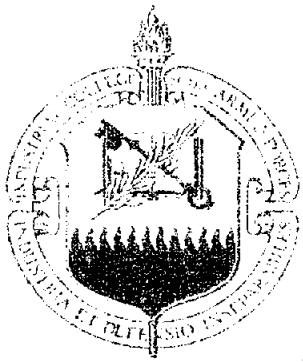

THE ROLE OF COMMERCIAL TELECOMMUNICATIONS SYSTEMS IN PREPAREDNESS FOR NATIONAL EMERGENCIES

Mr. Charles C. Duncan

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Reviewed by: Colonel Thomas C. Keach, USAF

Date: 17 March 1960

INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

1959-1960

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GENERAL HOUSEMAN: On this windy morning, if you will notice, the Army Signal Corps took over the first part of the morning and started our general thoughts along the communications lines.

Now we are going to continue discussion about communications this morning. We are going to take up commercial telecommunications, the telephone type, as far as they pertain to national security. It is not necessary to go into detail as to why commercial telecommunications are so important to us, but we in the military, and people in civilian life who are connected with government, either municipal or at the national level, are almost completely dependent upon telecommunications for the control of their activities.

That commercial dependence extends to the international sphere and beyond our borders, insofar as we in the military are concerned. The long lines of AT&T, American Telephone and Telegraph, are without doubt the all-pervasive and all-extensive system which completely blankets the commercial field in this area.

And of course it is appropriate that we get the man who is in charge of this activity to talk to us here this morning. So we are glad to have with us at this time Mr. Charles C. Duncan, Assistant Vice President of the Long Lines

Department of American Telephone and Telegraph . We are particularly happy to have you join us.

MR. DUNCAN: Thank you, General. It is a real pleasure for me to come back to this group again. I guess it isn't the same group.

GENERAL HOUSEMAN: We hope not.

MR. DUNCAN: I don't know whether it is a compliment or not. Maybe it's just the fact that the people said, "Well, if we had to listen to that ~~xxxxx~~ guy, let's inflict him on the next bunch, too."

General Power not long ago said to me, "Without communications I only command a desk." I think this dramatizes the role that communications are playing in the defense of the country, and certainly the role that the communications industry is playing, because a great deal of the communications that you are using for defense and for other government use are supplied by the commercial communications industry.

This industry, as you probably all know, covers a very wide field, including development, research, manufacturing, operation and maintenance of communications systems in this country, and between this country and other countries. The common carriers, as we call them, groups like the Telephone Company, Western Union, and people like that who are set up to give service to all comers, are made up of the Telephone Company, the Bell System. There are 3700 independent companies, Western Union, and International Cable and Telegraph carriers.

The assets of this group of people ~~is~~ are $25 billion. There are more than

two million share owners. This group of companies employ about a million men and women. There are about 60 million telephones in this country, which is a little over half of all of them in the world, and 23,000 telegraph offices. These communications companies furnish, in addition to message telegraph, message telephone, and similar services, a lot of teletypewriter exchange, private line service, telephone private lines, teletypewriter, telephoto facsimile, television, radio broadcasting circuits, telemetering, and circuits for the transmission of data. What we do is furnish circuits for this purpose. I said television. We do not furnish the television stations. We furnish the circuits connecting the stations. The same goes all across the board.

Actually, communications have become a part of our way of life. I guess our present way of life couldn't go on without communications. It's getting pretty complex. We are asked for new and unusual types of communications every day. We have to stop and tell ourselves what kind of services we are giving, because, when new kinds of services are multiplying so fast, that the people who are running the business have a hard time keeping up with them.

These requirements range all over the map. For one extreme you might say we have requirements for furnishing circuits to transmit the track of a guided missile as it is actually flying. On the other extreme, you probably have been reading in the paper lately that the Post Office is getting circuits from us on an experimental basis for the transmission of ordinary letters by wire. Those are two of the extremes of some of the

special services we are called on to give.

There are many many branches in the military field. Undoubtedly the military is our biggest customer. The Government is our biggest customer. I am not going to try to cover them all, but I thought that we might take a look at a few of them which are representative of the kind of services these commercial communications companies are giving.

(Chart)

This is just a very schematic chart, for security reasons. It covers the circuitry that is being set up for BMEWS. I guess you are all familiar with this Ballistic Missile Early Warning System. It has one station in Thule. I think 3000-mile range radars are being built there by RCA. There is another station at Clear, in Alaska, and a third station will be built over on the other side in the Atlantic.

