STANFORD ACCELERATOR POWER SUPPLY

HEARING

BEFORE THE

JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

EIGHTY-EIGHTH CONGRESS

SECOND SESSION

ON

STANFORD ACCELERATOR POWER SUPPLY

JANUARY 29, 1964

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STANFORD ACCELERATOR POWER SUPPLY

WEDNESDAY, JANUARY 29, 1964

JOINT COMMITTEE ON ATOMIC ENERGY,
CONGRESS OF THE UNITED STATES,
Washington, D.C.

The Joint Committee on Atomic Energy met, pursuant to call, at 10 a.m., in room S–407, the Capitol, Hon. Chet Holifield (acting chairman) presiding.

Present were: Representatives Chet Holifield, Melvin Price, Thomas G. Morris, Craig Hosmer, William H. Bates, and Jack Westland.

Also present: John T. Conway, Executive Director, Edward J. Bauser, Assistant Director, Jack Newman, staff counsel, Jack Rosen and Robert Hart, staff consultants.

Representative HOLIFIELD. The committee will be in order.

The Joint Committee begins hearings this morning on current plans for supplying the electric energy requirements of the Stanford linear accelerator project.

(The Joint Committee announcement of the hearing follows:)

JOINT COMMITTEE ANNOUNCES HEARINGS ON ENERGY SUPPLY FOR STANFORD LINEAR ACCELERATOR

An open hearing on current plans for supplying the electric energy requirements of the Stanford linear accelerator project was announced today by Congressman Chet Holifield, vice chairman of the Joint Committee. The hearing will be held at 10 a.m., on Wednesday, January 29, in the open hearing room of the Joint Committee on Atomic Energy, U.S. Capitol, Washington, D.C.

In these hearings, the committee will look into the latest cost estimates and plans associated with supplying electric energy to the Stanford linear accelerator project.

The Stanford linear accelerator project was authorized by the Congress in 1961, at a cost of approximately $114 million. When completed in 1966, it will be the world's largest electron accelerator. The first phase of the Stanford project will require approximately 100,000 kilowatts of electricity.

Witnesses representing the Atomic Energy Commission, Pacific Gas & Electric Co., Stanford University and the city of Woodside, Calif., and San Mateo County, Calif., are expected to testify.

Representative HOLIFIELD. We hope, in the course of these hearings, to receive information on the current status and schedule for this important project in the field of high energy physics.

Specifically, we will also look into the supply of electric energy for the Stanford project, the costs of this energy and the means of its transmission to the Stanford site.

The Chair wishes to welcome our guests from the Pacific Gas & Electric Co., Stanford University, the city of Woodside and San Mateo County, and especially the Congressman from that area, my colleague from California, the Honorable J. Arthur Younger.

We are going to begin by extending the courtesy of the committee to Congressman Younger in view of the fact that he has an executive meeting and he would like to go back to that.

STATEMENT OF CONGRESSMAN J. ARTHUR YOUNGER, A REPRESENTATIVE FROM THE STATE OF CALIFORNIA

Representative YOUNGER. Thank you very much, Mr. Chairman, and thank you for the privilege of appearing first because I do have to attend an executive meeting of our Interstate and Foreign Commerce Committee.

I would like to go back just a little bit to the hearings which were held before in regard to the granting of the authorization for the accelerator. These were the hearings held on March 8, 10, 11, and April 5, 6, and 7 of 1960.[1] I was quite concerned at that time because I had received protests concerning the possibility of this accelerator destroying the beauty of the countryside. While we wanted to have the accelerator, we did not want to destroy the beauty of the hillside. As you know, our section is essentially a residential section and not an industrial section.

At the time this was brought up, I talked to my colleague from California, Congressman Hosmer, in regard to this. I would like to read a section from those hearings.

Representative HOSMER. As I recall that was one of the architectural beauties of the West.

Representative HOLIFIELD. What page is that on? Do you have the reference?

Representative YOUNGER. It is on pages 410 to 416 and I am reading parts of it. They were speaking of the architectural beauties of the West.

Dr. GINZTON. We like to think so.

Representative HOSMER. This would be carried on in the same general spirit that the university has always carried on its construction activities, I imagine.

Dr. GINZTON. Yes, sir.

Then again—

Representative HOSMER. They are probably incomparable, anyway. Let me ask you this: Are you agreeable to working with the local county zoning people and those who have an interest in it?

Dr. MCDANIEL. I am certain that our engineers who will be in charge of the design criteria for this building will work very effectively with the local authorities and will not design an eyesore. I can assure you of that.

Later on he said he was asking these questions because I had requested him to do so.

Now I am assuming the Commission still has the same idea in mind and since the county zoning commission or the county planning commission and the City of Woodside Planning Commission have ruled against all methods of bringing the power in with the exception of underground that we can be assured the Commission will do what they can on that basis. I am assuming that they are going to do that.

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[1] AEC authorizing legislation, fiscal year 1961. See also JCAE hearings entitled "Stanford Linear Electron Accelerator," dated July 14 and 15, 1959.

The problem is, how are we going to pay for the extra charges in regard to bringing the power in underground as against the overhead tower system? I think there are at least two ways that can be done. It seems to me after talking with the engineers—and I know the P.G. & E. have made one proposition that they would pay for the cost provided the cost was put into the base rate, which is permitted by the California Utilities Commission. They are perfectly willing to do that.

There is another compromise that might be reached in view of the fact that this underground would be some 6 miles, 2 miles of which is parallel to the accelerator and should be on the campus grounds of Stanford that Stanford might pay for a third of it, the Commission pay a third and the P.G. & E. pay a third of it and take it out of their surplus and not put it into the rate. That is a possible compromise.

But in any event I think neither the Commission nor the committee wants to do something to which the people in the county, the people in the locality, and the elected authorities in that area are violently opposed. That isn't the way I think we want to operate.

The Commission has already, I think, put in some $220,000 to beautify the area alongside the accelerator. I think they have gone to some expense to put the accelerator partially underground rather than overground. I understand that cost a little more, but they were willing to do it. It seems to me it would be rather pennywise and pound foolish, after trying to make this whole affair acceptable and not a detraction to the area, to go ahead on top of that and put in a lot of big towers or poles that are going to be distasteful to the people in that area.

I am hopeful that the Commission can sit down with the people out there and with the P.G. & E. and work out a satisfactory solution to this problem.

Representative HOLIFIELD. Thank you very much, Congressman Younger, for your testimony on behalf of your constituents in this area.

The committee, of course, has called this meeting at the request of the people in the area. Their representatives have appealed to the committee to place all of these facts on the record. We do want to put the facts on the record and we will hear testimony this morning from the P.G. & E., from the Stanford people, and from the AEC. We will take a very careful look at the record when it is completed.

Congressman Hosmer, do you have any questions to ask?

Representative HOSMER. I would like to express my appreciation for Mr. Younger being here this morning.

As far as the questioning quoted from the previous hearings is concerned, at that time it was my understanding that the community was somewhat alarmed that the installation itself might be of an ungainly nature and my questions to Dr. Ginzton were in that context. Subsequent to that time this powerline issue developed. I still think that every effort should be made to accommodate the esthetics of the situation to the practical necessity of the power.

The thought occurs to me that if additional expenses are involved, as you brought out in your testimony, perhaps the solution lies in working out some equitable arrangement for somebody to bear them inasmuch as the Federal Government's investment here and the kind

of work it attracts certainly is of value to the community. Therefore, for that value perhaps the community has some obligation if it desires certain restrictions and constraints be placed upon the powerlines. Some cooperative arrangement might be made.

Representative YOUNGER. Mr. Chairman: I agree with you, Mr. Hosmer.

Here we have gone to some expense to try to get the architectural design and the installation to fit into the beauty of the landscape. My theory is that it is just penny wise and pound foolish to go ahead and put up a lot of towers that are going to destroy everything you have already done. They might as well not have done anything in regard to the accelerator. That is the way I feel about it because this thing is going to be here for more than 2 years, 3 years, or 4 years. This is going to be here probably for 20 or 30 years. We don't know.

Representative HOSMER. However, in the design of the accelerator and the accompanying buildings, the features that were included of an aesthetic nature were not of a costly nature. Here we have something in excess of a million dollars involved.

Representative YOUNGER. That is right, but a cost in excess of a million dollars when you are dealing with $114 million is not a large percentage on the original cost. Certainly when you are spending $114 million, which I understand is the ultimate cost of the accelerator, you would not want to destory its appearance by putting in a pole line or a tower line or something of that kind that is going to detract from the whole operation.

Representative HOSMER. That is true, but the difficulty here is that the Government is not the entity that is putting in this powerline.

Represenative YOUNGER. The P.G. & E. is perfectly willing to put it in provided they can put it into the rate and get something back on it.

You have another situation in the contract there. As you well know they have a contract to wheel power—Bureau power in there at 1 mill. There is no assurance so far as P.G. & E. is concerned that within 2 years or 3 years or by 1972, when the accelerator will be using not the maximum but only 180 megawatts.

Representative HOSMER. Thousand kilowatts——

Representative YOUNGER. Then they will probably have Bureau power and say "We are the preference customer and P.G. & E. should wheel all this power in." If you can give some assurance to P.G. & E. that you are going to buy power from them in some kind of a contract, it would seem to me that P.G. & E. are not going to fly in the face of all the people of San Mateo County.

Representative HOSMER. That is an interesting question. I don't know whether P.G. & E. has under the California——

Representative YOUNGER. Yes, they have a contract——

Representative HOSMER. In a rate-fixing operation whether P.G. & E. has this discretion to engage in extra expense.

Representative YOUNGER. After talking with their engineers, I understand they have a contract to wheel power from Tracy into the area at 1 mill per kilowatt. They are doing the same thing for Palo Alto.

If the Bureau later on has ample power—by the time they need their maximum—there is nothing to prevent the AEC from saying,

"We are a preference customer. Therefore we are entitled to complete allocation of our needs." So P.G. & E. will have to wheel this power in, that is all.

Representative HOSMER. Yes, but that one mill wheeling rate is not going to help them if they put in an extra million dollars.

Representative YOUNGER. That is the reason I think if we could get some kind of assurance they are going to be able to sell power at the industrial rate that probably some solution could be reached. But they don't know what their rates are going to be.

Representative HOSMER. We are anticipating probably the P.G. & E. witnesses but I don't know whether they have any discretion to go and incur extra costs over what would be the normal costs of transmission lines witout making some arrangements to recoup.

Representative YOUNGER. The California Public Utilities Commission, as I understand it, is perfectly willing to allow the additional cost to be in the fixed rate. They will not allow it——

Representative HOSMER. That throws the whole thing back into a Government installment plan.

Representative YOUNGER. That is correct, but they can fix the rate in that way.

Representative HOLIFIELD. You spoke a minute ago about their using some money in a cooperative arrangement out of their reserve which would not be included in the rate structure.

Representative YOUNGER. That is right.

Representative HOLIFIELD. Is there a possibility along that line?

Representative YOUNGER. I think there is. I don't——

Representative HOLIFIELD. I think that is what you were thinking of, Craig.

Representative YOUNGER. I have no commitment on their part. Certainly P.G. & E. isn't going to fly in the face of all the people in San Mateo County. They are not in that business. It seems to me we ought to be able to work something out that would be satisfactory.

The biggest beneficiary of this whole thing is Stanford University with a big experimental station, but it is going to be in our county. The cost of operation will probably be around $30 million a year, as you have told me, and this is a very fine allocation of funds to that area. Part of it will be spent in Palo Alto and part will be spent in our area. Those scientists will live there and we like it. I say it is a good thing, but we should not spoil it now by putting in something that is going to make everybody very angry. I don't think that is good public relations for the Atomic Energy Commission, for P.G. & E. or for anybody. Certainly we ought to be able to work out a deal here that would satisfy these people.

Representative HOSMER. If we were to raise their power rates enough to pay for this thing?

Representative YOUNGER. That is all right.

Representative HOSMER. Would that satisfy them?

Representative YOUNGER. I don't care how you do it as long as you work out some kind of a deal here that is going to supply the necessary power, but is not going to fly in the face of all the people who live there.

That is one of the finest residential sections we have probably in the whole area. They have very fine homes. They pay lots of taxes. I would say probably Woodside pays more income taxes per section than most any other section in the country. They are entitled to real consideration and I am appealing to you to give them that.

Representative HOLIFIELD. The chairman wishes to state before you leave the stand that you have been most diligent in representing the interest of your constituents not only now, but in the previous hearings in 1960 to which you referred. At that time you presented to me a telegram which was addressed to the Senate and House Atomic Energy Committee. It was read into the record and appears on page 412 of the hearing.[1] You have spoken to me about this matter in the interim period and you are here this morning representing your constituents. We express our pleasure at having you here and appreciate your testimony.

Representative YOUNGER. Thank you very much, Mr. Chairman.

Representative HOLIFIELD. I think we will start now with the Government agency responsible for the construction of this. I understand Commissioner Ramey is here to make the presentation on the part of the Atomic Energy Commission.

Will you introduce your associates?

STATEMENTS OF JAMES T. RAMEY, COMMISSIONER; GEN. A. R. LUEDECKE, GENERAL MANAGER; EDWARD J. BLOCH, ASSISTANT GENERAL MANAGER FOR OPERATIONS; DR. PAUL W. McDANIEL, DIRECTOR, DIVISION OF RESEARCH; HERBERT L. KINNEY, SPECIAL ASSISTANT TO DIRECTOR, DIVISION OF RESEARCH, ATOMIC ENERGY COMMISSION

Mr. RAMEY. Mr. Chairman, as I understand it, the purpose of this hearing is twofold. One is to get some general background on the status of the accelerator project at Stanford and the other purpose is to consider this powerline problem.

Dr. Panofsky is here and he will give you a picture later on of the status of the project and we will supplement that to whatever extent is necessary for the record.

Representative HOLIFIELD. All right, but let's go into this matter of the supply of electrical energy which is of primary interest right now. Of course we are always interested in the status of the program, but if it is a long technical presentation we would like to postpone that until we get the information on the electrical supply.

Mr. RAMEY. Yes, sir. General Luedecke will give our statement on the electrical problem and Mr. Bloch will assist. We also have our technical people here.

Representative HOLIFIELD. Fine. General Luedecke.

General LUEDECKE. Mr. Chairman, in presenting material this morning on the problem of providing power for the Stanford Linear Accelerator Center, the Commission wishes to establish the background and context in which the present impasse has arisen, and then discuss the alternatives that we apparently face. As mentioned by Mr. Ramey, Dr. Panofsky will give some information on the status of the project and the power requirements. We understand that the

[1] "AEC Authorizing Legislation," fiscal year 1961.

Pacific Gas & Electric Co. will describe the provisions of the power supply contract and review its efforts to obtain local governmental use permits for construction of the transmission facilities needed to serve the project.

On January 10, 1963, the Commission and the Pacific Gas & Electric Co. executed a power supply contract which included provision for the construction, operation and maintenance by P.G. & E. of (1) an overhead 60-kilovolt wood pole line to meet the project's initial power requirements during the construction phase, and (2) an overhead 220-kilovolt tap line running from a proposed P.G. & E. primary feeder (the Monta Vista-Jefferson 220-kilovolt loop) to the Stanford Accelerator Center. P.G. & E.'s execution of the contract is subject to approval of the contract by the California Public Utilities Commission and is conditioned on P.G. & E.'s construction of an overhead line along a general route known as the Searsville Route. (See map, p. 180.)

Representative HOLIFIELD. Let me be sure I understand this. The contract has been made, but it is not final and in effect at this time.

General LUEDECKE. This is correct, sir.

Representative HOLIFIELD. Does the finality of the contract rest only on the action of the California Public Utilities Commission?

General LUEDECKE. And upon P.G. & E.'s ability to undertake the work as I have mentioned.

Representative HOLIFIELD. P.G. & E. at this time, as I understand, is foreclosed from building this line as a result of the action of local bodies. Is that true?

General LUEDECKE. As of the present moment, yes, sir.

Representative HOLIFIELD. Is it P.G. & E. responsibility under the contract to bring this power to the accelerator?

General LUEDECKE. Yes, it is, sir.

Representative HOLIFIELD. Would you elaborate on that?

General LUEDECKE. Yes, sir. P.G. & E.'s contract provides that P.G. & E. will supply power to the project and the accelerator by either Bureau of Reclamation Power which they would wheel, or to the extent Bureau of Reclamation power is not available, power which they would supply from their own system.

Representative HOSMER. They are under contractual obligation at the present moment in any event to get that power into the Stanford campus. Is that right?

General LUEDECKE. Except, Mr. Hosmer——

Representative HOSMER. Subject to availability of route. Is that right?

General LUEDECKE. That is right. The contract states that—

> In event of the contractor's inability to construct said lines, as above set forth, the parties shall agree on such course of action as shall be mutually acceptable and shall modify any terms of this contract affected thereby.

Representative HOLIFIELD. So the contract is not a final contract and it is subject to modification in view of the circumstances that may be involved.

General LUEDECKE. Yes, sir.

Representative HOLIFIELD. All right. Proceed.

General LUEDECKE. Mr. Chairman, this map should assist in understanding the area involved, the location of the accelerator, and the routes of the transmission lines proposed. As of now the 60-kilovolt line has been installed and is delivering power to the project.

Representative HOLIFIELD. Does it come from the heavy line that you proposed to use in bringing in the 220 line?

General LUEDECKE. No, it does not, sir.

Representative HOLIFIELD. It comes from the general residential area transmission lines?

Mr. BLOCH. That is correct, sir.

Representative HOLIFIELD. What is the direction?

Mr. KINNEY. Menlo Park and Atherton.

Representative HOLIFIELD. What are the directions on the map? Is the right side of the map west?

Mr. KINNEY. This would be approximately northeast.

Representative HOSMER. Where is Sand Hill Road? (See app. 14, p. 180.)

Mr. KINNEY. Sand Hill Road is right along here. It parallels the accelerator and is slightly to the north of the accelerator.

Representative HOLIFIELD. As I understand it, the line we are speaking of comes from the southeast of the accelerator.

Mr. KINNEY. This is correct—the tap line.

Mr. BLOCH. Southwest, sir.

General LUEDECKE. This is west—to the left. We will cover those lines.

Representative HOLIFIELD. We are not concerned at this time with the pole line that will bring your temporary power in, are we?

Mr. KINNEY. No.

Representative HOLIFIELD. And that pole line is through a residential section to the site. Pole lines do serve the area that you have in pink on that map there. Those are all pole line transmission methods, aren't they?

General LUEDECKE. So far as I know, yes, sir. There are some distribution lines underground. I mention this as pertinent here because one of the alternates would involve beefing up this pole line. That is the reason it is mentioned in this statement.

P.G. & E. has recently completed construction of the Monta Vista-Jefferson 220-kilovolt overhead loop line running along the mountain ridge west of the project site. The problem arises in the construction of the 220-kilovolt overhead tap line running from the feeder loop to the accelerator center, a distance of approximately 5.3 miles along the Searsville route.

Last June P.G. & E. made application to the Woodside Planning Commission for a use permit for the construction of an overhead transmission line along the Searsville route. When this ran into serious opposition P.G. & E. made an application for a route along the proposed Junipero Serra Freeway. This application offered two alternatives—the conventional tower structures and a tubular steel pole construction, less obtrusive and slightly greater in cost. The general characteristics and costs of the lines are shown in the table attached to the statement submitted to the committee.

Route	Number of circuits	Type of construction	Capacity per circuit (megawatts	Property owners			Total (feet)	Total (dollars)
				Others		Stanford feet of line		
				Number	Feet of line			
Searsville (overhead):								
1a	2	Towers	300	6	12,000	16,000	28,000	668,000
1b	1	Poles	300	6	12,000	16,000	28,000	[1] 922,000
Junipero Serra Freeway (overhead):								
2a	2	Towers	300	35	22,000	7,000	29,000	951,000
2b	2	Poles	300	35	22,000	7,000	29,000	1,012,000
Canada-Whiskey Hill Rd.:								
3a	1	Underground	300	0	23,600	11,000	34,600	[1] 3,644,000
3b	2	do	300	0	23,600	11,000	34,600	[2] 6,440,600
3c	1	do	180	0	23,600	11,000	34,600	[1]2,640,000
3d	2	do	180	0	23,600	11,000	34,600	[2] 5,080,000

[1] These alternates will require the "heavying up" of the 60-kilovolt line to provide 30 megawatts of power. Such additional work is estimated to cost the AEC an additional $350,000 for SLAC terminal facilities. Present estimate is $130,000.

[2] 2 circuits same trench. Add $200,000 if separate trenches or later construction.

Both the AEC and Stanford University supported the P.G. & E. applications. Both applications were subsequently denied by the Woodside Planning Commission reflecting strong community pressures for an underground line.

The expressed opposition to the construction of an overhead line has been based on esthetic reasons and the lack of any benefit accruing to the city of Woodside. After the denial by the planning commission P.G. & E. filed an appeal with the Woodside City Council in accordance with established procedures. At the same time, however, in a further effort to reach a solution, the P.G. & E. proposed the construction of a compromise line along the Searsville route utilizing tubular steel poles with a single 300-megawatt circuit in place of the conventional tower structures. There was some hope that such a line might prove acceptable to the community. Based on this hope P.G. & E. filed new applications for use permits with Woodside and San Mateo County Planning Commissions. These applications were heard on January 22, 1964 (San Mateo County), and January 23, 1964 (Woodside), and both were denied. This would have been the 1(b) line on the chart here.

Representative HOLIFIELD. The one you have designated on the chart is the overhead 1(b).

Mr. KINNEY. Yes, sir.

General LUEDECKE. This is correct.

Representative HOLIFIELD. The Searsville line?

General LUEDECKE. That is right.

Representative HOLIFIELD. You show a cost of $922,000 on that as compared with $668,000 for the tower line along the same route.

General LUEDECKE. That is correct, sir.

Representative HOLIFIELD. Who offered this compromise?

General LUEDECKE. P.G. & E. offered it.

Representative HOLIFIELD. In other words they offered to go up some $200 and——

Mr. KINNEY. $254——

Representative HOLIFIELD. $254,000——

Mr. CONWAY. Also $350,000 for beefing up your other line.[2]

Representative HOSMER. I can't get any idea of where these alternates are from this map you are using with these blotches of green and white and pink and blue.

Representative HOLIFIELD. Let's go over it again and will you point out by name according to this chart.

Representative HOSMER. Will you bring the chart up closer here so we can see what you are talking about.

Representative HOLIFIELD. I notice there is a reference on the $922,000 to a footnote of $350,000. Would this be an additional cost to the AEC?

Mr. BLOCH. Yes, sir. This is a current estimate. All of the lines that would involve single circuits would require strengthening of the 60-kilovolt line to provide additional power for back-up in the case of outages and it is estimated that this would require around $350,000 [2] in additional terminal facilities, which we would build on the accelerator site.

Representative HOLIFIELD. Is this going to be built anyway regardless of how electricity is brought in?

Mr. BLOCH. That would not be built if the original plan of bringing in two circuits over the transmission line went through.

Representative HOLIFIELD. Then this alternate would involve the original $668,000, which would be adequate for the tower line, and $254,000 additional cost of the pole line which would be borne by the P.G. & E. I assume that amount along with the $668,000 would go into the rate structure. Is that right?

Mr. BLOCH. In connection with studying these alternates, Mr. Chairman, P.G. & E. have indicated they would be prepared to build these alternate overhead lines including the one along the Junipero Serra Freeway, 2(b) on the chart, which is estimated at $1,012,000. They would be willing to go that far at their own expense without any increase in rates of power to the Commission.

Representative HOLIFIELD. That $1,012,000 is for the freeway route which has been ruled out for some reason. Hasn't that freeway approach been ruled out?

Mr. BLOCH. The application for a permit along the freeway was rejected; yes, sir.

Representative HOLIFIELD. Was that objected to because of esthetics by the local people?

Mr. BLOCH. Yes, sir.

Representative HOLIFIELD. They don't want any kind of a line on the freeway or adjoining the freeway.

Mr. BLOCH. This is a proposed freeway. I don't know what the schedule is for building it, but it is several years off.

Representative HOLIFIELD. And the land that might be acquired is freeway land?

Mr. BLOCH. No, sir.

Representative HOLIFIELD. You are talking about a hypothetical case then really because you have no access to acquired right-of-way property. This is a theory rather than a possibility in view of the finishing date of the accelerator and the need for the electricity.

General LUEDECKE. I understand the plans for the freeway are definite, but it is correct the land has not been acquired.

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[2] Later estimates indicate a net of $130,000 in lieu of the $350,000.

SCHEDULE FOR POWER REQUIREMENTS

Representative HOSMER. In what year are you going to need the 180,000 kilowatts?

Mr. BLOCH. The forecast estimates that we might require 180,000 kilowatts by 1972, as I recall.

Representative HOSMER. When are you going to need this line for anything less? What is the outside date now when you have to get that line hooked up?

Mr. BLOCH. If the construction goes forward as scheduled, it is forecast we will need it for power by July 1965—power in excess of the 18 megawatts that we can get currently over the 60-kilovolt line. So we really need to move ahead now. We really need to be building the transmission to bring in additional power right now. We have about 17 months if the project schedule holds.

Representative HOLIFIELD. I don't think we can talk about the freeway route with any degree of realism in view of the fact that the rights of way have not been acquired. Therefore the acquisition—the legal periods to the time periods that would be involved would drag this out to where it would be impractical.

As far as this committee is concerned—as I see it—we can certainly refer to this as showing a disinclination on the part of the local people to accept even this type of access, but from a practical standpoint it isn't a practical alternative, is it?

General LUEDECKE. It doesn't appear so at this time, sir.

Mr. BLOCH. I believe—and P.G. & E. can speak to this in more detail—that they thought perhaps a powerline along this route, which would parallel the freeway and for which they would still have to acquire their own right-of-way to parallel the freeway, might be less objectionable to the citizens of Woodside than one would be coming down the hill inasmuch as the freeway was going through that territory anyway.

Representative HOLIFIELD. But we are talking about a time period that doesn't fit into the schedule?

Mr. BLOCH. Yes, sir.

Representative HOLIFIELD. It takes time to go in and acquire these rights-of-way. I suppose they would have to deal with a number of people in that.

General LUEDECKE. I believe there are 35 property owners.

Representative HOLIFIELD. How many do they have to deal with on the other routes?

Mr. BLOCH. Four or five.

Representative HOSMER. What prevents them from coming up from the south?

Mr. KINNEY. Over here?

Representative HOSMER. A little more to the west—somewhere over those hills. Do you have some more communities in there?

Mr. BLOCH. Communities and the microwave laboratory is in there somewhere also.

Mr. KINNEY. The radioastronomy laboratory.

General LUEDECKE. And you have a greater cost because of greater distance.

Representative HOSMER. Your towers will cost you a little more than $100,000 a mile according to this chart. You get about 5 miles

of tower for 1 mile of underground. I am just wondering if it makes too much difference in that context, unless there are some other geographical considerations.

Mr. BLOCH. As I remember the geography this would have to go through a builtup area. The shaded area is the town of Woodside. The area down below, the other shaded area, is the city of Palo Alto, but there is a community or there are communities in between those two shaded in the Portola-Los Altos Hills area. There are several small communities through there.

Representative HOLIFIELD. And it would be anticipated this same objection on an esthetic basis would be taken there.

Mr. BLOCH. You would have the same problem even from the people of Woodside because it would go along parallel to Woodside and undoubtedly they could see it and it would offend their esthetic sensibilities.

Representative HOSMER. Where is Canada Whiskey Hill? (See app. 14, p. 180.)

Mr. KINNEY. This is right through the center of Woodside.

Representative HOLIFIELD. We can assume the same objection has been made to that.

General LUEDECKE. This would be the proposed underground route so there would not be the same objection to that.

Representative HOLIFIELD. What are the distances involved there in comparison to the other distances?

Mr. KINNEY. About 7 miles.

Representative HOSMER. How many miles total compared to the other?

General LUEDECKE. 5.3 on the other.

Representative HOSMER. 1.7 miles.

Representative HOLIFIELD. Then at $1 million a mile that would be approximately $7 million if you come in underground on that route with a 300,000-kilowatt capacity; is that right?

Mr. BLOCH. And two circuits.

Representative HOLIFIELD. I am talking about double circuits.

Mr. BLOCH. Yes, sir; the estimate for bringing in two circuits which would be of comparable capacity to what was originally anticipated on the towers is $6,440,000. This is item 3(b) on our table.

Representative HOLIFIELD. With the descriptive term "Whiskey" in front of it. [Laughter.]

General LUEDECKE. Yes, sir; Canada Whiskey.

Representative HOSMER. On the Searsville route is there any possibility of running it partly overhead and partly underground when you get to Woodside city limits?

General LUEDECKE. P.G. & E. can speak more specifically, but I understand the changes in elevation are such that to put underground a 220-line through there becomes technically quite questionable.

Representative HOSMER. I see.

Representative HOLIFIELD. As I see the chart there on the proposed pole line route—do you designate that as the Searsville route?

General LUEDECKE. This is the Searsville route.

STANFORD UNIVERSITY REQUIREMENTS

Representative HOLIFIELD. There are about 2 miles running along the side of the accelerator there. Have the Stanford people indicated any antagonism to having a pole line through their grounds?

Mr. BLOCH. Early in the project the board of trustees of Stanford agreed that we could bring the powerline in on towers above ground.

Representative HOLIFIELD. On towers or poles?

Mr. BLOCH. Tower or poles—bring it in above ground overhead.

Representative HOLIFIELD. Has Stanford asked for any remuneration or any type of consideration for that privilege?

Mr. BLOCH. As I recall, our lease with Stanford further provides or gives us the right to bring transmission lines in over Stanford property. This is part of the lease and there is no provision or requirement for any compensation associated with bringing any lines in.

Representative HOLIFIELD. I have visited the Stanford campus on several occasions. It is a beautiful campus and certainly has a lot of buildings on it. It is to the northwest——

Mr. KINNEY. That is right.

Representative HOLIFIELD. The land is Stanford-owned land that goes out where the accelerator is, is it not?

Mr. KINNEY. Yes.

Representative HOLIFIELD. Apparently their sensibilities are not offended by this pole line that would be very near their campus buildings and they are willing to accept this in order to get the accelerator located on their property.

Mr. BLOCH. In fairness to Stanford, generally they would like powerlines on the campus to be underground. In this instance they recognized that in a line of this size that the costs were unreasonably high and they did not feel justified in requiring an underground line of this capacity.

Representative HOLIFIELD. I recently read that Stanford had been successful in raising over $100 million in their last drive for philanthropic donations. Apparently their sensibilities are not affected enough to spend some of that money to put the line underground. Is that right?

General LUEDECKE. They have made us no offer.

Representative HOLIFIELD. I think they have achieved a record in the United States in obtaining funds for the support of the university I noticed that in the newspaper.

They haven't offered to use part of that $100 million to put this underground on their property?

Mr. BLOCH. No, sir.

Representative HOLIFIELD. Proceed, General Luedecke.

General LUEDECKE. It was the sense of these denials that the line would be acceptable only if they were placed underground.

In view of the extent of this controversy, the P.G. & E. had studied several possible underground solutions to this problem. Four of these solutions are shown as 3 (a), (b), (c) and (d) on the table attached to the statement along a route generally referred to as the Canada-Whiskey Hill Route. (See table, p. 9.)

It is immediately apparent that underground lines are much more costly than overhead lines. Whereas the overhead estimates range from $668,000 to $1,012,000 for 300-megawatt dual circuits, the underground lines were estimated to cost $2,640,000 for a single circuit of 180 megawatts up to $6,440,000 for a dual circiut of 300 megawatts.

Representative HOLIFIELD. I am going to ask you this question and I will ask the same question of the Stanford people.

Could we stipulate for the record that it is logical and reasonable to expect that you will need between 250,000 and 300,000 kilowatts, say, by the year 1971 or 1972?

General LUEDECKE. I would like Dr. McDaniel to speak to that, sir.

Dr. MCDANIEL. Yes, sir; that is fair to say.

Representative HOLIFIELD. In other words it is projected and the accelerator can absorb that capacity on a full load basis.

Dr. MCDANIEL. We have every reason to believe that is correct, yes, sir.

Representative HOLIFIELD. And if you operated on less than that amount, you would not be getting the full use out of the $114 million capital investment. You would be getting less than capacity use.

Dr. MCDANIEL. I think this is true, sir. We know with a great deal of dependability the exact amount of power that will be required to operate the accelerator itself. Where our estimates begin to take on some degree of prognostication is in the use of power for experimental purposes. We have provided in other parts of the testimony a chart which will show our projected power requirements. Certainly by the time period that you mention we will need that type of power; yes, sir.

Representative HOLIFIELD. So for the purpose of this hearing we can stipulate this will be the eventual need in order to get full utilization out of the accelerator and therefore any discussion of a single underground line, which would cost in the neighborhood of $2,640,000, would be only on the basis of a temporary fulfillment of needs and not eventual fulfillment of need.

Dr. MCDANIEL. If you wish, sir, a rough estimate for the next 10 years, this would be about right. With respect to the next two decades I cannot predict what our power requirement will be, but certainly more than what we are saying here now. But for the next decade you are certainly right.

Representative HOLIFIELD. I am right on the figure of 300,000 for the next decade.

General LUEDECKE. No.

Dr. MCDANIEL. On the 180 megawatts for the next decade.

Representative HOLIFIELD. Your chart doesn't show that. Your chart shows a potential use. (See p. 19.)

General LUEDECKE. I think it is pretty clear, our requirements before 1971–72 will probably not be above 180 megawatts, but beyond that time I think it is clear that it will go above that.

Representative HOLIFIELD. In this chart that has been furnished us I notice a sharp surge in power from 1971 to the end of 1973. Is that carried out according to scale after it crosses the 220 line? If so, then it shows a need of 260,000 kilowatts by the end of 1973.

General LUEDECKE. Yes, it is at the same scale. I think the difference is in——

Representative HOLIFIELD. That is within the decade——

General LUEDECKE. I think the difference is in the firmness with which we can estimate the 180 megawatts as opposed to the firmness and timing that we could estimate that curve after the time.

Representative HOSMER. You have to get this accelerator running on the 180 basis before you know how rapidly you are going to add klystrons and so on. In other words, after she crosses the 220 line

on that chart we are referring to, it is all up in the air. We can anticipate some rather rapid increases assuming the accelerator works OK and assuming that we are persuaded to provide the funds.

General LUEDECKE. That is correct, sir, except the major requirement for power will be more dependent upon the extent of the experimental participation rather than on the accelerator itself. That makes it even more difficult to be real firm about which way this will go, but it is our anticipation it will go at about this rate.

Representative HOLIFIELD. All right, proceed. We wanted to know whether we are talking about a comparison of $1 to $5 million or $1 to $2.6 million. We want to know what we are talking about.

General LUEDECKE. The AEC considers that the major disadvantages of underground lines are: (1) Much greater cost, (2) longer time necessary for construction, (3) longer duration of outages, and (4) the creation of a precedent that could adversely be used against the Government in future situations.

The most economic proposal for undergrounding, namely a single circuit 180-megawatt line, has two additional serious disadvantages—a much reduced capacity and the impossibility of expansion without further construction. Should expansion become necessary it would require an additional underground line at an estimated cost of $2.640 million.

Representative HOLIFIELD. And such escalation as increased cost might demand within that time.

General LUEDECKE. As escalation would require.

In the latter part of October and early November the P.G. & E. developed alternate proposals for financing an underground line. These were in context of a single circuit 180-megawatt underground installation at an estimated cost of $2.640 million. Item 3(b) in the table reflects the situation.

In these initial proposals P.G. & E. agreed to increase their contribution from $668,000 (the cost of dual circuit overhead tower line along the Searsville Route) to $1,012,000, the estimated cost of a dual circuit overhead pole line along the Junipero Serra Freeway.

Representative HOLIFIELD. That would involve also the AEC adding $350,000 for terminal facilities.

AEC COSTS

General LUEDECKE. No, sir. That would still supply 300 megwatts dual circuit power so that other expansion would not be necessary.

This increase in contribution on their part would be without added charges to the AEC for power. The AEC would then assume the remaining cost of $1,628,000 with several alternate possibilities of handling such a cost. In one instance it was proposed that the AEC make a $1,628,000 capital contribution with a continuing annual special charge of $70,000. In a second instance it was proposed that the AEC obtain the rights-of-way, and construct and own a proportionate share of the line. The third instance proposed that P.G. & E. fund and build the entire line with the AEC required to pay P.G. & E. a continuing annual special charge of $199,430.

Thus as things stand today the AEC is faced with the choice of obtaining a less desirable power study at a considerably increased cost or assuming the responsibility of acquiring its own right-of-way by purchase or condemnation, and then constructing and owning its own overhead tapline to the accelerator.

While the Commission has not yet made a formal decision on this matter, it is difficult to justify the higher cost to the Government for a less desirable source of power.

Representative HOLIFIELD. Everybody is for economy and for the Federal Government to cut down on its expenditures, you know, until it affects their particular neighborhood or a particular project they are desirous of having in their community, it seems. We are accustomed to running into that frailty of human nature. [Laughter.]

General LUEDECKE. We are prepared to answer any questions the committee might have, Mr. Chairman.

Representative HOLIFIELD. Mr. Hosmer.

PRESENT INVESTMENT IN ACCELERATOR

Representative HOSMER. How much do we have invested in this project now by way of physical improvements on the campus?

General LUEDECKE. Dr. Panofsky is prepared to speak to that in his testimony, sir.

Representative HOSMER. I wondered—roughly.

Mr. BLOCH. Cost plus outstanding commitments as of the first of the year was about $31 million.

Representative HOSMER. In other words we have too much invested in there to pull out now?

General LUEDECKE. We have; yes, sir.

Mr. BLOCH. Yes, sir.

Representative HOSMER. So it comes down to the fact that we have to get power by the condemnation route unless something else can be worked out. We have to get our power in there. If the P.G. & E. can't get lines in we are going to have to condemn the property and put them in ourselves. Is that right?

General LUEDECKE. This is the alternative we face.

Representative HOLIFIELD. Does P.G. & E. have the right of eminent domain in condemnation? I don't speak of it from the standpoint of the Federal right but from the standpoint of a State right.

General LUEDECKE. I understand that they do, sir.

Mr. BLOCH. I would prefer they speak to that question. It is somewhat involved.

Representative HOLIFIELD. They may be in an embarrassing position in not wanting to irritate some of their customers in the exercise of that eminent domain.

Is there anything that you wish to add, Mr. Bloch?

Mr. BLOCH. No, sir. I think this pretty well summarizes our dilemma.

Representative HOLIFIELD. All right, if you gentlemen will step aside, we will have our next witness.

Our next witness will be Dr. Panofsky, Director of the Stanford Linear Accelerator Center.

Dr. Panofsky, we are very much interested in this whole approach to high energy physics and the importance of it, and we would like to have some testimony from you in regard to that. I am wondering, however, if we might not—in order to make your testimony completely germane to this problem—have you comment on this part of it and then possibly discuss the other part or we will call you back so that you may give us a status report and stress the importance of this accelerator project.

STATEMENT OF DR. W. K. H. PANOFSKY, DIRECTOR, STANFORD LINEAR ACCELERATOR

Dr. PANOFSKY. Very good, sir.

Representative HOLIFIELD. Then we will accept your prepared statement for the record and have it inserted at this point.

TESTIMONY PRESENTED BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY ON WEDNESDAY, JANUARY 29, 1964, BY W. K. H. PANOFSKY, DIRECTOR, STANFORD LINEAR ACCELERATOR CENTER

I very much appreciate this opportunity to appear before your committee. My testimony will deal primarily with the power needs of the Stanford Linear Accelerator Center. However, in order to put these needs in proper perspective, I would like to give some general testimony about the current status of the project.

GENERAL STATUS OF THE STANFORD LINEAR ACCELERATOR CENTER

As you know, the construction of the Stanford Linear Accelerator Center was authorized by the Congress in September 1961, at a total cost of $114 million. Ground was broken in July 1962, and other key dates are shown in table I. Through December 31, 1963, $31,744,000 (27.8 percent) of the total construction has been costed or committed. Table II gives a summary of the current fiscal status in terms of the current construction cost working estimate. You will note that a reserve for escalation and contingency of $18 million is remaining. Throughout the construction period this quantity has remained approximately as a constant fraction of the uncommitted balance of the project. At this time cost estimates on those items which have to be procured or contracted outside are quite firm. The largest remaining uncertainty is associated with the ability of our laboratory and our subcontractors to meet our schedule objectives and also our ability of converting the completed accelerator into an operational research tool in a short time. Our schedules still aim for April 1966 for the initial "shakedown" of the machine using an electron beam and operation in early 1967 for physics research. However, these dates can only be achieved with a very maximum of effort and in the absence of unforeseen delays. For this reason we consider it prudent to maintain our contingency in a constant relation to the uncommitted balance.

Four of the eight major buildings have been completed and occupied. The first third of the 10,000-foot accelerator housing has been constructed, and 1,000 feet of this has been covered with its 25-foot earth shield. On top of the shield the first 500 feet of the aboveground klystron building has been constructed. Design criteria on all the remaining major site items is completed; target area buildings are in title I or title II design.

We would like to note that we have paid particular attention to esthetic considerations in developing the site. Our buildings have been designed with the assistance of an eminent architect and are intended to harmonize with other construction on the Stanford University campus. Landscaping design within the budget originally contemplated has been proceeding and the absolute maximum of the original trees on the site has been preserved. All site utilities including the secondary power distribution from the substations are being distributed underground.

The design of the accelerator itself is approximately 55 percent accomplished while about 7 percent of in-place construction has taken place. Contracts for procurement of accelerator components totaling over $10 million, or about 25 percent of total procurement, have been signed. In-house construction of the final accelerator sections has commenced.

At present 715 persons are on the staff of the Stanford Linear Accelerator Center. The personnel is housed partially in the new buildings on the accelerator site and partially in temporary quarters on the Stanford University campus.

OPERATION AS A NATIONAL FACILITY

The fundamental objective of the Stanford Linear Accelerator Center is to contribute to the research program in high-energy physics. For this reason, in parallel with engaging in the construction of the accelerator, we have been building up an experimental and theoretical research staff aimed at putting the accel-

erator into productive use on completion of construction. Their work has been supported under operating funds of the Atomic Energy Commission.

A scientific policy committee has been established to monitor the work of the center on behalf of the scientific community at large. This group has held numerous meetings to discuss the progress of the center and to ascertain that the laboratory is evolving to operate as a national facility. In particular, the committee has ascertained that the relation of the buildup of research staff to the evolution of the facilities is such that adequate support to non-Stanford scientists can be provided.

ANALYSIS OF POWER REQUIREMENTS

Analysis of the power requirements has been made in relation to the schedules of the laboratory. These requirements have been continually updated as the schedules have become more firm. Figure 1 shows a curve of the anticipated power demand versus time. At present a 16-megawatt source at 60 kilovolts has been made available through an overhead line feeding the Stanford University campus from the network of the Pacific Gas & Electric Co. This source derives from the P.G. & E.'s feeders along the Bayshore Highway along the San Francisco Bay. By the beginning of operations of the accelerator center for research the project requirement will be 81.6 megawatts. Table II indicates the distribution of this demand over the various services. You will note that only about a third of this demand arises from feeding the accelerator proper; the balance arises from the needs for general laboratory support and for various auxiliary functions, but in particular for supplying power to the large research tools of the physicists.

We consider the needs as of 1967 to be firmly established. The combination of this table in connection with our schedules therefore predicts that additional power to the site will have to become available by the middle of 1965.

The power projections beyond 1967 as given in our figure are less firm. The bulk of the increase originates from the expanding needs of the physicists planning to use the accelerator as a research tool. Since the laboratory is being managed as a national facility—that is, partially as a service facility to provide support for outside users—we are obligated to supply power to such users without exact knowledge of their detailed plans for research. Estimates on the evolution of power requirements must therefore be based mainly on current experience with the evolving research techniques of high-energy physics. Research in high-energy physics using high-energy and high-intensity particle beams is being carried out with bubble chambers, large magnetic spectrometers, spark chambers placed in large magnetic fields, and similar devices. The factor in common to all these devices is the use of very large magnetic fields, large in intensity and large in volume. As an example, single magnetic spectrometers and single bubble chamber magnets can require power in the 20-megawatt range each. A load growth beyond 1967 as shown in figure 1 has been based on reasonable assumptions as to the rate at which the needs might expand to reach very-long-range power demands. We have analyzed the long-range projected power demands of the laboratory as a whole, and the figures are given in table IV. In this table the 1967 needs from table III are compared with speculative long-range needs. A part of the long-range power growth assumes the authorization and accomplishment of the accelerator in its stage 2 form. The larger part of the long-range demand forecast originates from the anticipated growth of the use of the accelerator by the scientific community as discussed above. The only item specifically dependent on stage 2 accelerator construction would be the entry under "klystron gallery" in table IV. With the exception of this item, the balance of the long-range needs is not specifically associated with stage 2 authorization but would depend primarily on the extent to which the scientific needs developing in using the accelerator would justify expansion of target area facilities and research support. Although the growth of the needs beyond 1967 is very difficult to forecast accurately, we believe that it is extremely unlikely that the level of 180 megawatts can be exceeded during this decade.

We are concerned with both quantity and quality of the power supply to the laboratory. In terms of quality, we are concerned with the "regulation" of the power supply—that is, the steadiness of the supply voltage under varying load conditions. From the point of view of "regulation" we are fortunate that the Pacific Gas & Electric Co. has developed a 220-kilovolt loop; by tying into this service, we obtain a source of adequate regulation. Supplying the needs of the

project at a lower voltage would be less satisfactory from the "regulation" point of view.

Because of the large investment in the accelerator project and because of the large scientific interest in using the machine we are concerned with reliability. The best method to achieve reliability would be by dual-circuit 220-kilovolt service. There are three alternate methods now being considered to provide power to the project:

(1) Dual-circuit 220-kilovolt overhead service on conventional steel towers; capacity, 300 megawatts per circuit;

(2) Single-circuit 220-kilovolt service on steel poles of lower height; capacity, 300 megawatts; and

(3) Single-circuit underground service; capacity, 180 megawatts.

We would consider single-circuit service acceptable providing the existing 60-kilovolt service is strengthened to provide power up to 30 megawatts. In the event of failure of the 220-kilovolt circuit, the laboratory could continue to operate at minimum level as indicated in table III.

Under the conditions of single-circuit service, overhead service is preferable to underground feeders from the point of view of reliability. Even though the chance of a failure for overhead and underground service is comparable within the limits of experience at hand for underground service, the duration of an outage in the case of underground service would be of the order of a month as compared to a few days for overhead service.

From the point of view of the laboratory, the dual-circuit 220-kilovolt overhead line on convention steel towers provides optimum service. However, the single-circuit line on steel poles and the single-circuit underground line would afford an acceptable solution provided it is accompanied by strengthening of the 60-kilovolt backup service to a demand capacity of 30 megawatts. Of the two single-circuit alternatives the steel pole solution is the preferable one from the standpoint of capacity and reliability of service. We recognize, however, that considerations other than optimum service to the laboratory may determine the choice of power system.

To summarize, then, SLAC will require additional power by the middle of 1965. Further, we believe that our demands for power will be satisfied by 180 megawatts until 1970 at least, although the very long range needs may well be larger. The responsibility for providing electric power to the project has been assumed by the Atomic Energy Commission. Therefore the decision concerning the choice among the various methods of providing service in relation to performance, cost, and public acceptance must be made by the Commission.

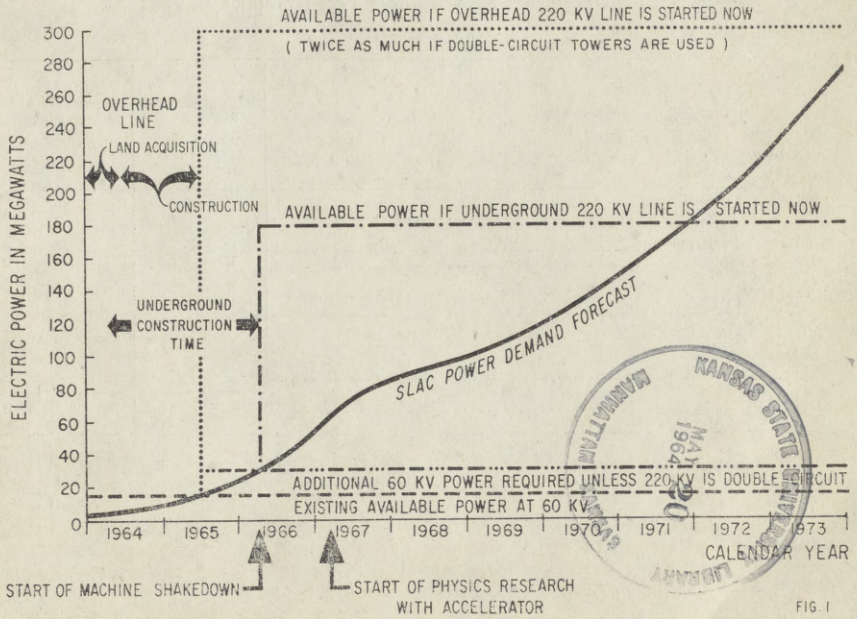

FIG. 1

TABLE I. SCHEDULE

1961 September, project authorized by U.S. Congress.
1962 July, start of building construction.
1963 May, start of underground housing for accelerator.
1963 June, completion of first building (test laboratory).
1963 August, completion of second building (administration and engineering building).
1963 November, completion of third building (electronics building).
1963 December, completion of fourth building (fabrication building); "pre-operating" contract signed.
1964 January, 3,000 feet of accelerator housing completed.
1964 March, start of accelerator installation.
1964 December, completion of all administration and laboratory buildings (all activities located on site); completion of underground housing for accelerator.
1965 December, completion of all accelerator buildings.
1966 April, completion of accelerator installation; electron beam turned on.
1967 April, accelerator ready for full-scale research.

TABLE II.—*Stanford Linear Accelerator Center, design and construction status as of January 1964*

	Percent complete		Working cost budget (dollars in millions)
	Schedule	Actual	
Engineering	62.0	58.0	$9.5
Stanford University	56.0	52.0	6.0
A.B.A.	77.0	73.0	3.5
Construction	18.0	15.0	71.6
Improvements to land and utilities	20.0	20.0	10.0
Buildings and structures	35.0	34.0	19.4
Accelerator structures	7.0	3.0	6.5
RF systems			9.1
Electrical and mechanical systems			13.0
Nonaccelerator equipment	21.0	19.0	13.6
Indirect costs of construction			14.9
Project contingency and escalation			18.0
Project grand total			114.0

TABLE III.—*Typical SLAC power requirements in 1967*

[In megawatts]

	Full operation (20 billion electron volts)	Minimum operation at reduced beam energy (10 billion electron volts)
Support and service area	11.3	4.0
Klystron gallery:		
Auxiliaries and cooling	8.5	5.0
Modulators	26.5	7.0
Beam switchyard:		
Auxiliaries	1.5	1.1
Magnets	3.8	.2
End stations:		
Auxiliaries	4.0	2.5
Magnets	24.0	9.2
Cooling	2.0	1.0
Total	81.6	30.0

TABLE IV.—*Long-range projected power demands*

[In megawatts]

	1967 needs from table III	Long-range needs
Support and service area	11.3	12.8
Klystron gallery:		
Auxiliaries and cooling	8.5	14.8
Modulators	26.5	96.5
Beam switchyard:		
Auxiliaries	1.5	3.0
Magnets	3.8	5.8
End station facilities:		
Auxiliaries	4.0	4.0
Magnets	24.0	64.0
Cooling	2.0	2.0
Colliding beam facility		10.0
Additional end station facilities		90.0
Total	81.6	302.9

HIGH ENERGY PHYSICS

Dr. PANOFSKY. I will try then to talk very briefly about the position the accelerator has in the entire field of high-energy physics. I will then very briefly give a progress report to respond to the question raised here as to what extent matters have progressed. But I will in the main body of my testimony deal with questions germane here, namely the schedule and magnitude of the power need.

Representative HOLIFIELD. I do not mean to reflect on you because I do think it is important that this record show the importance of the project to the scientific community.

Dr. PANOFSKY. Very good, sir.

Mr. Chairman, I very much appreciate the opportunity to again appear before your committee.

I would like to respond first to your request to discuss very briefly the whole field of high-energy physics and in particular the position of this linear accelerator project. The field of high-energy physics is, I believe, the most fundamental field of all of science because ultimately all other laws of nature, with a possible exception of the life sciences, will have to be explainable in terms of the behavior of the ultimate particles of matter, and high-energy physics deals with just these questions.

One of the paradoxes of high-energy physics is that one needs bigger and bigger tools to look at smaller and smaller things. In fact, science right now has two frontiers: to go larger distances with larger tools and to go to smaller distances with larger tools. Nobody has yet invented a way in which to avoid this dilemma. If we want to look at the structure of nature on a smaller and smaller scale, which ultimately has to explain how all of nature is built, we have to have bigger tools.

SOVIET HIGH ENERGY PHYSICS PROGRAM

The science of high-energy physics is an international activity. It is carried on vigorously and effectively in this country. It is carried on vigorously and effectively in the Soviet Union and it is carried on in Western Europe. The level of activity in this country

is comparable to that of Western Europe and the Soviet Union combined.

The lead in particle research has seesawed back and forth in the achieving of higher beam energies between the Soviet Union and the United States. However, in terms of productivity of results of really basic discoveries which will affect all our future views of nature, the United States has had unquestioned leadership.

In particular, in the last few years there has been discovered a whole new world at high energies—above 1 billion electron volts energy of acceleration there has been discovered a whole new range of spectral lines of emissions—states of nature which had never been expected to be there. We believe that similar to the way we learn about the composition of stars from spectral lines—from the lines which come from them; similar to the way we learn about the nature of atoms by analyzing the lines emitted by excited atoms, we are now learning about the nature of still more fundamental building blocks of nature by examining these newly discovered states, or resonances as they are called; these have been discovered during the last 2 or 3 years primarily in American laboratories.

The question which is often asked is: What does this all have to do with us? Do we understand now the link of our understanding of the small particles with the environment in which we live? In high-energy physics with these accelerators we are learning about fundamental particles. The study of fundamental particles will tell us what nuclei do and what the forces are between nuclei. Nuclei, in turn, give rise to the whole range of phenomena with which your committee deals; finally, nuclei make up the atoms which then, in turn, constitute our surrounding world.

It is true that over the course of the last 10 years nobody has found the link which really ties these new discoveries in the subparticle world to the field of atomic energy, but we know that this whole new world is there. It would be really a very remarkable surprise if nature had put in this whole new subatomic world just for fun without any kind of connection to nature as a whole, as we know it.

However, I believe it is true that no scientist can point a finger at this time to the specific way in which the study of high-energy physics can and will affect our immediate environment, our health and safety, our productivity, or any human affairs. All we know is that a whole world lies there which had never been suspected to exist. The question is, why it was put there. We do not know in detail how it links into the forces with which we deal.

At the same time, had we always looked at the immediate in the past, we would not have the present. It is for this reason that both in this country and abroad this kind of effort is being put into this field and is being pursued. I mentioned that the activity in high-energy physics is an international one. The high-energy leadership at present is held by the Brookhaven circular accelerator sponsored by the AEC. High-energy leadership will shift to the Soviet Union in approximately 1965 with a 70-billion-electron-volt machine—late 1965 is the present estimate, Mr. Chairman.

Representative HOLIFIELD. What is the projected power of that machine?

Dr. PANOFSKY. It will be a 70-billion-electron-volt circular accelerator located at Serpukhov.

Representative HOLIFIELD. What would be the power of the Stanford machine?

Dr. PANOFSKY. In terms of energy, the Stanford machine is of lower energy. It is a 20-billion-electron-volt electron accelerator, but of extremely high intensity.

Let me comment on this. There are two frontiers in this field: the energy frontier and the intensity frontier. I have not prepared charts on the matter, Mr. Chairman, but the scientific world has pushed at both frontiers. That means we try to reach higher and higher energies and at the same time to produce sources which have more and more particles which reach a given energy, because when you do experiments you need both. You need the energy to get above the threshold of these new phenomena, but you need also the intensity so that over the human lifetime you can make a sufficient number of observations to give usable answers.

Actually, nature in the form of cosmic rays has provided us with a source of particles which is of energy higher than both the Brookhaven Laboratory's or the Russian's Serpukhov machine. None of the manmade sources now in existence or planned by any country will exceed the energy in natural sources. However, the natural sources are of so low intensity that the experiments which can be done with them are exceedingly limited. So both things are important. The Stanford linear accelerator will be the world's largest on the intensity frontier but not on the energy frontier. It will be the world's largest in terms of the fact that it accelerates electrons and no protons.

It turns out that the different kinds of accelerators are not in competition with one another. There is no such thing as the best accelerator for all purposes. It is the same problem as the story in which one person asks his friend, "What shall I give my brother as a present?" The friend says, "Give him a book." But the other person replies, "He already has a book." The situation here is the same: The fact that there already is a 20-billion-electron-volt accelerator does not mean that the frontiers are covered.

One of the problems with this field is that we have to plan large enough steps so that we do not proliferate our efforts in too many small installations which will involve very large operating costs; at the same time we cannot necessarily justify extremely large steps because plans for further steps have to be based on rational plans and experience. It is this dilemma which the AEC, the laboratories, and the scientists are facing continuously.

Representative HOLIFIELD. Would you say the importance of this accelerator will be such that it will be the center of attention in this particular field of science in the world?

OBJECTIVES OF HIGH ENERGY PHYSICS

Dr. PANOFSKY. Yes, sir.

Representative HOLIFIELD. You spoke a few minutes ago about the frontiers that need to be crossed in this particular area. At the present time you could not, of course, predict the practical application either from a domestic utilization standpoint or from a national defense

standpoint, any more than we could have predicted the eventual application of splitting of the atom.

Dr. PANOFSKY. This is correct. As I said before, I believe there is nobody who can identify at this time the direct link to this world with which this whole field of science deals.

There are technical byproducts. But these, in themselves, are not justification for expenditures of this magnitude. There have been byproducts primarily because in order to achieve these energies we push the frontiers of the technology and because able and inventive people work in this field and because high-energy physics attracts our best academic minds. There have been important byproducts.

There has been, for instance, a great deal of computer technology based on early counting circuits of nuclear physics. The high-power transmitting tubes are based on early cyclotron work in the radiation laboratory at Berkeley.

Representative HOSMER. Mr. Chairman.

Representative HOLIFIELD. Mr. Hosmer.

Representative HOSMER. I would like to ask you a question in another way.

Dr. Panofsky, you have explained this in terms of the byproducts we get from actually conducting research. You have explained what you are after ultimately is an identification of the fundamental building blocks of nature. Not too long ago I read an article contending that this possibly amounts to no more than what could be conceived of as wormholes in a vast space-time turbulence. Assuming this turned out to be the case after your investigations were completed on all these high-energy machines, so what?

