it also depends upon the section of the line between valves already in place being full of water, and the valves being closed. Thus, the transferring of information among three field operations, all relating to one item of work, is necessary if the safe completion of the work is to be accomplished in the shortest time, and this can be done only with mobile radio and additional communication facilities to afford extended range. These additional communication facilities are essentially the same as those required for communication from point to point along the pipe line.

V. MICROWAVE COMMUNICATIONS

About the time oil pipe lines adopted tight line operation, and natural gas pipe lines extended their systems over vast distances, thus creating a need for more reliable and continuous communications, microwave radio, fortunately, became available for industry use. The petroleum industry, always aggressive and striving to find the best facilities for every activity in which it is engaged, has adopted microwave, one of the fastest growing means of communication ever to be developed in this country.

Microwave radio communication came into its own during World War II, when tremendous strides were made in the development of radar, implemented by the intensive wartime research carried on by government and industry. Several techniques were developed by manufacturers in the United States and a few relative short length microwave systems came out of the laboratories as the first microwave communication systems available for industry usage. Many extensive systems are now in operation and more are being installed. Among the advantages are continuity of service, secrecy of communications, and economies effected, as compared to operation of wire lines either privately-owned or leased.

The multiplicity of circuits available in a microwave system permits use of telemetering and supervisory controls in addition to normal voice, teletype and facsimile services. Pumps and motors may be started or stopped, pressures, viscosities, RPM's of equipment, power demands, and other data may be transmitted and recorded; indicating lights on dispatching boards at headquarters can be wired to show, automatically, units operating or idle; and many functions involving the opening or closing of an electrical circuit can be performed.

In addition to the communication flexibility offered by microwaves, the simple addition of the microwave system's multi-channel capabilities to the techniques available to the pipe line industry, is going to influence the industry more profoundly than any development since the introduction of the electrically driven centrifugal pump.

Once a microwave system is installed, an almost limitless number of signaling channels may be made available for supervisory control and remote indicating applications, which do not affect the ability of the system to carry communication signals.

This added capability of microwave systems, which is available at a very low cost after the system has been installed, makes the completely remote operation of pump stations economically feasible for the first time. This type of operation will result in lower first costs, lower operating costs, and safer operation at all times.

Because of the inherent line-of-sight transmission limitations of ultra-high frequencies, microwave systems must utilize repeater stations, which may be completely unattended. These locations are determined by the topography of the route traversed. The antenna towers must be so spaced that the radio beam will clear all intervening obstructions by fifty feet. With 150' towers, over average terrain, repeater points are spaced approximately 30 to 35 miles apart.

The radio transmitting and receiving equipment is generally placed at the base of the towers, with parabolic antennas pointing upward to passive reflectors mounted at an angle of 45° on top of the towers. There is no physical connection between the antenna and the reflector. The radio beam is deflected by the reflector along a narrow path to the next tower where the process is reversed and repeated.

The paraboloids are equipped with thermostatically-controlled heaters, which are automatically energized when the atmospheric temperature drops to 30° F. This keeps them free of snow and ice which would blot out the signal if allowed to remain in the dish.

Power requirements in a microwave system are very low; in fact, about half of the total power consumed is for lights on the towers. However, a dependable source of constant electric power is an absolute necessity. At locations where the continuity of commercial electric power is questionable, it is the practice to install an auxiliary power supply such as a gasoline, natural gas or propane-driven generator, which automatically takes over during power interruptions.

One of the most disturbing factors to the orderly development of pipe line microwave usage and expansion is the proposal now pending before the Federal Communications Commission in Docket number 9552 concerning a requested allocation of frequencies and promulgation of rules and regulations for a theater television service. The industry's concern results from the request of the theater television proponents for either an exclusive allocation of frequencies from 5925 to 6285 mc, with some possible secondary use on a non-interfering basis for other users, or provision for theater television on a frequency-sharing basis with users in the Industrial Radio Service. Both of these proposals are highly dangerous to the pipe line microwave users, since the proposed theater television use would occupy the same frequency bands as those now used so extensively by pipe line microwave users.

The Central Committee on Radio Facilities of the American Petroleum Institute met this direct threat to the industry's microwave usage by entering a formal appearance in this Docket and preparing an elaborate presentation of the industry's position for the public hearings in the matter scheduled by the Commission. Only one of the petroleum industry witnesses has appeared to date, because, in the midst of the hearings and, in view of the very serious opposition experienced, the theater television proponents suddenly amended their request for an allocation, agreeing to withdraw their present proposal if the Commission would classify them as Limited Common Carriers and permit them to use, instead of the Industrial Radio Service frequencies, those assigned to the Common Carrier Service. This amended request presents less of an immediate threat to the petroleum industry's interest in these frequency bands, but does not wholly remove the threat to its continued use, because, if the present proposal should be approved by the Commission, it would inevitably result in efforts to have Industrial Radio Service microwave frequencies reallocated to the Common Carrier Service, in order to alleviate the channel crowding which would result there.

The Commission at this writing has not acted on this latest proposal. Whatever action is taken, the industry will continue to oppose, through the Central Committee on Radio Facilities, any proposal which would jeopardize in any way pipe line use of microwave facilities. An unfavorable outcome of these proceedings would inflict such serious damage upon the petroleum and natural gas industries and the public that we feel a full presentation of the industry's position in this important matter is essential.

The pipe line transportation of petroleum, petroleum products and natural gas affects the welfare of every segment of our population. It is certainly in the public interest to have all necessary facilities at the disposal of the industry to insure daily deliveries.

The continued use of microwave channels, as well as the expansion of these facilities by the industry, is consistent with the public's highest interest.

IV. CONCLUSION

Utilization of those frequency bands, which the Federal Communications Commission has made available for microwave systems on a developmental basis, has been great in the Petroleum Radio Service and in particular by the long haul pipe lines.

The petroleum industry has pioneered in the development of microwave facilities, and has proven their dependability, economy and efficiency. The petroleum industry today owns more miles of microwave systems than all other services combined. These established and well functioning systems are an integral and vital part of this important industry.

The pipe line industry is essential to the continued expansion of our economy. It is also realized that the great network of pipe lines now in operation is one of our first lines of defense, and will be as long as the engines of war are powered by petroleum products.

PETROLEUM RADIO RELAY STATIONS

I. INTRODUCTION

Radio communication from base stations to mobile units and among base stations is used extensively in the development and operation of oil fields. Radio communication between fixed stations, base stations, and mobile stations is required in pipe line construction, maintenance, and operation. This radio usage also improves the efficiency of men and equipment and also gives great protection to life and to property.

There are many applications of radio where communications are needed over distances greater than can be covered directly between fixed or base stations or from a fixed or base station to mobile stations. Very often mobile stations must communicate with each other, but they cannot do so directly because of the terrain or the distance involved. In these cases relay stations must be used to extend the range to accomplish the desired results.

II. TYPES OF STATIONS

By definition, in Part 11 of the Federal Communications Commission's Rules and Regulations, relay stations are of two types. First - a fixed relay station, which is an operational fixed station in the fixed service, established to receive radio signals directed to it from any source and to retransmit them automatically on a fixed service frequency for reception at one or more fixed points. Second - a mobile relay station, which is a base station in the mobile service, authorized primarily to retransmit automatically on a mobile service frequency communications originated by mobile stations.

III. SYSTEM USAGE

Relay stations may be so arranged that several channels of voice communication are handled simultaneously, using suitable sub-channeling equipment. Similarly, sub-channeling equipment may be used which will permit simultaneous use of telemetering, teletype, and remote control in addition to voice communication. These relay stations may operate on frequencies in the 72-76 mc band, in the 952-960 mc band, or in any band available for fixed station assignment. Either frequency modulated or amplitude modulated equipment is suitable for relay stations, and sub-channeling equipment of many different types has been developed. One of the advantages of this type of relay system is its flexibility, in that any necessary changes to meet changing communication needs can be made easily, and cheaply in most cases.

In mountainous areas it is not economical to provide relay stations to reach all points. However, emergency communications can be obtained at any place by stationing a mobile unit at a vantage point, and the mobile operator can relay messages by repeating them into the main relay system. Usually, for ordinary communications, spots can be found within easy driving distance where signals are good.

A pipe line approximately 185 miles long through rough, mountainous country has been operated for several years with such a system. This pipe line goes through territory where it would be practically impossible to maintain a wire telephone line during the heavy snow season. The radio system eliminates the exhorbitant expense of installing and maintaining a pole line under adverse conditions. It provides much more reliable service than could have been obtained by the use of the wire line, and it provides communication with mobile units not only along the pipe line but also traveling along roads remote from the pipe line. Repair trucks and snow cats can communicate by means of radio during hazardous weather conditions, and thus can call for material or help of any kind when needed. With radio communication available, the psychological effect on crews working in hazardous, isolated areas is a great boost to morale. There are times when repair crews go out unhesitatingly, to take care of pipe line maintenance where it is doubtful if they would go at all if they did not have radio communication. Maintenance foremen can reach pump stations and the pipe line dispatchers promptly to restore the line to service after repairs. This greatly assists in maintaining the flow of oil essential to the industrial and governmental activities served by the pipe line. No other system of communication would have served as well, and without it, the hazards to life and to property would be infinitely greater.

A communication relay system has been installed on another pipe line, through mountainous territory, where hazardous conditions also exist. The same advantages hold as outlined above. Recently, a heavy construction job over a portion of this line was planned. This involved 320 miles of line to be installed, paralleling an existing line. Due to circumstances beyond control of the operator, construction work was postponed many weeks and was begun late in the summer.

Every method of speeding up the work was put into use so as to get the job done before the snow season began. Work had to go on at many isolated points. Radio communication between headquarters points and mobile units working anywhere along the line was employed. Mobile radio between the various control units was also used to a very great extent. The fact that headquarters was in direct contact instantaneously with the field engineers, field inspectors, foremen, and contractor's representatives, permitted remedial measures to be taken immediately, if anything arose to delay the work. It was largely through the use of radio relay that the job was completed on time, and the additional capacity of the pipe line was made available for the handling of fuels urgently needed during winter weather. No other form of communication could possibly have done this job.

One advantage of an extensive relay system for communications is that many people can listen in on both sides of conversations and so be informed of things going on which may affect their work directly or indirectly.

Under the recent clarification of the Federal Communications Commission's Rules and Regulations, there can be more than one mobile relay station coupled together in series in an emergency. Thus it is possible, by mobile relay stations, to cover several hundred miles. However, the control link between any two of these mobile relay stations must operate on fixed service frequencies. The relay stations which transmit to the mobile units, can operate on mobile frequencies.

This has the great advantage in the western states, of broad mobile coverage with fewer relay stations in the 72-76 mc band, without causing interference to television channels 4 and 5.

IV. TELEVISION INTERFERENCE

The frequencies in the 72-76 mc band are ideal for relay systems requiring from one to four communication channels. However, under the present Rules and Regulations, the use of these frequencies in the petroleum and other industrial services is being very seriously curtailed, and in many cases is not available at all, because of possible interference with television channels 4 and 5. This limitation on the use of 72-76 mc frequencies means that the next frequency available for fixed service is in the 952-960 mc band, requiring shorter hops and more relay stations.

The Federal Communications Commission is currently considering, in its Docket number 10315, revisions of its rules which will outline the protection which must be afforded by mobile relay users in the 72-76 mc band to television stations operating on channels 4 and 5. The petroleum industry, through the Central Committee on Radio Facilities of the American Petroleum Institute, has filed appropriate comments with the Commission, pointing out that it is possible to operate mobile relay stations in this band without interference to channels 4 and 5 by shifting operations to the low or high part of the band, depending upon which channel requires the protection. Co-operation of the television manufacturers in setting specifications for television receivers, so as to reduce the possibility of picking up an interfering signal, was also suggested. It is believed to be entirely feasible to continue these operations in the 72-76 mc band without creating interference to television channels 4 and 5.

USE OF RADIO IN MARITIME SERVICE

I. INTRODUCTION

The earliest use of radio in the petroleum industry was in maritime operations. The industry's ocean going transportation has utilized all of the radio aids to navigation and the radio safety aids common to all ocean traffic. As the industry expanded its water-borne transportation to the Great Lakes and Inland Waters, radio continued to play an important role in this development.

The large fleets of tankers owned and operated by the American petroleum industry under United States or other registry consist of nearly 1000 ocean going vessels of 2000 gross tons or over.

On the Mississippi River system and along the Atlantic, Gulf and Pacific Coasts, the industry has over 2000 tank barges in operation. Radio has a significant role in the operation of all of this water-borne traffic.

While it serves as an important operational tool in water transportation, its greatest contribution is in the increased safety of personnel and equipment.

II. OCEAN AREAS

There is a difference between the use of radio in the ocean areas and from that on the Great Lakes and Inland Waters. This results from the fact that cargo vessels of 1600 gross tons and upward are required to meet certain government regulations covering the compulsory fitting of radio equipment and its conditions of operation. In brief, the requirement is for the fitting of radiotelegraph equipment operating in the medium frequency band (405-515 kc), supplemented by certain safety facilities such as emergency power supplies and auto alarms. This equipment must be manned by a licensed radiotelegraph operator and specified radio watches maintained for safety purposes. In addition to this medium frequency telegraph, most ocean vessels voluntarily carry high frequency telegraph equipment for long distance communication, and in recent years, many have had radiotelephone installed for ship to shore and intership voice communication purposes. Radar, although not compulsory equipment, has now become a common installation aboard most ocean vessels.

At the present time the United States, together with other countries of the world, is in the midst of implementing various international agreements (Atlantic City, 1947 and Geneva, 1950) involving all radio services, but which will have a particular impact upon marine radio systems. The marine service is expected to benefit ultimately from these changes in that exclusive frequencies will be authorized for use by ship and coast stations.

The entire radio spectrum below 30 megacycles is involved in frequency changes. All ship communication equipments (telegraph and telephone, medium or high frequency) will be affected, some more than others. The question of what specific modifications will be required and the exact time when each will have to be effected is very complicated. However, in general, the changes in shipboard equipments involve the retuning of transmitting circuits and the purchase and installation of new crystals to operate on new frequencies being assigned. The date of June 3, 1953, is the date tentatively adopted for commencing the transfer to these new frequencies in the high frequency bands, but this is subject to change by order of the International Telecommunications Union. Adjustments required in the medium frequency telegraph band have already been accomplished (November, 1952).

Two items of technical specification will cause some high frequency telegraph equipments to become obsolete or require extensive modification. These are (1) a tightening up of the tolerance limitations on radio frequency emissions and (2) ship equipments must be capable of being shifted from one frequency to another within 5 seconds within the same band, and within 15 seconds from band to band. These requirements will not become mandatory until a year after the frequency implementation is commenced, but the equipment modification program must be started now in order to meet the anticipated effective date of June 1954.

The Safety of Life at Sea Conference, London 1948, became effective in November 1952. This has also resulted in important changes. Ocean-going cargo vessels of 500 gross tons and over will be required to carry portable lifeboat radio equipment meeting certain specifications. Federal Communications Commission rules in this matter have already been adopted and the manufacturing companies are now in the process of designing these equipments. Vessels will carry such equipments as soon as they become available.

Direction Finders also become required equipment aboard cargo vessels of 1600 gross tons and over. However, since ocean vessels have voluntarily carried these equipments for years, the major effect of this new requirement has been to subject such equipments to the Federal Communications Commission's regulation and inspection.

Vessels in the tonnage range between 500 and 1600 gross tons on international voyages will be required to be fitted with either radiotelephone or radiotelegraph equipment for safety purposes. Authorization for the use of telephony for safety purposes for such vessels is a significant step and is associated with the adoption of the frequency 2182 kcs as an international calling and distress frequency for telephony.

The tanker industry, together with other segments of the ocean shipping industry has been following these matters closely through participation in the Telecommunication Committees of the steamship associations with which they are affiliated, through the activities of the Radio Technical Commission for the Marine Services (RTCM), a joint government-industry organization with semi-official status, and the Central Committee on Radio Facilities of the American Petroleum Institute.

III. GREAT LAKES AND INLAND WATERWAYS AREAS

Maritime use of radio has reached the stage where radio for Inland Waterways and the Great Lakes consists entirely of radiotelephone. Radiotelegraph was used prior to 1940, but shortly after the allocation of additional frequencies by the Federal Communications Commission for radiotelephony enable operators to convert entirely to radiotelephone service.

To indicate the importance of the inland waterways area, the United States Gulf coastline from the Texas-Mexico border to Key West is roughly the same as Key West to Philadelphia, or about 1300 statute miles. The Mississippi River and its principal tributaries (the Missouri, Illinois, Ohio, and Tennessee Rivers) together with the Gulf Intracoastal Waterway total about 5300 miles. These figures indicate the complexity of the communication problem and the resultant effect on the choice of frequencies and equipment. The "Merchant Marine Statistics, 1951" (U.S. Treasury Department Bureau of Customs) indicates that this area has approximately twenty percent of U. S. registered steam and motor vessels, barges (and other non self-propelled craft) as well as yachts. For this area, steam and motor vessels number about 6800; barges number about 1500 and documented yachts total about 700.

Radiotelephone operation on the Great Lakes consists of AM equipment, utilizing eight channels, and VHF-FM equipment, which has developed and received wide acceptance in the last four years, operating on thirteen channels.

VHF in the Great Lakes Area has proved to be very satisfactory and has given much longer range than originally anticipated, on some occasions reaching 150 miles. With properly operating sets, reliable ship-to-ship communication is obtained over distances up to 30 to 40 miles, and ship-to-shore 50 miles or more.