The purpose of these radar stations is to observe any missile attack the minute that it gets above the horizon, roughly, 3000 miles away. As you know, it takes about 30 minutes for a missile to get from Russia to where we are standing, and during that 30 minutes it is necessary for our retaliatory planes to get off the ground, if we stand any chance of deterring the attack at all.

Thirty minutes is not very long. Each one of those minutes is probably worth a plane for every runway that SAC has. So it is important that the communications system between these outposts at Thule, Clear, and the other side of the Atlantic, and the communications system back to Colorado

Springs, which is the nerve center, will radiate out to SAC and all the air bases the necessary information. So this has to be absolutely reliable. You cannot have any interruption of this service. An interruption of 15 minutes in one of these things might mean a difference between survival of the country or not. To put it more bluntly, it might mean the difference between the survival of Russia and us, if they attacked us. So, if these communications could be interrupted for any extensive period of time, it might make a difference in the decision as to whether the country was attacked or not.

One of the fundamentals of the way of getting this reliable communication is, of course, that we are using the best possible types of facilities—submarine cables, radio relay, and other types of facilities--and, as you will notice, we are providing dual routes, separated insofar as possible, to the points, and there is a lot of diversity built into the routes themselves. I don't plan to go into that. So, if you have a failure on the one route from Clear, which comes down through Ketchikan, and through submarine cables back to the south 48 States, it is expected that the facilities on a new radio relay system being built through Canada will not fail simultaneously.

That is an illustration of one kind of service we are giving. It is interesting in this that there are a lot of communication companies involved. I mentioned RCA, which is building the radar detection equipment. There is the Western Electric Company which has a contract for providing the communications equipment. But there is a total of 15 companies altogether

working on this. There are 13 different groups including 15 companies and two of the military departments.

(Chart)

This is a different type of network. This is the n etwork that we are in process of providing for the Signal Corps. It is called SCAN. That means Signal Corps Automatic Network. This is a network of an ordinary type of facilities, a voice type of facilities, which can be used for voice, facsimile, teletype, and so on, at will, between any two points on the network, as you can see here. We have switching points at these places. These switching points are primarily to switch the private-line circuits that radiate out of those. These switching points at Gillispie, Thomasville, Frederick, and Santa Rosa are all in existing telephone company offices which are outside of target areas, and these are the private lines provided. If any of these private lines is overloaded, this network will automatically use the regular telephone message network. I want to talk some more about that a little bit later.

This is another type of switch network that is being provided for the military. In providing these facilities between these two points, we make a great deal of use of our express and bypass routes so that likelihood of the circuits being interrupted by bombing is reduced. I'll talk about that a little bit later.

(Chart)

This is another kind. This is where one man wants to say something to a lot of people and say it right now. It is not two-way conversation at all. This is to say to the SAC planes, "Get off the ground." This must be absolutely reliable. This is the network that we are providing between OFFutt Air Base, the three SAC headquarters, and all the various SAC bases. There are loud speakers in each one of the SAC bases, and there is a red telephone at Offutt. The general in charge there can pick up the phone and issue instructions to every SAC base instantly. This must be absolutely reliable.

There are alternate routes provided. You can tell by the different colors. So that if Offutt is destroyed, there is another alternate point, and you can reach all these places. Each one of the numbered Air Force Bases--March, Barkdale, and Westover--is independent and can operate independently. If one route goes out there is an alternate route. There are two circuits or different routes into each one of these places. There is a provision for sending out a tone on the circuit continuously, and this is checked back to the originating point, so that you know at any moment whether the network is intact. If someone interrupts one of the circuits immediately SAC Headquarters knows it. So that you have a guarantee that the circuits are in service, and you know they are there all the time.

(Chart)

This is another type of system that we provide. This is a national warning system provided for the Office of Civil and Defense Mobilization.

This is a backbone network that is used to send out warnings from Colorado Springs to the main centers of the country, and in turn to all sections of the country, saying that an attack is imminent, so that people can take shelter. This of course has to be a very extensive network and has to be in operation at all times. This is a telephone network backed up with a teletypewriter network.

(Chart)

This is a breakdown of the New York State portion. You can see how it reaches into every large city in New York State. You have similar places at other points.

These are just a few of the kinds of services that are being furnished by the commercial communication companies for the Government. There are many others. Western Union furnishes them. We in the Bell System furnish many others. I tried to pick some typical examples.

There is one thing that has always been a problem in furnishing any kind of communications system. That is that communication circuits fail. We do everything we can think of to improve the reliability, to improve our engineering and our maintenance, and we are able to cut down our failures materially, but we still have failures. They fail due to storms, fires, and floods. Even a farmer cuts a cable in his corn field sometimes, when he is digging a ditch.