Dr. PANOFSKY. I think the statement you are referring to is one of several theories which recently have questioned whether the whole question about fundamental building blocks of nature has meaning. There is a possibility that the fundamental family of particles is there, but that you are dealing with essentially a chicken and egg proposition; namely, you do not know which one is more fundamental than the other one. It means that one can develop alternate views of whether these two are made of this one or this one is made of the other two. That means they are simply a family of particles, but you get them to interact with one another such that the whole question of the fundamental building block of matter has no meaning.

This may or may not be true. This is one of the open questions. If it is true, it explains this particular part of the subatomic world. If it is not true, that means if we do find specific building blocks, then the explanation is different. But in either case we will have gained understanding of this world and it is a world on which the rest of the world has to be based. So the fact is that we don't know the answer.

Representative HOSMER. My point, Dr. Panofsky, is that so many times this type of research is justified on the basis of a fallout of discovery and invention and not in terms of the end product. Is it worth the candle to get it? I don't think you have actually covered that in your answer.

Dr. PANOFSKY. I am not of the school who tries to defend this kind of work through its byproducts. I believe if you want the byproduct, you should develop the byproduct. I think you could do it more

economically and do it more effectively. If you want to develop high-powered radio tubes, then the best way to do so is to push the development of high-powered radio tubes and not to build accelerators which require high-powered radio tubes.

Representative HOSMER. I take it if it turns out we are all wormholes in time and space, we will be better for knowing of it.

Dr. PANOFSKY. Yes, sir. I believe that our whole culture is based on the fact that our applied activities keep drawing on our basic knowledge. Our basic knowledge keeps being exhausted and our society will stop developing unless at the same time we give support to those elements in our country who like to pursue knowledge for knowledge itself even if they cannot honestly demonstrate because they do not know the link this will have to the practical environment.

Representative HOSMER. Then the specific situation before us is that the people of Woodside do not think it is worth looking at a bunch of power lines in order to get this end product. Is that it?

Dr. PANOFSKY. You have to ask the people of Woodside, sir. [Laughter.]

Representative HOSMER. I think they are present probably.

Dr. PANOFSKY. Shall I continue?

Representative HOLIFIELD. Yes.

Dr. PANOFSKY. I can discuss this further, but I have not prepared any testimony on these matters, Mr. Chairman.

Representative HOLIFIELD. I think in view of the fact my colleague has brought up the problem of being a wormhole in a period of time and space turbulence, I am going to have to have a special discussion with him to find out exactly what this article is. [Laughter.]

You may proceed.

Dr. PANOFSKY. The main point here I am trying to make, Mr. Chairman, is even though there has been discussion of technological fallout, this is not the motivation of the people who are doing this kind of work. They are motivated basically by a need for understanding. The only way you can prove or be convinced that the kind of work does have consequences in relation to our general environment is by looking at history. It is simply the fact we have the conviction that if a new world is discovered, which we didn't know was there, it wasn't put there by chance—just to be a toy. It was put there because it in itself will constitute the basis of further things. But how the bigger scale things rest on it is something about which at present we lack understanding.

This is as honest a statement of the matter as I can make.

Representative HOLIFIELD. You sold us on the linear accelerator on that basis a few years ago.

Dr. PANOFSKY. Thank you, sir.

Let me now turn to the practical matter and briefly review the status physically and constructionwise.

You authorized the construction of the Stanford accelerator in September 1961 at a cost of $114 million. Ground was broken in July 1962. This chart, which I hope you can see, gives the other key dates. (See table 1, p. 20.)

First is the authorization date by Congress. The start of building construction was July 1962, and in May 1963 the underground housing for the accelerator proper was started. Between June and November 1963 the first three buildings were completed.

In the beginning of this year the first one-third of the accelerator—3,000 feet of accelerator housing—was completed, and we hope to start the installation of the accelerator proper by the spring of this year.

By the end of this year this site will be an operating complex. That means all the temporary quarters which are now located on Stanford University campus proper will have been located on the main AEC-sponsored site. Also by the end of this year we hope to start pilot operation of the first 600 feet of the accelerator. By the end of 1965 the whole plant will be completed and by 1966 the first shakedown of this accelerator will start. It will not be until the spring of 1967 that the accelerator will be used for full-scale research for the national and international community of science.

Representative HOLIFIELD. Can we say roughly it will be 3 years before you are ready to go to full-scale research and 2 years before you turn on the accelerator for your initial testing?

Dr. PANOFSKY. This is correct.

Representative HOLIFIELD. When will you need this energy and at what scale will you need energy in this complex you have described for 1967? How much energy will we need in 1964 and 1965 or will you come to that later?

Dr. PANOFSKY. I will come to it later, but I can respond now.

Representative HOLIFIELD. I will postpone the question.

Dr. PANOFSKY. Our schedule, as you see it here, is April 1966 for initial shakedown and in 1967 for further physics research. However, these dates can only be achieved with a very maximum effort and in the absence of unforeseen delays. This is a very tight schedule at the present moment. (See p. 20.)

Let me mention the physical aspects and then come back to the schedule.

Representative HOLIFIELD. May I ask if you are on schedule now?

Dr. PANOFSKY. Yes, we are on schedule now—within a month or two. Things have changed in detail relative to the original schedule, but we are on this same general schedule, which is the one presented in earlier hearings, although it is a very tight matter to actually come in on this.

KLYSTRON TUBE DEVELOPMENT

Representative HOSMER. How is the klystron development coming along?

Dr. PANOFSKY. The klystrons are being handled by a three-pronged approach. We have subcontracts with two major firms, which were awarded after competitive proposals, to Sperry Gyroscope and RCA, to deliver klystrons to us. Both of these contractors are somewhat behind their promised delivery dates. We have extended their dates by a few months. My understanding is that the first acceptable tube will be delivered by the RCA subcontractor some time early next month—in February. They are a few months behind.

Representative HOSMER. Are they having difficulty meeting specifications?

Dr. PANOFSKY. They are having difficulty meeting specs. They are behind schedule and in some difficulty in meeting specs.

Representative HOSMER. Thus far it has not in your mind been a serious enough problem to readjust it.

Dr. PANOFSKY. This has not been an alarming matter. We are doing the following. We have a three-pronged approach. We are procuring these—developing the two outside competitive sources—and we are maintaining in-house capability, simply by making our own tubes. So far, by virtue of delayed delivery of these tubes from the outside, we have simply kept our own tube sockets filled from our own in-house production. This means that those tubes which we need for our test program, we have provided from our in-house produced tubes, and this has not worked any undue hardship.

Representative HOSMER. I heard a complaint at one time that you breathing down the contractors' necks on how to put the parts and pieces together rather than holding them responsible for the end product.

Dr. PANOFSKY. I am not acquainted with this complaint. Does it relate to this particular contractor that we are breathing——

Representative HOSMER. I don't remember who it was.

Dr. PANOFSKY. We are breathing down many contractors' necks on a very large number of items. We have many subcontracts.

Representative HOSMER. Are they building it to your designs?

Dr. PANOFSKY. No.

Representative HOSMER. Or building it to your requirements—specs?

Dr. PANOFSKY. We have contracts of both kinds. The klystrons are being built to our performance specifications, not to our design. On the other hand, one of our largest subcontracts is for modulators to be built to our design and not to performance specifications.

Representative HOSMER. I was referring to the klystrons.

Dr. PANOFSKY. As the occasion demands we use either form of contracting.

Representative HOLIFIELD. Are your specifications in your opinion—and I have heard this complaint—too demanding and impossible of attainment, or have you proven in your laboratories that your specs can be attained?

Dr. PANOFSKY. On this particular tube it turns out we have not met our specs in our own laboratories, but there is a tube commercially available on the market, but not by the successful bidder, which meets these specs. There is a tube manufactured by a French manufacturer which both in terms of power, average power, peak power, and in physical dimensions and so forth would have met the specs that these manufacturers have some problems in meeting. That particular manufacturer was, in fact, not bidding in this particular competition. So there is physical proof that these specs are capable of attainment.

Let me go to the financial picture.

STANFORD ACCELERATOR COST ESTIMATES

This is the working cost estimate as of January 1964. This is the schedule and actual percent completion of the various phases of the work and these are the current budgetary estimates to the completion of the accelerator.

(See table 2, p. 20.)

At the present moment project contingency and escalation is $18 million and the amount which has been committed to date—and you asked this question of the Commisison witnesses—is $31,700,000 as of December 31, 1963, which is about 27.8 percent of the $114 million or

is almost exactly one-third of the $114 million less the reserve. That means of the projected cost at this time one-third has either been costed or committed. Approximately our project contingency and escalation has remained at a constant percentage of unexpended balance. That means we have not gone into the reserve any more rapidly than the percentage of the completion of the project.

Representative HOSMER. At that linear rate that will consume the $18 million contingency.

Dr. PANOFSKY. At the present moment, since by definition the contingency is a contingency, we are obviously not in a position to state where it will go, but from other experience—our experience and your experience—it is clearly prudent to have such a contingency.

Representative HOSMER. I am trying to find out if you are digging into the contingency.

Dr. PANOFSKY. Yes. We have the original contingency and the escalation which was in the original proposal——

Representative HOSMER. In other words, you are digging into that at a rate that will consume it by the time you get the project completed.

Dr. PANOFSKY. Approximately, yes, sir. The escalation and contingency originally in the budget which was submitted at the time of authorization was $24.6 million.

Representative HOSMER. It doesn't look like there will be anything in that contingency item for this powerline.

Dr. PANOFSKY. At present we have the following statement on this score. As far as our main procurements are concerned, we now firmly believe that we will have no further surprises or changes, so the way in which the contingency may or will get used would be associated with a schedule slippage. That means if we are able to maintain our schedule precisely during the most uncertain period to come, namely the period of installation and shakedown, which is the one that is most difficult to estimate, then we will be in very good shape on the contingency.

From now on in we are not in a situation of simply projecting the loss of this contingency on a linear basis. On one hand it is more optimistic. Namely, we are now having all our major procurements well enough committed or we have enough experience with industry and so forth to know that we are on firm ground on these numbers before contingencies. On the other hand, we are facing that part of construction which is most speculative. Namely, how long does it take to accomplish the job, shake the thing down, and put it into use as a useful tool as an accelerator?

So at this time we cannot say whether the contingency is adequate or where we stand other than by the fact that we consider it prudent to keep it roughly a constant percentage of the uncommitted funds, which is the way we have kept it.

In summary, as far as our major procurement and subcontracts are concerned, we feel that we are now on quite firm ground in terms of the funds before contingency. Therefore, our major remaining uncertainty is associated with schedule rather than procurements.

I think that is as definite a statement as I can make.

Let me now briefly mention the physical status. I mentioned that four of the eight major buildings have been completed and occupied.

The first third of the accelerator housing has been constructed. One thousand feet of that has been covered with earth shield and the beginning of the klystron gallery on top of that has been made.

We would like to note—and this is in reference to some of the testimony given earlier—that we have paid particular attention to esthetics in developing the site, and I hope that at an appropriate time during these hearings I may show some slides of the present physical development of the laboratory. Our buildings have been designed with the asistance of an eminent architect and they are intended to harmonize with the other construction on the Stanford University campus. The budget for landscaping is about $200,000; landscaping has now been planned in general terms and has been in our budget approved by the AEC. We have preserved the maximum number of trees on site. We have, in fact, modified design in order to miss trees. We have placed all site utilities and secondary distribution underground. This, in particular, relates to the 12½-kilovolt secondary distribution. In this respect we are following the adopted Stanford University practice. I might mention in this respect that Stanford University leads the practices prevailing in this general area.

The design of the accelerator itself is approximately 55 percent accomplished, while in contrast about 7 percent of the facilities and structures has been completed at this time. The design of the accelerator proper must by necessity lag the design and construction of its environment. The in-house construction of the final accelerator sections has commenced and we have converted the 1-billion-volt electron accelerator, which has been sponsored previously by the joint program of the AEC and the Office of Naval Research, using our new SLAC accelerator sections. In so doing we have arrived at a project of mutual benefit. It will improve the performance of the 1-billion-volt machine and at the same time will give us valuable pilot experience.

As I mentioned before, the fundamental objective of the Stanford linear accelerator is to contribute to the national program in high-energy physics. For this reason, in parallel with engaging in the construction of the accelerator, we have been building up an experimental and and theoretical staff aimed at putting the accelerator into productive use on completion of construction. The work of this group has been supported out of the operating funds of the AEC.

A scientific policy committee, which contains representatives of eight other laboratories of this country, has been established to monitor the work of the Center on behalf of the scientific community at large. The group has held numerous meetings to discuss the progress of the Center and to ascertain that the laboratory is evolving to operate as a national facility. In particular, the committee has ascertained that the relation of the buildup of research staff to the evolution of the facilities is such that adequate support to non-Stanford scientists can be provided on their request and initiative.

I would like to go to the germane part of the testimony—the problem at hand—namely, the analysis of power requirements, if it pleases the committee.

Representative HOLIFIELD. Proceed.

STANFORD ACCELERATOR POWER REQUIREMENTS

Dr. PANOFSKY. Analysis of the power requirements has been made in relation to the schedules of the Laboratory, and these requirements have been continually updated as the schedules have become more firm.

Figure 1 shows the curve of the anticipated power demand versus time. This curve has a number of components. We have, as mentioned before, a source at 60 kilovolts which can deliver between 16 to 18 megawatts of power, which is given by this curve here. Therefore, the point of intersection of that curve with our anticipated demands forecast, which is by the middle of 1965, reflects the time at which additional power sources have to become available. (See fig. 1, p. 19.)

We have been informed by the Pacific Gas & Electric Co. that it is, in principle, possible to strengthen the 60 kilovolts supply from its current level up to, maybe, a maximum of 30 megawatts, which is this jump here. This additional power has been mentioned in the previous testimony, and would be required as backup power in case the primary power source would only be a single rather than a dual circuit in order to protect the large investment in the laboratory against outages.

There are two things of importance here. One is the quantity of the power and the other is its quality. This graph here tells you about quantity. There are two parts of the forecast here. The first forecast is up to the beginning of full-scale physics research and the other forecast extends into the much more uncertain future beyond that.

I would like to show you two additional charts which give you the power breakdown of the requirements during these two epochs. One of the consequences you will see on this chart is that the forecast beyond 1967 becomes progressively more uncertain. In fact, by the time you come to the very high levels it is a purely speculative forecast.

This is a breakdown of the power requirements for 1967, which we estimate to be about 82 megawatts. The largest single figure is the 26.5 megawatts, which we call modulators. These are the primary power sources for the accelerator. You will notice, as has been mentioned in the Commission testimony also, that this is not the largest fraction of the total requirement.

The rest of the requirements are 11.3 megawatts for the support and service area; that is, shops, component facilities, and so forth and approximately 5 megawatts come from what we call the beam switchyard. That means the magnetic distribution center which switches the beam to the different users both from Stanford and other laboratories.

Finally there is a requirement of 28 megawatts for what we call end station target areas. These are the facilities for uses of the machine. Finally, 2 megawatts of power are required for cooling towers and circulating pumps.

This estimate to here is quite a firm one once full operation is reached.

In addition to that I am showing a breakdown of what I call the minimum backup operation. If there is an outage in the primary line, it is still possible to operate the machine at a low energy—half the design energy, or 10 billion electron volts—and simply decrease the level of activity in different areas. It is from this second tabulation that the requirement for backup power of 30 megawatts is derived in

case there is a failure, in case we would only provide a single circuit primary, and in case there is a failure in the primary power.

The question has been raised also concerning the minimum level in case of outage from the point of view of safety. That means keeping emergency facilities going, transportation and communication going, and so forth. The figure on that is that the presently installed 16-megawatt source is entirely adequate to maintain the regular laboratory services, to maintain communications, to maintain ventilation, lighting, and so forth.

Representative WESTLAND. Entirely adequate?

Dr. PANOFSKY. Entirely adequate; yes, sir. From the point of view of maintaining the laboratory, preventing damage to continually running equipment and matters of that kind, the presently available power is entirely adequate. No research can be done with the beam with the presently available power if there is an outage in the primary source.

So to summarize we have the full operating level. We have the emergency backup level to prevent damage to capital equipment, for that the present supply is adequate. We have a backup requirement to be able to do research at low level with the facility; that is, 30 megawatts; and we have a requirement at the time of full operation for the machine of 81.6 megawatts.

Representative WESTLAND. May I ask a question? Would you subtract the 30 from the 81 or add it for full operation? (See p. 20.)

Dr. PANOFSKY. 81.6 is the total. The 30 is part of the 81.6.

Mr. CONWAY. Dr. Panofsky, in order that the record might be clear, the 10 billion electron volts which you have on that chart, is that a correction to the table you submitted to the committee?

POWER REQUIREMENTS SCHEDULE

Dr. PANOFSKY. This was a typographical error. I have corrected that.

As you may recall, our contract with the AEC defines the energy range which would be normally considered to be contractual fulfillment to be 10 to 20 billion electron volts maximum.

There are two questions then of importance. First we consider this estimate to be a firm one. We believe we will cross the line at which our supply will be inadequate by July 1965. The problem is what happens beyond that. To make a very good forecast beyond that date is almost impossible for the reason that the laboratory is being created to be a national facility.

Since the laboratory is a national facility, we are obligated and desirous to supply services to other scientists in the United States and abroad whose research plans have not been formulated and whose research plans we certainly don't know. This means that the long-range forecast is partially governed by the experience of the other laboratories and by what we believe the state of the art to be rather than by firm engineering forecasts.

Our long-range forecast then, which I put under the column of "Long-range needs," has basically two components. One component, which is associated with the national facility nature of the laboratory, has to do with our best estimate as to what might develop during the next decade or two in terms of additional power requirements of the users of the machine. The second part has to do with the possibility of a stage II authorization of the machine. As you know, when we re-

quested authorization from the Congress for this machine, we requested authorization for stage I. I believe the record is clear in stating that we believed at that time—and we still say the same thing—that there is no adequate justification now for requesting additional authorization for stage II, and that such authorization would only be requested on the basis of experience, both in terms of research interest on the one hand and operating costs on the other with this machine.

So the item here in the long-range forecast, which is specifically associated with a possible increase in power of the accelerator—and I am emphasizing that we are not requesting this here and we have not requested it of the AEC and that at the present we do not believe we can support such a request—is this item here under Klystron Gallery. These two items in combination are those items which are specifically associated with a power expansion of the accelerator.

The other items here are those which we are estimating—and I emphasize this is an estimate—that would be required, and the estimate is mainly based on experience of others in terms of the expanding needs of the users of the accelerator.

Representative HOSMER. Let's put it this way, Dr. Panofsky: Unless there are those expanding needs, the entire machine is a failure or the administration has failed to generate sufficient interest. So unless you do run up to those requirements we have made a bad investment.

CRYOGENIC MAGNETS

Dr. PANOFSKY. There is one possible addition to your remarks, Mr. Hosmer. That is this. The estimate is based on present technology. In present technology almost all the detectors used by high-energy physicists use very large electromagnets.

Representative HOSMER. You can throw out the economics——

Dr. PANOFSKY. There is the possibility that the technology will either increase or decrease these demands. For example, if in the next decade the technology of cryogenic magnets, of which I believe you have heard about in this committee, comes into being, it might decrease power requirements.

Representative HOSMER. I am talking in terms of the work that the machine is doing, both involving and increase in the power of the machine and quality——

Dr. PANOFSKY. Right.

Representative HOSMER. The real test of any piece of equipment is its use.

Dr. PANOFSKY. I agree in this completely. I would like, therefore, to emphasize that I do not have detailed backup anywhere as detailed for our estimate of the long-range needs as we do for the beginning of full operation requirements in 1967.

Representative HOSMER. But there is a reasonable anticipation upon your part, based upon judgment of your conversations with other scientists and so forth, that the workload will accelerate and that you will get to approximately a 300,000-kilowatt need long range.

COST OF POWER TRANSMISSION LINES

Dr. PANOFSKY. Yes, sir.

Representative HOSMER. I think it is pertinent to point out that your tower line at some $668,000 cost would provide everything that you could anticipate. In other words, you could carry 300,000 kilowatts on that line. (See table, p. 9.)

Dr. PANOFSKY. That is correct.

Representative HOSMER. Your overhead pole line could also carry that amount.

Dr. PANOFSKY. Yes; on a single circuit.

Representative HOSMER. Your one-pipe installation underground would only carry 180,000 kilowatts.

Dr. PANOFSKY. This is correct at this particular cost. The point is——

Representative HOSMER. At the cost of $2,640,000——

Dr. PANOFSKY. I would like to——

Representative HOSMER. If you did install the same capacity, in other words 300,000 kilowatts, you would have to have two pipes—you might say duplicate pipes in order to have that 300,000 kilowatts. You could do it either at the time of installing the initial underground line or you could do it later with an additional cost of $200,000.[3]

Dr. PANOFSKY. $200,000?

Representative HOSMER. In addition——

Dr. PANOFSKY. Additional cost?

Representative HOSMER. An additional cost of $200,000 because you are duplicating the original cost of $2,640,000, which would bring it up to better than $5 million.

Dr. PANOFSKY. Yes, sir. These are the figures and these figures are based on the fact that if underground construction is used, we believe that because of the uncertain nature of the long-range forecasts, it would not be wise to recommend the expenditure of going immediately to the higher level because the penalty for doing the work twice—to do additional trenching is relatively small and the long-range forecast exceedingly uncertain.

Representative HOLIFIELD. And the interest cost on that additional investment initially would more than offset additional trenching cost.

Dr. PANOFSKY. Not only that, but since there are no public acceptance problems with the underground line, deferring the construction of the underground line would not be a matter of concern as to whether it could be accomplished later.

Therefore, if one goes the underground route, there is no question that one would go to the minimum power which is economical, which will fulfill our shorter range requirements and which makes economic sense based on the transmission voltage which is 220 kilovolt.

If one analyzes the cost versus power requirements, the cost versus power transmission of the underground line, it turns out with the voltage of 220 kilovolts if you go below 180 megawatts, then the sav-

[3] See footnote 2 to table on p. 9.

ings become extremely small because at that point the costs are almost independent of the size cable installed. So 180 megawatts is that power which is the lowest level which makes sense to put in an underground circuit at the 220-kilovolt level. If one installed it at a 110 or lower kilovolt level then we would need transformer equipment at the source, which would offset any possible saving. Therefore, going lower than 180 megawatts, even though the requirement as of 1967 is only 82 megawatts turns out not to be a sensible move. This then is the situation about the requirements and its timing.

As you know, I am here to give you the technical status report of the project and to explain the schedule of the power requirements—the quantity and quality of the power requirement. The responsibility for the power supply had been assumed by the Commission and it is being negotiated by a direct contract, not involving Stanford University, between the Commission and the Pacific Gas & Electric Co. Therefore, the question at issue here—namely the question of choice among the various means of providing service in relation to performance and cost and public acceptance—is a matter for the Commission and this committee.

Representative HOLIFIELD. We understand that. We wanted you to establish the potential need and the status of the project.

Do you have anyone from Stanford with you, who is on an administrative level in Stanford as far as being able to commit Stanford to any type of participation in a cooperative arrangement?

Dr. PANOFSKY. No, sir. Mr. Moulton, who is both on the president's staff and the staff of SLAC, is here, but he is not anymore in a position to commit the university on this question than I am.

Representative HOLIFIELD. Will you come forward please and identify yourself to the reporter?

STATEMENT OF ROBERT MOULTON, ASSISTANT TO PRESIDENT STERLING OF STANFORD UNIVERSITY AND ASSOCIATE DIRECTOR AT THE ACCELERATOR CENTER; ACCOMPANIED BY KENNETH COPENHAGEN, HEAD OF THE SLAC PLANT ENGINEERING GROUP

Mr. MOULTON. Yes, sir. I am Robert Moulton, assistant to President Sterling and associate director at the accelerator center.

Representative HOLIFIELD. Mr. Moulton, do you have any authority at all to discuss any kind of a cooperative arrangement at this point?

Mr. MOULTON. No; I do not.

Representative HOLIFIELD. As far as utilizing additional funds of Stanford University?

Mr. MOULTON. That is correct.

Representative HOLIFIELD. However, you have administratively determined that an overhead line across approximately 2 miles of university ground is acceptable from an esthetic standpoint to the directors of Stanford University.

Mr. MOULTON. Yes, sir.

Representative HOLIFIELD. And you can state that Stanford will not institute any claims for condemnation or severance of any Stanford property as a result of overhead transmission lines to the accelerator.

Mr. MOULTON. Yes, sir, I believe that to be correct.

Representative HOLIFIELD. Are there any questions?

Representative HOSMER. Perhaps you can give us some help on another subject. I have a gas station map here which indicates over on the westernmost boundary of Stanford University property that possibly part of the city of Woodside is on Stanford property. Is that correct?

Mr. MOULTON. That is correct, I am advised.

Representative HOSMER. There are some streets that are not in Woodside: Lake Shore Drive, Cyprus Drive, Sears Drive, Crest Drive, and so forth. Are you familiar with those streets?

Mr. MOULTON. Not in detail, Mr. Hosmer.

Representative HOSMER. Do you know whether or not there are houses on them?

Mr. COPENHAGEN. The answer is "Yes."

Mr. MOULTON. We have additional evidence that we would like to present if agreeable.

Representative HOSMER. Will you state your name?

Mr. COPENHAGEN. My name is Kenneth Copenhagen and I am head of the SLAC plant engineering group.

Representative HOSMER. What is on those streets I mentioned?

Mr. COPENHAGEN. There are generally houses as the streets wind up the hills from Portola Valley Road up toward the skyline. The area consists of 1-, 2-, or 3-acre sites, so the houses are not dense.

Representative HOSMER. Does the university own those houses?

Mr. COPENHAGEN. No. The university has some land in that area which is leased to different individual homeowners. They own their own houses, but Stanford maintains title to the land.

Representative HOSMER. Are they people who are associated with the university?

Mr. COPENHAGEN. Not necessarily.

Representative HOSMER. But they are large sites?

Mr. COPENHAGEN. Generally 1 acre and larger sites in that area.

Representative HOSMER. There are other streets such as Lake Shore Drive in this area. How many houses total are in there—approximately?

Mr. COPENHAGEN. I would have to take a look at one of the USGC–GS maps——

Representative HOSMER. See if you can guess. Do you think there are 100 houses or 35 houses? How many people are we dealing with in that area whom we might esthetically offend—within the university leased property?

Mr. COPENHAGEN. I am sorry, I was referring to the west side of Portola Valley Road. These are nondeveloped areas on the east side of the road. This area down here is the western area to which I was referring.

Representative HOSMER. Then the streets I mentioned to you are——

Mr. COPENHAGEN. Uninhabited.

Representative HOSMER. Just roads?

Mr. COPENHAGEN. Dirt roads.

Representative HOSMER. Like on the farm.

Mr. COPENHAGEN. That is right.

Representative HOSMER. How about lakes? There are three little lakes, one designated as Searsville Lake and two others.

Mr. COPENHAGEN. It is all Searsville Lake intertied by streams.

Representative HOSMER. Are those lakes used for anything?

Mr. COPENHAGEN. Stanford water supply for irrigation water that flows to the campus.

Representative HOSMER. And those have a practical and not an esthetic connotation.

Mr. COPENHAGEN. They are used some for recreation.

Representative HOSMER. Of what nature?

Mr. COPENHAGEN. Swimming, boating.

Representative HOSMER. By whom?

Mr. COPENHAGEN. The public.

Representative HOSMER. Under permit entry, daily fee or what?

Mr. COPENHAGEN. Stanford has an operator of the area who has a contract with Stanford to maintain the area, but to use it for public picnicking and swimming.

Representative HOSMER. It is a concession then?

Mr. COPENHAGEN. A concession, yes, sir.

Representative HOSMER. Do you have any idea of how much use is made of that during the summer periods?

Dr. PANOFSKY. Jammed.

Mr. COPENHAGEN. On hot days it is jammed. It is quite a popular place.

Representative HOSMER. There is no habitation within this area?

Mr. COPENHAGEN. With the exception of the man who has the contract with Stanford, no one lives on that side of the road—that side of Portola Valley Road in that area.

Representative HOSMER. Portola Valley Road is at one point named Sand Hill Road and Sand Hill Road goes into——

Mr. COPENHAGEN. Sand Hill Road is an extension of Portola Valley Road——

Representative HOSMER. On the west side of Sand Hill and Portola Valley Road there is habitation?

Mr. COPENHAGEN. That is correct.

Representative HOSMER. There is none on the east side in the city of Woodside?

Mr. COPENHAGEN. There are areas developing up in here that are beyond the Stanford land.

Representative HOSMER. On the east side of the road there is no development?

Mr. COPENHAGEN. On the east side—there are some in here.

Representative HOSMER. Along Family Farm Road.

Mr. COPENHAGEN. On Family Farm Road there is some development on this side of it.

Representative HOSMER. You are indicating the west side——

Mr. COPENHAGEN. The west side of the road—by private citizens with no connection with Stanford.

Generally the area in here is a swamp that backs up around the lake, which is used for a watershed for the lake rather than homesites.

Representative HOSMER. That is all, Mr. Chairman.

Representative HOLIFIELD. At this time the Chair would like to ask the indulgence of the committee to announce we have a visiting group of foreign students from some of our neighbor countries. They are here as observers under the sponsorship of Mrs. Albert Gore, who is the wife of one of our colleagues on the committee.

I would like the record to show that we have representative students here from United Arab Republic, Italy, Greece, Korea, Peru, Germany, Denmark, Kenya, Russia, India, Northern Rhodesia, Brazil, Tanganyika, Trinidad, Britain, and South Africa. We welcome these students this morning and Mrs. Gore, we appreciate your bringing them in to see the Joint Committee function in one of its hearings.

You may proceed, Dr. Panofsky.

Dr. PANOFSKY. That concludes my testimony, Mr. Chairman. I do have some slides, however, to show the present development.

Representative HOLIFIELD. All right. I would like to have you and Mr. Moulton before you leave the chair, give us a breakdown, if possible, of the annual cost—at least percentagewise—in relation to the cost of the electrical energy. What will you pay for energy in comparison to the other types of maintenance operation, personnel costs, and so forth.

Dr. PANOFSKY. Mr. Chairman, I do not have this available. The operating cost estimate now is $20 million per year of 1960 dollars. The expected power billing—I believe Mr. Copenhagen has that available.

Mr. COPENHAGEN. We are expecting an annual power bill under these many different conditions of power rates and under the energy level that we use of about $0.5 million to $1.5 million a year——

Representative HOLIFIELD. Can you give us now the proportion of power that will come from the so-called public sources and the amount that will be furnished by the private company?

Mr. COPENHAGEN. We probably can better handle this in the testimony later because we do not have the exact proportion of what power is——

Representative HOLIFIELD. P.G. & E. will give us that—or some feel for that?

BUREAU OF RECLAMATION POWER

Mr. COPENHAGEN. Yes, and the AEC also has this because they are making arrangements with the Bureau of Reclamation.

Representative HOSMER. That power bill might be paid to P.G. & E. by the university, but the ultimate cost is to the U.S. Government; is it not?

Mr. COPENHAGEN. Yes. The AEC has a contract with P.G. & E.——

Representative HOSMER. When we are talking about the cost of power we are talking about an expenditure by the United States of America?

Mr. COPENHAGEN. Yes.

Representative HOSMER. Very well.

Dr. PANOFSKY. We made an analysis of this question and I believe we could probably get the material together in the next few hours, but we do not have it with us. We could furnish it later on in the hearing or possibly submit it separately. (See p. 44.)

Representative HOLIFIELD. We would like to have that because we would like to know the proportion of power you expect to get directly from P.G. & E. by purchase and the amount that we will be wheeled in order that we might ascertain what the load factor will be during those years that you can predict.

Dr. PANOFSKY. I believe the Commission has this material.

Representative HOLIFIELD. General Luedecke.

General LUEDECKE. Mr. Chairman, we have some breakdowns on cost of power which we are prepared to go into for the committee which would cover this point.

Representative HOSMER. Off the record——

(Off the record discussion.)

Representative HOLIFIELD. We do have witnesses here from P.G. & E. and also representatives of the San Mateo County Planning Commission and the city of Woodside. I understand Mr. McCloskey is the official representative of the town of Woodside and interested citizens of San Mateo and Santa Clara Counties. I suppose this is a group that has organized itself in opposition to this above-ground transmission line. Is this correct, Mr. McCloskey?

(Telegrams on the subject of witnesses for the hearing follow:)

REDWOOD CITY, CALIF., *January 21, 1964.*

Congressman CHET HOLIFIELD,
House Office Building, Washington, D.C.:

Respectfully request opportunity for representative of the county of San Mateo, Calif., to be heard at the scheduled meeting of the Joint Committee on Atomic Energy in Washington, D.C., on January 29, at 10 a.m., relative to the high-tension powerline to serve the Stanford linear accelerator. Further request confirmation.

E. R. STALLINGS, *San Mateo County Manager.*

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C., January 22, 1964.

Mr. E. R. STALLINGS,
San Mateo County Manager,
Redwood City, Calif.:

In response to your telegram you have been scheduled to testify before the Joint Committee on Atomic Energy, January 29, room AE–1, U.S. Capitol Building, Washington, D.C. Hearing will commence at 10 a.m. with testimony from AEC witnesses. In line with customary committee practice I would appreciate receiving at least 1 day in advance a copy of any prepared statement you may have. If you have any questions please feel free to call me at Capitol 4–3121, extension 6171.

JOHN T. CONWAY, *Executive Director.*

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D.C., January 24, 1964.

Hon. DONALD GRAHAM,
Mayor, City of Woodside,
Woodside, Calif.:

This is to invite you and/or the designated representative of the city of Woodside to testify at hearings before the Joint Committee on Atomic Energy, January 29, room AE–1, U.S. Capitol Building, Washington, D. C. Hearings will commence at 10 a.m. with testimony from AEC witnesses. In line with customary committee practice I would appreciate receiving at least 1 day in advance a copy of any prepared statement you may have. If you have any questions please feel free to call me at Capitol 4–3121, extension 6171.

JOHN T. CONWAY, *Executive Director.*

WOODSIDE CALIF., *January 24, 1964.*

JOHN T. CONWAY,
Executive Director, Joint Committee on Atomic Energy,
Washington, D.C.:

Acknowledge receipt your telegram. I will be there. Insufficient time to transmit prepared statement but plan to make oral statement.

DONALD J. GRAHAM,
Mayor, Town of Woodside, Calif.

Mr. MCCLOSKEY. That is correct, sir. There is the Sierra Club, and Committee for Green Foothills who are members and also members of conservation groups, in addition to the town of Woodside.

Representative HOSMER. Mr. Chairman, I would like to ask Mr. McCloskey if this town of Woodside is a city or just a community that calls itself Woodside?

Mr. MCCLOSKEY. Mr. Hosmer, the town of Woodside incorporated several years ago.

Representative HOSMER. That is all I wanted to know. Are you representing the town officially or unofficially or citizens or what?

Mr. MCCLOSKEY. No, sir. I am special counsel for the town by resolution of the board. Mayor Donald Graham is also here.

Representative HOSMER. You also represent interested citizens; is that correct?

Mr. MCCLOSKEY. Yes, sir.

Representative HOSMER. You are here in a dual capacity?

Mr. MCCLOSKEY. Yes, sir.

Representative HOSMER. Very well.

Representative HOLIFIELD. Mr. Westland suggests that we utilize the rest of our time with the slides. How long will it take, Doctor?

Dr. PANOFSKY. Just a few minutes. This will just illustrate the statements and figures I gave.

This area is a view of the whole 2-mile installation.

This is the view to the west—the injector here. Here is the 2-mile excavation, and here is the laboratory complex. This shows you approximately the state of construction. The actual construction of the accelerator housing or tunnel has progressed to this point.

Could I have the next slide please?

This shows the actual beginning of the 2-mile installation here. Here is the ground slab. Across it is waterproofing material and then the beginning of the tunnel here which then gets backfilled afterward for shielding.

Representative WESTLAND. How deep is that?

Dr. PANOFSKY. From here to here is 25 feet which will be the height of the shielding.

Representative HOSMER. How many feet?

Dr. PANOFSKY. Twenty-five feet.

Representative HOSMER. Is that in depth or is that the cut across?

Dr. PANOFSKY. No; 25 feet here in depth. It will be clear on the next slide.

Here is the state of construction where some of the tunnel has already been covered by the earth and the rise is being constructed and continuing down here. We approach the one-third point of construction here.

Next slide.

This shows again the accelerator housing emerging out of the already filled portion back here. You can see here every 20 feet the pipes which are put down—the microwave radiofrequency power feeding down from the upper story which then feeds the power to the accelerator.

Representative HOLIFIELD. Will that be covered?

Dr. PANOFSKY. It will all be covered. The next slide will show that.

Here it is already covered. You see down here the opening of the tunnel which you saw in the last one. It is now all covered to the 25-foot level, and building construction has commenced on top of it for the housing which will contain the klystron-power supplies, modulators, water cooling, electronics control, and all that kind of thing.

It has progressed here up to 300 feet. Here the people are getting ready for the next 300 feet. You see here this dotted line. They are the pipes which penetrate through the 25 feet of earth radiation shielding which then go down below. So all this construction that you saw in the last slide is now fully covered up, as you see here.

Next slide.

Representative HOLIFIELD. May I ask if the idea of putting that underground was from the standpoint of esthetics or was it to obtain a level accelerator location through rolling hill country?

Dr. PANOFSKY. Radiation shielding, sir. This is the housing on top, which is now beginning. First there is the cutting of the trench, then putting in the accelerator housing, then backfilling over it with earth, and then building the gallery which goes over the top of this.

Representative HOSMER. You are going to bring the beam up from the underground for targeting.

Dr. PANOFSKY. At the end it will be on the level of the lower story. It will not be brought up.

Representative HOSMER. Below ground?

Dr. PANOFSKY. It will be in a separate shielded building above ground. The ground level will drop down and the use of the beam will be in shielded buildings at a lower level.

Representative HOSMER. But above ground.

Dr. PANOFSKY. Above ground.

Representative HOSMER. Very well.

Dr. PANOFSKY. This is the entrance to the accelerator. The accelerator will be in here and up here are power sources, so this gives you the whole perspective.

Next, please.

This is the laboratory area as you see it being developed. The landscaping has just begun. You see the general area is beautiful. It is gentle rolling grassland with oaks all around.

Representative HOSMER. How is the powerline going to look coming across it?

Dr. PANOFSKY. I believe there are some pictures of this available from other witnesses here. We have some pictures as to what the powerline will look like.

This is the general country. Here you see the 150-foot radioastronomy telescope of Stanford University upon the hillside next to us here, which is one of the many various reasons why a route in this southern direction gives problems.

Representative HOSMER. This is some distance from the campus of Stanford, is it not?

Dr. PANOFSKY. Yes; it is.

Representative HOSMER. About how far?

Dr. PANOFSKY. Distance?

Representative HOSMER. Yes.

Dr. PANOFSKY. It is approximately 2 miles.

Representative HOSMER. It is out in an isolated area.

Dr. PANOFSKY. But it is part of the campus.

Representative HOSMER. I understand that. You have one of the biggest campuses in the world.

Dr. PANOFSKY. But it is in an isolated area; yes. The distance from the target end of the accelerator to its beginning is the same as the distance from the target end to the center of the campus.

Next, please.

This is the first completed building, the Test Laboratory—again showing how we are trying on the one hand to achieve economy of construction and on the other hand have something merging with the general appearance of the campus architecture and preserving the trees and so forth around the buildings.

Next, please.

This is a view of the Administration and Engineering Building and of the future campus area which will be developed around here.

Next, please.

This is a color photograph of the construction of the accelerator housing as it emerges from the filled-over portion.

Representative HOSMER. Will that eventually be covered?

Dr. PANOFSKY. Yes, sir; all of this will be covered. None of this will be seen.

That is all I have in the way of slides. I believe other witnesses do have slides which show the actual powerlines.

Representative HOLIFIELD. Thank you, Doctor.

Representative WESTLAND. Doctor, you spoke of this shielding. Are radioactive isotopes going to be used in this?

Dr. PANOFSKY. No, sir. No radioactive isotopes are used.

There are two types of radiation problems involved with the accelerator. One is the prompt radiation. That means the beam itself produces radiation when it hits materials. Therefore, in the design of the accelerator, radiation shielding to very conservative standards has to be incorporated.

Secondly, there is residual radioactivity due to radioactive isotopes which are produced inside the housing. This means that there will be residual activity which means that certain precautions of reentry into the accelerator housing have to be taken. We have those two types.

Representative WESTLAND. You are not using gamma rays.

Dr. PANOFSKY. No; we are not using radioactive sources. We are producing radioactive sources as unwanted byproducts of this accelerator operation.

Representative WESTLAND. Thank you.

Representative HOLIFIELD. Are there further questions, gentlemen?

If not, the committee stands adjourned until 2 o'clock.

(Whereupon at 12:20 p.m., Wednesday, January 29, 1964, the committee recessed to reconvene at 2 p.m. the same day.)

AFTERNOON SESSION

The Joint Committee on Atomic Energy met, pursuant to call, at 2 p.m. in room S–407, the Capitol, Hon. Chet Holifield (vice chairman) presiding.

Present were: Representatives Chet Holifield and Craig Hosmer.

Committee staff present: John T. Conway, executive director, Edward J. Bauser, assistant director, Jack Newman, staff counsel, and Jack Rosen, staff consultant.

SHARING OF POWER TRANSMISSION COST

Representative HOLIFIELD. The committee will be in order.

General Luedecke, will you please come to the stand for just a minute? We failed to ask you two or three questions for the record.

Has the AEC explored the possibility of a three-part sharing of the cost by the city of Woodside, P.G. & E. and the AEC?

General LUEDECKE. Mr. Bloch will speak to that.

Mr. BLOCH. No, sir, we have not. Up to this point P.G. & E. has been attempting to secure rights-of-way. As we testified, they were suggesting alternates and a compromise line. Action was taken by the Planning Board on their permit for the compromise line only last week. We felt until they had exhausted the possibilities of their executing the contract, as was planned, that it was inappropriate for us to undertake this type of discussion.

Representative HOLIFIELD. Certainly the main responsibility is on the P.G. & E. They are the ones selling the electricity to the Government and it is up to them to exhaust their possibilities before any other method is followed.

Mr. BLOCH. That is the way we felt, sir.

COSTS OF CONDEMNATION

Representative HOLIFIELD. We were told several weeks ago that the Corps of Engineers was evaluating cost of condemnation along the Searsville route. Has this evaluation been completed? If so, what are the results?

Mr. BLOCH. We have not seen the report yet. The Corps of Engineers has advised us of the total figures. Their appraisal for the right-of-way along the Searsville route is $157,000. For an alternate, which is apparently of some slight variation but still along this general route, it is $175,000. We just received the numbers. We have not seen the appraisal report.

Representative HOLIFIELD. What is the statutory basis for the AEC's authority to condemn property in order to run transmission lines such as this to the Stanford accelerator? I am speaking now from a legal standpoint.

General LUEDECKE. Mr. Reich from our General Counsel's office will speak to that.

STATEMENT OF JOHN REICH, ASSISTANT GENERAL COUNSEL, RESEARCH AND DEVELOPMENT, ATOMIC ENERGY COMMISSION

AUTHORITY TO CONDEMN

Mr. REICH. Since its inception the Atomic Energy Act has provided authority to the Commission to acquire title to or a lesser interest in real property. This has continued without hiatus. More specifically in 1960, when the fiscal year 1961 authorization act was enacted for AEC programs, Public Law 86–457 stated explicitly that—

> There is hereby authorized to be appropriated to the Atomic Energy Commission in accordance with the provisions of section 261a.(1) of the Atomic Energy Act of 1954, as amended, the sum of $338,467 for acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction or expansion as follows * * *.

There follows an itemization which includes authorization of funds for the linear electron accelerator, $114 million.

It is our view that our authority is clear, explicit, and unqualified in this respect.

Representative HOLIFIELD. I think that is a clear statement of your legal position.

Is your condemnation authority in this case affected in any way by section 271 of the Atomic Energy Act, which states:

> SEC. 271. Agency of Jurisdiction—Nothing in this Act shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to the generation, sale, or transmission of electric power.

Mr. REICH. It is our opinion—and we have no doubt in our minds—that section 271 has absolutely no effect either to bar or qualify our otherwise unqualified right to condemn property for this project. We believe the history of section 271 will show quite clearly that it was enacted in the context of major 1954 amendments and had relevancy to our new regulatory role and the new activities the Commission would be engaging in by virtue of nuclear power and so forth, and the intended effect the history shows was to make it quite clear that in the nuclear power field the authority of other agencies, Federal, State, or local, in the stated areas, was not be be considered as added to or subtracted from; that whatever authority they had before the 1954 amendment would continue.

In short, Mr. Holifield, we think it does not qualify in any way our right to condemn in this situation.

Representative HOLIFIELD. Do you have any questions, Mr. Hosmer?

Representative HOSMER. No questions.

Representative HOLIFIELD. I think that covers the legal situation. I will excuse you gentlemen at this time.

General Luedecke, did you want to present those operating costs at this time or later?

General LUEDECKE. At your pleasure, sir.

Representative HOLIFIELD. I think it might be well to do it now. We may get into this subject when we are talking with other people.

POWER COSTS

Mr. BLOCH. If you will bear with me, there are a few words of explanation I should give you. Estimating the power bill from this project is quite complicated.

First of all we talk about two classes of power: firm power and interruptible power. For these two types of power there are really three sources. With respect to firm power there is power from the Bureau of Reclamation and power from P.G. & E. The interruptible power would come from the P.G. & E. system.

These three sources of power similarly have three different rates. Due to these variations, Mr. Chairman, as well as other variables such variation in load factor for the interruptible power, which would fluctuate widely depending on the nature and duration of experiments, we have had to make some rather arbitrary assumptions in trying to really come up with estimates that are by way of illustrating the type of power bill or the range of power costs under variations in these assumptions.

If you will recall, Dr. Panofsky said that in 1967 they estimate a load of 82 megawatts. Assuming that 20 megawatts of that total would be firm power, that is power that is required basically with a high load factor around the clock, say 95-percent load factor—assuming that all of the power would be secured from P.G. & E. and assuming that the interruptible power, which would be the difference between 20 megawatts and 85 megawatts or 65 megawatts, is used at only a 10-percent load factor, you come up with an anticipated power bill of about $2 million a year.

If you use the same assumptions but assume that all of the 20 megawatts of firm power came from the Bureau of Reclamation and the remaining power including additional energy to firm up the Bureau of Reclamation power to 95-percent load factor, then you can calculate a power bill of about $1,417,000.

Representative HOSMER. Under the condition——

Mr. BLOCH. All of the 20 megawatts of firm power being available from the Bureau of Reclamation rather than from P.G. & E.

Representative HOSMER. In your first figure then, approximately how much of the $2 million would go to P.G. & E. and how much to the Government?

Mr. BLOCH. The first figure was made on an arbitrary assumption. I am trying to present extremes here.

Representative HOSMER. All we are trying to get is where P.G. & E. has the possibility of recovering some money on these powerlines because the wheeling rate isn't going to.

Mr. BLOCH. The first figure I quoted was on the assumption P.G. & E. would supply all of the power.

Representative HOLIFIELD. That is the $2 million a year——

Representative HOSMER. That is not in the cards, is it?

Mr. BLOCH. No, we have an allocation now of 8.2 megawatts of power from the Bureau of Reclamation. We have an application in for more. We think we can depend over the long period of time for at least 10 from the Bureau of Reclamation. We may have 20 or 25 from the Bureau for an extended period, but 8.2 is all we have now.

If you assume that half of the firm would be supplied by the Bureau of Reclamation, that is 10 megawatts, and half by P.G. & E., which is

the likely case, then the annual power bill on the basis of the assumptions that I previously stated, would be $1,733,000.

Representative HOLIFIELD. Half of that would be supplied by the Bureau of Reclamation. It wouldn't be fair to say that half of the $1,733,000 went to P.G. & E. They would only get 1 mill. They would charge for all of it, but they would get about a fifth of that, would they not, for wheeling purposes? One mill out of four and one-half mills cost at the Bureau.

Mr. BLOCH. About 4 mills, yes.

Representative HOLIFIELD. In other words, of that half of $1,733,000, they would get about $215,000. So their income would be $215,000 for wheeling and—I am using round figures—$860,000 for their own power. I am taking your figures of 10 and 10. So their actual income then would be about $1,750,000 rather than $1,733,000.

Mr. BLOCH. It doesn't quite figure that way, Mr. Holifield, because so-called firm power from the Bureau of Reclamation is available only 74 percent of the time. That is a maximum of 540 hours a month so the Bureau power would have to be supplemented by additional energy from P.G. & E. to bring that firm up to 90 to 95 percent, whatever your load factor was.

The breakdown in the bill on the calculations and on the assumptions we made for this particular case of 10-megawatt power from the Bureau of Reclamation and 10 from P.G. & E., the Bureau of Reclamation would get about $253,000 for their share of the firm power. P.G. & E. would get about $799,000 for their half of the firm power plus the additional energy they would be supplying to firm up the Bureau power. Of a total annual bill of $1,733,000 P.G. & E.'s share would be $1,480,000 and the Bureau of Reclamation's share would be $253,000. In addition, P.G. & E. would get a mill per kilowatt-hour for wheeling the Bureau power.

Representative HOLIFIELD. For the 254——

Mr. BLOCH. Those are dollars. Actually it would be 264,800,000 kilowatt-hours which would be the number of hours of Bureau energy that would be wheeled. About $64,000 is all they collect for wheeling.

Representative HOLIFIELD. As far as they are concerned, their share would be $1,480,000 plus about $64,000.

Mr. BLOCH. Yes, sir.

Representative HOLIFIELD. After they paid their bill with the Bureau.

Mr. BLOCH. In that situation, yes, sir.

General LUEDECKE. We have other examples of different load factors and different proportions.

Representative HOLIFIELD. I don't think we will take your time now.

General LUEDECKE. I think that illustrates the principle.

TRANSMISSION LINE COSTS

Representative HOSMER. There is one other thing, possibly we should know.

Of the $1,540,000 gross billing by P.G. & E., how much is profit with which to play around with, the doubling or tripling or whatever else has to be done with that power line?

Are you contemplating just raising P.G. & E. rates so as to have us pay the increased cost of these lines over the tower lines?

Mr. BLOCH. As we indicated this morning, the contract we have negotiated and the rates that are in this contract are based upon or conditioned upon P.G. & E. building an overhead line along this Searsville route. The contract can be adjusted in the event they cannot carry out this commitment.

The preliminary proposals we have received for an underground line essentially involve the Commission picking up the cost of underground construction in excess of $1,012,000. The power company has indicated that it would absorb any cost of construction up to this $1,012,000 figure without any increase in our rates. But over and above that figure, the Government will have to pick up the tab. The alternates merely discuss ways in which we might pick it up either by putting out $1.6 million or by increasing the special annual charges under our power bill to pay for it.

Representative HOSMER. I have one other question.

General Luedecke, with respect to the various alternates that you listed, are those the only alternates or are they illustrative groupings of alternates for the purpose of price comparison?

General LUEDECKE. They are alternates to which we have given consideration and actually tried to price out. We are, of course, looking for any other alternates which might prove to be workable.

I think I should clarify Mr. Bloch's statement on the $1,012,000 that P.G. & E. have said they would absorb. That includes the $668,000 that is in our contract. It is the difference between those two figures and not the total.

Representative HOSMER. We understand that. So if we went to $6,404,000 somebody would have to pick up another $5-million-plus.

General LUEDECKE. Right.

Representative HOSMER. That is what we are squabbling about.

Mr. CONWAY. You gave us an annual operating cost of approximately $2 million. Would there be any additional annual operating charges if you were underground, say under the 3(c) proposal?

Mr. BLOCH. On the basis of the proposals we have received to date—and I must emphasize that we have not really gone back and had any extensive negotiations—it would essentially add $200,000 a year to our power bill unless in lieu of that we wanted to build approximately two-thirds of the line ourselves with Government money and own that portion of the line.

General LUEDECKE. I think the answer is whether it is reflected in the rate structure or an annual assessment——

Mr. BLOCH. Yes; it would add.

Representative HOLIFIELD. What about the maintenance and operation of an underground line compared to a pole line?

General LUEDECKE. I believe P.G. & E. are better prepared to answer that. We have some figures.

Representative HOLIFIELD. We will excuse you for the time being, then.

Thank you.

Our next witness will be Mr. R. W. Joyce, who is vice president, commercial operations, of the Pacific Gas & Electric Co.

Mr. Joyce, we are pleased to have you as a witness before our committee. Would you please introduce your associates, whom you expect to testify?

STATEMENT OF R. W. JOYCE, VICE PRESIDENT, COMMERCIAL OPERATIONS, PACIFIC GAS & ELECTRIC CO.; ACCOMPANIED BY F. T. SEARLES, GENERAL COUNSEL; J. F. ROBERTS, MANAGER, RATE DEPARTMENT; AND W. R. JOHNSON, CHIEF ELECTRICAL GENERATION AND TRANSMISSION ENGINEER

Mr. JOYCE. Thank you, Mr. Chairman.

I have with me today, our general counsel, Mr. Searles——

Representative HOLIFIELD. Would you give their initials also, please?

Mr. JOYCE. Mr. F. T. Searles, general counsel; Mr. J. F. Roberts, manager of our rate department, and Mr. W. R. Johnson, who is our chief electrical generation and transmission engineer.

Representative HOLIFIELD. You may proceed with your statement.

Mr. JOYCE. Thank you, Mr. Chairman, and Congressman Hosmer.

The Pacific Gas & Electric Co. is pleased to have this opportunity to submit a statement to the Joint Committee on Atomic Energy in response to its invitation to provide information with respect to the supply of power to the Stanford Linear Accelerator Center (SLAC).

SLAC lies within P.G. & E.'s service area which covers most of northern and central California. Also within this area are the generating plants of the Central Valley project of the U.S. Bureau of Reclamation. Under certain conditions P.G. & E. wheels Bureau power over its transmission system to customers of the Bureau pursuant to a contract between the Bureau and P.G. & E.

The arrangements for power supply to SLAC had to take into account a number of special factors. Among these were (1) the unusual characteristics of the SLAC electric requirements, consisting in large part of highly variable loads at a low annual load factor; (2) the desire of the Government to take the power needed, to the extent available, from the Bureau of Reclamation pursuant to the wheeling arrangement; and (3) the need for a high-voltage power transmission line to supply the large power demands anticipated by SLAC.

After a careful study of the situation and a long period of negotiations P.G. & E. and the Government entered into a contract dated January 10, 1963, in which P.G. & E. agrees to deliver to SLAC Bureau power and such additional power from P.G. & E. resources as may be required to meet SLAC's needs.

The contract was negotiated upon the premise that P.G. & E. would deliver power to SLAC by means of a 220-kilovolt transmission tower line connecting with its Monta Vista-Jefferson 220-kilovolt transmission tower line, and the rates and charges for services were based upon the same assumption.

Construction of an overhead line was blocked in September of 1963 when the planning commission of the town of Woodside denied a use permit for the line as a result of objections to the appearance of the structure. The Woodside Commission indicated that an underground line was the only alternative acceptable to it, despite the fact that un-

derground construction would increase very substantially the capital cost of the supply line. This increase would be reflected in increased annual costs of service which would not be recovered under the contract rates and charges. To make up the amount of these increased costs from revenues obtained from P.G. & E.'s other customers would be discriminatory and would not be permitted under rulings of the California Public Utilities Commission. Under these circumstances it is P.G. & E.'s position that it will supply underground service to SLAC only if it is compensated for the consequent increase in its cost of service over and above the costs of overhead service, which is its normal practice.

With this brief introduction I would like to describe in somewhat more detail the provisions of the power supply contract. I would like to review also our efforts to obtain use permits for the overhead tower line contemplated by the contract and for a modified type of overhead line on tubular steel poles. Finally, I will describe the alternative proposals which have been made to the Government for underground service to SLAC.

POWER SUPPLY CONTRACT

First is the power supply contract. The contract of January 10, 1963, between the Government and P.G. & E. provides, among other things, that P.G. & E. is to install two overhead lines of 60 and 220 kilovolts, respectively—kilovolts as used here means thousands—of specified capacities, and along specified routes, and to supply by means thereof the entire electrical load requirements of SLAC. P.G. & E. will sell to the Government all power and energy required by SLAC in excess of that allocated to the Government by the Bureau of Reclamation and delivered by P.G. & E. to SLAC under P.G. & E.'s contract for wheeling service with the Bureau. P.G. & E. will supply two classes of service; firm service and interruptible service as defined in the contract, in such amounts as the Government may designate from time to time.

The rate for firm service initially will be P.G. & E.'s schedule A–13 applicable to large power loads including large industries and governmental use such as Vandenburg Air Force Base. However, when firm service is supplied in conjunction with wheeled power, the charges to the Government will be only the incremental charges that result from assigning energy use for both blocs of power at the combined load factor. P.G. & E. is now preparing to file with the California Public Utilities Commission a rate to be designated as schedule A–14 which is similar to, but substantially lower than, schedule A–13 for use in excess of 300 kilowatt-hours per kilowatt-month. The Government will be able to take advantage of this new lower rate under a provision of the contract which gives the Government the opportunity to benefit from any of P.G. & E.'s rates applicable for similar conditions of service that result in lower charges.

The rate for interruptible service is similar to, and the demand and energy charges are identical with, the special rate authorized by the California Public Utilities Commission for Ames Laboratory where such service is sold to the National Aeronautics and Space Administration.

A study made by P.G. & E. on the basis of the power requirements estimate received from SLAC for the years 1965 throught 1972 shows that P.G. & E.'s rate of return under the contract will not exceed 6¼ percent even though costs were determined on the basis of using an overhead line. Such a rate of return has been found by the California Public Utilities Commission to be no more than reasonable for P.G. & E.'s electric department.

The contract provides a minimum charge for billing purposes to protect the P.G. & E. investment in facilities installed to supply only the SLAC load. The minimum charge would not be effective unless SLAC's use of power falls far below present expectations.

The contract has an initial term of 10 years and continues thereafter from year to year. It may be terminated by either party at the end of the initial term or any subsequent anniversary. However, provision is made for the Government to terminate during the initial term for any reason, upon payment to P.G. & E. of its actual installation and removal costs of the facilities installed to serve SLAC less the salvage value of the facilities removed, and if such termination occurs with less than 3 years' notice, by payment of a decreasing schedule of cancellation charges.

I would like to leave my prepared statement and talk about our efforts to obtain use permits from local planning bodies. I have here, Mr. Chairman, a map, which is an aerial photograph and on this map are shown the various alternate routes of overhead lines and routes being looked at as a possible underground alternate.