The radiotelephone equipment aboard a vessel generally consists of a transmitter, receivers, power supply and control units, a transmitting and a receiving antenna, and one or more telephone instruments installed at suitable locations. There are two categories of vessel radiotelephone communication: (1) ship-to-shore and (2) ship-to-ship. The importance of radio to the Inland Waterways Transportation Industry may be visualized by reference to some of its practical uses.

The personnel of Inland Waterway vessels usually make soundings of all dangerous crossings and locations on the rivers and these findings can be relayed to other vessels approaching such channels. Likewise, channel information furnished by the United States Corps of Engineers and the United States Coast Guard can be passed on by radiotelephone to vessels immediately upon its becoming available. This is a highly essential function since river channels do not remain static because of the continuous shifting of sandbars and consequent channel changes.

Many of these Inland Waterways vessels now operate on round trips of 2000 to 3000 miles, and while enroute, it is essential that quick management to operating personnel communication be established. This is carried out by long distance land-line communication to coastal harbor station, coastal harbor station radio to vessel on 2-8 mc frequencies. The rapid expansion and successful operation of this system has proved that a truly practical approach was made to the problem in the early 1940's when the Federal Communications Commission made allocations of frequencies for this service.

The rivers on which this traffic is carried wind through valleys so that the VHF line of sight transmissions obtained on the Great Lakes are not possible on the rivers which follow circuitous routes. For this reason, the threatened loss of some of the 2-8 mc frequencies is cause for great concern among the operators. Unfortunately, the Atlantic City Conference and the Extraordinary Administrative Conference, (Geneva, 1951) failed to provide for marine telephone communication in the 6 mc band. Experience has shown that the 6 mc band is far superior to the others in use (2, 4 and 8 mc) and handles over half of all the traffic. It would cripple inland rivers and Great Lakes communications if either or both the 6 and 8 mc channels were lost to other services or localities.

The Federal Communications Commission is currently considering the disposition of the two and six megacycle frequencies for Inland Waterway use in Dockets number 10377 and 10444. Through the Central Committee on Radio Facilities of the American Petroleum Institute, the operators have made their views known to the Commission and have requested the continuation of the six mc frequencies in derogation of the International agreements so that adequate radio service will continue to be available to them.

IV. CONCLUSION

Marine operators moving petroleum products have been the first to take advantage of the aids offered through radio communication and radar. Ship board use of radio and radar is licensed by the Federal Communications Commission under the Maritime-Mobile Radio Service. The importance to the petroleum industry of water-borne transportation is so great that the continued provision of adequate and appropriate frequencies is a matter of grave concern.

Radar has proven to be an invaluable navigational aid both on the high seas and the Inland Waters and is discussed in detail in the next section.

USE OF RADAR AND OTHER RADIOLOCATION METHODS

I. INTRODUCTION

The billions of dollars spent on research and technical development during World War II have found numerous industrial applications since the close of that war. One of the major developments was that of radar and the associated measuring techniques and equipment. This research provided methods for the measurement of time to fractions of a microsecond. This ability to measure time intervals with extraordinary accuracy, coupled with the rectilinear propagation of radio waves, has introduced an entirely new technique of surveying. This is the technique of radiolocation.

Basically, radiolocation makes use of the fact that the velocity of a radio wave is approximately 186,000 miles per second or one billion feet per second. A radio wave travels approximately one thousand feet in one millionth of a second, a microsecond. If one can measure the time required for a radio wave to travel between two points with an accuracy of one microsecond, one can determine the distance between the two points with an accuracy of one thousand feet. If one can determine the travel time with an accuracy of a fraction of a microsecond, the distance can be determined with an accuracy of the corresponding fraction of a thousand feet. In actual practice, most of the radiolocation techniques involve the determination of the round-trip travel time from an initial transmitter to a remote object and back to the transmitter. This improves the accuracy by a factor of two. The importance of the radiolocation methods lies in the fact that it is not necessary for the distance between the two points to be traversed by the surveyor, as is the case in conventional surveying with a chain. At the same time, the distance between the two points is determined directly rather than by a measurement of angles. This permits a great simplification in operations since the measurements can be made from a moving object, such as a ship or an airplane. It also makes possible the location of an inaccessible object without any cooperation between that object and the surveyor in the radar methods.

The petroleum industry has made use of three types of radiolocation techniques - radar, shoran, and phase comparison.

Radar

Radar, the word being coined from the phrase Radio Detection and Ranging, has developed rapidly since it was first introduced to commercial marine interests in 1946. A brief resume of the historical development of radar indicates that the basic discovery that radio waves are reflected from solid objects was made in 1886. Subsequent work in 1922 by two Naval Aircraft Radio Laboratory scientists at Anacostia, Maryland, who were then working on a plane-to-ground communication system, determined that the shipping moving in the Potomac River distorted the radio wave pattern and caused a fluctuating signal.

Development work was pursued from that date until 1935 when Congress provided $100,000 to the Naval Research Laboratory for the development of radar. The first crude radar was tested successfully in 1937 aboard the U.S.S. LEARY, and extensive sea trials were given to a greatly improved unit on the U.S.S. NEW YORK in 1939.

Development of radar moved rapidly throughout the last year before the War and in the early years of the War itself, when only the Armed Forces used radar at this time. Because of its close connection with the maritime industry, the United States Coast Guard delegated the responsibility for disseminating pertinent data on radar to interested parties. Early in the post war period, consultations were held between the Coast Guard, manufacturers, potential users, and interested Government agencies, and considerable development and experimental work was done on vessels of the International Ice Patrol and vessels operating along the coastal and inland waters of the United States.

In radar, an extremely short pulse of radio energy is transmitted from the station making the radiolocation survey. The energy is directed into a comparatively narrow beam by a complex antenna system. When the energy pulse strikes any object in the path of the beam, a portion of the energy is reflected back to the radar location and there is detected by an extremely sensitive receiver. This received pulse produces a spot of light on a cathode ray tube similar to the television picture tube. The position of the spot is made to correspond to the direction of the beam and to the travel time of the pulse. As the beam rotates a full circle around the horizon from the transmitter, a series of dots of light appears on the picture tube corresponding, on a reduced scale, to the positions of the objects which have reflected pulses back to the radar. The picture tube then displays a map of reflecting objects surrounding the radar set. From this map one can determine the direction and distance to each object. By the addition of special circuits, it is possible to determine the distances with far greater accuracy than can be determined by measurements on the picture tube.

The petroleum industry has made four diverse uses of radar in its operations. These are:

(1) As a navigation device and as an anti-collision device on board the tankers of the petroleum industry's fleet

(2) As a location method for determining the position of the geophysical survey boats on the Continental Shelf off the coasts of the United States

(3) As a harbor surveillance device for guiding the boats for marine drilling operations into and out of coastal harbors during periods of low visibility resulting from fog

(4) As a device for detecting changes in weather, such as line squalls or hurricanes

Shoran

The second type of radiolocation device used in the petroleum industry has been shoran. Shoran is quite similar to radar in its basic principles. A transmitter sends out over an antenna a short pulse of radio energy. This pulse of radio energy travels out until it reaches the object to be located. In the case of shoran, however, there is an auxiliary transmitter on the object to be located. This auxiliary transmitter, or beacon, is so designed that it does not normally transmit radio energy. But when a pulse is received from the base transmitter, a pulse is transmitted from the auxiliary transmitter on the object to be located. The receiver at the base station receives the pulse from this auxiliary transmitter, and by measuring the time delay between the transmission of the original pulse from the base transmitter and the receipt at the base of the pulse from the auxiliary transmitter, the distance from the base transmitter to the object carrying the auxiliary transmitter can be determined. In practice, shoran differs from radar in another important respect - the antenna at the transmitter does not transmit a narrow beam but rather a broad beam covering the entire area in which the objects to be located may be expected to operate. Thus, the shoran equipment gives no indication of the direction from the base station to the object to be located. In order to determine the position of of this auxiliary object, it is therefore necessary to use two base stations located at known points. By determining the distance from each of these two base stations to the object to be located, it is possible to determine the precise position of the object to be located. This makes shoran suitable only for operations where fixed base stations can be used. In practice, the equipment for measuring the times is actually located on board the object to be located, rather than at the base stations.

Shoran was developed for the guidance of aircraft engaged in precision bombing and is particularly applicable to aeronautical use. It has been used in the petroleum industry only in connection with geophysical exploration, either the airborne magnetometer or the waterborne operations on the Continental Shelf.

Phase Comparison Systems

The third type of radiolocation method used by the petroleum industry is the so-called phase comparison method. This method differs from radar and shoran in that the base transmitter or transmitters do not send out pulses of radio energy. Instead, they transmit a steady signal. The use of phase comparison methods is primarily a radio spectrum conservation technique. In order to measure the arrival time of a pulse with a high degree of accuracy, the pulse must begin very abruptly. The abruptness with which a pulse can begin depends upon the amount of spectrum space occupied by the transmitted signal. Roughly, the band width in cycles is equal to the reciprocal of the required time accuracy, measured in seconds. Thus, if time is to be measured with an accuracy of one millionth of a second, a band width of one million cycles, one megacycle, is required. This would give an accuracy of distance measurement of one thousand feet. If an accurary of ten feet were required, a band width of one hundred megacycles would be required.

Technical considerations of the design of the transmitter and of the receiver, as well as considerations of spectrum conservations, require that the band width be a small fraction of the center frequency of the transmitter energy. Thus, if a band width of several megacycles is to be required, the center frequency must be of the order of several hundred, or preferably several thousand, megacycles. Radio waves of such frequency travel essentially in straight lines and, consequently, can be received only by stations at limited distances from the transmitter. The distance depends on the height of the transmitting antenna and the height of the receiving object. In any case, for practical heights of antennas and heights of objects on the surface of the earth or on shipboard, the distances that can be used for such high-frequency radio waves do not exceed fifteen to twenty miles. If the object to be located is an aircraft that can fly at altitudes of several thousand feet, the line of sight distance is correspondingly increased, and pulse type methods can be used over long ranges. In the geophysical operations of the Continental Shelf, distances of a hundred miles or more are involved. This precludes the possibility of using pulse type radio-location methods for such surveying purposes, except for airborne operations.

Fortunately, radio waves with frequencies of the order of a few megacycles or less travel along the surface of the earth for great distances and can be received at several hundred miles from the transmitter if sufficient power is available to override the other sources of radio energy, such as static. The phase comparison methods make it possible to use such low frequencies satisfactorily for determining positions with an extraordinarily high degree of accuracy. It is not practical to build antenna structures with a high degree of directivity for such low frequencies; consequently, the phase comparison techniques are useful only in measuring distances. This means that in order to locate an object it is necessary to measure the distance from two accurately located bases to the object. This limits the use of phase comparison methods to those situations where base stations can be located at points whose positions have previously been determined. Most phase comparison systems are such that the object to be located need carry only a receiver and associated measuring equipment and does not require a transmitter. This makes possible the use of a single radiolocation network by an unlimited number of users, each operating entirely independently in the same area.

II. RADAR USAGE

Tankers

The first use of radar in the petroleum industry to be discussed is the conventional usage of radar by petroleum tankers as radio navigational aids and as anti-collision devices. The tanker usuage of radar for these purposes is exactly the same as other ship radar usage and is governed by the same rules and regulations. This use of radar has made very important contributions to tanker operations. The most important of these is in the avoidance of collision either with other ships or with stationary objects. This has resulted in substantial saving of life and property. The second contribution of radar to tanker operation is the time that is saved by permitting the operation of the tanker under weather conditions where operations normally would have to be suspended. This relates primarily to operations in harbors but also applies to some extent to operations in the open seas. Radar has become an indispensable tool in tanker operations.

Geophysical

Radar has likewise been widely used in geophysical operations. The principal application has been in offshore operations, but radar has also been used in some overland operations, particularly in areas where the terrain presents difficult problems of transportation that complicate conventional surveying techniques. In geophysics the determination of the position of the sites of the geophysical measurements with a high degree of accuracy is very important. This determination is necessary in the first instance in order that one may know where the possible oil-bearing structures are located on the ground. However, for this purpose, an accuracy of a tenth of a mile is adequate. A higher degree of accuracy is required by the fact that it is necessary to tie the results of measurements along a series of lines together. Also, for certain types of geophysical measurements it is necessary to apply corrections, depending upon the geographical position of the measurement. The variations of the observed quantity with geographical location, independent of subsurface conditions, over a distance of a hundred feet may be as large as the changes in the observed quantity that would be produced by significant subsurface changes. In order to apply an adequately accurate correction for this effect, if is necessary to know the geographical position with an accuracy of the order of fifty feet.

Conventional radar equipment is barely adequate for such accuracy. For this reason, most of the geophysical operators provide modifications of their radars in order to measure distances with a higher degree of accuracy. Likewise, the measurement of angles by radar is not adequate for this accuracy of position determination at ranges of ten or twenty miles. For this reason, radar operations in geophysical prospecting usually make use of the measurements of distances from the object to be determined to two stations whose positions are accurately known. These might be oil wells, lighthouses, buildings, or other natural or man-made objects that are good reflectors for radio energy and whose position had been or could be accurately surveyed. In some instances, radars are modified so that they would act as beacons similar to shoran; that is, the radar beacon will normally not transmit a pulse but whenever a pulse is received it transmits a pulse. Thus, if two such beacons are set at known positions and a conventional radar placed aboard the vessel whose position is to be determined, the time between the transmission of the pulse from the vessel and the receipt of the pulses from the beacons could be measured and the distances obtained. This procedure has two important advantages. One advantage is that the beacon transmitter transmits many times as much power as would be reflected from even the largest of man made or natural targets. The second is that the radio frequency on which the beacon transmits can be made different from the radio frequency on which the radar transmits and thus the signal from the beacon distinguished from the reflections. This solves one of the more difficult problems in the application of radar to geophysical surveying. This is the problem of identifying the target from which the radar signal is reflected.

In addition to the use of radar for radiolocation purposes in geophysics, it also serves a very important role as a navigational tool. The weather conditions in marine operations frequently involve periods of low visibility due to fog. Such conditions are most apt to occur when wave disturbances are at a minimum so that geophysical operations could be conducted with maximum efficiency if radar permits operation under such conditions. Also, because of the necessity of operating at long distances from the nearest port, particularly in the Gulf of Mexico, it is customary for geophysical operations to be conducted for a ten-day period between returns to port. As a result, it is impossible to predict what weather will be encountered during the latter part of the work period. The possibility of safely returning to port under adverse weather conditions of fog or squalls makes radar a valuable adjunct to marine geophysical prospecting. Such operations are hazardous at best, and the reductions in the hazard afforded by the use of radar is extremely important. An example of such experience occurred during the last operations off the coast of Texas. A seismograph crew had suspended operations because of heavy fog. They accidentally had an explosion of dynamite which injured two of the men quite severely. This particular crew was not equipped with radar. However, another crew operating in the same area was equipped with radar. The boat carrying the two injured men contacted the radar equipped crew by radio and told them of their difficulty. The boat equipped with radar was able to locate the boat carrying the injured men in spite of the fog. The men were transferred to the radar equipped boat, and the boat then proceeded by use of its radar to find its way through the fog back to port. The men were thus able to be given treatment in a hospital within a fairly short period of time. It is quite possible that had the radar equipped boat not been available, these men would have died from the results of their injuries. Some 26 radars have been licensed to geophysical operators, mostly in the Continental Shelf of the Gulf of Mexico.

Drilling

Under the best of conditions the drilling of an oil well is an enterprise fraught with possible hazards. Extremely heavy machinery is required for handling the tons of drill pipe which may be suspended in a hole over three miles deep. The drilling well may encounter pressures of many thousands of pounds per square inch, which sometimes are not predictable and may result in a blow-out. The blow-out may simply be salt water or may include oil or gas. In the latter case, there is a very real possibility that the oil or gas will be ignited and the well burn. The drill crews are trained to take all precautions to prevent such hazards and to meet such emergencies. However, due to the unpredictable nature of certain of the hazards, they cannot always be avoided. When indications are noticed that such conditions may be encountered, outside help is needed and needed promptly.

When the well is being drilled on land, the problem of providing aid to the drilling crew is much simpler than when the well is being drilled in the open waters on the Continental Shelf. To minimize the hazard under these circumstances, it is essential to provide a transportation service from shore to well site that can operate under all except the most extreme of conditions. One of the problems encountered in providing such a transportation system is that of fog. This problem has been solved in one instance of marine operation by having a radar at the port. This radar can observe all vessels in the port and approaching the port. The radar operator can maintain contact with the vessels by radio and thus is able to give them minute to minute instructions on how to enter the port. This technique of harbor surveillance by radar has proved to be extremely beneficial in off-shore operations and is credited with the saving of several lives.

A fourth use of radar by the petroleum industry likewise is an important factor in off-shore drilling operations where the protection of life and property is intimately associated with weather conditions. Clouds reflect part of the pulses sent out by radar and thus radar is able to locate clouds. This makes it possible to locate both line squalls and hurricanes by means of radar. Not only does the radar detect the presence of the line squall or the hurricane but gives an accurate description of its location and its extent and permits the determination of the speed with which it is moving. Some appropriate idea of the intensity of the disturbance is also given by the radar. This meteorological application of radar has been used with considerable success in off-shore operations and has made it possible for meteorologists to advise the drilling crew of the approach of the line squall in adequate time to make suitable preparations for the high winds accompanying the squall. Likewise, the boats used in transporting men and equipment from shore to the drilling sites or pulling the barges carrying the oil from the well to the shore are warned by the meteorologists in time to prepare for the approaching storm. This application of radar has prevent important loss of equipment and has minimized the danger of loss of life. Also, since it is known that adequate warning of the approach of the storms will be given, the men are relieved from the fear of the storms when there is no danger, and thus it adds greatly to the efficiency and morale.