The way that we get around this is providing diversity. If you have routes between two towns, circuits between two towns, part of the circuits

go on one route and part on the other. If you have a failure of one route part of them are still working. This principle of diversity is of prime importance in providing reliable commuhications. And of course this grew up automatically around the country as the country grew and communication circuits went from town to town. You automatically got a network all through the whole country which looks like a spider web, and it was practically impossible to cut off communications by the failure of any one route. When the Holland Tunnel fire happened we cut off a lot of communications out of New York, but not all of them. But we learned one thing from the Holland Tunnel fire, which was that we had to have some bypasses around our big centers of communication. We started that right after the Holland Tunnel fire a few years ago.

When we started looking at what would happen if all the big cities were bombed simultaneously with nuclear bombing, we realized that we had a very weak network, because all of our circuits, practically all of them, went through the centers of the big towns, and, consequently, if we took out all the big towns, we were in bad shape. So we started the system of building bypass routes around all these big towns, the target areas.

(Chart)

This is an illustration of how the bypass route works. Originally, before the green line was built around Omaha, all the circuits going through Omaha went into downtown Omaha and then out. So, if Omaha was destroyed, a lot of through circuits were destroyed as well. Of course, what we have

done is build a bypass radio relay route around Omaha to the north and on down, which connects up with what we call an express route. The difference between the bypass and the express route is that a bypass is more or less a ring around the town and an express route is like a through highway that goes across the country missing these big towns. The result now is that, if Omaha is destroyed, we will still have many of the through circuits that formerly went through Omaha continuing in operation because they are around on the bypass routes.

This shows how it ties into Offutt Air Force Base. It ties into Red Oak, and we are working now on a plan to tie it into this North Bend station, with an underground cable.

(Chart)

With our express and bypass routes--and I am going to show you a movie in a few minutes that goes into that in more detail--we got to the place where we could survive--the communications in the country could survive--an attack on all of our major target areas. But the art of war moves on and our problem moves on, too. One of the problems that we find is, with a possible missile attack on the country, the initial attack will probably not be the big towns. It will probably be such things as the SAC bases, and many of these are out in the country and many of these are close to our bypass routes.

So, looking at what we could do about that, to provide better communications to the country in case of attack on our bases rather than on the big towns initially, we came to the conclusion that our best solution is to put

some of our new main routes completely underground. This red line on the map is a project that we are starting. It goes from the eastern part of the country across the country. It is a buried cable. In the section between Washington and New York it will have a capacity of 12, 000 circuits. West of Washington it drops down to about 10, 000. The minimum capacity will be around 5, 000 circuits. It will be entirely underground. All the buildings and all the repeater stations will be underground. It will miss all known target areas, including all the military target areas. This project is just starting now.

(Chart)

Here is an artist's sketch of what we expect one of our buildings to look like. We will have one of them out here around Frederick, completely underground. This shows a junction building. It will be manned all the time. It will feed circuits into Washington and other places around here. It has protection against fallout. It has independent water supply facilities, food facilities, and so on, so that people can live in there indefinitely during fallout conditions.

(Chart)

This is an example of one of our repeater stations, amplifying stations, that are normally built above ground, every 3-1/2 miles along a coaxial cable route. This is how it will look underground. This, of course, will not be manned.

Last summer we made a movie. I am trying to summarize some

of these points and I would like to show it to you now to show you how some of these things tie together. This movie is entitled "Security for the Nation's Communications." It is an account of the facilities available and the measures taken by the Bell System to insure the continuity of communication during ordinary emergencies as well as under possible nuclear attack. (These include express and bypass routes, emergency power, automatic switching, and overseas radio and submarine cables.) A simulated exercise showing the operation of the Emergency Operating Center outside New York City points up these contributions to the reliable operation of service.

(Film)

Now, I have been talking largely about domestic communications. You have seen in this film that we are also involved a lot with international communications. I thought we might spend a few minutes talking about that.

(Chart)

This chart shows the countries that we reach by direct radio or cable circuits. There are some 66 of these countries and a total of 135 countries that we reach either directly or through switch services. They fan out from New York, Miami, Seattle, and San Francisco. Originally all these were high-frequency radio and now about half of them are in cable or over the rise in radio. All three of these means of transmission are used and will be useful, I think, for a long time.

High-frequency radio is the most practical way of getting to countries that are a great distance away, where we have only a few circuits. As most of

you, I am sure, realize, high-frequency radio is plagued with frequent interruptions through magnetic storms and there is also the problem of an adequate number of frequencies.