I would like to have Mr. Johnson indicate as I go along with the routes and specify the route and area as they appear on this map and by color so they can be found in the record.

I mention now the 5.3-mile-long route passing through territory under the jurisdiction of the town of Woodside and the county of San Mateo.[1]

Mr. JOHNSON. The town of Woodside is outlined in the red marking and this line is shown in light green.

Representative HOSMER. Would you indicate the parts of that line to which the Woodside people are objecting? I don't suppose they can object to where you connect into the main line.

Mr. JOHNSON. I believe the city of Woodside is officially concerned with the portion across Woodside because of the use permit required and the county of San Mateo with the parts outside of Woodside which are in the county of San Mateo.

Representative HOSMER. Are those inhabited locations or does the line just go over mountains?

Mr. JOYCE. As I recall the overlaying red shows the outline of the town of Woodside on this map.

Representative HOSMER. That is correct and I am asking about the area in San Mateo County that is west of the city limits of Woodside extending to your now existing overhead line from which the power is to be taken.

Mr. JOHNSON. I would characterize it as being sparsely settled. There are houses along the Skyline area.

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[1] Various routes are shown in figure on p. 180, app. 14.

Representative HOSMER. Are there houses along the area where your existing line is?

Representative HOLIFIELD. The 60-kilovolt line.

Representative HOSMER. Were these objections raised by the county at the time you put in the existing line?

Mr. JOHNSON. Yes, we had a considerable amount of discussion with appearances before the planning commission and so forth.

Representative HOSMER. Apparently the county conceded to your position. Is that correct?

Mr. JOHNSON. We were finally granted the permit.

Representative HOSMER. Would you tell us approximately how long the proposed line is that goes from the existing line to roughly the city limits of Woodside?

Mr. JOHNSON. I would estimate that as about 2½ miles.

Representative HOSMER. Would you estimate how much of this line would be in the city of Woodside?

Mr. JOHNSON. I think this is slightly more than a quarter of a mile.

Representative HOSMER. At the eastern boundary of the city of Woodside does the line then go on to Stanford University property?

Mr. JOHNSON. Yes. This is Stanford land at this point.

Representative HOSMER. How much of this line would be on Stanford University property?

Mr. JOHNSON. Approximately 2½ miles.

Representative HOSMER. Very well.

Representative HOLIFIELD. That would narrow this down to about 3 miles that would be outside the Stanford property.

Mr. JOHNSON. I believe that is about correct; yes, sir.

Representative HOLIFIELD. And this route is only available for an overhead line?

Mr. JOHNSON. It is not feasible for an underground line. This point is a high ridge. There is approximately 1,500 feet or more drop in elevation coming down a rather steep hillside.

Representative HOSMER. Let's direct our attention then to that portion of the line which is in the city of Woodside. What is the topography there in relation to the feasibility of an underground line?

Mr. JOHNSON. The portion here—about halfway is on a hillside. Then we get down to the lower part and it is in the area adjacent to Searsville Lake, which is rather low and swampy, but fairly level.

Representative HOSMER. Do you have to have a flat surface for your underground line?

Mr. JOHNSON. No. We do not have to have a level plain, but it cannot have too large a difference in elevation.

Representative HOSMER. Would it be feasible to put a portion of this line in the city of Woodside underground?

Mr. JOHNSON. I haven't made a study of this particular problem. I would hesitate to say that it could not be done.

Representative HOSMER. If there could be a part overhead and part underground of that nature, would it fall somewhere between the cost that you have estimated in these various alternatives about which the committee has already heard?

Mr. JOYCE. Would we not have to have terminal facilities on both sides of that section?

(Question directed to Mr. Johnson.)

Mr. JOHNSON. Oh, yes. If it does go underground we have to provide terminal switching where it would convert back to an aerial line.

Representative HOSMER. I understand that. My question is: If it is feasible, would that kind of a combination be somewhat lower in cost than that of a fully underground line on one of your alternative routes?

Mr. JOHNSON. I think it would be.

Representative HOSMER. Very well.

Representative HOLIFIELD. I understand there has been no objection on the part of Stanford to the line that goes through pasturelands or farmlands on the Stanford property of about 2½ miles but doesn't interfere with residential use.

Mr. JOYCE. Mr. Chairman, that is true but this is land in the county of San Mateo and we are faced with the same use permit denial for that.

Representative HOLIFIELD. Does the county object to that notwithstanding the fact it is on Stanford property?

Mr. JOYCE. That is correct.

Representative HOLIFIELD. Because it would be inadvisable from the standpoint of surrounding residential areas and considered as not being aesthetic?

Mr. JOYCE. I do not know why. It would be visible if that is the reason.

Representative HOLIFIELD. Would it be visible from the surrounding residential properties as it crosses the Stanford line?

Mr. JOHNSON. Oh, yes. There are residential areas on both sides.

Representative HOLIFIELD. Both sides of that ridge?

Mr. JOHNSON. Yes.

Representative HOLIFIELD. Where is the high point on the ridge?

Mr. JOHNSON. There is a road known as Skyline Road which can be seen, which is approximately the crest of the ridge.

Representative HOLIFIELD. Some of that is San Mateo County area and also there is the Woodside side of the ridge?

Mr. JOHNSON. Yes, sir.

Representative HOSMER. According to information furnished us there are only six property owners in all the distance from the existing line from Stanford University boundary both in San Mateo County and in Woodside.

Mr. JOYCE. Mr. Chairman, in connection with your question on the area of visibility we have four small photographs that might be of interest. They show the general area with an artist's dubbing in of this tapered pole arrangement that we have in one of these proposals.

Representative HOSMER. In addition to the six landowners whose view would be affected, how many more homeowners are there who might be offended by this line? Are there 6 more or 20 more? Does anyone have an idea?

Mr. JOYCE. We have made no count. As a matter of fact in considering such a situation it is hard to determine the area in which the existence of such a line would be offensive.

Representative HOSMER. Could you give us a number?

Mr. JOYCE. I have no number. The only thing I could add is the contemplation of standard tall structures—if I am correct, Mr. Johnson—of some 100—200 feet tall——

TYPES OF TRANSMISSION TOWERS AND POLES

Mr. JOHNSON. Not 200. If conventional towers are used, they would be on the order of 120 feet. (See drawing, app. 15, p. 183.)

Representative HOSMER. I don't have much sympathy for putting up a conventional tower, but I have seen some of these steel poles you are talking about. (See app. 15, pp. 182–183.)

Mr. JOHNSON. We have data on poles also and they are of lesser height.

Representative HOLIFIELD. What is the height of the tubular poles?

Mr. JOHNSON. They vary widely, but around 70 feet more or less. Some are 80. Some are as high as 90. Some are down in the 60's.

Representative HOLIFIELD. I notice in your drawings—and I looked at those drawings before—that you have not cleared any brush out where that pole line goes through. Your artist certainly hasn't gone out of his way to indicate where the pole line is going to be. I can hardly find it. I am wondering if it will be that invisible when it is actually put in there.

Mr. JOHNSON. This is an accurate rendering to the best we can of this section.

Representative HOLIFIELD. Isn't it customary to cut out a swath of trees and underbrush?

Mr. JOHNSON. We do not intend to cut any more trees than those which will interfere with the line.

Representative HOLIFIELD. The line itself.

Representative HOSMER. You won't clear a wide path underneath the lines themselves.

Mr. JOHNSON. No, sir.

Representative HOLIFIELD. Are those trees in that neighborhood of the order of 35 or 40 feet high?

Mr. JOHNSON. Most of these trees are oaks or——

Representative HOLIFIELD. Scrub oaks——

Mr. JOHNSON. If we can stay clear of the tall redwoods, then we do not have to cut many trees—only those which may get into the line.

Representative HOLIFIELD. Of course the pole line would extend above the general level of the treetops.

Mr. JOHNSON. Yes, as shown here. Those pole heights are as accurate as we can portray them.

Representative HOLIFIELD. That pole line would carry, when needed, 300,000 kilowatts.

Mr. JOHNSON. Yes, sir.

Representative HOLIFIELD. The same as the tower line would.

Mr. JOHNSON. The same as either circuit of the tower line.

Representative HOLIFIELD. Would a single circuit be acceptable rather than a double circuit?

Mr. JOHNSON. This pole line is a single circuit.

Representative HOLIFIELD. The tower line would be double.

Mr. JOHNSON. It would be double.

Representative HOLIFIELD. The additional advantage of the double circuit would be against interruption in case of a breakdown.

Mr. JOHNSON. It is better continuity. The alternate source permits maintenance.

Representative HOLIFIELD. The testimony of Dr. Panofsky was that there is a minimum amount of power from other sources necessary to operate the accelerator without damage to its continuous operation. There is backup in case you only have a single circuit.

Mr. JOHNSON. That is correct. We have the 60-kilovolt as we have shown on the map.

Representative HOLIFIELD. It would stop the experimental program, but it would not cause damage to the accelerator.

Mr. JOHNSON. That is my understanding.

Mr. JOYCE. Mr. Chairman, would you care to take a moment to look at the several alternate routes that we considered? I might add for the record these are not all of the routes that have been considered. There have been a number of other routes considered. However, these appeared to have some practical chance of construction and approval.

Would you just briefly cover the routes as marked on the map, Mr. Johnson?

Mr. JOHNSON. One of the alternate routes was the route along the proposed Junipero Serra Freeway, which is shown here with the blue tape. The route of the line would be parallel, but not on the freeway right-of-way, as indicated by the green tape or a slight alternate as shown by the orange. (See app. 14, p. 180.)

Designs were contemplated employing either double circuit towers or double circuit steel poles along this route.

The other route——

Representative HOLIFIELD. Before you leave that, is this a distance of about 7.5 miles?

Mr. JOYCE. Wasn't that 6.83 miles?

Mr. JOHNSON. That is underground.

Mr. JOYCE. I am sorry. My statement was incorrect.

Representative HOLIFIELD. You heard the questions and answers this morning about acquisition of rights-of-way and that the right-of-way has not been acquired for this proposal.

Do you agree with the conclusion—I guess you would call it—that you are talking about a potential route rather than one that is feasible at the present time?

Mr. JOHNSON. Maybe one of the others would be in a better position to answer that than I am.

Representative HOLIFIELD. Which one of you gentlemen would like to answer that?

Mr. SEARLES. I would be glad to state there is no doubt we can proceed. We understand that the alinement of the freeway is established and we could acquire a right-of-way parallel to that.

Representative HOLIFIELD. What would be the time period involved for you to acquire that right-of-way?

Mr. SEARLES. A contested condemnation suit may take at least a year. Sometimes they take longer. Most of them are disposed of much more quickly.

Representative HOLIFIELD. If this was an above-surface line, there is no doubt but that it would be contested.

Mr. SEARLES. I think so.

Representative HOLIFIELD. Did you compute the cost of an underground line along that way?

Mr. JOHNSON. The underground line cost is based upon a route that would not require a purchase of a right-of-way because it could be built on existing streets and roads on which we have franchise rights.

Representative HOLIFIELD. Are those paved streets?

Mr. JOHNSON. Yes.

Representative HOLIFIELD. In the main?

Mr. JOHNSON. In the main, yes.

Representative HOLIFIELD. That would mean the breaking up of pavement and putting in the underground line. There would be a cost involved in that.

Mr. JOHNSON. That is right.

Representative HOLIFIELD. Then restoration of the pavement.

Mr. JOHNSON. That is right.

Representative HOLIFIELD. What would it run in cost?

Mr. JOHNSON. The figures that have been presented for the single circuit underground 180 megawatt capacity.

Mr. SEARLES. $2 million——

Mr. JOHNSON. $2,640,000.

Representative HOLIFIELD. Is that called the Hill Road underground route?

Mr. JOHNSON. Coming along Canada Road, Whisky Hill Road and Sand Hill Road.

Mr. SEARLES. 3c. (See table, p. 9.)

Mr. JOHNSON. To the accelerator.

Representative HOLIFIELD. The 3c route you have on that chart.

Mr. SEARLES. 3c on the table furnished by the AEC.

Representative HOLIFIELD. Is that the only underground line you have planned?

Mr. JOHNSON. It is easily the most feasible and the lowest cost underground route.

Representative HOLIFIELD. I suppose you did look at the possibility of coming in from the south there—up that riverbed.

Mr. JOHNSON. We looked at many possible approaches that might be considered in order to avoid the right-of-way problem. We tried to take advantage of the streets and roads coming this way. There are no routes that are any shorter that would enable us to do the same thing.

Representative HOLIFIELD. There would be no delay in this. You have existing franchises so there would be no delay for acquisition if you were to use this route.

Mr. JOHNSON. My understanding is that we do not have to acquire any additional routes.

UNDERGROUND LINES

Mr. JOYCE. These rights. I may say for the record, are franchise rights of indeterminant nature.

I might add, Mr. Holifield, that I am advised one of the problems in an underground line of this nature is that with oil-filled conduits, if you have grade, of course, you have pressure differentials. That makes a problem over rugged territority, bend pressures, and whatnot.

This route is desirable in that the grade, as I understand it, is satisfactory for the physical limitations of high-pressure oil-filled cable.

Representative HOLIFIELD. Satisfactory or unsatisfactory?

Mr. JOYCE. Satisfactory.

Representative HOLIFIELD. In an underground pipe like that you have to pump oil through it for cooling purposes. Is that right?

Mr. JOHNSON. The oil is chiefly for insulating purposes. It must be kept at very high level of purity and provision must be made for temperature changes and expansion of the oil so that there is pumping necessary to maintain the pressure under 200 pounds pressure and the temperature changes require that the volume of oil be pumped in or out to maintain this pressure.

Representative HOLIFIELD. So there is an expense there of operating the pumps for the oil and so forth?

Mr. JOHNSON. Yes, sir.

Representative HOLIFIELD. And there is no parallel expense for an overhead line? It cools itself in the air.

Mr. JOHNSON. The overhead line is cooled by the air.

Mr. CONWAY. Do you have underground lines of the nature you are describing in your system today?

Mr. JOHNSON. We have 45 miles of 110,000-volt underground lines. These lines are pressurized with nitrogen gas rather than oil. But in going to the higher voltage the practice in the industry has been to go to oil because of its superior insulating qualities. The lines that use gas also operate under 200 pounds pressure. It is not difficult to maintain that presure of gas which is done by pressurized gas cylinders. The problems are similar. They are not identical. We have had quite a few years of operating experience with those 110,000-volt lines.

Representative HOLIFIELD. Have you had any experience with the 220 kilovolts?

Mr. JOHNSON. We have not.

Representative HOLIFIELD. You spoke of having 45 miles underground. Where are these lines generally located?

Mr. JOHNSON. These are, in general, within the cities of San Francisco, Oakland, and Richmond.

Representative HOLIFIELD. Heavily populated areas?

Mr. JOHNSON. Yes; where there were no possible routes for overhead lines of these voltages and capacities.

Representative HOLIFIELD. In view of the fact that you haven't had any experience in this size or voltage line, would it be possible you could learn quite a bit about the underground transmission of electricity in a heavy voltage line like this which you do not, at this time, know?

Mr. JOHNSON. There are a number of installations already existing of 220,000-volt underground lines in the United States.

Representative HOLIFIELD. That are being cooled with oil?

Mr. JOHNSON. That are being cooled with oil?

Our engineers have visited a number of these installations. They have, I believe, benefited from the information available so that we do not feel there is a technical difficulty in constructing or operating such a line from the standpoint of being a new development.

Representative HOLIFIELD. Would it be possible then for you to claim a research and development chargeoff on this type of a line in view of the fact that it is your first use of it?

Mr. JOHNSON. In my opinion it would not be.

Representative HOLIFIELD. The Public Utilities Commission of California would not allow it?

Mr. JOHNSON. In my opinion any charge to research and development here would not be justified.

Representative HOLIFIELD. Do you concur in that, Mr. Counsel?

Mr. SEARLES. On the basis of the facts which I have obtained from Mr. Johnson I do not believe that we could justify a research and development expense on the installation of this line.

Representative HOLIFIELD. Under the public utilities commission's regulations and rules, are you obligated to charge the user at the end of this line—being one large single user—any peculiar costs such as this or could you spread it over the complete system?

Mr. JOYCE. The decisions of the California Public Utilities Commission on this very type of thing indicate that it would be considered as undue discrimination. As a matter of fact, a specific case to which I can refer is the town of Walnut Creek on this question of undergrounding and I will give you the reference on the case.

The Commission after a full public hearing with representatives of all parties decided that such a method of spreading these costs could not be allowed and that the utility; namely, Pacific Gas & Electric in this case, should be properly compensated for the extra additional cost. This is based on the premise, of course, that our rates are established on a large systemwide basis and are based upon overhead construction.

So when additional investment for reasons other than the primary necessity of handling large loads where you move into, shall we say, esthetics for some specific group, under those circumstances this decision, which states it much more succinctly than I have, pointed out that if underground lines were required by an ordinance that the city had passed; namely, Walnut Creek, somebody had to pick up the tab. It could not be spread to our ratepayers.

That decision is No. 58–551 in Case 6S73.6173, dated June 8, 1959.

Representative HOLIFIELD. In that case the city of Walnut Creek was charged the specific overage?

Mr. JOYCE. No, sir. In that case the developer took service by means of overhead. The waiver of the underground ordinance that the city had passed was granted. On underground, in later development of this area, the difference has been paid by the developer—the excess cost of the underground over the overhead in accordance with the Commission's order.

Representative HOLIFIELD. So far as you are concerned, that principle is pretty well established.

Mr. JOYCE. It is quite well established; yes, sir. There are other precedents.

POWERLINE COSTS

Representative HOLIFIELD. Under what latitude did you make the concession to go from the $668,000 on the tower line to $922,000 on the overhead pole lines. (See table, p. 9).

Mr. JOYCE. On the basis that we are under contract to supply this service by overhead service and by the shortest practical route. Our purpose is to fulfill that contract if we may be permitted to do so by obtaining use permits. Consequently, it is proper to say that in the tubular type of pole or the most expensive type of pole structure on a

longer route that we can get rights for at all the alternate explored, the $1,012,000, as estimated, would be proper in our efforts to fulfill our obligation to serve overhead.

Representative HOLIFIELD. Let me clear up one thing. The Searsville overhead pole route, as I have it, is $922,000 and the Junipero Serra Freeway is $1,012,000. Is that right?

Mr. JOYCE. That is right.

Representative HOLIFIELD. I questioned one figure and you quoted another. I just wanted the record straight.

Mr. JOYCE. That is correct. There are several other routes at lesser cost. Incidentally this route we are talking about—the Searsville route—would be; am I correct in this, Mr. Johnson—this is a twin circuit—dual circuit?

Mr. JOHNSON. No, that is single.

Representative HOLIFIELD. Dual?

Mr. JOHNSON. That is a single-circuit route for the poles; double circuit for the towers. The $922,000 is a single circuit.

Representative HOLIFIELD. The Junipero Serra Freeway is a double circuit.

Mr. JOYCE. That is correct.

Mr. JOHNSON. That is correct.

Mr. JOYCE. That is a double circuit for the freeway. That is a different figure. But it is in the top ceiling of $1,012,000 we have gone for.

Representative HOSMER. If the freeway route is finalized, the only thing that would be required of you to use it would be the acquisition of property rights—easements? Is that the idea?

Mr. JOYCE. What we planned was to acquire our own rights, Mr. Hosmer, parallel to the freeway. The acquisition of joint use at their state of planning, to my knowledge was explored and I understood it was not feasible.

ACQUISITION OF EASEMENTS

Representative HOSMER. We understand that. If you acquired your own easements along that freeway route, you could go ahead and put your poles in prior to the construction of the freeway. There is not a safety problem with respect to housing that may be there or anything like that.

Mr. JOYCE. Yes; that is my understanding.

Mr. JOHNSON. That is correct.

Representative HOSMER. Are you willing to do that?

Mr. JOHNSON. Yes, sir.

Representative HOSMER. What is the hitch? Is it the time it takes to get easements?

Mr. JOHNSON. No; it is obtaining of the use permit. You see we have time——

Representative HOSMER. Have you been refused on that one, too?

Mr. JOHNSON. Yes, sir.

Representative HOLIFIELD. Let me ask this question: You have objections to a parallel route there and objection to putting poles on the Searsville route. You can't put in poles even on the city streets you now have franchises on.

Mr. JOHNSON. We could not put in poles along these roads that would carry the 220 kilovolts without encroaching upon private property and overhangings and guys, such that we would have to get rights to do that.

Mr. JOYCE. And at the same time we would have the problem of continuing service on lines that are on the street which cannot be handled by the underground installation.

Representative HOLIFIELD. Do you have any other customers with an energy requirement comparable to the AEC requirement at the Stanford linear accelerator? I am speaking now of a requirement that would involve up to 180,000 kilowatts.

Mr. JOYCE. We supply, as I have referred to in my testimony so far, the Ames Laboratory service to the Government for loads that—I can't quote them exactly, but as I recall the onpeak is about 120 megawatts, offpeak runs up to 260 megawatts, interruptible. It is a larger load than 180 megawatts; it approaches the 300 megawatts we are discussing here.

Representative HOLIFIELD. Your answer is, "Yes," that you do.

POWER COST RATES

Mr. JOYCE. Yes. Involved here again are three kinds of power. As far as firm power is concerned, yes, we have loads on firm power that are equivalent to or larger than the firm power we are supplying here on regular schedule A–13.

Representative HOLIFIELD. Are the rates you are negotiating and have reached in the table of rates similar in nature to that which you are now charging the Government for Ames?

Mr. JOYCE. Yes, sir; exactly the same.

Representative HOLIFIELD. On page 3 you state a new schedule of cost is presently being prepared, known as schedule A–14. This is the first we have heard of that. We have only heard of A–13.

When did you start preparing this new schedule and what is the difference between it and A–13?

Mr. JOYCE. This new schedule has been under preparation a matter of only a few weeks. The preparation for filing has reached a state now that while we cannot anticipate the decision of the California Public Utilities Commission—it has been gone through with the staff—we contemplate filing and have such rate available by about March 1.

Representative HOLIFIELD. Will the rate be of advantage to the Government?

Mr. JOYCE. From our analysis of their load requirements, it will be of advantage to the Government. It can be described perhaps simply this way. It is a rate schedule of decreasing cost for more use, exactly the same as schedule A–13, which is our general large industrial schedule applicable throughout the system except that at the use point in schedule A–13, for 300 kilowatt-hours per kilowatt per month, the terminal block of the A–13 schedule drops 1½ mills. In other words, it is 5-mill power after 300 kilowatt-hours per kilowatt use per month. This means a rather substantial saving to load factor use in that realm.

Rough calculations that we have made, based again on the estimate of power obtained from SLAC and working with them on it, would indicate a saving on the order of up to perhaps $90,000.

Representative HOLIFIELD. A year?

Mr. JOYCE. A year, sir. In other words it is a break-even loan factor on firm power at a load factor of 14 percent. Power over that has been reduced by this 1½ mills.

Representative HOLIFIELD. On page 3, you state:

> However, when firm service is supplied in conjunction with wheeled power, the charges to the Government will be only the incremental charges that result from assigning energy use for both blocks of power at the combined load factor.

Mr. JOYCE. Yes, sir.

Representative HOLIFIELD. What does this mean?

Mr. JOYCE. I will try to draw an oral picture.

Let us say that we are supplying 20 megawatts—20,000 kilowatts of firm power. Under the terms of the contract that may be all wheelpower or it may be all firm power from us or it may be any combination thereof.

So, let us say, for example, that 15 megawatts are being wheeled and the balance of 5 megawatts in the total of 20 are coming from us on schedule A–13. The way you would compute the bill then for the A–13 portion or the 5-megawatt portion is that we would compute 20 megawatts at that demand factor and deduct on the charges in the rate and utilize the energy factor for the total energy.

In other words, you would make out the bill first as though we had sold all power—sold 20 megawatts of power at x number of kilowatt-hours. Then we do the same thing for 15 megawatts at the same load factor. Then you take the difference of those two bills which means that the Government would be liable only for the incremental excess of billing over the first 15 megawatts with its associated kilowatt-hours, which would be billed at the 1-mill rate.

BUREAU OF RECLAMATION POWER

Representative HOLIFIELD. In other words, the Government would get the advantage of the lower rate in relation to load factor of that portion that was wheeled from the Bureau of Reclamation.

Mr. JOYCE. Yes, sir. The advantage goes this way: If you billed at 15 megawatts as an entity on wheelpower and then picked up 5 megawatts with the measured kilowatt-hours that went with it at a very low factor, because of the formation of the rate—which is the more you use, the less you pay—you would pay a higher rate for that extra demand with less associated energy.

TRANSMISSION LINE COSTS

Representative HOLIFIELD. Are you firmly convinced that your estimate of underground installation is a current and reliable figure? We have had some indication that might be a little high; that there are new methods of placing lines underground which would not be as expensive as this table would indicate.

Mr. JOYCE. Based on the long experience of our staff of engineers, the work we have done with underground of this nature, but at 110,000

volts instead of 220, together with the information that has been supplied to me and advice given me of the investigations we have made of all other known installations and their costs, I feel that the figure is a good estimate and it will probably work out quite close thereto.

As a matter of fact, Mr. Holifield, in our discussions with the staff of the AEC during the negotiations and discussions that have been going on with respect to possible underground alternates, I have committed my company to this.

If it comes to this payment for the excess cost of the underground line above that for the overhead, we figured in our estimate an allowance against that of $1,012,000 that we would have invested in the most expensive overhead line; $1,628,000 in excess will not be higher. In other words, we are saying our estimate, we believe, is right. If it it higher, we will stand it. If it is lower, however, and the contract will provide, as it does in overhead, for adjustment to actual cost, adjustment will be made downward on the contribution that would have been made for excess.

RELIABILITY OF TRANSMISSION LINES

Representative HOLIFIELD. Can you describe for us the difference in reliability between the underground and overhead transmission lines, the interruptibility, and the difference in cost of maintenance?

Mr. JOYCE. On the reliability feature, I would like to have Mr. Johnson speak to that portion of the question. On the maintenance cost, the estimates that we have made—and these are continuing studies on these costs—the actual dollar figures from an operation and maintenance standpoint would be dollarwise higher for the underground, but not necessarily a great amount of dollars. I am speaking now to only the system average cost, the experience cost picked up from existing underground installations we have translated to 220,000 volts underground. We feel that the operation and maintenance would be, shall we say, slightly higher but in dollars might not amount to a great deal per year.

On the other portion of the question with respect to interruptibility, Mr. Johnson has gone into this quite thoroughly with not only ourselves, but with others who are experienced. I would ask him to speak to that portion.

Mr. JOHNSON. With regard to reliability of an underground high-voltage line, there is no question but that the experience of ourselves and also nationally has shown that for equal lengths of line, the underground line has fewer failures, fewer interruptions than an equivalent length overhead line.

However, in considering this one also must realize that for an overhead line many of the faults or flashovers are of a transient or temporary nature or can be repaired in a matter of hours whereas for an underground line of the voltage which we are discussing, the time necessary to repair a failure typically will run approximately a month.

Representative HOLIFIELD. Thirty days.

Mr. JOHNSON. Thirty days, so that although the failure rate is much lower, the time for repair is much longer.

Representative HOLIFIELD. It is more difficult to find the fault and then you have to cut into the steel lines, withdraw the oil and that sort of thing.

Mr. JOHNSON. All of these complications enter into the repair of an underground line which are not usually present for the overhead.

Representative HOSMER. Where do you put your underground line? Is it in a piece of pipe?

Mr. JOHNSON. This underground line would be in a steel pipe approximately 8 inches in diameter with the three conductors which, in turn, are wrapped with hundreds of layers of special kraft paper so that the individual conductor is about 3 inches in diameter. Three of these would be pulled into this steel pipe. Then very pure and dry oil is pumped in and maintained under 200 pounds pressure. The actual thickness of insulation is less than 1 inch to insulate the 220,000 volts of the conductor from the outside metallic wrapping. This must be maintained—this insulation—with a very high quality to give dependable service. Any repairs that are made, such as a splice of a new section of cable in case of a failure, must be done with extreme care under very carefully controlled conditions.

These are some of the factors that enter into the time and difficulty of making the repair.

Representative HOSMER. Referring a moment to the steel poles we have been talking about. Do they come in colors now that blend in with the background or are they all the same color?

Mr. JOHNSON. I am sure we would be pleased to consider and to paint these steel poles any color that could be agreed upon. Sometimes it is difficult to decide what is a desirable color in these things.

Representative HOLIFIELD. As far as blending in with the landscape it might vary with spring and fall.

Mr. JOHNSON. This is sometimes a problem.

Representative HOSMER. You might want to make a powerline "smog color." [Laughter.]

Mr. JOYCE. Please, we are speaking of San Francisco. [Laughter.]

Representative HOLIFIELD. You have finished proposal A. Go ahead with proposal B.

Mr. JOYCE. Yes; and would it be possible to have this statement put in the record as though read because there are some matters to which we have referred which may have been misunderstood?

Representative HOLIFIELD. Yes.

Mr. JOYCE. I would appreciate it.

(The statement follows:)

Mr. JOYCE. Pacific Gas & Electric Co. (P.G. & E.) is pleased to have this opportunity to submit a statement to the Joint Committee on Atomic Energy in response to its invitation to provide information with respect to the supply of power to the Stanford Linear Accelerator Center (SLAC).

SLAC lies within P.G. & E.'s service area which covers most of northern and central California. Also within this area are the generating plants of the Central Valley project of the U.S. Bureau of Reclamation. Under certain conditions P.G. & E. wheels Bureau power over its transmission system to customers of the Bureau pursuant to a contract between the Bureau and P.G. & E.

The arrangements for power supply to SLAC had to take into account a number of special factors. Among these were (1) the unusual characteristics of the SLAC electric requirements consisting, in large part, of highly variable loads at a low annual load factor; (2) the desire of the Government to take the power needed, to the ex-

tent available, from the Bureau of Reclamation pursuant to the wheeling arrangement; and (3) the need for a high voltage power transmission line to supply the large power demands anticipated by SLAC.

After a careful study of the situation and a long period of negotiations P.G. & E. and the Government entered into a contract dated January 10, 1963, in which P.G. & E. agrees to deliver to SLAC Bureau power and such additional power from P.G. & E. resources as may be required to meet SLAC's needs.

The contract was negotiated upon the premise that P.G. & E. would deliver power to SLAC by means of a 220-kilovolt transmission tower line connecting with its Monta Vista-Jefferson 220-kilovolt transmission tower line, and the rates and charges for service were based upon the same assumption.

Construction of an overhead line was blocked in September of 1963 when the Planning Commission of the town of Woodside denied a use permit for the line as a result of objections to the appearance of the structures. The Woodside Commission indicated that an underground line was the only alternative acceptable to it, despite the fact that underground construction would increase very substantially the capital cost of the supply line. This increase would be reflected in increased annual costs of service which would not be recovered under the contract rates and charges. To make up the amount of these increased costs from revenues obtained from P.G. & E.'s other customers would be discriminatory and would not be permitted under rulings of the California Public Utilities Commission. Under these circumstances it is P.G. & E.'s position that it will supply underground service to SLAC only if it is compensated for the consequent increase in its cost of service over and above the costs of overhead service as is the normal practice.

With this brief introduction I would like to describe in somewhat more detail the provisions of the power supply contract. I will then review our efforts to obtain use permits for the overhead tower line contemplated by the contract and for a modified type of overhead line on tubular steel poles. Finally, I will describe the alternative proposals which have been made to the Government for underground service to SLAC.

THE POWER SUPPLY CONTRACT

The contract of January 10, 1963, between the Government and P.G. & E. provides, among other things, that P.G. & E. is to install two overhead electrical lines of 60 kilovolts and 220 kilovolts, respectively, of specified capacities, and along specified routes, and to supply by means thereof the entire electrical load requirements of SLAC. P.G. & E. will sell to the Government all power and energy of SLAC in excess of that allocated to the Government by the Bureau of Reclamation and delivered by P.G. & E. to SLAC under P.G. & E.'s contract for wheeling service with the Bureau. P.G. & E. will supply two classes of service, firm service and interruptible service as defined in the contract, in such amounts as the Government may designate from time to time.

The rate for firm service initially will be P.G. & E.'s schedule A–13 applicable to large power loads including large industries and governmental use such as Vandenburg Air Force Base. However, when firm service is supplied in conjunction with wheeled power, the charges

to the Government will be only the incremental charges that result from assigning energy use for both blocks of power at the combined load factor. P.G. & E. is now preparing to file with the California Public Utilities Commission a rate to be designated as schedule A–14 which will be similar to, but substantially lower than, schedule A–13 for use in excess of 300 kilowatt-hours per kilowatt per month. The Government will be able to take advantage of this new lower rate under a provision of the contract which gives the Government the opportunity to benefit from any of P.G. & E.'s rates applicable for similar conditions of service that result in lower charges.

The rate for interruptible service is similar to, and the demand and energy charges are identical with, the special rate authorized by the California Public Utilities Commission for Ames Laboratory where such service is sold to the National Aeronautics and Space Administration.

A study made by P.G. & E. on the basis of the power requirements estimate received from SLAC for the years 1965 through 1972 shows that P.G. & E.'s rate of return under the contract will not exceed 6¼ percent even though costs were determined on the basis of using an overhead line. Such a rate of return has been found by the California Public Utilities Commission to be no more than reasonable for P.G. & E.'s electric department.

The contract provides a minimum charge for billing purposes to protect the P.G. & E. investment in facilities installed to supply only the SLAC load. The minimum charge would not be effective unless SLAC's use of power falls far below expectations.

The contract has an initial term of 10 years and continues thereafter from year to year. It may be terminated by either party at the end of the initial term or any subsequent anniversary. However, provision is made for the Government to terminate during the initial term for any reason, upon payment to P.G. & E. of its actual installation and removal costs of the facilities installed to serve SLAC less the salvage value of the facilities removed, and if such termination occurs with less than 3 years' notice, by payment of a decreasing schedule of cancellation charges.

P.G. & E.'S EFFORTS TO OBTAIN USE PERMITS FROM LOCAL PLANNING BODIES

The planning commissions of the county of San Mateo and the city of Menlo Park granted use permits for the 60-kilovolt wood pole line on January 9, 1963, and January 7, 1963, respectively.

The 220-kilovolt tower line specified in the contract would be approximately 5.3 miles long on a route passing through territory under the jurisdiction of the town of Woodside and the county of San Mateo. Consultations with the planning authorities in these two jurisdictions were commenced in January of 1963. After several conferences and field inspection trips, applications for use permits were filed in June of 1963 for a double circuit, 220-kilovolt line, capable of delivering 300 megawatts to SLAC over either of the two circuits. The estimated cost was $668,000.

The Woodside application came on for hearing on June 27, 1963. There was susbtantial community opposition, and the hearing was continued by the planning commission until August 22, 1963, in

order that the commission might be fully informed as to both the line applied for and the feasibility of an underground line to serve SLAC.

At the hearing on August 22, P.G. & E. offered to supply service by means of an alternate overhead line from Jefferson substation along a route adjacent to the proposed Junipero Serra Freeway, which passes directly across the SLAC project. P.G. & E. also offered at this hearing to construct the line on tubular steel poles to the greatest extent possible on either alinement. The estimated cost of a tower line adjacent to Junipero Serra Freeway was $951,000, and the estimated cost of the tubular steel pole line on this route was $1,012,000.

At the hearings, P.G. & E. presented a complete study of power supply to SLAC by an underground line. This study made it clear—

1. That a feasible route (utilizing public streets and Stanford University lands) was available for an underground line to serve SLAC from Jefferson substation.
2. That the cost of an underground line equivalent in capacity to the overhead tower line which was the subject of the applications was $6,440,000.
3. For P.G. & E. to pay the cost of such an underground line without increasing the charges for service to SLAC would constitute discrimination in favor of the Government contrary to P.G. & E.'s obligations as a public utility and contrary to rulings of the California Public Utilities Commission.

On September 26, 1963, the Woodside Planning Commission denied P.G. & E. a use permit for construction of the overhead line on either of the alternate routes.

P.G. & E. appealed the planning commission's decision to the Woodside Town Council on November 13, 1963. During the pendency of this appeal, now scheduled for hearing on February 10, 1964, Mr. Herman Halperin, an independent consulting engineer on electric power systems, proposed a compromise single circuit, 220-kilovolt, 300-megawatt line for construction on new types of poles rather than towers. Mr. Halperin met with representatives of P.G. & E; SLAC, and the Government on numerous occasions, who finally agreed that this compromise line could be constructed and would be acceptable.

Accordingly, on January 2, 1964, and January 7, 1964, applications for use permits for the compromise line were filed with the San Mateo County Planning Commission and the Woodside Planning Commission, respectively. The estimated cost of the compromise proposal is $922,000.

The applications for use permits for the compromise line were heard by the San Mateo County Planning Commission on January 22, 1964, and by the Woodside Planning Commission on January 23, 1964. Both bodies denied use permits on the basis that an underground line should be constructed to provide service to SLAC.

P.G. & E'S PROPOSALS TO THE AEC

Pending hearing of P.G. & E's appeal to the Woodside Town Council, several conferences were held by P.G. & E., AEC, and SLAC representatives. As a result of these discussions, P.G. & E. submitted two proposals to the AEC to substitute a single circuit, 750-mcm., 220-

kilovolt underground line capable of delivering 180 megawatts for the overhead 220-kilovolt tower line. According to SLAC estimates such an underground line would supply all its power needs until 1972.

This underground line would commence at Jefferson Substation and follow Canada, Woodside, Whiskey Hill, and Sand Hill Roads to a point opposite SLAC, and thence a short distance across Stanford property to the SLAC substation, a total length of approximately 6.83 miles. With a normal construction schedule of about 2 years, P.G. & E. estimates the cost of this underground line to be $2,640,000.

The two proposals are summarized as follows:

Proposal A: As I have previously stated, P.G. & E. estimates the cost of the most expensive alternate overhead line along the route of the Junipero Serra Freeway to be $1,012,000. Under proposal A P.G. & E. would provide this amount of capital toward the cost of the underground line. AEC would provide the remaining capital needed; that is, $1,628,000. P.G. & E. would own the terminal facilities at Jefferson Substation, and P.G. & E. and AEC would own, respectively, segments of the line equaling 33 percent and 67 percent of the total length of the line (that is, ownership in proportion to capital provided for the cost of the line). P.G. & E. would operate and maintain the entire line at its expense and the rates for service would remain as provided in the existing contract

Proposal B: P.G. & E. would provide the total amount of capital, that is, $2,640,000, required to build the underground line. The Government would pay P.G. & E. annually $199,430, representing the amount by which P.G. & E.'s annual costs for the underground line are estimated to exceed P.G. & E.'s cost on the $1,012,000 overhead line on the Junipero Serra Freeway route. Apart from the additional annual charge the rates for service would remain as provided in the existing contract.

Under either of the foregoing proposals, a number of changes would be made in the contract of January 10, 1963. These would include appropriate adjustment of minimum and cancellation charges.

The 180-megawatt line was chosen after discussion with the Government and SLAC in an endeavor to provide an underground line which would require a minimum capital outlay and still meet SLAC's needs for a reasonable period of time. If and when additional power is required, additional facilities will be needed. This would require further modification of the contract. It is expected that in such case any arrangements for providing additional capacity will take into account the fact that P.G. & E. will already have furnished an amount equivalent to the cost of a 300-megawatt capacity overhead line.

CONCLUSION

To meet SLAC's estimated power requirements on schedule it is evident that a decision as to the supply line should be made at an early date. P.G. & E. will continue to cooperate in every way to expedite the matter. If any further information is desired by the Joint Committee we will be pleased to furnish it.

Representative HOLIFIELD. Under alternative B, your company would provide all of the capital and the Government would pay annually an amount of $199,430 which would represent the amount of your annual cost for the underground line.

Mr. JOYCE. That would represent the cost of the underground line for that portion of the investment that is in excess of the continuing costs that we would have to stand for the investment portion. We would have $1,012,000.

Representative HOLIFIELD. Percentagewise what would that amount to on your capital investment?

Mr. JOYCE. As I recall the figure it divides about 33 to 66⅔ percent. Is that correct, Mr. Searles?

Mr. SEARLES. I thought I understood the question to mean what percentage was the $200,000——

Representative HOLIFIELD. To $2,640,000——

Mr. JOYCE. Yes, it should be related to the $1,628,000 figure, I believe, sir, because——

Representative HOLIFIELD. Oh, yes——

Mr. JOYCE. It is running——

Representative HOLIFIELD. No, under proposal A, the P.G. & E. would provide the $1,012,000 and AEC would provide $1,628 million. But under proposal B, as I understand it, P.G. & E. would provide the total amount of capital of $2.6 million. (See table, p. 9.)

Mr. JOYCE. You are correct for this last portion of the statement. Let's make this first clear. The proposal that I am talking about that involves this $199,430 continuing figure that was mentioned this morning represents an investment in an underground line of $2,640,000. The continuing costs on that total are $332,115. The portions that would be assigned to P.G. & E. would be for the $1,012,000 or $133,000. The remainder is $199,000——

GOVERNMENT COSTS

Representative HOLIFIELD. That would be excess cost to the Government.

Mr. JOYCE. I am advised that runs in answer to your earlier question about the percentage.

Representative HOSMER. Does any one of these proposals contemplate anything other than the Government coming in and taking up the overage that P.G. & E. isn't assuming?

Mr. JOYCE. We have been discussing it with the AEC. We say that we will pick up all the overhead on the investment of $1,012,000 that we would make in the most expensive route.

Representative HOSMER. I understand that but anything else on top of that Uncle Sam would be expected to pick up——

Mr. JOYCE. Or someone else.

Representative HOSMER. Your proposal contemplates Uncle Sam, I guess.

Mr. JOYCE. We have been discussing it with the AEC with whom we have the contract and also discussing an arrangement for modifications of the contract. We have not gone to others and asked them if they wanted to take it up, sir.

Representative HOSMER. If you go ahead and build on the freeway route before they have the freeway, aren't there going to be problems when they start to dig out a lot of dirt to level up for the road? (See app. 14, p. 180.)

Mr. JOYCE. To the best of my knowledge and belief we will have no unusual problems there. Freeway construction in California occurs all the time.

Representative HOSMER. Is this freeway route going through any housing areas? Do they have to take out any houses or does it go around outside in open territory?

Mr. JOYCE. I can't speak for the freeway route. I have seen it on maps and it is, of course, as straight as they can make it. There are turns in it and so on.

Representative HOSMER. Are they going to have to move a lot of houses for the freeway or does it go mostly through areas where there are no houses at the present time?

Mr. JOYCE. Not necessarily. I don't know that.

Representative HOSMER. There are some 35 owners listed on some 35 miles of property so I guess it must be mostly vacant land.

Mr. JOYCE. As I understand it, most of it is vacant land and the advantage of going through on a freeway route is that we could avoid houses and cutting properties within reason by adjusting the route for curves and overheal line.

Representative HOLIFIELD. In the event you decide on going the freeway route, how would that fit in with the needs of the accelerator? You said there would be a year's delay. Could the needs of the accelerator be supplied from your 60-kilovolt line during the interim period or would there be a gap in which they would need more than you could supply?

SCHEDULE FOR POWER REQUIREMENTS

Mr. JOYCE. Yes, I believe there is very little chance that we can't meet all the requirements of the Stanford Linear Accelerator Center undertaking until we could get the right to go ahead by condemnation, if necessary, and construct the overhead line and of course you understand the construction with the line itself once you are cleared to go is much less than underground. I think it was mentioned that at this time we are considering about 24 months for underground installation. That surely could be met, in my opinion, by an overhead line even going through condemnation.

As far as taking care of the needs are concerned; yes, sir. We have a 60-kilovolt line, as you know, supplying the temporary requirements or the interim requirements for construction and needs now. We are constantly increasing existing lines and we will be able, based upon our load growth, to get new capacity in there—30 megawatts or more until, say, 1965—1966.

Referring to the chart in the Stanford Linear Accelerator Center exhibit, we have talked with them and we are talking about mid-1966 as when we can surely have the overhead line in and we know we can have the underground if it is decided upon. (See fig. 1, p. 19.)

Mr. SEARLES. May I add to that, sir, that all of this assumes we have no problems with respect to use permits. So far we have been denied the use permit for the Junipero Serra alternative as well as for the others. If we were to try to proceed with condemnation and

litigate the use permit question, the 1-year estimate would be far too short. It would take us much longer than that.

Mr. CONWAY. Would you estimate that it would take about a year to go through condemnation proceedings and that you could automatically add 1 more year to this?

Mr. SEARLES. I don't know that 1 more year would be enough. Our usual practice has been condemnation and construction in about 2 years' time. But this presumes that we are not arguing about the use permits and that we are all clear as far as the county of San Mateo and the town of Woodside are concerned. If we are in litigation with those, I can see a much longer time and it might be a year or two longer.

Mr. SEARLES. As far as I know we only have poles on freeways where they cross. The general policy with respect to pole lines on freeways is to forbid them, as a matter of fact.

Representative HOLIFIELD. To forbid them running contiguous to a freeway, but to allow you to cross the freeway?

Mr. SEARLES. That is right.

Representative HOLIFIELD. This would be another hurdle then with the State of California or whoever is building the freeway.

Mr. SEARLES. Our plans here contemplated we would acquire right-of-way completely independent of the State's right-of-way and alongside that so they could have no objection.

Representative HOLIFIELD. Have you studied this from the esthetic point of view as to which side of the freeway would be best? I suppose Woodside wouldn't want it on the east side and Menlo Park wouldn't want it on the other side.

Mr. SEARLES. I don't think I can comment on that.

[Laughter.]

Representative HOLIFIELD. You are not a judge of esthetics then.

Mr. SEARLES. Except on a personal basis; I am not.

Representative HOLIFIELD. Is there anything else you gentlemen wish to volunteer that you think this committee should know?

Mr. JOYCE. I don't think so. If there are other questions that come up, we will still be available.

We do have some slides. I don't know the number of them or whether you wish to take time for that or not. I can tell you the slides would merely again show the areas in which the line would go through. There is a line dubbed through, as you saw in these pictures, to scale to try to give you a picture of the area we would be going through on these various routes.

Representative HOLIFIELD. Would you stand by? We do want to talk to these other witnesses and maybe we can get to that afterwards.

Thank you gentlemen for your responses.

Our next witness will be Mr. Robert Levy, chairman of the San Mateo County Planning Commission.

Mr. Levy.

Mr. LEVY. Here is the master plan and some pictures of the area in which the committee might be interested and also an opening and closing statement.

Representative HOLIFIELD. Thank you. Mr. Levy, the committee is pleased to have you as the representative of the county before us today. You may proceed.

STATEMENT OF ROBERT LEVY, CHAIRMAN OF THE SAN MATEO COUNTY PLANNING COMMISSION

Mr. LEVY. Thank you, sir. I would like at this time, sir, to refer to a few of the accusations and statements that have been made. I would like to clear them up a little bit.

One is in regard to the county agreeing to the high-tension line on the west side 12 years ago. That is the main line from the tap line. The county agreed to this line under somewhat of a protest. The board of supervisors reluctantly allowed that line to go through because they had no other choice. That was 12 years ago and things naturally change.

Representative HOLIFIELD. I think you can leave that stand where it is now. Just set it up on the stand. We are beginning to feel acclimated to the map now.

Mr. LEVY. Another thing is Pacific Gas & Electric Co. have agreed before our planning commission to the underground line as no problem whatsoever. There has been no argument as to feasibility of the line, the oil or anything like that. Whether they could do it or not, they agreed this was a feasible route and it could be done.

Representative HOLIFIELD. You are speaking about what route?

Mr. LEVY. From the tapline to the accelerator.

Representative HOLIFIELD. Through the streets?

Mr. LEVY. Through the streets, yes, sir.

Representative HOLIFIELD. What is that called?

Mr. LEVY. It is called the underground tapline from the main line east to the Stanford accelerator, which would go through the streets and which the county would allow to do without any condemnation or any rights-of-way. This could go right through there.

Mr. CONWAY. Is that the Whiskey Hill Road? (See app. 14, p. 180.)

Mr. LEVY. Yes, sir, underground.

Representative HOLIFIELD. All right.

PAYMENT OF UNDERGROUND LINE COSTS

Mr. LEVY. One more thing I would like to take note of is in regard to Walnut Creek having to pay their cost. Foster City was agricultural land 5 years ago. There wasn't a house on it nor a tree. A subdivider came before the planning commission and asked the right to rezone the property from agricultural land to a residential area. We told them they could do that if they went underground. Foster City with a population of 40,000 people have agreed to pay the cost themselves. It is assessed to the land in that area.

Representative HOLIFIELD. The people in this city pay——

Mr. LEVY. In land—the choice of lots which brings it right back to myself. When I subdivided 16 acres in Hillsboro, the city council said, "You will have to go underground." This is their ordinance. I had to pay P.G. & E. $1,000 per lot for underground.

The same reference to Walnut Creek would apply here.

So I will go on with the testimony.

I appear before you today, not as a professional planner, lawyer, lobbyist, or elected official. And not as a property owner, who would be personally affected by the proposed transmission lines, but as a

restaurant owner and operator, who was appointed to the San Mateo County Planning Commission 10 years ago by my supervisor, Ed McDonald.

In taking this appointment, I pledged myself to do all in my power that I thought best for the people of San Mateo County, regardless of race, religion, or creed. And above all, never for a selected group or individual. This, gentlemen, is why I am here.

The late President Kennedy, in his 1961 message to Congress on the open space program, made reference to the issue now at hand. I quote:

> Open space must be reserved to provide parks and recreation, conserve water and other natural resources, prevent building in undesirable locations, prevent erosion and floods, and avoid the wasteful extension of public services. Open land is also needed to provide resources for future residential development, to protect against undue speculation, and to make it possible for State and regional bodies to control the rate and character of community development.

This is in the open space or land urban sprawl which shows cities which have sprung up in the last 10 or 15 years that was vacant land—and there are no wires. They are all underground.

The county had a letter from Washington, D.C., saying safeguard the open space and go underground. The urban land instituted all row houses. There are no wires. These houses spring up. These subdivisions spring up.

This San Mateo County that you are looking at. There are very few homes but I want to tell you gentlemen there are going to be many homes, just as sure as I am sitting here, because the population is going to increase in another 20 years to double—from 500,000 to 1 million—as it has doubled in the last 20 years.

On open space areas and parks the FHA has a ruling showing that they are in favor of these underground facilities and the new cluster groupings of houses. The American Society of Planning officially in a newsletter are saying this. So the Government plus private lenders, plus private people and plus private groups are all working on the theory that underground is necessary.

I would like to impress you with the fact that we have a countryside worth saving and that we in San Mateo County want to save it and want to ask you to do all within your power to help us prevent the devastation of our hillsides with power transmission lines. The powerlines that threaten us would serve solely a Federal facility—owned and operated by the AEC. We ask that you request the AEC to cooperate with the local power company and with the local jurisdictions of Woodside and San Mateo County in the design of powerlines so they will be below ground where they belong instead of above ground where it will be offensive to the eyes of all who behold them.

Twelve years ago the Pacific Gas & Electric Co. requested permission of the county to construct a power transmission line through this same territory. At that time the residents of the area, and the San Mateo County Board of Supervisors were firmly convinced that it would be contrary to the public interest to allow the desecration of Portola Valley with power transmission lines. The board of supervisors strongly favored underground lines, and only after it was proven not feasible to put the lines underground did the board dismiss the idea of underground construction and agree reluctantly to a

compromise location for the line on the other side of the Skyline Ridge.

P.G. & E. has applied for permits to bring a tapline from this original line to the accelerator. This tapline is proposed to run down the face of our Santa Cruz Mountain and through the rolling hills of Portola Valley.

A week ago today, the San Mateo County Planning Commission denied P.G. & E.'s application for a use permit, on the grounds that the construction of this line would be highly damaging to the scenic values of the county; that the creation of the unsightly mess of towers, strings of wire, and the scars on the landscape would be inappropriate to this beautiful area and therefore contrary to the public welfare. The commission took this action with the knowledge that a reasonable alternative for a power supply does exist: underground construction southward from the Jefferson substation.

The proposed tapline would pass through Portola Valley, one of the finest unspoiled rural areas of the San Francisco Peninsula which itself is world renowned for its beauty.

Representative HOLIFIELD. How far is this from San Francisco?

Mr. LEVY. About 30 miles, sir, south.

San Mateo County and Woodside have adopted master plans as guides for future development. I have brought copies of our county master plan for your information. Perhaps the most important policy that it contains says that the rural and open space areas of our county (of which Portola Valley is a prime example) must be safeguarded to keep them rural and unspoiled. Incidentally, the county plan was prepared with the financial assistance of the Federal Government under the 701 program.

And let me assure you that we in San Mateo County do more than just talk a good game of preserving the countryside. For over 30 years we have had an energetic and successful program of acquiring the shoreline for public use. We have a continuous program for acquisition and development of county parks. We are one of the few counties in the Nation with a specific provision in our charter saying that each year the county shall set aside money for the acquisition of needed public lands. The Portola Valley area is in the very heart of the established riding and hiking trail system. We care about our countryside, and we act vigorously to preserve it. We ask that you help us to preserve the open space and beauty which is such a valuable part of our county.

As chairman of the San Mateo Planning Commission, I would like to say in closing that we are not requesting the U.S. Government to comply with any regulations other than those asked of our citizens and, or, private developers. Therefore, in this respect, we believe the Government of our Nation is no different than the people of our Nation; for certainly the people are the Government.

Thank you.

Representative HOLIFIELD. Are there any questions of Mr. Levy?

Representative HOSMER. Mr. Levy, in preserving the rural beauties of the San Mateo County against the United States, I presume you have the same attitude as to the State of California?

Mr. LEVY. Yes.

Representative HOSMER. What are you doing about the Junipero Serra Freeway they want to run through there?

Mr. LEVY. I don't know what part of the county is involved. I haven't seen any plans. They applied for a use permit——

Representative HOSMER. I think we are all familiar with it. I don't think they have to apply for a use permit.

Mr. LEVY. I don't know.

Representative HOSMER. Do you feel that San Mateo County is going to oppose the construction of this freeway?

Mr. LEVY. I know they have already approved the alinement.

Representative HOSMER. Then it is OK to put in the freeway.

Mr. LEVY. As far as the freeway is concerned, but if we have no power over the right to where the powerline is going, I would have to ask somebody a little more qualified than myself.

Representative HOSMER. I understand the attitude on that. I am talking about the freeway right now. That is going to make a total alteration in the area around the location of that freeway from a rural to a very commercial type use.

Mr. LEVY. No, it is a pleasure——

Representative HOSMER. Mainly it will be automobiles and trucks running up and down it.

Mr. LEVY. It is not a commercial type use. It is a beautiful freeway. It is going right through the heart. You have to move people.

Representative HOSMER. That is right. We have to move kilowatts, too.

Mr. LEVY. That is right.

Representative HOSMER. I am just trying to get a feel for the attitude as to the esthetic difference between this stretch of ground where the freeway is to go as against a freeway and the power poles.

Mr. LEVY. All right——

Representative HOSMER. It will be running alongside.

Mr. LEVY. I can give it to you, sir.

First of all we know we have an alternate with the powerlines because you can go underground.

Representative HOSMER. You can go around Fireman's Island but there is an amount of money involved.

Mr. LEVY. We are not talking money here. We are talking esthetics.

Representative HOSMER. We are buying esthetics if we assume these additional expenses.

Mr. LEVY. That is correct.

Representative HOSMER. Now we are trying to figure out how much of an esthetic nature we are going to get for $6 million as against $1,012,000.

Mr. LEVY. Yes.

Representative HOSMER. In a situation where you would have a freeway with these power poles as against a freeway without these power poles. That is what you are going to buy for over $5 million in esthetics. Is there $5 million worth of esthetics here?

Mr. LEVY. I would say, yes.

But on the freeway alinement, sir, a committee has worked with the State for an alinement to go through property that we could possibly give up that would look best for the county and that would not be quite as valuable. As to the powerline, I couldn't answer that because I don't know anything about it.

Representative HOSMER. You answered a question I didn't ask. I asked whether the esthetics of a freeway without poles would be worth $5 million.

Mr. LEVY. That is right.

Representative HOSMER. That must mean we have narrowed the issue down to a judgment of men who are qualified possibly to make a judgment on whether or not that amount of esthetics is involved in this particular situation.

Will you agree on that?

Mr. LEVY. Yes.

Representative HOSMER. Then we have to toss around a freeway with or without some poles alongside of it as against $5 million-plus.

Mr. LEVY. That is right.

Representative HOSMER. That is a fair way to look at it, isn't it?

Mr. LEVY. Yes.

Representative HOSMER. Do you see any other considerations that ought to be factored in when we think about this?

Mr. LEVY. Yes, I do, sir.

When we sat down with President Sterling when the first thought of the Stanford accelerator came into being and the money was just appropriated or——

Representative HOSMER. Does this bear on the question that we are discussing?

Mr. LEVY. Esthetics.

Representative HOSMER. About the——

Mr. LEVY. Cost and esthetics——

Representative HOSMER. Value of the esthetics.

Mr. LEVY. That is right.

The president called in the head of the chamber of commerce and everybody in the whole area because he was very perturbed because word had gotten about they were going to radiate things and everybody was going to be shocked and it caused a big scare through the hillside. This aroused a lot of people. He called in the Planning Commission of Palo Alto and San Mateo County and so forth. He went on to say that there would be no scares; that they were going to spend so many thousands of dollars just to put this plant in the area; that there would be an underground facility around this and there would be no overhead poles and so forth.

Representative HOSMER. Wait a minute now.

Mr. LEVY. In the area—not a tapline.

Representative HOSMER. Did you hear anything said about overhead poles? Was that brought up?

Mr. LEVY. Only in the area down below—not overhead from the tapline. Everything would be underground and all big buildings would be esthetically designed into the area. No trees would come out of there unless absolutely necessary. There was to be a $250,000 planting program. He painted a very nice picture.

We didn't have anything to say about this because the U.S. Government is bigger than any chairman of the San Mateo County Planning Commission. If they want to put it in, they put it in. This was a courtesy to kind of keep people in line and to tell them this was going to be a nice thing for the peninsula. Then comes the overhead line. He never said there wouldn't be.

Representative HOSMER. The figure that President Sterling mentioned of $250,000——

Mr. LEVY. Just for little plants——

Representative HOSMER. Of 2 miles——

Mr. LEVY. Just for planting——

Representative HOSMER. Along the accelerator. This thing is 5 miles——

Mr. LEVY. Don't forget, sir, he has the cost of the underground wire in there. I don't know what that cost is. It is quite a bit for that little area.

Representative HOSMER. It is $14 million when you throw in the incrementals. Those were not for esthetics. Those were for the linear accelerator.

Mr. LEVY. I think they could have put them overhead if they wanted to do so. They didn't have to go down.

Representative HOSMER. Nobody has ever talked about putting this accelerator any place but underground because of radiation.