III. SHORAN USAGE

The problems of rules and regulations and frequency allocations for shoran usage are much more complicated than those of radar. This arises from two factors. First, other than its use in geophysical prospecting, shoran has had little commercial application. Second, the frequencies on which shoran operates are frequencies which are normally governmental frequencies under the United States frequency allocations. It has been necessary, from time to time, to obtain special permission from the military services to use these frequencies for geophysical prospecting. The Joint Chiefs of Staff, who are responsible for this question on behalf of the military services, have been extremely cooperative in extending the period of time that shoran could be used on these frequencies for geophysical prospecting, in view of the strategic importance of continued ample sources of petroleum for military operations.

In geophysical prospecting, shoran is used for the purpose of locating the position of the vessel, either the ship or the aircraft, which carries a geophysical measuring device. The aircraft would carry an airborne magnetometer; a ship may carry either seismic prospecting equipment or gravity prospecting equipment. In either case, two shoran repeaters or beacons are located at known points. The equipment aboard the geophysical vessel sends out pulses which causes pulses to be transmitted from the beacons at these two known points. This enables a determination of the distance from the vessel to each of the two known points to be made and thus the location of the vessel to be determined. An accuracy of the order of fifty feet is obtainable in this fashion. The operating distance is approximately equal to the line of sight and is determined by the curvature of the earth and the height of the antenna at the fixed repeater stations and at the geophysical operating vessel.

In anticipation of the eventual discontinuance of the use of shoran on the frequencies allocated to military operations, two different developments have gone forward. One of these developments is the phase comparison method which operates on frequencies below two megacycles. This method will be described in more detail in a later section. The other development has been the conversion of shoran from the military frequencies to frequencies in the microwave portion of the bands allocated to the radio-location service. This latter development has met with reasonable success and has been used under actual operating conditions by a major oil company for several years.

At the present time, there are 32 shoran transmitters licensed to operate in the United States. These are operated by four companies, two of which are oil companies and the other service companies which provide either radio surveying service or a complete geophysical service. The microwave band is not so suitable as the band allocated to the military equipment for shoran usage. It would be desirable for the petroleum users to continue to have permission to operate in the military frequency bands. However, should this prove impractical, operations can be conducted in a reasonably satisfactory manner in the microwave band, although the equipment for this band is not commercially available at present.

IV. PHASE COMPARISON RADIOLOCATION USAGE

On a conventional map, the location of any point is determined by giving two coordinates. These coordinates may be latitude and longitude expressed in degrees, minutes, seconds, and fractions of seconds, or they may be some other type of coordinate system agreed upon by all the users of the particular map. The map will show selected values of these coordinates as a network of lines. In most coordinate systems used in mapping, the network of lines are approximately squares. One determines the values of the coordinates of the point by measurements from known points whose coordinates have previously been determined by accurate surveys. The phase comparison radiolocation methods are similar in principle to this use of coordinate systems on maps. The coordinate system used in a given radiolocation system depends upon the design of the particular system. In the systems which are at present used in geophysical prospecting, the coordinate systems are hyperbolic; that is, the lines of the networks on the maps are not straight lines but instead are hyperbolas. The hyperbolas do not intersect exactly at right angles. This introduces some complications in the computation of the coordinate systems and the construction of the map but presents little or not complication in the actual use of the system once the maps have been prepared. The reason hyperbolas are used is that it is relatively simple to measure the difference in the travel time of the radio waves from two known points to the surveying vessel. The locus of a point which moves so that the difference between its distances to two known points is constant is a hyperbola. Thus, at all points along such a hyperbola, the difference in the travel time of the radio wave from the two base stations at known points to the survey boat is constant. When one measures the difference in the travel time of the two radio waves, the value that one obtains is a designation of the particular hyperbola on which the geophysical survey boat is located. By repeating this process for a second pair of base stations, one locates a second hyperbola on which the geophysical survey boat is located. The intersection of these two hyperbolas is the position of the survey boat. One measures the difference in the travel times by comparing the phases of the radio waves received. In principle, this is quite simple. In practice, rather complex circuits are required in order to avoid various difficulties that could decrease the accuracy of the measurements.

The choice of the optimum frequency depends on the accuracy of the measurement required and, to some extent, on the distance that is to be surveyed; that is, the size of the area that one would like to cover with a given network. In general, the lower the frequency and, consequently, the longer the wave length, the larger the area that can be covered but the lower the accuracy. A reasonable compromise among the requirements of accuracy, distance required, and the existing allocations of frequencies to other services was achieved by the Federal Communications Commission in assigning the band from 1750 kc to 1800 kc to the phase comparison radiolocation service. However, this frequency allocation applies only to the Gulf of Mexico area, and hence this radiolocation method is, unfortunately, not available to geophysical operations elsewhere.

Two competing service companies are now offering radiolocation service to the geophysical industry in the Gulf of Mexico on the Continental Shelf. The two systems involve basically the same principles but have differences in the specific engineering solutions based on these fundamental principles. Four networks have been licensed covering a distance along the Louisiana and Texas coast of 275 miles. The two service companies have plans for applying for additional licenses to permit networks in other areas along the Louisiana and Texas coast to cover the entire area as soon as the service is required by the geophysical prospecting companies. These networks have been in operation for a period of some six months to a year and have given relatively satisfactory service. Continued experience with these networks has indicated various modifications that are required and has indicated the limitations to the service as now offered.

One problem which has been encountered is the need for what is known as lane identification. By phase comparison is meant a measurement of the time that elapses between the instant when one of the received radio signals has zero value and the instant when the other received radio signal has zero value. Unfortunately, each of the zeroes of the given signal is indistinguishable from the other zeroes; that is to say, one cycle of the signal cannot be distinguished from any other cycle. Thus, one is able by a phase comparison measurement to determine the fraction of a cycle difference in the travel time but not the total difference. The technique currently being used to avoid this ambiguity is to start the measurements from a known point and to keep count of the number of cycles or lanes, as the radio surveyor calls them. This method is generally satisfactory since automatic devices can be provided for keeping count of the number of cycles. However, should a power failure occur or should strong radio interference be experienced, it is possible to lose count of the number of lanes and thus introduce an error in the position. It is possible to provide auxiliary systems which will give a solution to the problem of lane identification; that is, remove the possibility of ambiguity, so that at any point it is possible to determine one's position uniquely without the necessity of starting from a known point. Several different methods have been proposed for this identification. Each of these involves either operation of additional radio stations at slightly different frequencies or of operating the same stations with radically different frequencies. At the present time, no system in commercial operation provides lane identification.

V. CONCLUSION

The petroleum industry adapted the radar and shoran which were developed by the military forces during World War II to their own use immediately at the close of the war. They have provided modifications of both these two systems and have introduced a third system, the phase comparison system, that is peculiarly suited to their specific needs. The petroleum industry, in its operation of ships, in its drilling operations off shore, and in its geophysical prospecting, has found the use of radar, shoran, and phase comparison radiolocation systems indispensable tools. In fact, it is no exaggeration to say that prospecting in much of the off-shore area is practical only if adequate radiolocation services are available.

Under the existing rules and regulations of the Federal Communications Commission and existing allocations of frequencies, there are adequate provisions for all the radar uses of the petroleum industry. The use by tankers is covered by the ships' radar where the provisions for tankers are the same as those for any other ship. The use by geophysics for radiolocation is covered by the radiolocation service under the industrial radio service. The production use of radar for harbor surveillance and for meteorology are both covered by developmental services until such a time as these two latter services have had a more extensive usage. This is an appropriate manner of handling these services.

Commercially available shoran equipment is operated on frequencies allocated for military usage. The geophysical use of these frequencies is based on periodically renewed permission from the Department of Defense and is scheduled to cease on July 1, 1953. This presents some problems to the industry.

The existing rules and regulations of the Federal Communications Commission and the allocation of frequencies are satisfactory for the operation of a phase comparison radio-location system for geophysical prospecting on the Continental Shelf in the Gulf of Mexico. The rules, as they now exist, do not permit the use of phase comparison methods in any other area or for any other purpose. At the present time, this limitation is perhaps not too serious. However, it appears inevitable that in the future the need will arise for this type of service in other areas.

The facilities which are now available to the petroleum industry under the rules and regulations of the Federal Communications Commission are essential, and no substantial reduction in these facilities or restrictions on their use could be tolerated without serious loss of the efficiency of the operation.

USE OF RADIO IN REFINERY OPERATIONS

I. INTRODUCTIONS

The use of radio communication within the refineries of the oil industry has grown with phenomenal speed in the last few years. At first thought, one might conclude that even the larger refineries would find point-to-point wire communications adequate for their needs. An average sized refinery of 100,000 barrel-per-day capacity will encompass an area of one thousand acres and be manned by 1500 to 2000 people. To carry out their duties, most of these people must be in motion between unspecified locations. This presents a communication problem that is unique.

The largest section of manpower that benefits by this aid is that involved in maintenance and repair. None the less important in the job of supplying an abundance of petroleum products are the coordination of process unit supervision and rapid mobile communications during emergencies.

II. PRESENT USES

The maintenance of plant equipment in safe and operable condition is the job of over half the manpower in a refinery. The rapid and efficient dispatching of men, materials and transportation is the real key to efficient use of these men and materials.

At present, refineries of various sizes are finding that their use of manpower is twenty to twenty-five percent more effective through the use of the radio communication networks. Every truck, every car, essentially every vehicle is in constant two-way communication with a central dispatcher. Thus the network of communications is formed.

Vital processing equipment must be taken out of service at regular intervals for repair. The refinery unit and the maintenance shops are centers of activity during these periods. The flow of men and materials must be closely coordinated with the needs of the unit. Supervisory personnel direct these transportation activities from on the spot through radio and a central dispatcher.

A typical network for maintenance and construction in an average refinery of 100,000 barrel-per-day processing capacity would consist of a base station and approximately one hundred mobile units. The mobile units would be located in supervisors' cars, craft foremen's pickup trucks, transportation department trucks and straddle carriers. Lubrication trucks and mobile equipment service vehicles should be similarly equipped.

Actual statistics from existing systems show that, on such a system, the total number of messages handled in an eight-hour day will fall between 800 and 900. During peak operating periods the call density will reach one call every thirty seconds. This is virtually saturation. The human element precludes a higher use factor. Operating techniques have been brought to a high point of perfection in order to realize this extensive use of facilities. The rewards have been great, however, for the development of the present system and techniques.

Factual data have been recorded to show the increased efficiency of maintenance personnel. Because this personnel is used over a wide area from central bases, rapid communication is essential to high efficiency. During periods of national emergency this added efficiency is of vital importance, for with the same manpower and materials more petroleum products can be produced.

The service factor or use factor of a vehicle is decreased by idle periods while the operator looks for a land line phone to seek new orders. "Dead head" time used in running back to a dispatch office for directions decreases the production of essential petroleum products. Mobile radio communications have virtually eliminated this lost time. Most operators report ten to fifteen percent increase in vehicle use factor through radio communications.

Regardless of how well planned a refinery may be, regardless of the intricate measures taken to avoid disaster, there comes the day when a serious emergency occurs. Point-to-point communication on what well may be a rapidly changing field is needed with instant dispatch. Most of the users of refinery radio have worked out emergency systems and procedures of which the normal operating radio network is an essential part. However, it is necessary to place mobile units in fire trucks, foam trucks and the ambulances for use in emergencies. As the emergencies are infrequent, these units do not add to the peak load on the systems. In this field the "walkie-talkie" and "handy-talkie" are used extensively.

Frequently sections of the wire communications system in the yard areas are made inoperative by accidental breakage of cables. Mobile units are brought into use to bridge the gap for essential calls until temporary repairs can be made.

Refinery operators are finding that stray earth currents are continually corroding tankage and pipe lines within their plants. Extensive surveys are made to evaluate the effectiveness of cathodic protection equipment. These surveys require several instruments at widely separated temporary test locations to be read simultaneously. In many instances the use of radio is absolutely essential for the transmission of accurate data.

Another refinery use of radio is for the control of electrical power loading. By means of a transmitter in the power house and receivers located at various critical points in the plant, operators are kept informed of changes in power requirements so that interruptions in processing may be avoided. Frequencies for this purpose have been made available in the Low Power Industrial Radio Service.

III. FUTURE GROWTH

There are two major sources of growth in refinery use of radio. The first is by extension of present techniques to more refineries. From June 1951 to June 1952 alone there was a twenty-five percent increase in the systems authorized. About half of the larger refineries are presently equipped with radio systems.

The second factor that will influence the growth in use is the development of midget mobile units operating above 450 mc. This will open entire new fields. Mass production techniques, such as the printed circuit, are examples of the advances which have been made. Long-life, lightweight batteries, transistors and subminiature electron tubes are also being effectively used.

Some typical examples of uses for such equipment would be:

(a) Process instrument repair crews for simultaneous instrument adjustment at both ends of instrument control piping.

(b) Electrical field crews working on distribution circuits.

(c) Safety teams and air pollution teams for their field coordination.

V. CONCLUSION

The present networks and those now under development are all adding to the high efficiency of refining operations. They are making it possible for a pound of steel and a manhour of labor to produce more refined petroleum products vital to our national economy and security.

USE OF RADIO IN MARKETING OPERATIONS

I. INTRODUCTION

Radio is being put to extensive and rapidly increasing use in the marketing and distribution of petroleum products. As of December, 1952, there were approximately 140 licensees and 4,300 licensed radio units authorized to operate in the Highway Truck Radio Service (Part 16, Subpart G of the Rules and Regulations of the Federal Communications Commission). Of this number, approximately 85 licensees, or over 50 per cent, were engaged in the transportation of fuel and fuel oil or liquid and bottled gas.

This use of radio in marketing operations has developed almost entirely since the establishment of the Highway Truck Radio Service on July 1, 1949. Prior to that date, radio for highway trucks was licensed on an experimental basis only and was in extremely limited use. There is every indication that growth in the marketing use of radio will continue.

Section 16.301 of the Rules and Regulations sets forth the eligibility requirements for the Highway Truck Radio Service. This section provides that persons regularly engaged in the operation of trucks on a route basis outside of metropolitan areas and non-profit corporations or associations organized for the purpose of furnishing a radio communication service solely to persons engaged in this activity are eligible to hold authorizations in the service. It is expressly provided that the service is not available for truck routes within a single metropolitan area. A formal petition to remove this restriction has been before the Federal Communications Commission since shortly after the establishment of this service. Favorable action upon this petition would result in a tremendous increase in the applications for authorizations in the service.

II. DESCRIPTION OF USE

The basic use of radio in marketing operations may be illustrated readily. A truck which has left the central office of the trucking company to make a specific delivery can be dispatched to any point in the area to fill later received orders or for any other purpose without returning to the central office. This procedure reduces the company's overall operating costs by: (1) making it possible for the company to distribute over a given area with less trucking units; (2) reducing the depreciation of the company's trucking units and its operating expenses such as gasoline, oil, and maintenance, by reducing the number of miles driven in covering the same area and delivering the same quantity of products; (3) making it possible to serve a greater area and distribute a greater quantity of products thus reducing labor costs; and (4) enabling the central office to retain direction and control over all trucking units at all times.

The use of telephone for the communication between the central office and the trucking units has several disadvantages when compared with radio. It does not provide control over the units by the central office, since all communications must be originated by the driver. The cost of each communication is very high. In addition, it is probable that telephone lines would be inadequate to handle the burden of the calls of a large trucking system.

III. L-P GAS COMMUNICATIONS ASSOCIATION

One of the largest users of radio in the Highway Truck Radio Service is the L-P Gas Communications Association. This association is comprised of 38 fuel dealers in the state of Arkansas who have banded together for the sole purpose of providing a radio communication service to the members. The association holds authorizations from the Federal Communications Commission for 38 base stations and 200 mobileunits. This association presents a unique and apparently successful solution to the problem of making the most effective use of the limited number of frequencies available to the Highway Truck Radio Service in a given geographical area. With these 38 L-P fuel dealers making extensive use of a single frequency throughout the state, it is probable that other trucking companies will not request the use of this frequency. Consequently, any interference problems in connection with that frequency will involve only the members of the association and, accordingly, can be promptly and easily solved. On the other hand, the exclusive use of the one frequency by the fuel dealers will also benefit the other trucking companies in the state, since they will have the use of the other available frequencies without competition from the fuel dealers. In addition, the association can assure the maximum effective use of the time when the stations are on the air by the adoption of a standard operation procedure.

IV. CONCLUSION

Radio facilities are now being used effectively in marketing operations by over 85 trucking companies engaged in the transportation of petroleum products. These users comprise over 50 per cent of all the licensees in the Highway Truck Radio Service. The marketing use of radio has developed almost entirely since 1949, and indications are that this growth will continue, particularly if the restriction as to metropolitan areas is removed from the rules governing the service.