The over-the-rise radio system that we have to Cuba and that we recently installed to Nassau, and that is used very extensively in Alaska for the White Alice System, provides good service. It is not subject to as much interruption as the high-frequency radio. However, it has very definite limitations because it is a frequency hog. You are spraying the whole country with these beams that do go beyond the horizon, and consequently its place is in remote areas, like Alaska, and in over-water jumps. It has no place in the scheme of things as we see it intern ally in the United States, because of the frequency problem.

The submarine cables that have been developed in the last few years provide means of giving a number of circuits, very reliable circuits, which are not subject to frequent interruptions. But, of course, they are expensive. As you saw in the other picture, we have put in submarine cables to England, France, Cuba, and recently to Hawaii and Alaska. And we recently put one into Puerto Rico.

As an interesting little sidelight on that, we had to go to press with our advertisements about a month and one-half before this, and we had to put out our announcements and all the rest of it. At the time we were stating the date we were going to put it in service, the ship bringing half the cable

was still over in London. It had to come across the Atlantic and lay 1100 miles of cable. We sweated it out a bit. But the cable was put in service on time just 40 hours after the last splice was made.

The submarine cables, like all communications, have their troubles. Just a few weeks ago we had a trawler cut one of our cables on the Grand Banks of Newfoundland, about 200 miles out from Newfoundland, but, because we had two cables across the Atlantic and radio systems, because we had diversification and alternate routes, very few people knew that this cable was cut.

There was a total of 13 government private line circuits in these two cables. Six were in the damaged cable. They were restored almost immediately, within the matter of a few hours at most, and most of them were up in a few minutes. We normally have 48 circuits to London. We had 37 circuits working throughout the time of this break. We have 14 normally to Paris, and we had 13 working through the break. We have 20 to Frankfurt--these are ordinary message circuits--and 19 of them worked throughout the break. I think this is a good example of the benefits of diversification in our overseas service.

The trawlers are the greatest foe of submarine cables and we are working through the governments involved to see if we can't get the various governments, including Russia, to cooperate in avoiding our cables. One of the problems we have had on this is the fact that in the past we have been reluctant to tell the people exactly where the cables were. We sort of just

said, "Stay out of this area." Well, the area we were saying to stay out of was the Grand Banks in Newfoundland. To all intents and purposes, that's where the people are making their living fishing. So now it has been decided to tell them more explicitly where the cables are and ask the people to stay away from them. This is the biggest problem we have on submarine cables, the problem of trawlers.

(Chart)

I thought you might spend a few minutes looking at the developments in the submarine field. These are the types of cables. Our present submarine cables, which are the three on the left--that's all the same core -- have a central conductor with outer tapes around it, copper tabes, and outside of that we have varying sizes and strength of armor. The one on the left is the double-armored cable which is used in the areas that might be subject to ice floes, icebergs, and things of that kind, and right up close to shore in very shallow water. The next one is the type of cable we use across the Grand Banks of Newfoundland to try to minimize trouble from ships' anchors and trawlers. The next one is the type we use in the deep sea. The armor around the outside provides relatively little protection, but provides the strength we need to keep the cable from parting when we are laying it or when we pick it up. The kind of cable we have at the right is a new one that we are just in the process of developing. It has no external armor. The central core of the cable is of steel wire rope with copper around it and polyethylene insulation and an outer copper conductor.

The outside is polyethylene. This is just to provide mechanical protection. The strength wire is the center of the cable. This will be the type that will be used in the deep sea in place of the one next to it. With this new kind of cable we have some new repeaters.

(Chart)

Our old cable, the type we have been using over both oceans to date, has a flexible repeater. This is the repeater itself. It looks just like a piece of cable going over the sheaves out of the cable tank. It is flexible and it can be bent around the sheaves, around the drums. It has vacuum tubes inside of it, and these are located about every 39 miles across the ocean. There are 51 of these repeaters, and each repeater gives amplification of a million times. So there is overall amplification of 51 million across the Atlantic to England and a corresponding loss so that the voice comes out at the same level that you put it in. This gives us a total of 48 circuits on two one-way cables, one way for each direction.

(Chart)

We are building a new type of repeater, which is a lump repeater or a rigid repeater. This has the same kind of components in it but arranged differently. This will permit us to put about 128 circuits on a single cable. So with one cable now we will have more than twice as many circuits as we formerly had with twin cables. This enables us to economically place the cables in many places where we were not able to do it before, because this is naturally cheaper.