Mr. LEVY. I mean the overhead wire in that area——

Representative HOSMER. We are talking right now about the overhead wires along this 2 miles down to where it connects the tapline connection into the facility. So we are talking about overhead lines anyway on this tapline.

Mr. LEVY. Now we are——

Representative HOSMER. They are not——

Mr. LEVY. They have spent quite a bit for underground, I think, around the accelerator too.

Representative HOSMER. That was not done for esthetic reasons.

Mr. LEVY. I see.

Representative HOSMER. Fine. I think we have an idea of what the issue is here.

PAYMENT OF TAXES

Representative HOLIFIELD. Let me ask you one or two questions before you leave.

This transmission line will run through San Mateo County. Will the county ordinarily collect property taxes on the capital value of those transmission lines?

Mr. LEVY. From private enterprise——

Representative HOLIFIELD. If P.G. & E. put in an underground line, would they be charged taxes on the capital value?

Mr. LEVY. I believe so, yes, sir.

PAYMENT OF TRANSMISSION LINE COSTS

Representative HOLIFIELD. Has the county considered in any way a contribution toward this project, such as a cash contribution in setting up a certain amount of bonds or a willingness to waive taxes on the capital investment of this underground transmission line?

Mr. LEVY. I don't think it was ever discussed before the planning commission. The board of supervisors would have that authority.

Representative HOLIFIELD. If it goes the underground route, it will have this esthetic value to your whole community. This is your testimony.

Mr. LEVY. That is right.

Representative HOLIFIELD. You have testified also that any new developer who puts in a subdivision is required by your county to——

Mr. LEVY. We ask him. We haven't the right to require.

Representative HOLIFIELD. You ask that he put the lines underground and the value of this be charged up against the——

Mr. LEVY. The developer——

Representative HOLIFIELD. And eventually the resident buyer.

Mr. LEVY. That is right, sir.

Representative HOLIFIELD. This area, as I understand it, or at least a great deal of it is divided up into 2- or 3-acre homesites and I suppose with better than average type homes.

If the Federal Government were to spend anywhere from $1.6 to $4 million more than the cost of a pole line, it would be for the esthetic benefit of your Woodside community and your county.

Mr. LEVY. Yes, sir.

Representative HOLIFIELD. It wouldn't be for the benefit of the Federal Government.

Mr. LEVY. That is correct, sir.

Representative HOLIFIELD. I receive many telegrams from county planning commissions, county supervisors, city mayors, and chambers of commerce asking us to cut down on the Federal expenditures.

Mr. LEVY. Correct.

Representative HOLIFIELD. They come in quite prolifically except when it comes to a project that affects their own economy.

Mr. LEVY. That is right.

Representative HOLIFIELD. Then they are all for spending Federal dollars.

Are you putting yourself in the position at this time of saying you want the Federal Government to spend from $1.6 to $4 million in case we go to a 300,000-kilowatt underground line for the esthetic value of your community—of your small area?

We are doing this project for the advancement of science, for the benefit of bringing possibly untold blessings to all of the people of the United States and the people of the world so far as that is concerned. Therefore, the taxpayers of the United States are paying for this. You are paying for it. I am paying for it. We are all paying for it. However, the esthetic value you are trying to obtain will not be for all the people of the United States. This will be for the people of this community.

Are you, as a representative of the county—and I will ask the same question of the city—willing now to participate in this extra cost which would be charged up to the Federal Government for the esthetic beauty of your community?

Mr. LEVY. I couldn't answer that because I don't hold the strings of the government of San Mateo County. I am only a member of the planning commission. The board of supervisors have the right to answer that question.

Representative HOLIFIELD. The board of supervisors are not represented here.

Mr. LEVY. No, sir, they are not.

Representative HOLIFIELD. You represent the planning commission and not the board of supervisors.

Mr. LEVY. That is correct and I don't hold the purse strings. If our county could afford it they would probably be willing to contribute the same as Stanford, the same as anyone else in trying to preserve the beauty.

Representative HOLIFIELD. I don't hold the purse strings on this. That is the Appropriations Committees of the House and Senate.

Mr. LEVY. Don't forget we didn't ask for this tapline to come through there. The Government is putting in something there which we feel is going to desecrate the hillside.

Representative HOLIFIELD. This is the establishment of a tremendous scientific tool. Mr. Hosmer and I can both assure you this California location was not brought about without a great deal of sweat and blood on the part of ourselves individually.

Representative HOSMER. With considerable urging from your fellow citizens to place it there.

Mr. LEVY. This I don't doubt, but as a planning commissioner I can only take one stand. I can't take the stand the accelerator should be or should not be there. I can only take a stand as a planner.

Representative HOLIFIELD. You can understand the point I am bringing out.

Mr. LEVY. I can sir. You bet your life.

Representative HOLIFIELD. To expend a substantial sum of additional money for the benefit of a particular area and not for the benefit of the people of the United States does run counter to the Government operating in an economical and efficient manner. You can see the position, that position that we, as custodians of the Federal tax money, must take. We have to look at both sides of this picture, you know, and try to arrive at some kind of an equitable settlement that will not do too much violence to anyone concerned, but may not be completely acceptable to all concerned.

Mr. LEVY. Correct. I agree to that except one thing. The subdivider has to put money in for the esthetic value and this would be the same as for anyone else.

Representative HOLIFIELD. I understand that, but he is, in turn, making a profit on an investment because he gets this out of the people when he sells the houses.

Mr. LEVY. I think the Government is going to make a profit off it, particularly if what we are going to find out is a profit to everybody.

Mr. CONWAY. Mr. Chairman, so the record may be clear, Mr. Levy, as chairman of the planning commission was not requested to be here today. Specifically the county manager, Mr. E. R. Stallings, sent a telegram requesting that a representative of the county be present to be heard at the scheduled meeting. The committee acknowledged this request and scheduled a representative of the county and so notified the county manager. You, Mr. Levy, were designated representative of the county.

Mr. LEVY. There is a little technicality in the fact that the hearing with regard to P.G. & E. is before the board of supervisors and they could not send a representative directly because they have not had the final hearing. P.G. & E. asked for an extension of time. So they had

me appear as a planning commissioner rather than as a member of the board of supervisors, but they have been on record——

Representative HOSMER. Are you a member of the board of supervisors, too?

Mr. LEVY. No, I am a member of the planning commission.

Representative HOLIFIELD. But this was approved by the board of supervisors.

Mr. LEVY. Approved and the fact is the county of San Mateo is paying my expenses.

Representative HOLIFIELD. At this point the Chair will place in the record the following telegram under date of January 21. It was addressed to Congressman Holifield.

Respectfully request opportunity for representative of the county of San Mateo, Calif., to be heard at the scheduled meeting of the Joint Committee on Atomic Energy in Washington, D.C., January 20 at 10 a.m., relative to the high-tension powerline to serve the Stanford linear accelerator. Further request confirmation.

E. R. STALLINGS, *San Mateo County Manager.*

Our staff director, Mr. Conway, immediately on January 22 sent the following telegram:

Mr. E. R. STALLINGS,
San Mateo County Manager,
Redwood City, Calif.

In response to your telegram you have been scheduled to testify before the Joint Committee on Atomic Energy January 29, room AE–1, U.S. Capitol Building, Washington, D.C. Hearing will commence at 10 a.m. with testimony from AEC witnesses. In line with customary committee practice I would appreciate receiving at least 1 day in advance a copy of any prepared statement you may have. If you have any questions please feel free to call me at Capitol 4–3121, extension 6171.

We received a further letter from Mr. Stallings under date of January 27, 1964.

JOINT COMMITTEE HEARING ON ENERGY SUPPLY FOR STANFORD LINEAR ACCELERATOR

DEAR MR. CONWAY: This is to inform you that Mr. Robert H. Levy, chairman of the San Mateo County Planning Commission will represent San Mateo County, Calif., at the January 29 hearing.

Very truly yours,

E. R. STALLINGS, *County Manager.*

I believe that places the record in proper shape.

Mr. LEVY. All right. Thank you, sir.

Representative HOLIFIELD. Thank you very much.

Our next witness will be the Honorable David Graham, mayor of the city of Woodside, Calif.

Mr. McCloskey, do you request to appear separately or with Mr. Graham?

Mr. MCCLOSKEY. Mr. Chairman, the prepared statement on behalf of the town of Woodside was prepared by me. I thought perhaps I should give that statement.

Mr. Graham flew in this morning without having a written statement on file.

STATEMENT OF MAYOR DONALD GRAHAM, WOODSIDE, CALIF., AND PAUL N. McCLOSKEY, JR., REPRESENTING THE TOWN OF WOODSIDE AND INTERESTED CITIZENS OF SAN MATEO AND SANTA CLARA COUNTIES

Representative HOLIFIELD. All right, Mr. Graham.

Mr. GRAHAM. Mr. Chairman, I was directed by the Council of the City of Woodside to appear before you to give the views of the citizens and the planning commission of Woodside and also to inform you that Mr. McCloskey has been appointed special counsel to represent the city of Woodside on these matters in view of the fact that he has done such a completely exhaustive research job and can provide the committee with detailed information backing up our reasons for requesting action of your committee.

Representative HOLIFIELD. You are then asking that he be allowed to proceed?

Mr. GRAHAM. Yes, sir. I would like to say one thing, however.

Representative HOLIFIELD. There is something you would like to say in addition?

Mr. GRAHAM. Yes, sir, if you will forbear with me for a moment and excuse me for an occasional lapse into an emotional statement or so. It is pretty hard for me, as an elected official, with the telephone calls and the constant personal contacts with my constituents to be unemotional about something which affects these people as directly as the proposed overhead powerline.

I represent some 4,200 people who are residents of Woodside and these people are spread over quite an extensive geographical area. The town is about 13 square miles in area but virtually the entire area has views the value of which is depreciated by any major overhead structure of the type considered for the linear accelerator.

The other position that our people take—and this is more or less in line with the question you asked of Mr. Levy—is just how would the Federal Government be justified in picking up the tab for the underground installation where no benefit directly to the Government appears to be derived. Our position is that the Government located the facility here for very good reasons. No one in Woodside takes issue with this, but they feel it is incumbent upon the Government, therefore, to provide some solution for the supply which does not abuse or sacrifice the values that the people already there have.

These people settled a long time ago in most cases. Although these properties are held in large pieces, the value is quite high and, as Mr. Levy indicated, the population growth and the pressures in San Mateo County will ultimately saturate these sites. So with respect to the question which Mr. Hosmer asked a few times as to how many people are concerned and how many will see these things, it is our position that the entire community of Woodside will be affected by this as well as extensive areas of San Mateo County.

So we ask your consideration and your best efforts to induce the Atomic Energy Commission to consider the underground alternative and not to proceed with condemnation which they may have the full legal authority to do.

Representative HOLIFIELD. We are very happy to have your statement, Mayor. You are certainly acting in the highest way in representing the wishes of the people of your city and we are glad to have you here before us today.

Mr. GRAHAM. Thank you.

Representative HOLIFIELD. Mr. McCloskey.

Mr. MCCLOSKEY. Thank you, Mr. Chairman.

I was pleased to hear the remarks of the chairman just a few minutes ago because I do believe that the town of Woodside has taxing authority over this underground line, if it is created. I believe if this matter can ever be resolved to where reasonable men can sit down and resolve this difference of a possible sharing this additional cost, that it can be done. In many ways I regret it has reached the committee without qualified representatives of the AEC, Stanford University, the town and the county sitting down together with the Pacific Gas & Electric Co. and trying to compromise this. We attempted to compromise it. You will note the rate schedule which P. G. & E. proposed. There are compromises on many sides of this issue.

SHARING OF TRANSMISSION LINE COSTS

I am convinced if representatives can sit down—unfortunately Mr. Levy cannot commit the board of supervisors or any legislative body any more than the committee can commit the Congress—but if the people could sit down in good faith and resolve this matter, we believe that the line can be placed underground and the cost equitably borne and shared by those who benefit by it.

I think there is an issue here today which has not been discussed. That is the issue of instruction and determination of local governments. I have a number of statutes to cite to this committee where it has been declared to be national policy for cooperation, particularly in planning between local, State, county, and the Federal Government. This is such an issue and it is just a crying shame that there has been no means before to reach the key people in the AEC so as to discuss these matters and to try to compromise them out with the people who are empowered to make decisions and with the appropriate people from these areas that are involved.

I have a prepared statement. I would like to read some portions of it which have not thus far been covered.

AEC RESPONSIBILITIES

Representative HOLIFIELD. Before you start your statement, let me say this: The Atomic Energy Commission has had representatives dealing with the various organizations involved including Stanford University on this matter. The Pacific Gas & Electric Co., as a local free enterprise business, has been dealing with your different political subdivisions on this matter. The AEC has proceeded in line with its responsibilities as a Federal agency representing the Federal Government and, of course, has proposed a normal, economical, and efficient method of servicing this scientific facility. Outside of conversation we haven't had any proposals, from the areas affected there esthetically, as to any kind of a cooperative arrangement.

If there is some feeling on the part of the county of San Mateo and the city of Woodside and the general area there that they wish to sit down and negotiate in an orderly and in a timely manner without unreasonable delay, I am sure you can have an audience with the people who are affected. The Pacific Gas & Electric Co. has certainly shown—their representatives and their actions have shown a willingness to make some concessions. Now we are giving the local people who are involved an opportunity to come forward.

I think we have established the fact that the esthetic value is the thing of primary concern to the community and not to the taxpayers of the United States. Therefore we await your further testimony.

Mr. McCloskey. All right, sir.

One of the members of this committee, the Honorable Craig Hosmer, in the 1960 hearings on this project, referred to the neighboring landscape as "incomparable." The term "incomparable" is unquestionably a proper description for the rolling, oak-studded foothills and wooded ridges of the coast range which furnish the scenic backdrop for Stanford University and over 50,000 homes in the neighboring cities.

In the same rolling foothill country, where the accelerator is located, lie three cities which have incorporated solely to preserve the scenic beauty of the area; these cities being Woodside to the north, and Los Altos Hills and Monte Sereno to the south. Immediately to the west of the accelerator site, the community of Portola Valley is presently seeking incorporation status for a similar purpose.

The area at the west end of the accelerator is traversed by a large number of hiking and riding trails created and maintained by both public and private groups. San Mateo County has pioneered this type of recreational facility for its citizens and this technique of preserving open spaces for recreational use has been formalized by a 1963 act of the California Legislature.

Within a mile of the accelerator passes the trail followed by Gaspar de Portolo in 1769. The sites of San Mateo County's first church and lumber mill are marked with historic monuments within sight of the accelerator. Searsville Lake, one of the finest recreational spots in the county, lies at the west end of the accelerator. In the Searsville Lake area, the Pacific Telephone & Telegraph Co. is in the process of placing its lines underground. I would like to point out what the telephone company is doing because they likewise are a public utility.

If there is a scenic route anywhere in use, it is Sand Hill Road. Sand Hill Road leads out of the urban areas, and Menlo Park, and parallels the accelerator. It goes in a straight line and perpendicular to the coast range when suddenly out of these oak-covered foothills rise redwood trees and others and rise up and furnish a bowl-like effect to the entire area.

Along Sand Hill Road the telephone company, across the road from the accelerator, is placing its entire cable system underground along the entire length of Sand Hill Road from the accelerator down to Searsville Lake at the other end. In the neighborhood where the road turns into Portola Valley—which runs in this way to Portola Valley in the south and Woodside to the north—the telephone company is in the process of placing its telephone lines underground.

OVERHEAD LINES IN EXISTENCE

Representative HOSMER. Let me show you a photograph for identification as exhibit A. Do you recognize what that purports to be?

Mr. MCCLOSKEY. I do, Mr. Hosmer. This is the road I speak of.

Representative HOSMER. Is that Sand Hill Road?

Mr. MCCLOSKEY. It is an extension of Sand Hill Road. I believe it is called Portola Road at this point—crossing around the west end of the accelerator.

Representative HOSMER. Is that the point where the telephone company is going to put their lines underground?

Mr. MCCLOSKEY. Yes, it is. The telephone line will go underground as soon as the company gets the cable.

Representative HOSMER. Let me show you a photograph marked "Exhibit B."

Mr. MCCLOSKEY. That is the same line, sir, under the same circumstances. The telephone company will be placing this line underground.

Representative HOSMER. In exhibit B is that Sand Hill Road?

Mr. MCCLOSKEY. At that point, I believe, it is Portola Road but Sand Hill starts right up on the other side of this hill, sir.

Representative HOSMER. Does that represent the area of most unique scenic beauty in California that you described?

Mr. MCCLOSKEY. Yes, it does, and the ground on the other side of it, sir.

Representative HOSMER. Very well. I ask you again to refer to exhibit A.

I ask you if those poles that are existing in there are not powerlines too?

Mr. MCCLOSKEY. Yes, sir; as I understand it, they are 12-kilovolt transmission lines which under present circumstances cannot be directly buried by the power company.

Representative HOSMER. The power company has not intended to bury their lines as the telephone company has.

Mr. MCCLOSKEY. There is a Pacific Gas & Electric Co. representative here today. He would have to answer that question.

Representative HOSMER. You can't state that you have any knowledge of their intentions to follow the telephone company in this.

Mr. MCCLOSKEY. No, sir; I cannot.

Representative HOSMER. Very well.

I will ask if you are familiar with the zoning laws of the city of Woodside.

Mr. MCCLOSKEY. I don't live there, sir. I know generally.

Representative HOSMER. Mayor Graham, I suppose you are familiar with them?

Mr. GRAHAM. Yes, Mr. Hosmer.

Representative HOSMER. Do you have a zoning law or an ordinance prohibiting the erection of powerlines or telephone lines?

Mr. GRAHAM. Not——

Representative HOSMER. Overhead.

Mr. GRAHAM. Not as such. The erection or construction has to be approved by a use permit.

Representative HOSMER. The city was formed 3 or 4 years ago.

Mr. GRAHAM. In 1956.

Representative HOSMER. Since the city was formed has it, in fact, authorized the erection of any overhead telephone or electrical lines?

Mr. GRAHAM. To my knowledge, no.

Representative HOSMER. I would like you to take a look at this exhibit and ask you if this is part of the city of Woodside.

Mr. GRAHAM. Yes, that is part of the city.

Representative HOSMER. Was that area developed insofar as housing is concerned before or after 1956?

Mr. GRAHAM. Before, sir.

Representative HOSMER. This line running up here [indicating] is an overhead powerline, I presume.

Mr. GRAHAM. Small house residential service.

Representative HOSMER. Are you absolutely certain there has been no housing construction in the city of Woodside since the city was formed?

Mr. GRAHAM. No, sir, there has been appreciable construction.

Representative HOSMER. In every instance has the powerline going to new houses been buried underground?

Mr. GRAHAM. No, sir, they have not been in every case since in most cases the services existed already on rural street lines.

Representative HOSMER. Do you know of any case where lines had to be put in by the company in order to service new construction?

Mr. GRAHAM. I don't know, sir.

Representative HOSMER. Then we are down to a point where we don't know whether Woodside has had anything above ground by way of telephone or by way of electric powerlines.

Mr. GRAHAM. Anything new, sir?

Representative HOSMER. Since the city was formed.

I want to ask whether any of the P.G. & E. witnesses who are here know whether they have put in any overhead lines in the city of Woodside since the city was formed.

Mr. JOYCE. I can't state specifically that we have put in any overhead lines.

This might contribute to your thinking. In 1957 there was a small subdivision of two homes where the lines were put underground and the difference was paid by the developer. That has moved very slowly but there are six homes and the difference has been paid by the developer in the city of Woodside.

Representative HOSMER. Mr. Mayor, when you go back to Woodside would it be possible to have your city engineer or somebody look into this and let use know.

Mr. GRAHAM. Yes, I would be happy to do so.

Representative HOSMER. I think it is important for the committee to know whether or not you are just against all overhead lines or just against a big one. It makes a difference to us to know whether you are willing as a city to bear whatever expenses there are for burying lines of a smaller nature where the expense is local and not on somebody else's back.

Mr. GRAHAM. Yes, sir, I will be happy to get that information for you.

Representative HOSMER. And I would like to ask, Mr. Chairman, if that information could be added to the record before it is printed.

Representative HOLIFIELD. Will you get it to us as expeditiously as possible?

(The information requested follows:)

TOWN OF WOODSIDE,
Woodside, Calif., February 4, 1964.

Mr. JOHN T. CONWAY,
Executive Director, Joint Congressional Committee on Atomic Energy, Capitol Building, Washington, D.C.

DEAR MR. CONWAY: I am transmitting herewith the additional information requested of the Woodside delegation at the January 29, 1964, Joint Committee hearing on electrical power supply to the Stanford linear accelerator.

Dating from the incorporation of town of Woodside on November 16, 1956, to the present time 277 wooden poles have been placed in Woodside for the Pacific Gas & Electric Co., along dedicated public easements to provide electrical service to residental developments. These poles are of modest heights to carry low-level secondary distribution lines and for the most part are placed in heavily wooded areas where they are unobtrusive. The easements are franchised to the Pacific Gas & Electric Co., and the improvements are therefore not under the direct control of the town.

The installation of all transmission lines (as distinguished from the above distribution lines) is controlled by the town through specific use permits. No transmission line in or through Woodside has been permitted since the incorporation of the town.

The one or two underground extensions mentioned by Pacific Gas & Electric Co. spokesmen at the committee hearing are outside the town limits.

It is felt desirable at this point to reiterate that in our minds there is no comparison between transmission lines of above 100-kilovolt potential on steel towers and low-level residential distribution lines on wooden poles.

I will be pleased to provide any additional information on this subject desired by the committee.

Very truly yours,

DONALD J. GRAHAM, *Mayor.*

Mr. SEARLES. Could I just contribute to that. It is our opinion no use permit is required in the town of Woodside to build a distribution line along the town streets or roads and this is one of the reasons we do not have any particular knowledge of just what we have done. We haven't had to apply to the town and wouldn't expect to have to do so to extend a distribution line.

Representative HOSMER. Apparently they haven't worried about overhead lines until this particular line came up. We will clear that up when we hear from the mayor.

Representative HOLIFIELD. If the gentleman will yield, I would like to ask the proper person among the P.G. & E. representatives—and I will address the question to Mr. Joyce and he may assign it to the one who should answer.

There are some surrounding communities there: Los Altos, Palo Alto, Menlo Park, Atherton. These are names I see on this map. Are those areas served by overhead residential lines?

Mr. JOYCE. Yes, sir.

Representative HOLIFIELD. Are there any underground lines in those communities? Palo Alto is quite an extensive community and has some very fine homes, does it not?

Mr. JOYCE. Yes, sir.

Representative HOLIFIELD. Where does the 60-kilovolt line come into the Stanford grounds? Does it come from the north? Can you tell us where that comes from and what community it goes through?

Mr. JOYCE. I believe Mr. Johnson could answer.

Representative HOLIFIELD. Mr. Johnson, where does it start?

Mr. JOHNSON. The line is shown on the topographic map.

Representative HOSMER. The only map we can read here is this gas station map. Will you come up and show it to us on this?

Mr. JOHNSON. The line is actually shown on the map prepared by the AEC staff starting from Cooley Landing Substation on up to your right.

Representative HOLIFIELD. Here is Stanford University. Cooley Landing Substation is in this area designated at the top of the map.

Representative HOSMER. Is that a county or some town?

Mr. JOHNSON. It is a city—Palo Alto.

Representative HOLIFIELD. Where does it come down?

Mr. JOHNSON. It comes on various roads and streets and generally through——

Representative HOLIFIELD. Here is Lindenwood——

Mr. JOHNSON (continuing). The town of Menlo Park and finally Valparaiso.

Representative HOLIFIELD. That is between Atherton and the borderline?

Mr. JOHNSON. I believe so.

Representative HOLIFIELD. What type of line is that?

Mr. JOHNSON. This is a pole line.

Representative HOLIFIELD. How high a pole line is that?

Mr. JOHNSON. Pole line—50–60 feet, or something like that. And finally——

Representative HOLIFIELD. This is all a built-up area in here?

Mr. JOHNSON. Yes, sir.

It goes along this direction and then there is a tap into Stanford University and another one that goes into the SLAC project. All of these are shown on the other map in detail.

Representative HOLIFIELD. Are these pole lines the regular wood poles with crossbeams that go through these communities or are they aluminum or steel poles?

Mr. JOHNSON. They are all wood pole construction.

Representative HOLIFIELD. They are not generally considered to be as sightly as the metal poles that you have proposed here.

Mr. JOHNSON. It is a matter of some opinion.

Representative HOLIFIELD. A matter of esthetic judgment.

Mr. JOHNSON. In part I may say that the higher voltage larger lines require taller and stronger poles which are hard to obtain in wood, aside from any esthetic considerations.

Representative HOLIFIELD. This whole area is served by overhead lines.

Mr. JOHNSON. As far as transmission is concerned, they are all overhead.

Representative HOLIFIELD. And go up to as high as a 60-kilovolt line.

Mr. JOHNSON. Yes, sir.

Representative HOLIFIELD. Go ahead, Mr. McCloskey.

Mr. MCCLOSKEY. Mr. Chairman, I would like to make this comment. In the past, as the Congressman knows, California has been traditionally served by overhead powerlines. There are three types of high-voltage transmission in California now as we understand it.

There is the 220 kilovolt which is capable of delivering 300 megawatts of power or maximum use of the accelerator; 110-kilovolt lines which are capable of delivering 80 megawatts or the maximum use of the accelerator as it was first considered by the committee back in 1959; and 30 megawatts are carried by a 60-kilovolt transmission line. The accelerator is presently serviced out of the system with this 60-kilovolt line. I have pictures of that, as the Congressman asked, as it comes through the cities of Menlo Park and Palo Alto. You will notice the 60 kilovolts is carried on telephone poles. Then as it moves out into the country area it drops considerably to an ordinary wooden pole—and I do not have the precise height of this pole—but as it leaves the built up area of Menlo Park, you will notice the 60-kilovolt pole drops to a fairly minor size and then finally this is the last pole. The picture you will notice shows that pole line going over the hills to the accelerator itself. That is a 60-kilovolt transmission which is capable of carrying 30 megawatts. It is not too difficult a job to change that type of transmission line to a 110-kilovolt line because if the poles are strong enough then the crossbars are braced and the spacing of the conductors is slightly increased. That line that you see there coming through the city on poles, which comes through an area which has traditionally used poles, can be changed to 100-kilovolt line.

Representative HOLIFIELD. Without regard to the safety of that high-voltage line on a low pole?

Mr. MCCLOSKEY. If you will note the poles that you see in that picture carrying the 60 kilovolts and compare that with the size of the tubular steel poles that are going to carry the 220-kilovolt line, I believe those poles are as high as the poles P.G. & E. purpose to carry the 220 kilovolts.

Representative HOSMER. These people are looking at poles and your people aren't, is that it?

Mr. MCCLOSKEY. Mr. Hosmer, let me put it this way. This is a fair question, sir. We who live in areas of the community which are down on the flat ground are used to wooden poles traditionally. We are used to seeing wires against the horizon. But I don't think there is a person in the State of California as our cities expand and use up available land and as these new subdivisions are built who isn't attempting to preserve the scenic areas. In the new subdivisions that are being built today, you find more and more going underground. I think 25 percent of new construction is going underground.

You are familiar with the fact the Urban Renewal Administrator has urged going underground in our urban renewal progress. There is immense evidence—and I have cited it as a matter of fact in my statement—that 1963 was the year in which California residents insisted on changes to underground and said, "We are willing to pay for it henceforth."

Representative HOSMER. There is a point about Woodside which I didn't ask and, if I may, I will do so now.

When a new line comes into Woodside, to supply electricity, is the city of Woodside willing to commit its own treasury or its own people for that extra cost? Have they taken steps to do so? Have they met this problem as yet?

Mr. McCloskey. Sir, I think you can be sure that for any type of construction in the city of Woodside that would interfere with the esthetic beauty of the countryside that the town or the developer or whoever was concerned would have to pay for it and would be willing to do so.

Representative Hosmer. Is there a law?

Mr. McCloskey. No law applies, sir, unless someone applies——

Representative Hosmer. We have something else that is going to disrupt the esthetic beauty of that area. That is the freeway we have been talking about. What are you going to do about that?

Mr. McCloskey. Let me comment on that, Mr. Hosmer. The freeway brings up a very good point.

I referred in my statement to the Federal law which applies to freeways. The Federal Government is building 48.6 miles of freeway in this area. I am sure that some of you traveled the Bayshore Highway under standard crowded conditions. Bayshore, sir, is paralleled literally by three parallel towers. Down here in this industrial area the people's view of the bay has long since been lost. Industry has concentrated on the bay side.

The residential area is proceeding into the hillside. The route of the new Junipero Freeway follows roughly where I am placing the pointer now. You see that in this area it follows the route of the proposed P.G. & E. line. It was chosen for the reason that when you acquire land, the land acquisition cost is significant. So they moved out away from the homes as much as they could. The highways are trying to buy these areas in advance now before they are developed so the land costs will be cheaper.

The highway here will be roughly a 200-foot right-of-way. Under the Federal law 3 percent of the cost of the construction will be reimbursed to the States if they acquire scenic easements on either side. The Highway Act itself, which I have cited in my statement, provides for the acquisition of strips of land for the purpose of providing for the enjoyment of the traveling public and to provide scenic easements.

Representative Hosmer. To keep the billboards out. What does that amount to in dollars?

Mr. McCloskey. 48.6 miles of that highway traveling from San Francisco to San Joes is interstate system and 90 percent of its cost is paid by the Federal Government. Of the $138 million cost estimated, the Federal Government will thus pay $124 million. Of that $124 million, $4 million can be spent for preserving the scenic outlook.

Representative Hosmer. How many miles?

Mr. McCloskey. 48.6.

Representative Hosmer. Getting back to our figure, that is around $1,000 a mile.

Mr. McCloskey. This will demonstrate to you the Federal Government has authorized and could conceivably spend more than $35 million for this area for the preservation of scenic beauty.

Representative Hosmer. I understand that.

Mr. McCloskey. As you know if the State and county require there be no billboards within 660 feet of right-of-way, the State gets another one-half of 1 percent. In this case it would be $621,000 by keeping billboards 660 feet off of this right-of-way.

Representative HOSMER. Do they get anything for telephone poles or electric poles?

Mr. MCCLOSKEY. No, sir.

Representative HOSMER. This is where we are.

Mr. MCCLOSKEY. May I go on with my statement because I have some respectable State authorities on poles.

The California Public Utilities Commission—and I would like to read a citation from them if I may because we want to show you, Congressman, that the determination made by these local bodies is not a determination of people who are offended by the view. It is made in their opinion in the public interest.

Representative HOSMER. That is right, but——

Mr. MCCLOSKEY. We would battle just as hard to try to protect the esthetic beauty of the wooded estates along Potomac Park as we would for our own area.

Representative HOSMER. We are not talking about a capricious group of poles. We are talking about a group of poles to supply a very necessary function in scientific research for a research facility which was welcomed into this area by almost all of the residents there.

I want to keep this in context with whatever you are going to read. We must not be thinking about just poles in general, but poles to supply a particular need, a particular place, a particular facility for a particular purpose.

STANFORD ACCELERATOR POWER REQUIREMENTS

Mr. MCCLOSKEY. Yes, sir; but I do point out, Congressman, that when the citizens welcomed this accelerator into the community, the only evidence we had of the amount of power that would be required by that accelerator was, as I recall, 50 to 60 megawatts; 50 to 60 megawatts of power can be served by one single wooden 110-kilovolt pole line.

Representative HOSMER. I think you may be wrong there if you go back into the hearings. There was discussion of the extrapolation and of increasing the accelerator into the phase II development which required a great deal more power. So it doesn't come as a surprise.

Mr. MCCLOSKEY. Not as a surprise, sir, but a 200-kilovolt transmission line is the largest overhead type of transmission in the State of California and I think it would be a shock to everyone involved if they had envisioned a 220-kilovolt coming into this area.

Representative HOLIFIELD. The voltage isn't as important as the design and general look of the thing, is it?

Mr. MCCLOSKEY. Congressman, we can't contest that the existing forces of poles and wires that exist in California communities, largely on the flat ground, are unattractive. We think with the telephone company going underground we are going to find power companies going underground. With 12 kilovolts and with 14 kilovolts, they can bury these cables and I think they will find them burying them.

Representative HOLIFIELD. Of course, they have a very different problem than that of this heavy line which requires this method of cooling and maintenance and all that sort of thing. It is very simple to put a telephone cable underground or even a very light voltage line underground. But we are talking about a heavy line, as you know.

Mr. McCLOSKEY. Yes, sir; and I think Congressman, you pinpoint the problem which is this. It is that up the countryside on the entire tip up to the California border, there is the question that we can't afford anything underground. We have to have these overhead tower lines, but in cities we know that we can't afford to put them overhead. They have to be underground. New York hasn't had any overhead transmission.

Everything south of Dunwoody in the State of New York is underground in the Consolidated Edison system. We know this is the coming thing in California. And with our population we have to go underground in our cities and in the preservation of these open green areas around the cities. Out in the country, conceded these must be overhead.

Representative HOSMER. With this proposed line alongside the freeway, you would not be using extra territory.

Mr. McCLOSKEY. No, sir; but——

Representative HOSMER. Let's face it. I don't want to be hard-nosed about this. I am not for poles but there has to be some give in here so we can work out this problem. They do have tall poles on many freeways with incandescent lights on them. In California we are quite used to seeing heavy foglights and other types of lights on tall poles on the highways; are we not?

POWER OUTAGES

Mr. McCLOSKEY. We are. Let me make an argument though about power in that connection, Mr. Chairman.

P.G. & E. has had 44 miles of underground for 17 years. They have never had an outage on this primary underground transmission. As I understand it, if this accelerator goes out of action for a day, it is a $30,000 loss. I think I saw that figure in one of the previous hearings.

What causes power outages? We have had storms with power outages in Marin County—4 days out in Serra. We commonly have once or twice every 2 or 3 years in California real windstorms—high winds and trees falling. The last power outage in our area was a drunk hitting a power pole with a car. There are cranes. There are outages which are caused by things on the surface. The only cause that I know of for an underground outage would be an earthquake. If there is an earthquake, there is an earth fault and the accelerator isn't going to get any power for a while and it is likely going to be affected. So as far as reliability of service and outages, there would seem to be some reason for not putting a powerline along a highway.

Representative HOLIFIELD. The Commission has never mentioned that to the committee in connection with the accelerator. I don't think they could have felt this enough of a factor to worry about.

Mr. McCLOSKEY. Let me add one more thing, Congressman. You will remember when they tried to bring water down from Owens Valley farmers' depleted dams, when P.G. & E. built an 18-mile line, one of the boys got so mad he shot all the insulators off four of the towers. There are things that can cause outages which can affect this accelerator that would not apply to an underground line. That was one of my clients incidentally.

Representative HOSMER. I don't suppose the citizens of Woodside would take that kind of recourse, do you?

Mr. MCCLOSKEY. No, sir; I don't think it is a threat, but if you are talking of a national security facility, an underground line is a valuable thing and I think should be considered by this committee.

Representative HOSMER. We haven't thought of it as national defense in the immediate sense in any event.

Mr. MCCLOSKEY. Sir, let me go forward, if I may, with the reasons why the local determination is reasonable.

I would like to quote from a case recently decided by Mr. Bennett—a unanimous decision of the California Public Utilities Commission in *Ligda et al.* v. *P.G. & E.*, case No. 7587, May 7, 1963.

Representative HOSMER. Is that the new fellow who is chairman of the PUC. Did he say this?

Mr. MCCLOSKEY. He wrote the decision. He said:

> It is clear, particularly in a State such as California where unplanned suburban expansion, coupled with our population explosion, may quickly result in a depletion of all scenic attractions, the citizenry must become more and more vocal in their desire to maintain their native landscape. * * * The evergrowing and oft-expressed desire of more and more Californians for green space conservation should be acknowledged by California public utilities in their planning.

P.G. & E. has gotten to this point. We have reached status quo—a status where the utility company, the State and local planning agencies can resolve these matters and I think would resolve them but for the Federal interest here.

Representative HOSMER. Are you saying that we are interfering with your getting together on this?

Mr. MCCLOSKEY. No, sir; I don't imply that at all nor mean to infer it in any way. I mean to say that but for the fact this is a Federal customer there would be no question but that the line would go underground; no question at all. But this is a Federal customer and it brings in the Federal Government.

Mr. Bennett also said this:

> In view of the potential growth of California and the ever-decreasing green space areas of California, the utilities must, in their planning, give special consideration to future recreational needs and must not take over through eminent domain the choice beauty spots of the State for concrete and steel installations.

So we don't have just the county here, sir. We have the State.

Representative HOSMER. I think Mr. Holifield and I have both said that in speeches with respect to the general proposition. Here we have a specific problem to deal with where generalities just do not fit. We are trying to come to some way of running this accelerator that is reasonably satisfactory to everybody.

Mr. MCCLOSKEY. Yes, sir. Let me add this. You know we are pleased to have the two California representatives here today. I might add this is peculiarly a State problem here, sir. I don't know whether the Congressman has ever had the privilege of driving on Skyline Drive.

Representative HOSMER. Let me advise you I took all my undergraduate work up at the University of California and when I could borrow a car and drive a girl around Skyline Drive, I did so. So I have a pretty good idea of what it is like. [Laughter.]

Mr. MCCLOSKEY. May I suggest sir that courting a girl under a powerline does not have quite the same effect?

Representative HOSMER. You can do a little sparking. [Laughter.]

Representative HOLIFIELD. Mr. McCloskey is that route the pole line would take from the tie-in there—the yellow line—to Stanford all residential area?

Mr. MCCLOSKEY. No, but I wouldn't hesitate to say that nearly all of this area is completely visible to all of the residents that you see in this area. The hill rises about 1,000 feet—it is in the very short distance here. It is a wooded ridge line. The fog comes over in the afternoon. It is a beautiful spot.

Representative HOLIFIELD. Divided up into 2- or 3-acre plots throughout the Woodside community.

Mr. MCCLOSKEY. Part of this area is 3-acre zoning and part is 1 acre.

Representative HOLIFIELD. Has this all been developed or is a lot of it just unused land?

Mr. MCCLOSKEY. The area across which the line will go, sir, is hardly developed at all.

Representative HOLIFIELD. Is that area in which we are told there are four owners?

Mr. MCCLOSKEY. I believe so, sir.

Representative HOSMER. Five.

Representative HOLIFIELD. How many acres do these four owners have there?

Mr. MCCLOSKEY. I can only speak for one. I can give it because it is relevant to the damage figure. That is Mr. Wonder's property who, I believe, owns around a thousand acres.

Representative HOLIFIELD. Are the other tracts of commensurate size or smaller?

Mr. MCCLOSKEY. I don't know that. I don't represent the property owners along that route until you get down near Searsville. There are a great many homes scattered around Searsville up on the ridge above this and immediately around here.

Representative HOLIFIELD. What does that land sell for an acre?

Mr. MCCLOSKEY. Our appraiser, sir—and it depends on whether you get a homesite or not—it is hard to measure by acreage. I would say a 3-acre homesite would sell for possibly $30,000. Is there any question about that?

Mr. GRAHAM. No, that is right.

Mr. MCCLOSKEY. A 1-acre——

Representative HOLIFIELD. That is unimproved?

Mr. MCCLOSKEY. That is without streets. That is right. A 1-acre homesite might sell for as much as $20,000.

When you talk about crossing over a very small area you have severance damage to the people on the other side who are in view of it. I have one statistic that I cited in my statement because we have been looking most assiduously for some record of what happens. The only offer to purchase we have been able to find was when a man recently found there was to be a powerline there that he dropped his offer 18 percent.

So if that is the proper measure of severance damage to land within view of this line, the Government may find severance damages are considerably higher than anticipated.

I think both of you gentlemen may be familiar with the case in 1936 when the city of Los Angeles, the city of Huntington Park, and Southgate brought in metropolitan water and powerlines. It is interesting because in that case the appellate court discussed the fact while both the city of Southgate and Huntington Park wanted Los Angeles to go underground, that undergrounding had not reached a standard of reliability and consequently that while it could not deny, in turn, the court could not say it was not the responsibility of the two cities to ask that the city of Los Angeles not go across with overhead lines.

That is precisely the issue here—the key issue.

Representative HOLIFIELD. They did use an overhead line. It runs within three blocks of my house.

Mr. MCCLOSKEY. Yes, sir; in 1936——

Representative HOLIFIELD. In the city of Montebello.

Mr. MCCLOSKEY. But in 1963, Mr. Holifield, things have changed because the Department of Light and Power of the City of Los Angeles put in 5 miles of 220 kilovolts underground because residents protested it going along drainage—I think in the area of the drainage canal up above Glendale.

In his report, as I will cite later on, Mr. Blankenburg, chief of underground for Southern California Edison, has said in his opinion 1963 was the year in which California decided, "We will put underground in urban and suburban areas lines of this voltage, 220 kilovolts."

Representative HOSMER. However, the powerline that you mentioned would be different from a powerline paralleling a freeway.

STANFORD UNIVERSITY INTERESTS

Mr. MCCLOSKEY. I agree with you, Congressman.

I would like to say this if I may. Stanford University is the one party we haven't heard from. It is interesting that there has been no willingness to pay some part of this cost from Stanford. As was pointed out they wanted to raise $100 million for the space program and they have just raised $100 million so there is some money there extra.

I feel if we can sit down and discuss these things we can show a benefit to Stanford. At this end of the accelerator there are two new housing developments. You see the accelerator buildings here. There is a development here called Stanford Hills and right across the street there is a development area called Sharon Heights. Both of those developments have several hundreds of homes and all of them have underground power.

Stanford University has a resolution of its board of trustees that everything on the campus shall be underground. They made a specific exception for the accelerator. The accelerator does not take all of the Stanford property. This is Stanford property, for instance, here across Sand Hill.

If we assume that Stanford has 500 acres of land and that land is worth $7,500 an acre—let's put it at a low value—we have approximately $500,000 of damage to that Stanford property by that line going over it.

Mr. CONWAY. Mr. McCloskey, we did have a witness from Stanford this morning who testified they were not going to make any charges for this.

Mr. MCCLOSKEY. Mr. Conway, that is correct, I mean to point out that Stanford is counting on that powerline going overhead on towers as far as we know.

Mr. CONWAY. I want to make it clear for the record that the $500,000 you are talking about will not be a cost to the Government because they are not going to ask for anything. Otherwise it looks as though it will cost the Government at least a half a million.

Mr. MCCLOSKEY. No, sir; it will not cost the Government anything for the overhead tower on Stanford property.

My only point is if the line goes underground for 2 miles along the accelerator, Stanford's adjacent property will be benefited by $500,000, at the very least in our opinion and consequently should be willing to contribute to the cost of putting this thing underground because their land directly benefits. They won't get any funds out of this, but they will benefit by a half a million dollars at the very least if the line on their property is underground.

WOODSIDE CONTRIBUTIONS

Mr. CONWAY. During the months that Woodside has been disturbed about this—I guess it is over a year—have you made any overtures to Stanford or attempted to negotiate with them as to how much Woodside might contribute and how much Stanford might contribute?

Mr. MCCLOSKEY. Mr. Conway, representatives of Woodside, representatives of P.G. & E. and Stanford have sat down and tried to work these things out. In each case it has been the position of Stanford that the board of trustees would not authorize any money.

Mr. CONWAY. Can you indicate to the committee how far the city of Woodside would go?

Mr. MCCLOSKEY. This is a difficult thing to ask, sir, because I can't speak for the legislative body. I can suggest this. Part of the cost that the Federal Government will have to pay P.G. & E. to build this line is what they call the cost of ownership charge, 15 percent per year which includes a provision for the utility to pay taxes. I don't know what those taxes are that are paid to the city and county, but it seems perfectly reasonable to me that this matter be proposed to both the board of supervisors and the town council that, as part of their contribution to get this line underground to the great benefit of the county and town that there be some waiver of taxes, if possible.

I can't speak for them, obviously. Part of our difficulty is because this is a legislative body and somebody has to approach them.

Mr. CONWAY. I wonder if the mayor as the chief executive has in any way approached his legislative body.

Mr. GRAHAM. Actually the town of Woodside is in no financial position to undertake any such encumbrance.

Mr. CONWAY. I have heard about the cost of acreage there and what the minimum is. I assume you could float or have facilities at least or at least legislative authority to issue bonds or raise revenue legally.

Mr. GRAHAM. There is a possibility for exploring this.

Mr. MCCLOSKEY. I don't know the legal aspects for giving up taxes. It may be it can't be done under the laws of the State of California.

I do want to mention this because the question came up. I believe it is General Order 96A of Palo Alto, Calif., Public Utilities Commission does permit the utility to give preferential rates to agencies of the Federal Government. I have a copy of General Order 96A if the committee wishes to see it.

Congressman, I brought up Skyline Drive because a bill to make Skyline Drive a Federal scenic parkway, or at least to study it for that purpose, has been introduced by Congressman Gubser of Santa Clara County and it is presently under consideration by one of the committees of Congress. Skyline Drive runs roughly along the crest. It is located very close and in many cases views where this power line will go. One of the regulations of the Federal Government is that all lines of 12 kilovolts or under go underground in the vicinity of scenic parkways.

Representative HOLIFIELD. Would that indicate if it does go into that program, that whole yellow line would have to be put underground?

Mr. MCCLOSKEY. No; that cannot be done. We fought the yellow line on the basis——

Representative HOLIFIELD. I know; but if the line goes through then they are going to have to bear this aesthetic disability or liability if you want to call it that.

Mr. MCCLOSKEY. It may have endangered that highway being accepted as a parkway for that reason.

I raised in my statement, Congressman, the Housing Act of 1961, because that Housing Act entitled VIII authorized the Housing and Home Finance Administration to enter into contracts with local public bodies for grants not to exceed $50,000 to assist them to acquire permanent interests to open spaces for park and recreational purposes, for conservation of land and other natural resources and for historic or scenic purposes.

The city of Palo Alto recently committed itself to the expenditure of over $1,200,000 for the purchase of 1,200 acres as a foothill park—which is just south of this area. I think this indicative because the city of Palo Alto with forces of lines and wires over it has adopted an ordinance requiring all new subdivisions to go underground and here has purchased 1,200 acres out in the foothills for the benefit of Palo Alto citizens. The city of Palo Alto, which has always gone Republican, declined to take Federal funds, but they would have been entitled to take 20 to 30 percent of that price in Federal money. So here is one case where the Federal Government would have authorized a considerable expenditure for this purpose but it was not requested.

Second, the Federal Housing Act, the HHFA, in 1963, adopted a regulation providing for reimbursement for both investor-owned and publicly owned utilities for the difference in cost in urban renewal areas between overhead and underground installations providing for either relocation or initial construction of powerlines.

Finally, William Slayton stated:

> The total effect of careful planning and competent architectural craftsmanship can be cancelled by vistas of unsightly overhead wires. * * * It pays to invest a little more in the prevention of adverse influences. * * * The opportunity provided by urban renewal, to place utilities underground, should be seized whenever possible.

I also have a quote from the London Daily Telegraph of September 21, 1962, because they have the same problem:

> Electricity will be switched on for the first time at Widecome in the Moor. Uncle Tom Cobley's Village at Dartmoor next Thursday. Church bells will be rung and there will be dancing on the green. In the parish hall an oil lamp will be ceremoniously doused by Mr. A. N. Irans, chairman of the southwestern electricity board. The parish council has written to thank the board for bringing in the powerlines without spoiling the village.

They have done this in several scenic spots of England. We think this village qualifies.

I then cite Public Law 85–767 on highways.

I think sir, that the $4 million that will be spent for the acquisition of scenic strips and the $621,000 for billboard control should be measured in comparison with what would be the expenditure here.

I would like to say one thing on the question of the two circuits. When you talk about the $5 million difference you are talking about the two circuits. We do not understand why the Government would benefit by building a double circuit line if a single circuit can carry 200 megawatts and they have a backup line of 60 megawatts. We fail to see why this should be two circuits of 220 kilovolts because this line only goes 6 miles and the average number of outages, as we understand it, per mile is something around one outage per hundred miles per year.

Representative HOLIFIELD. The proposed underground costing $2,640 million is a one circuit.

Mr. MCCLOSKEY. Yes, sir.

Representative HOLIFIELD. The two circuits would be actually two separate lines to meet their projected needs estimated to occur after 1972.

Mr. MCCLOSKEY. Yes, sir.

Representative HOLIFIELD. The two steel lines with these electric lines encased in them would seem parallel and duplicative——

Mr. MCCLOSKEY. Right, if they did it that way, sir.

I would like to point out that we filed with the committee yesterday and I would like to call it to the Congressman's attention—an alternate proposal that embraced a report of Victor Siegfried, who is an electrical power engineer who was retained by our committee some time ago. (See app. 2, p. 139.) I would like that report to be included in the record and also the report of Mr. Blankenburg, chief of underground (see app. 3, p. 143) because the report of Mr. Siegfried indicates that in the potential cost of a two-circuit line, each circuit is capable of only 150 megawatts, but he proposed to put underground the other 220 source in the vicinity, which is the Ravenswood area. P.G. & E. has a 220 line that crosses over the site of a proposed Ravenswood substation in this area and to bring it underground along these city streets, a distance of approximately 7½ miles, as an alternate to the Jefferson route. Mr. Siegfried prepared this report and he indicated that with two circuits of 150 megawatt capacity in each circuit put in a single trench, that a line could be constructed for the neighborhood of $3,500,000. This is an alternative. While that report has been filed, we know of no consideration by the AEC. It was filed with you yesterday for the first time but it has been before the Pacific Gas & Electric Co.

Representative HOLIFIELD. Could I ask you to pause for just a moment while I ask General Luedecke if this alternative plan of Mr. Siegfried's has been presented to the Commission.

General LUEDECKE. We have a copy of the study.

Representative HOLIFIELD. When did you get it?

General LUEDECKE. May I correct my statement? We are aware of the study. To the best of my knowledge we do not have a copy.

Representative HOLIFIELD. Mr. Joyce, are you aware of this study?

Mr. JOYCE. Yes, we are.

Representative HOLIFIELD. Have you studied it?

Mr. JOHNSON. Yes, we have studied it.

Representative HOLIFIELD. Are you prepared to comment on it?

Mr. JOHNSON. Yes, sir.

Representative HOLIFIELD. We will call upon you later for that.

Mr. JOHNSON. Yes, sir. (See app. 2, p. 139.)

Mr. MCCLOSKEY. I might say that is an indication of the course of the negotiations in this matter because this statement was filed many months ago with one of the planning commissions in which the AEC has an interest.

Representative HOLIFIELD. Wait a minute. Was this filed with an employee of the AEC?

Mr. MCCLOSKEY. No, sir; we prepared it and presented to the Woodside Planning Commission, I think last June——

Representative HOLIFIELD. It is dated May 13.

Mr. MCCLOSKEY. It is dated May 13 and it was tendered to the Woodside Planning Commission in this matter.

Representative HOLIFIELD. Did the Woodside Planning Commission then make it available to either Stanford or the AEC or other parties involved?

Mr. MCCLOSKEY. It is part of the public record, sir, and an AEC representative was present. That is all I know about it. We have never discussed the report with them. But you see at that time they wanted a double circuit, each circuit capable of bringing in 300 megawatts, and of course, Mr. Seigfried's report only covered one circuit. He didn't have a standby circuit. But when they indicate the possibility of 180 megawatts on a single circuit, this report has considerable merit, we think, because it has two large circuits and it has the total capacity which the accelerator will need in the future apparently of 300 megawatts.

I think it merely poses this problem, sir. This committee and the AEC must consider whether they need two circuits or whether one is adequate because this is the key question.

Representative HOLIFIELD. The testimony of Dr. Panofsky was that one line bringing in 180,000 kilowatts would be sufficient, as far as he knew, until 1972.

Mr. MCCLOSKEY. Right.

Representative HOLIFIELD. But there are also indications that if it is used as they contemplate that they would need a second line of the same capacity for the decade that follows.

Mr. MCCLOSKEY. Yes, sir; and with those two lines they would then have 300 megawatts. That is the virtue of Seigfried proposal which has 300 megawatts right now—using both circuits.

Mr. CONWAY. The other report to which you referred, I think, was a report by Mr. Blankenburg who, I understand, is a consultant to the property owners of Woodside. (See app. 3, p. 143.)

Mr. MCCLOSKEY. Yes, he was retained by the citizens group which I represent.

Mr. CONWAY. I have been glancing through the report you referred to, and which we received yesterday, and one of the recommendations apparently made was that the property owners direct their efforts toward delaying a final decision in this matter just as long as possible without serious delay to the essential operations at SLAC.

I think that raises a question. In these negotiations that have been going on, have the property owners been following this recommendation? Perhaps this is the reason we have not gotten a meeting of minds.

Mr. MCCLOSKEY. I can assure you that is not the case. I must represent to you personally that there has been no attempt on the part of anyone—and I can say why. The reason for it is this. In August, General Luedecke wrote a letter to the planning commission in which he said, "I hope you will consider this favorably so this will preclude any consideration of alleviating measures on our part." Immediately we thought that means they are going to condemn. So clearly with the decision on condemnation having to be made very quickly it has been to the citizens' benefit to try to push these matters.

CONTRIBUTIONS FOR TRANSMISSION LINE COSTS

Mr. CONWAY. It rather surprises me that somewhere during these negotiations there hasn't been an attempt to get from Stanford some interest on their part to contributing to the cause or that the communiy of Woodside has not within itself discussed how far and to what extent it might be willing to contribute to the objective they have in mind.

Mr. MCCLOSKEY. Yes, sir, I concede the problem and I can only say that any legislative body is bound up with its routine and it has to wait until somebody brings things to it. The positions that have been brought before the legislative bodies have changed materially. The pole line proposal didn't come up until the tower line was turned down. P.G. & E. has delayed on its application on several occasions, not because of any request on our part that they be delayed.

These are good points, Mr. Conway, and I respectfully suggest that the issue, I think, has come down to the Government condemns, or an underground line is built by P.G. & E. unless some sort of compromise is worked out on some sort of pole line. But I must state to you, sirs, the residents of this community and the people of this county, I think, have reached the state where they don't feel there should be any overhead high voltage lines in the area. I think if there is a compromise to be worked out it is what pays the cost and who pays the cost of the underground.

I believe with the stimulus of this committee—frankly if this committee would say to the AEC, "Go back and sit down with these people. Let's get all five interested parties together and negotiate and see how we can compromise the issues." That is the relief we seek, sir.

Representative HOLIFIELD. In the first place we are the legislative body. We are not in the executive implementing body. The AEC is part of the executive branch and the implementing body. They

have been proceeding in a normal businesslike way as they have proceeded in many, many, cases in contracting for powerlines. After all we have power brought into our facilities at Idaho, Oak Ridge, and other facilities on poles. They have proceeded in a completely normal way. As far as I can see, Pacific Gas & Electric has progressed in a completely normal way under the laws of the public utilities commission in the State of California. If the city of Woodside and the county of San Mateo are dissatisfied with this on the grounds of esthetics and not on the grounds of governmental economy and efficiency, it seems to me it is up to the city of Woodside and the county of San Mateo to decide, within their own capacities, as to how much they want to cooperate in order to change a situation which exists.

The situation which exists is clearly legal. It is clearly within the right of the Government to use the right of eminent domain. It is certainly in line with the economy and efficiency in expenditure of Federal money. If there is some compromise that can be worked out, I am sure it would be most desirable.

You have said this would possibly affect your property values to the point of 18 percent. I can't pass judgment on whether that is right or not, but if the exercise of eminent domain would affect in a downward way your property values to that extent—and you know full well your legal possibilities of stopping the Federal Government in its exercise of the right of eminent domain—then it would seem to me that the communities involved from the standpoint of the financial interests involved in the value of the land, and from the purely financial standpoint, would put their heads together and come up with some kind of an offer of cooperation.

I can't direct the AEC to do anything, but I will say if you are of that mind to get down to business and discussing this on the basis of a cooperative participation, I would be willing to ask the AEC to sit down and consider your proposals. However, if there has existed a procedure such as recommended by one of your consultants to prolong this matter just as long as possible and to delay a decision just for the purpose of delay, of course, I would not feel justified in making such a recommendation.

Mr. McCloskey. Mr. Chairman, as I say, I filed this report with you hoping that it would be recognized for what it is—a consultant's report.

Representative Holifield. We only received these reports yesterday. Our staff will look at this and I am sure if you have an extra copy the AEC people would be glad to look at it.

I think it is clearly within the responsibility of your own local interest for you to put your heads together and come up with a proposal.

Mr. McCloskey. May I point out, Mr. Congressman, in defense of the city and county, they likewise have done everything in an orderly and in a regular business procedure.

Representative Holifield. I am sure they have.

Mr. McCloskey. Mr. Blankenburg was retained by the private citizens group that I represent. His report was presented to the committee, of course, or to the planning commission, but the point here is that it is like many controversies when the parties can't communicate. The city and town planning commission have to wait until the application is made before they can act. The first application was made

last June. The planning commission meets each month. After it meets, the council meets. This is an orderly procedure. They never had a threat of condemnation out in the open until January the 9th, when the AEC pointed out to us the immediate need for power on schedule of the accelerator—this is 3 weeks ago—that the immediate need for power within 30 to 60 days justified consideration of condemnation. Until then the parties hadn't really gotten down to consideration of the ultimate resolution of this question.

Representative HOLIFIELD. This need for power within 30 to 60 days wasn't expresed to you?

Mr. MCCLOSKEY. No, the need to resolve how and what power was going to come.

Representative HOLIFIELD. Of course, you have to plan in advance. You have to build these pole lines or you have to build underground lines. It takes time to do it.

Mr. MCCLOSKEY. No criticism of anyone here, sir. It is merely an explanation why this matter has reached this unfortunate situation. I think everyone involved are reasonable men. There is no question but that the Pacific Gas & Electric Co. is ready to compromise. The county wants to do the best they can. The AEC is faced with a need to immediately resolve this issue. I think if we can sit down with Stanford University it can be worked out.

I hate to see the concept of eminent domain be used here. While the Federal Government has that power, sir, this entire project was brought to California on the basis of cooperation between local, State, and Federal Government agencies involved. I don't think anyone conceived, when these hearings were first held, that the Federal Government would use eminent domain in this sort of manner. Eminent domain power is clear. I don't know that I agree with the flat statement that it clearly has the power here because eminent domain will be used in this case not only to acquire power, but it will be used to overcome local regulation of the transmission of electricity. There is a provision in the act which says that nothing was intended to interfere with local regulation of transmission of power. I concede there is a legal issue.

Representative HOLIFIELD. We won't have to sit in judgment on that.

Mr. MCCLOSKEY. No, sir; that is a judicial matter.

Mr. CONWAY. I think the Department of Justice has been asked to comment and that they agree with the AEC Counsel is my understanding.

