PETROLEUM RESOURCES

Dr. Richard J. Gonzalez

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CONTENTS

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COLONEL BLACK: General Mundy, Gentlemen:

Oil is the most important of all the war materials, considered in the light of the quantity used. Oil is also one of the most important natural resources required in developing our national economy. Oil is the subject for our discussion this morning.

I know the importance of the subject is appreciated by all of you. We Americans have a three-fold interest in the petroleum industry. First, we must have an adequate supply of petroleum if our economy is to function effectively. Secondly, our military forces require huge supplies of gasoline and fuel oils for their mobility. Third, our petroleum reserves serve both to enhance our economic well-being and as a potent ingredient for national defense.

Before proceeding with the introduction of our speaker I would like to present the panel members with whom you will all work this afternoon in our seminars on petroleum. You have read the biographies and have found that we certainly have, I am sure you will agree, some of the most experienced men in their field here this morning. We consider ourselves extremely privileged that these senior officials from government and industry have taken time from their busy schedules to be with us.

I shall now introduce these panel members to you. Will you please

withhold your applause until they are all introduced. And, gentlemen, as I call your names, will you please stand up for a second so that the student body will recognize you.

Mr. Jack Tarner, Phillips Petroleum Company.

Colonel Ralph E. Zahrobsky, USA, Military Petroleum Supply Agency.

Mr. James A. Ransford, Tidewater Oil Company.

Mr. Richard J. Miller, Military Petroleum Supply Agency.

Dr. Francis McIntyre, California Texas Oil Company.

Captain Matthew V. Carson, Jr., USN, Department of the Interior.

Colonel Merwin H. Smith, USA, Joint Chiefs of Staff.

Mr. J. S. Baldwin, Jr., Standard Oil Company.

Vice Admiral Burton B. Biggs, Office of Assistant Secretary of Defense.

Mr. William D. Price, Shell Oil Company.

Mr. William B. Harper, American Petroleum Institute.

Mr. Roscoe A. Cattell, Department of Interior.

Mr. Carl C. Anderson, Department of Interior.

Mr. Ralph S. Fowler, Pure Oil Company.

Captain A. A. Pabst, USN, Office of Assistant Secretary of Defense.

Mr. Alexander H. Chapman, Consulting Engineer.

Dr. Bruce C. Netschert, Resources for the Future.

Captain P. D. Chubb, USN, Military Petroleum Supply Agency.

Thank you, gentlemen.

We are most fortunate in having as our speaker this morning Dr. Richard J. Gonzalez, Director of the Humble Oil and Refining Company of Houston, Texas.

Our speaker brings an intimate background of many years' experience in the oil industry which, coupled with his basic professional training as an economist, ably fits him to understand and resolve the multitude of current complex problems confronting him daily in the petroleum field.

Dr. Gonzalez, we all feel that we are welcoming back an old friend of the Industrial College. I am very happy indeed to present you to this class.

Dr. Gonzalez.

DR. GONZALEZ: Thank you, Colonel Black, for that kind introduction and for the opportunity to be here today to kick off this discussion of petroleum resources. I am delighted to see that you have a panel, because the most important part of our discussion will be the question and answer period, particularly this afternoon.

I hope that all you gentlemen are wide awake and clear-eyed this morning. We have a few slides. We have arranged so that the lights won't all go off. Perhaps that will help you to stay awake.

In view of the results, I suspect that you will be getting some more

economists in Washington next year. It reminds me of the story about the engineer and the economist who were discussing their professions and how far back they could be traced. The engineer said that his was clearly much older than the economist's profession, because one of the first things that happened was that the Lord created the earth out of chaos. Immediately the economist spoke up and said, "And who do you suppose was responsible for that chaos?"

This morning we are going to talk about energy resources in general as a background to a more specific discussion of the petroleum resources of the United States. Then from that we will turn to a brief review of the world picture in resources. In view of the developments in Russia, this time we'll close with some comments on the Russian petroleum industry.

I am sorry that George Piercy of Standard Oil could not be here today. He is represented by Jack Baldwin. George is one of the men who have been over to Russia with the mission that just returned recently. He has made some very interesting talks on it. I understand that he is now busy helping to act as host for the visiting Russians, and that's why he can't be here.

Gentlemen, without further ado, I would like to start showing you some slides that will serve as a basis of our discussion of this subject.