WASHINGTON PETROLEUM RADIO REPORT

BY

JOSEPH E. KELLER, SPECIAL REPRESENTATIVE
CENTRAL COMMITTEE ON RADIO FACILITIES
of the
AMERICAN PETROLEUM INSTITUTE

and the

NATIONAL PETROLEUM RADIO FREQUENCY COORDINATING ASSOCIATION

600 MUNSEY BUILDING
WASHINGTON 4, D. C.

PRESENTED AT THE 25TH ANNUAL CONFERENCE
of the
PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION

HOUSTON, TEXAS
APRIL 9, 1953

INTRODUCTION

Texas is an appropriate locale and the 25th Annual Conference of the Petroleum Industry Electrical Association is an appropriate time to present to your membership this annual report on recent developments in petroleum radio in Washington. In order to fully appreciate the importance of petroleum radio, we must first understand the importance of the petroleum and natural gas industries themselves.

The role that oil and gas play in the economy of the United States is becoming more important each year. This is particularly significant in a nation dependent for its production on machines as in the case for the United States. In this country we used ten times as much energy per capita as the people of the rest of the world, and twenty times as much petroleum energy per capita.

The pattern of energy consumption in the United States has not been static. There have been two obvious trends: (1) Total energy consumption has shown a strong growth trend and (2) Oil and gas have supplied all of the increase in energy since about 1920. (Chart No. 1)

Total energy consumption almost doubled between 1920 and 1951. Coal consumption in 1951 was actually less than in 1920. On the other hand, compared with 1920, oil consumption was five and a half times as great while gas consumption was nine times as great. In other words, the increase in energy supplied by oil and gas has been greater than the gain in total energy. As a result of these changes, petroleum (oil and gas) supplied more than 60 per cent of these changes, petroleum (oil and gas) supplied more than 60 per cent of the mineral energy consumed in 1951, compared with less than 20 per cent in 1920.

The petroleum industry represents an investment of about $30 billion in facilities to produce, transport, refine, and distribute petroleum and its products. In terms of capital investment, the petroleum industry is considered the fourth largest in the nation, exceeded only by agriculture, railroads, and the combined divisions of the public utility field.

The industry presently supplies over 285 million gallons of oil daily from its domestic operations. These operations are carried on by thousands of competitive concerns, ranging in size from small operators who own one service station or a few wells to large corporations with assets mounting to several hundred million dollars. To increase efficiency and reduce costs, most of the larger companies and many of the small operators carry on integrated activities from the exploration and development of oil to the final stage of supplying finished petroleum products to consumers at their homes and in near-by service stations. Both the small and large companies are in keen competition with each other at every stage of operations in the industry and that competition is the explanation of the extraordinary success of the American industry in supplying nearly two-thirds of the world's oil output, in maintaining low prices, and in improving the quality of products.

The petroleum industry is characterized by scientific techniques and specialized equipment. Science has been applied extensively in the search for oil, in the improvement of drilling methods to carry wells down almost four miles into the earth, in the refining of crude oil and finished products, and in transportation. The oil industry has its own specialized and low-cost transportation system of pipelines, barges, tankers, and tank trucks which move oil at a fraction of the cost that would be incurred for transportation by rail. The entire operation from the producing wells to the service stations is marked by mass production techniques which involve tremendous investment of capital, but result in relatively low cost because of the greater efficiency possible with automatic devices. The investment per employee in production, transportation, and refining operations is many times more than the average for industry generally.

Petroleum Radio Service

The use of radio by the petroleum industry dates from the middle 1920's, when it made practical the exploration for new oil and gas fields by seismic prospecting. The pipelines soon adopted radio as an unequalled tool to cope with emergency repairs with resultant substantial reduction in the hazard to life and public properties. With drilling being extended to ever greater depths and into more and more isolated and difficult terrain, the production departments found radio essential to both efficient operation and the protection of life and property from the spectacular hazards of an uncontrollable wild well or a hurricane or the less spectacular hazards associated with high speed drilling machinery.

The extraordinary demands made on the petroleum industry during World War II and the equal demands of the postwar period of rehabilitation and cold war, have had the inevitable result of greatly increasing the pace of the industry. It has been necessary to expand into even more difficult territory. It has been necessary to change operation techniques so that existing facilities could be utilized far beyond their design capacity. The efficiency of all operations has been markedly increased. Many of the changes have been possible only by the efficient and flexible communication made possible by radio.

The Federal Communications Commission, in its General Allocation Proceedings, established the Petroleum Radio Service on July 1, 1949. The Commission thereby regularized the various special petroleum radio services they had established from time to time and made possible a coordinated, long-range expansion of the Petroleum Radio Service to meet the essential needs of the industry. A description of the many and varied uses of Petroleum Radio and of the operations it has made possible, accounts of lives that it has saved, damage to property that it has minimized and economies it has effected are interesting but only indirectly relevant to this hearing. We illustrate here the rapid rate of growth of the Petroleum Radio Service from less than 5000 transmitters in 1949 to over 22,000 today. (Chart No. 2) This growth has far exceeded even the most extreme predictions of those in the industry. It has been possible to accommodate this large number of users on relatively few channels only by the closer possible coordination within the industry and by a fine spirit of cooperation between the industry and the Commission's Bureau of Safety and Special Radio Services. The National Petroleum Radio Frequency Coordinating Association through its seven Regional Coordinating Committees makes an engineering study of the frequency problems involved in each application and makes recommendations to the applicants of the frequencies which will result in minimum interference. The association has developed a model operating procedure manual as a guide to the individual users in making the most efficient use of their radio systems. The Association and this Committee have encouraged the development and use of improved equipment and are now engaged in studies that may materially reduce the present congestion on many channels. The industry both as individual users and as represented by their Association and Committee have shown an exceptional willingness to pioneer in the adoption of new developments that offer the possibility of more efficient utilization of the radio spectrum. The individual companies have made large investments for such purposes and will continue to do so.

Industry Cooperation Program

The Petroleum and Natural Gas Industries have in characteristic fashion set about to provide the means for dealing with petroleum radio owners through effective industry cooperation. To this end there has been created within the Division of Transportation of the American Petroleum Institute a Central Committee on Radio Facilities.

The Central Committee on Radio Facilities was established in the Division of Transportation as a result of recommendations made to the General Committee of the Division. The General Committee approved these recommendations and so reported to the Board of Directors. The Board authorized the formation of the Committee on April 23, 1947, and a temporary Committee was appointed a few days later. The first permanent Central Committee on Radio Facilities was appointed on September 4, 1947, and the Committee met for the first time on November 9, 1947, in Chicago. Annual meetings of the Committee have been held in 1948, 1949, 1950, and 1951, and interim meetings between the annual meetings have also been held in Washington, St. Louis, and Kansas City. Dr. Wm. M. Rust now serves as Chairman of this Committee.

In order to deal with frequency coordinating problems and to carry out effectively the Federal Communications Commission requirements for coordinating the use of frequencies which have been assigned on a shared basis, the Petroleum and Natural Gas Industries also created the National Petroleum Radio Frequency Coordinating Association. This group has been, and continues to be, of great technical assistance to the Commission and is doing increasingly important work through its seven regional organizations in the field of frequency coordination. The Association deals effectively with all of those techniques which make for the more effective and efficient use of existing facilities. Chairman H. A. Rhodes of the Transcontinental Pipe Line Company, who is also Chairman of your

Petroleum Industry Electrical Association Conference this year, serves as the Chairman of the National Petroleum Radio Frequency Coordinating Association. He has served in this capacity ever since its organization and I desire to pay tribute at this time to the fine work which he has done. I also want to mention the outstanding work done by Mr. F. W. Littell as the first Chairman of the Central Committee on Radio Facilities I would be certainly remiss if I were not also to give testimony to the fine work being done by Dr. William M. Rust of the Humble Oil and Refining Company, who now serves as Chairman of this Committee.

Radio continues to be adopted by the petroleum industry at an increasingly fast rate. A review of the various committees working under the Central Committee on Radio Facilities gives some idea of the scope of petroleum and natural gas industry use. The Central Committee has within its organization a Committee on Radio Engineering, a Committee on Radio Coordination, a Committee on Geophysical Use of Radio, a Committee on the Use of Radio in Oil Production, a Committee on Pipeline Use of Radio, a Committee on Maritime Use of Radio, and a Committee on Refinery Use of Radio. The most dramatic use of radio within the last two years has been that made by the Petroleum and Natural Gas pipelines.

Pipeline Microwave Usage

The willingness to make heavy investments in a pioneering effort, fully aware of the risks and difficulties implicit in the installation of practically untested equipment, is perhaps most spectacularly demonstrated by the pipelines' installation of microwave facilities. As striking and even daring as this was in the so-called "2000 megacycle" band (1850-1890 mc), it was far more so in the "6000 megacycle" band (6516-6875 mc). Our chart shows the routes of the microwave systems actually existing or under construction. (Chart) These systems are operated by twenty-two different companies. The systems shown on the chart total 14,584 system miles* and represent an investment of over seventeen million dollars. (Chart No. 3)

In considering these figures there are several factors that must be kept in mind. First, although the pipeline industry is over 80 years old, the suitable microwave facilities have been available to them only since 1948. The systems shown, which exceed all other microwave systems combined, including common carrier relay, by 50 per cent, represent only three years' growth.

Second, every installation has been in fact a development project in which both the purchaser and manufacturer invested money and engineering talents to determine what the actual propagation facts are, what tolerances of electrical systems and mechanical structures are sound, what tube life could be expected under actual conditions and the myriad of other vital factors that could at best be only estimated on the basis of laboratory and small scale field tests. By no means all of these problems have yet been solved. But the pipelines and the

* The circuit miles are many times this figure since a microwave system makes many circuits available on a single channel.

manufacturers are making important contributions to radio engineering knowledge and will continue to do so.

Third, all existing pipelines have communication systems and the designers of new pipelines all have experience with the conventional pipeline communications systems. Thus the new pipeline that decides to employ microwave facilities or the existing pipeline that decides to replace a conventional system by a microwave system, must be firmly convinced that the microwave system will have very real advantages in the efficient operation of the pipeline. Sound business practices give heavy weight to the use of tried and proved methods. The widespread adoption of microwaves by the pipeline companies, in the face of these adverse considerations,is the most eloquent argument in favor of the thesis that microwave facilities are peculiarly adapted to contribute very substantially to efficient pipeline operations.

The companies who now have microwave facilities are sound companies with sound engineering departments and sound management. Their choice of microwave facilities is the result of careful study. These twenty-two companies represent a plant investment of some three billion dollars. Through their eighty thousand miles of pipelines they pump crude oil, products and natural gas valued at some four billion dollars per year. They include ten of the twenty pipelines considered by the American Gas Association to be major interstate gas transmission lines. These companies now have some first-hand experience with microwave facilities. On the basis of this experience, they are currently proposing additional microwave installations that will more than double their microwave systems, measured either in system miles or in dollars invested.

These twenty-two companies represent only a fourth to a third of the existing pipelines. It requires no imagination to see that many of the other companies will experience a continuing demand that they utilize their facilities even more effectively than they do today. This will inevitably mean that their needs for communications will be greater and more stringent. This will result in the installation of microwave facilities by many of these companies with the inestimable contribution to national defense and to every segment of the national economy which such installations make possible.

Competition for Radio Facilities

Important as are the uses of radio by the petroleum and natural gas industries, it must be understood that it is not possible to obtain all of the radio spectrum space which can be used by these industries. The competition for frequencies is intense and continuing and this must be recognized by all of the users within the Petroleum Radio Service as established by the Federal Communications Commission.

During the Federal Communications Commission's fiscal year 1952, the number of radio authorizations on the books of the communications regulatory agency exceeded the 1,000,000 makr. It was pointed out that 45 times more non-broadcast stations than broadcast stations exist which are "equally important to the public interest and convenience." In other words, "more than 200,000 radio authorizations are held by public agencies and by private industry and individuals as compared with less than 5000 stations engaged in program broadcast." The broadcast total includes about 1200 engaged in program broadcast. The broadcast total includes about 1200 pick-up and studio-transmitter links, while the safety and special radio services collectively represent nearly 540,000 transmitters operating on land, sea and in the air.

The Federal Communications Commission stated that the growing interest in the safety and special radio services "is attended by the fact that more than 141,000 applications were received during the fiscal year, 1952, which was 34,000 more than in the year previous and 48,000 more than in fiscal year 1950." The Petroleum Radio Service is competing for frequencies against this background. The Service is a part of the Safety and Special Radio Services Bureau of the Federal Communications and, in turn, this service is a part of the Industrial Service.

Theatre Television Hearing

The Federal Communications Commission is currently considering in Docket No. 9552, a request by the Motion Picture Association of America and the National Theatre Television Committee for the creation of a Theatre Television Service. This proposed service constitutes a grave threat to the use of microwave facilities now being made by the Petroleum and Natural Gas Industries.

The great bulk of the fixed stations currently operated in the Petroleum Radio Service are within the 952 to 960 mc., 1850 to 1990 mc. and 6575 to 6875 mc. bands. Accordingly, the Central Committee is strongly opposed to the proposal reported in the Commission's release of January 31, proposing that theatre television might use frequencies between 5675 and 7125 megacycles. The Central Committee wishes to further point out that the reason for the Petroleum Industry's failure to utilize the other frequencies listed in Part II.303(b) has been the unavailability of proper equipment, a condition which, it is anticipated, will be remedied in the near future.

Realizing the importance of this matter to both of these industries the Central Committee on Radio Facilities filed with the Federal Communications Commission a Statement and Notice of Appearance in the Theatre Television Hearing for the purpose of contesting any possible encroachment on the frequencies presently assigned to the Petroleum Radio Service.

The Central Committee on Radio Facilities of the American Petroleum Institute together with the National Petroleum Radio Frequency Coordinating Association represent every user in the

Petroleum Radio Service. In this hearing, only the pipelines carrying crude petroleum, products and natural gas are immediately concerned. Each of these users has been individually contacted and they are in unanimous agreement with the basic position of this Committee.

It is not within the scope of this Committee to consider whether the establishment of a Theatre Television Service would serve the public interest. But the two proposals set forth in the Notice dated November 12, 1952, in this Docket, both are of vital interest to the pipelines now using microwave facilities and to those additional pipelines who will urgently need microwave facilities in the near future. Nor is the danger implicit in these proposals confined only to the pipelines. Every gallon of crude oil and every cubic foot of natural gas is at some stage moved through a pipeline. Any threat to the pipelines is thus a threat to the entire petroleum industry. Therefore, this Committee in opposing these proposals and any alternative proposal that would jeopardize the pipeline use of microwave facilities, represents the entire petroleum and natural gas industry.

An unfavorable outcome of these proceedings would inflict such serious damage upon the petroleum industry and upon the public that we feel a full presentation of the industry's position is essential. We have a group of witnesses who will discuss the various phases. The general statement will deal principally with statistics covering three points. First, the importance of petroleum and natural gas to industry, the public and defense. Second, the use of radio in the petroleum industry. Third, the pipeline use of microwave facilities.

The second witness will describe the operation of a petroleum product pipeline with particular detail on the role of communications and the unique suitability of microwave facilities.

The third witness will give an analogous discussion of the somewhat different problems of a crude oil pipeline.

The fourth witness will cover the quite different problems of natural gas transmission lines and the problems of frequency coordination between different users.

The fifth witness will describe the use of microwave facilities for the remote control of a pipeline booster pump station. This is one example of the numerous new uses of microwave facilities that will benefit the public by making the pipeline operations more efficient.

The sixth witness has already presented an analysis of the engineering features pertinent to this proceeding in the hearing before the Commission.

On February 27, the Motion Picture Association of America and the National Exhibitors Theatre Television Committee stated that if theatre TV limited common carriers, eligible for use of existing common carrier fixed frequencies, are authorized under certain conditions, they would have no objection to dismissal of their theatre TV frequency allocation request.

MPAA-NETTC requested the Commission to issue "a statement of policy designed to make clear (a) that the Commission will expect all common carriers utilizing the common carrier frequency allocations to cooperate in the resolution of conflicts pertaining to the utilization of those frequencies through advance joint consultation, (b) that it will expect interconnection of the facilities of such common carriers with respect to channels suitable for theatre television transmission purposes where frequency usage conflicts must be resolved, either by the parties or by the Commission, in favor of the general common carriers, and (c) that in such cases the general common carriers will be expected to provide facilities technically equivalent to those of the theatre television carrier with which interconnection is desirable."

This action was taken two days after the request by Western Union Telegraph Company for inclusion in the theatre television case of an issue on physical interconnection of common carriers' theatre TV channels, in the event the Commission decided the service should be established on a commoncarrier basis, was turned down by the Federal Communications Commission and the Commission ruled that the Western Union plea, joined in by MPAA-NETTC,was "not germane" to the pending frequency allocation case and was "prematurely raised." The Commission added that the telegraph company may seek the relief requested in an appropriate separate case, subject to final disposition of the petition for reargument of the Commission decision refusing to require the Bell System to interconnect its intercity television network channels with those of Western Union.

The Commission will act on this petition before proceeding with any further hearings in the matter.

Party In Interest Ruling

In a Memorandum Opinion and Order, the Federal Communications Commission has issued its first interpretation of the new Section 309(c) of the Communications Act, insofar as it relates to authorizations in the Safety & Special Radio Services. Section 309(c) provides that "When any instrument of authorization is granted by the Commission without a hearing as provided in Sub-section (a) hereof, such grant shall remain subject to protest as hereinafter provided for a period of thirty days. During such thirty-day period, any party in interest may file a protest under oath directed to such grant and request a hearing on said application so granted."

In previous decisions, the Commission has stated that the legislative history of Section 309(c) restricts "parties in interest" from an economic standpoint to those "defined by the Supreme Court decision in the Sanders case." By the decision in the case of

Federal Communications Commission vs. Sanders Bros. Radio Station, 309 U.S. 470, if any party can show that he will suffer economic injury from a grant, he is a "party in interest" and has standing to protest a grant.