Mr. MCCLOSKEY. Yes, sir.

Representative HOLIFIELD. Have you finished with the exhibits you wish to give us?

Mr. MCCLOSKEY. Yes, but I did want to file one other report, which is an Advisory Committee Report No. 10, of the Federal Power Commission which indicates the cost of underground on a national basis are considerably lower. It gives figures. I have some extra copies of that. (See app. 1, exhibit A, p. 110.)

Representative HOLIFIELD. We will accept all of these exhibits but I will have to take it up with the committee as to the inclusion in the record. We will consider the inclusion of the pertinent ones in our record.

COST OF TRANSMISSION LINES

Of course, we are not so much interested in national averages as we are in the topography of the soil, rock, granite, or whatever it is that must be excavated in order to put in a line. I assume there would be a great deal of difference between excavating for a line like that in rock and granite and salt and alluvial soil. (See app. 1, p. 103.)

These averages do not mean a great deal but I am most interested, and I am sure the committee will be most interested in any kind of question of cost involving a competent analysis of the local situation in regard to excavation for the burial of lines.

Mr. McCLOSKEY. I know that our labor costs are higher on the peninsula, sir. However, I ask that the figure be at least considered by the committee.

It uses, I think, $359,000 per circuit for 230-kilovolt, single-circuit, 335 mva. That would be a single circuit capable of serving the accelerator and, even if $359,000 per mile were increased considerably, it would mean much less cost than what has been recited here. I think the experts who prepared that report for the Federal Power Commission are worthy of consultation. That is all. It is offered merely as a consideration.

Representative HOLIFIELD. A quick division of that into $2,640,000 gives me roughly a round figure of about 500——

Mr. McCLOSKEY. Yes, sir; but that is only 180 megawatts. This line, mentioned by the Federal Power Commission at page 3 of that Advisory Committee Report No. 10, is, I think, capable of 335 mva——

Representative HOLIFIELD. Your double line——

Mr. McCLOSKEY. Your two pipes buried would be $6,400,000. This is $400,000.

Representative HOLIFIELD. I was only dividing the 5 miles into the single-circuit underground 180-kilovolt line which was around $500,000. You said the national average was around $359——

Mr. McCLOSKEY. No; the figure that was used in this report was for a single circuit, 230 kilovolts capable of carrying 335 mva. That figure is $359,000 per mile. If you multiply it by seven——

Representative HOLIFIELD. We can consider that.

I have already asked P.G. & E. if they felt they were justified in their cost differential here. They have said that they were. I will ask them to recheck their figures and taken into consideration this information which Mr. McCloskey has laid before the committee and report to the committee whether they are still firm in the figures they originally presented to us.

Mr. JOHNSON. We can report right now, if you wish, sir.

Representative HOLIFIELD. As soon as Mr. McCloskey is finished, I will call on you.

Mr. McCLOSKEY. I would like to bring to your attention Public Law 85–470, enacted on June 27, 1958, which established a National Outdoor Recreation Resources Review Commission. That act clearly establishes a national policy for cooperation amongst local, State, and Federal agencies for coordination in preserving scenic and recreational areas for the common use.

There is also one interesting statistic from the report of the Commission to the Congress in January 1962, that driving and walking for pleasure accounted for 42 percent of the total annual recreation ac-

tivity of residents of the United States. We find the same to be true in San Mateo County, sir. The primary residential recreation is driving on Sundays or walking through the countryside. This is the thing we seek to preserve for the country.

It isn't just for the people who live there and have to look at that line. Every citizen in Woodside turned out, I would say, in support of keeping this tower line out, not because they look at the line from their front window, but because this is a scenic area which is incomparable from our standpoint. We would like to keep it that way. We would like to keep it that way for the hundreds of thousands of visitors who pass through to visit these three historic sites that are marked with monuments.

I would like to site the recommendation that was made only in 1962 by this national commission:

> It shall be the national policy, through the conservation and wise use of resources to preserve, develop, and make useful to all American people such quantity and quality of outdoor recreation as will be necessary and desirable for individual enjoyment, and to insure the physical, cultural, and spiritual benefits of outdoor recreation.
>
> Implementation of this policy will require the cooperative participation of all levels of government and private enterprise * * *.

At these meetings of the Woodside Planning Commission and the San Mateo County Planning Commission, sir, the AEC has never appeared to represent what its position was except for a single letter written in August 1963, to say we hope you will pass it so that we won't have to consider other measures. This is the single appearance.

The town and the county have proceeded in a reasonable way. I think it would be a crime actually if these governmental agencies cannot get together and cooperate through their duly designated representatives and settle this problem.

Representative HOLIFIELD. You have talked a great deal about cooperation. The Chair hopes there will be some cooperation and that it will come about speedily because the public business must be transacted. Our responsibility is, of course, to the Federal section of it.

I think you will find this committee perfectly willing to do what is reasonable and right in this and I be lieve you will find this also to be true of the Federal Government and the AEC.

Mr. MCCLOSKEY. Yes, and I appreciate the time that has been extended. If I may do so I would like to make this last statement because it is the crux of our position, sir.

This has to do with Mr. Blankenburg's report. Mr. Blankenburg is the chief of underground for Southern California Edison, a private power company. He made this report as a registered civil engineer for us. He said:

> There are many straws in the wind today which suggest that the public is able and about to declare their willingness to pay the extra cost and have underground lines.
>
> Thus, we are about to witness underground changing from a willingness to a necessity. Such a change will not mean the sudden disappearance of power holes and towers. It will bring a rapid halt to overhead line extensions in many urban and suburban areas * * *.
>
> In time to come, we will look back upon 1963 as about the time that the value of underground lines, rather than overhead lines, was recognized as being substantially more than the cost difference * * *.

I might add one last point. That is, sir, that the Atomic Energy Commission selected this site for the accelerator. In the committee hearings back in 1959 and 1960 the primary reason given for the selection of Stanford was the qualified personnel that existed there. They developed the klystron tube. They had this tremendous center of people skilled in the art. This is a national facility. It is going to attract people from all over the world. I think, sir, if the scientists could give their private opinions rather than public opinions, you would find that the great majority of the scientists themselves would like to preserve the area in the manner it is in now.

There is an advertisement I clipped out of the San Francisco Examiner when they were advertising for employees. It stresses, "Come live in the beautiful San Francisco Peninsula and the university environment." This environment is what the town and county want to preserve and which, I think, the university wants to preserve. It is easy to understand their position, sir. They came before the Congres and vertified in every way they could that it would not exceed $114 million; that the cost would not exceed $15 million a year. Now, of course, they have to take a position that they cannot support spending any more money beyond that for the preservation of the scenic value, but I think they do. I think I speak for many of them, sir. I think I speak for a great number in saying that if we can keep this thing underground, the State of California benefits and all the people of that State will benefit. This line is going to be there a long time.

Representative HOLIFIELD. Thank you.

Mr. MCCLOSKEY. I thank you for the privilege of this hearing, sir.

Representative HOLIFIELD. You have made a good witness. We are glad to have you before us representing your citizens' group.

Were you asking for recognition, Mayor?

Mr. GRAHAM. No, sir. Thank you.

Mr. LEVY. Mr. Holifield, could I say one thing? I want to thank you also for the opportunity of appearing here and the board of supervisors for sending me.

I don't know whether it is legal but I feel that if we could get together with Stanford and the interested parties and if it was possible with respect to the taxes P.G. & E. would be paying, which are considerable—and I wouldn't want to go on record as to how much—I feel sure the board of supervisors would sit down to compromise as much as we can to save the beauty of their countryside and if it is legal could divert some of the taxes toward getting this underground. I cannot speak for them, but I feel if you would give us the opportunity to act that our county would be the first one to carry the ball.

Thank you very much.

Representative HOLIFIELD. Thank you, Mr. Levy.

Now, Mr. Joyce or Mr. Johnson, which ever wishes to speak?

Mr. JOYCE. Mr. Johnson will make a brief statement. He has covered these reports.

Mr. JOHNSON. We have been well aware of these reports on underground: Mr. Blankenburg's report, Mr. Seigfried's report, and the National Power Survey Subcommittee report. We are well aware of the figures cited. (See app. 1, exhibit B, p. 115.)

We are quite positive that our estimates are proper, reasonable and accurate. I think Mr. Joyce expressed our position when he said that we were certain enough of our estimate that we would guarantee it would not be exceeded and if the cost were less those who paid the cost of the underground would benefit accordingly.

With regard to Mr. Blankenburg, of the Southern California Edison Co., as far as I know his company has no high-voltage underground cable and his experience in that company is in the field of distribution underground.

We would be perfectly willing to discuss with the staff or anyone who wishes the cost matters. We have already done so.

Dr. Panofsky I think covered thoroughly and very adequately the alternative considerations which led to the selection of the 180-megawatt underground cable for consideration.

Representative HOLIFIELD. I will terminate the public hearing at this time.

General Luedecke, did you have something you wished to offer?

Mr. LUEDECKE. I wonder if I may make a short statement, Mr. Holifield.

Representative HOLIFIELD. All right.

General LUEDECKE. Mr. Chairman, in light of some of the comment this afternoon I want to state it has been the Commission policy in projects of this nature anywhere to cooperate as fully and closely with State and local communities and authorities as propriety will allow us to do. We feel we have done so in this case both with respect to the accelerator and with the powerline.

I think with respect to the powerline that P.G. & E. is trying to carry out the provisions of their contract with us and this is one of the tasks they undertook in the contract. Up until last week P.G. & E. had proposals pending before the boards of both the county of San Mateo and the city of Woodside. The extent of our participation in those hearings is something we had to determine on the basis of our own views as to the propriety of our appearance in those hearings.

(Whereupon at 5:10 p.m., Wednesday, January 29, 1964, the Joint Committee concluded the hearing.)

APPENDIXES

Appendix 1

McCloskey Memorandum to Woodside Planning Commission Re P.G. & E. Proposed 220-Kilovolt Tapline

I. PENINSULA POWER NEEDS AND SOURCES

1. Sources and transmission of power

In order to understand the issues of the proposed 220-kilovolt line to serve the Stanford linear accelerator, it is necessary to understand the basic terms and definitions which P.G. & E. uses to describe the transmission of electric power. P.G. & E. has various generating plants scattered throughout the State, its primary sources being its hydroelectric plants located in the mountains along the rivers of northern California (such as the Pit River powerhouses) or its steam generating plants such as those at Pittsburgh at the northern end of the San Francisco Bay and Moss Landing, located to the south of Monterey Bay. From these generating plants, electric power is transmitted by high-voltage transmission lines to the major population centers.

There are presently three types of major transmission lines: 60, 110, and 220 kilovolts. These lines conduct power in ratio to their size. Thus, a 60-kilovolt line can conduct approximately 30 megawatts of power; a 110-kilovolt line can conduct approximately 80 megawatts of power, and the large 220-kilovolt line can conduct up to 300 megawatts of power. It will be noted that the power capacity increases by about the square of the line (or conductor).

The height of the towers also increases with the size of the conductors; the average height of the present skyline 220-kilovolt line, for instance, is in the neighborhood of 135 feet, with some towers as high as 160 feet.

The 220-kilovolt lines require towers. The 110-kilovolt lines, however, have been successfully installed in wooden poles over city streets, and 60-kilovolt lines can be placed on ordinary wooden telephone poles. For example, along the Alameda de las Pulgas at its intersection with Alpine and Sand Hill Roads, you will note a line of wooden poles carrying three 60-kilovolt conductors. In providing the initial power supply for the linear accelerator, a few months ago, P.G. & E. installed ordinary wooden poles out along Alpine Road and then crossing over to the accelerator site. These lines carry a 60-kilovolt circuit.

2. The peninsula power requirement

For its own planning purposes, P.G. & E. designates the cities along the bay from San Bruno to and including Los Altos as the peninsula service area. A part of this area is called the skyline and coastal service area and extends over to Half Moon Bay and the cities along the west side of the peninsula.

In 1960, the peak power requirements for the entire peninsula, including the skyline and coastal area, was less than 300 megawatts. The power demand, however, has been increasing at the rate of 10 percent per year, and a peak demand of some 369 megawatts is expected during this next winter of 1963–64. By 1980, it is estimated by the advisory committee to the Federal Power Commission's National Power Survey that the peak demand could be as high as 1,600 megawatts.

To serve this increasing demand, P.G. & E. now has under construction two new 220-kilovolt bundled transmission lines, each potentially capable of delivering 1,800 megawatts. These lines are in addition to the powerlines along the Bayshore highway which have traditionally served the peninsula area. There are at least three such lines, of either 60- or 110-kilovolt construction, and they connect with the four substations which serve the peninsula, Martin (near Brisbane), San Mateo, Bair (near Redwood City) and Cooley Landing (Menlo Park).

From these four substations, the high voltages are stepped down by transformers, and the power is then distributed on pole lines throughout the peninsula cities, and countryside.

Since the turn of the century, all high-voltage transmission lines have brought power to the peninsula from the north, south or east. Until recently, the high-voltage lines all terminated along the bay shore. The area traversed by these lines has been zoned for commercial or industrial in large part, and peninsula residents became accustomed to the existence of power transmission lines as well as industrial plants in these areas.

The first intrusion into the foothills came with the building of a 110-kilovolt line down to the Jefferson Substation site several years ago. Also, in 1952, P.G. & E. obtained a permit for a "loop line" up to Jefferson from its Monta Vista substation near Cupertino.

The construction of these lines represents the first such invasion of the scenic and recreational areas of the skyline and its foothills.

II. THE PROBLEM OF UNDERGROUND TRANSMISSION

1. Background

The expansion of high voltage transmission lines into previously unspoiled scenic areas poses a very simple problem. In rural areas, the utility companies cannot afford to put the lines underground. In cities and built-up suburban areas, the utilities cannot afford not to put the lines underground. The high cost of acquiring necessary rights-of-way makes undergrounding a necessity in built-up areas. The question arises, "What of the suburban area in between, the semirural city which has incorporated for the very purpose of preserving itself as a residential area free from industries, traffic, and powerlines?"

This problem is not unique to Woodside. It can be expected to arise in every similarly situated area where a utility company seeks to install high voltage tower transmission lines. Woodside is merely the first battleground for this overall problem.

And this is no ordinary line. A 220-kilovolt line is the largest line thus far constructed in California, and to our knowledge no such line has hitherto been proposed for an area in northern California even remotely similar to Woodside.

The chief transmission engineer for Southern California Edison Co. (P.G. & E.'s counterpart in southern California), Mr. R. C. Blankenburg, has stated in a report submitted to the Woodside Citizens' Committee:

"In time to come we will look back upon 1963 as about the time we recognized that the value of underground lines rather than overhead lines was substantially more than the cost difference. Currently the city of Los Angeles is building several miles of 220-kilovolt underground lines. Their original plans had been to build a major portion on towers placed along a rather wide flood control channel. Protests of the residents in the adjacent areas caused them to change their plans."

The problem then resolves itself down to this: Where is the line to be drawn in requiring underground lines?

There is ample precedent for drawing the line in the present case involving the city of Woodside.

2. The experience in England

For several years, England has wrestled with the problem of overhead transmission lines traversing the English countryside in increasing size and number. A 1957 English statute specifically required the public utilities to have regard to the amenities (or esthetics) of local areas in establishing their lines.

On a number of occasions, English public utility companies have rerouted their lines in the face of public criticism. It is pertinent here to quote excerpts from three such cases reported in the English press:

"In March 1961, the East Midlands Electricity Board agreed to put underground the disfiguring overhead electricity wires in the Northants village of Cranford and bear the cost itself. Several other picturesque villages to receive similar attention. Results of efforts by Northants County Council and the East Midlands Consultative Council." London Times, March 13, 1961.

"In July of 1961 the Northwestern Electricity Board reversed its decision to run lines overhead in Upper Barrowdale without waiting for the public inquiry because it was impressed by the anxiety aroused by its proposal and especially by the offer of the friends of the lake district to contribute to the cost.

The board would put all cables in Upper Barrowdale underground." The London Times, July 31, 1961.

In September 1962, this excerpt appears from the London Daily Telegraph of September 21.

"Electricity will be switched on for the first time at Widecome in the Moor, Uncle Tom Cobley's Village at Dartmoor next Thursday. Church bells will be rung and there will be dancing on the green. In the parish hall an oil lamp will be ceremoniously doused by Mr. A. N. Irans, chairman of the Southwestern Electricity Board. The parish council has written to thank the board for bringing in the powerlines without spoiling the village."

3. The Virginia Power Co. case

Closer to home, and as recently as June of this year, 2 months ago, the Virginia Electric Power Co. reversed an earlier decision to route a major powerline through the rural fox hunting country of northern Virginia. In withdrawing its application for the route originally proposed, the attorney for the Virginia Electric Power Co. is quoted as follows in the Washington Post of June 25, 1963:

"Vepco Attorney George W. Gibson told the Commission that the company proposes a more northerly route around the hunt country in view of the 'resolute opposition of responsible citizens to the routing first proposed.' The new route selected by the company was 35.6 miles longer than the one previously proposed."

III. THE ATTITUDE OF PACIFIC GAS & ELECTRIC CO. IN PRESENTING THIS APPLICATION

P.G. & E.'s use permit application contains this express reservation:

"The application is made without recognition of jurisdiction, and all rights of the applicant to contest the authority and jurisdiction of the City Council of the City of Woodside or the planning commission of said city to require applicant to obtain a use permit for the above described use are reserved, and this application is not an admission of nor does it concede, such authority or jurisdiction."

In contrast to that sort of reservation is the sworn testimony of a P.G. & E. employee at the recent Public Utilities Commission hearing when a number of skyline residents objected to the 20-mile Monta Vista-Jefferson 220-kilovolt line. On April 25, 1963, approximately 4 months ago, Mr. Stanley P. Barton, the manager of its land department (and the person who signed the verified application to this planning commission) testified as follows (Mr. Barton was being questioned about the location of the route from the skyline down to the linear accelerator, since the company had not yet determined that route):

Question: "Can you state the factors that will govern the selection of this route?"

Answer: "It will be consideration of a number of items, including the impediments or obstacles between the beginning point and the entry to the university grounds, Stanford grounds. It would be governed by the needs of the area, and by those needs I mean the needs as determined by the local bodies, the planning commissioners, and planning agencies.

"It will be determined to some extent, certainly, by cost. And, certainly, so far as can be determined and considered, the needs and desires of the residents of the area."

When P.G. & E. was seeking the vote of the citizens of Palo Alto in favor of putting the lines overhead in Palo Alto rather than underground, they published a full page advertisement with three-quarter inch headlines as follows:

"Twelve years of planning and cooperation with all local public agencies involved have preceded construction of P.G. & E.'s foothill transmission line to serve the midpeninsula."

That ad goes on to state:

"Several considerations re involved in the location of any transmission line. As a public utility regulated by the California Public Utilities Commission, P.G. & E. is required to provide adequate and dependable service at the lowest reasonable cost to consumers. *The esthetic problems of visibility also must be taken into consideration.*" [Emphasis added.]

And further:

"Following the recommendations of the public planning experts, P.G. & E. has spent 10 years securing rights-of-way for a 20-mile line originating in Santa Clara County and terminating near Redwood City in San Mateo County. All local

governmental jurisdictions involved have studied the location of the line and given their approval."

With these confident assurances to the State public utilities commission and to the public at large, we can expect that whatever may be the decision of this planning commission and city council, that P.G. & E. will adhere to the same. It is true that the P.G. & E. attorneys have in the past suggested the possibility that they are not bound to follow the action of the planning commission, and that as a State licensed and regulated utility they have the right to place the lines where they wish. Back in the early 1950's, it was not until they were actually apprehended doing the initial work on the Monta Vista-Jefferson line that they came before the San Mateo County Planning Commission to request a use permit. Of interest here is the following excerpt from the San Mateo County Planning Commission minutes of March 17, 1950.

"A large delegation of people from the Woodside area were present protesting the proposal of Pacific Gas & Electric to cross their lands with high-voltage lines on steel towers. Among those present were the following: George H. Hotaling, Woodside; Don Edwards, 1595 Canada Road, Woodside; Sam Eastman, Whiskey Hill Road, Woodside; Arthur Law, Woodside; Richard Elkus, Woodside; W. H. Lowe, Woodside; L. M. Cipollina, Woodside; E. S. Erwin, Stanford University; Alf Brandin, Stanford University; D. L. Holdan, Woodside; Mrs. D. L. Holden, Woodside; Creed Haberlin; L. J. Steinhardt, Post Office Box 853, Route 1, Woodside; G. M. Harwood, 1028 Canada Road, Woodside; C. B. Rogers, 1026 Canada Road, Woodside: Charles Johnson, 1030 Canada Road, Woodside; Murray Foster, Canada Road, Woodside; Jane Swinerton Mills, Woodside; Mr. Rohan, Woodside."

"Adviser Campbell reviewed some of the proceedings so far. He said it was quite by accident that the staff learned that there was a movement to locate a high-voltage power transmission line through the Portola-Woodside area and extending into Santa Clara County. No use permit had been applied for in either county. Santa Clara County held a hearing and demanded that they apply for a use permit; that the Pacific Gas & Electric attorneys said they do not have to do that; that they had the right to locate the power lines; Santa Clara challenged this position. It then became apparent that they were coming through this county to Millbrae.

Nevertheless, in its recent decision on the Monta Vista-Jefferson line, the State public utilities commission handed down some very significant language. While approving the P.G. & E. position in that case, the commission, speaking unanimously, said as follows: "The commission should only interpose its jurisdiction in adjudging public convenience and necessity, in matters relating solely to esthetics where the proposed action of a utility is of the type which would shock the conscience of the community as a whole."

If this planning commission and the city council should consider the proposal as one "shocking the conscience of the community as a whole" presumably its decision, if contested by P.G. & E., would be backed up by the State public utilities commission under the reasoning stated above. The commission's decision also expressed the principle: "The evergrowing and oft expressed desire of more and more Californians for green space conservation should be acknowledged by California public utilities in their planning."

Thus, it is reasonable to expect that P.G. & E. will respect and adhere to any decision by the town of Woodside rather than invoke its once-claimed supremacy rights as a State-franchised utility.

IV. THE NEEDS OF THE STANFORD LINEAR ACCELERATOR

1. The purpose of the proposed 220-kilowatt line

The sole purpose of the proposed 220-kilovolt line is to serve the Stanford Linear Accelerator Center (SLAC). Inasmuch as the Atomic Energy Commission has entered the route controversy with a request for approval of one of P.G. & E.'s two proposed routes, it is appropriate to review the history of the accelerator and its power needs.

Particularly is this pertinent in view of the great variance in cost between the various types of underground cables which can be used. Using the figures collected by the engineering committee of the citizens group, the cost per mile variances are extreme.

	Cost per mile
P.G. & E. type No. 2	$822, 000
P.G. & E. type No. 3	589, 000
P.G. & E. type No. 4	660, 000
Los Angeles Department of Water and Power	466, 000
Siegfried estimate	393, 000
National average for 230-kilowatt underground (from "National Power Survey" of Federal Power Commission, May 1963)	359, 000

The three P.G. & E. proposals average a cost of $690,000 per mile, which is nearly twice the cost of an average 230-kilovolt line according to the "National Power Survey" (a copy of which is appended as exhibit B to this memorandum), and more than 2½ times as costly as one type of 250-kilowatt underground cable mentioned in the survey (see p. 5, exhibit B).

From exhibit B it will be noted that the installation costs of 110-kilovolt underground cables are somewhat less than 220 kilovolts. (See p. 4, exhibit B for 138-kilovolt comparison).

2. History of the linear accelerator project

The accelerator project was authorized by Congress in the fall of 1961, with an appropriation of $114 million approved for initial construction. The design and construction stage was estimated to require 6 years.

Stanford physicists commenced to study the feasibility of a 2-mile linear accelerator in 1954. A proposal was made for Federal funds in 1957, and the project was given tentative approval by the National Science Foundation, and the Atomic Energy Commission presented the proposal to Congress, with initial hearings before subcommittees of the Joint Committee on Atomic Energy on July 14 and 15, 1959.

At these hearings, and in the Atomic Energy Commission staff report prepared in 1961, it is significant that no mention whatsoever appears on a 220-kilovolt line. Indeed, Stanford represented to Congress that a single 110-kilovolt line would supply power to the accelerator, with a second 110-kilovolt line to be installed in the future if the need arose.

The following excerpts are taken from the hearing reports of the 1959 hearings and staff report prepared in 1961;

From the hearing reports, 1959, at page 480, under the title "Electrical description:"

"The system is described as follows: Main power supply is from a single 110-kilovolt line from the P.G. & E. Monta Vista Substation."

From the staff report, 1961, at page v:

"For the past 2 years the Subcommittee on Legislation of the Joint Committee on Atomic Energy has reviewed proposals to construct a high energy physics research facility * * * the materials presented in this volume are intended to provide a background for the Joint Committee's use in considering the authorization requested for the proposed Stanford linear accelerator project for fiscal year 1962."

At page 12:

"Design and construction of the machine and associated facilities will require 6 years, beginning in fiscal year 1962."

At pages 315–316:

"Main power supply is from a single 110-kilovolt line from the P.G. & E. system. A single 110-kilovolt line and breakers will be added as the future load is added.

"Future klystron power supply and additional power requirements to the end station will be supplied by the second 110-kilovolt feeder and 110-kilovolt/12-kilovolt transformers at the main switchyard."

Bearing in mind that a single 110-kilovolt line is capable of carrying 80 megawatts of power, it appears that two 110-kilovolt lines (or four 60-kilovolt lines carrying 30 megawatts each) would carry well over the power requirements considered by Congress when the project was authorized.

(From P.G. & E.'s supplement to the power supply study which P.G. & E. filed with this Commission, it appears that Congress has thus far authorized only stages 1A and 1B of the accelerator, and at page 2 of the supplement it appears that the peak megawatt requirements are 100 megawatts.)

At the present stage, then, it appears that the 110-kilovolt lines originally proposed will be more than adequate to handle the accelerator's authorized activities.

While in 1972 it appears that the accelerator may require 200 to 300 megawatts, this power requirement is not yet authorized. The uncertainties of its ultimate authorization are more particularly set forth in the engineering committee's study appended as exhibit A hereto.

V. THE WEIGHT TO BE GIVEN P.G. & E.'S COST ESTIMATES

P.G. & E.'s undergrounding experience

P.G. & E. has never installed a 220-kilovolt line underground.

As early as 1951, however, P.G. & E. has installed 110 kilovolts underground, and proudly mentioned this fact in its public relations pamphlet, P.G. & E. Progress, in an article entitled "Keeping Ahead of Needs," stating that:

"A program to increase the supply of electricity in the Berkeley-Richmond region included construction of a new substation and twin 4-mile underground transmission lines to feed it from Golden Gate Substation and substation F in Berkeley. Such underground circuits are an innovation which the Pacific Gas & Electric Co. pioneered in San Francisco, by which 110 kilovolt lines can be run through cities safely and economically."

The above item was included in the record at the San Mateo Planning Commission 12 years ago, on September 19, 1951.

While we have no guide as to P.G. & E.'s comparative costs for 220-kilovolt underground lines, we do have recent authority for P.G. & E.'s comparative costs for undergrounding residential service. In this month's (August, 1963) volume of House & Home, the self-styled "Management magazine of the housing industry," the following appears:

"Arizona Public Service Co. charges about $120 a lot for underground wiring—down 80 percent from 5 years ago. Southern California Edison Co. charges about $150 a lot—roughly half as much as 5 years ago. San Francisco's Pacific Gas & Electric Co., which charged as much as $1,000 a lot 15 years ago and $600 a lot 3 years ago, now charges less than $400 a lot. And Houston Lighting & Power Co., which has just begun to offer underground service already charges less than $200 a lot."

The same article gives some indication of future trends.

"There are hopeful signs for the future. Less than 3 years ago many of the power companies queried by House & Home said they simply weren't doing underground wiring. Today most of them at least offer underground service, and those that still don't are finally giving the subject serious thought.

"The big reason for this changed attitude is the changed policy of the Bell Telephone System, which operates 81 percent of the Nation's telephones. Bell has asked its 22 operating companies to bury their cables wherever possible, and expects that by 1970 virtually all new service will be underground.

" 'This puts us in a very sensitive position,' says one electric company executive, 'With all the other utility lines out of sight, we're the only ones left messing up the landscape, and we're really beginning to feel the public pressure. It's good public relations for us to go underground as fast as we can.' "

Utility companies other than P.G. & E. have discovered considerable benefits in underground lines. The senior staff engineer for Commonwealth Edison of Chicago is quoted (at p. 129):

" 'In 30 years we've never had to replace a cable because of deterioration, and manufacturing faults in the cable are very, very rare. The few troubles we have are widely spaced in both area and time. With overhead systems, on the other hand, a disaster like a big ice storm gives us trouble in one big wallop. Another point is that we have no tree trimming around wires. That item alone costs us millions of dollars a year.' "

2. P.G. & E.'s prior statements regarding tower lines

In 1950, after being apprehended in its work, P.G. & E. applied to the San Mateo County Planning Commission for the original Monta Vista-Jefferson line.

Then, as now, the urgency of the requested use permit was strongly expressed by P.G. & E.'s representatives.

Note the following excerpts:

From the minutes of November 17, 1950:

"Mr. Fred Searls, attorney for P.G. & E., addressed the commission, saying that they wished to proceed to construct the substation applied for today as soon as possible."

From the minutes of June 15, 1951:

"Mr. Long. He said they are being hounded no end to finish this line; to complete the rights-of-way, and they are making every effort; it is really urgent; that they hope to build the wood pole line through Woodside."

From the board of supervisors' minutes of March 19, 1952:

"Mr. John A. Sproul and Mr. Douglas Aiken, representing the P.G. & E. were present and stated that their company would like to have a tentative approval of a plan today; * * *."

"Mr. Aiken stated that the application is in general terms and that if the commission could grant this permit it would enable them to go ahead and secure rights-of-way; that they would like some margin of at least 500 feet both ways. He stated that they are now pressed for time."

The use permit was granted on March 19, 1952, and regardless of the sincerity of the men who made the representations for P.G. & E., those representations have proven to be demonstrably false as predictions of fact. P.G. & E. made no move whatsoever to build the line for 10 years.

As to the beauty of the line proposed in 1950, 1951, and 1952, the following exchange occurred on September 19, 1951, involving Mr. Searls, a P.G. & E. attorney:

"Mr. Werder stated that a temporary use permit would necessitate the cutting of a swath through the park and who is going to put these trees back?"

"Mr. Searls stated that investments of several hundred thousand dollars are not put in temporary lines; and that it is not going to be necessary to cut a swath, that they would be willing to make that a condition; * * *."

One needs only to travel Skyline Drive at the present time, or to visit the Dyer property, to see that a swath was indeed cut, with every single tree, large and small, cut for a width of between 70 and 100 feet.

3. Palo Alto election promises

In the matter of representations to the public, P.G. & E.'s current proposal for Junipero Serra Freeway route should be compared with its advertisements in the recent Palo Alto election. In Palo Alto the opponents of the line suggested that the line might more appropriately be routed along the freeway. P.G. & E. caused the following advertisement to be inserted in the Palo Alto Times:

"CONSIDER THIS FACT, FREEWAY ROUTE

"Changing to a Serra route (Junipero Serra) now would take years, disrupt prime residential areas, and, if carried out, result in an eyesore. Vote for proposition B."

VI. THE COMPARATIVE COSTS OF OVERHEAD AND UNDERGROUND PROPOSALS BEFORE THIS COMMISSION

From the summary of the citizens' committee's engineering findings previously filed with the commission and referred to earlier in this memorandum, it has been noted that two alternative underground routes are proposed by the citizens' committee. One of these routes, from Ravenswood substation, would require 3.42 miles of underground cable. A second underground alternative, from Jefferson substation, would require 3.54 miles of underground cable.

P.G. & E. is apparently estimating the cost of overhead lines construction at $100,000 per mile, and the appraisal report of David Ingram, M.A.I., appraiser, appended as exhibit C hereto, indicates that right-of-way acquisition costs for the freeway route will be no less than $650,000. Thus, the acquisition costs add an additional $130,000 per mile in costs for the overhead route, for a total of $230,000 per mile.

Comparing this figure with the various underground estimates submitted by P.G. & E., as well as with the costs provided from other sources and tabulated at page 10 of this memorandum, it appears that the differences for the 3 miles of underground cable will be a minimum of $450,000 and of maximum of $1,150,000, using P.G. & E.'s lowest estimate.

In other words, 3.5 miles of underground cable will possibly cost only $450,000 more, depending on which type of cable is selected by the Atomic Energy Commission for its investment.

Quoting again from the staff reports of the Atomic Energy Commission which were submited to Congress in 1961, it appears that the annual power provided for the linear accelerator was estimated to be as high as $1,500,000 per year.

We know that included in such budget was provision that P.G. & E. pay 15 percent per year for the capital construction of the line which was to service the accelerator. Thus, the $450,000 would be paid over a period of 6 years. It can scarcely be conceived that a research facility of this type cannot afford the additional $75,000 per year for 6 years.

It is appreciated that this commission has no control over what Stanford may choose to do with its property. We know that until 1961 it was Stanford's policy to require that all transmission lines be placed underground. In October 1961 the Stanford Board of Trustees apparently reversed themselves to make an exception in the case of this particular powerline. We can only hope that the appraisal report of Mr. Ingram appended hereto will give the board some concept that overhead powerlines are destructive to landowners in terms of dollars and cents as well as esthetics. It would seem reasonable to expect that if this commission requires the line to go underground, Stanford may do likewise, thus preserving the esthetic beauties of the Sand Hill Road areas which are important to us all.

The technical information supporting this memorandum has been culled from a number of sources but primarily the records of the San Mateo Planning Commission and Board of Supervisors, the U.S. Government Printing Office records of the hearings before Congress and the various professional magazine articles which have been quoted.

Four exhibits are appended:

Exhibit A is the discussion by the citizens committee's engineering group.

Exhibit B is the advisory committee's report No. 10 of the Federal Power Commission's national power survey.

Exhibit C is the preliminary appraisal report of David Ingram, M.A.I., dated August 22, 1963.

Exhibit D is summary of the opinion of Sol E. Schultz, formerly with the Bonneville Power Administration and presently a transmission line consultant with the firm of H. L. Zinder & Associates, Seattle.

Reference should also be made to the summary of SOS Engineering Committee recommendations which is filed concurrently with this memorandum.

Respectfully submitted,

PAUL N. MCCLOSKEY, Jr.

AUGUST 22, 1963.

Exhibit A

DISCUSSION OF UNDERGROUND POWER SUPPLY TO SLAC AT REASONABLE COST

(By SOS Engineering Committee)

INTRODUCTION

Underground transmission lines are now being installed in growing numbers all over the world. Although esthetics are often a factor in the decision to go underground, the most compelling reason is usually economic. Surprisingly, undergrounding of the tapline being considered here could have been justified except for two unusual circumstances. First, the cost of the Monta Vista-Jefferson line, built primarily to supply this load, is not included in the cost of the tower line approach. Second, Stanford and the Stanford Linear Accelerator Center (SLAC) have given, without cost, a right-of-way over their property which in other circumstances P.G. & E. would have had to pay for. If these costs were added to realistic estimates of the construction, right-of-way, and severance damage costs of the proposed tapline, the total would probably be large enough to construct an adequate underground line from the soon-to-be-existing Ravenswood substation.

In view of the discussion above, we feel that SLAC and P.G. & E. should make every effort to find a way of supplying power to the accelerator which, while perhaps not ideal for SLAC, will still allow it to operate, fulfill the con-

tractual obligations of P.G. & E to SLAC, and avoid a permanent scar on the hills of Woodside. This report is an effort to point the way toward such a solution.

SLAC–P.G. & E. contract

This contract was entered into on January 10, 1963, and defines the way in which P.G. & E. shall deliver power to SLAC, both that generated by P.G. & E. and that generated by the U.S. Bureau of Reclamation, and how the billing for that power shall be determined. The following aspects of this contract are of particular interest to us.

1. There are two classes of service which P.G. & E. is to supply: Firm service up to some level set by SLAC and interruptible service covering demands greater than that level. Firm service is to be continually available, barring "uncontrollable forces" [1] but interruptible service is available only when and if, in the judgment of P.G. & E., there exists sufficient margin of various kinds, including transmission margin, on P.G. & E.'s whole system.[2]

We believe that the unforeseen breakdown of one of two cables supplying SLAC could be listed under uncontrollable forces and thus be an excuse for curtailing the firm service. Even if this is not acceptable, however, such a breakdown should certainly be sufficient reason for curtailing the interruptible service. Thus at most, the cables need only be large enough so that the firm service required by SLAC can be supplied when one cable is out of operation, and need not be large enough to supply both the firm and interruptible service combined with one cable out as has been assumed by P.G. & E.

2. SLAC has, under the contract, the power to set the level of firm service wherever it wishes.[3] It is unlikely to set it very much higher than the level which it will continuously use however, because if it does, the cost of the power goes up rapidly.[4] Representatives of SLAC have told us that the power level which will be needed continuously to keep the accelerator running is 25 to 50 megawatts with the latter figure representing the level when stage II is authorized. The remaining power will be needed only about 10 percent of the time and is therefore unlikely to be included in the "firm power" category.[5] It thus appears that the firm power level set by SLAC is unlikely to be higher than half of the peak power level at any time during the growth of the load.

3. P.G. & E. is required by the contract to build and maintain the powerline to SLAC.[6] It is released from this obligation if it is unable to secure all necessary easements, rights-of-way, etc., for an overhead line. In such a case, the parties to the contract shall agree on such course of action as shall be mutually acceptable and shall modify any terms of the contract affected thereby.[7] The initial power-carrying capacity of the tapline is not directly specified in the contract except that P.G. & E. is not obligated to supply more than 300 megawatts from its 220-kilovolt line.[8] Whatever the initial capacity of the line, P.G. & E. is required to provide additional capacity when it is required by SLAC, provided advance notice sufficient for obtaining rights-of-way and for construction is given.

4. The contract specifically gives a right-of-way, with [9] a building restriction on a strip 100 feet wide, over the land which has been set aside for the accelerator. This right-of-way is given at no cost to P.G. & E.[10] There is no mention of similar rights-of-way over Stanford lands not included in SLAC.

5. P.G. & E. states that the cost of ownership of the 220-kilovolt tapline is $10,750 per month or $129,000 per year.[11] They have estimated construction cost as $527,000 and right-of-way cost as $131,000 for a total of $668,000. They, therefore, appear to estimate that the cost of ownership is 19 percent of the original cost per year or else that the original cost is higher than $668,000.

To sum up

P.G. & E. is not required to build two powerlines, each capable of handling the ultimate maximum SLAC load.

SLAC is required to pay for firm service if it wants it.

P.G. & E. is being given its right-of-way over SLAC lands for nothing.

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[1] P. C–2–3, p. C–13, and p. C–17.
[2] P. C–3 and p. C–13.
[3] P. C–6.
[4] In a calculated example, from $150,000 to $200,000.
[5] Meeting at Crosby's, July 21, 1963.
[6] P. E–9.
[7] P. C–15.
[8] P. E–2.
[9] P. E–10.
[10] P. C–15, 16, and 17.
[11] P. E–6.

The cost of ownership of excess capacity is such that if it is built, but not needed for 5 years, its cost at the end of this time is at least double what it would have been if its construction had been delayed until it was needed.

SLAC operation and problem

The 2-mile-long linear accelerator is a machine which is expected to work satisfactorily and to provide a tool of great value in studies of the basic nature of matter. It has been preceded by two smaller, similar machines which provide a basis for these hopeful predictions. The table of power requirements at various dates is based on several assumptions, among these:

1. The machine can be made to work satisfactorily.
2. The machine will not be superseded in the near future by other machines.
3. Congress will authorize funds for the addition of more klystrons to raise the power of the machine.

None of these assumptions are certainties. It is possible that the machine will be much more successful than anticipated and that the auxiliary equipment, which is what raises the power requirements,[12] will be added at a rate faster than the table reflects. It is also possible that the rate of growth will be much slower than that predicted and may, in fact, never reach the level of 300 megawatts at all.

Suggested course of action

In view of the above uncertainties, a sensible course of action would seem to be to build an initial double circuit, underground powerline with enough capacity to carry the estimated load for the first 5 to 10 years. For much of this period, the capacity would be double the expected peakload so that the desired continuity of operation would be assured. For the rest of the period, the firm power could be assured but the interruptible power might have to be shut off, if a cable failed. At the end of this period, the following information, which does not now exist, would be available to help in planning for the future:

1. The success of the accelerator as a machine.
2. The success of underground transmission lines installed by P.G. & E.
3. The probable future growth of SLAC based on past operating experience.
4. The importance of having double capacity in the powerline.

If SLAC appears to be a success at this time, an effort will probably be made to increase its power by installing more klystrons. This will require congressional action, and it would seem appropriate at this time to also request additional funds either to build the necessary additional power circuits or to pay higher electric charges which will repay P.G. & E. for building them.

If SLAC is not a success at this time, or is being superseded by other machines, it is quite possible that the initial powerline installation will be all that is required.

SOS cost estimates

Based on the reasoning outlined above, our committee has attempted to investigate the costs of reasonable alternatives to the proposed overhead tapline. In order to avoid as many mistakes of a technical nature as possible, we have employed consultants[13] knowledgeable in the field to advise us. Some of the pertinent findings of these gentlemen follow:

1. The substation termination costs shown in the P.G. & E.'s "A Study of Power Supply to SLAC Utilizing Underground Cables" are not required for the underground system unless they are also required for the overhead tapline. Thus a charge of about $210,000 per circuit can be eliminated.

2. The tapline can easily be built with some of its length on towers and some underground. Some problems may arise if the number of circuits used in the two sections is different, but at worst, this will only reduce the capacity during the short period after the occurence of a fault in a circuit required to dispatch a man to perform manual switching.

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[12] Meeting at Crosby's, July 21, 1963.

[13] Mr. Victor Sigfried, consulting engineer, 2442 Park Boulevard, Palo Alto, Calif., and Mr. R. C. Blankenburg, supervisor of underground, Southern California Edison Co., member of the California & National Society of Professional Engineers and a national director of the society from California, member of IEEE and a long-time member of its insulated conductors committee.

3. If lower capacity circuits are to be constructed with additional capacity added as the load grows, 110-kilovolt lines should be considered. Power at this voltage is available at many locations throughout the bay area so that a supply almost as stable as the 220-kilovolt supply should be achievable. P.G. & E. has had a great deal of experience with cables of this voltage so that very accurate estimates of costs could be made. Four circuits might ultimately be required to supply 300 megawatts with one circuit inoperative but an initial installation of two circuits seems quite reasonable. The cost of these two circuits will probably be somewhat less than half of P.G. & E.'s case 2.

4. In addition to the major exceptions to P.G. & E.'s estimates noted above, there is a general feeling that the estimates are somewhat on the high side. P.G. & E. has not installed a line of this voltage underground before, and so has probably made fairly generous allowances for contingencies.

The "Summary of SOS Engineering Committee Recommendations," which was submitted earlier, is one attempt to arrive at realistic cost estimates based on various original estimates by P.G. & E. and others. It should be pointed out that all of the systems considered there have total capaciy well over that required to carry SLAC past 1972 and are therefore larger and more expensive than necessary. The main purpose of this summary was to show that reasonably priced alternatives to the overhead line do exist.

It is our earnest hope that if the applications for the overhead lines are refused, P.G. & E. and SLAC will agree on a mutually acceptable course of action along the lines of those suggested above. Such a course will not only insure the continued friendship of their customers and neighbors, but will also avoid, for P.G. & E. the quite possible and quite dubious honor of building the last tower line ever built in America through this sort of area.

Exhibit B

FEDERAL POWER COMMISSION
NATIONAL POWER SURVEY

ADVISORY COMMITTEE REPORT NO. 10
on
ESTIMATED INSTALLED COST FOR EHV TRANSMISSION FACILITIES

Prepared by
a Subcommittee * of the
Transmission and Interconnection Special Technical Committee

May 1963

* Subcommittee Members:
Chairman: James A. Rawls, Virginia Electric & Power Company
John B. Robuck, Texas Power & Light Company
Harry R. Wall, Consumers Power Company

ESTIMATED INSTALLED COST FOR EHV TRANSMISSION FACILITIES

The following pages give information on average estimated costs of EHV line and substation facilities. These data are based upon information obtained from electric utilities and manufacturers. Much of the information from utilities was based upon actual costs and necessary adjustments have been made to bring these costs to 1962 price levels. Land costs and labor rates vary widely over the country and even for any given section, and appropriate adjustments must be made in applying the average figures to the particular problem.

These costs are typical costs for the purpose of making comparisons in this study and should not be construed as standards for design or application to any particular problem or area.

The detail clarifying criteria are shown on each sheet or each group of related sheets.

These cost data are summarized as follows:

EHV overhead AC and DC lines with explanatory notes

EHV underground AC and DC cables with explanatory notes

EHV AC substation facilities with explanatory notes - Supporting data and graphs 1 through 7

EHV DC terminal equipment with explanatory notes

EHV corrective equipment with explanatory notes - Supporting data and graphs 8 through 11

Substation site development costs

Electrical workers' labor rates for various areas in the United States for reference

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
ESTIMATED COSTS OF EHV OVERHEAD LINES
A.C.

Kv	Structure	No. Circuit	Conductors MCM-ACSR**	Costs Per Mile R/W & * Clearing	Labor & Material	Total# Cost
230	Wood	1	1-954	$ 10,000	$ 35,000	$ 45,000
230	Steel	1	1-954	10,000	45,000	55,000
230	Steel	1	1-1431	10,000	50,000	60,000
230	Steel	2	1-954	10,000	60,000	70,000
345	Wood	1	1-1414	12,000	48,000	60,000
345	Steel	1	1-1414	12,000	55,000	67,000
345	Steel	1	2-795	12,000	60,000	72,000
##345	Steel	1	2-954	12,000	65,000	77,000
345	Steel	2	1-1414	12,000	80,000	92,000
345	Steel	2	2-795	12,000	86,000	98,000
345	Steel	2	2-954	12,000	93,000	105,000
##500	Steel	1	2-1780	14,000	85,000	99,000
##700	Steel	1	4-954	18,000	125,000	143,000
700	Steel	1	4-1272	18,000	142,000	160,000

(See explanatory notes on Page 3.)

11-16-62

ESTIMATED COSTS OF EHV OVERHEAD LINES
D.C.

Kv	Structure	No. Circuit Bipolar	MW Capability***	Conductors MCM-ACSR****	Costs Per Mile R/W & * Clearing	Labor & Material	Total# Cost
## ± 250	Steel	1	600	1-3000	$ 10,000	$ 56,000	$ 66,000
## ± 375	Steel	1	900	1-4000	12,000	68,000	80,000
## ± 500	Steel	1	1200	1-4000	14,000	78,000	92,000

Configuration and Right of Way

230 - 18' phase spacing; 125 ft. right of way.
345 - 32' phase spacing; 150 ft. right of way.
500 - 38' phase spacing; 175 ft. right of way.
700 - 45' phase spacing; 225 ft. right of way.
±250 - 125' right of way.
±375 - 150' right of way.
±500 - 175' right of way.

* Assume 60% of right of way to require clearing.
** Since capability of A.C. overhead lines varies with distance and degree of compensation, refer to "Report on Criteria for Transmission Studies".
*** The capability of D.C. overhead lines is determined by the current rating of terminal equipment and the conductor is chosen for economic sizes.
**** Assuming 10% voltage drop, the 3000 MCM ACSR conductor for ±250 kv will carry 600 mw 600 miles; the 4000 MCM ACSR conductor for ± 375 kv will carry 900 mw 1200miles; and the 4000 MCM ACSR conductor for ± 500 kv will carry 1200 mw 1600 miles.

#.All costs have been adjusted to 1962 costs based on use of "Handy-Whitman Index of Public Utility Construction Costs", Bulletin No. 75.
Preferred construction to be used in the study.

The above costs are average based on reports received from all sections of the country and any specific application should be studied in detail, adjusting them as necessary. These adjustments should consider the labor area, right of way acquisition costs and the length of line involved. These costs are typical for making comparisons in this study only.

13.5% included in cost of line for engineering and general overhead.

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
COST OF EHV UNDERGROUND CABLES
A.C.

Kv	Type of Construction	Conductor Size	Type of Cable	MVA Thermal Capability	Material Cost Per Mile	Installation Cost Per Mile	Materials and Labor Cost Per Mile	Fixed Cost of Accessories Per Circuit
138	Single Circuit	2000 MCM	Copper Pipe Type H.P.O.	246	$ 190,000	$ 137,000	$ 327,000	$ 91,000
230	Single Circuit	2000 MCM	Copper Pipe Type H.P.O.	335	201,000	158,000	359,000	124,000
345	Single Circuit	2000 MCM	Copper Pipe Type H.P.O.	455	306,000	391,000	697,000	170,000
500	Single Circuit	2000 MCM	Copper Pipe Type H.P.O.	750	502,000	554,000	1,056,000	250,000

Notes:

Fixed cost includes two three-phase cable terminations and one oil pressuring plant with accessories.

One pressuring plant adequate for 15-20 miles of pipe with small variations in elevation.

MVA capability based on normal summer - 75% daily load factor.

For two circuits in common trench - multiply cost of materials by 2 and multiply cost of installation by 1.25 - multiply MVA capability by 1.6.

The above costs are average based on reports received from all sections of the country and any specific application should be studied in detail, adjusting them as necessary. These adjustments should consider the labor area, route conditions (rock, type of soil, paving, other obstructions, traffic, etc.) and the length of cable line involved. These costs are typical for making comparisons in this study only.

13.5% included in cost of facilities for engineering and general overhead.

11-16-62

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
COST OF EHV UNDERGROUND CABLES
D.C.

Kv	Type of Construction (Bipolar)	Conductor Size	Type of Cable	MW Thermal Capability	Materials and Labor Cost Per Mile	Fixed Cost of Accessories Per Circuit
± 250	Single Circuit	1500 MCM	Copper Pipe Type H.P.O.	540	$ 264,000	$ 80,000
± 375	Single Circuit	2000 MCM	Copper Pipe Type H.P.O.	760	$ 634,000	$ 100,000

Notes:

Fixed cost includes two cable terminations per circuit and one pressuring plant with accessories.

One pressuring plant adequate for 15-20 miles of pipe with small variations in elevation.

MW capability based on normal summer - 75% daily load factor.

For two circuits in common trench - multiply cost of one circuit by 1.7 - multiply MW capability by 1.6.

The above costs are average based on limited cost data available and any specific application should be studied in detail, adjusting them as necessary. These adjustments should consider the labor area, route conditions (rock, type of soil, paving, other obstructions, traffic, etc.) and the length of cable line involved. These costs are typical for making comparisons in this study only.

13.5% included in cost of facilities for engineering and general overhead.

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
ESTIMATED INSTALLED COSTS OF EHV SUBSTATION FACILITIES

These costs are typical costs for the purpose of making comparisons in this study and should not be construed as standards for design or application to any particular problem or area.

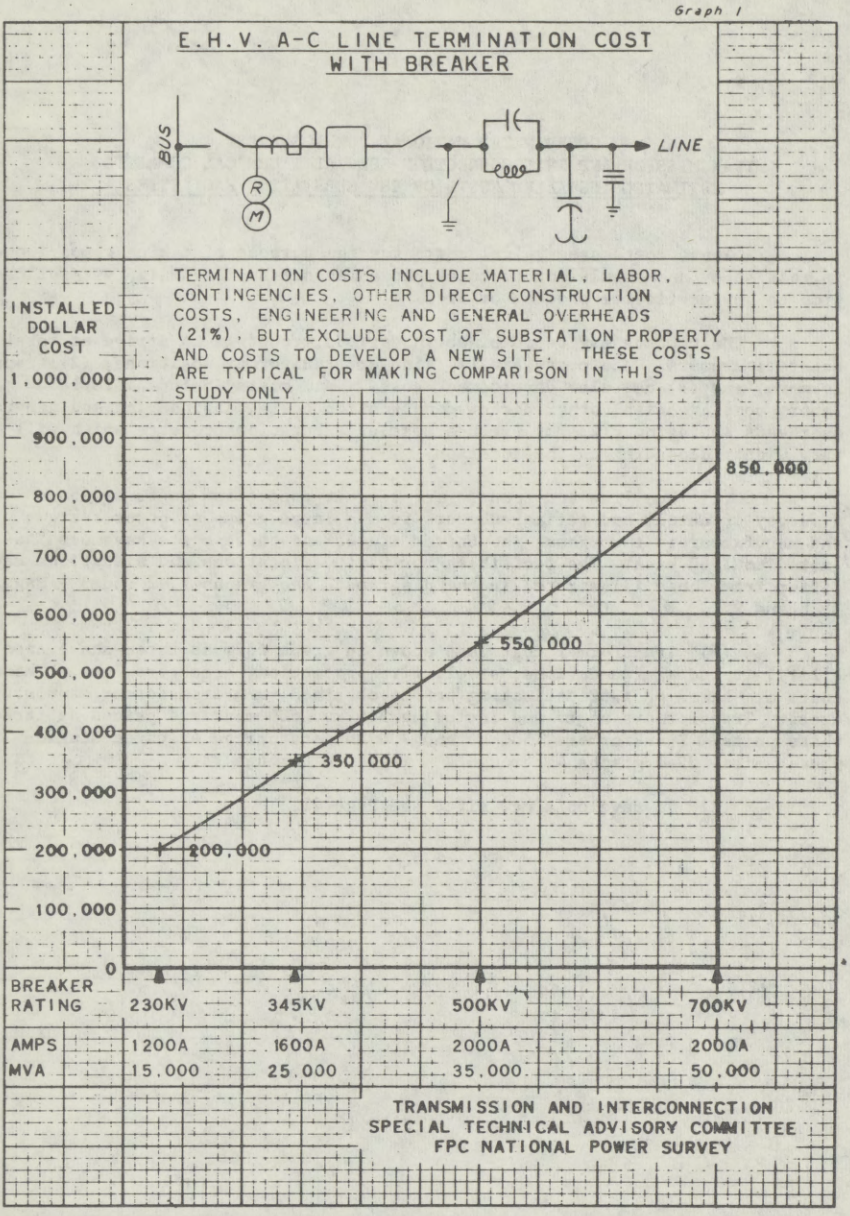
Unit costs may be combined in various groupings to arrive at total substation costs. The costs are (1) line or transformer positions, (2) transformers, and (3) new site development costs. All costs include material, labor, contingencies, other direct construction costs, engineering and general overheads averaging 21%, but exclude cost of substation property which will vary widely depending on the location.

(1) The line and transformer circuit connection costs are based on a survey of actual and estimated costs from a large group of power systems and manufacturers throughout the United States and these costs have been adjusted to 1962 base. The facilities for various locations and situations may differ from those illustrated in the diagrams. See graphs 1, 2 and 3 - Pages 7, 8 and 9.

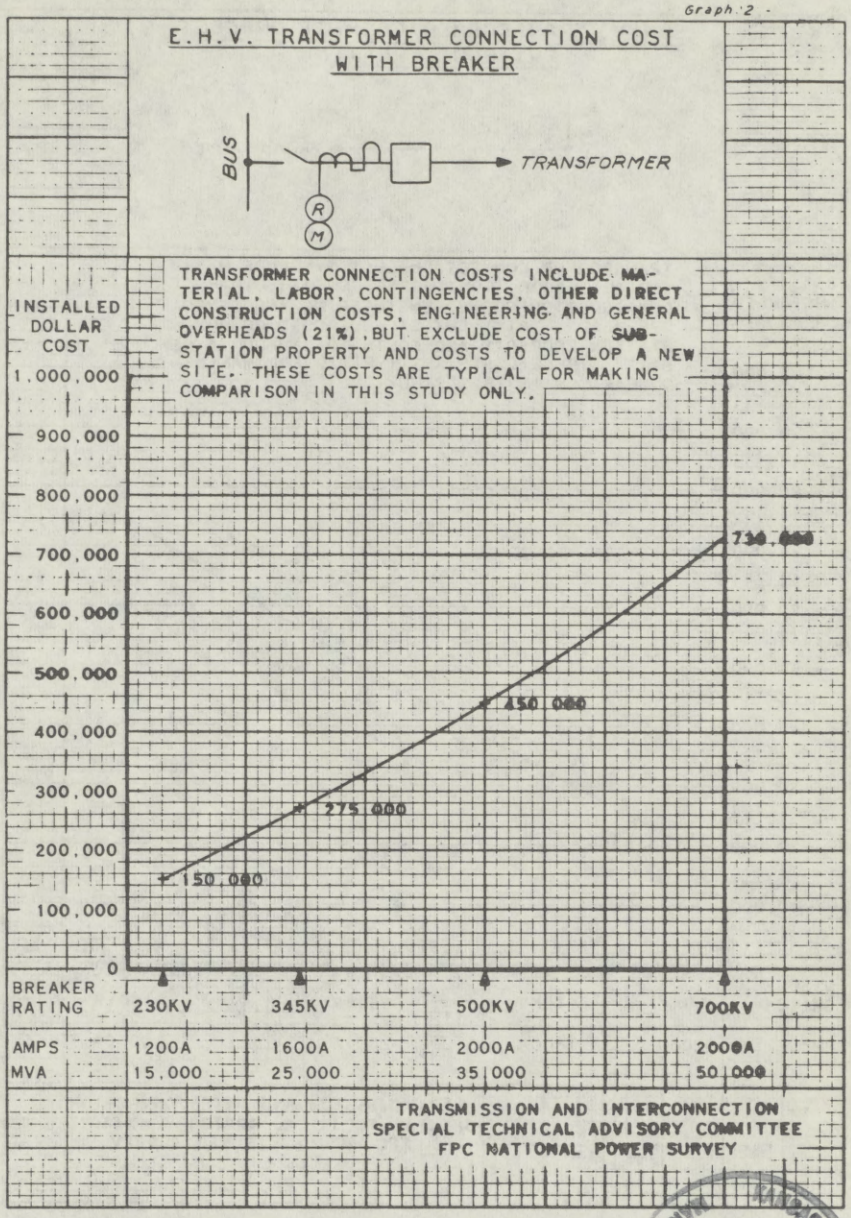
(2) Transformer costs are shown in graph form as three-phase capability, including foundations, steel, fire protection, arresters, etc. These costs are based on 1962 estimating prices obtained from transformer manufacturers. Transformers up to and including 345 kv, 600 mva, are priced as three-phase units. Transformers, 500 kv and 700 kv, are priced as three single-phase units. See graphs 4 through 7 - Pages 10 through 13.