SLIDE 1

Let us consider first what makes resources available. We know that there are undiscovered deposits of uncertain magnitude that form the resource base from which man must extract economically useful supplies. Until we start looking for these resources, we really don't have much idea how large the base is.

Uranium is a good example. Ten or fifteen years ago we probably didn't realize how much uranium was available. When we began to look for it we found quite a bit in the United States.

After we discover resources, we find that they are of one of two categories--either commercial, which then can be expressed as operating mines and wells, or noncommercial. A fine example of noncommercial resources are the shale oil deposits of the Rocky Mountains. We know that they contain a great deal of liquid but so far we haven't been able to figure out how to mine them at a cost that will make them economically significant.

Third, technology and price determine how much can be recovered from known resources. Technology changes with time, and so do prices, and these factors affect how much we can recover from known resources.

Finally, production draws on our known and developed resources, but it stimulates new development that adds further resources. In other

words, it converts previously unknown into known resources.

There has been a great deal of interest in recent years in the magnitude of our resource base. One of our panelists, Bruce Netschert, has done a lot to bring this concept into the fore. A new book, of which he is one of the authors, will soon be published on this subject. The Bureau of Mines has recently published some figures on the proved and potential resources of energy in the United States. Their figures will show up on this next slide.

SLIDE 2

We see here the proved resources of gas, crude oil, shale, and coal. In the lefthand bar they are expressed in quadrillion BTU's. Then there are the estimates that are currently being used by the Bureau of Mines of potential sources. On the lefthand side you will see a little box that gives you the ratio of the potential to the proved resources. In the case of gas, it's 4 to 1; oil is 11 to 1; shale is 10 to 1; coal is 4 to 1.

Let me point out that the term, "proved," does not mean the same in all of these cases. In the case of gas and crude oil the proved reserves are those that we definitely know can be recovered from presently known fields with existing technology and at existing prices. This is not true in case of the shale or the coal. If we had figures on what is back of commercial shale mines we would have practically zero

deposits proven, and if we had the figures back of the commercial mines they would be considerably less than the proved. Proved in this case means "known to exist"--not necessarily commercial.

At all events, the concept that we have here is that the energy resources of this country are really quite large, sufficiently so to warrant the Atomic Energy Commission in saying recently that we can look forward to having ample fossil fuels for the rest of this century at fairly reasonable cost. Incidentally, the "Resources for the Future" study will suggest that the real cost of these energy resources can remain constant for quite a period of time.

SLIDE 3

Energy is important, as Colonel Black said, because of its significance, not only to the military but also to the industrial economy. Here we have a picture of the relationship between U. S. energy consumption and gross national product per capita from 1929 to 1959. The similarity of the movements, of course, is very significant. There is a very high degree of correlation both in periods of boom and in periods of recession. This relationship is true not only in the United States but throughout the world as well, as we will see in our next slide.

SLIDE 4

Here we have a number of countries in the world arranged according to their energy consumption and their income per capita. We see countries such as India and Japan, with relatively low energy consumption

and low income. At the other end of the scale we see Canada and the United States, with high energy consumption and high income.

In this slide we have measured the per capita energy consumption in terms of gallons of crude oil, and we have expressed income in U. S. dollars. It is interesting to note that by and large a gallon of energy is the base for about a dollar of income. Now, as you know, energy in the form of crude oil, for example, sells for the equivalent of 5 to 7 cents a gallon at the well. We are not saying that the energy alone is responsible for the income, but we are saying that the energy is a requisite to multiply the productive capacity so that income can keep pace with it.

In other words, inanimate energy runs the machinery that makes it possible for real income to increase. What the world is engaged in is an effort to move up the economic ladder as we see it here on this slide. Russia would like to catch up with the United States. We want to keep ahead of Russia. And many countries in the world would like to move into the position that the Western countries now occupy.

We will turn from this now to a consideration more particularly of the U. S. energy picture and the petroleum industry.

SLIDE 5

Here we take a quick look at what has happened to energy consumption over a period of years, and we see that the total has gone up to where

we now consume approximately 43 quadrillion BTU's a year. We see that at the beginning of this period our consumption was, roughly, 15 quadrillion BTU's. The rate of growth of energy consumption has been somewhere between 2 and 3 percent a year, trend, over a long period of time. Over the last 20 years it has been roughly 3 percent.