(Chart)

These are some of the plans going on in the world for the provision of submarine cables. The black lines to England, to Scotland, and to France are the existing cable systems across the North Atlantic. We have one going to Alaska, one going to Hawaii, one going to Puerto Rico, and one going to Cuba. The red lines are the ones that we are in the process of studying and negotiating. There will be another cable across the Atlantic of the new type. There will be another cable which we are looking at to Bermuda. There is a cable that we are considering to South America through the Caribbean. There will be a similar system across the Pacific. It may end up landing at a few different intermediate islands that we are talking about here, but it will go through Hawaii to Guam and branch out from Guam to such places as the Philippines, Okinawa, Japan, and Australia. We'll have another cable between the California Coast and Hawaii of the new type. The green lines on here are the announced plans of the British Post Office Commonwealth System for our submarine cable system that will literally go all around the world. We are working closely with the British Commonwealth people. We will have a great deal of diversity. For example, the cable will come across the North Atlantic, the Canadian-British cable. We are going to route some of our circuits for our Government in that cable. So we will have them divided among the three cables. This green cable will go in 1961, and the red one will go in 1963.

By the same token, out at Hawaii we expect that when this cable system

goes in we will have our cable terminals right next to each other in Hawaii so that they can get an automatic interchange of circuits. In case this system fails, we can go around through Australia and get there.

(Chart)

While we are building this cable system we are always building something obsolete. We have been building the twin cable systems long after we knew they were obsolete, while we were developing the single cable systems, and now we are spending hundreds of millions of dollars building the submarine cable system all over the world, and we are pretty sure that that will be obsolete by the time it is completed and that the system of satellite transmission will be in the act.

You probably all know what there is a project Echo that is going on with the laboratories and people out in California under the NASA group to transmit a voice circuit across the country, bouncing off an aluminized 100-foot balloon to be put up in orbit around the earth. This will be done in just a matter of a few weeks. The equipment will consist of transmitting equipment at Homedell, New Jersey, and receiving equipment there, and the same thing out in California.

Of course this one balloon that is orbiting around the earth will give you only a few minutes of transmission a few times a day, and the equipment set up originally will be a single circuit. However, this opens up the possibility that if, in place of putting up one balloon we put up say 25 of them in random orbit around the earth, you would be able to see only one of them.

In place of using the present equipment which is designed to give you a single circuit, there is no reason why, when some of the problems are solved of frequency allocations and such, that we couldn't put hundreds of circuits on them, maybe hundreds of circuits plus television circuits. So that we can end up by literally having worldwide television and worldwide communication by satellites. It doesn't have to bounce off of this type of balloon. We could have an amplifier built into the satellite so that it would amplify and transmit it back to earth. That's where we think it will be, and this is not in the too-distant future. When this is done this won't take the place of submarine cables; it will merely supplement the submarine cables. Just like our present submarine cables are not taking the place of our existing radio systems.

There are a few things I'd like to hit, a few things of general interest that I'd like to touch on and I think you will be interested in, in the communications field for the future. One very simple thing is that of all number numbering. We think that we are going to change out all of the numbers in the country in place of letters and numbers. My number is Manhasset 70254. It will be all numbers. This is a big step forward. It will permit us to have many more central office codes. As you know now there are some that we can't use. It will also help us a great deal on overseas dialing. We have the problem of the zero and the operators' code on European dials being different from what it is on American dials. We don't want to change all our dials and they don't want to change all theirs. If we have all numbering

this O and zero will no longer present a problem. This is being tried out and works very well. People can remember the numbers even better than they could remember the office names.

Another interesting item that is going on is electronic switching. We are putting an electronic central office in Morris, Illinois, and, while this is a glamorous thing that everyone thinks will spring into being overnight there are many problems on electronic switching. However, we expect these problems will be solved and that the trial that is being made right now will be a big help.

There is another system that we are working on. We haven't really got it named yet. We call it the Automatic Dataphone. Another term we use for it is line switching. What it amounts to is that we plan to substitute for many of the private line networks that we have now a thing that you might call extended area service. So that, if a person has a teletypewriter in his office, in place of that being connected up to teletypewriters by a private line network all over the country, he will merely send a code in the machine saying that he wants to talk to some other machine that is on his network, and this will automatically be switched on to the public message network.