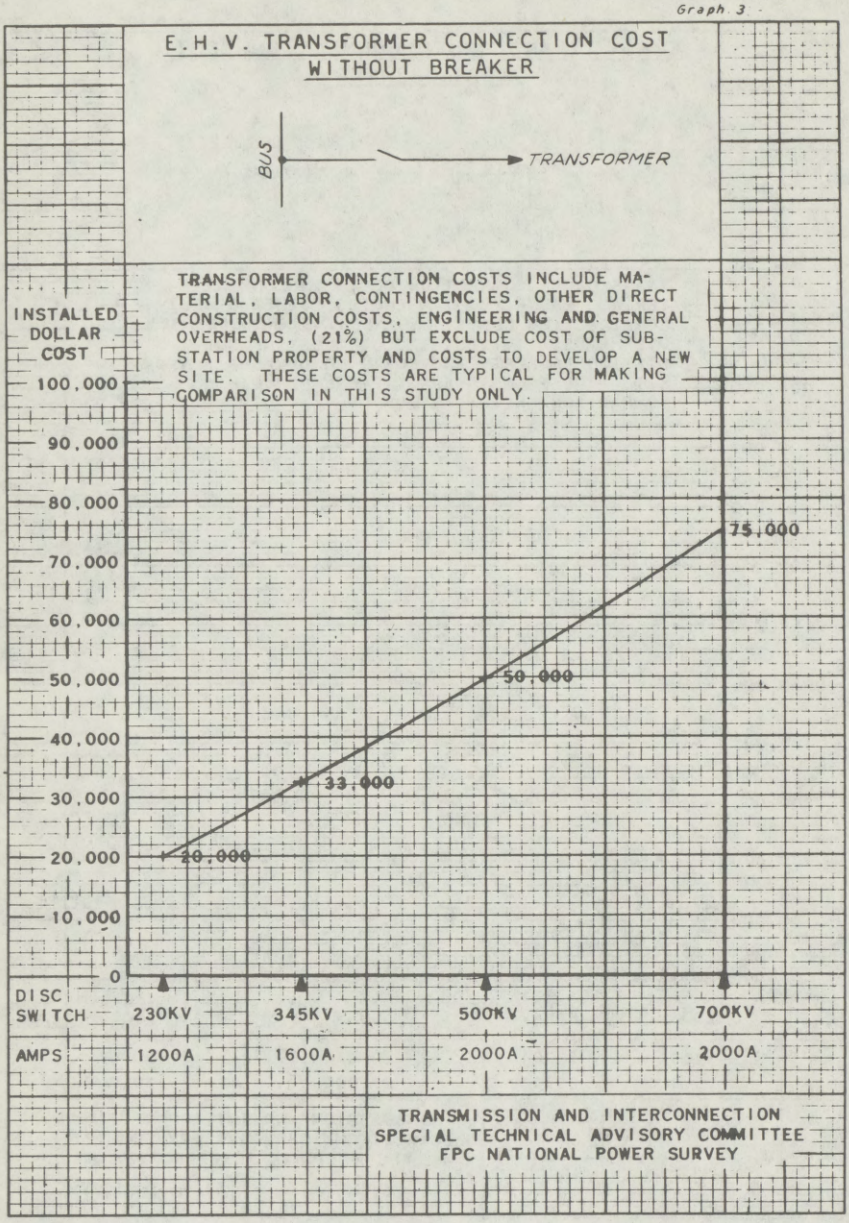
(3) To develop a new site, see Page 21.

Graph 1

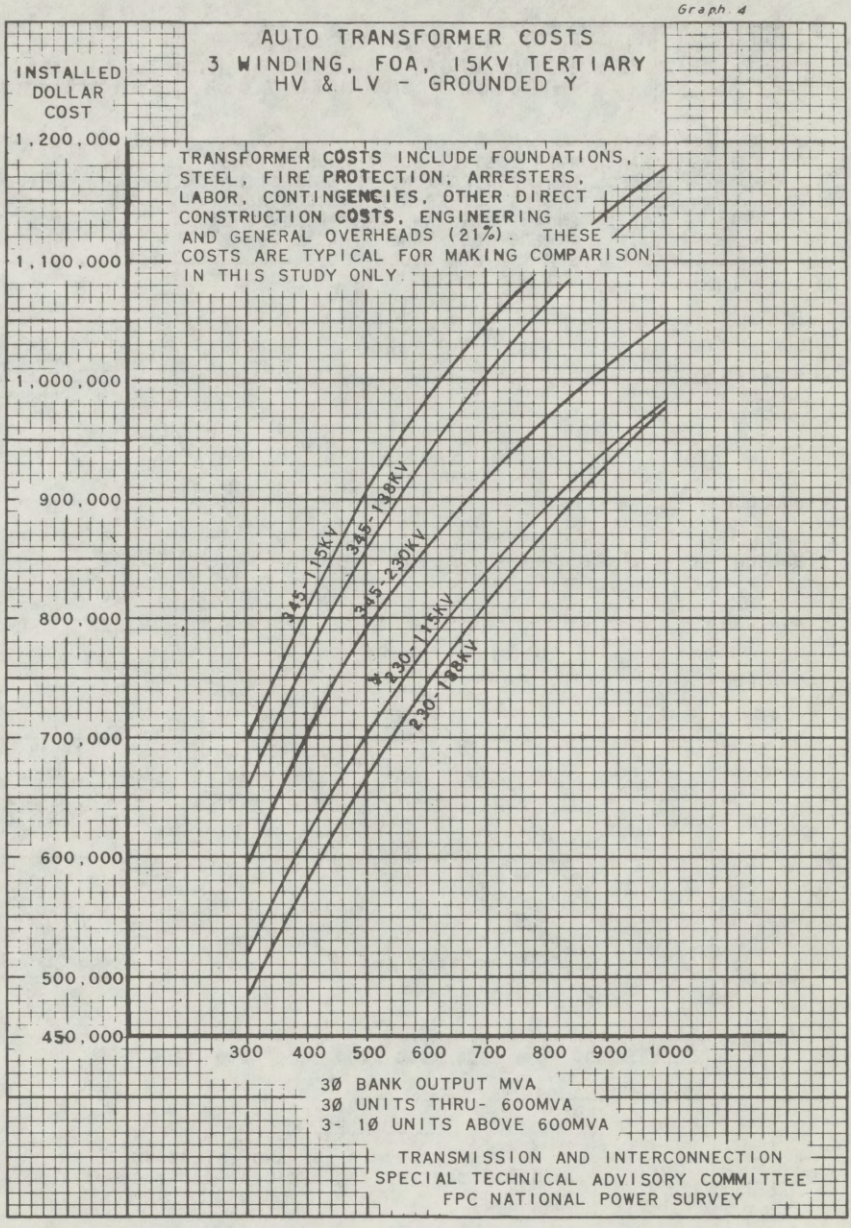

E.H.V. A-C LINE TERMINATION COST
WITH BREAKER
BUS
R
M
LINE
TERMINATION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%), BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP A NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY
INSTALLED DOLLAR COST
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
850,000
550,000
350,000
200,000
BREAKER RATING
230KV
345KV
500KV
700KV
AMPS
1200A
1600A
2000A
2000A
MVA
15,000
25,000
35,000
50,000
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

Graph 2

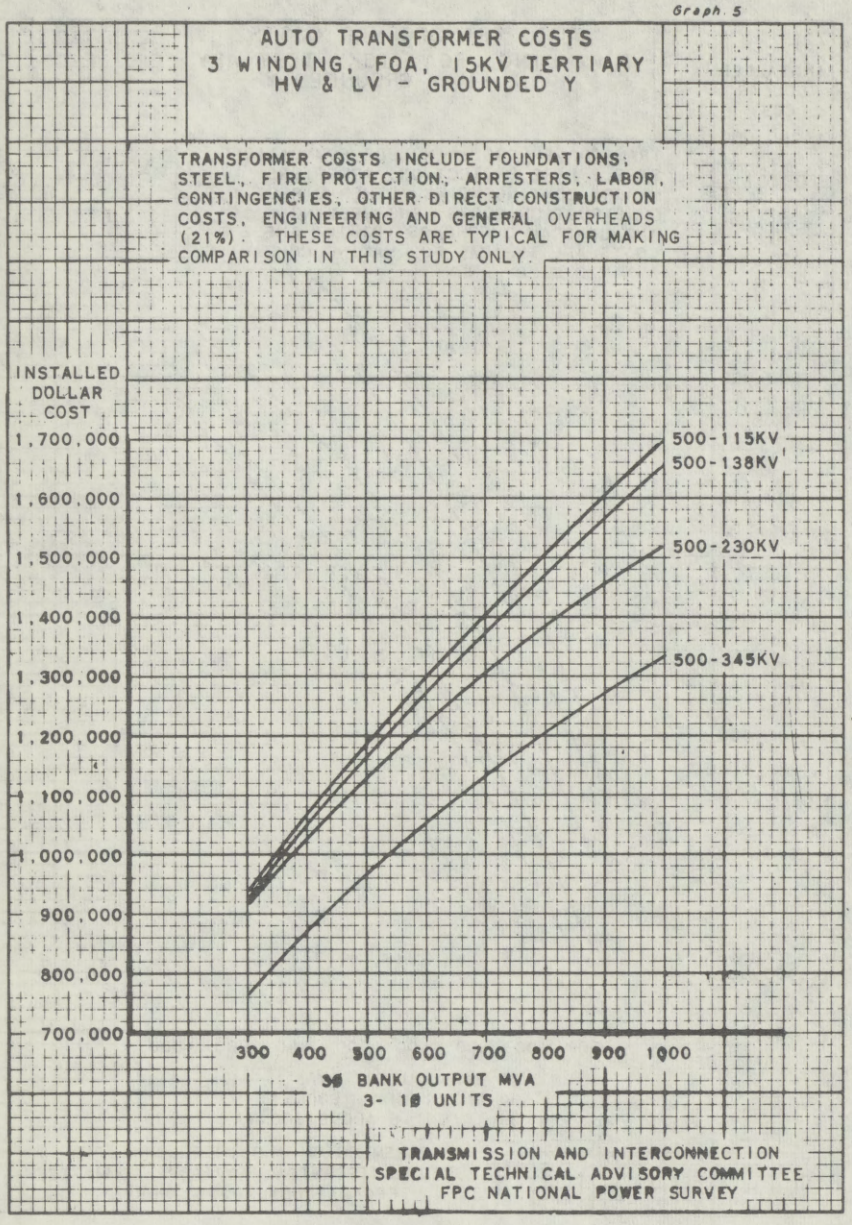



Graph 3
E.H.V. TRANSFORMER CONNECTION COST
WITHOUT BREAKER
BUS
TRANSFORMER
TRANSFORMER CONNECTION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS, (21%) BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP A NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
INSTALLED DOLLAR COST
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
20,000
33,000
50,000
75,000
DISC SWITCH
230KV
345KV
500KV
700KV
AMPS
1200A
1600A
2000A
2000A
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

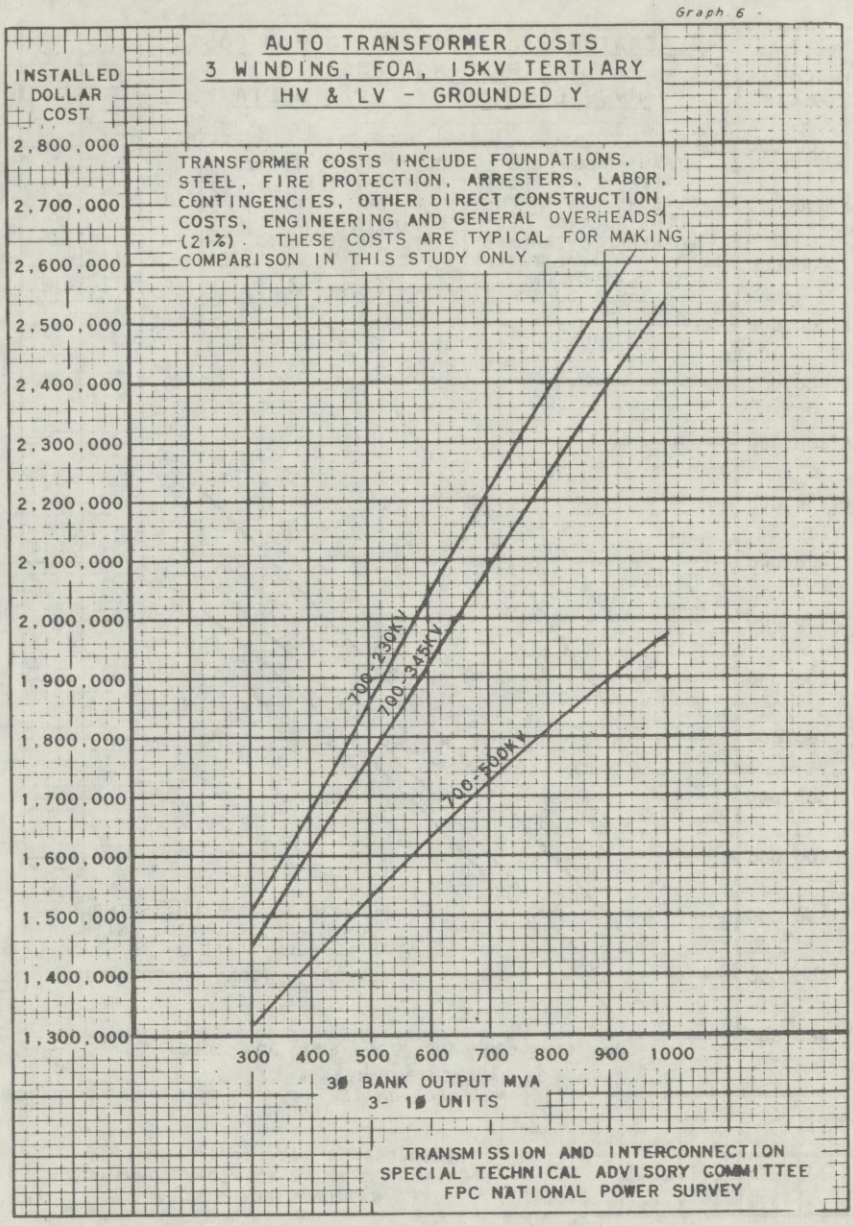
Graph 4



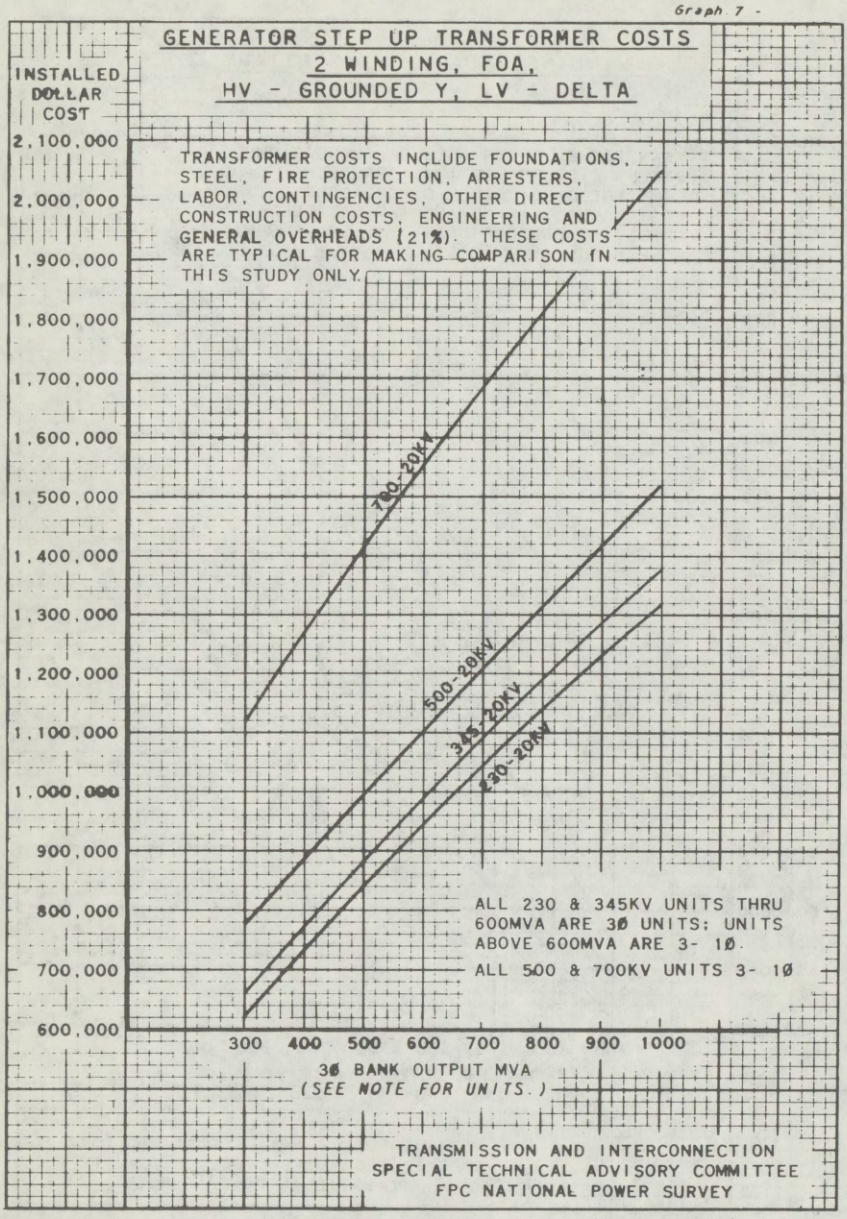
31-973 O—64——9


Graph 5
AUTO TRANSFORMER COSTS
3 WINDING, FOA, 15KV TERTIARY
HV & LV - GROUNDED Y
TRANSFORMER COSTS INCLUDE FOUNDATIONS, STEEL, FIRE PROTECTION, ARRESTERS, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%). THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
INSTALLED DOLLAR COST
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
500-115KV
500-138KV
500-230KV
500-345KV
300 400 500 600 700 800 900 1000
3Ø BANK OUTPUT MVA
3- 1Ø UNITS
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

Graph 6


AUTO TRANSFORMER COSTS
3 WINDING, FOA, 15KV TERTIARY
HV & LV - GROUNDED Y
INSTALLED DOLLAR COST
TRANSFORMER COSTS INCLUDE FOUNDATIONS, STEEL, FIRE PROTECTION, ARRESTERS, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%). THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
2,800,000
2,700,000
2,600,000
2,500,000
2,400,000
2,300,000
2,200,000
2,100,000
2,000,000
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
700-230KV
700-345KV
400-500KV
300 400 500 600 700 800 900 1000
3Ø BANK OUTPUT MVA
3- 1Ø UNITS
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

Graph 7 -


GENERATOR STEP UP TRANSFORMER COSTS
2 WINDING, FOA,
HV - GROUNDED Y, LV - DELTA
INSTALLED DOLLAR COST
2,100,000
2,000,000
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
TRANSFORMER COSTS INCLUDE FOUNDATIONS, STEEL, FIRE PROTECTION, ARRESTERS, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%). THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
700-20KV
500-20KV
345-20KV
230-20KV
ALL 230 & 345KV UNITS THRU 600MVA ARE 3Ø UNITS; UNITS ABOVE 600MVA ARE 3- 1Ø.
ALL 500 & 700KV UNITS 3- 1Ø
300 400 500 600 700 800 900 1000
3Ø BANK OUTPUT MVA
(SEE NOTE FOR UNITS.)
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
COST OF EHV TERMINAL EQUIPMENT
D.C.

Voltage (Kv)	Current (Amperes)	Power (Kw)	Installed Cost ($/Kw Per Terminal)
± 250	1200	600,000	$28
± 375	1200	900,000	$30
± 500	1200	1,200,000	$32

These values, which are "turn key"costs excluding site development and property (see Page 21), include KVAR supply (static capacitors) for two-way power flow, some filtering equipment on the A.C. side, power transformers, and all necessary power, auxiliary and control equipment in the station. To these figures should be added the cost of necessary A.C. circuit connections. If transmission is from source to load only, it is assumed that the reactive supply is inherent in the source. In that instance, deduct $3 per Kw from the above cost for one terminal only. The above "turn key"values include user company engineering, overheads, etc.

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
ESTIMATED INSTALLED COSTS OF EHV CORRECTIVE EQUIPMENT

Estimated installed costs for 345, 500 and 700 kv reactors, capacitors and synchronous condensers are shown on Pages 16 through 20. All costs include material, labor, contingencies, other direct construction costs, engineering and general overheads averaging 21%, but exclude cost of substation property and cost to develop new site.

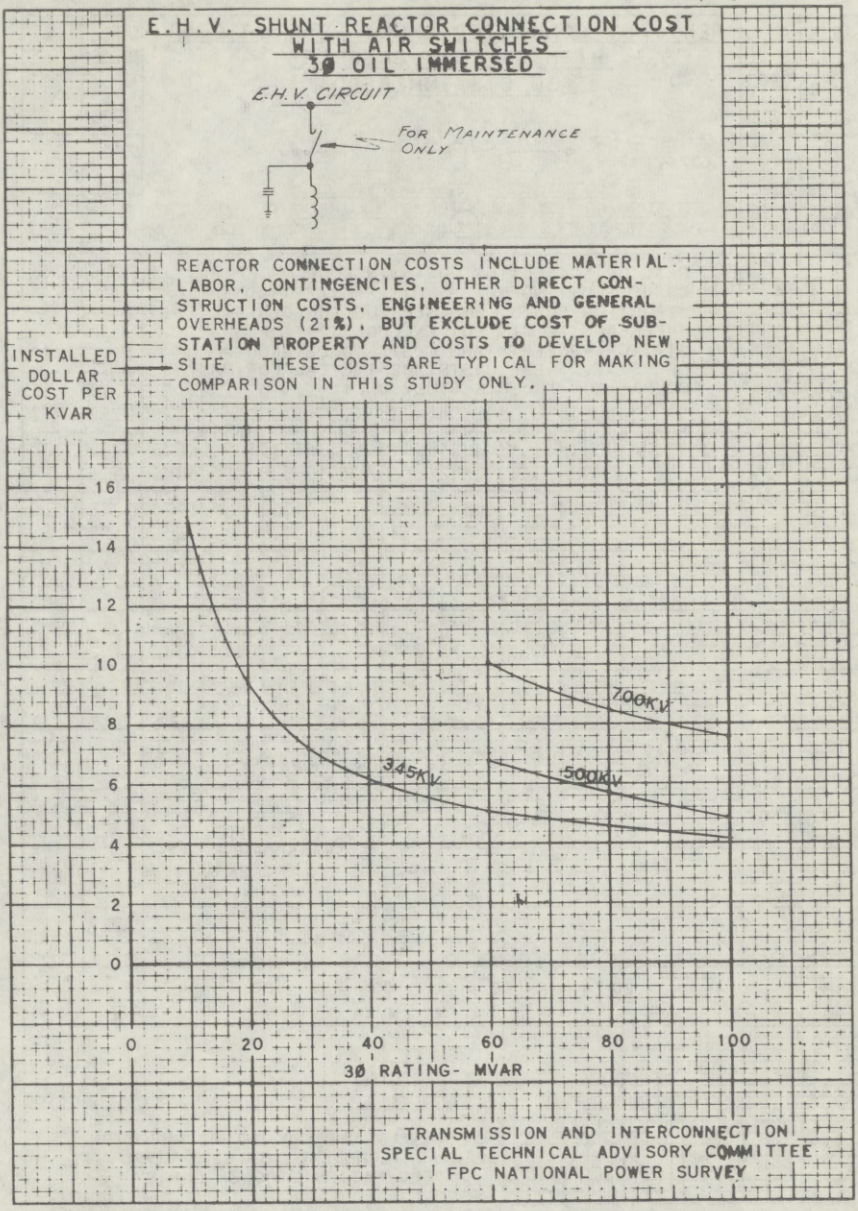
Shunt reactor costs are shown on graphs 8 and 9 - Pages 16 and 17. The costs shown on graph 8 - Page 16 - are for shunt reactors connected at transmission voltages. Costs shown on graph 9 - Page 17 - are for shunt reactors installed on 15 kv or 69 kv tertiary windings of large auto-transformers.

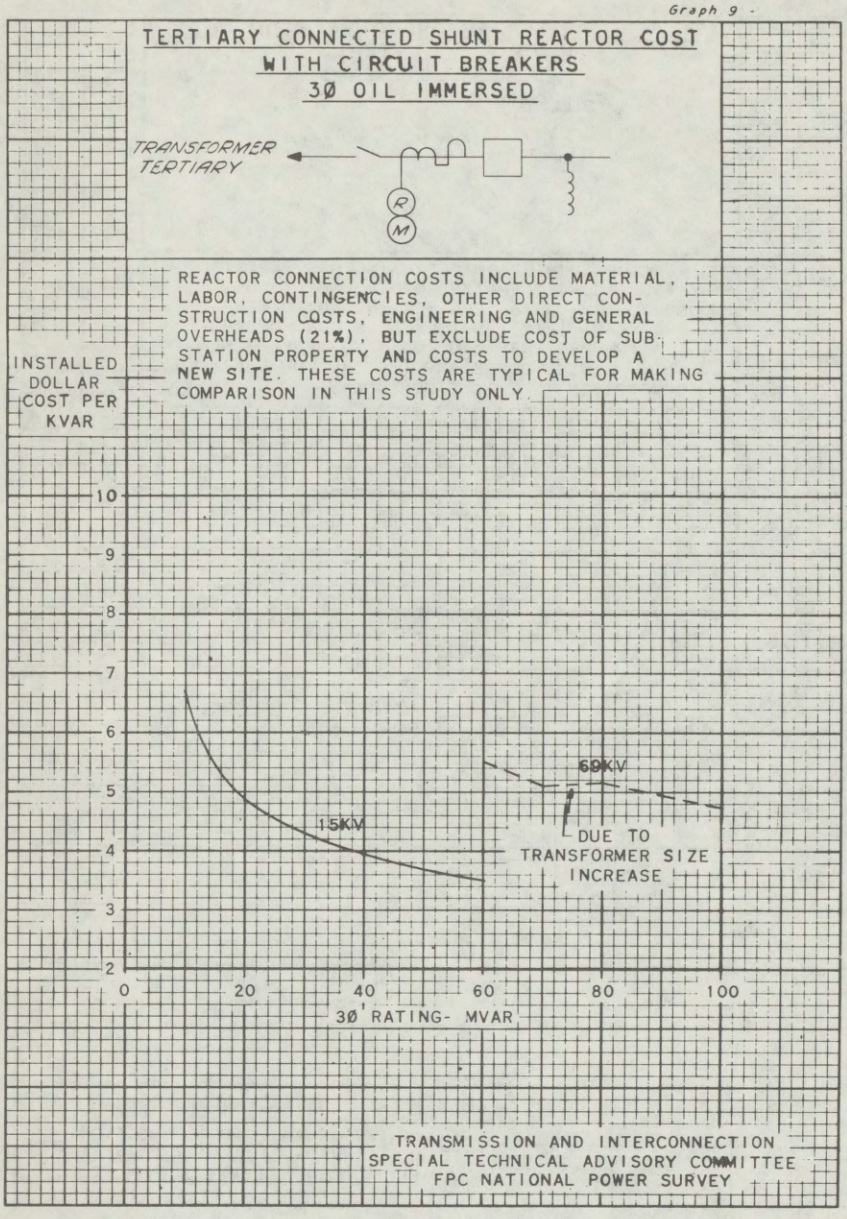
Shunt capacitor costs are shown on graphs 10 and 11 - Pages 18 and 19. The costs shown on graph 10 - Page 18 - are for shunt capacitors connected on the transformer tertiary. Costs shown on graph 11 - Page 19 - are for shunt capacitors connected at transmission voltages.

The tabulations on Page 20 give installed costs for synchronous condensers connected on transformer tertiary, or at transmission voltages. Also shown on Page 20 are installed costs of series capacitors.

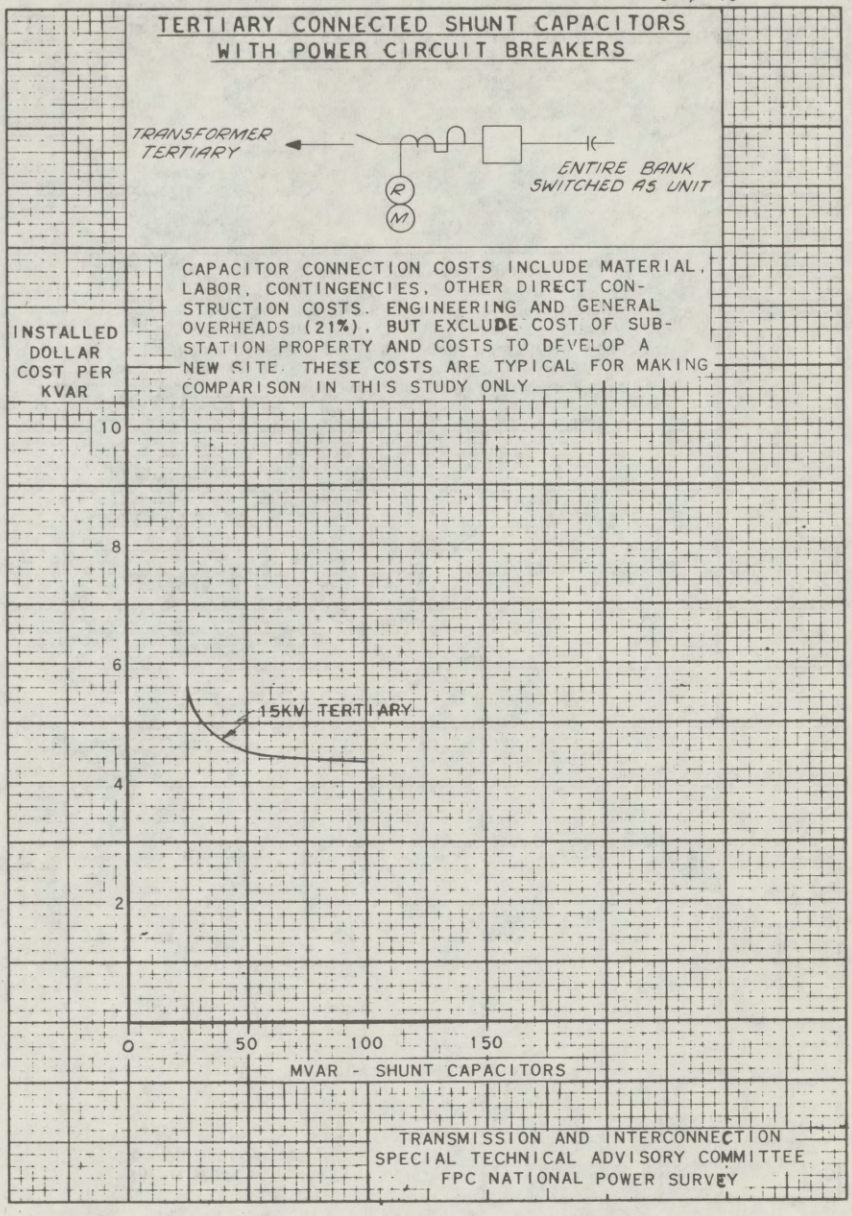
All of these EHV corrective equipment costs are based on 1962 manufacturers' prices.

Graph 8

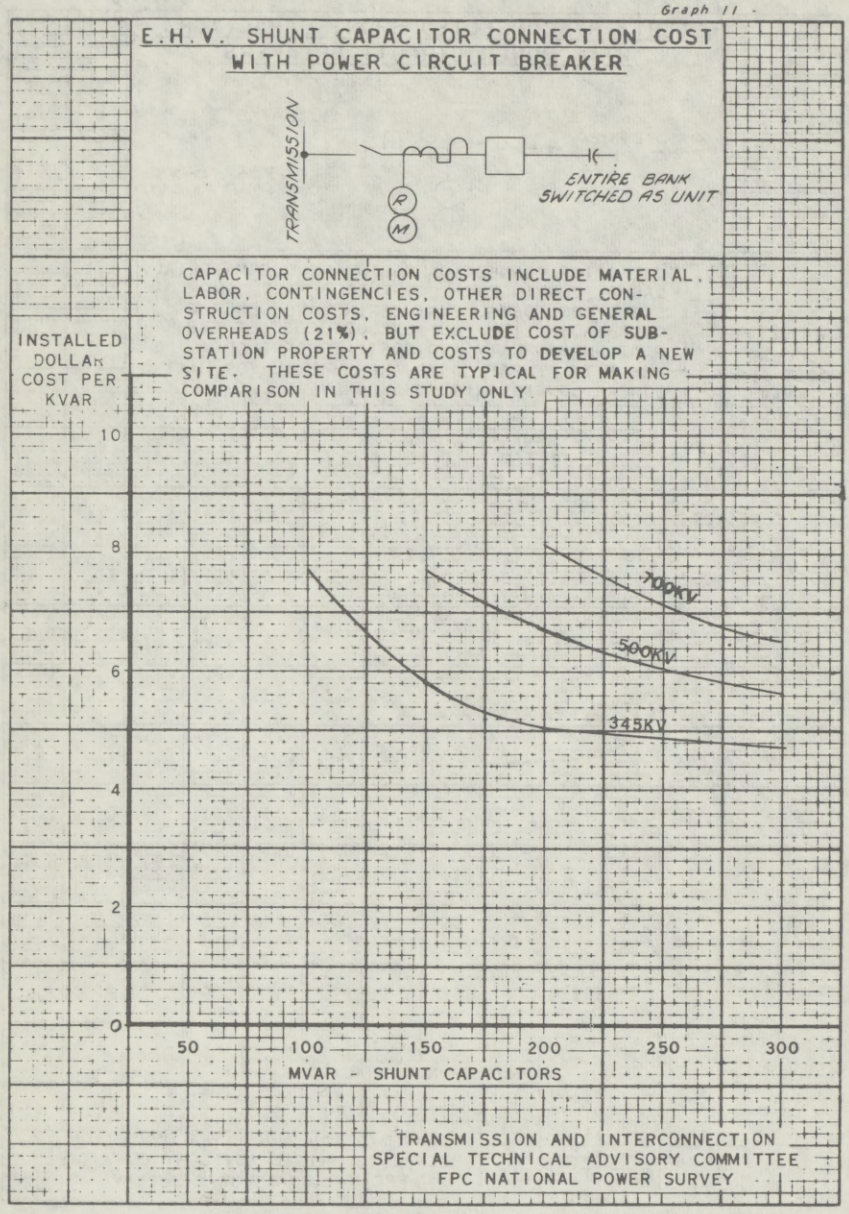

E.H.V. SHUNT REACTOR CONNECTION COST
WITH AIR SWITCHES
3Ø OIL IMMERSED
E.H.V. CIRCUIT
FOR MAINTENANCE ONLY
REACTOR CONNECTION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%), BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
INSTALLED DOLLAR COST PER KVAR
16
14
12
10
8
6
4
2
0
700KV
345KV
500KV
0
20
40
60
80
100
3Ø RATING- MVAR
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY


Graph 9
TERTIARY CONNECTED SHUNT REACTOR COST
WITH CIRCUIT BREAKERS
3Ø OIL IMMERSED
TRANSFORMER TERTIARY
R
M
REACTOR CONNECTION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%), BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP A NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
INSTALLED DOLLAR COST PER KVAR
10
9
8
7
6
5
4
3
2
0
20
40
60
80
100
3Ø RATING- MVAR
69KV
15KV
DUE TO TRANSFORMER SIZE INCREASE
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

Graph 10 -


TERTIARY CONNECTED SHUNT CAPACITORS
WITH POWER CIRCUIT BREAKERS
TRANSFORMER TERTIARY
R
M
ENTIRE BANK SWITCHED AS UNIT
CAPACITOR CONNECTION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS. ENGINEERING AND GENERAL OVERHEADS (21%), BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP A NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY
INSTALLED DOLLAR COST PER KVAR
10
8
6
4
2
0
15KV TERTIARY
50
100
150
MVAR - SHUNT CAPACITORS
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

Graph 11


E.H.V. SHUNT CAPACITOR CONNECTION COST
WITH POWER CIRCUIT BREAKER
TRANSMISSION
R
M
ENTIRE BANK
SWITCHED AS UNIT
CAPACITOR CONNECTION COSTS INCLUDE MATERIAL, LABOR, CONTINGENCIES, OTHER DIRECT CONSTRUCTION COSTS, ENGINEERING AND GENERAL OVERHEADS (21%), BUT EXCLUDE COST OF SUBSTATION PROPERTY AND COSTS TO DEVELOP A NEW SITE. THESE COSTS ARE TYPICAL FOR MAKING COMPARISON IN THIS STUDY ONLY.
INSTALLED DOLLAR COST PER KVAR
10
8
6
4
2
0
700KV
500KV
345KV
50
100
150
200
250
300
MVAR - SHUNT CAPACITORS
TRANSMISSION AND INTERCONNECTION
SPECIAL TECHNICAL ADVISORY COMMITTEE
FPC NATIONAL POWER SURVEY

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
ESTIMATED INSTALLED COST PER KVAR
FOR SYNCHRONOUS CONDENSERS AND SERIES CAPACITORS

	Tertiary	345 kv	500 kv	700 kv
Synchronous Condenser Installed $/Kvar	$18	$18	$18	$18
Step-Up Transformer	-	3.8	4.5	8.5
High Voltage Connection	-	3.7	5.5	8.5
Incremental Cost of Transformer for Tertiary Connection	1	-	-	-
Total Installed Cost Per Kvar*	$19	$25.5	$28	$35

* Costs based on 100 mvar condenser, with voltage rating of 20-24 kv. Synchronous condenser connection costs include material, labor, contingencies, other direct construction costs, engineering and general overheads (21%), but exclude cost of substation property and cost to develop a new site.

Estimated Installed Cost of Series Capacitors

345 kv - $ 8 per Kvar
500 kv - 9 per Kvar
700 kv - 10 per Kvar

Capacitor connection costs include material, labor, contingencies, other direct construction costs, engineering and general overheads (21%), but exclude cost of substation property and cost to develop a new site.

All the costs on this page are based on 1962 manufacturers' prices.

COORDINATED NATIONAL POWER SURVEY
TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE
ESTIMATED COSTS TO DEVELOP SUBSTATION SITES

230 kv A.C.	$ 100,000
345 kv A.C.	120,000
500 kv A.C.	160,000
700 kv A.C.	200,000
±250 kv D.C.	175,000
±375 kv D.C.	220,000
±500 kv D.C.	300,000

The above costs include material, labor, contingencies, other direct construction costs, engineering and general overheads averaging 21%, grading, roads, drainage, fencing, landscaping, control and equipment buildings, ducts or troughs for control facilities, water and sewage.

These figures do not include cost of substation property.

ELECTRICAL WORKERS' LABOR RATES PLUS FRINGE BENEFITS
IN VARIOUS PARTS OF THE UNITED STATES

Reference: Engineering News-Record, September 27, 1962

City	Hourly Wage Rate
Atlanta	$4.25
Baltimore	4.18
Birmingham	4.03
Boston	4.60
Chicago	4.75
Cincinnati	4.81
Cleveland	4.44
Dallas	4.00
Denver	4.30
Detroit	4.91
Kansas City	4.68
Los Angeles	5.19
Minneapolis	4.38
New Orleans	4.23
New York	6.16
Philadelphia	4.86
Pittsburgh	5.41
St. Louis	4.99
San Francisco	4.75
Seattle	4.52
Average Hourly Rate	4.67

Transmission and Interconnection
Special Technical Advisory Committee
FPC National Power Survey

Exhibit C

MENLO PARK, CALIF., *August 22, 1963.*

Re appraisal of proposed P.G. & E. route, Woodside, Calif.

Mr. PAUL N. MCCLOSKY,
Palo Alto, Calif.

DEAR SIR: In accordance with your request, I have made a preliminary investigation into the property values along the route of the alternate route proposed paralleling the Junipero Serra Freeway. I have no way of knowing whether the line is supposed to be to the east or west of the highway, however, considering either possibility, it is my opinion that the cost of right-of-way would be much the same. I have assumed, following our conversation that the right-of-way would be 100 feet in width as a minimum. On this basis there would be approximately 12.1 acres to the mile of line. Scaling out 1,000-foot scale map indicates that there would be 60 acres more or less to be acquired.

From our knowledge of the area and previous appraisals in Woodside, I am convinced that the land values along the route would be $10,000 an acre, or more. In addition, there are undoubtedly parcels which would involve acquisition of improvements and/or damages to the remainder lands if this line is constructed. It is also possible that several of the parcels which would be affected would not be raw acreage as yet unsubdivided but would be smaller parcels of 1 acre or less. These would be more adversely affected and, therefore, would suffer greater damage. I have in the past valued lands being acquired for P.G. & E. in cases involving tower lines on the basis of 75 percent damage to the underlying fee and I see no reason why the same would not be true in this instance. On this basis I believe that the cost of acquisition of the 100-foot right-of-way would be at least $450,000 for land and $200,000 for improvements and severance, an estimated total of $650,000 to run the line from the Jefferson substation to the Stanford lineal accelerator.

At such time as right-of-way maps can be made available showing the exact route and the parcels affected, I would ask that they be furnished so that these figures may be refined and completed in more detail.

Respectfully submitted.

DAVID INGRAM, Jr.

Exhibit D

SUMMARY OF OPINION, SOL SCHULTZ

The following quotation is from the September 1962 report of Sol E. Schultz, one of the foremost electrical transmission line experts in the United States. Mr. Schultz, formerly of the Bonneville Power Administration, is presently a powerline consultant with the firm of H. L. Zinder & Associates, Seattle. He was retained by a group of citizens contesting the Monta Vista-Jefferson 220-kilovolt line in September 1962. Before submitting the following opinion, Mr. Schultz had asked the P.G. & E. engineers for the power flow diagrams for the peninsula service area. The company refused to disclose these diagrams to Mr. Schultz. His opinion follows:

1. It is not possible to determine from available data whether the company's plan for supplying power to the area is the one best suited to the purpose taking into account the overall interests of the community, the property owners, and the company. From my observations there appear to be several alternative solutions—not requiring the construction of the proposed line—to the problem of meeting the short- and long-range power needs of the area.

One such plan was mentioned by a company spokesman at the hearing. It envisions the extension of 66-kilovolt facilities supplied from reinforced 230-kilovolt bayshore facilities. The spokesman stated that this plan would entail $1,700,000 more in costs than the plan adopted by the company.

I have no means for checking this figure. Neither can I appraise, for lack of information, the significance of this indicated cost differential. I would ask, for example, does it take into account present worth factors? Or are property values given due consideration? Another plan worth of note is the use of 110-kilovolt transmission. *It is quite common practice to build transmission lines at this voltage on wood poles on city streets. The economy of this type of construction has been demonstrated in other areas.* [Emphasis added.]

2. Without the information requested from the company, I cannot appraise the urgency of the power supply situation in the area which would be served by the proposed transmission line.

APPENDIX 2

SIEGFRIED REPORT ON FEASIBILITY OF 220-KILOVOLT CABLE FEEDER FOR STANFORD LINEAR ACCELERATOR CENTER

SUBMITTED TO COMMITTEE FOR GREEN FOOTHILLS, MAY 13, 1963

(By Victor Siegfried, consulting engineer, 2442 Park Boulevard, Palo Alto, Calif.)

INTRODUCTION

This report is being made to examine the feasibility of a 220-kilovolt cable as the entrance feeder for power to the Stanford Linear Accelerator Center as an alternative to the Monte Vista-Jefferson overhead transmission line proposed for the skyline route now under consideration.

Only the requirements for serving the Stanford Linear Accelerator Center (SLAC) are considered in this evaluation, and the magnitudes and costs are predicated upon what are understood to be the requirements of SLAC for its maximum power when in full operation. For purposes of this study, no additional power requirements for the immediate area nor for serving Jefferson Substation are included, in the belief that ample alternatives will soon be available from other directions for loads served by Jefferson Substation.

The necessity for transmission at 220 kilovolts is to serve SLAC and is accepted for purposes of this study; 60-kilovolt transmission would require multiple circuits and routes, and similarly 110 kilovolts would limit the available power to the project or necessitate uneconomical construction of additional circuits as compared with 220 kilovolts.

Since the primary consideration is for power to SLAC, its power needs dictate the size of the cable. The use of cable presupposes a factor on reliability which says one circuit may have to be out of service at times for maintenance or repair; consequently, a double circuit system is envisioned. The power requirement of 300 megawatts for the ultimate load on the accelerator, thus dictates two circuits of 150 megawatts each for this consideration.

Summary of conclusions

This report demonstrates that a feasible route is available connecting SLAC with power sources soon to be available at 220 kilovolts over a low-level route available to the utility without acquisition of right-of-way or condemnation. It examines the possible costs of such a power cable system on the basis of preliminary design details contained in the report. The cost estimate is given as a single figure which represents, in general, outside costs as far as can be determined where there is a choice of lower versus higher figures.

The conclusion is stated, simply, that a double circuit pipe-type cable for 220-kilovolt entrance, connecting Ravenswood Substation in East Menlo Park by way of city streets and Willow Road, open country along the Stanford campus can connect the SLAC to a suitable source of power for a cost of approximately $3 million. These are rough order of magnitude costs but, as stated above, represent not more than 20- to 25-percent error for the design considerations stated in the body of the report.

This proposed cable route can be constructed within the time required to deliver the first large block of power to SLAC over the 220-kilovolt system on January 1, 1965, with standby power being made available through 60-kilovolt circuits now being constructed for the interim.

The route described is approximately 7.5 miles from Ravenswood Substation to the east or target end of SLAC, but does not include the possible additional mile of cable which would carry the bulk of the power used by the accelerator to the central substation, since this has been provided in the cost of the accelerator and is, therefore, not a consideration of this report, except that use of cable into the project might dictate a choice of cable for the extension along the line of the accelerator.

Source of 220-kilovolt power

A basic consideration for serving SLAC with 220 kilovolts is the source of power at this voltage; 220 kilovolts is available at San Mateo and at Monte Vista Substations from the hydro portion of the P.G. & E. system or from Moss Landing, near Watsonville. Moss Landing power is carried to Monte Vista presently by 220-kilovolt service through Metcalf Station in the vicinity of San Jose and a tie is being constructed to Newark Substation which will proceed to San Mateo Substation by means of a Dumbarton crossing and a switching station now known as Ravenswood Substation, currently under construction. This development, while single circuit at the present time, furnishes a source of power for 220 kilovolts to give this alternate route to SLAC prime consideration. Even if the Monte Vista-Jefferson line is completed with SLAC power as its primary function, a tapline down the hill would have to be provided which could be either overhead transmission or cable, but the cost factors would make a cable run quite expensive as compared to the overhead and also require complete clearing of such a cable route. The length of this route would be approximately 5 miles to the accelerator site and involve expensive construction if pipe-type cable is used because of the differences in elevation. This has been explored previously by the SLAC project and concluded as economically unjustifiable because of the elevation difference and other vital considerations.

This report thus addresses itself entirely to the feasibility of bringing power at 220 kilovolts to SLAC from Ravenswood substation near the westerly end of Dumbarton Bridge. Ample power is available even with a single circuit but consideration may well be given to making this a double circuit route with this possibility of a 300-megawatt load depending upon this entrance. Reliability considerations also indicate the desirability of having a double circuit for continuity of service for this major load. The connection to San Mateo also furnishes a second route for 220-kilovolt power should the Newark circuit be open or unavailable on the current single circuit basis.

Cable design considerations

The cable system being proposed is high-pressure oil filled (HPOF) cable designed for 220 kilovolts. There is ample experience with cable at this and higher voltages in Canada and the United States to justify its acceptance for this project without having to pioneer the entire field of cable design and auxiliary requirements. It consists basically of one steel pipe with three insulated conductors per circuit, the entire pipe being filled with insulating oil maintained at a high pressure such as 200 pounds per square inch. A second circuit would require a second pipe for its three conductors. A pressure regulating system with appropriate alarms for indicating loss of pressure and reservoirs for accumulating expansion of the system under loaded conditions is a necessary part of this system. The two circuits would be installed in one trench and would terminate at either end with high-voltage potheads on switch racks at either terminal, in this case at Ravenswood Substation and on the grounds of SLAC.

For the power requirements as stated of 150 megawatts per circuit, three conductors each of 500,000 circular mils (500 M c.m.) will be required per circuit. For this voltage, 835 mils (0.835 inch) insulation will be applied over the conductors with appropriate outer shielding tapes and skid wires to facilitate pulling into the pipe. The pipe diameter for such a system is 8⅝ inches outside diameter, with welded construction joining 20-foot lengths together. Open trenching is suitable for most of the route, with the exception of probable piercing methods for major interchanges along the cable route. Pulling lengths of cable are usually a maximum of 2,000 feet for such installations, and therefore require manholes for splicing at approximately 2,000-foot intervals, with shorter distances indicated where major turns are involved in the route as selected.

The route as described below, for purposes of this report, will be open country for approximately 4.2 miles on relatively straight lines with 3.3 miles of city streets in Menlo Park with only four right-angle turns as contemplated. Two crossings of San Francisquito Creek will involve a means of supporting the cable on a bridge or causeway for the route proposed, although an alternative route not involving crossing of the creek might be feasible, except for the fact that the major portion of it would then be in city streets with more expensive construction to offset the cost of the bridge support for the cable system.

In city street construction, the most rigid requirements for trenching, backfilling, and capping before repaving are contemplated.

Available route

Ravenswood substation is located on the northwest side of Willow Road in swampy land filled for this use. This investigation considered the possibility of using the proposed Willow Freeway route, but restraints involved indicate that it is not available without purchase of additional right-of-way and considerable difficulty in negotiating interchanges. Therefore, full use is made of the privilege available to P.G. & E. of coming through city streets with a minimum of regulation other than for adequate restoration of the surface. There is a choice of overhead versus cable connection from Ravenswood to the Dumbarton railroad right-of-way, in that the cable potheads could be located just outside of the railroad property with overhead connection to Ravenswood substation, but for purposes of this report it is assumed to be cable for the entire distance with potheads located in Ravenswood substation switchyard.

The route indicated for this presentation is a pierced crossing underneath the Dumbarton railroad right-of-way, open trench along Carlton Avenue in Menlo Park, a pierced crossing underneath the Bayshore westerly of the Willow Road interchange, proceeding along Van Buren frontage road to Willow Road proper and along Willow Road to Middlefield. A pierced crossing underneath Middlefield Road may be necessary and consequently is allowed for in the cost proposal. The route continues along Willow Road to the Southern Pacific main line, where another pierced crossing will be effected. At the westerly end of this crossing, a question of right-of-way is encountered between the railroad and the El Camino Real piercing, as this property is now used as commercial development for automobile establishments. After crossing El Camino Real, the route proceeds into Cambridge Avenue with a right-angle turn onto University Drive to permit a crossing of San Francisquito Creek on a small bridge or causeway well apart from the proposed Willow Freeway crossing of the creek. There will be another right-angle turn to proceed on Stanford land in front of the convalescent home along the northwesterly side of the present Willow Road. The continuation in open country along Willow Road encounters a second crossing of San Francisquito Creek which can be accomplished along the existing bridge if it is established that this bridge will not be relocated in the final Willow Freeway alinement. Otherwise, a second causeway across the creek must be allowed for in the cost of this proposal, and is so considered. For this presentation, it is assumed that the cable run may proceed in trench across Santa Cruz Avenue, up Sand Hill Road to the vicinity of the project on Stanford land, and across the line of the accelerator at the easterly target end to the projected substation.

One other detail in crossing established facilities is that of the Hetch Hetchy aqueduct between the Dumbarton railroad right-of-way and the Bayshore Highway. It has not been established whether this would require a pierced crossing underneath the aqueduct or whether the aqueduct is at sufficient depth to permit installing the cable trench on top of it. This would have to be established for a final design and might affect the cost slightly.

Installation considerations

Basically, the pipe type cable can be installed in a single trench 4 feet wide at a nominal depth of 4 feet. In open country, continuous trenching and backfilling with machinery are presupposed with a certain amount of sand being used for the immediate covering of the pipe. This has been determined to present conditions which result in a cost of $4 per trench-foot. For city street construction, the city of Menlo Park requirements are quite stringent, with the requirement that backfill be flooded and a 6-inch concrete cap be laid over the trench before paving is restored. All material used in backfill is new, requiring added hauling expense. Therefore, the cost of trenching in city streets is taken as $10 per trench-foot.

Where a roadway is not to be breached, installation of steel casing through which the cable system pipe will be installed is taken as consisting of a 16-inch casing with a quarter-inch wall and one per circuit will be required. The cost of such casing is approximately $25 per lineal foot installed, or $50 per lineal foot of double circuit casings, of which 660 feet have been estimated.

Other cost considerations

The use of cable in conjunction with overhead systems requires lightning arresters at both terminations of the cable to protect against possible overvoltages due to lightning surges or switching surges which would be a hazard if not protected with lightning arresters. Therefore, a legitimate charge to this alternative system is to include 12 stacks of 220 kilovolt lightning arresters at $2,500

each as added equipment not otherwise contemplated for the connections to SLAC from some 220 kilovolt source. Cost of installing the cable include jointing and terminating labor and pulling in the cable under closely controlled conditions. Exact figures for this cost are not immediately available but are estimated as 10 days of three shifts of crews around the clock at $750 per crew per day, or a total of 30 crew-days. Likewise, the exact requirements for the manhole vaults are dictated by the local considerations at the point of construction, but are approximated at $5,000 each for 20 such vaults. Engineering, supervision, and overhead costs are taken as 25 percent of gross construction and installation costs rather than of the entire project, since the major portion of the cost is in materials and equipment which are vendor produced and may be procured with a minimum of engineering effort. The 25 percent factor is felt to be a fair assessment of the engineering costs which might be charged to this alternative cable system as compared with the engineering of the entire power supply system represented by construction now underway.

Design and cost statements

The following tables present a restatement of the design considerations involved in selecting the system which is being priced and indicate sufficient details of cost considerations in equipment and materials for analysis and comparison with other proposals.

It should be stated that the design of this system, since it is based principally on requirements for the Stanford Linear Accelerator Center, does not attempt to duplicate the costs of the cable system which would replace the entire capacity represented by the Monte Vista-Jefferson design. Since this is beyond the scope of this investigation, only the costs relating to power supplied to Stanford Linear Accelerator Center are considered. As indicated in the introduction, the additional cable which might be considered along the length of the accelerator from the eastern terminus to the central substation has not been factored into the lengths of cable here presented, nor have the additional switching and terminating facilities been studied, inasmuch as they represent equipment already allowed for in the basic power requirements of Stanford Linear Accelerated Center. Should the use of cable as the primary entrance to the project for 220-kilovolt power indicate that its extension to the central substation should be cable also, an earlier study would indicate that this figure would be increased by approximately $500,000 for the two circuits with open-country type of trench construction available along the length of the accelerator. It is to be noted that no power requirements exist at the westerly end of the accelerator and therefore the length of this additional feeder would be approximately 1 mile only.

TABLE I.—*Design considerations*

Power requirements—Stanford Linear Accelerator Center only:	
Firm power Jan. 1, 1965	150 megawatts.
Maximum power contemplated (1970)	300 megawatts.
Number of circuits: 3 conductors, 220-kilovolt cable	2.
Cable conductor size for Stanford Linear Accelerator Center Requirements	500 MCM.
Possible route:	
Open country—	
Ravenswood substation to Dumbarton railroad right-of-way (approximate)	1.2 miles.
Willow Rd. (west of El Camino Real and Sand Hill Rd. to Stanford Linear Accelerator Center (approx.))	3 miles.
Total of open country route	4.2 miles
City streets—	
Menlo Park, Carlton Ave., Van Buren Rd., Willow Rd. (east of El Camino Real), Cambridge Ave., University Dr. (approximate)	3.3 miles.
Total length of system (approximate)	40,000 feet.
Interchanges requiring piercing and jacking:	
Hetch Hetchy aqueduct (assume trench OK) Southern Pacific Dumbarton Railroad	60 feet.
Bayshore Freeway—Carlton Ave. to Van Buren Rd	200 feet.
Middlefield Rd., if trench not allowed	100 feet.
Southern Pacific, main line	100 feet.
El Camino Real	200 feet.
Total pierced casing	660 feet.

TABLE II.—*Materials of construction costs*

HIGH-PRESSURE, OIL-FILLED CABLE SYSTEM COSTS

(High-pressure, oil-filled, pipe-type cable)

Conductors: 6 conductors times 7.5 miles (approximately 40,000 feet), 240,000 feet of 500 MCM 220-kilovolt cable core, at $5.50 per foot	$1,320,000
Pipe: 8⅝ inches outside diameter steel pipe, 80,000 feet, at $3 per foot	240,000
Oil: 150,000 gallons in pipe and reservoirs, at $0.90 per gallon	135,000
Expansion reservoirs: 2 of 3,000 gallons, at $3,000 each	6,000
Pressure controller: 1 twin-unit pumping plant	12,000
Potheads: 220-kilovolt, 200 pounds per square inch, 12 at $6,500 each	78,000
Joint materials: Based on 2,000-foot pulling lengths, 40 3-phase kits, at $2,250 each	90,000
Termination materials: 4 3-phase kits, at $3,000 each	12,000
Lightning arrestors: 220-kilovolts, 12 at $2,500 per stack	30,000
Miscellaneous and contingencies: Racks, fittings, and miscellaneous	40,000
Total materials of construction	1,963,000

TABLE III.—*Construction and installation costs*

Trenching, backfilling, and compaction:	
Open-country trenching, 22,500 feet, at $4 per trench-foot	$90,000
City streets (including repaving), 17,500 feet, at $10 per trench-foot	175,000
Piercing and jacking of casings: 660 feet of dual casings, at $50 per foot	33,000
Laying and welding pipe: 40,000 feet, at $3 per trench-foot	120,000
Bridges or causeways over San Francisquito Creek: $25,000 each	50,000
Pulling-in conductors: 10 days of 3 crews, at $750 per crew-day	22,500
Vaults: Manholes, 20 at $5,000 each	100,000
Jointing and terminating: 42 at $8,000 each	336,000
Subtotal	926,500
Engineering, supervision, and overhead: 25 percent of above subtotal	231,500
Total construction and installation costs	1,158,000

TABLE IV.—*Summary of costs*

Total costs, materials of construction, table II	$1,963,000
Total costs, construction and installation, table III	1,158,000
Total costs of 220-kilovolt, high-pressure, oil-filled cable	3,121,000

APPENDIX 3

BLANKENBURG REVIEW OF SELECTED FACTORS CONCERNING THE POWER SUPPLY LINES FOR THE STANFORD LINEAR ACCELERATOR CENTER

(Submitted to Mr. John K. Crosby, August 27, 1963)

(By R. Carter Blankenburg, P.E., Registered Electrical Engineer, 712 North Curtis Avenue, Alhambra, Calif.)

FOREWORD

The author speaks from his own knowledge and experience as an individual. The comments and conclusions herein are in no manner those of any organization.