On March 9, the Yellow Cab Company of Chicago, Illinois, filed a protest with the Commission directed against the action of the Commission of February 27, granting an application of Service Livery, Inc., of Chicago, for a construction permit and station license to operate a station in the Taxicab Radio Service. The Yellow Cab Company claimed that it is a party in interest within the meaning of Section 309(c), on the ground that as a taxicab company doing business in Chicago in competition with the business of Service Livery, Inc., it will suffer substantial and direct financial injury from the grant of a radio license to Service Livery, Inc.

In the Memorandum Opinion and Order, referred to above, the Commission decided that the Yellow Cab Company was not a party in interest within the meaning of Section 309(c), and dismissed the protest. The Commission's decision that this license in the Safety & Special Radio Services cannot make the showing of economic injury required to give him standing to protest a grant by the Commission to another applicant is based upon the fact that (1) such a licensee uses radio only as an incident to a primary business in which he is already engaged, and (2) the frequencies allocated are available only on a shared basis by all users.

Chairman Walker and Commissioner Hennock dissented to the ruling. The latter issued a dissenting statement in which she stated that "The limitation imposed by the Commission in this case with respect to who is a 'party in interest' runs counter to the language and to any reasonable interpretation of the Communications Act, as well as counter to the basic rationale of the Sanders case. That radio is not the primary business of these parties and that the license here under challenge is an adjunct rather than the essence of the competition between them is a distinction without a substantial difference."

The decision in this case is important and of the utmost interest to all petroleum licensees, not only as the first interpretation of Section 309(c) as it relates to the Safety & Special Radio Services, but also as an indication of the increased formality and competition which may be expected in the non-broadcast radio services.

Construction Permit Waver

FCC Chairman Paul A. Walker sought relief from a twenty-five year old provision of the 1934 Communications Act and its predecessor in radio regulation - the Federal Radio Act of 1927 - in letters to the Senate and House of Representatives urging the abolition of the construction permit for all mobile radio stations and the waiving of the construction permit requirements by Commission discretion in the other non-broadcast radio fields. The recommendation would require amendment of the Communications Act and has been referred to the Senate and House Committees on Interstate and Foreign Commerce. A similar suggestion was sent by the Commission to the 82nd Congress and was never acted upon. The amendment would mean little immediate change in present Federal Communications Commission practices. The Commission is presently issuing combination construction permits and licenses for certain classes of non-broadcast stations, particularly in the safety and special radio services.

The Federal Communications Commission recommended that the amended Act provide that no waiver be applicable to any fixed or base station whose construction is begun prior to the effective date of the waiver. This was done in order that the basic aim of the section be maintained - the prevention of improper pressure on the Federal Communications Commission by applicants for licenses who have already expended substantial sums in the construction of their stations.

"By far the most important of the Commission's functions" in the safety and special area, he stated, "is the allocation of frequencies to new services as they are developed and the promulgation of rules and regulations to permit the use of the new services." If the rules and regulations are current in the safety and special field, he said, "application processing becomes a routine clerical problem... If the rules lag behind developments, then it is no longer possible to treat applications in a routine manner and the whole regulatory machinery bogs down."

New Commissioner Appointed

On March 20, President Eisenhower sent the name of Chairman John C. Doerfer, of the Wisconsin Public Service Commission, to the Senate for confirmation as the third Republican member of the Federal Commission. Mr. Doerfer will fill the unexpired term of former Commissioner Robert F. Jones, who resigned from the Federal Communications Commission last fall, and his confirmation is virtually assured. The term, which runs until July 1, 1954, has, in the meantime, been filled by Commissioner Eugene H. Merrill, a Democrat recess appointee of former President Truman. With Mr. Doerfer, the Commission will stand at three Republicans, three Democrats and one Independent. The term of Chairman Paul A. Walker, a Democrat, runs until June 30. Commissioner Doerfer's appointment was confirmed by the Senate Committee April 1st and he has been sworn in. Commissioner Rosel H. Hyde has been named Chairman of the Commission by President Eisenhower.

FM Multiplexing

A request was filed with the Commission for approval to use supplemental communication channels derived from multiplexing of FM broadcast stations' signals for a variety of suggested purposes, including administrative communications of FM networks, one-way public, industrial, or land transportation signaling services, and emergency channels for use by public authorities and for national defense. This is in line with a petition filed by the Multiplex Development Corporation two and one-half years ago. No FCC action was ever taken on the petition but it was stated that there has been substantial engineering improvement of the Multiplex Development Corporation equipment which makes possible the derivation of the additional channels without degradation of the FM broadcast signal.

Antenna Tower Lighting

The November proposal amending its Rules concerning the construction, marking and lighting of antenna towers and supporting structures has been finalized by the F.C.C. The specifications for marking and lighting of guy wires have been deleted and the new Rules became effective March 30. The F. C. C. approved the optional use of transmitter cards to be made of metal or plastic and all information contained on the FCC cards with the exception of the signature must be shown on the permanent tags.

F.C.C. Backlog

There continues to be a serious backlog of pending applications before the Bureau of Safety and Special Services at the Commission. This results from inadequate appropriations which in turn are reflected in a critically reduced staff to handle the greatest volume of applications in the history of the Commission. President Eisenhower's budget now calls for a further Staff reduction of twenty persons in the Bureau.

Starting with the February statistics a change in the method of tabulating the number of applications received, disposed of, and still pending with the FCC's Safety and Special Radio Services Bureau has been initiated. Under the new method, a request for a combination construction permit and license is counted as only one application, instead of two. In the February statistics the figures for pending cases at the beginning of the month, totalling 14,751, still reflect the old method of counting but all other figures were reached under the new method.

Categories of Service	Received-Disposed of During February		Pending Actions Beginning-End	
Petroleum	129	405	690	414
Total Safety and Special Services	11,229	11,744	14,751	14,236

2398 KC Frequency

A new frequency - 2398 kilocycles - would, under an F.C.C. rule proposal be added for assignment to industrial radio operations, excepting the relay press and low power industrial services, on a shared-usage basis. The frequency would be available to the power, petroleum, forest products, motion picture, and special industrial radio services, and the move is in line with the international radio agreement reached at the Extraordinary Administrative Radio Conference in Geneva, in 1951. It was stated, however, that the use of the frequency "is subject to the condition that harmful interference shall not be caused to the service of any station not in those services which, in the discretion of the Commission, may have priority on the frequency or frequencies used for the service to which interference is caused," and accordingly, 2398 kilocycles may not be available for industrial assignment "in all cases or at all locations where its use is desired."

Radiolocation Service

The Federal Communications Commission has adopted new rules providing for the allocation of frequencies in the 1750-1800 kilocycle band to the Radiolocation service on a developmental basis. Development on a regular basis of the new service is expected to be accelerated in the immediate future, with Congressional action as to whether the states may have jurisdiction over the submerged oilfields possibly touching off a spurt in radiolocation activity in the petroleum industry.

Two applicants have already begun service within the Radiolocation Service, one by a Seismograph Service Corporation of Tulsa and one by Offshore Radist, Incorporated, of New Orleans, Louisiana.

The Federal Communications Commission issued special temporary authority until April 17 for the use of three frequencies in connection with a special off-shore drilling operation in the Gulf of Mexico by the Phillips Petroleum Company to Raydist Navigation Corporation. The three frequencies, 2398 and 4805 kilocycles and 40.42 megacycles, will be used in a system to experimentally determine the feasibility of using phase measuring techniques to accurately maintain two vessels within one-half mile of each other during the operation. Other methods to maintain the distance between the two vessels have been unsuccessful.

Emergency Standby Facilities

The finalized amendments affect the special emergency rules by providing emergency stand-by radio facilities for private as well as common carrier communication circuit operators for use during periods of failure of the normal circuits. It was stated that in the case of the private operators, this facility is restricted to circuits which normally carry essential communications which, if disrupted, would endanger life or public property. The Central Committee had requested this provision. Ten interested parties and organizations filed written comments on the proposal with the Commission, including the Central Committee on Radio Facilities of the American Petroleum Institute.

Any person or organization operating communication circuits is eligible, under the revised edition of the rules, for special emergency stand-by facilities if (1) the applicant is a communications common carrier or (2) the applicant is a person or organization operating communications circuits which normally carry essential communications of such a nature that any disruption thereof will endanger life or public property.

McFarland Act Report

In response to the McFarland Act's requirement that a report be sent to Congress of the cases which have been pending for specified periods without final action, the Federal Communications Commission sent a 95-page listing, nearly three-quarters of which was devoted to AM, FM, and television broadcast proceedings on January 29. The Safety and Special Services listing was the shortest, about five pages. About eight pages of common carrier matters were shown, and in almost all instances, the reason given for the delay was "awaiting information", "frequency clearance", "rule-making", "not reached for processing", etc.

Non-Government Fixed Frequency Use

The Commission amended its rules governing the railroad, power, petroleum, forest products and special industrial radio services regarding the assignment of government frequencies to non-government fixed stations under certain circumstances. In instances where the Commission finds, after consulting with government agencies, that the assignments are necessary for intercommunication with government stations, or required for coordination with government activities, frequencies may be assigned to non-government fixed operations under the new rules. A number of hydrological and meteorological frequencies which may be assigned to non-government stations are shown in Part 2 of the Rules. The changes are effective immediately, and since they involve only codification and clarification of existing policy, they were issued by the Commission in final form without going through the proposed rule procedure.

Shoran

The Joint Communications-Electronics Committee of the Joint Chiefs of Staff has approved another extension of the use of three military frequencies for Shoran operations in oil exploration. After hearing from American Petroleum Institute Special Representative, the Committee, which was opposed to the extension, reversed its stand and authorized the use of the frequencies, pending Federal Communications Commission approval, until July 1, when the industry expects to have the 1750-1800 kilocycle equipment in full operation. It was pointed out that the six-month extension is for the frequencies 230, 250 and 310 megacycles only, when used off the coast of Southern California, off the Texas coast from Point Bolivar to the Mexican border, off the southwest coast of Florida in the Everglades area from Romano to Marquesas Key, and in the Gulf of Mexico Air Force bombing range forty miles out into the Gulf, south of Cameron Parish, Louisiana.

The Central Committee on Radio F cilities is presently arranging to ask the Joint Chiefs for a further extension beyond July 1, 1953, of the use of these important radio frequencies.

A list of special conditions to be observed in using the frequencies was signed by Rear Admiral John R. Redman, USN, Chairman of the Joint Committee. It was pointed out that the hours of use of the three frequencies may be restricted when they conflict with military operations; that in the event two or more companies require the use of the frequencies in the same general area, it will be necessary for them to work out time-sharing arrangements; and that should the use of the frequencies "prove impracticable in any area for any reason", it will be necessary to terminate their use and employ some other means of "horizontal control for oil exploration work."

20 KC Operation

Both the Central Committee and the National Petroleum Radio Frequency Coordinating Association are continuing to explore the possibility of 20 Kilocycle separation operation.

The Federal Communications Commission granted authorization to the Western Natural Gas Company to establish a nine base station, thirty mobile unit petroleum radio service communications system using split-channel radio facilities. At the expiration of the grant, December 29, 1953, the company is to submit a detailed report on the feasibility of operation on the 20 kilocycle basis in the 50 megacycle portion of the spectrum. The system authorized a total of nine base stations near Rockport, Mirando City, Nursery, Oakville, Houston and Edinburg and at temporary locations in southern and southwestern Texas, and for thirty mobile units on 49.00 megacycles, which is midway between petroleum channels 48.98 and 49.02 megacycles, and was approved primarily for the purpose of accumulating performance test data on narrow-band operation.

Section 319 Interpretation

In a recent decision, Section 319 of the Communications Act of 1934 has been literally interpreted and applied by the Federal Communications Commission. Section 319 reads in part as follows:

"No license shall be issued under the authority of this Act for the operation of any station the construction of which is begun or is continued after this Act takes effect unless a permit for its construction has been granted by the Commission."

In granting a construction permit for a new television broadcast station to TV Colorado, Inc., Colorado Springs, Colorado, the Commission stated that "because Section 319 of the Communications Act precludes the Commission from licensing a station, the construction of which is begun before a construction permit has been issued, the Commission is stipulating that TV Colorado, Inc. not use a transmitter building and 3 piers for antenna supports which it erected prior to this authorization."

New Form 400

A conference was held by the Federal Communications Commission's Staff with manufacturers' representatives in Washington, D. C. in order to facilitate the transition from the present radio station application forms to the new Form 400. This new form went into effect during the first part of January. This new form will affect applications in the public safety, industrial and land transportation radio services.

FCC Staff members explained the new forms and described the procedure involved in filling them out. The meeting was open to anyone likely to come into contact with the new forms and in addition to manufacturers representatives, it was aimed at all present and prospective users of mobile, base or fixed installations in the three radio service groups.

National Petroleum Council Report

In response to a request from H. A. Stewart, Acting Director of the Oil & Gas Division of the Department of the Interior, Walter S. Hallanan, Chairman of the National Petroleum Council appointed a petroleum industry committee to study the use of radio and radar in the oil and gas industries in connection with defense planning. Mr. Stewart said that "the use of radio and radar in the oil and gas industries has greatly increased during the past few years and the industries are becoming increasingly dependent on these for dependable day-to-day operation and this is especially true in oil and gas pipe line operations.

"Many of the frequency channels allocated for the use of the oil and gas industries are basically reserved to the military and are licensed under such reservation. It therefore would be desirable to have a study made of the present extent of the use of radio and radar in the oil and gas industries, the possibility of use of alternates in extreme emergencies and the degree to which the national security and defense might be affected if the radio channels were taken over by the military."

The petroleum radio service users were classed as essential operators, and will probably be allowed to remain on the air even during national emergencies. Some phases of the petroleum communications problems have been studied. Mr. Stewart said "an authoritative, comprehensive and up-to-date study and report by the National Petroleum Council would be particularly valuable to the Petroleum Administration for Defense and to the Federal Communications Commission."

Mr F. W. Littell, of Shell Pipe Line Corporation will head the committee and other officers of the group are J. A. Polhemus, Jr., Standard Oil Company of California, Vice-Chairman; and Joseph E. Keller, Washington, D. C., secretary.

Committee members include F. S. Bird, The California Company; Weldon Brigance, Rowan Drilling Company; W. T. Bulla, Natural Gas Pipeline Company of America; Robert Gray, Ashland Oil and Refining Company; Carl L. Lathrop, Standard Oil Development Corporation; W. M. Rust, Jr., Humble Oil and Refining Company; Chet F. Whaley, Chet F. Whaley Well Servicing Company; and R. D. Wyckoff, Gulf Research & Development Company.

Progress reports have been made at both the December and February meeting of the National Petroleum Council in Washington. It is hoped to have the full report available for presentation at the May meeting of the Council.

72-76 Megacycle Usage

Filings with the F.C.C. on the Commission's proposal to adopt a new policy governing the assignment of frequencies for point-to-point communications in the 72-76 megacycle frequency band have indicated extreme interest in this problem by communications users who are occupying the band now or who are intending to do so in the future. The proposal would allow the maximum use of the 72-76 megacycle band for point-to-point communications and at the same time give adequate protection from interference to television stations on Channels 4 and 5.

On February 20, the Engineering Department of the Radio-Television Manufacturers Association submitted a report to the Federal Communications Commission dealing with television receiver susceptibility on Channels 4 and 5 to interference from point-to-point communications stations operating in the 72-76 megacycle frequency band. The comments were filed on the deadline, which had been extended to that date, and established a new policy governing the assignment of frequencies in the 72-76 megacycle band to operational fixed stations and fixed stations in the domestic fixed public service.

At the same time the Radio Service Corporation of Utah, licensee of KSL-TV, Channel 5, in Salt Lake City requested the deadline to be put off for another thirty days in order to complete a field study which "will be helpful to the Commission in demonstrating actual conditions resulting from adjacent operation of TV and fixed stations."

The RTMA report offers two suggested methods by which a given percentage of interference from a fixed station to the TV receiver may be determined for use in establishing rules for this operation differing from those outlined by the Commission in the respect that more factors, such as antenna directivity patterns, station powers, antenna heights and direction of receiving sites are considered. Columbia Broadcasting System stated because the interference would be destructive to television operations, the Commission-proposed criteria for assignment of fixed frequencies in the 72-76 megacycle band should not be adopted and proposed a molified basis for assignment which, it stated, would result in a more limited amount of interference." CBS suggested several changes in the Commission's proposal and said that "taking both the shape and extent of interference areas into account, it is believed impractical to operate fixed stations within 100 miles of a television station on a closely adjacent frequency."

The Central Committee on Radio Facilities is planning to file an additional statement with the Commission in this matter by April 13. The Committee hopes to illustrate in this further statement some experience actually had to illustrate that workable authorizations for 72-76 megacycle fixed stations, even in areas that are protected for TV Channels 4 and 5. Engineering information can also be developed which will demonstrate the manner in which this can be accomplished. There is a possibility that the Commission will continue to hold this docket open to receive this additional information.

Semi-Annual Meetings in June

The Central Committee on Radio Facilities will hold its semi-annual meeting at the Mayflower Hotel, Washington, D. C. on Wednesday, June 24, 1953. The National Petroleum Radio Frequency Co-Ordinating Association will hold its annual meeting at the same place the following day, June 25, 1953. The meetings are being held in order to permit members of both groups to attend both meetings if they desire. The agenda for the Central Committee's meeting contains a number of very important items and it is expected that a large attendance will be present for this meeting.