Notice the divergence in the components. The actual consumption of coal has moved sidewise, somewhat downward, in fact, and the consumption currently is close to what it was at the bottom of the depression in the thirties.

On the other hand, the consumption of oil has shown a very sharp rise in the early years into the twenties. It was affected by the depression, and then moved again, and there was a long, steady sweep up until fairly recently, when you can see the trend line changed.

In the case of gas again you can see a somewhat similar movement to that of oil, with a sharp rate of increase.

The growth trends here have been, as I said, in the past 20 years 3 percent for energy as a whole, 5 percent for oil, and 8 percent for gas. Inevitably these had to change because oil and gas have now reached the point where they supply over 70 percent of the total energy requirement. As you can see, coal, at 10 quadrillion BTU's, now supplies less than one-fourth of the energy requirements in the United States.

This is one of the developments that are affecting the petroleum industry currently. This shift from a traditional 5 percent growth rate to this new 3 percent growth rate takes some time to adjust to, and it

creates some problems that we will discuss later during the day.

SLIDE 6

This slide shows us the participation of these forms of energy in the total picture for the United States. Water power has remained remarkably constant at roughly 4 percent of the total throughout this period of time--from 1910 to 1960. Coal has dropped sharply, as you can see in the lower portion of the chart, until it now supplies about 23 percent of the energy. Gas has increased until it supplies 27 percent of the energy. Oil supplies 46 percent of the energy.

This is quite a different situation from the one that we saw earlier in the relationships of the so-called proved and potential resources. All of this brings us back to the fact that the use depends on economic availability, the price at which these resources can be made available. Fortunately, the domestic petroleum industry has been able to supply oil and gas at prices that have made it attractive for people to use liquids and gas in place of coal.

So we have had this change in this development, despite the fact that potentially, in the long run, the coal resources overshadow the oil resources.

Most of these charts that we have looked at up to this point have dealt with developments of the 20th century. I would now like to turn to get a longer perspective over the first century of the petroleum industry.

SLIDE 7

Here we have looked back to the beginning of the petroleum industry to see how this industry has expanded, and we have divided the history into roughly three generations of 33 years each. We have shown by numbers across the top of the chart the gross new oil that was discovered and developed in the period, the production, and the amount that was added to reserves.

The first thing that we see is that in the first generation of 33 years, bringing us up to 1892, the industry didn't find or produce much oil. It found about a billion; it produced only about a little more than half a billion; and it had relatively small reserves at the end of the period.

In the second generation the industry stepped up its rate of finding and also its rate of production. Here we have a little more than 12-1/2 billion barrels discovered, a little over 8 billion barrels produced, and an addition to the reserves of approximately 4-1/2 billion barrels.

The really major development of the petroleum industry in the United States has come in the last generation, since 1926. You can see from the chart itself the tremendous expansion in reserves and in production, keeping pace with each other. At the top of the chart you can see the figures of gross new discovery of oil, more than 77 billion barrels, production 50 billion barrels, and additions to reserves 26

billion barrels. Notice how sharply these figures in the last generation overshadow everything that has gone before.

This gives us a background and a perspective against which to weigh the possible future development of the United States. This is a mature industry. It is undergoing some changes that are evidences of maturity, but it is not necessarily a declining industry that is just going to turn around and duplicate in a mirror image the changes that have occurred in the first 100 years. On the contrary, we expect that with known reserves and known productive capacity the United States can maintain and increase the production of oil and gas for some years to come.

How our production will develop will depend on the competition from other sources of energy, including energy from foreign areas--imports of oil and gas.

We'll turn, then, to a consideration of more specifically the U. S. petroleum situation and look at the major sources of supply.

SLIDE 8

Here we have picked the years 1950, 1955, and 1959, to show you a few major components of supply, starting with the production of crude oil in Texas at the bottom, then the production of crude oil in other States, in yellow above that, then in green the production of natural gas liquids, that is, the liquids that are produced with gas and then extracted from it by various processes, and, finally, a bar showing

the net crude oil imports.

The production in the United States has increased during this period of time, but, as you can see by the percentage participation figures, not as rapidly as the total supply. This has not been because of any lack of ability to produce oil but because of competitive pressures from natural gas liquids and from imports.

As you can see, the net import piece has shown an increase from roughly 545,000 barrels daily in 1950 to 1,540,000 barrels daily in 1959. As a result of this, the participation of net imports in the domestic supply has increased from 8 percent to approximately 16 percent.