PREMISE

From conversations with Mr. John K. Crosby of Woodside, Calif., and information he has obtained from the sources involved, certain matters are understood to be as related below:

1. The ultimate power requirement for SLAC is 334 megavolt-amperes, of which 2 percent appears in 1964, 3 percent more in 1965, 13 percent more in 1966, 9 percent more in 1967, and 6 percent more in 1968, for a total of 111 megavolt-amperes at that time. For the stages requiring over the 111 megavolt-amperes, it is projected that these occur in two additional amounts of 111 megavolt-amperes, the first about 1972 and the second some time between 1973 and 1980.

Full load will be used for long enough periods that the load factor, for thermal limits, is considered to be 100 percent. Power factor of the load is estimated to be 90 percent.

2. Continuity of service is so vital that a reserve of one circuit is required, in SLAC's opinion.

3. The property owner, Stanford University, is reported to be indifferent as to the consequences of placing the proposed 220-kilovolt tower lines on their property.

CONCLUSIONS

There are three major factors involved in this matter, which, in the opinion of your consultant, provide keys to resolving it. In two instances the facts may have been mixed as to priority of significance. In the third instance we must rely upon a forecast of public attitudes some years hence.

A. The issue

At issue here, basically, is a matter of ethics, not one of costs. It might be stated thusly: "Shall a tax-financed, experimental installation, such as SLAC, be allowed to place a disproportionate share of costs on a group of property owners by means of causing a tower line to be built in a location detrimental to their rights and property values, under circumstances where underground cable installations, or alternate routings, or both could be used?"

The attitude of the responsible personnel of SLAC, as it has been explained to your consultant, is a matter of more than a little contradiction. The reluctance to pay the costs for elimination of the objectionable tower lines contrasts with an apparent haste to build these same lines on towers to a capacity which may not be needed until 1980, if ever. It contrasts even more with a plan which places the receiving station at the far end, away from the proposed source, thus causing the tower line to parallel the load for a full 2 miles of accelerator tube length. This arrangement adds both to the cost and to the length of line which is the source of protest from nearby property owners.

The statement that Stanford is not concerned about having some 2 miles of tower lines on their property raises a question as to conflict of interest by their spokesman. There is a great prestige value to having SLAC at Stanford. The building and the operation and the analysis of results obtained from the accelerator tube means many opportunities for material rewards, gaining experience, and building of reputations. Before the "we don't care" reply about the tower lines is accepted as valid it should be established that the respondent does or does not speak from an unbiased point of view. If there is some individual or group, charged with the final responsibility for the future of Stanford, which can take an unbiased view of the matter, then the tower line situation should be explained in detail to that group.

B. The adversary

The adversary of the Woodside property owners is SLAC. The contract establishes that underground circuits are not to be provided at the expense of P.G. & E.

The fact that P.G. & E. has participated in negotiations with the Woodside representatives to such an extent should not be taken as evidence of weakness of their position. It is well established that power companies place great value on earning the good will of the public. The record shows that they go out of their way to discuss and explain their position in instances where the law is clearly on their side.

There is little reason to doubt that the P.G. & E. Co. could win, should the Woodside owners elect to go to court about their right to build a tower line or the amount of their estimate for 220 kilovolts underground.

Court action is not suggested, rather it is recommended that this course be avoided. However, should it be entered into it must be recognized that SLAC should be the defendant. Neither SLAC nor P.G. & E. should be able to estab-

lish that 220 kilovolts underground is an impossibility. The argument hinges on too much cost, not on the possible or impossible. If there is to be this cost, it must be financed by SLAC.

C. Changing standards of esthetic values

What is considered a luxury or a convenience or a necessity changes with time and public opinion. Cost is often talked about in opposition to progress, particularly by the advocates of whatever is being outmoded. In the final analysis, the fact that something else is cheaper carries no weight with the public. Both the automobile and the airplane have gained in popularity in spite of being much more costly than the form of transportation they displaced.

There are many straws in the wind today which suggest that the public is able and about to declare their willingness to pay the extra cost and have underground powerlines. Thus we are about to witness underground changing from a convenience to a necessity. Such a change will not mean the sudden disappearance of power poles and towers. It will bring a rapid halt to overhead line extensions in many urban and suburban areas.

The Woodside property owners have reason to fear that the justification of their protests may be found valid only after the tower line has been built. It is understandable that they prefer to reverse the situation and be known as one of the first groups to benefit from this change in public thinking rather than one of the last to be without it.

Within the next 12 months there will be a much better and more widely spread understanding of these changes in the making. How rapidly this will occur and when it will come to be accepted as a factor of the future, is a matter of speculation at this time.

It seems evident that the responsible personnel at SLAC do not recognize the imminence of this change away from poles and towers. Until they do, it is unlikely that they will be willing to obligate funds to pay for underground. The alternative is for the Woodside property owners to direct their efforts to delaying of final decisions in this matter just as long as possible without serious delay to essential operations at SLAC.

LAMENTABLE TIMING

The crux of these negotiations with SLAC may hinge on the calendar. Ten years ago there would have been little reason for the Woodside group of property owners to hope for success in pursuading the user to avoid having the power brought in by tower line. In another 10 years, and perhaps much less, it is not likely that any agency spending public funds would be indifferent to the protests of owners about to have the value of their property reduced as a result of the agency's actions.

In time to come we will look back upon 1963 as about the time that the value of underground lines, rather than overhead lines, was recognized as being substantially more than the cost difference. Currently, the city of Los Angeles is building several miles of 220-kilovolt underground lines. Their original plans had been to build a major portion on towers placed along a rather wide flood control channel. Protests of the residents in the adjacent area caused them to change their plans.

Another illustration of changes in the making appeared in the Los Angeles Times real estate section, Sunday, July 28, 1963. Mr. Tom Cameron, Times real estate editor, under the heading "At Last! Utilities Go Underground" says, quoting from a statement by W. C. Drewry, Southern California Edison Co. vice president:

" 'Low-cost underground facilities for residential electric service * * * are now a reality for new residential tract developments in the area. * * *

" 'The slash in costs means that electric lines generally can now be buried below ground at new residential developments with a cost to the developer of $100 to $200 a lot. * * *

" 'Edison already has a backlog of orders to install underground electric service in 15,000 lots in new subdivisions.' "

The foregoing is only the first of a number of announcements of similar nature which are likely to appear in the news from other utilities throughout the United States, in the next 12 months.

A further example is to be found at the Commonwealth Edison Co. in Chicago. They have been building very low-cost underground to homes in new tracts for the past few years. In less than 5 years, it is understood, they have added more than 20,000 homes to their lines in this manner.

Transmission, of course, is quite different from distribution and the trend of one does not necessarily predict that of the other. There is no recent, sensational, breakthrough to lower costs, nor is one known to be pending. There has been a growing use of underground transmission circuits. There is a serious effort being made to perfect the art of building cables rated at much higher voltages. This is one manner in which to lower the relative cost of underground transmission in terms of capacity and distance per unit of cost. There is little doubt that once the public is aware of the value of having underground distribution they will develop a taste for it. Where enough value is put on appearances, they will satisfy this taste by paying the costs of it in higher rates or otherwise.

SMALL PRECEDENT

The conditions at SLAC do not duplicate the majority of cases where underground transmission has been used or considered to supply such a large block of load.

The most typical case has been to supply commercial and business centers. The application of underground power transmission was initiated in the United States in 1927. Table I summarizes some of this history. In 1927 the Commonwealth Edison Co. of Chicago energized 5.80 circuit miles of 138-kilovolt cable. That same year, the Consolidated Edison Co. of New York energized 11.6 circuit miles of 138-kilovolt cable. Since that time a few thousand miles, mostly at voltages between 69 and 138 kilovolts, have been put into operation in the Western Hemisphere. Nearly all of this mileage is in congested business areas in and around major cities. A typical circumstance for these is that the land costs rule out tower line construction, even if this could be considered.

Following in popularity by number of circuits, although of small total mileage, are the in-station installations. It has been found that this is a convenient means of having the high voltage originate in the heart of a congested area, near the generators, and yet not appear on towers until far enough out to find the necessary elbow room. Circuit lengths of a few tenths of a mile or so are most common.

Situations where a very large block of power is suddenly required in a small site surrounded by well developed suburban areas, are very rare if, by chance, previous ones have occurred. The rarity of the circumstances in no way makes the use of tower lines any less objectionable to the property owners concerned.

220-KILOVOLT UNDERGROUND CABLES

Cable at this voltage is probably another 10 years away from general acceptance. Some 38 circuits, averaging less than 1 mile each in length, have been installed in the Western Hemisphere. Some details appear in table IV. The earliest known dates from 1954. About half of these circuits are of the in-station type. A review of table I shows that the oil-filled cables, in the 110- to 138-kilovolt ratings, went through a trial period of some 20 years before meeting with general acceptance. In these voltages the early trials were for relatively fewer of the in-station circuits and more of the transmission line type of application.

The growth of oil-filled installations was slowed somewhat by the advent of the pipe-type design. These two are essentially variations of each other. If we take the combined quantities, it is in the 22d year before the average exceeds two additional circuits per year.

The knowledge and experiences with the lower voltages will be of value at 220 kilovolts. The increase has posed new problems, however, and new solutions are being investigated. Offsetting the help from experience at the lower voltages, is another circumstance which promises to slow the use of 220 kilovolts. Many users, particularly those having 138 kilovolts as their major transmission voltage (these are very numerous), doubt that going to 220 kilovolts is enough of an increase.

As a consequence of this situation, the development of 345-kilovtol cable is being pushed. Test lengths of four different makes of three variations in design were placed under test at Cornell in 1960. These evaluations are still going on.

While the P.G. & E. Co. estimates for 220 kilovolts could prove to be high, there is no assurance of this. In view of the limited experience and the uncertainties any estimate should allow for contingencies. It is believed that any competent estimate, made with the same knowledge, will substantiate theirs.

110-KILOVOLT UNDERGROUND CABLES

The use of cable at this voltage, and on up to 138 kilovolts, is extensive. Table I traces the history of such installations. Since the end of a 20-year trial period, about 1946, some 900 circuit miles of cable in the 110- to 138-kilovolt ratings has been placed in service. The P.G. & E. Co. has reported more than 40 miles of these totals.

There is little uncertainty as to costs or other matters regarding cables at these voltages. Probably the biggest unknown in many instances now is the cost of trenching. Whether or not this voltage can be used to supply SLAC is a matter worthy of careful investigation. In favor of such a solution is the existence of a number of 110-kilovolt circuits in the general area and on north in the San Francisco area. The utility has the operating experience and the construction experience. As will be shown later, the use of 110-kilovolt cables rather than 220-kilovolt cables has certain cost advantages.

CIRCUIT ECONOMY

The fact that the load will increase by a substantial ratio over an appreciable period of time has an influence on the choice of circuit arrangements. With the ultimate load being established as to size, although there is some uncertainty as to date of occurrence, it is also easier to make a good choice.

It is quite common to use a value of 15 percent to determine the annual cost of utility plant. This approximates the cost of interest, taxes, depreciation, maintenance, and related costs. If we use this rate and assume that funds will earn 4 percent it is found that any amount of investment which can be deferred for a short number of years may represent large reductions in overall costs. The original deferred sum, plus the credit for the annual 15 percent not realized in costs, plus interest at 4 percent results in doubling the original amount in about 5 years and tripling in about 9 years.

In the case at hand we find that two circuits, each of about 111-megavolt-ampere capacity, will provide for the proposed load program until 1972. At that time a third 111-megavolt-ampere circuit would be necessary if the projected loads actually materialize. In each of the instances above one entire circuit represents spare capacity available for emergencies and for operating convenience.

The total investment required for the four 111-megavolt-ampere circuits in underground cable should come to somewhat less than is being estimated by P.G. & E. Co. for two 334-megavolt-ampere circuits, underground. This relation is based on the use of 110 kilovolts for the four circuits, compared with the use of 220 kilovolts for the two circuits. At equal costs there would be about $210,000 per mile available for the 110-kilovolt circuits. It is believed that circuits of this voltage and the required capacity have been built for around $175,000 per circuit mile through suburban areas. The records of the P.G. & E. Co. experiences with similar lines through more congested areas may provide a helpful comparison.

REQUIRED CIRCUIT CAPACITY

The need for one full circuit as a spare to be used during emergencies, so that maximum demand can be supplied while one circuit is out of service, is not substantiated by the contract. As a matter of fact the contract makes it clear that a substantial portion of the maximum demand used by SLAC is to be on an interruptible basis. The requirement of "one standby circuit at all loads" is stated in the P.G. & E. supplemental study dated June 5, 1963, and attributed to "authorized SLAC personnel."

The consequence of requiring one more circuit as protection against interruption which, according to the contract, can occur without any circuit failure being involved, is to increase the final costs by one circuit under various alternate circuit arrangements and to advance the date by which additional circuits will be necessary. The intent of the contract, if it is to be followed, suggests that there may be a place for the existing temporary 66-kilovolt line and perhaps more like it, to help to further reduce the number of other lines required and to retard the dates when such other lines must be ready.

It is possible that SLAC might function, within the terms of the contract so far as continuity of service is concerned, with power from only the existing 66-kilovolt line for a few years. Should it be found possible to build and use another temporary 66-kilovolt line then the construction of other sources such as the 220-kilovolt lines might reasonably be deferred for some years.

Attachments: Questions and answers, tables I, II, III, and IV.

QUESTIONS AND ANSWERS

Q. Is the extra equipment required at the substation to protect the underground line in case of fault and does this equipment and accessories cost $210,000 per circuit?

A. There is little if any "extra" in the way of protection equipment required because of the circuit being underground. There are the costs of cable terminators, (potheads) pressure maintenance facilities, and such items which are required only because the circuit is underground.

The cost of all such equipment, both extra and not extra, might amount to $210,000 per circuit if it includes the oil circuit breakers, disconnect switches, bypass facilities, rack structures, relays, and a proportionate share of land, fence, buildings, roads, and other station accessories. Most of these costs apply equally to tower line circuits.

Q. Are there any special problems which arise when part of a line is on towers and part underground? (*a*) When both have two circuits? (*b*) When towers have two and underground has three?

A. Nothing of consequence in case (*a*) provided each overhead and one related underground function as one circuit in each instance.

Yes, there could be problems in case (*b*) unless all five elements work as one circuit. Such an arrangement would defeat most of the advantage of having more than one circuit.

Q. What are the costs for potheads, lightning arrestors, etc., for various size underground circuits?

A. The cost is not particularly a function of cable size. It is influenced largely by voltage, design of pothead, and the pressures involved. Potheads for the 220-kilovolt circuits in question (2,000 mcm high pressure pipe-type) would cost about $7,500 each for material, labor, and overhead on those items. Cost of space occupied would be in addition. Three of these are required for each terminal of each circuit.

Lightning arrestors would not seem to be a special charge because of underground. It is customary to use these items to protect transformers, circuit breakers, and other equipment. A cable circuit of itself does not attract lightning, it is where such circuits attach to overhead lines or open bus work in stations that they become exposed to lightning.

Q. What is the current carrying capacity of various sizes of underground cable when buried in soil with a thermal resistivity of 90 thermal ohms?

A. This depends on factors in addition to the thermal resistivity. Table 11 shows from 30 to 40 current carrying values for each of three conductor sizes. The voltage, the load factor, use of gas or oil and whether or not the conductors are assembled to limit circulating current all influence the answer to this question. It takes several hundred pages of tables on 8½ by 11 sheets to provide answers to typical circumstances.

The values in table II are gross conductor current, not net load current. An adjustment must be made because of charging current. Table III shows some values for this. The charging current is in quadrature with the energy component and exactly negative to any inductive component. Vectors must be used to determine the resultant of these three currents, all of which appear in most instances.

Q. Is 90 thermal ohms the minimum figure that can be achieved by corrective backfill in our area?

A. The corrective backfill is not the most critical factor. In most instances the moisture content is most influential. However, with suitable imported backfill, where required, and maintenance of moisture content, a value of less than 90 thermal ohms can be attained.

Q. What are reasonable ditching costs on the two routes being considered? How much are these basic costs increased by refilling with corrective backfill and repaving as necessary?

A. Trenching costs are most difficult to forecast. Experts who make their living on this work have been observed to miss by as much as 50 percent in either direction. The amounts stated here are expectations rather than estimates. On this basis it is expected that bids, or actual costs would exceed $2 per foot but not $6 per foot average for the entire job for a 24-inch wide trench, not including repaving.

Corrective backfill should cost from $6 to $10 per cubic yard at the trench side. If it is to be blended with native soil to reduce the imported quantity, this will add about $1 per cubic yard of blended material.

Repaving costs may vary from about $3 per square yard on up to $20 per square yard. In addition, some street departments require saw cutting of the edges before repaving. This will add from 50 cents to $1 per trench foot.

Q. Is equipment available which can determine the faulted conductor in a three-conductor, duct-type, underground system and automatically switch a spare, fourth conductor in to replace it?

A. Not that is known. This could be done by hand, however. It would probably take some 15 minutes at each terminal, plus traveltime to the job and between terminals.

Q. Can a 220-kilovolt circuit of 300 megavolt amperes be carried on wooden poles? If so, how tall and what is the comparative cost with towers?

A. Yes; in a physical sense. It would be more costly and most likely more objectionable. Tall poles are very costly. It is probable that 90- to 100-foot poles are the maximum heights to consider; two-pole supports with a steel cross member and from 6 to 12 anchors at each support is what might result. These might be necessary at a rate of from 8 to 10 per mile. Costs are not available. The fact that nearly all such lines are on steel towers suggests that poles are not attractive.

Q. Can you give us estimates of a reasonably priced, inoffensive means of supplying 200 megawatts at 90 percent power factor with the possibility of later expansion (1971) to 300 megawatts?

A. My most likely suggestion is to use 110 kilovolts. This is being described more fully in a report.

Q. Will the proposed P.G. & E. tapline be expandable to a higher capacity in the future?

A. In a physical sense; probably yes. However, it is not likely that a 300-megavolt-ampere line will be increased in capacity at some future date.

TABLE I.—*Cables in Western Hemisphere 110 kilovolts to 138 kilovolts, inclusive*

[Accumulated totals are shown]

Year ended	Oil-filled		Pipe type		Combined	
	Number of circuits	Circuit miles	Number of circuits	Circuit miles	Number of circuits	Circuit miles
1927	2	7			2	7
1929	3	8			3	8
1930	6	17			6	17
1932	7	17			7	17
1934	9	21			9	21
1935			4	6	13	27
1937	10	30			14	36
1938	11	34			15	40
1939	12	36			16	42
1940			6	7	18	43
1941	14	44	7	13	21	57
1942	15	44	9	14	24	58
1943	20	62			29	76
1946	24	78	11	19	35	97
1947	28	88	16	41	44	129
1948	30	98	30	94	60	192
1949	37	105	33	109	70	214
1950	39	105	43	159	82	264
1951	43	109	55	193	98	312
1952	49	114	62	207	111	321
1953	53	129	72	239	125	368
1954	58	138	80	248	138	386
1955	64	166	102	310	166	476
1956	70	176	134	406	204	582
1957	76	191	145	449	221	640
1958	83	211	169	530	252	741
1959	90	227	189	616	279	843
1960	(1)	(1)	209	658		
1961	(1)	(1)	226	704		
1962	(1)	(1)	240	747		

[1] Not available.

Source: Summarized from AIEE publications S–131, June 1961 (oil-filled and S–110–A, November 1962 (pipe type).

Circuit miles rounded to nearest whole mile. Data may not include all installations. The above quantities include 10 circuits with a total of 41 circuit miles reported by P.G. & E.

TABLE II.—*Selected ampacities, copper conductors, 2 pipes in 1 trench, 20° C. earth ambient, rho and load factor as shown*

69-KILOVOLT HIGH PRESSURE, OIL-FILLED, PIPE TYPE

Size, thousand circular mils (1)	Rho 60			Rho 90			Rho 120		
	50 linear feet	75 linear feet	100 linear feet	50 linear feet	75 linear feet	100 linear feet	50 linear feet	75 linear feet	100 linear feet
500	653	583	520	597	519	454	550	470	406
(1,000)	935	816	716	847	718	618	774	644	547
1,000	993	864	756	897	758	650	818	678	575
2,000	1,376	1,163	997	1,226	1,005	846	1,106	890	741

115-ILOVOLT HIGH PRESSURE, OIL-FILLED, PIPE TYPE

500	626	560	502	574	499	437	529	451	389
1,000	949	828	726	857	724	621	779	645	545
2,000	1,342	1,127	963	1,196	969	810	1,073	850	701

161-KILOVOLT HIGH PRESSURE, OIL-FILLED, PIPE TYPE

500	598	537	482	548	477	418	503	429	370
1,000	885	778	686	792	674	582	710	593	504
2,000	1,250	1,059	909	1,099	898	754	969	773	641

115-KILOVOLT HIGH PRESSURE, GAS-FILLED, PIPE TYPE

500	584	530	480	541	478	423	593	435	379
1,000	894	791	701	816	700	606	748	628	536
2,000	1,277	1,089	939	1,151	947	798	1,042	838	696

NOTE.—(1) 500,000 circular mils is compact strand, larger sizes all segmental except 1 instance shown: (1,000).

Source: From "AIEE–IPCEA Power Cable Ampacities" 1962 edition.

TABLE III.—*Charging megavolt ampere 2,000,000 circular mils conductor high pressure oil-filled pipe-type cable circuits*

Kilovolt	Megavolt ampere (gross)	Rho	Charging megavolt ampere (per mile)
66	110	80	1.8
132	200	80	4.5
220	300	80	8.6
2,220	250	100	8.6

Source: Extract from AIEE Paper No. 56-69 "Charging Current Limitations of High-Voltage Cable Lines," C. S. Schifreen and W. C. Marble both of Philladelphia Electric Co.

TABLE IV.—*Cables in Western Hemisphere, 220 kilovolts and higher*

Year energized	Operation, kilovolts	Circuits		Total miles	Type	Operator [1]
		Number	Miles			
1954	301	2	0.38	0.76	O–F	a.
1955	230	4	.285	1.14	Pipe	b.
1956	301	1	.38	.38	O–F	a.
1956	230	4	.285	1.14	Pipe	b.
1956	230	3	.19	.57	Pipe	c.
1957	301	2	.38	.76	O–F	a.
1957	230	1	3.29	3.29	O–F	d.
1957	230	1	5.90	5.90	O–F	d.
1957	230	2	2.08	4.15	O–F	d.
1957	230	1	1.20	1.20	Pipe	e.
1957	230	1	.25	.25	O–F	f.
1957	230	1	.29	.29	O–F	f.
1959	230	1	4.53	4.53	O–F	d.
1959	230	2	.46	.92	Pipe	e.
1960	230	1	.29	.29	Pipe	b.
1961	230	1	.29	.29	Pipe	b.
1962	240	6	N.L.	5.02	Pipe	e.
1962	240	4	N.L.	1.80	Pipe	e.

[1] Operators: a. Alum of Canada; b. Brazilian Traction L. & P.; c. U.S. Corps of Engineers; d. B.C. Electric; e. New York State; f. Niagara Mohawk Power. Source same as table I. In addition to above about 15 miles of 230 kilovolts and 15 miles of 345 kilovolts is planned or built.

APPENDIX 4

POWER TRANSMISSION FOR STANFORD ACCELERATOR

A. AEC CHRONOLOGY

January 7–9, 1963: P.G. & E. was granted use permits by the planning commissions of the county of San Mateo County and the city of Menlo Park for the 60-kilovolt wood pole line required to supply electric power for the construction of the Stanford linear accelerator.

January 10, 1963: P.G. & E.-AEC contract for supply of power required for the construction and operation of the accelerator was signed. The contract stipulates a 60–kilovolt wood pole line, and a 220-kilovolt power line along the Searsville route.

January 24, 1963: P.G. & E. had a preliminary meeting with the Woodside Planning Commission. It requested that P.G. & E. consult with Woodside's staff planner and with the planning officials of San Mateo County to develop the best possible location for an overhead line.

June 1963: P.G. & E. filed applications with the planning commissions of Woodside and San Mateo County for use permits for a double circuit, 220-kilovolt line, capable of delivering 300 megawatts to SLAC over either of the two circuits. The estimated cost of this line was $668,000.

June 27, 1963: The Woodside Planning Commission held a hearing on P.G. & E.'s application. The Woodside Planning Commission requested additional data. It also asked why the overhead line could not parallel the proposed Junipero Serra Freeway.

August 7, 1963: P.G. & E. filed an amended application to cover, also, a line along the Junipero Serra route, either on towers or on dual circuit poles. The estimated cost of the tower line adjacent to the proposed freeway was $951,000, and the estimated cost of the tubular steel poles on this route was $1,012,000.

August 15, 1963: Upon being informally advised that P.G. & E.'s applications were encountering serious opposition because of a desire that the transmission line be placed underground, AEC's general manager wrote to the Woodside Planning Commission to state his belief that the extra cost that AEC would be compelled to bear if the line were buried could not be justified. He reviewed the history of the project and stated other facts bearing on the problem.

August 22, 1963: The Woodside Planning Commission held another hearing to consider the additional data and the alternate application. At this hearing P.G. & E. presented a study of the problem of installing an underground line to SLAC. Among other things, this study indicated that the estimated cost of an underground line equivalent in capacity to the overhead tower line was $6,440,000.

September 26, 1963: The Woodside Planning Commission denied P.G. & E.'s applications for a use permit for an overhead line on either the Searsville or the Junipero Serra route. Findings were to be prepared to this effect.

October 24, 1963: The Woodside Planning Commission made findings and formally denied P.G. & E.'s applications for both routes. The following are pertinent excerpts from the minutes of this meeting of the Woodside Planning Commission:

"The proposed use is not needed to serve any portion of the town of Woodside and is intended to serve only the Stanford Linear Accelerator Center (SLAC).

"The proposed use will not contribute directly to the general wellbeing of the neighborhood or community in that its only purpose is to supply power to a facility which is located outside the town boundaries. It is recognized that SLAC may prove to be of benefit nationally, and thereby very indirectly contribute to the general wellbeing of residents of the town of Woodside; however, this does not appear to be a sufficiently certain or direct benefit to justify the granting of the permit, particularly in view of the fact that the major adverse affects of the transmission lines would be borne by the town of Woodside while any benefits resulting would accrue to the Nation as a whole."

October 29, 1963: The Woodside Planning Commission sent its recommendations to the Woodside Town Council.

November 13, 1963: P.G. & E. appealed the Planning Commission's decision to the Woodside Town Council. During this appeal, Mr. Herman Halperin, an independent consulting engineer on electric power, proposed a compromise single circuit, 220-kilovolt, 300-megawatt line on a new type of tubular steel poles rather than towers. P.G. & E, Stanford, and AEC were willing to accept this compromise line.

January 2 and 7, 1964: P.G. & E. filed applications for use permits for the compromise line on tubular steel poles with the Planning Commissions of Woodside and San Mateo County.

January 9, 1964: Staff met with Mr. Paul N. McCloskey, Jr., at his request, He represented a group of citizens who were opposed to an overhead line.

January 22 and 23, 1964: The Planning Commissions of Woodside and San Mateo County denied use permits for the compromise line.

January 29, 1964: Hearing before the Joint Committee on Atomic Energy.

February 14, 1964: Woodside Town Council approved a resolution to raise funds for placing a powerline underground. The town proposed to raise $150,000 if this could be done legally.

February 1964: P.G. & E. appealed to the county board of supervisors the denial by the Planning Commission of San Mateo County of P.G. & E.'s applications. P.G. & E. also appealed to the Woodside Town Council the denial of the Woodside Planning Commission of a use permit for a single circuit line on tubular steel poles along the Searsville route.

February 27, 1964: At a special meeting the San Mateo Board of Supervisors returned to the county planning commission for reconstruction P.G. & E.'s applications for a use permit.

March 7, 1964: Dr. Seaborg wrote to the mayor of Woodside and to the county manager of San Mateo County, recounting the background facts and explaining AEC's position. As a courtesy, AEC decided to postpone until March 16, 1964, action to assure the availability of electric power for the operation of SLAC.

March 9, 1964: The San Mateo Planning Commission granted the conditional use permit to P.G. & E. for tubular steel poles, appropriately appended, along the Searsville route. The Woodside Town Council denied P.G. & E.'s appeals from the three denials by the Woodside Planning Commission. The town of Woodside passed a so-called temporary interim zoning ordinance prohibiting the overhead installation by anyone, including the United States, of electric lines of 50,000 volts or greater capacity.

March 16, 1964: Dr. Seaborg wrote to the mayor of Woodside and to the county manager. This letter indicated that AEC was sincerely hopeful that it would not be necessary for the Government to acquire portions of the right-of-way in the unincorporated area of the county, and that a county use permit to P.G. & E. would enable AEC to construct, through Woodside, the tubular steel poles that P.G. & E. would install in the unincorporated area of the county under a county use permit.

March 24, 1964: Condemnation action was begun by the U.S. attorney.

April 21, 1964: Conditional use permit issued by San Mateo County Planning Commission on March 9, 1964, denied by San Mateo County Board of Supervisors, 5 to 0.

April 30, 1964: Declaration of taking for necessary right-of-way both in the city of Woodside and also in San Mateo County filed in U.S. district court in San Francisco by Department of Justice at request of U.S. Atomic Energy Commission. Conditional possession granted by court to permit surveys and engineering work but no construction pending the hearing by the court of a motion to dismiss now scheduled for June 4.

In the course of the above events, AEC endeavored to keep all interested parties informed of the facts, the position of the Federal Government, and the compromise solutions it could accept. Also, AEC has been courteous and cooperative.

B. SUMMARY

The national facility that AEC and Stanford University are endeavoring to build and operate is a unique, 2-mile linear electron accelerator complex. When completed, it will be manned by over 700 scientists and technicians and it will be used as a major tool for exploring the immensely important world of the atom, nature's building block. We expect that this facility will contribute greatly to man's understanding of the physical aspects of the universe and of life within it, and to the scientific and technological stature of the United States. The accelerator complex will cost about $114 million to build. Congress authorized that amount after AEC made very extensive studies and cost estimates over a number of years. Construction is now well along. The present schedule calls for completion of the facility by the end of 1965, and for shakedown activities during 1966 before full-scale research use is begun.

In January 1963, Pacific Gas & Electric Co. undertook to furnish AEC with the electric power needed for the construction and operation of this accelerator complex. Rates and terms were agreed to; they are subject to the approval of the California Public Utilities Commission. These rates and terms were conditioned on P.G. & E.'s proposal to furnish power for the operation of the facility by means of an overhead transmission line to be installed along a general route known as the Searsville route. The line would begin at a point of connection to P.G. & E.'s newly constructed Monta Vista-Jefferson 220-kilovolt overhead loop line which runs along the mountain ridge west of the project site, and would terminate at the accelerator center. The estimated cost of this transmission line, $668,000, was reflected in the rate pattern stipulated in the agreement. AEC was satisfied with the contract terms applicable to the electric power it would receive as a customer of the utility company because, among other features in the contract, P.G. & E. agreed to wheel Bureau of Reclamation power to the project at an advantageous rate to AEC, and because the Searsville transmission line on which P.G. & E.'s rate was predicated represented the most value for the least cost to the Federal Government. It would consist of two 300-megawatt circuits and consequently would provide all the power the accelerator might require plus affording the comfort of a backup circuit if the power over one of the 300-megawatt circuits was interrupted.

In the course of the long study that this project was subjected to prior to its endorsement by Congress, and in the hearings before the Joint Committee on Atomic Energy that preceded congressional authorization, there was no question at any time but that the project would use the cheapest available power delivered by the usual overhead means. Furthermore, when AEC signed its agreement with P.G. & E. in January 1963, it had no reason to believe it would be confronted with a problem—let alone with the demand which the authorities of the town of Woodside, some of the authorities in San Mateo County, and groups of residents of these communities have made. I will describe the nature and dimensions of this demand in a moment.

After the P.G. & E.-AEC power agreement was signed, local opposition developed to the stipulated double circuit Searsville line and P.G. & E. was denied a use permit by the town of Woodside and by San Mateo County for the construction of this line within their boundaries. Spearheaded by a spokesman for a citizens' group, who also on occasions represented the town of Woodside, and by other members of the community, a flat demand was in effect made on AEC as the price for permitting the national facility to be served with electric power. This demand the Atomic Energy Commission simply cannot satisfy. The demand was, and is, that the Federal Government agree to the underground installation of the transmission line to serve the project notwithstanding the significantly greater cost that the Government would have to bear in addition to the other burdens it would be forced to assume if the line were placed underground.

The key figures, very briefly, are as follows:

1. First, it must be borne in mind, the best service, in the interest of the project, is the double circuit 300-megawatt Searsville line P.G. & E. originally proposed to install and on which the P.G. & E.-AEC contract rates are predicated. It would cost about $668,000, and would provide all the power the accelerator might need, plus a backup source if something went wrong with one of the circuits.

2. A single overhead 300-megawatt line, built on the much more esthetically desirable, new type of tubular steel poles suggested by an independent consulting engineer on electric power systems, would be less advantageous for the project and would cost approximately $922,000 plus $130,000 for augmented terminal facilities at the accelerator complex for necessary backup for the single circuit line. These estimates relate to the Searsville route.

3. For a double circuit 300-megawatt line along an alternate route paralleling the proposed Junipero Serra Freeway the cost is estimated to be $951,000. This figure is comparable to the $668,000 estimate for the Searsville route. For double 300-megawatt circuits on tubular steel poles along the freeway route the cost would be about $1,012,000 plus $130,000 for the auxiliary facilities mentioned above.

4. The following are the estimated costs for underground installations: For a double circuit 300-megawatt line, about $6,440,000; for a double circuit 180-megawatt line, about $5,080,000; for a single circuit 300-megawatt line, about $3,641,000; and finally, for a single circuit line of 180-megawatt capacity, approximately $2,640,000.

The above figures include the estimated land acquisition costs as well as other pertinent cost ingredients.

Since August 1963, when AEC first learned that P.G. & E.'s applications to the Planning Commission of Woodside and San Mateo County were encountering serious opposition, AEC's General Manager and staff devoted much time and effort in attempts to arrive at a solution that would be generally satisfactory to all parties concerned. They studied various types of possible construction, alternative powerline routes, and attendant cost figures. AEC representatives participated in many meetings with the principal spokesman for the citizens' group that has been in the forefront of the development of this controversy, and with others. The Commission, itself, gave careful consideration to the problem. In January of this year, the Joint Committee on Atomic Energy held a hearing to review the entire situation. It lasted all day. At this hearing, presided over by Mr. Holifield, vice chairman, Mr. Holifield and Mr. Hosmer opened for discussion virtually every aspect of the situation. Representatives of Woodside, San Mateo County, Stanford University, P.G. & E., and AEC testified. Recently, the mayor of Woodside wrote to the President of the United States. His letter was answered by Mr. Lee White, Special Assistant to the President.

During all of this time, right up to March 16, 1964, and notwithstanding the fact that essentially no progress had been made since early 1963 to provide the transmission line needed to enable the operation of the accelerator, AEC postponed taking any action on its own in deference to the requests and wishes of the local communities and in the hope that a generally acceptable compromise solution could be found. It informed these communities and the spokesman for the citizens' group of its willingness to accept delays as long as it possibly could without seriously hurting the project, and of the compromises it believed it could make. It did this as honestly and forthrightly as it could. It used no bluffs or threats. It did not deviate from this course despite the provocations of some deliberate unnecessary delays, misleading statements, and other dis-

ingenuous tactics. When on the 7th of this month AEC once again, as a courtesy, postponed taking action on its own until the 16th, it realized that the town would probably use this period to attempt to improvise some sort of legal basis for resisting the only solution AEC was being compelled to adopt.

Between August 1963, and March 16, 1964, AEC indicated it would accept these alternative compromises:

(*a*) A single 300-megawatt overhead line on tubular steel poles along the Searsville route.

(*b*) A single 300-megawatt overhead line on tubular steel poles along a route parallel to the proposed Junipero Serra Freeway.

(*c*) A single underground line, plus an AEC contribution of $350,000 toward the added cost of burying such a line of 180-megawatt capacity; this amount would, of course, be in addition to the $668,000 included in the power rates presently stipulated in the P.G. & E.-AEC agreement and which the Government would also have to bear if the line were placed underground.

One must consider that alternatives (*a*) and (*b*) would be more costly to the Federal Government and less desirable for the project than the cheaper double circuit, tower transmission facility contemplated in the P.G. & E.-AEC agreement. As for the underground line mentioned in alternative (*c*), this is by far the least desirable from the standpoint of the best interests of the project, while being much greater in initial cost as well as encumbered with the troublesome possibility that in future years 180 megawatts may well be insufficient to permit the full-range research use of the accelerator and consequently require an additional outlay of over $2½ million.

All of these compromise solutions were rejected. The town of Woodside states it will issue a use permit to P.G. & E. to build a transmission line to serve the national facility only if the line is installed underground. It is unmoved by the AEC's inability to justify bearing practically all of the significantly greater costs that would be involved in satisfying this desire, particularly in the face of these plain facts:

(1) An underground line would, by far, be the least desirable for the project. Due to the excessive costs entailed, AEC would probably have to accept a single line of 180-megawatt capacity; I have mentioned above the possibility that at some future time a second line may well be required. Additionally, outages on an underground line are of much longer duration than those occurring in overhead transmission. A month or 6 weeks may be required to find and fix breaks and other deficiencies.

(2) The town of Woodside now has many overhead lines and related structures that are not as esthetically unobstrusive as the tubular steel pole P.G. & E. is willing to install and AEC to accept.

(3) No transmission line has ever been placed underground in Woodside, and, as far as we are aware, there is no such practice in any areas other than in large cities. We believe insistence on undergrounding here and now is wholly unjustified. We submit this is clearly the wrong time, place, and occasion to inaugurate the pioneer practice of burying transmission lines in communities such as those here involved. Aside from all the technical and cost considerations, AEC is simply seeking to obtain power as a customer of the utility company. It has to be careful lest it trespass, however involuntarily, into the jurisdiction of others in the Federal Government who have responsibilities in conservation and power transmission fields.

The Planning Commission of San Mateo County, recently granted a so-called conditional use permit that would permit P.G. & E., to build a single-circuit 300-megawatt line on tubular steel poles along the Searsville route. By its terms, it is not yet effective. The county manager has informed AEC that this permit will probably be withdrawn. AEC is sincerely hoping that the permit will become firm because AEC could, under those circumstances, provide the tubular pole construction through the town that would conform to P.G. & E.'s construction outside of the town pursuant to its county permit. AEC regrets very much the necessity for the Government's acquisition of the portion of the right-of-way within the limits of the town of Woodside. It simply had no choice. It explained all this to the officials of the town and the county, and it told them frankly that if the Government has to acquire all or a major part of the entire right-of-way it would be difficult for AEC to justify any construction other than that which constitutes the least costly type to provide adequate transmission facilities.

AEC has gone just as far as it possibly can to accommodate the esthetic desires of these communities. It cannot meet their extreme demand.

On March 17, in order to assure that electric power would be available for the operation of this national facility, the Atomic Energy Commission requested the Department of Justice to institute eminent domain proceedings with respect to that portion of the right-of-way within the town's boundaries. If the county use permit is withdrawn or P.G. & E. is unable to proceed under it without undue delay, the Federal Government will be compelled to acquire the remainder of the right-of-way by eminent domain.

C. LEGAL AUTHORITY

Since the Atomic Energy Act of 1946, the Commission has been empowered to acquire title to or a lesser interest in real property. The Atomic Energy Act of 1954 continued this right without hiatus. Section 161(g) specifically authorizes the Commission to "* * * acquire * * * real and personal property * * *." This authority enables the Commission to acquire property by eminent domain. The basic act of August 1, 1888 (40 U.S.C. 257), states explicitly that officers of the Federal Government may institute condemnation proceedings when authorized to procure real property. Appropriations for purposes of this project were provided by the Congress.

Pursuant to Section 261 of the Atomic Energy Act of 1954, the authorization acts for fiscal years 1961 and 1962 (Public Laws 86–457 and 87–315) authorized funds for the linear electron accelerator project, including the "acquisition or condemnation of any real property" in connection with the project.

Section 271 of the Atomic Energy Act of 1954, as amended, reads:

"AGENCY JURISDICTION. Nothing in this Act shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to the generation, sale, or transmission of electric power."

The legislative history of this provision indicates that this disclaimer was intended to apply to electric power generated by nuclear means, and not to a situation such as is here involved. Even if it were otherwise, the condemnation by the Federal Government would not, in the opinion of the Federal Government, impinge on any valid legal requirement of the town of Woodside. The ordinance it passed shortly before the Department of Justice started eminent domain proceedings is believed by the Federal Government to be invalid, not only with respect to its scope and contents, but also by reason of the manner of its enactment.

The Federal Government believes that its right to condemn in this case is reasonably clear.

D. STATEMENT BY THE ATOMIC ENERGY COMMISSION ON STANFORD LINEAR ACCELERATOR POWER SUPPLY

The Atomic Energy Commission, as the agency responsible for the Stanford linear accelerator project, is also responsible for seeing that this facility will have an adequate source of electric power when construction, now underway, is complete.

The Commission and its staff, sympathetic with the desires of the local communities to preserve the natural beauty of the countryside, have devoted much time and effort since August 1963, to seeking a satisfactory solution to the problem of providing electric power to the accelerator. The Commission has been willing to accept several alternatives to the original plans as a result of the request of the town of Woodside and San Mateo County that the powerlines be placed underground. All of these alternatives would involve greater costs than would the originally proposed overhead powerline and because of reduced capacity would be less desirable for the project. None of the alternatives has satisfied the communities. The Commission has expressed its willingness to accept substantial additional costs for less advantageous systems on overhead tubular steel poles which are not unattractive. It has also indicated it would accept an even less advantageous underground system toward which it would also contribute a substantial additional amount if the remaining costs were absorbed by other groups involved.

The Commission must operate within the limits of funds appropriated to it by the Congress. The funds authorized for the Stanford project were based on very careful cost studies and were provided after close congressional

scrutiny over a number of years. The cost of the overhead powerlines originally proposed for this installation is estimated at $668,000. The estimated cost of placing comparable lines underground is $6,440,000. The probable cost of the less-adequate overhead line on tubular steel poles proposed as a compromise is $922,000, compared to an estimated cost of $3,644,000 for a similar line located underground. An even less adequate underground line would cost $2,640,000; the Commission, in the spirit of compromise, has determined that this could be considered to meet the minimum needs of the project for the first few years of operation. The above figures include the estimated land acquisition costs as well as other pertinent cost ingredients.

It should be noted that the town of Woodside now has many overhead lines and related structures. Moreover, no transmission line has ever been placed underground in Woodside.

The Commission has gone far to meet the understandable esthetic desires of the residents. As has been explained previously to supporters of the town's and county's point of view, in the absence of explicit congressional authorization the Commission believes that as a practical matter it cannot undertake to pay virtually all of the extra expense of placing the transmission line underground.

There are many other scientifically meritorious projects requiring Federal support, which the Commission has had to put aside or curtail in consonance with the President's efforts to reduce national expenditures. In the field of high-energy physics, for example, the allocation of $1 million could make a tremendous difference in another project of comparable high scientific significance.

The accelerator is being built at a cost of $114 million and it is expected to cost $20 million a year to operate and engage a staff of 700. It will provide an outstanding research and educational asset that would be a credit to any community. In addition, such an enterprise would be a great economic asset to any region in the country and would be eagerly sought after by many.

The Stanford linear accelerator power supply question has received serious and sympathetic attention of the Atomic Energy Commission. The decision was the Commission's, but it was made in consultation with the Joint Committee on Atomic Energy and the administration. The Assistant Special Counsel to the President in his letter of March 7, 1964, to the mayor of Woodside, said: "The chronology of the issues which AEC has supplied for our review indicates clearly a cooperative, sympathetic, and sincere attitude on its part * * *. Under the circumstances, it is our conclusion that AEC's handling of this difficult issue has been and continues to be both fair and proper."

Appendix 5

AEC Correspondence to Town of Woodside and San Mateo County

U.S. Atomic Energy Commission,
Washington, D.C., March 7, 1964.

Hon. John O. Pastore,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

Dear Senator Pastore: As you know the problem of obtaining electric power for the Stanford linear electron accelerator has been receiving the attention of AEC for a long period of time. I am enclosing copies of letters that I have just dispatched to the county of San Mateo and the town of Woodside, Calif.

You will note that the Commission has decided that it would be in the national interest for AEC not to postpone action on its part beyond March 16, 1964, and to acquire by condemnation as soon after that date as possible a right-of-way over the Searsville route for the overhead construction of transmission facilities required to supply electric power to the national installation at Stanford. Should the county and Woodside grant use permits to P.G. & E. for an overhead installation over the Searsville route, or the freeway route, we would not proceed with this plan, which, as we believe you appreciate, we would otherwise be compelled to employ. Also, if contrary to all indications, the Commission receives an offer which presents, without any delaying or contingency factors, a contribution of substantially all the remaining costs entailed in placing the line underground, the Commission will consider such offer carefully.

The interest of the committee in this matter has been most helpful. We will keep you advised of developments and be pleased to provide any additional information.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., March 7, 1964.

Hon. DONALD J. GRAHAM,
Mayor, Town of Woodside, Calif.

DEAR MR. GRAHAM: I am writing to you concerning the problem that has arisen in connection with AEC's endeavor to obtain electric power for the national facility often referred to as the Stanford linear electron accelerator.

Since last June, when serious opposition arose to P.G. & E.'s application to the Woodside Planning Commission for a use permit for the construction of an overhead transmission line along the Searsville route, our General Manager and staff have devoted much time and effort in attempts to arrive at a solution that would be generally satisfactory to all parties concerned. They have studied the various types of possible construction, alternative powerline routes, and attendant cost figures.

Now they have again reviewed the situation. Also, the Commission has, itself, gone over the entire record and considered the matter carefully. I think it may be helpful to recount briefly the salient facts comprising the history and substance of the problem:

1. On January 10, 1963, the AEC and P.G. & E. signed a power supply contract under which P.G. & E. obligated itself to construct, operate, and maintain an overhaed 60-kilovolt wood pole line to meet the initial power requirements of the project during its construction phase and an overhead 220-kilovolt tapline running from a then proposed, now actual, P.G. & E. feeder called the Monta Vista-Jefferson loop to the accelerator center. P.G. & E.'s execution of the agreement was expressly made subject to the approval of the California Public Utilities Commission, and the contract was contingent on P.G. & E.'s construction of the overhead 220-kilovolt tapline along a route known as the Searsville route. The contract power rates appropriately reflected recovery from AEC of the cost to P.G. & E. of the tapline estimated at $668,000. When this contract was signed by the AEC, we were acting as a customer for electric energy and had no real involvement in the means to be employed by the utility company in furnishing the required power. Furthermore, we had no idea that such an involvement would ever be forced on us by events such as those which have occurred since last summer.

2. When the General Manager was informally advised that P.G. & E.'s applications to the planning commissions for use permits for the construction of an overhead transmission line were encountering local opposition because a strong sentiment for undergrounding the line was developing, he wrote the Woodside Planning Commission on August 15, 1963, to state his belief that the extra cost that AEC would be compelled to bear if the transmission line were to be buried could not be justified. In his letter to the planning commission, the General Manager reviewed the congressional history of the project and emphasized the fact that the validity of the cost estimates supporting the authorization of the project was of deep concern to the Congress. He advised the planning commission that since congressional authorization of the project the AEC had been able to continue to assure interested Members of the Congress, as well as the Executive, that the project estimates remained realistic. This was due, he stated, to AEC's efforts and those of Stanford University to see to it that all project activities were accomplished in the most economical manner compatible with the essential scientific requirements of the facility. He said that since an underground line might involve an additional cost of several million dollars, perhaps in excess of $5 million, AEC could not accept such a cost increment for a nonstandard installation. He closed with the hope that in the light of the facts recited in his letter the planning commission would in effect support the success of the project by acting favorably on P.G. & E.'s request for a permit to build an overhead line, thereby precluding any further concern and consideration of alleviating measures on AEC's part.

3. A few days later, on August 20, 1963, Mr. Paul N. McCloskey, Jr., of the firm of McCloskey, Wilson & Mosher, wrote to the General Manager to inform him that he represented "the citizens opposed to the overhead 220-kilovolt routes presently proposed by P.G. & E." He stated that he had read with interest the General Manager's letter of August 15 to the planning commission and that he wished to have clarification of what was meant by the reference to "alleviating measures" that AEC might have to take if P.G. & E.'s applications were denied.

4. On September 5, 1963, the General Manager replied to Mr. McCloskey's letter of August 20 and, confirming a telegram he had sent him on August 21, advising Mr. McCloskey that the Commission had not yet made a determination as to the measures it should take to protect the best interest of the Government if the favorable action requested of the Woodside Planning Commission did not eventuate.

5. On September 26, 1963, the Woodside Planning Commission denied P.G. & E.'s applications, and P.G. & E. later appealed to the Woodside Town Council. On October 21, Mr. McCloskey wrote a long letter to the General Manager in which he stated that Lawrence G. Mohr, AEC's area manager at Palo Alto, had said that one of the alleviating measures that the Commission might take would be Federal condemnation of a right-of-way through Woodside for the overhead transmission line; Mr. Mohr's statement was correct. Mr. McCloskey said the residents of Woodside were concerned that AEC might initiate condemnation proceedings. Then Mr. McCloskey requested that the AEC "(1) hold a public hearing in this area before future consideration of action which would affect the legal issues here, and (2) furnish immediate assurance to the town of Woodside and its citizens that they will have an opportunity to be heard by the Commission before any action is taken."

6. On November 15, Mr. Hollingsworth, our Deputy General Manager, replied to Mr. McCloskey's letter of October 21 stating that, although, in AEC's view, the public hearing Mr. McCloskey asked for was unnecessary, the Commission would be pleased to talk with members of the Woodside Planning Commission and the town council should they so request. A copy of this letter was sent to these Woodside bodies. They did not ask to meet with the Commission. In his letter, Mr. Hollingsworth, replying to a point specifically raised by Mr. McCloskey, said it was AEC's opinion that it had the legal authority to acquire by eminent domain easements or other rights to real property for the purpose of obtaining power for the project.

7. On December 27, Mr. McCloskey wrote to Mr. Hollingsworth and stated that he had some difficulty in attempting to ascertain the legal basis for AEC's opinion. He also asked for an opportunity to confer with Mr. Hollingsworth on January 8 or 9, when he planned to be in Washington. Mr. Hollingsworth replied that he would be pleased to meet with Mr. McCloskey in his office in Washington.

8. On January 2 and 7, 1964, P.G. & E. filed applications for use permits with the San Mateo County Planning Commission and the Woodside Planning Commission, respectively, for a compromise line that had been suggested by a Mr. Herman Halperin, an independent consulting engineer on electric power systems; this would consist of a single-circuit, 220-kilowatt, 300-megawatt line constructed on new types of tubular poles rather than towers. AEC supported this plan notwithstanding the fact that it was less desirable for the project than a double circuit line.

9. On January 9, 1964, Mr. Hollingsworth and AEC staff had a lengthy conference with Mr. McCloskey. He explained that he was representing a citizens' group and not the officials of Woodside or San Mateo County. He had a number of questions which the AEC people endeavored to answer to the best of their ability. They included, I am told, the following:

Mr. McCloskey asked whether, if P.G. & E. could be persuaded to build the underground line and pay for it, AEC would accept this type of construction. AEC staff replied that they would be willing to recommend that the Commission accept an underground line despite its shortcomings, if P.G. & E. or others would pay for it. Other items discussed included the possibility of Stanford University and other parties sharing the extra cost of an underground line, the type of construction which AEC would undertake if it were to construct the line itself, and other matters pertinent to the problem. At the conclusion of this meeting Mr. McCloskey indicated that he needed time in which to pursue certain possibilities and asked how much time he could have. Mr. McCloskey was told that the transmission line was already unduly delayed from the standpoint of project

requirements and that action would have to be initiated within the next 60 days at the outside. Before leaving, Mr. McCloskey stated he had contacted Mr. Holifield and Mr. Younger.

10. On January 22, 1964, the Planning Commission of San Mateo County denied P.G. & E.'s applications, and thereafter P.G. & E. appealed to the San Mateo Board of Supervisors. We understand that the county and Woodside officials have scheduled meetings on March 9 to consider these appeals as well as amended applications which, we are informed, P.G. & E. has or is submitting for a single circuit tubular pole 300-megawatt line to parallel the proposed route of the Junipero Serra Freeway.

11. The Joint Committee on Atomic Energy held hearings on January 29, 1964, to review the entire situation. Officials of Woodside and the county, Mr. McCloskey, and representatives of P.G. & E., Stanford University, and the AEC were invited to attend and to testify. The hearing, presided over by Mr. Holifield, vice chairman, lasted all day. Mr. Holifield and Mr. Hosmer opened for discussion virtually every aspect of the situation. Costs, routes, the power needs of the project, and all other features of the problem were explored through the questions raised by Mr. Holifield and Mr. Hosmer and statements of the witnesses. As you know, at this hearing, Mr. McCloskey appeared as a representative for the town of Woodside and made statements respecting the validity of the views of the town of Woodside. Mr. Levy spoke for the county. It was the sense of the remarks of the committee at this hearing that AEC was endeavoring to conduct the public's business by reasonable means and that if the town of Woodside and San Mateo County were dissatisfied with AEC's efforts to discharge its responsibilities in the usual manner because of esthetics deemed important by the local communities, that the parties concerned about esthetic consequences should put their heads together and come up with a proposal to defray a significant part of the additional costs. Mr. Holifield told Mr. McCloskey that he thought the AEC would be willing to consider such a proposal for assumption by the local groups of the increased costs involved in undergrounding, provided undue delay was not involved.

12. As a result of the hearing before the Joint Committee, Mr. McCloskey wrote to the General Manager on February 3 and suggested that a meeting be held at the AEC area office in Palo Alto on February 8 to be attended by representatives of the AEC, P.G. & E., Stanford University, Woodside, and San Mateo County. The purpose of the meeting would be to explore a compromise suggested by Mr. McCloskey, the formula for which would require a contribution of $700,000 by AEC, $500,000 by Stanford University, $1,012,000 by P.G. & E. (an increase of $344,000 over its contractual commitment, estimated at $668,000 recoverable from the AEC, which increase P.G. & E. had previously offered to bear in connection with an overhead line on tubular poles paralleling the freeway route), and the balance to be made up by the town of Woodside, San Mateo County, and the local public. Pursuant to Mr. McCloskey's request, a meeting was held on February 8 in AEC's area office. This meeting, we are told, was attended by Mr. McCloskey and Mr. Clapp, representing the "Save Our Skyline Committee," by yourself, by a representative of the district attorney's office of the county, by AEC, P.G. & E., and Stanford representatives and by a representative from Mr. Younger's office. Mr. Shute, the Manager of our San Francisco office, spoke for the AEC. He reminded the conferees that the AEC could not wait beyond March 9 for the definitive assurance of the availability of power the project would require. Mr. Shute advised the conferees that AEC would seriously consider any bona fide proposal that did not contain a built-in delaying or contingency factor. He pointed out that shortly after the congressional hearing there had been some indication that the town and county would hold emergency sessions to consider possible proposals and that apparently more than a week had gone by without any such occurrence. Stanford's representatives advised that the University's trustees would consider the possibility of a Stanford contribution at its meeting on February 20.

13. Events subsequent to the February 8 meeting, and to date, have resulted in a resolution by the town of Woodside to contribute $150,000 toward the extra cost of undergrounding, conditioned, however, upon a contribution of $500,000 by Stanford, $300,000 by the county, and a combined contribution of $1,700,000 by P.G. & E. and AEC, and conditioned, further, on other factors including the legal ability of the town to accomplish this intention. Following this resolution, the Stanford trustees met on February 20 and concluded that it would be inappropriate for the university to pay any part of the extra costs of underground-

ing. P.G. & E. remains unwilling to assume any additional cost beyond its previously stated ceiling of $1,012,000 (which includes the $668,000 to be recovered from the AEC. San Mateo County has given no indication that it is agreeable to any plan involving a contribution by the county. The General Manager, consistent with the advice previously given by Mr. Shute to the interested parties, has recommended to the Commission that AEC contribute up to $350,000 toward the total cost of burying the line, notwithstanding the fact that this added expense would purchase nothing of value to the project and, indeed, would help enable a substitution which could well have an adverse effect on the needs of the project.

The record, it seems to the Commission, clearly evidences the willingness of the General Manager and his staff to cooperate to the fullest extent possible in efforts to find a solution that would satisfy the esthetic wishes to the town and the county and at the same time be consistent with the national interest. This matter, over a long period of delays, many of which were perhaps unavoidable despite the sincere efforts of the local bodies and groups to find an early generally satisfactory answer, has reached the point where further delay would jeopardize the use of this major national facility. Nevertheless, the Commission, in the course of its consideration of the situation, decided to agree to a postponement of action on its part until March 16, 1964.

The Commission's conclusions coincide with the views of our General Manager and the AEC people who have devoted much time and attention to this matter. We support the alternative, compromise plans of P.G. & E. for overhead lines, although they do not afford the project the added assurance of reliability of power that double 300-megawatt circuits would provide while constituting, at the same time, the most economical as well as normal means of transmitting power.

We are prepared to go along with an underground line notwithstanding the fact that the interests of the project would be better served by an overhead installation. We are willing to contribute up to the amount of $350,000, recommended by staff—as an approximate five-way sharing of the added costs of burying a 180-megawatt capacity line—toward the total additional costs involved. In addition, as previously mentioned, AEC would be absorbing the amount of $668,000 in the power rates presently stipulated in the P.G. & E. contract.

Based on the record to date, the Commission has decided that it would be in the national interest for AEC not to postpone action on its part beyond March 16, 1964, and to acquire by condemnation as soon after that date as possible a right-of-way over the Searsville route for the overhead construction of transmission facilities required to supply electric power to the national installation at Stanford. Should the county and Woodside grant use permits to P.G. & E. for an overhead installation over the entire Searsville route, or the entire freeway route, we would not proceed with this plan, which, as we believe you appreciate, we would otherwise be compelled to employ. If the county or Woodside grants P.G. & E. a use permit for an overhead installation over the part of either route in its jurisdiction, we will consider the situation and determine whether and to what extent the decision to condemn should be modified.

If, contrary to all indications in the remote or recent past, an offer is received by the Commission, which presents, without a built-in delaying or contingency factor, a contribution of substantially all the remaining costs entailed in burying the line, the Commission would be prepared to consider it carefully. Should such an offer be submitted subsequent to the initiation of eminent domain proceedings, the Commission would nevertheless give it due consideration if the practicalities involved, considering the Government's acquisition posture and the other existing circumstances, permitted.

We appreciate your earnestness and sincerity. There is no question in our minds but that you are conscientiously endeavoring to take all reasonable measures to minimize interferences with the natural beauty of your surroundings. As a Californian, I have a personal understanding of your views in this respect. You, in turn, will, I feel sure, understand that I and the other Commissioners must act in the larger context of the national interest which affects the entire public. We made our decision accordingly.