The Washington section of the Professional Group on Vehicular Communications is arranging a group symposium for Tuesday evening, June 23rd, on the subject of "Microwave and VHF Communication Integration" in the hope that a number of those who plan to attend the Central Committee meeting will also be able to be present for this interesting symposium. It is planned to have a luncheon for members of the Federal Communications Commission and Commission Staff members in connection with the semi-annual meeting and a new movie on microwave usage in the petroleum industry will be shown at that time. Reservations should be made direct to Hotel Mayflower and should be made before June 15th, as the hotel is holding a block of rooms for Committee members until that date. Further details concerning the meeting will be sent to all members of the Central Committee.

Basic Radio Propagation Predictions

The CRPL Series D, Basic Radio Propagation Predictions, is issued monthly as an aid in the determination of the best sky-wave frequencies over any path at any time of day for average conditions for the month of prediction, three months in advance. Charts of extraordinary-wave critical frequency for the F2 layer, of maximum usable frequency for a transmission distance of 4000 km, and of percentage of time occurrence for transmission by sporadic E in excess of 15 Mc, for a distance of 2,000 km, are included. The annual subscription for 12 issues is $1.00 and subscriptions, remittances, and all inquiries relating thereto, to be forwarded to the Superintendent of Documents, U. S. Government Printing Office, Washington, 25, D. C.

FM Frequency Band Usage

Jerry S. Stover, of the Communications Engineering Company, has suggested that FM broadcasting bands, between 88 and 108 megacycles, be used as possible areas for the establishment of fixed radio systems.

"In most parts of the United States at the present time", he said, "there are entire megacycles between 88 and 108 megacycles that are unoccupied. Contracting with other frequency bands of the spectrum, occupancy of the 88-108 megacycle band is diminishing, rather than increasing. It is paradoxical for such entire megacycles of spectrum space to be left vacant, while eligible services are being denied similar frequencies. It is believed that the use of carefully selected frequencies in the 88-108 megacycle band would provide a means of establishing fixed services, without causing interference to the broadcast services."

"Due to the lack of occupancy of the 88-108 megacycle band", Mr. Stover said, "particularly in remote areas where the lower, longer range, fixed frequencies are required, it is possible to find many frequencies that are a full megacycle or more from an FM broadcast station within a hundred miles or more. Upon establishment of the necessary frequency 'guard'", he suggested, "grants for fixed stations could be made in the 88-108 megacycle band subject to restrictions similar to those proposed for the 72-76 megacycle band." Present 72-76 megacycle equipment, he emphasized, "either in use or in production, can be modified with little expense to operation in the 88-108 megacycle band."

Joint Technical Advisory Committee Study

The Joint Technical Advisory Committee, established jointly by the Institute of Radio Engineers and the Radio-Television Manufacturers Association, was asked by the Federal Communications Commission to supplement its recently published report on "Radio Spectrum Conservation" with an additional study of "certain problems relating to spurious radiations from transmitters and receiver emissions and inadequate selectivity."

The Commission stated that the report is a "substantial effort" and a "worthwhile contribution to the understanding of the radio service allocations problems faced by the Commission and other agencies." A five-step study which it said would be a "useful supplement" in achieving "effective conservation of the radio spectrum" was outlined.

The questions posed for study by JTAC are: (1) the limits which should be established for radiations, which are incidental to the operation of equipment and which do not fall within allocated frequency bands, to assure safe and reasonable protection from interference to radio broadcasting, communication and navigation services; (2) the technical problem of reducing spurious radiation from various devices to determine the feasibility of the suppression measures necessary to accomplish the radiation limitations determined under Item 1; (3) the problem of instrumentation necessary to effectuate a national program of the control of spurious radiations, considering the practical problems of quantity control measurements for the factory and simple tests which can be applied in the field to completed installations; (4) the procedures and organizational activity in this field to determine whether additional effort is required to coordinate interference reduction efforts; and (5) any needed action to coordinate the external performance of receivers with the engineering of service and station allocations.

Progress reports have been made at both the December and February meeting of the National Petroleum Council in Washington. It is hoped to have the full report available for presentation at the May meeting of the Council.

450-460 Megacycle Rules

The Federal Communications Commission rearranged the 450-460 megacycle frequency band to provide greater flexibility in assignments for five service classes: the domestic public, remote pickup broadcast, industrial, land transportation and public safety radio services. The proposed revision would provide more separation between assignable frequencies without changing the total allocations.

With the VHF frequencies so heavily used, the 450 megacycle band is seen as the next move and some services, particularly the taxicab radio users, have already begun expanding into the UHF band with considerable speed. The Commission's move is a step toward facilitating orderly growth of the band. It appears that the 450-460 megacycle frequencies are suitable for land mobile communications systems, at least in urban areas. It also appears that the direct range between mobile units "is quite short when compared to that obtained with similar installations in the 25-50 megacycle and the 152-174 megacycle bands." One method of overcoming this is to permit automatic relaying between the mobile units via a mobile relay station. Since it is necessary to transmit and receive simultaneously at such stations, the present allocation makes it difficult to consider making provision for this type of operation by those who may desire it. The proposed change makes future consideration of this solution more practical.

The proposed change would appear to eliminate the lack of adequate frequency separation between the base and mobile station frequencies which has retarded development of public service in this band. It was suggested that the change should be made as quickly as possible to minimize the inconvenience and cost involved, since commercial equipment suitable for land mobile service in the 450-460 megacycle band is becoming available in quantity and a change in allocations of the type proposed will require that many of the existing users of the band ultimately change frequencies. The proposal, in its present form, will result in the least number of changes. Where the presently assigned frequency becomes unavailable for continued use as a result of the allocation revisions, the permittees and licensees of stations in the 450-460 megacycle band will be allowed one year from the date of final action to change frequency. An example: - the 453.85 megacycle assignment which currently is available to the automobile emergency service but which, under the proposal, will fall in the public safety category.

Channeling 952-960 Megacycle Frequencies

Some action can be expected within the next two or three weeks on the channeling system for operational fixed stations in the 952-960 megacycles frequency band. Operational fixed stations, not open to public correspondence, are operated by and for the sole use of those agencies operating their own radiocommunication facilities in the public safety, industrial, land transportation, marine or aviation radio services.

Trade Publication Information

In an effort to keep the industry fully informed concerning all developments in the Petroleum Radio Service, the Central Committee is making information available on a weekly and monthly basis to leading trade publications in the petroleum industry. Monthly articles are prepared for "Electrical News", published by the

Petroleum Industry Electrical Association, the "Pipe Line News", "Communications Engineering", "Telegraph and Telephone Age" and weekly bulletins are furnished also the Oil and Gas Journal, Oilgram and National Petroleum News. At the same time, the Central Committee is maintaining close liaison with other industrial users of radio facilities with whom certain frequencies are shared, including the National Forest Industries Communications and National Committee for Utilities Radio.

Maritime Uses of Radio

Thus far we have made little mention of the maritime uses of radio but this is one of the oldest forms of usage and certainly one that is very important to the petroleum industry. In this connection much work is done by the Central Committee through the Radio Technical Commission for Marine Services.

The RTCM 1953 Spring Assembly Meeting is being held in Washington, D. C., on April 20-21-22nd at the Wardman Park Hotel. The theme for the meeting is "Application of Electronics to Marine Safety" with emphasis on the reduction of marine hazards. The business meeting will be held Monday morning. An important part of the business meeting will be a summary of the active work of RTCM presented in the form of reports by the Chairman of each of the active special committees. Each report will be brief, but taken together the reports still constitute a comprehensive description of the present activities of the organization.

Three technical sessions will be held, one during the afternoon of the first day and the other two during the morning and afternoon sessions on the second day, respectively. The three technical sessions will be responsive to the general theme of the meeting namely "Application of Electronics to Marine Safety", and will cover this subject in three separate but related phases.

Proposed Use of 156.5 MC on Great Lakes

By Notice of Proposed Rule Making, the Commission looks toward amending Parts 7 and 8 of its maritime rules to designate the frequency 156.5 megacycles in the Great Lakes area as a standardized radiotelephone channel for business and operational short-distance communication between limited coast stations and commercial and governmental vessels which navigate outside or between harbors or ports. This proposal is based upon a petition filed by the Lake Carriers' Association requesting that there be the same provision on the Great Lakes for business and operational communication between commercial transport vessels and government vessels navigated primarily between separate harbors and ports and shore points as is provided for these types of vessels in other areas. Comments may be filed on or before April 15, 1953.

5500-5550 KC Excluded From Use by Maritime Mobile Stations

The Commission finalized its proposal of December 23, 1952, amending Parts 2, 7 and 8 of its rules concerning the assignment of frequencies in the band 5500-5550 kilocycles so as to exclude the Maritime Mobile Service from using frequencies in this band now allocated to the aeronautical mobile radio service effective March 15, 1953 (Docket 10361).

Docket 10377

In Docket 10377, the Commission is proposing to amend Parts 7 and 8 of the Rules and Regulations to delete authority for operation by coast stations, ship stations and aircraft stations on currently assignable frequencies for telephony within the band 4000 kilocycles to 18000 kilocycles; and to include authority for operation by such stations on other frequencies for telephony within the same band. In a statement filed on March 5, the Special Representative asserted that the Central Committee is fully aware that certain amendments of the rules are required, pursuant to the Geneva Conference, and has no desire to object to those changes. It was pointed out, however, that traffic on the inland waterways is of the utmost importance to the nation, in peace time and in war time and that this traffic depends greatly upon adequate communication facilities. Accordingly, the Commission was urged to make adequate frequencies available to this important service.

Docket 10359

The Commission, pursuant to the Safety of Life at Sea Convention, 1948, has proposed to replace Section 8.704 of its temporary rules with a permanent rule which would require the installation of an emergency antenna unless it can be shown with respect to any particular cargo vessel that the installation of an emergency antenna is impracticable or unreasonable. In the latter circumstance a made-up spare antenna must be provided. The present temporary rule gives the owner the option of providing either an installed emergency antenna or a made-up spare antenna. Comments from the shipping industry have pointed out to the Commission that it is impracticable and unwarranted for cargo vessels, generally, to be provided with emergency antennas, and that the Commission should take full advantage of the power authorized by the Convention to except vessels from the required fitting of an emergency antenna.

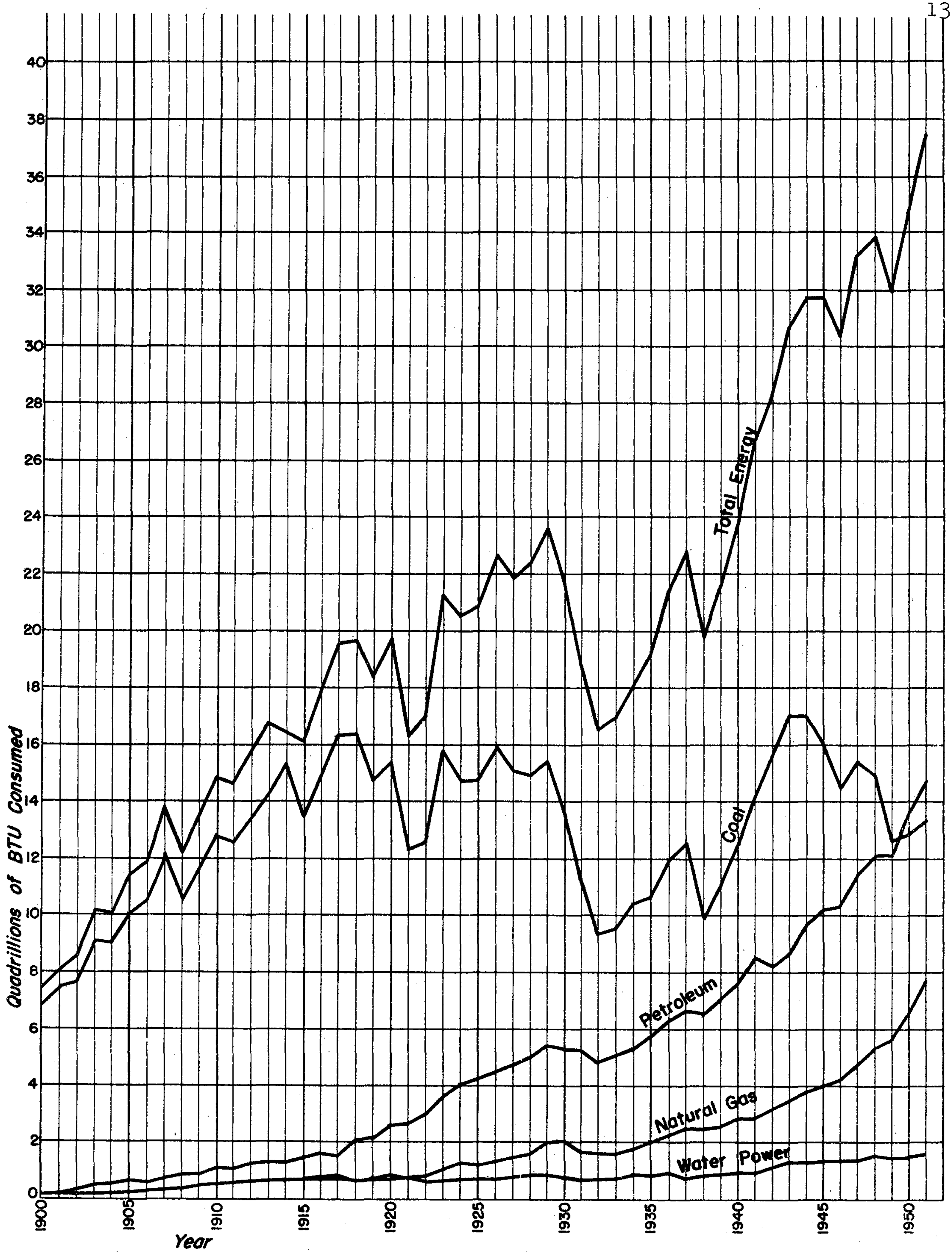
Conclusion

The above report is intended to cover some of the more important matters being handled for the Central Committee on Radio Facilities and the National Petroleum Radio Frequency Coordinating Association. We always welcome the interest of all segments of the petroleum and natural gas industries who are making use of radio in their industrial operations and all comments or suggestions are always welcome and we shall be glad to be of any assistance possible. It has been a pleasure to be with you again and I hope that the important uses of radio by the petroleum and natural gas industries will continue to grow so that we may make an even greater contribution to the future of our Nation.