What are the advantages of this? In the present system you have a private line system. If it fails any place the whole system is out of service until that section is replaced. That takes some time. In the present system, if you have a lot of people all trying to use the same circuit at the same time,

someone has to wait. By using the public message network, we have got hundreds and thousands of circuits between two points, so that the private line customer can get on that public network with his private line circuit, private line message, and get through instantly to any place on the network, and if his business goes up 10 times it doesn't make any difference--this system will automatically take care of it. It will be much faster and much more flexible than the present system.

We think that this has a great field in the use of government. It won't take the place of such things as SAC alert network and BMEWS, but it might very well take the place of some of the other government networks that are now relying purely on private line service.

So far it is being put in in the teletypewriter field, but of course it will expand into all other fields.

That's about the length of what I want to talk about on the normal communications job that we are doing. There are a number of special projects that the communications industry has been called on to do. I think you are all familiar with them. I thought I might mention a few of them.

For example, the Western Electric Company has been operating the Sandia Laboratories under contract with the Atomic Energy Commission, from the beginning.

We built a submarine cable for the missile range between Cape Canaveral and Puerto Rico, and we now plan to extend it on beyond. This was a special job that we did.

We built the White Alice facilities in Alaska and the DEW Line facilities, various companies. Western Electric Company built those, and IT&T, for example. Federal Electric Company is now operating them. That DEW Line, of course, extends on out to the Aleutians and extends all the way across the Atlantic.

I know you are all familiar with the Nike Project, including the Nike-Zeus, which is being handled by the Bell Laboratories.

The guidance systems being built for the ICBM's are being built by the Bell Laboratories and the Western Electric Company.

One glamorous project that we are working on right now is to provide communications systems all over the world to maintain constant communication with the astronauts when they are orbiting around the world in space. This is a joint system of Bell Laboratories, Western Electric Company, Bendix, Burns and Roe, and the IBM.

In all these systems generally the big communications companies are called on to act as prime contractors. But they use literally thousands of small subcontractors. It's a kind of partnership between big and little business, and I think that it works very well.

You fellows are probably thinking that I am up here bragging. We are very keenly aware of what we are not doing. We are not satisfied. We know that the government people are not satisfied with what is going on. We should never be satisfied. We can't afford to be satisfied. But I want to assure you in all seriousness that we are working at it, trying to do the job you want us to do.

Thank you.

QUESTION: Sir, we are very cost conscious here recently. I understand how you finance these strictly military installations, by contract and so forth. But how do you fund this underground installation and all these bypasses that you are now talking about?

MR. DUNCAN: Well, the underground installation and the bypasses specifically are funded by the whole telephone-using public. The bypass systems and the switching centers outside the towns--you saw one of them in the picture there at White Plains--cost about $150 million. There is no special charge at any one point. This underground cable system that you looked at is about the same order of magnitude, about $150 million. That is more expensive than putting in radio relay, for example, across the country. That simply goes into our overall rate base, and, in effect, every person who places a long-distance call pays a little bit to take care of it.

We do have some special charges. The SAGE System has some of them. We build facilities that are not used by the general public and can't be used by the general public because they are at some remote and isolated location. We generally have in there what we call a termination charge. This is strictly used by the Government, but it is a facility that we charge for at the regular rates. But we say that if you cancel this within 10 years you will pay a decreasing termination charge, with is one-tenth for each year. What this amounts to is, at the end of five years, if you cancel it, you will pay half of the cost, the non-recoverable cost, of building this plant. If you take the equipment out and use it someplace else, you have

some non-recoverable cost of labor, and so forth, in building the original one. This is a commitment made by the Government people for that special service. In a few cases we have a special-construction charge. The cable that went from Offutt out to Red Oak is 10-feet deep, and the Government paid as a special-construction charge the difference between the nominal depth of 30 inches and the 10 feet that were stipulated, because that was a special thing.

QUESTION: Sir, regardless of the number of automatic features that you build into your warning system, you still have to rely on personnel in many places, in key spots. Would you say a few words about the security checks, safeguards, and things of that sort that you employ to avoid sabotage to your system?

MR. DUNCAN: We are very conscious of this thing. I guess no one could say that we are 100 percent sure. I doubt if we are 100 percent sure, though, that all the people in this room are completely security checked. We don't know. The closest we can come to this is to say that our experience has been--I think we have some 3,000 people checked for Top Secret for one project--that of 3,000 people--and this was a pretty thorough check--there were something like five people who were questionable, and no one of those was questioned on the grounds that he or she was Communist. These five were questioned because this man drank too much and talked in the bar, and that sort of thing. All those five, of course, are off that job, and some of them are out of the company. We are very conscious of this all the time. I doubt, with the complexity of our system, that

a spy could do much harm.