This has been due to the availability of ample foreign supplies at very attractive prices. We become involved here in the issue of imports and import policy. You are well aware of the fact that the Government has decided that for security reasons some restrictions on imports are necessary at this time.

This is a controversial subject and is one that can be looked at from different points of view. There are many who feel that, if we are concerned about petroleum supplies for the future, we ought to conserve our own domestic resources and use all the foreign oil we can while it is available. Actually, the matter is not quite that simple, because, as we have already seen, the development of new resources depends on the production and the stimulus to search for new supplies.

What the Government is concerned with, and the reasons for its import policy, is that imports might unduly discourage the development of the discovery and development of new resources. We will see a little later some of the trends in exploration and drilling that have caused this concern.

There has also been some concern that the cost of domestic supplies might be headed sharply upward. Now, there was an increase in cost in domestic supplies from the depression years when we had an unusually low cost as the result of a combination of technological development and a depression to the postwar years, when we had some factors tending to cause us to incur higher costs.

Nevertheless, in real terms, we will find that the cost of these petroleum resources has remained remarkably reasonable. Also we will find that a good deal of the concern about the increase in cost of petroleum comes from looking at the cost of oil alone, ignoring gas; and we can't ignore gas, because gas has become of great importance in the postwar period. We will see this in the next slide.

SLIDE 9

Our changes in oil and gas reserves for 1950 to 1960. We start off with proved reserves on January 1, 1950, of 28.4 billion barrels of petroleum liquids and 180 trillion cubic feet of natural gas. In the 10-year period, 1950-59, we produced 26.5 billion barrels of liquids and 97 trillion cubic feet of gas.

Note, please, that the production was almost equal to the amount of reserves that we thought we had at the beginning of the decade. But we didn't run out of oil. Instead we developed new reserves of very substantial magnitude, and ended up with proved reserves, January 1, 1960, of 38 billion barrels of petroleum liquids and 262 trillion feet of natural gas.

In other words, it was the research and development of our new resources that led to this increase in proved, developed, ready-to-go reserves; and it is this kind of reserves that we need to have if we ever get into an emergency when we must have supplies quickly. It takes a long time to find and develop fields, and the time is so long that in a period of war we really have to operate with what we begin the war with.

At the bottom of this slide we see the ratio of reserves to production. In 1949 the ratio was 14 to 1 for oil. In 1959 it was 13 to 1. There was not a great deal of change--a slight decline. In the case of natural gas the ratio has declined from 29 to 1 to 21 to 1. This is significant, and it is approaching the level that the Federal Power Commission requires as a minimum for the certification of new gas pipeline facilities. The Federal Power Commission likes the pipelines to have 20-year supplies, at least, back of their proposed shipments.

SLIDE 10

Again, concentrating on the postwar period, we have the picture

here of what has happened to the exploratory activity as measured by seismic crews and by exploratory wells, and the total drilling as measured by the yellow line on the total well completion.

Note the sharp rise in seismic crews on an index basis. The figure more than doubled between 1946, coming out of the war, and going into 1952. Then there was a decline, which carried the index back down below the 100 level, which in this case is the year 1950.

Note, then, in the case of exploratory wells, a similar movement, except that the peak comes roughly 4 years after the peak of exploration. This is what we might expect, that the actual drilling of the exploratory wells follows the mapping of the prospects by seismic activity.

As the total well completion has turned down in this same period of time, since 1956, and is approaching the 100 level, that means that the drilling this year will not be substantially different from what it was in 1950.

The percentage of dry holes has gone up in this period of time. It has now fairly leveled off at a range of roughly 38 percent of the total wells drilled.

SLIDE 11

We have here an analysis of the new reserves developed related to the wells drilled in a 10-year period of time, divided into two 5-year

periods, so that we could get a closer picture of what we are getting for the wells drilled in terms of oil and gas.

We have converted the gas into an equivalent amount of oil, based on the heat content, and we then make clear in the upper portion of the slide that, although the amount of oil has gone down, from 1950-54 into the 1955-59 period, by a slight amount, the amount of gas has gone up sufficiently so that the total in oil equivalent has increased slightly less than 20 percent in this period of time.

The number of wells drilled, down at the bottom part of the chart, has also increased. When we express the total energy developed by those wells, we find a remarkable consistency between the two periods. In other words, the development of energy per well is continuing at about the same pace in the United States.