Respectfully submitted,

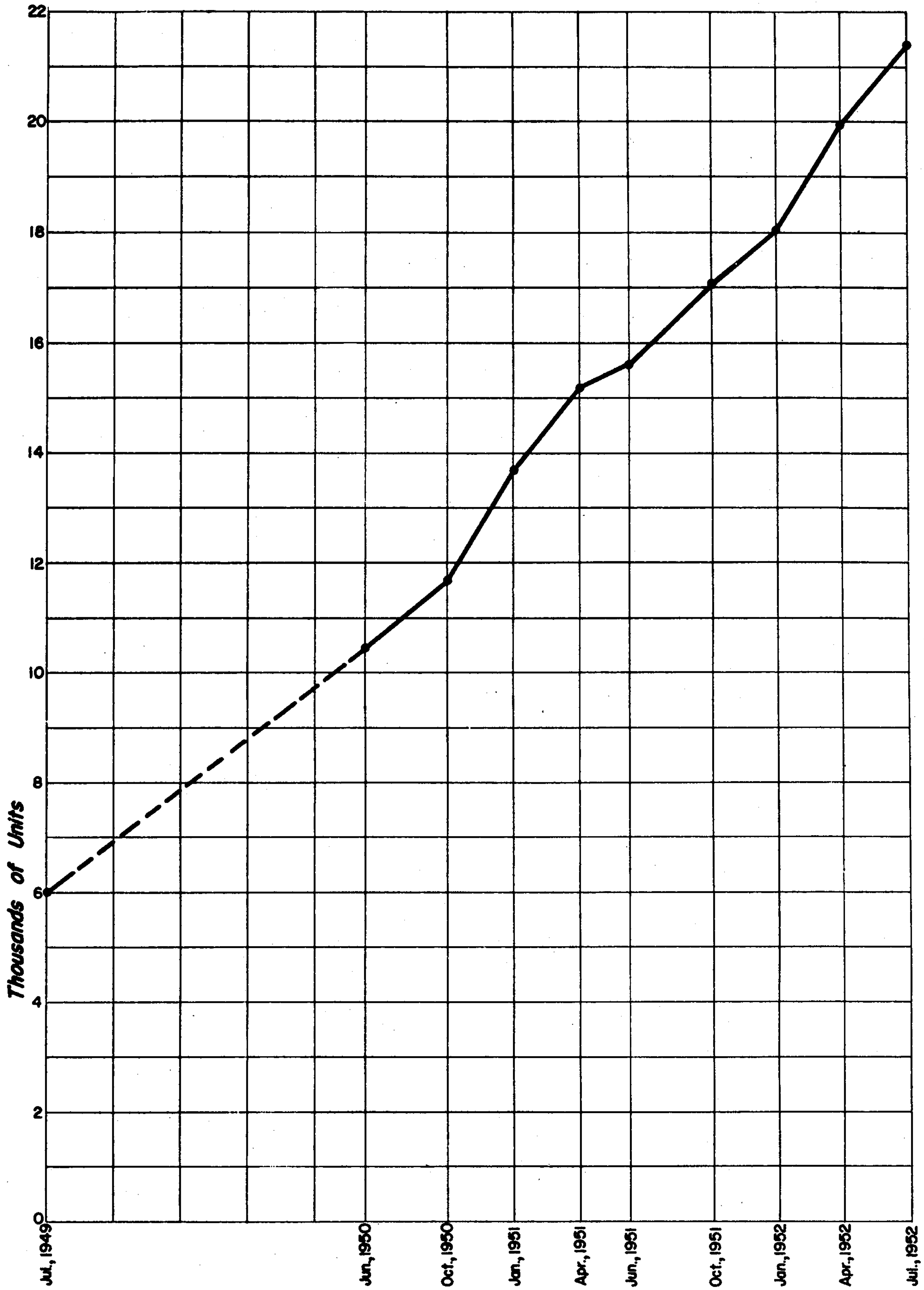
SIGNED/Joseph E. Keller

Special Representative



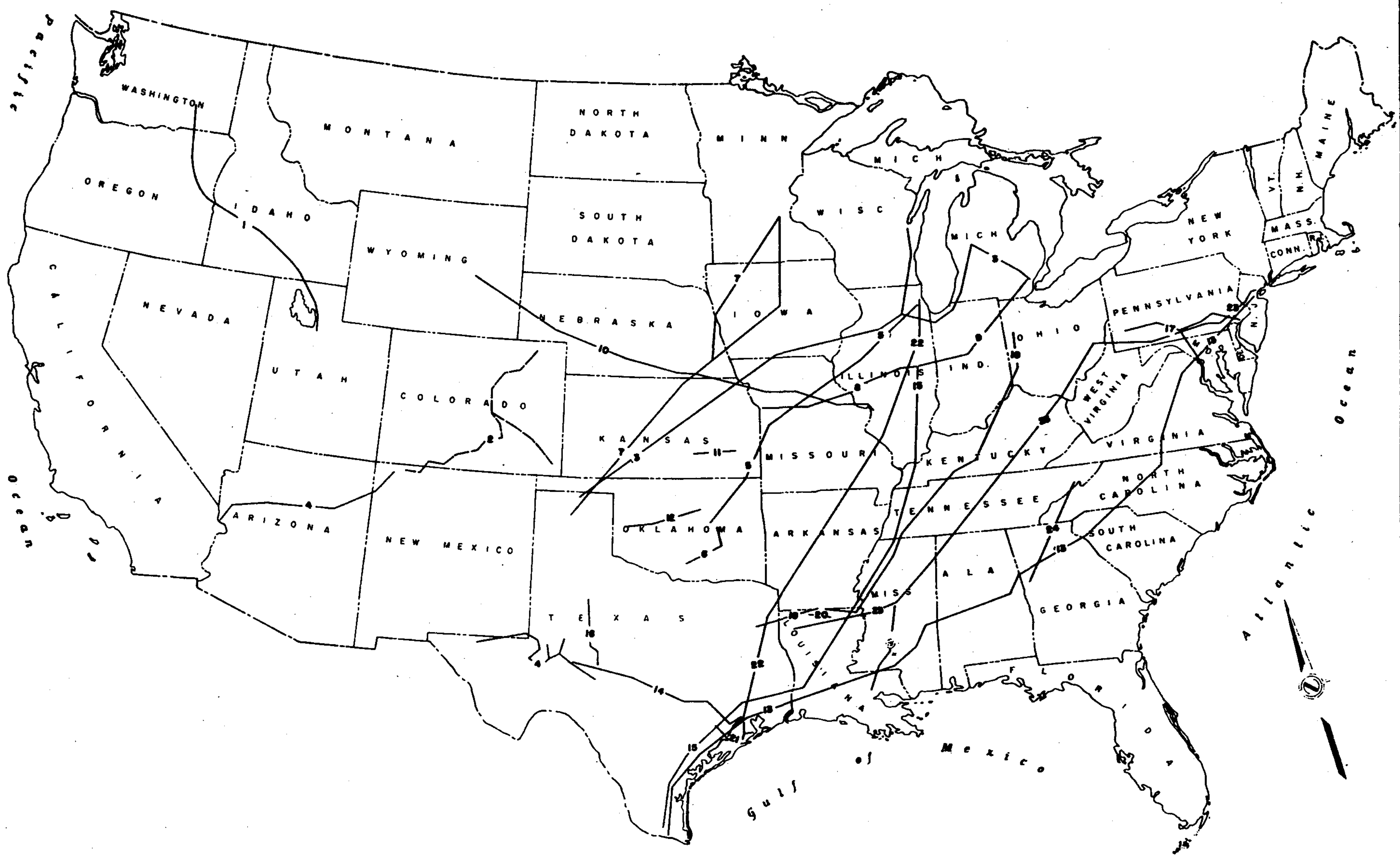
U.S. Annual Energy Consumption, 1900-1951.

Chart No. 1



Petroleum Radio Service Transmitters

Chart No. 2



PETROLEUM SERVICE MICRO-WAVE SYSTEMS

Chart No. 3

PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION

PETITION

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington 25, D.C.

In the Matter of:

Petition for Establishment of New Radio Service Governing Radio Stations Used in Petroleum Industry Production and Pipeline Operations and Promulgation of Rules and Regulations therefor.)

Comes now the Petroleum Industry Electrical Association and by its attorney hereby petitions the Federal Communications Commission to establish a new radio service for, and to promulgate rules and regulations governing, radio stations used in the petroleum industry, such service to include radio stations used in connection with petroleum production and pipeline operations, and to transfer from the presently established Utility Radio Service to the requested new Petroleum Radio Service radio stations used in connection with such pipeline operations. In support of this request, your Petitioner states as follows:

I.

The Petroleum Industry Electrical Association (hereinafter called the Petitioner) is an association organized in 1928 and for all branches of the petroleum industry having telegraph, telephone, or electrical departments. Its membership now comprises representatives of twenty-nine oil companies, these companies being representative of the petroleum industry, especially with relation to production and pipeline operations. This petition is filed by the Association not only on behalf of its members, but in the interest of all companies desiring to use radio communications in order to improve the safety and efficiency of petroleum production and pipeline activities and to aid in increasing and conserving this nation's oil supply and reserves.

II.

On October 24, 1944, Petitioner appeared and presented evidence in Docket No. 6651, entitled "In the Matter of Allocation of Frequencies to the Various Classes of Non-Government Services in the Radio Spectrum from 25,000 Kilocycles to 30,000,000 Kilocycles" and outlined, in its testimony, the need for radio frequencies to serve all branches of the petroleum industry, including production operations, geophysical services, and pipeline operations, and the various ways in which radio Communications were and could be regularly utilized to improve the safety and efficiency of the industry's operations (Vol.15, pp. 2944-2974).

III.

On January 15, 1945, the Commission issued its "Report of Proposed Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles." This report proposed the allocation of 20 frequencies or channels above 25 megacycles "for the use of electric, gas, water, and steam utilities on a shared basis with petroleum and other services" (p. 125). The Commission, in this report, further recognized the need of the petroleum industry for the use of radio on a more permanent basis than was possible under the provisional radio station authorizations[1] then being issued to the industry, stating in this respect (pp.135-6):

> "It appears from the record herein that the communication needs of oil companies, particularly in connection with their pipeline operations, may require the use of radio upon a basis more permanent in character than that which is contemplated by the present rules of the Commission which govern the operation of Provisional Stations. Accordingly, the Commission will give consideration to the necessity for establishing a class of stations which will provide the Oil Industry with a radio service consistent with its communication requirements."

IV.

On May 25, 1945, the Commission issued its final "Report of Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles" in Docket No. 6651, increasing the number of frequencies finally allocated above 25 megacycles to the use of the electric, gas, water, and steam utilities and the petroleum industry from 20 to 31. These frequencies were distributed in four different bands, as follows (p.110):

Frequency Band		No. of Channels
25 - 30 mc		12
30 - 40 mc		7[2]
72 - 76 mc[3]		6
152 -162 mc		6
	TOTAL	31

1 - Pursuant to Section 11,121 of the Rules Governing Miscellaneous Radio Services provisional station authorizations are expressly required to be issued upon a "temporary basis for a specific period of time not to exceed one year under appropriate restrictions and subject to the condition that the authority granted may be revoked at any time without advance notice or hearing. In addition to other requirements of law and regulation, applications for renewal of such authority shall show that the use of the facilities is not intended as a permanent service."
2 - Proposed to be increased to 17 channels, by Commission action described in its public notice of January 7, 1947.
3 - The 6 channels allocated in the 72-76 megacycle band by the Commission's "Report of Allocations from 44 to 108 Megacycles" dated June 27, 1945, were originally tentatively allocated in the 104-108 megacycle band. See p. 110 of the May 25, 1945, report and p. 5 of the June 27, 1945, report.

V.

On August 13, 1946, the Commission issued its proposed new Part 17, Rules Governing Stations in the Utility Radio Service. The Commission's Order of August 7, 1946, accompanying the new Part, provided that the proposed Rules would become finally effective on September 9, 1946, unless substantial objections were filed ther-to by August 27. The proposed Rules established three new classes of radio stations - power utility, transit utility, and petroleum pipeline stations - for the respective use of power utilites, transit utilities, and petroleum pipeline operators, but did not establish a class of station for use in connection with the producing activities of the oil industry. Inasmuch as the frequencies made available under the new Utility Radio Service to the power utilities and petroleum pipeline operators had been made available for the use of the petroleum industry generally as a result of the Commission's general reallocation proceeding in Docket 6651,[4] this failure to establish a class of station for use in connection with petroleum production activities at the time the proposed Utility Radio Service Rules were issued was called to the attention of the Commission by your Petitioner in statement dated and filed August 29, 1946. Because your Petitioner did not wish to take any action which might postpone the effective date of the new Utility Radio Service Rules, the Association's statement expressly provided that the Association did not object to the adoption of the proposed Utility Radio Service Rules, although these Rules did not satisfy all the needs of the petroleum industry for radio communication. The right later to file the present Petition was reserved, however.

4 - See "Proposed Report of Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles" dated January 15,1945,pp.125-126,135-136;and "Report of Allocations from 25,000 Kilocycles to 30,000,000 Kilocycles" dated May 25, 1945, p.110.

VI.

In addition to the radio service provided petroleum pipe-line stations, under Utility Radio Service, Part 17, your Petitioner respectfully states that the petroleum industry requires regular radio service for other functions of the industry, particularly in production operations, upon a basis more permanent in character than is presently afforded by the operation of provisional stations. The scope of communications to be authorized for such service should be broad enough to include the following categories of use:

(a) Oil is frequently sought and found in areas remote from existing communications facilities and where the construction of telephone or telegraph lines would be economically infeasible. During drilling operations it is essential that communications be established between the well site and the field headquarters in order to maintain proper supervision over drilling operations, often of a hazardous nature. Breakdown of equipment, accidents and other emergencies, such as a blowout, fire or explosion, not only present hazards to life and property, but also involve loss of productive time. Ready intercommunication between the well crew and the field headquarters office should at all times be available in order to minimize such hazards to life and property and uneconomic loss of time.

(b) After a field is proven and steady production is begun, the need for communication facilities of a reliable nature continues. The prompt and uninterrupted movement of equipment and supplies, transmission of operating instructions and reports, direction of well servicing crews, repair crews and other routine operations in the producing field are dependent upon the instant and reliable means of communication radio alone affords where no other means of communication is available.

(c) At the present time, it is necessary frequently to shut down a well for the period of time required to send copies of electrical well logs to the headquarters of the drilling company for examination by geologists to determine various factors. To eliminate this costly expenditure for shutdown time on drilling rigs, it is proposed to transmit the well logs over a radio-facsimile circuit. Likewise, radio facsimile will be used to transmit pressure gauges, meter readings, technical drawings, and maps when the urgency of the situation warrants the employment of such means.

(d) Radio circuits will also be utilized for the automatic transmission of signals from operating wells to a centrally located receiver at field headquarters. Upon any change in well pressure, the signal transmitted from the affected well will be registered in the field office in a manner which will indicate the location of the particular well where the trouble exists. Field headquarters may then immediately communicate by radio with the necessary field personnel for the purpose of investigating and correcting the source of the trouble. This substantially reduces the time required on the part of personnel in checking individual producing wells.

The establishment of a new radio service or the establishment of a new class of station (petroleum production) in any existing service that will permit the petroleum industry to use radio communications on a regular basis for the production activities indicated (as well as for pipeline purposes), will not only improve the safety and efficiency of operations of this nationally important industry, but will also effectuate the decisions previously made by the Commission in the Docket 6651, reallocation proceeding, as outlined in Paragraphs III, IV, and V above. While the establishment of a new class of petroleum production station in an existing service would be entirely satisfactory as a temporary expedient, it would appear preferable to establish a new radio service governing stations used in connection with the production activities of the industry. The establishment of such a new service would have the added advantage of permitting the withdrawal of petroleum pipeline stations from the Utility Radio Service and their transfer to the new petroleum industry radio service. The inclusion of petroleum pipeline stations in this new service would be particularly desirable because Section 17.1 of the Rules Governing Stations in the Utility Radio Service presently defines the term Utility Radio Service as "a radio communication service used in connection with and concerning the operation of certain public utilities" whereas petroleum pipelines generally do not fall in this classification. Consequently, no satisfactory service now exists for those petroleum pipelines which are not public utilities. The establishment of a new petroleum radio service covering pipeline and production stations alike would also seem to accord with the wise policy the Commission has continually followed of establishing a separate radio service for the regulation of the stations used by a particular industry.[5]

5 - For example, radio station use by the shipping and aviation industries has long been regulated by separate radio services, namely, Part 8, Rules Governing Ship Service, and Part 9, Rules and Regulations Governing Aviation Services. Following this policy, the Commission on December 31, 1945, established a new Part 16, Rules and Regulations Governing Railroad Radio Service, to govern radio station use in connection with railroad operations. This policy was again enunciated, and for prospective use in this particular instance, as recently as August 9, 1946, when the Commission issued its final report on the petition of National Bus Communications, Inc. in Docket 6651. In that report it was stated that as soon as the number of frequencies needed by the intercity passenger bus industry had been established, "a separate intercity passenger bus radio service will be established by the Commission to govern the operation of all radio stations furnishing communications exclusively to busses," (p.9). The advantage to a particular industry of having a tailor-made single regulation to govern its radio stations use requires no elaboration.

WHEREFORE, Your Petitioner respectfully requests:

1. That the Commission promptly establish a new radio service for, and promulgate rules and regulations governing, radio stations used in the petroleum industry, such new service to include both radio stations used in connection with petroleum production and pipeline operations, and to transfer from the presently established Utility Radio Service to such new Petroleum Radio Service radio stations used in connection with pipeline operations. A suggested set of rules and regulations to cover such new service is attached as Appendix A hereto.

2. If the Commission decides not to establish, at this time, such a new radio service for the petroleum industry, that it

a. Establish a new class of stations (petroleum production) in an existing radio service;

b. Change its definition of Utility Radio Service (Section 17.1) to make it expressly available to petroleum pipelines irrespective of whether or not they are public utilities; and

c. Extend the coverage of the existing Utility Radio Service to persons furnishing radio communication services to Power Utilities, Transit Utilities, and Petroleum Pipeline Operators as there defined.

Respectfully submitted
PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION

By ______________________
Joseph E. Keller, Its Attorney

Joseph E. Keller
Dow, Lohnes and Albertson
600 Munsey Building
Washington 4, D. C.
January 20, 1947

Appendix A

Rules Governing Stations in the Petroleum Radio Service

DEFINITIONS

Petroleum Radio Service - The term "Petroleum Radio Service" means a radio communication service used in connection with the production or pipeline operations of the petroleum industry.

Petroleum Operator - The term "Petroleum Operator" means any person* engaged in, or who proposes to engage in, the operation of radio stations in connection with petroleum production or pipeline operations.

Petroleum Production Station - The term "Petroleum Production Station" means a station operated by a petroleum operator for communications essential to the establishment, maintenance, or operation of petroleum pipeline facilities.

Petroleum Pipeline Station - The term "Petroleum Pipeline Station" means a station operated by a petroleum operator for communications essential to the establishment, maintenance, or operation of petroleum pipeline facilities.

(For general provisions regarding Applications and Licenses, Technical Specifications, Records, Tests, and Miscellaneous rules, reference is made to the Utility Radio Service rules on these subjects. The reference to the "Utility Radio Service" in those rules should be changed to "Petroleum Radio Service." Further, a change in the form numbers of the applications referred to in the Utility Radio Service rules may be necessary if these forms may not be used for Petroleum Radio Service as well as Utility Radio Service authorization.)

* The term "Person" wherever used in these rules includes an individual, partnership,unincorporated association, corporation, and cooperative organization.

PETROLEUM PRODUCTION STATIONS

Eligibility for license - Authorizations for petroleum production stations will be issued to "petroleum operators" as defined in Section _____ of these rules.

Frequencies available -

(a) The following frequencies ** are presently available for assignment for use by petroleum production stations on a temporary basis only, pending the adoption of a final frequency assignment plan for stations in the Petroleum Radio Service:

30.86 mc	75.42 mc	153.05 mc
31.98 mc	75.46 mc	153.23 mc
33.02 mc	75.50 mc	153.41 mc
33.58 mc	75.58 mc	153.59 mc
39.98 mc	75.62 mc	156.81 mc
	75.66 mc	157.11 mc

Frequencies in certain television channels as indicated in footnote 5, Section 1, Report of Allocations, Federal Communications Commission, May 25, 1945.