QUESTION: Sir, this is really a two-part question. (1) With a such monopoly/as you have, how have you avoided the atrophy that usually such comes with the sort of operating philosophy which has made it/a viable system? (2) How have you avoided the brickbats that normally come even though you may be viable?

MR. DUNCAN: I wish I could agree that we have avoided both of them completely. We haven't avoided them. It is a problem, of course, in any big organization, and, even if we were a monopoly, which we are not--but in some respects we are--we have this problem. This is largely by internal competition. We have a great deal of very keen internal competition, the very simple kind of competition that you have in the military forces. If this man is better than you are he is going to get promoted. If you are not good enough to do your present job you are going to get demoted. This kind of internal competition is very keen in the Bell System and it has helped a great deal.

On the question of brickbats, we think there are some unjust brickbats thrown at us, very definitely. We think that it is not to our interest to take a short-term view of things and it is not to the interest of the country to take a short-term view. Consequently, we have no real conflict of interest. We are not out to make a quick killing. The stockholders in the Bell System are a million and a quarter people. In the present Bell System a stockholder doesn't have any big block of stock, so he can't expect a big dividend cutting proposition. It wouldn't help him. So it is to our interest

and the interest of all the management people in the Bell System to look at the long-term pull. This helps a great deal on this brickbat question.

QUESTION: I think, after viewing the slides and the movie you had here for us, that all of us in the room would wish that the Fort McNair telephone exchange operators had the same efficiency. This is my question. To go back to the inquiry about security in the security check, is this done by an agency or organization within your company, or do you rely on the Federal Government to assist you? Just how is this done?

MR. DUNCAN: The security check that I mentioned was all done by the Federal Government, on Top Secret clearances. We don't do it. We have our own security group. In our long lines our security man is an ex-member of the FBI. We are constantly jacking ourselves up on our own security measures. We fire the guard every once in a while at the doors of our building because he let one of us walk by because he knew us. We have to do this constantly. I was checked yesterday for the fifth time by people from the FBI who come around talking to people in our building. I had another questionnaire to fill out. This was for some new group that I am associated with in the Government. The security checks I mentioned were all government security checks.

QUESTION: Sir, recently a distinguished speaker from this platform stated that the problem facing our more sophisticated communications today is in the allocation of frequencies. Is this a problem in your company? Do you think the measures being taken are satisfactory to solve the problem in the near future?

MR. DUNCAN: I think this is a very great problem. It is a problem that we have been very vocal about, this decision of the FCC to throw the field open in the so-called above 890 case. Very frankly, I think that the future of satellite transmission depends on not cluttering up the frequency spectrum. There are not enough frequencies to go around, looking into the future. Let me give you an example. This satellite transmission, to provide the worldwide system we are talking about, will take about 2,000 megacycles of frequency space. Whether that is clear frequency space or not, no one knows. We know that these receivers have got to sweep the horizon. If some one has a private system that is shooting into this thing, when it gets down there it is going to knock it out. The balloon, or the transmitter, that is up in space may be 22,000 miles away, or certainly at least 2500 miles away. With a very small output, that is going to be matched by some local thing, and we are going to have to have zones of silence around these receivers. I think the frequency problem is an extremely difficult one. I think we don't have enough frequencies and that anyone who feels we do is simply sticking his head in sand. That's one reason why we developed the submarine cables. It's one reason why we are working on very many things to conserve frequency space.

QUESTION: Since you have indicated that you have been checked recently on clearance, I feel free to ask you this question. You mentioned the fishing boats up on the Grand Banks cutting one of your cables a few weeks ago. I believe that 2 or 3 years ago there was some cable cutting

up there, too. I had duty up there for a while, and I know that these fishing boats are fishing, all right, but they are also equipped very elaborately for lots of other things. The Canadians came up with the theory, the Canadian intelligence people, that the submarines and the fishing boats, acting in conjunction, were seeking out areas of cable crossings to be used as fixes for launching missiles from submarines. I wonder if the cuttings that you have experienced to date have given any credence to this thought. Then I have another completely different tactical question. These cables that have tubes in them have to be brought up to replace the tubes. How do you repair a break in a cable?