SLIDE 12

Here we look at the real price of petroleum hydrocarbons in the United States, expressed in constant dollars, 1954 purchasing power, from 1918 to 1958.

The price of crude oil, in real terms, as you can see, showed a declining trend from the World War I period into the depression years; then a modest rise; an upward surge at the end of World War II; and a leveling-off thereafter.

Natural gas shows a declining real trend all the way into the postwar

period, when the construction of new pipelines began to create a strong demand and rising prices. We can see that the real price of natural gas has been on an upward trend, leveling off in recent years, but returning to a figure that is no higher than it was in the depression years of the 1930's.

Finally, at the bottom of the chart, we see the combined cost of all of these petroleum hydrocarbons, the liquids and the gases together, and here we get a different picture, because of the changing relationship of these two pieces. You will remember the natural gas is growing faster than the liquids.

Again we see the general decline in the depression years, some upward movement at the end of the depression and into World War II, and then a sharp postwar rise, followed by this declining trend all the way from 1948 to 1958.

I think this is a rather significant aspect of developments in the petroleum industry to keep in mind. We have been greatly concerned about the rise in the price of gas and the rise in the price of crude oil, but we haven't paid enough attention to the fact that the product mix has altered so that energy continues to be available from this industry at very attractive prices.

SLIDE 13

We'll turn now briefly to a few aspects dealing with the question of the rate of return on the capital invested in this business and the tax

payments of this industry. This may become quite an interesting topic, in view of the discussions that have occurred in the Presidential campaign about percentage depletion.

This chart shows the net rate of return on net assets of leading corporations in the major industries of the United States--chemicals, iron and steel, petroleum, automobiles, and all manufacturing are plotted here. You can see many fluctuations, but the interesting thing about the chart is that the petroleum rate of return is very much in line with the average for all manufacturing. The petroleum line is the tan one; the all manufacturing is the yellow one. If you concentrate on those you can see that they run very close together.

You will also see that the automobile industry and the chemical industry have reported higher rates of return, generally, than has the petroleum industry. In other words, this means that the petroleum industry has realized only a reasonable rate of return on its investment, despite claims of fabulous profits, tax loopholes, and so forth.

SLIDE 14

There are some who say that the petroleum industry does not pay its fair share of taxes. The question of the fair share of taxes is a very subjective one, and we have dealt here instead with an objective question of what is the tax revenue generated by a typical oil well.

A typical oil well in the United States develops something like 125,000 barrels of crude oil, some 10,000 barrels of other liquids, and some

natural gas. The direct tax payments end up being about 63 cents a barrel--roughly 1-1/2 cents a gallon--to the State and local governments for ad valorem and severance taxes and to the Federal Government for income taxes.

Indirectly we see taxes of about 10 cents a gallon on gasoline and products. These taxes then generate the equivalent of $2.23 a barrel of tax revenue. This is a fairly sizable sum of tax revenue. It is quite possible that if percentage depletion were changed we would generate less resources and less tax revenue for the United States.

SLIDE 15

We'll turn now quickly and briefly to the international aspects of petroleum resources. We see first the 1959 petroleum demand and supply by major areas. We will concentrate on the fact that the Western Hemisphere picture is shown at the top and the Eastern Hemisphere at the bottom. These areas are roughly self-contained. As you can see, the United States is a net importer of a million and one-half, but this comes from the Western Hemisphere.

The Eastern Hemisphere is in balance with about 8 million 600 thousand barrels daily or considerably less than the Western Hemisphere supply of roughly 12 million barrels daily.

SLIDE 16

This chart gives us the information on the distribution of population and reserves. On the reserve figures I might say that the numbers shown

are taken from world oil, and that you can get different estimates, particularly on the Middle East, which in this case is shown under other free areas, that may range higher than shown here.

The important thing, first of all, is to see that the United States has 6 percent of the population and 13 percent of the world's proved crude reserves. In other words, we are not exactly short. It so happens, however, that we are a large consumer, and relative to our consumption we are not as well backed by reserves as are some other areas. You can also see that the rest of the Western Hemisphere is in pretty good balance. The Western Hemisphere as a whole, with 14 percent of the population, has 23 percent of the crude oil reserves.