(b) The following frequencies may be assigned for use by licensees of petroleum production stations previously authorized to operate provisional stations on these frequencies:

31.02 mc	35.46 mc
31.18 mc	37.14 mc
31.54 mc	39.14 mc
33.46 mc	39.54 mc
33.62 mc	

** These are the same frequencies as have been made available for petroleum pipeline station use under Section 17.812 of the Utility Radio Service Rules. If definite frequency assignments may not be made in the 25-30 megacycle band, it is requested that there be added to these frequencies the 12 frequencies that were allocated for petroleum industry use in the 25-30 megacycle band as well as the additional frequencies made available for petroleum industry use in the 30-40 megacycle band by reason of the Commission's actions described in its public notice of January 7, 1947, increasing the spectrum space allocated to power utility petroleum groups in the 30-40 megacycle band from 7 channels to 17 channels. (See Paragraph IV of this petition).

(c) The above frequencies will be assigned on a temporary basis only and are subject to change without advance notice or hearing if assignments should prove to be at variance with the final plan of assignment of specific frequencies to the various stations operating in the bands listed in (a) and (b) above.

(d) Any frequency or group of frequencies allocated for use by petroleum production stations may be restricted for use in one or more specified geographical areas. The frequencies immediately available for assignment for use in any particular area may be ascertained by communicating with the Washington 25, D. C. office of the Federal Communications Commission.

Permissible communications - Petroleum production stations are authorized to transmit communications essential to:

(1) public safety and the protection of life or important property; or

(2) operations in connection with the establishment, maintenance, and operation of petroleum production facilities.

Points of communication -

(a) Petroleum production land stations, mobile stations, and portable stations are authorized to intercommunicate with mobile or portable units licensed in the Petroleum Radio Service.

(b) Petroleum production stations operating at fixed locations are authorized to intercommunicate or to transmit to receivers at fixed locations only under the following limitations and conditions:

(1) when messages transmitted are of immediate importance to mobile or portable units; or

(2) normal communication facilities between such points are inoperative, inadequate, or unavailable; or

(3) express authority has, upon a proper showing of need, been first obtained therefor.

PETROLEUM PIPELINE STATIONS

(The same rules and regulations which now govern the use of these stations in the Utility Radio Service shall apply. This would necessitate changing the term "petroleum pipeline operators" used in the Utility Radio Service to "petroleum operators"; and the reference to the "Utility Radio Service" in those rules would also be changed to "Petroleum Radio Service.")

BYLAWS OF THE NATIONAL PETROLEUM RADIO FREQUENCY COORDINATING ASSOCIATION

1. Name

1.1 The name of this organization shall be NATIONAL PETROLEUM RADIO FREQUENCY COORDINATING ASSOCIATION.

2. Purpose

2.1 The purpose of this Association shall be to advise and assist the petroleum industry in complying with the provisions of Section 11.57, Policy Governing the assignment of Frequencies, Rules and Regulations of the Federal Communications Commission.

3. Organization

3.1 Regional Groups
To carry out the purpose of this Association the United States is divided into seven Administrative Regions, as shown on Exhibit "B" attached. In each of the Administrative Regions there shall be formed a Regional Petroleum Radio Frequency Coordinating Association. The membership of these seven Regional associations shall comprise the National Association.

3.11 Eligibility
Membership in Regional Petroleum Radio Frequency Coordinating Associations shall be open to representatives of operating organizations which are eligible for radio service under Part 11, Sub-Part G, Petroleum Radio Service, of the Federal Communications Commission's Rules and Regulations.

3.12
Each eligible organization which has applied for or holds a Construction Permit or License in the Petroleum Radio Service may appoint one representative to active membership status. Each active member is entitled to only one vote irrespective of the number of organizations he may represent. Only active members may be elected to office.

3.13

Each eligible organization may appoint one or more representatives to associate membership status. Associate members may not vote nor be elected to office but may be appointed to committee, attend all meetings, and take part in discussions.

3.14

Each active member may designate an alternate to act in his absence.

3.15

By-laws of each Regional Petroleum Radio Frequency Coordinating Association shall be submitted to the National Executive Committee for approval before final adoption.

3.2 <u>National Executive Committee</u>
The National Executive Committee shall consist of 12 members as follows:

3.21 The Chairman of each Administrative Regional Association or a designated alternate and

3.22

Five additional members to serve for one year to be selected by the above seven members, one from each of the following divisions of the Petroleum Industry.

a. Production
b. Geophysical
c. Oil and Products Pipe Lines
d. Gas Pipe Lines
e. Refining

3.23 <u>Officers of National Association</u>
The elected officers shall be: Chairman, Vice-Chairman and Secretary-Treasurer. Officers shall be elected from and by a majority vote of the Executive Committee. The term of office shall be one year, or until their successors are elected.

4. Scope

4.1 The Executive Committee shall act for the National Association:

4.11
To study and recommend solutions for frequency coordination problems which cannot be resolved by the Regional Associations.

4.12
To study and recommend solutions for frequency coordination problems with other services.

4.13
To review work of all Regional Associations from time to time as circumstances require, to make recommendations for inauguration of special studies or cessations of existing activities.

5. Meetings

5.1 National Association
A meeting of the National Association may be called on 30 days' notice:

5.11
At any time by the Executive Committee

5.12
By petition of 50 members

5.2 National Executive Committee

5.21
The National Executive Committee shall meet at least once annually.

5.22
A meeting may be called at any time by the Chairman.

6. Amendments

6.1 Proposed amendments of these bylaws shall be submitted to the Executive Committee for approval and if approved, shall be distributed to all members for approval by letter ballot. Amendments disapproved by the Executive Committee shall be distributed to Association members with reasons for the disapproval shown.

6.2 Proposed amendments shall become effective immediately upon approval by two-thirds of all members voting within 30 days after mailing.

MEMBERSHIP

EXECUTIVE COMMITTEE OF THE NATIONAL PETROLEUM RADIO FREQUENCY COORDINATING ASSOCIATION

REGION I	D. K. Ruth Manufacturers Light & Heat Company 800 Union Trust Building Pittsburgh, Pennsylvania
REGION II	J. C. Williams The Ohio Fuel Gas Company 99 North Front Street Columbus, Ohio
REGION III	D. R. Wofford Texas Gas Transmission Corporation P. O. Box 577 Owensboro, Kentucky
REGION IV	McKinley Rhodes Tennessee Gas Transmission Company P. O. Box 2511 Houston, Texas
REGION V	W. B. Haas Northern Natural Gas Company 2223 Dodge Street Omaha, Nebraska
REGION VI	T. A. Wilson Southern Union Gas Company Box 757 Farmington, New Mexico
REGION VII	W. E. Church (Shell Oil Company) Interstate Petroleum Communications, Inc. 1008 West 6th Street Los Angeles, California
CHAIRMAN	H. A. Rhodes Transcontinental Gas Pipe Line Corporation Houston, Texas
VICE CHAIRMAN	L. E. Cook Sinclair Pipe Line Company Sinclair Building Independence, Kansas

SECRETARY — W. A. Shipman
Virginia Gas Transmission Corporation
P. O. Box 215
Falls Church, Virginia

Also - R. D. Wyckoff
Gulf Research & Development Company
Box 2038
Pittsburgh 20, Pennsylvania

Clifton D. Campbell
Humble Pipe Line Company
Room 652, Humble Building
Houston, Texas

SPECIAL REPRESENTATIVE — Joseph E. Keller
600 Munsey Building
Washington 4, D. C.

CENTRAL COMMITTEE ON RADIO FACILITIES
OF THE
AMERICAN PETROLEUM INSTITUTE

Chairman:	W. M. RUST, JR., Humble Oil & Refining Co., Houston, Texas
Vice Chairmen:	J. A. POLHEMUS, JR., Standard Oil Co. of California, Standard Oil Building, San Francisco 20, Calif.
	V. J. SITTEL, Service Pipe Line Company Service Pipe Line Building, Tulsa, Oklahoma
Secretary:	B. H. LORD, JR., American Petroleum Institute 1625 K Street, N. W., Washington 6, D. C.
Special Representative:	JOSEPH E. KELLER 600 Munsey Building, Washington 4, D. C.

CHARLES F. BERNARD....Interstate Oil Pipe Line Co., Box 1107 Shreveport 83, La.
F. S. BIRD............The California Co., 1818 Canal Bldg. New Orleans, La.
W. T. BORN............Geophysical Research Corp., Box 2040, Tulsa, 2?, Oklahoma
S. M. BRANAN .... Continental Oil Co., Box 2197, Houston, Texas
W. T. BULLA.......... Natural Gas Pipeline of America, 20 N. Wacker Dr. Chicago 6, Illinois
R. S. CAPLAN .... Gulf Refining Co., Box 2100, Houston, Texas
W. F. CARLETON........The Texas Pipe Line Co., Houston 1, Texas
W. E. CHURCH..........Shell Oil Co., 1008 W. 6th St., Los Angeles, Calif.
F. T. CLARKE..........Union Sulphur and Oil Corp., Sulphur, La.
D. H. CLEWELL.........Magnolia Petroleum Co., Dallas, Texas
M. S. COLLETT.........The Atlantic Refining Co., 260 S. Broad St., Philadelphia 1, Pa.
E. E. COMSTOCK........Phillips Petroleum Co., Bartlesville, Okla.
L. E. COOK............Sinclair Pipe Line Co., Sinclair Bldg., Independence, Kansas
HARRY L. CORNELL......Esso Shipping Co., Rm. 301, 115 Broadway, New York 6, N. Y.
C. F. de MEY..........Columbia Gas System Service, 120 E. 41st, New York, N. Y.
J. H. FIELD ....Sohio Petroleum Co., 2300 1st Natl. Bank Bldg., Oklahoma City, Okla.
ROBERT L. GRAY........Ashland Oil & Refining Co., Ashland, Ky.
KARL S. HAGIUS........Colorado Interstate Gas Co., Colorado Springs, Colorado
W. W. HARDY...........Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.

CLYDE R. HEPLER.......Pan-American Pipe Line Co., Houston, Texas
L. M. HUBBY ....The Texas Company, Box 425, Bellaire, Texas
VANCE JENKINS.........Union Oil Co., of Calif., 617 W. 7th St., Los Angeles 17, Calif
CARL M. LATHROP.......Standard Oil Development Co., Box 121, Linden, N. J.
C. B. LESTER .... Mid-Valley Pipe Line Co., 430 North Center, Longview, Texas
D. H. LEVY............Petroleum Industry Electric Assn., c/o Magnolia P. L. Co., Dallas, Texas
F. W. LITTELL .... Shell Pipe Line Cop., Shell Bldg., Houston 2, Texas
STANLEY LUC.......... Standard Oil Co. (Ind.), 910 S. Michigan Ave., Chicago 80, Ill.
S. R. McCONOUGHEY.....Michigan-Wisconsin Pipe Line Co., 500 Griswold St., Detroit 26, Michigan
J. D. McCULLOUGH......The Buckeye Pipe Line Co., 137 W. North St., Lima, Ohio
R. D. MONTGOMERY......Richfield Oil Corp., 555 S. Flower St., Los Angeles 13, California
O. W. MORTON .... Panhandle Eastern Pipe Line Co., 3040 Idaho Ave., Washington, D. C.
H. G. PEGUES ....United Pipe Line Co., Shreveport, La.
H. A. RHODES..........Transcontinental Gas Pipe Line Corp., Houston, Texas
E. M. SHOOK ....Magnolia Pipe Line Co., Dallas, Texas
R. M. SLOUGH .... The Ohio Oil Company, Findlay, Ohio
C. E. SUTTON .... The Pure Oil Co., City Natl. Bank Bldg. Houston, Texas
E. H. WILDER ....Sun Oil Company, Beaumont, Texas
JOSEPH H. WOFFORD.... Radio Communications Engr. Service, 4317 Montrose Blvd., Houston, Texas
R. D. WYCKOFF.........Gulf Research & Development Co., Pittsburgh 30, Pa.

PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION

W. D. COLEMAN........ Ajax Pipe Line Corp., Springfield, Mo.
G. H. BUMB........... Arkansas Natural Gas Corp., Shreveport, La.
F. J. GEISEL......... Atlantic Pipe Line Co., Dallas, Texas
J. D. McCULLOUGH......Buckeye Pipe Line Co. (The), Lima, Ohio
J. W. FLINT...........Cities Service Gas Co., Wichita, Kansas
WILLIAM J. BLOUNT.....Colorado Interstate Gas Co., Colorado Springs, Colo.
A. F. HARREL..........Continental Pipe Line Co., Ponca City, Okla.
CHAS. E. NEALE ...... Dow Chemical Co., Freeport, Texas
EVRON L. McNEEL.......East Ohio Gas Co.(The), Cleveland, Ohio
L. G. WAINMAN .... El Paso Natural Gas Co.,El Paso, Texas
JAMES V. BOWEN........General Petroleum Corp., Los Angeles, Calif.
C. H. SCRUGGS.........Great Lakes Pipe Line Co., Kansas City, Mo.
K. P. McCORD..........Gulf Oil Corporation, Pittsburgh, Pa.
C. HARVEY.............Gulf Refining Co., Houston Pipe Line Division, Houston, Texas
M. C. CALLAHAN........Gulf Refining Co., Tulsa Pipe Line Division, Tulsa, Okla.
J. F. COLLERAIN.......Houston Pipe Line Co., Houston, Texas
C. R. GAST............Huber Corporation, J. M., Borger, Texas
HEZZIE CLARK..........Humble Pipe Line Company, Houston, Texas
HOWARD GUMM...........Industrial Gas Supply Corp., Houston, Texas
D. W. LIPE............Interstate Oil Pipe Line Co., Tulsa, Okla.
W. H. MASSEY..........Interstate Oil Pipe Line Co., Shreveport, La.
C. O. DILLER.... .....Lone Star Gas Company, Dallas, Texas
D. H. LEVY............Magnolia Pipe Line Co., Dallas, Texas
S. R. McCONOUGHEY.....Michigan-Wisconsin Pipe Line Co., Detroit, Mich.
L. C. LAMER .... Mid-Continent Pipe Line Co., Tulsa, Oklahoma
C. B. LESTER..........Mid-Valley Pipeline Co., Longview, Texas
ELWOOD KISBY..........Michigan-Ohio Pipeline Corp., Mt. Pleasant,Mich.
F. D. PATTERSON ......National Transit Co., Oil City, Pa.
J. C. WILLIAMS........Ohio Fuel Gas Co. (The), Columbus, Ohio
R. M. SLOUGH... ......Ohio Oil Co. (The), Findlay, Ohio
W. R. KUBISTA.........Oklahoma Natural Gas Co., Tulsa, Okla.
C. R. HEPLER..........Pan-American Pipe Line Co., Houston, Texas
J. O. PHILLIPS ...... Pan-American Gas Company, Houston, Texas
J. A. FOWLER..........Panhandle Eastern Pipe Line Co., Kansas City,Mo.
E. E. COMSTOCK... ....Phillips Petroleum Co., Bartlesville, Okla.
T. R. SHAW........... Phillips Petroleum Co., Refining Dept., Bartlesville, Okla.
FRED ARMSTRONG....... Plantation Pipe Line Co., Atlanta, Ga.
A. R. HEIDEBRECHT.....Platte Pipe Line Co., Kansas City, Mo.
D. D. PICKRELL....... Premier Oil Refining Co., Ranger, Texas
A. L. PAULLIN.........Pure Transportation Co., Tulsa, Okla.
W. E. CHURCH..........Shell Oil Company, Los Angeles, Calif.
F. W. LITTELL .... Shell Pipe Line Corp., Houston, Texas
L. E. COOK........... Sinclair Pipe Line Co., Independence, Kansas
F. P. O'CONNOR ...... Service Pipe Line Co., Tulsa, Okla.
V. J. SITTEL..........Service Pipe Line Co., Engineering Dept.,Tulsa, Okla.

A. C. ALTER .... Southern California Gas Co., Los Angeles, California
J. A. POLHEMUS, JR. ..Standard Oil of California, San Francisco,Calif.
F. L. JOHNSON.........Sun Physical Laboratory, Newton Square, Pa.
W. E. DICKINSON.......Sun Pipeline Co., Beaumont, Texas
J. R. ELLIS...........Sunray Pipe Line Co., Tulsa, Okla.
A. L. STEGNER.........Tennessee Gas Transmission Co., Houston, Texas
THOS. B. KELLEY.......Texas Eastern Transmission Corp.,Shreveport,La.
WM. C. BRADY..........Texas Eastern Transmission Corp., Shreveport,La.
F. VINTON LONG........Texas Eastern Transmission Corp., Shreveport,La.
DELBERT R. WOFFORD....Texas Gas Transmission Corp., Owensboro, Ky.
C. E. UPSON.......... Texas-Illinois Natural Gas Pipe Line Co., Chicago, Ill.
O. V. SUMMERS........ Texas Pipe Line Co., Houston, Texas
P. F. DAVIS .... The Texas-Empire Pipe Line Co.,Tulsa,Okla.
H. A. RHODES..........Transcontinental Gas Pipe Line Corp., Houston, Texas
M. O. SHARPE ....Trunkline Gas Co., Houston, Texas
B. C. BARNETTE,JR.....Union Sulphur and Oil Corp., Sulphur, La.
H. G. PEGUES..........United Gas Pipe Line Co., Shreveport, La.
E. D. NUITTALL........United Gas Corporation, Shreveport, La.
J. M. WEST............West Production Co., Houston, Texas
DAVID SHEFFET.........Western Geophysical Co. of America, Los Angeles, Calif.