MR. DUNCAN: One thing I want to make clear is that the cables I was talking about were all telephone cables. There are many more cables that have been in existence since our field built the original ones, the telegraph cables, and we have had a great deal of experience in that. The cutting of cables by trawlers has been going on long before the Russians got in the act. Five or six years ago I was in Newfoundland, and at that time there were 10 telegraph/cables operating out of Newfoundland and they had all been cut almost simultaneously, and with no war problem at all. This was from fishermen trying to get rid of these pesky cables that were tangling up their nets. I don't think that any of the cables that have failed so far have been the result of deliberate sabotage. I think they have been cut deliberately--I draw that distinction. I don't think that the Russians are stupid enough to put us on our toes on this question by going out and rehearsing

the cable cutting. I don't think it is too good a way to sabotage the cables, to go out in a trawler for them. We can't pick them up the minute we want to repair them. You have to make several passes over them. And, obviously, with a system like BMEWS feeding to the cable, you would have to time this thing to the split-second. If you cut the cable 20 minutes before, you set off the missile. You are warning everybody, because the instant one of these cables is cut the whole system in the country is put on the alert. So you have to time it exactly, and I don't think that deep-sea operations are operations of that kind.

I think is is simply fishermen. They tangle it up. They pick it up. They tangle the cable and their gear. They have been told both through the law and otherwise that we will pay for the gear if they will throw it away, but the simplest thing for them to do is to cut the cable. I think that is just what it is. It has been going on since the beginning with the telegraph cables and the trawlers. I think it is as simple as that.

I believe we do get a good deal of cooperation. We got a telegram from a Russian mother ship which said that they picked up a cable off Newfoundland and asked us to please send a cable ship out to free it. It turned out that this was an abandoned French cable. We sent a telegram back to **them** and said that the French government gave them permission to cut it. While this was happening we were having a failure off the Coast of England. We have had four failures up to now on cables. The failure off the Coast of England was, I am sure, because the cable was cut by a

British trawler. It was an American-British cable.

I don't believe that their intention is sabotage, but there are different schools of thought on it. Two out of four have been cut intentionally. The last one was broken and a mile away it was cut. It was evidently picked up, and all in between was fouled.

You asked the question about how we replace the vacuum tubes. These vacuum tubes are designed to last a minimum of 20 years. We actually have prototypes of them burning in the laboratory for 20 years. Whenever they fail we will simply replace the repeater by grappling for it, picking it up, cutting it, putting a new one in, and throwing the old one away.

STUDENT: Are you able to tell where the repeater is?

MR. DUNCAN: We know which repeater it is. We will know which one has failed. Only one repeater has failed so far, and that was on dry land in Havana. It is being shipped back. We had a heck of a time getting it out of Cuba. We had it shipped back and they are in the process now of dismantling it to see what has failed. Out of several hundred that have been built, that is the only failure we have had.

QUESTION: Supposing I place a phone call to Moscow and the telephone company taps me about 15 bucks or so. Does part of this money go to the Russian phone system? Or how do you tie in with them?

MR. DUNCAN: If you place it here half of it goes to Russia and we get half of it. If you placed it, we'll say, from San Francisco, we would deduct from that line hall component a small amount for the line haul in

this country. The rest would be split fifty-fifty. The call to Moscow would be on radio. It's a very simple proposition. They've got their radio terminal and we've got ours, so it's a fifty-fifty division for everything. All our revenue is on that basis. When you get into cables, you of course have to have proper ownership and compensation arrangements, so that the cable usage ties in with the cable ownership. It gets a little bit complicated in the case of, say, one circuit being used in a cable to Rome, for example, a cable that is owned by the British, the French, the Germans, and ourselves.

QUESTION: Mr. Duncan, are you planning to send TV over the submarine cables? If so, when?

MR. DUNCAN: By TV I assume you mean real, honest to goodness, live TV. No, we are not planning to send over any existing design. First, one doesn't have the band wave. It is a 160,000 cycle band wave. The new cable we are putting in has a total of a million cycles, but we had to make a decision about two years ago as to whether we were going to have two million-cycle cables or one cable with a half-million cycles in each direction. So we decided to do the latter. It's much cheaper for one cable than for two. It enables us to get going all over the world in a hurry. We had to sacrifice the ability to transmit TV over it.

One problem on that is, if we did transmit TV, we would have to turn down all the telephone circuits. It isn't economically feasible to build a cable that would be used solely for TV. The new design won't have it, either.

Some of these days, if satellite transmission doesn't prohibit it, we might have a cable that can transmit both TV and message service at the same time. This would probably be transistorized. We do transmit what they call slow-scan TV. We are simply sending a picture every few seconds. We take 100 minutes to send one minute of a movie film. But this is not TV. The Queen's visit to Canada was sent that way.

COLONEL FORBES: Mr. Duncan, we are grateful to you for coming down here and giving us so much information so capably on such an important subject. On behalf of the Commandant, the faculty, and the students, thank you very much.