The Eastern Hemisphere has the great bulk of the population and the great bulk of the proved reserves of the world. The Communist areas, if you will look at their figures, have proved reserves that are less than those of the United States, and of course they have a much larger proportion of the world's population.

SLIDE 17

This chart shows us the development of world production since 1900, with the United States dominating the picture for a long period of time--then an increase in production from the other Western Hemisphere areas, and postwar from other Eastern Hemisphere areas. On the right we see the figures in terms of million barrels daily for the United States--7.1 million--for the other Western Hemisphere areas--

4 million--for the Russian areas, only 2.9 million--and for the other Eastern Hemisphere areas--5.5 million barrels daily.

SLIDE 18

We'll look now very briefly at energy in the Soviet Union, and start by considering their production of various forms of energy as a percent of the United States production in 1958. In coal they had about 93 percent; crude oil, 33 percent; natural gas, only 8 percent; hydroelectrics, 29 percent. Their program for the next seven years is a very ambitious one. They expect to have a major increase in their production of energy between 1958 and 1965, particularly in crude oil, which you can see is expected to be more than doubled, and natural gas, which is expected to increase roughly 5-fold. Coal shows only a modest increase. Hydroelectrics shows an increase, but is not large in relation to the total.

Note the figures also reported here for wood, peat, and shale oil, which are modest but significant figures in the Russian case.

Percentages of the total energy are also shown on the righthand part of the slide. You can see from this that by 1965 they, too, expect crude oil and natural gas to be more significant in their energy economy than coal. At that time they hope to have almost 50 percent of their energy from these sources.

At the bottom of the slide you will see some figures on the petroleum exports from the Soviet Bloc. They were running only about 100,000 barrels a day in 1955; 170,000 barrels a day in 1957; and roughly

335,000 barrels a day in 1959. They will tend to increase, and they are a factor of some importance because they can be used politically rather than just economically.

I hope these figures have not confused you unduly but have provided some basis for your discussion this afternoon. I think the charts and the information make it clear that energy is of vital importance to the economy of the United States and of the world.

Russia is engaged in an intensive drive to improve her position in terms of energy and in terms of economics, and to use surplus energy as an economic weapon.

The free world is equally interested in its energy position because of the significance of energy to its standard of living and to its security.

We in the United States are going to have some very interesting problems ahead of us as to our policies with respect to energy resources, and particularly oil and gas. Fortunately, in the past we have followed policies that have encouraged the dynamic development of our resources. In fact, I think we can say that petroleum is very much an American industry and that the technology of this country has been applied throughout the world by American companies and by other companies to develop resources.

The terrific job that has been done under a system of private and competitive enterprise speaks well for what we can continue to do

throughout the world. But it is going to be very interesting to observe this race in the energy markets of the world as time goes on.

Thank you.

COLONEL BLACK: Dr. Gonzalez is ready for your questions, gentlemen.

QUESTION: Sir, what part do the various State regulatory agencies play in the control of this industry?

DR. GONZALEZ: If you are talking about the conservation regulations, I am sorry that we really don't have time to discuss them adequately. The conservation of petroleum is a complex thing in a society such as ours where mineral resources are loaned to the owners of the land and you have competing ownership over the same oil fields. In order to prevent waste in the development of fields and in order to achieve equity among landowners, the various States have found it necessary to adopt conservation regulations to control the drilling of wells and the flow of oil and gas, because they affect the recovery.

These laws start off basically with physical engineering concepts, but have also had to take into account markets, because you can't separate the two. And the question of equity, for example, depends on the fair treatment of operators not only in the same field but in different fields.

As a result we have had proration to market demand in Texas,

Louisiana, New Mexico, Oklahoma, and a good many of the principal producing States. This is what creates a margin of reserve or shut-in producing capacity which at the present time is estimated to be about 3 million barrels daily.

For the moment this is larger than we probably need for an emergency and it is actually more than we could move with the existing facilities. The military have thought that it might be well to have a million to two million barrels a day, possibly a million and one-half, as a reserve when an emergency breaks out. That is about what we had when World War II started, and it proved extremely useful, because we were able to cut back drilling to make steel available for the purposes and yet increase our production very sharply.

The States have a very complex role in this question. I won't try to answer that question in full. I did give a paper recently on the economics of petroleum conservation, and if you are interested in it I'll see that some copies are sent here to your library.

QUESTION: During the war when we ran into a rubber shortage we developed synthetic rubber. What are the possibilities of adding to our petroleum resources by developing synthetic petroleum products, using coal, for example, as a base?

DR. GONZALEZ: Well, we know that we could make liquid fuels out of shale, and the technology exists. It's just a question of cost and time. With our present amount of reserve shut-in capacity, I think

it would be economically wasteful to talk about developing a standby synthetic shale industry. If the time comes, we can do it, and certainly in case of an emergency we could do it on a crash basis, because we know the technology.

QUESTION: Doctor, during the campaign the new President indicated that the depletion allowance perhaps should be reevaluated. Should this be done and be lowered, what impact, in your estimation, would it have on the future exploration of oil in the United States?

DR. GONZALEZ: Last year I had the privilege of testifying before the House Ways and Means Committee in their long sessions on taxation on this question of percentage depletion and petroleum production. The testimony runs to about 30 pages and the hearing went on all day. The transcript runs to hundreds of pages. Again, if you are interested, I am sure we can make this material available for your library.

But let me answer you briefly. The search for oil and the development of oil is, of course, a function of the incentive to put money into this search. As you can see, the incentive has apparently already been declining, and so there has been this decline in exploration and drilling. If percentage depletion is curtailed, then the incentive will be reduced and we would expect fewer wells to be drilled. So the net result of this would be, over a period of time, smaller development of the domestic resources of oil and gas.

QUESTION: I was interested in the comment on the percent of the

production of oil that may eventually go into the petrochemical field or other products. Maybe this is merely a byproduct area, but many of us are wondering what percentage of the oil will be used for other than direct energy purposes.

DR. GONZALEZ: The percentage of oil or gas used for non-energy purposes is fairly small--not over 3 or 4 percent, counting asphalt, lubricating oils, waxes, and specialties of all kinds, including the so-called petrochemicals--plastics, synthetic rubber, et cetera.

We think of the chemical business as a large and rapidly growing one, and it is, but the volumes in chemicals are measured very frequently in pounds. In this business of energy we think in terms of tons, literally. So, when you talk of the magnitudes that we mentioned here, for instance, in the United States, we are now approaching a consumption of 3.6 billion barrels of petroleum liquids a year. You translate this into tonnage and you come up with a rather staggering figure.

So the specialties that you are talking about will always be a fairly small cut of the total petroleum barrel. And they are available to us at the price they are, so reasonably, because we do have the broad base load of energy.

QUESTION: Doctor, one of the techniques for conservation that we have read about appears to be that of replenishment of depleted resources in given areas. Would you tell us something of the technological, economic, and perhaps administrative problems that are

inherent in the task of pumping back into the depleted wells and fields oil that we might acquire from foreign sources?

DR. GONZALEZ: You are inquiring about what amounts to a program of storing foreign oil in underground reservoirs. Actually, this doesn't make as much sense economically if we want to achieve the equivalent as perhaps trying to find some way of using foreign oil and holding some of the domestic production in the ground.

This is a very complex matter because you do have the issue of the impact of bringing this foreign oil in on the different operators individually. Let me put it another way. The Federal Government does happen to own some oil resources in Califonia. They own the Elk Hills Naval Reserve, for example. There they have chosen deliberately to hold that production back so that it is available, shut in. The Government can afford to do that. Perhaps you might visualize some kind of program by which the Government might buy additional fields and perhaps keep them on a standby basis for the future.

It doesn't seem to me that this is necessary when the industry is already forced to carry large reserves and capacity by economic circumstances so that without the Government doing anything this additional productive capacity is available to us. Perhaps the time may come when it would be economically attractive for the Government to engage in the kind of program that you visualize. But I would doubt that it would

really prove advantageous simultaneously to be producing some of our domestic wells and then bringing oil and putting it back in other fields. I think if we were to go that road it would make more sense to hold back some of our domestic production and use more foreign oil.

QUESTION: Your chart on crude supply indicated that imports are increasing at about the same rate as the supply from Texas is decreasing. Is this because Texas is unable to hold its position in the market percentage-wise, or is this a control factor?

DR. GONZALEZ: Texas could produce a great deal more oil, and the change in the percentage participation is simply a reflection of the fact that Texas, as the largest producing State, with the conservation laws that are most directly geared to market demand, has found it necessary to adjust its production to the competition from other States and from imports. As a result of this, we now have in Texas currently only about 8 producing days a month. That doesn't mean quite what one might interpret it to mean at first glance, because the restriction does not apply to all of the wells. There are perhaps half of the wells and half of the production in the whole State not subject to shutdowns. This is what we call marginal and exempt production. These 8 producing days apply only to the better wells. They are the ones that take the brunt of this adjustment.

The answer to your question specifically is that Texas could produce

a great deal more oil if the market existed for it.

QUESTION: This has to do with the Russian situation in their 7-year plan that you made reference to. Would you care to speculate on the capability of the Russian consumer to take up this increased capacity that you talked about over the 7-year period, versus the possibility that the Russians may be doing this for economic reasons of dumping it on other markets or throwing our own industry into chaos?

DR. GONZALEZ: I think the Russian plans have a two-fold objective. One is that they need more energy to carry on the industrialization of their country. As you know, Russia has built primarily an agricultural economy, with the majority of its people working in agriculture. They are perhaps where we were possibly in 1900 in those terms of urban and rural agriculture versus industrial. So Russia definitely needs a good deal more energy for her industrialization.

But beyond that I think it is fairly apparent that Russia has large petroleum resources that she visualizes using as an economic weapon against the Western world. So we do anticipate that the exports from Russia will increase and will become a source of trouble throughout the world.

QUESTION: What are the comparative costs of exploration in, say, Alaska in particular, versus other remote regions?

DR. GONZALEZ: Unfortunately, no one can really tell what costs

are until long after the money is spent on an exploration venture. Thus far Alaska, I would say, has been above average cost in foreign areas, certainly nothing to compare with what North Africa has proved to be, or the Middle East. Incidentally, North Africa is an interesting example of how time changes our concept of resources. Ten or fifteen years ago we would not have shown any resources in Africa. Now, of course, resources are quite significant. You may have noticed a 5-billion-barrel estimate. This is possibly just the beginning of what may be developed in North Africa.

QUESTION: Would you comment on the land subsidence in connection with the recovery of oil? I am thinking of Long Beach, California.

DR. GONZALEZ: I really don't know much about that, except that you have had some problems out there. This sometimes occurs due to the withdrawal of oil. I t can be controlled in some cases by an injection of water as you withdraw oil, so that you maintain the fluid balance in the reservoir.

I am not sufficiently familiar with the Long Beach situation to give you a definite answer.

QUESTION: In foreign countries the price of gasoline is much more than it is in this country. If the Federal Government were to raise the taxes on gasoline would this not drive more people into compact cars, with perhaps the result of stretching our petroleum? If so, how much could it be stretched out?

DR. GONZALEZ: If there were any cause for concern in the immediate future about our domestic resources of energy this might be one of the alternatives that the United States would consider. Bear in mind that it would affect not only the petroleum industry but the steel industry, the rubber industry, the construction of highways, and many other things. I was asked by a representative of one of the government committees whether I didn't think that we would have been better off in the United States to have started with the philosophy of imposing high taxes on petroleum to discourage its consumption early in order to stretch out the life of these resources. My answer to it was definitely not, because, if we had followed such a policy, we would never have had the development that we have had in the automobile industry, in the steel industry, in the machine tool industry, and in all the other industries that have stemmed from this mass production of automobiles.

This concept of saving resources for an uncertain future is a hoarding concept when you don't know what you are hoarding for. Technology changes so rapidly that 10, 15, 20, 25, or 30 years from now we may be using energy directly from the sun rather than from fossil fuels. Then, what good would it have served us to have hoarded ample resources and then find that we had forced ourselves to a course of action that in retrospect was quite uneconomic?

QUESTION: This question arises from one of your charts. Would

you explain the use of net assets as a basis for computing profits?

DR. GONZALEZ: Net assets of course simply refer to the total invested capital in the business, because you also have receivables and payables. You have to take this into account when you decide what the net investment is in the business. The measurement here is the traditional measurement of the profits related to the net assets rather than to gross assets. The gross assets are larger than the net. If you were to express these on gross, the rate of return would go down, but its significance would still be the same.

COLONEL BLACK: Dr. Gonzalez, it is always a sincere pleasure for us to have you here, primarily so because you are always so liberal with your thoughts and knowledge. I think that has been attested to here this morning. On behalf of the Commandant and the College, I extend our sincere thanks for your being here with us and taking time away from your business. Thank you.