I am sending a similar letter to the San Mateo County manager.

Sincerely,

GLENN T. SEABORG, *Chairman.*

U. S. ATOMIC ENERGY COMMISSION,
Washington, D.C., March 7, 1964.

Mr. E. R. STALLINGS,
County Manager, San Mateo County,
Redwood City, Calif.

DEAR MR. STALLINGS: I am writing to you concerning the problem that has arisen in connection with AEC's endeavor to obtain electric power for the national facility often referred to as the Stanford linear electron accelerator.

Since last June, when serious opposition arose to P.G. & E.'s application to the Woodside Planning Commission for a use permit for the construction of an overhead transmission line along the Searsville route, our General Manager and staff have devoted much time and effort in attempts to arrive at a solution that would be generally satisfactory to all parties concerned. They have studied the various tyes of possible construction, alternative powerline routs, and attendant cost figures.

Now, they have again reviewed the situation. Also, the Commission has, itself, gone over the entire record and considered the matter carefully. I think it may be helpful to recount briefly the salient facts comprising the history and substance of the problem:

1. On January 10, 1963, the AEC and P.G. & E. signed a power supply contract under which P.G. & E. obligated itself to construct, operate, and maintain an overhead 60-kilovolt wood pole line to meet the initial power requirements of the project during its construction phase and an overhead 200-kilovolt tapline running from a then proposed, now actual, P.G. & E. feeder called the Monta Vista-Jefferson loop to the accelerator center. P.G. & E.'s execution of the agreement was expressly made subject to the approval of the California Public Utilities Commission, and the contract was contingent on P.G. & E.'s construction of the overhead 220-kilovolt tapline along a route known as the Searsville route. The contract power rates appropriately reflected recovery from AEC of the cost to P.G. & E. of the tapline, estimated at $668,000. When this contract was signed by the AEC, we were acting as a customer for electric energy and had no real involvement in the means to be employed by the utility company in furnishing the required power. Furthermore, we had no idea that such an involvement would ever be forced on us by events such as those which have occurred since last summer.

2. When the General Manager was informally advised that P.G. & E.'s applications to the planning commissions for use permits for the construction of an overhead transmission line were encountering local opposition because a strong sentiment for undergrounding the line was developing, he wrote the Woodside Planning Commission on August 15, 1963, to state his belief that the extra cost that AEC would be compelled to bear if the transmission line were to be buried could not be justified. In his letter to the planning commission, the General Manager reviewed the congressional history of the project and emphasized the fact that the validity of the cost estimates supporting the authorization of the project was of deep concern to the Congress. He advised the planning commission that since congressional authorization of the project, the AEC had been able to continue to assure interested Members of the Congress, as well as the Executive, that the project estimates remained realistic. This was due, he stated, to AEC's efforts and those of Stanford University to see to it that all project activities were accomplished in the most economical manner compatible with the essential scientific requirements of the facility. He said that since an underground line might involve an additional cost of several million dollars, perhaps in excess of $5 million, AEC could not accept such a cost increment for a nonstandard installation. He closed with the hope that in the light of the facts recited in his letter the planning commission would in effect support the success of the project by acting favorably on P.G. & E.'s request for a permit to build an overhead line, thereby precluding any further concern and consideration of alleviating measures on AEC's part.

3. A few days later, on August 20, 1963, Mr. Paul N. McCloskey, Jr., of the firm of McCloskey, Wilson & Mosher, wrote to the General Manager to inform him that he represented "the citizens opposed to the overhead 220-kilovolt routes presently proposed by P.G. & E." He stated that he had read with interest the General Manager's letter of August 15 to the planning commission and that he wished to have clarification of what was meant by the reference to "alleviating measures" that AEC might have to take if P.G. & E.'s applications were denied.

4. On September 5, 1963, the General Manager replied to Mr. McCloskey's letter of August 20 and, confirming a telegram he had sent him on August 21, advised Mr. McCloskey that the commission had not yet made a determination as to the measures it should take to protect the best interest of the Government if the favorable action requested of the Woodside Planning Commission did not eventuate.

5. On September 26, 1963, the Woodside Planning Commission denied P.G. & E.'s applications, and P.G. & E. later appealed to the Woodside Town Council. On October 21, Mr. McCloskey wrote a long letter to the General Manager in which he stated that Lawrence G. Mohr, AEC's area manager at Palo Alto, had said that one of the alleviating measures that the Commission might take would be Federal condemnation of a right-of-way through Woodside for the overhead transmission line; Mr. Mohr's statement was correct. Mr. McCloskey said the residents of Woodside were concerned that AEC might initiate condemnation proceedings. Then, Mr. McCloskey requested that the AEC "(1) hold a public hearing in this area before future consideration of action which would affect the legal issues here, and (2) furnish immediate assurance to the town of Woodside and its citizens that they will have an opportunity to be heard by the Commission before any action is taken."

6. On November 15, Mr. Hollingsworth, our Deputy General Manager, replied to Mr. McCloskey's letter of October 21 stating that, although, in AEC's view, the public hearing Mr. McCloskey asked for was unnecessary, the Commission would be pleased to talk with members of the Woodside Planning Commission and the town council should they so request. A copy of this letter was sent to these Woodside bodies. They did not ask to meet with the Commission. In his letter, Mr. Hollingsworth, replying to a point specifically raised by Mr. McCloskey, said it was AEC's opinion that it had the legal authority to acquire by eminent domain easements or other rights to real property for the purpose of obtaining power for the project.

7. On December 27, Mr. McCloskey wrote to Mr. Hollingsworth and stated that he had some difficulty in attempting to ascertain the legal basis for AEC's opinion. He also asked for an opportunity to confer with Mr. Hollingsworth on January 8 or 9, when he planned to be in Washington. Mr. Hollingsworth replied that he would be pleased to meet with Mr. McCloskey in his office in Washington.

8. On January 2 and 7, 1964, P.G. & E. filed applications for use permits with the San Mateo County Planning Commission and the Woodside Planning Commission, respectively, for a compromise line that had been suggested by a Mr. Herman Halperin, an independent consulting engineer on electric power systems; this would consist of a single circuit, 220-kilovolt, 300-megawatt line constructed on new types of tubular poles rather than towers. AEC supported this plan notwithstanding the fact that it was less desirable for the project than a double circuit line.

9. On January 9, 1964, Mr. Hollingsworth and AEC staff had a lengthy conference with Mr. McCloskey. He explained that he was representing a citizens' group and not the officials of Woodside or San Mateo County. He had a number of questions which the AEC people endeavored to answer to the best of their ability. They included, I am told, the following:

Mr. McCloskey asked whether, if P.G. & E. could be persuaded to build the underground line and pay for it, AEC would accept this type of construction. AEC staff replied that they would be willing to recommend that the Commission accept an underground line, despite its shortcomings, if P.G. & E. or others would pay for it. Other items discussed included the possibility of the California Public Utilities Commission authorizing P.G. & E. to absorb the added cost of an underground line, the possibility of Stanford University and other parties sharing the extra cost of an underground line, the type of construction which AEC would undertake if it were to construct the line itself, and other matters pertinent to the problem. At the conclusion of this meeting Mr. McCloskey indicated that he needed time in which to pursue certain possibilities and asked how much time he could have. Mr. McCloskey was told that the transmission line was already unduly delayed from the standpoint of project requirements and that action would have to be initiated within the next 60 days at the outside. Before leaving, Mr. McCloskey stated he had contacted Mr. Holifield and Mr. Younger.

10. On January 22, 1964, the Planning Commission of San Mateo County denied P.G. & E.'s applications, and thereafter P.G. & E. appealed to the San Mateo Board of Supervisors. We understand that the county and Woodside officials have scheduled meetings on March 9 to consider these appeals as well as amended applications which, we are informed, P.G. & E. has or is submitting for a single-

circuit tubular-pole 300-megawatt line to parallel the proposed route of the Junipero Serra Freeway.

11. The Joint Committee on Atomic Energy held hearings on January 29, 1964, to review the entire situation. Officials of Woodside and the county, Mr. McCloskey, and representatives of P.G. & E., Stanford University, and the AEC were invited to attend and to testify. The hearing, presided over by Mr. Holifield, vice chairman, lasted all day. Mr. Holifield and Mr. Hosmer opened for discussion virtually every aspect of the situation. Costs, routes, the power needs of the project, and all other features of the problem were explored through the questions raised by Mr. Holifield and Mr. Hosmer and statements of the witnesses. As you know, at this hearing, Mr. Levy spoke for the county. Mr. McCloskey appeared as a representative for the town of Woodside and made statements respecting the validity of the views of the town of Woodside. It was the sense of the remarks of the committee at this hearing that AEC was endeavoring to conduct the public's business by reasonable means and that if the town of Woodside and San Mateo County were dissatisfied with AEC's efforts to discharge its responsibilities in the usual manner because of esthetics deemed important by the local communities, that the parties concerned about esthetic consequences should put their heads together and come up with a proposal to defray a significant part of the additional costs. Mr. Holifield told Mr. McCloskey that he thought the AEC would be willing to consider such a proposal, for assumption by the local groups of the increased costs involved in undergrounding, provided undue delay was not involved.

12. As a result of the hearings before the Joint Committee, Mr. McCloskey wrote to the General Manager on February 3 and suggested that a meeting be held at the AEC area office in Palo Alto on February 8 to be attended by representatives of the AEC, P.G. & E., Stanford University, Woodside, and San Mateo County. The purpose of the meeting would be to explore a compromise suggested by Mr. McCloskey, the formula for which would require a contribution of $700,000 by AEC, $500,000 by Stanford University, $1,012,000 by P.G. & E. (an increase of $344,000 over its contractual commitment, estimated at $668,000 recoverable from the AEC, which increase P.G. & E. had previously offered to bear in connection with an overhead line on tubular poles paralleling the Freeway route), and the balance to be made up by the town of Woodside, San Mateo County, and the local public. Pursuant to Mr. McCloskey's request, a meeting was held on February 8 in AEC's area office. This meeting, we are told, was attended by Mr. McCloskey and Mr. Clapp, representing the "Save Our Skyline Committee," by the mayor of Woodside, by a representative of the district attorney's office of the county, by AEC, P.G. & E., and Stanford representatives, and by a representative from Mr. Younger's office. Mr. Shute, the manager of our San Francisco office, spoke for the AEC. He reminded the conferees that the AEC could not wait beyond March 9 for the definitive assurance of the availability of power the project would require. Mr. Shute advised the conferees that AEC would seriously consider any bona fide proposal that did not contain a built-in delaying or contingency factor. He pointed out that shortly after the congressional hearing there had been some indication that the town and county would hold emergency sessions to consider possible proposals and that apparently more than a week had gone by without any such occurrence. Stanford's representatives advised that the university's trustees would consider the possibility of a Stanford contribution at its meeting on February 20.

13. Events subsequent to the February 8 meeting, and to date, have resulted in a resolution by the town of Woodside to contribute $150,000 toward the extra cost of undergrounding, conditioned, however, upon a contribution of $500,000 by Stanford, $300,000 by the county, and a combined contribution of $1,700,000 by P.G. & E. and AEC, and conditioned, further, on other factors including the legal ability of the town to accomplish this intention. Following this resolution, the Stanford trustees met on February 20 and concluded that it would be inappropriate for the university to pay any part of the extra costs of undergrounding. P.G. & E. remains unwilling to assume any additional cost beyond its previously stated ceiling of $1,012,000 (which includes the $668,000 to be recovered from the AEC). San Mateo County has given no indication that it is agreeable to any plan involving a contribution by the county. The General Manager, consistent with the advice previously given by Mr. Shute to the interested parties, has recommended to the Commission that AEC contribute up to $350,000 toward the total cost of burying the line, notwithstanding the fact that this added expense would purchase nothing of value to the project and, indeed, would help enable a substitution which could well have an adverse effect on the needs of the project.

The record, it seems to the Commission, clearly evidences the willingness of the General Manager and his staff to cooperate to the fullest extent possible in efforts to find a solution that would satisfy the esthetic wishes to the town and the county and at the same time be consistent with the national interest. This matter, over a long period of delays, many of which were perhaps unavoidable despite the sincere efforts of the local bodies and groups to find an early generally satisfactory answer, has reached the point where further delay would jeopardize the use of this major national facility. Nevertheless, the Commission, in the course of its consideration of the situation, decided to agree to a postponement of action on its part until March 16, 1964.

The Commission's conclusions coincide with the views of our General Manager and the AEC people who have devoted much time and attention to this matter. We support the alternative, compromise plans of P.G. & E. for overhead lines, although they do not afford the project the added assurance of reliability of power that double 300-megawatt circuits would provide while constituting, at the same time, the most economical as well as normal means of transmitting power.

We are prepared to go along with an underground line notwithstanding the fact that the interests of the project would be better served by an overhead installation. We are willing to contribute up to the amount of $350,000, recommended by staff—as an approximate five-way sharing of the added costs of burying a 180-megawatt-capacity line—toward the total additional costs involved. In addition, as previously mentioned, AEC would be absorbing the amount of $668,000 in the power rates presently stipulated in the P.G. & E. contract.

Based on the record to date, the Commission has decided that it would be in the national interest for AEC not to postpone action on its part beyond March 16, 1964, and to acquire by condemnation as soon after that date as possible a right-of-way over the Searsville route for the overhead construction of transmission facilities required to supply electric power to the national installation at Stanford. Should the county and Woodside grant use permits to P.G. & E. for an overhead installation over the entire Searsville route, or the entire Freeway route, we would not proceed with this plan, which, as we believe you appreciate, we would otherwise be compelled to employ. If the county or Woodside grants P.G. & E. a use permit for an overhead installation over the part of either route in its jurisdiction, we will consider the situation and determine whether and to what extent the decision to condemn should be modified.

If, contrary to all indications in the remote or recent past, an offer is received by the Commission, which presents, without a built-in delaying or contingency factor, a contribution of substantially all the remaining costs entailed in burying the line, the Commission would be prepared to consider it carefully. Should such an offer be submitted subsequent to the initiation of eminent domain proceedings, the Commission would nevertheless give it due consideration if the practicalities involved, considerng the Government's acquisition posture and the other existing circumstances, permitted.

We appreciate the earnestness and sincerity of the residents of San Mateo County in conscientiously endeavoring to take all reasonable measures to minimize interferences with the natural beauty of their surroundings. As a Californian, I have a personal understanding of their views in this respect. The county residents, in turn, will, I feel sure, understand that I and the other Commissioners must act in the larger context of the national interest which affects the entire public. We made our decision accordingly.

I am sending a similar letter to the mayor of Woodside.

Sincerely,

GLENN T. SEABORG, *Chairman.*

APPENDIX 6

FURTHER AEC CORRESPONDENCE TO TOWN OF WOODSIDE AND COUNTY OF SAN MATEO

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., March 16, 1964.

Hon. DONALD J. GRAHAM,
Mayor, Town of Woodside, Calif.

DEAR MR. GRAHAM: This will acknowledge your letter of March 11, 1964, relative to the electric power supply for the Stanford linear accelerator. As you know, the San Mateo County on March 9, 1964, granted to P.G. & E. a conditional use permit for the construction of a transmission line over the Searsville route

which would allow P.G. & E. to install a 220-kilovolt single circuit line of 300-megawatt capacity on tubular poles in San Mateo County.

On March 13, 1964, a meeting was held at the offices of the Joint Committee on Atomic Energy to discuss further the problem of obtaining the power requirements of the accelerator. Participating in this meeting were members of the California congressional delegation, members of the Joint Committee on Atomic Energy, members of the Atomic Energy Commission, Mr. E. R. Stallings, manager of San Mateo County, and Mr. McCloskey. At this meeting Mr. Stallings presented a further proposal for construction of a 180–megawatt transmission line running underground from the Jefferson substation to a point on Stanford University property adjacent to Searsville Lake and there connecting to an overhead tubular pole line for the portion of the line to be constructed on Stanford property. We recognized the sincerity of purpose of the county in attempting, even at this late date, to find a resolution of this problem acceptable to all. However, the county was advised at the meeting, that its proposal was unacceptable to the Commission because (1) it would still entail a substantial AEC contribution toward the additional cost of the line and (2) it is discriminatory against Stanford University and unacceptable to the university. Stanford University is willing to have transmission lines placed overhead on its property only if the entire line is not placed underground.

Despite the action by the San Mateo County Planning Commission in granting a conditional use permit to P.G. & E., the town of Woodside has continued to deny P.G. & E.'s petition for a use permit through that community. Therefore, the Commission has determined that it is necessary, in the public interest, to initiate Government acquisition, by condemnation, at the earliest practicable date, of the parts of the Searsville route within the jurisdiction of the town of Woodside. In view of the opinion expressed in Mr. Stallings letter of March 11, 1964, to the effect that the county's conditional use permit might be withdrawn, and also to cover the contingency that P.G. & E.'s acquisition of portions of the right-of-way within the county's jurisdiction may be unduly delayed, the Commission has also determined that it is necessary, in the public interest, to initiate acquisition, by condemnation, of other portions of the right-of-way under the county's jurisdiction should such events occur. We, of course, are sincerely hopeful that it will not be necessary to implement this action beyond those sections of the right-of-way that are within the jurisdiction of the town of Woodside. This would enable the AEC to provide for tubular pole construction through the town conformance with P.G. & E.'s construction in the county under the county's use permit. On the other hand, if developments should make it necessary for the Government to acquire all or a major part of the entire right-of-way, it would be difficult for the AEC to justify any construction other than that which constitutes the least costly type to provide adequate facilities.

Notwithstanding this action which the Commission determined to be necessary in the national interest, the Commission, as stated in my letter of March 7, is still prepared to receive an offer which would provide for construction of an underground line provided it does not contain any built-in delaying or contingency factors and does not require the Commission to assume, to any significant extent, the additional financial burden associated with such a line. You will recall that my letter of March 7 indicated that should such an offer be submitted subsequent to the initiation of eminent domain proceedings, the Commission would nevertheless give it due consideration if the practicalities involved, permitted.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., March 16, 1964.

Mr. E. R. STALLINGS,
County Manager, San Mateo County,
Redwood City, Calif.

DEAR MR. STALLINGS: I was pleased to have the opportunity to meet with you, members of the California congressional delegation and members of the Joint Committee on Atomic Energy on March 13, to discuss further the problem of obtaining electric power supply for the Stanford Linear Accelerator Center.

First, I would like to state that the Commission appreciates the cooperative attitude of San Mateo County as reflected by the action of the county planning commission in granting a conditional use permit to P.G. & E. for construction of

an overhead pole line along the portions of the Searsville route that are within the county's jurisdiction. It is the hope of the Commission that this use permit will enable P.G. & E. to discharge in large part the responsibilities which it assumed under its contractual arrangements with the Commission to supply power to the accelerator center.

Secondly, I would like to refer to the meeting on March 13, during which you submitted a proposal, described in your letter to me of March 11, for construction of a 180-megawatt transmission line running underground from the Jefferson substation to a point on Stanford University property adjacent to Searsville Lake and there connecting to an overhead tubular pole line for the portion of the line to be constructed on Stanford property. We recognize the sincerity of purpose of the county in attempting, even at this late date, to find a resolution of this problem acceptable to all. However, as you were advised at the meeting, your plan is unacceptable to the Commission because (1) it would still entail a substantial AEC contribution toward the additional cost of the line, and (2) it is discriminatory against Stanford University and unacceptable to the university. Stanford University is willing to have transmission lines placed overhead on its property only if the entire line is not placed underground.

Despite the action by the San Mateo County Planning Commission in granting a conditional use permit to P.G. & E., the town of Woodside has continued to deny P.G. & E.'s petition for a use permit through that community. Therefore, the Commission has determined that it is necessary, in the public interest, to initiate Government acquisition, by condemnation at the earliest practicable date, of the parts of the Searsville route within the jurisdiction of the town of Woodside. In view of the opinion expressed in your letter of March 11, 1964, to the effect that the county's conditional use permit might be withdrawn, and also to cover the contingency that P.G. & E.'s acquisition of portions of the right-of-way within the county's jurisdiction may be unduly delayed, the Commission has also determined that it is necessary, in the public interest, to initiate acquisition, by condemnation, of other portions of the right-of-way under the county's jurisdiction should such events occur. We, of course, are sincerely hopeful that it will not be necessary to implement this action beyond those sections of the right-of-way that are within the jurisdiction of the town of Woodside. This would enable the AEC to provide for tubular pole construction through the town in conformance with P.G. & E.'s construction in the county under the county's use permit. On the other hand, if developments should make it necessary for the Government to acquire all or a major part of the entire right-of-way, it would be difficult for the AEC to justify any construction other than that which constitutes the least costly type to provide adequate facilities.

Notwithstanding this action which the Commission determined to be necessary in the national interest, the Commission, as stated in my letter of March 7, is still prepared to receive an offer which would provide for construction of an underground line provided it does not contain any built-in delaying or contingency factors and does not require the Commission to assume, to any significant extent, the addition financial burden associated with such a line. You will recall that my letter of March 7 indicated that should such an offer be submitted subsequent to the initiation of eminent domain proceedings, the Commission would nevertheless give it due consideration if the practicalities involved permitted.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

APPENDIX 7

AEC DECISION ON CONDEMNATION OF NECESSARY RIGHT-OF-WAY

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., March 17, 1964.

HON. JOHN O. PASTORE,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR SENATOR PASTORE: This is with reference to the power supply for the Stanford linear accelerator. You are familiar with the recent actions and the discussions in the meeting of March 13, 1964. This is to advise you that the Commission determined that it was necessary, in the public interest, to authorize condemnation of a part or all of the right-of-way along the Searsville route for the construction of overhead transmission facilities necessary to serve the

Stanford Linear Accelerator Center. The Commission's action will be implemented by initiating acquisition by the Government of those parts of the Searsville route within the jurisdiction to the town of Woodside. If necessary, such action will be extended to other portions of the required right-of-way if acquisition of such other portions is unduly delayed or if the county's use permit is withdrawn or modified so as not to constitute county permission for an overhead installation by P.G. & E.

Nothwithstanding tihs action which the Commission determined to be necessary in the national interest, the Commission is still prepared to receive an offer which would provide for construction of an undergrcund line provided it does not contain any built-in delaying or contingency factors and does not require the Commission to assume, to any significant extent, the additional financial burden associated with such a line. Should such an offer be submitted subsequent to the initiation of eminent domain proceedings, the Commission would give it due consideration if the practicalties involved permitted.

Your interest in this matter has been most helpful.

Sincerely yours,

GLENN T. SEABORG, *Chairman.*

APPENDIX 8

LETTER FROM SENATOR KUCHEL ON SLAC POWERLINE

U.S. SENATE,
COMMITTEE ON APPROPRIATIONS,
March 26, 1964.

Hon. JOHN O. PASTORE,
Chairman, Joint Committee on Atomic Energy,
U.S. Senate, Washington, D.C.

DEAR JOHN: You will recall that I spoke to you recently about the necessity for the Congress' Joint Committee on Atomic Energy to make the decision and take steps to cause the high-voltage transmission lines, which will serve the Stanford linear accelerator, to be placed underground. Efforts to have the Atomic Energy Commission and the Office of the President exercise the clear responsibility of the Federal Government in this matter have proved fruitless. I urge you to call an immediate meeting of the Joint Committee for the purpose of taking whatever steps may be necessary to avoid having the Federal Government commit the debauchery which it seems intent on doing.

You are familiar with the problem. It is not a local problem alone. It affects the national interest because the manner in which the Federal Government conducts itself in this instance will have wide and long-lasting repercussions. Community indignation, already widely voiced in the California press and reflected across the Nation, is so deep and so convincingly unanimous that your committee is amply on notice that the Atomic Energy Commission is not proceeding properly in the matter.

A priceless, irreplaceable, natural heritage of beauty is about to be defaced and destroyed by coarse and ugly works of man through a decision based upon money alone.

The Federal Government proposes to do that which no other entity could do. The Commission now arrogates unto itself the authority to override the determination of local government. And this is being done in the face of the following provision of the Atomic Energy Act of 1954:

"Nothing in this chapter shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to the generation, sale, or transmission of electric power."

It appears highly doubtful that the Commission has authority to do what it is doing. The National Government will, therefore, be tied up in litigation for an incalculable long and costly period of continued strife between it and its neighbors. Such discord may have untold adverse effect upon the ability of the facility to accomplish its national purpose. The highhanded tactics of the Federal Government can be avoided and should be. Other communities across the Nation must be given the basis for faith that the Federal authorities will deal fairly with them in similar situations.

The irony of it all is that the cost of doing what the Commission now proposes may well wind up being as great or greater than the cost of doing the job the right way in the first place. The funds authorized for this project have not

been totally expended. A capital expenditure at this time for the purpose of placing the lines underground would seem to be most appropriate. Indeed, the 20-percent contingency fund seems designed for just such a situation. Alternatively, the Commission's power contractor could make the capital investment and the Commission could repay the additional cost over a term of years as part of its power rate out of its operating budget with only a relatively minuscule increase in that budget.

Direction from the Joint Committee can yet salvage the situation. I urge you to move as soon as possible on this matter.

With kindest regards,

Sincerely yours,

THOMAS H. KUCHEL.

(For reply of Senator Pastore to Senator Kuchel, see p. 179.)

APPENDIX 9

REPLY TO SENATOR KUCHEL ON SLAC POWERLINE BY DR. PANOFSKY

STANFORD UNIVERSITY,
Stanford, Calif, March 30, 1964.

Hon. JOHN O. PASTORE,
Chairman, Joint Committee on Atomic Energy,
U.S. Congress, Washington, D.C.

DEAR SENATOR PASTORE: I am enclosing a letter I have written to Senator Kuchel, of California, concerning the question of the Stanford linear accelerator powerline.

As you know, the responsibility for furnishing power to the accelerator has been assumed directly by the Atomic Energy Commission. The role of the Stanford Linear Accelerator Center has been to furnish information as to the technical needs for power including the schedule requirements.

We have become concerned that in the discussions involving the Federal Government and the communities the actual nature of the proposed installation in relation to the usual practices has been almost completely ignored. Anyone familiar with the local scene, the practices of power transmission in the particular area on the one hand and the plans for a pole line made by the AEC and P.G. & E., would recognize that such line actually constitutes a substantial improvement over transmission practices in the particular area. Any accusations using words such as "desecration," "ruining hundreds of acres of valuable land," "debauchery," have no basis in fact.

It appears to me that the central issue in this situation is whether the Federal Government may be forced by local jurisdictions to adopt practices which are much more costly than those conforming to community, regional, or in this case even national, standards. On the other hand the Government may of course choose to take leadership in improving such standards.

Sincerely yours,

W. K. H. PANOFSKY,
Director, Stanford Linear Accelerator Center.

STANFORD UNIVERSITY,
Stanford, Calif., March 28, 1964.

Hon. THOMAS KUCHEL,
U.S. Senate,
Washington, D.C.

DEAR SENATOR KUCHEL: I am very sorry that I was able to see you for only a brief time during my last visit to Washington; I did, however, have the opportunity to speak extensively with Mr. Andrews of your staff.

I learned from Friday morning's San Francisco Chronicle that you have written a letter to Senator John O. Pastore, Chairman, Joint Congressional Committee on Atomic Energy, to review the situation in relation to the powerline feeding the Stanford Linear Accelerator Center (SLAC). You are, of course, aware that a full-day hearing devoted to this subject had been held by the Joint Committee on Atomic Energy at the iniative of a local group of residents on January 29, 1964. The AEC's decision to proceed along the current lines was made after that meeting.

I fully share the concern about the increasing encroachment of overhead utilities on the landscape and concur that in the future an increasing number of overhead lines must be placed underground. I am also personally deeply interested in conservation matters and am a member of the Sierra Club.

Obviously both the university as well as myself would perfer to see these and other powerlines underground. However, I feel compelled to inform you that from the point of view of disturbance of the landscape, the case made by the Woodside residents is a weak one; moreover, I cannot see how it can be considered a conservation issue at all. Under no circumstances can I see any justification in the actual situation for such terms as "debauchery of the landscape," "desecration," etc.

My reasons for the conclusion that the case is a weak one are as follows:

1. Most of the area through which the line is to pass is zoned and ready for subdivision into one- to three-acre lots.

2. An alternate route for the line completely acceptable technically and financially but rejected by the city of Woodside would parallel the route of a freeway to be constructed shortly in flat country. The line along this freeway would be supported on slender tubular steel poles of good appearance.

3. The Linear Accelerator Center has paid a great deal of attention to aesthetic considerations—both in terms of planning and actual practices. We have been able to persuade the AEC to adopt methods which are in accordance with good local standards, even when such methods were more costly than the minimum functional criteria; in particular, we have been able to obtain support for placing all secondary distribution circuits underground: these are at a voltage of 12,000 volts or less. In this respect our practices are superior to almost all the local communities; there are no underground lines of any voltage in Woodside. We also have placed underground all other utilities, are undertaken an extensive landscaping program, are preserving natural vegetation, and are carrying out screening of any unsightly instrumentation. However—and this is the key point—we were able to support provisions for the sake of aesthetics by being able to demonstrate conformance to community practice. When it came to the 220,000-volt primary transmission line, this argument proved impossible to support for the following reasons:

(*a*) There are only 10 miles of transmission line of this voltage underground in the entire United States, and these are placed in the center of densely populated metropolitan areas;

(*b*) The cost of placing a 220,000-volt line underground is approximately one-half million dollars per mile, while the cost of placing lines of 12,000 volts or less underground is around $30,000 per mile. I am enclosing two photographs: M–616 pictures the type of line which may be placed legally above ground now in the city of Woodside—in comparison with photograph M–588 which pictures the high-voltage line which the P.G. & E. proposes to construct for the Atomic Energy Commission. Clearly funds would be much better spent by undegrounding the lower voltage lines. Paradoxically enough, the city of Woodside, in contesting the AEC overhead primary lines, has adopted an ordinance which makes it illegal to place above ground powerlines of high voltage, which are very expensive to place underground; yet the city continues to permit the erection of overhead lines of much lower voltage but of the same physical size which would be inexpensive to bury.

In effect this ordinance is thus discriminatory against high-voltage lines of comparable physical size; if the Government were forced into undeground construction generally without a large improvement of transmission technology, then it would be more economical to construct separate generating stations whenever transmission distances exceed about 50 miles.

(*c*) The proposed high-voltage pole which is shown in M–588 represents a very substantial improvement over the usual 100-foot or higher towers which have been used previously by the local utility, and this pole is actually shorter than many of the low-voltage poles in common use in the area. Photograph M–674 makes a comparison of the "locally used pole," the P.G. & E.'s towers, and the proposed AEC-SLAC pole. Part of the reaction of the local communities is due to the confusion of identifying the proposed pole line with an earlier tower line which was constructed by the local utility over the objection of residents in this area. This improved pole was possible as a result of the work of a consultant of SLAC in surveying national practices and also by the willingness of SLAC and the AEC to reduce their requirements below the optimum. Finally, the utility was willing to assume the extra cost in constructing this pole line in

comparison to the less expensive conventional tower structures. The pole line does not require ground clearing of shrubbery; the utility testified at the hearing before the Joint Committee on Atomic Energy that ground cover up to 15 feet or more would be maintained under the poles.

We have constructed models of the entire area including the proposed pole line: any observer viewing these models on the one hand and examining the local scene on the other will find that the strong language used by the opponents of this line does not relate to the actual situation in any way.

I am of course not qualified to speak on the legal issues which have been raised in your letter to the Joint Committee. We have simply been assuming that the Commission has been proceeding under proper legal counsel

Negotiations with the communities on this matter have been in process since June of 1963. At this point the schedules of the laboratory are being jeopardized by this problem. I hope that you appreciate the threat of further delay to this unique scientific venture, which you yourself helped to initiate.

I am very grateful for your help and your interest in our laboratory.

Sincerely yours,

W. K. H. PANOFSKY,
Director, Stanford Linear Accelerator Center.

APPENDIX 10

AEC CHAIRMAN SEABORG'S PRESS CONFERENCE AT STANFORD

U.S. ATOMIC ENERGY COMMISSION,
OFFICE OF THE CHAIRMAN,
Washington, April 7, 1964.

Senator JOHN O. PASTORE,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR JOHN: I am enclosing for your information a copy of my press conference at Woodside, Calif., concerning the problem of transmitting electric power to the Stanford linear accelerator.

Cordially,

GLENN T. SEABORG.

NEWS CONFERENCE, APRIL 2, 1964

(The following is a transcript of the news conference conducted at the site of the Stanford Linear Accelerator Center under construction for the AEC by Stanford University.)

Conducting the conference were:

Dr. Glenn T. Seaborg, Chairman, U.S. Atomic Energy Commission.

Frederick Terman, Stanford University provost and vice president.

Dr. Wolfgang K. H. Panofsky, director, Stanford Linear Accelerator Center.

R. W. Joyce, vice president, commercial operations, Pacific Gas & Electric Co.

Also present were David Packard, chairman of the Stanford Board of Trustees committee on SLAC; E. R. Stallings, county manager, San Mateo County; Mayor Donald J. Graham, Woodside; and representatives of the news media.

Mr. SEABORG. I thought I would begin with a little explanation as to why I am here. I had scheduled a trip to the bay area a number of months ago, and I had scheduled it with a number of business items to take care of. As things have developed down here at Woodside I decided to cancel all of these appointments for this morning and take a firsthand look at the situation. And to meet my many admirers in Woodside. And perhaps give them an opportunity to see that a member of the AEC is not the ogre that some seem to think he might be.

We have made a tour of the area with the transmission line up in the hills and with the transmission line down to where the Stanford linear accelerator would hook in. Accompanying me on this our were Mayor Graham of Woodside; Mr. Stallings, the manager of San Mateo County; Mr. Joyce, vice president of the Pacific Gas & Electric Co.; Dr. Panofsky, director of Stanford linear accelerator Project; Mr. Packard of the Stanford Board of Trustees; and Mr. Ellison Shute, manager of the San Francisco operations office.

We have had a very friendly, I think, discussion. We have a mutual problem here that we are trying to solve in good faith. I might add that the members

of the AEC and the other members of the Federal Government who are involved in trying to solve this problem are in my view hard working public officials trying to do their duty in the manner that they see is right.

There are a number of problems here that occur to the impartial observer in trying to look at the possibility of placing this line underground in view of the high cost involved.

One is that the Federal Government adheres to good local practice in situations of this sort. And here we are faced with the situation where there already are hundreds of poles, something like over 500 power poles in the city of Woodside and thousands of power poles in the county of San Mateo, whereas if I counted correctly on the map, there are 14 poles at issue, 5 of them in the city of Woodside. Now to begin by trying to put this high voltage line underground at a cost of millions of dollars seems from the point of view of those who have responsibility for this is being the wrong way to start. You can put powerlines underground for one-tenth or one-twentieth of the cost at low voltage, and, so far as the observer is concerned, you can't tell the difference between a high voltage and a low voltage line.

Another aspect of this that I think should be brought to your attention is that as a practical matter this is not something for the AEC to determine. The legislative history of the project is such, and in view of the hearing that was held on January 29 before the Joint Committee on Atomic Energy where representatives of San Mateo County and Woodside were present, that an authorization from the Congress would be necessary as a practical matter in order to spend this much Federal money for a project of this kind.

Now, the Commission has tried to approach this from the beginning in a spirit of compromise. We have been working on the problem since last summer, something like 8 months, and in recent weeks I would say that this probably has been a matter on which we have spent more of our time than on any other matter. I think this is a fair statement. We have said that we would accept something far less adequate than P.G. & E. would furnish if they put the power in on overhead towers; that would be dual circuits of 300 megawatts each. In a spirit of compromise to try to find something that would be much better looking the AEC has said they would be willing to accept a single circuit, 300 megawatts, on tubular poles which at least to us don't seem to be unsightly. We have also said that we would go further than this and accept an even less adequate system of power conveyance, namely underground, where we would have only a single circuit, only 180 megawatts of power, provided a method of financing it could be evolved that would not involve the Federal Government paying the entire cost.

I think that I would like to close these brief opening remarks by saying that the community here has in the Stanford linear accelerator a tremendous scientific development. It is one that almost any other part of the country would welcome I believe, even with overhead powerlines, if I may be very frank about it.

High energy physics is one of the leading intellectual developments of our age. It is not only very exciting but it will probably, experimentation in high energy physics will probably, lead to some of the most important theoretical and, perhaps following the theoretical, the most practical developments of our age. It is distinctly in our national interest to carry on research in this field, and all parts of the country, many parts of the country, are vying for the privilege of carrying on research in this field. And I think the entire community should be happy that such an important aspect of science is being carried on in your community, in your neighborhood.

And I think with that perhaps I have said more than I should have, and I will be ready to try to respond to any questions anyone might have.

Question. Is the Commission flexible at all, Dr. Seaborg, on its decision to go underground only if there are other groups sharing the cost of the underground cables? Or is it a firm decision?

Dr. SEABORG. As a practical matter the Commission wouldn't be able to bear the entire cost for going underground without legislative authorization, in view of the history, the legislative history of the project. So in that sense I suppose I would say they are not flexible.

But don't misunderstand, I am saying, as I have said in all of the letters I have written to Mayor Graham and Mr. Stallings and others, that if any reasonable arrangement of cost sharing could be put forward, the Commission and the Federal Government and the Joint Committee on Atomic Energy are ready to consider it. And the representatives of the Joint Committee, particularly

Mr. Holifield and Mr. Hosmer told Mayor Graham and Mr. Stallings this at the January 29 hearing before the Joint Committee on Atomic Energy.

Question. You mentioned that the Federal Government adheres to good local practice. And in the 1954 act which created the Atomic Energy Commission there is a section which says that the AEC in transmission of power should not contravene local ordinances. Or something to that effect. I just wonder if you can explain how the AEC has the authority to move on this condemnation?

Dr. SEABORG. Well, it is the opinion of the AEC General Counsel that if it should unfortunately become necessary to move through eminent domain, the 1954 act as amended and the legislative history of the project does give the AEC through the Department of Justice this right.

Question. Has this particular point been amended?

Dr. SEABORG. No. I think that this particular point as you have described it doesn't forbid that or take away that authority as I understand it, as the result of the study of it by our General Counsel, the General Counsel of the Atomic Energy Commission.

Question. In the friendly discussion with the group in the car this morning did you get any indication that something could be worked out at this point?

Dr. SEABORG. We did discuss the advantages of the freeway route and it seemed to me that this has some advantages that might be explored further. Other than that, I don't know that we came up with anything concrete. You understand, of course, that we spent about an hour rather busily looking over the entire area.

Question. You didn't hear anybody offer any more money than you have heard up to now?

Dr. SEABORG. No, sir. I didn't hear anybody offer any more money this morning.

Question. What do you mean by exploring the freeway further? How does that fit in?

Dr. SEABORG. Well, we didn't discuss it in the detail of any plan of how you might do this.

Question. This would be underground routing?

Dr. SEABORG. No, no. Overhead poles on the freeway as being preferable, the tubular poles as preferable to the other route. I don't know. I haven't made that detailed a study of it but that was discussed. Somebody asked me if there were any possible solutions discussed and that was really the only one that was discussed during our automobile ride this morning.

Question. Do you mean along the freeway instead of over the countryside.

Dr. SEABORG. Along the freeway, through Woodside, yes, rather than over the countryside. This would take more than five poles I believe. That would take six or seven poles, I believe.

Question: In cost comparison what would be the difference between overhead and underground?

Dr. SEABORG. The overhead on the towers cost is about $668,000. The overhead on the tubular poles as I understand would be about $922,000 but augmented up to about $1,012,000 in order to give the complete installation. The cost underground for the dual circuits of 300 megawatts each is of the order of $6 million or something of that order—$6,400,000. The underground for a single circuit of 300 megawatts, of course, which is less adequate for the project, is of the order of $3,600,000. Cost for the underground for a single circuit of 180 megawatts line which is much less adequate, but which the AEC in a spirit of compromise is willing to accept, would be about $2,600,000.

Question: Aside from meeting these people face to face—Mayor Graham of Woodside and Mr. Stallings of San Mateo County—what do you think was accomplished by your visit?

Dr. SEABORG. I got a firsthand view of the situation that I can convey back to my colleagues on the Atomic Energy Commission and to the other members of the Federal Government and the Congress who are interested in this problem.

Question: Dr. Seaborg, did anything happen today that would make you think that the AEC's position as stated so far should be modified?

Dr. SEABORG. Well, the AEC's position as stated so far has been quite flexible. We are still holding open the possibility of an underground line under a cost sharing plan.

Question: On the same basis as you have already proposed though?

Dr. SEABORG. We would be willing to look at any proposal. We haven't had any proposal. Frankly, we haven't had any change from the initial Woodside and San Mateo County position presented to us during the whole course of the negotiations and it is my opinion that the only way that this can be settled will be with some kind of a compromise on both sides, and I don't feel that we have had any compromise offered on the other side yet, or if we have, I would be glad to have it called to my attention.

Question: Dr. Panofsky has said that he would prefer to have the line put underground. Would you consider that he is on the side of Woodside?

Dr. SEABORG. I would like for Dr. Panofsky, who is sitting by my side, to speak for himself.

Dr. PANOFSKY. I have expressed the preference for underground simply because of the fact that I believe, as I believe everybody around here does, that it is the direction in which things will be going slowly all over the country. At the same time I have also expressed in all candor that I felt that the particular case made for undergrounding of this particular line is a relatively poor one. The reason is associated with the numbers which were being discussed here; namely that for a given amount of money you can put 10 to 20 times more lines underground of equal physical size at low voltage than at high voltage. For example, if you will take the $150,000 which I believe Woodside is willing to contribute to the underground of the high voltage line and apply that to the 12- to 60-kilovolt lines which are now prevailing around here on poles of the same height as the poles we are talking about, you could get something like 5 miles undergrounding while for the $150,000 you only underground one-tenth of the line we are talking about, or something like one-third of a mile of the high voltage line. My own personal view on the matter is that the general way to go is by a two-pronged approach, namely, for the communities to push very hard to get all the lower voltage line underground as we have done here on the site. Once construction is finished SLAC will have no overhead facilities of any kind, with the exception of the primary high voltage line. And at the same time, we should try very hard to reduce the cost of these very high voltage lines because at this time the high voltage case is not a very good one, even if I would prefer to see them all underground.

Question: The AEC has said that the cost of overheading would amount to something over $800,000 which would include construction and the condemnation costs. The opponents claim that the condemnation costs would be considerably higher. And it might raise the total well over a million dollars. In any event the AEC has said it would cost over $800,000. Now, one of the proposals was to bring the line to the Stanford campus and let Stanford take it the rest of the way, either above ground or underground as they wanted to. Now this would cost about $2 million to bring the line to the Stanford campus. P.G. & E. has offered to put up $1 million for the cost of an overhead line which would be half of this. If the AEC would put up just a little over the $800,000 it has promised, it would bring the line underground to the Stanford campus, and would, in fact, eliminate most of the controversy. Doesn't this seem to you something of a reasonable compromise?

Answer. No. There is a little mistake in your arithmetic. This does keep cropping up and maybe I should make an attempt to explain that. You have counted the $800,000 twice. The AEC was never going to pay the $800,000 for the cost of the overhead line two times. In the $1 million as I understand it, I don't know whether it is $800,000—I thought it was $668,000 or something of that sort—is essentially recoverable to the P.G. & E. Co. from the Atomic Energy Commission in the rate structure, and shouldn't be counted twice.

Question. This was considered in that $1 million from P.G. & E.?

Answer. Yes, sir. That was considered in the $1,012,000 of the P.G. & E. money. So that is the response to that part of your question where it concerns your arithmetic. It is somewhat erroneous.

Now, with respect to Stanford University's reaction to having the lines underground up to their campus and then overhead, I would rather frankly refer to the representatives of Stanford University who are here—either Mr. Packard, or Dr. Panofsky, or Vice President Terman.

TERMAN. This has never been formally presented to the trustees. This alternative, that is. There has been discussion between a few of the trustees between board meetings. The trustees originally had the position that they would like to see the powerlines underground on Stanford land if possible. It became clear in time that this was going to be so expensive as to probably be

unfeasible. If it was going to be overheard other places, Stanford would not insist that they ought to be underground on Stanford land.

So in the first place we didn't ask for special treatment, but I think by the same token that without predicting what the trustees would do, I think they would object very strongly to a reverse discrimination policy which says that the lines will be underground outside Stanford land at Government expense, but Stanford would not be accorded the same treatment on Stanford land. Particularly as we have worked out the business of putting lower voltage lines underground which adjacent communities have not done.

Question. In either case isn't it true that Stanford is not willing to put up any money either for the first proposal or the second proposal?

TERMAN. This is true. Money that Stanford has been given is being held in trust for educational purposes. The amount of money that other people have offered to put in, that is not going to be reimbursed by the Government, is a relatively small fraction of the total cost of doing this operation. We are talking in the order of $1½ to $2 million cost; the total amount that has been offered, less tax money, is not very large in comparison with that total.

Question. I would like to know how long you are going to wait for something to be worked out here before you go ahead and come through with your condemnation?

Dr. SEABORG. I believe that the Department of Justice—didn't they file last week? Yes. The proceedings are underway. But there is time, if a proposal comes in, for another arrangement. We will consider a proposal right up to the moment it won't delay the project. And I should say, and by the way I should have said this earlier, because this is an important point—we have waited so long now that we have reached the point where we are jeopardizing our ability, Stanford's ability, Dr. Panofsky's ability, to start up this accelerator when it is completed. When the construction has been physically finished that is.

Question. I should like for you to clarify something. Are you saying that the AEC has jurisdiction over the city of Woodside in connection with the power-lines?

Dr. SEABORG. No, sir. No jurisdiction over the city of Woodside.

Question. Can they go ahead with construction if no compromise proposal is reached?

Dr. SEABORG. If the AEC exercises through the Justice Department the right of eminent domain, yes, sir, I suppose they can.

Question. How would you like to see this resolved? Would you like to see the tubular poles go in? Would you like to see the lines underground? Or do you care as long as it is resolved?

Dr. SEABORG. I want to make it clear that I have an appreciation for the esthetics of the situation. I really do. I think I made it clear that AEC is willing to put up quite a bit of money, but that as a practical matter to pay for it all is not within our power to do. I think I made that point earlier.

I am interested in the esthetics of the situation. I am a resident, on leave of absence, of Lafayette, a little town across the bay that I think is just as attractive a community as Woodside. We, by the way, also have our overhead poles. I visited my home in Lafayette last night. I think that as a logical matter the best solution at this time would be the eight tubular poles in the county and the five tubular poles in the city. These poles could be put up with as much attention to esthetics as possible, painted green in order to meld into the countryside, with the minimum cutting of the trees and the undergrowth, which I also understand is possible. This would be the most logical solution.

But, as I said, we will continue to consider the other solution despite its technical disadvantages to the project, the underground one.

Question. What would be your reaction if this $1,600,000 difference in overhead and the cheapest underground—if P.G. & E. and the local interests and the AEC split the difference, say $0.5 million each?

Dr. SEABORG. Oh, we would give that serious consideration.

Question. You would consider that?

Dr. SEABORG. Yes, sir. I can't commit my colleagues on the Atomic Energy Commission. We are, I can't say a five-man Commission, but a five-member Commission. We had a very nice lady join us on the AEC last week. All such matters are determined by the Commission as a whole, insofar as the Commission is concerned. It would also have to be considered by the Joint Committee on Atomic Energy and by the Bureau of the Budget and by the administrative branch of the Government, the executive branch.

Thank you very much. I hope I have succeeded in being of some help.

APPENDIX 11

SAMPLE OF LETTER SENT TO THE FOLLOWING NEWSPAPERS IS PRINTED BELOW: PALO ALTO TIMES, SAN JOSE NEWS, SAN MATEO TIMES, SAN FRANCISCO EXAMINER, OAKLAND TRIBUNE, SACRAMENTO UNION, UNITED PRESS, SAN FRANCISCO OFICE; DAILY COMMERCIAL NEWS, SUNNYVALE STANDARD, SAN JOSE MERCURY, MENLO PARK RECORDER, SAN FRANCISCO CHRONICLE, SAN FRANCISCO NEWS-CALL BULLETIN, SACRAMENTO BEE, ASSOCIATED PRESS, SAN FRANCISCO OFFICE; MCGRAW-HILL NEWS BUREAU, REDWOOD CITY TRIBUNE, NEW YORK TIMES, SAN FRANCISCO

STANFORD UNIVERSITY,
STANFORD LINEAR ACCELERATOR CENTER,
Stanford, Calif., April 9, 1964.

NEW YORK TIMES,
San Francisco, Calif.

DEAR SIR: From the voluminous publicity and expression of opinion regarding the SLAC powerline problem it has become evident that certain basic facts have not been generally available. The following brief statements of fact may be helpful:

1. P. G. & E.'s present "Searsville route" proposal is to install a tubular steel pole line up the hillside, carrying a single circuit of 220-kilovolt power. This line would involve 34 poles, distributed as follows:

(*a*) Five in Woodside (three of these on Stanford land).

(*b*) Eight in unincorporated San Mateo County territory.

(*c*) Twenty-one on Stanford land outside of Woodside.

These poles will be painted green and will range in height from 50 to 100 feet, averaging slightly under 70 feet. Ground cover will remain or will be restored.

2. The status of P.G. & E.'s Searsville proposal is:

(*a*) Refused by the Woodside Planning Commission and Town Council.

(*b*) Approved by the San Mateo County Planning Commission. (This approval has been appealed by local citizens to the San Mateo County Board of Supervisors and a hearing has been set before the board for 2 p.m. on April 21.)

3. Previously, the P.G. & E. had proposed an alternative route of these same tubular poles which would follow the alinement of the future Junipero Serra Freeway from Stanford to a substation behind Redwood City. Both Woodside and the county have refused this alternative.

4. P.G. & E. estimates that Woodside now has approximately 1,700 wooden poles within its city limits for power distribution and transmission. Of these poles 227 have been installed since the date of incorporation of Woodside and 26 since June 1963, the date of P.G. & E.'s first application to Woodside for a line to serve SLAC. Most of this is for power of 12 kilovolts and less. These poles range from 35 to 70 feet in height. Woodside has no underground power.

5. Normal distribution lines at SLAC (12 kilovolts and less) will be underground, following standard Stanford practice.

6. The costs of putting electrical systems underground vary tremendously depending on voltage as the following cost comparisons show:

(*a*) Low voltage (12 kilovolts and less)—$25,000 to $30,000 per mile.

(*b*) Very high voltage single circuit 220 kilovolts and higher—$400,000 to $500,000 per mile.

7. Numerous hearings and meetings have been held on the subject. The most important of these are:

(*a*) Woodside Planning Commission: January 24, 1963; June 27, 1963; August 22, 1963; September 26, 1963; October 24, 1963; January 23, 1964.

(*b*) Woodside Town Council: February 14, 1964; March 9, 1964.

(*c*) San Mateo County Planning Commission: January 22, 1964; March 9, 1964.

(*d*) San Mateo County Board of Supervisors: February 27, 1964.

(*e*) Joint Congressional Committee on Atomic Energy: January 29, 1964, in Washington, D.C.; full day hearing.

(*f*) Meetings at SLAC of all parties concerned: February 17, 1964 (attended by Congressman Hosmer of Joint Committee on Atomic Energy and Congressman J. Arthur Younger); February 24, 1964; and March 16, 1964.

(*g*) News conference: April 2, 1964, held at SLAC by Dr. Glenn T. Seaborg, Chairman, U.S. Atomic Energy Commission.

I hope that publication of these facts will be helpful to all interested in the subject.

Sincerely,

DOUGLAS WM. DUPEN,
Head, Technical Information Department.

APPENDIX 12

WOODSIDE TEMPORARY INTERIM ZONING ORDINANCE NO. (1964–145)

A TEMPORARY INTERIM ZONING ORDINANCE PROHIBITING AND REGULATING CERTAIN USES AND STRUCTURES CONNECTED WITH THE TRANSMISSION AND/OR DISTRIBUTION OF ELECTRICAL ENERGY AND/OR COMMUNICATIONS WITHIN THE CORPORATE LIMITS OF THE TOWN OF WOODSIDE

The council of the town of Woodside does ordain as follows:

1. The town council finds that the Planning Commission of the Town of Woodside is now conducting or intends to conduct studies within a reasonable time for the purpose of making recommendations to this council regarding the adoption of amendments or additions to Ordinance No. (1959–80) entitled "An Ordinance Adopting Zoning Regulations for the Town of Woodside," as amended, which will affect the transmission and/or distribution of electrical energy and/or communications through, on, or over lands within the limits of said town. It is further found that considerable time may clapse before the adoption of such amendments or additions, and that certain prohibitions and regulations of an interim or emergency nature are necessary to be adopted at this time in order to protect the public interest, peace, health, safety, and comfort or convenience, and to preserve the public welfare. Said prohibitions and regulations are hereinafter in this ordinance set forth.

2. The property to be affected by this ordinance includes all of the real property situate within the territorial limits of the town of Woodside, county of San Mateo, State of California.

3. "Person" as used in this ordinance shall include any person, firm, or corporation, public or private, the State of California and its agencies or political subdivisions, and the United States of America, its agencies and instrumentalities, and any agent, servant, officer, or employee of any of the foregoing.

4. Pending the completion of studies and the adoption of comprehensive zoning controls and rules to regulate the transmission and distribution of electrical energy and/or communications through, on or over lands situate within the territorial limits of the town of Woodside, it is ordered that—

(*a*) All electric transmission and/or distribution lines and all communication lines within the limits of the town of Woodside shall be installed underground, except as otherwise herein provided.

(*b*) No person shall directly or indirectly construct, erect, or fabricate any building or structure for the purpose of operating or maintaining any overhead electric transmission and/or distribution line or lines, and/or any overhead communication line or lines, or any appurtenant structure, or part thereof, on any property situate within the territorial limits of the town of Woodside, or attempt or commence to construct, operate, or maintain any such line or lines, appurtenant structure or structures, or part or parts thereof.

(*c*) The provisions of this ordinance shall not apply to any line, structure, or part thereof existing within the town of Woodside on the effective date of this ordinance.

(*d*) The provisions of subparagraphs (*a*) and (*b*) of paragraph No. 4 of this ordinance shall not apply in those cases wherein the engineer of the town of Woodside determines that underground installation is not feasible or practicable and that there is no resonable alternative location for the installation of underground electric or communication lines. Any person aggrieved by the decision of said engineer may appeal from said decision to the council of the town of Woodside.

5. It is hereby declared that this ordinance is an ordinance for the immediate preservation of the public peace, health, safety, and welfare, and is an emergency ordinance, as provided by law. It shall take effect immediately upon its passage. The facts constituting such emergency are as follows:

Since the adoption of the existing zoning regulations, it has become apparent that the present regulations of the town of Woodside did not and do not now provide adequate safeguards and regulations affecting the transmission and/or distribution of electrical energy and/or communications through, on, or over real property within the limits of the town, and the town planning commission is now conducting or will soon conduct studies for the purpose of holding hearings and subsequently making recommendations to the town council regarding the adoption of regulations and restrictions to effect the orderly development of and to provide adequate control over the use of real property for the purpose of transmitting and/or distributing electrical energy and/or communications.

6. It is the intention of the council of the town of Woodside to prohibit temporarily the establishment of any use of property which may be in conflict with new zoning regulations to be established in the town of Woodside until such time as public hearings can be concluded by the planning commission and a final form of new zoning regulations be either finally adopted or rejected by the town council. This ordinance is to be liberally construed to effect its purpose and the purpose of government code section 65806, pursuant to which authority this ordinance is enacted. If any section, subsection, clause, sentence, or phrase of this ordinance is for any reason held to be invalid or unconstitutional, such invalidity or unconstitutionality shall not affect the validity or constitutionality of any other portion of this ordinance.

7. Any person violating any of the provisions of this ordinance shall be guilty of a misdemeanor and shall be punishable by imprisonment for a period not to exceed 6 months, or by payment of a fine not to exceed $500, or by both such fine and imprisonment.

8. This ordinance is intended to be a temporary interim zoning ordinance. It shall automatically cease to have force and effect 1 year from the date of adoption hereof; *Provided, however*, That after notice pursuant to section 6061 of the government code of the State of California, and public hearing, the legislative body may by four-fifths vote extend such temporary ordinance for 1 year. No more than two such extensions may be adopted. This ordinance shall automatically cease to have the force and effect of law without specific repeal when either:

(1) The council of the town of Woodside shall enact the new zoning regulations, publish or post the same, and they shall become effective; or

(2) The council of the town of Woodside shall formally consider the new zoning regulations and finally reject the same and refuse to enact them into law.

DONALD J. GRAHAM, *Mayor.*

Attest:

IRMA LEWIS,
Clerk of the Town of Woodside.

I, the undersigned, hereby certify that the foregoing ordinance is a full, true, and correct copy of Ordinance No. 1964–145 of the town of Woodside, entitled as shown thereon; that it was passed and adopted by the council of said town of Woodside on April 13, 1964, by the following vote:

Ayes, and in favor thereof: Councilmen Chamberlain, Gill, Hawkins, Lowe, Wheeler, and Mayor Graham.

Noes, councilmen: None.

Absent, councilmen: O'Neil.

That it was posted in three public places in the town of Woodside on April 14, 1964, and being an emergency ordinance became effective immediately.

Dated April 14, 1964.

ERMA LEWIS,
Clerk of the Town of Woodside.

Approved.

DONALD J. GRAHAM, *Mayor.*

APPENDIX 13

REPLY TO SENATOR KUCHEL BY JCAE CHAIRMAN PASTORE

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
April 24, 1964.

Hon. THOMAS H. KUCHEL,
U.S. Senate, Senate Office Building,
Washington, D.C.

DEAR TOM: Thank you for your letter of March 26, 1964, concerning the transmission lines for the Stanford linear accelerator. I am, of course, pleased to have your personal views on this matter.

I believe that in a controversy of this nature, all interested parties should have a free and complete exchange of views and, in this case, I believe this objective has been particularly well accomplished.

As you are aware, on January 29, 1964, the Joint Committee on Atomic Energy held a full day's hearing on this matter. Representatives of the city of Woodside and the county of San Mateo, including Mayor Graham of Woodside; Mr. Levy, Chairman, San Mateo County Planning Commission; and Mr. McCloskey, Special Counsel, City of Woodside, were present.

Subsequently, on March 13, 1964, members of the Joint Committee representing both the majority and minority participated in a meeting at which AEC Chairman Seaborg, AEC Commissioner Ramey, General Manager Luedecke, along with other representatives of the AEC met with the following individuals: Mr. E. R. Stallings, San Mateo county manager; Mr. Paul N. McCloskey, attorney, Save Our Skyline.

In addition, committee members have visited the area and discussed the problem with local officials. Further, Chairman Seaborg advises me that he made a special trip to Woodside on April 2, 1964, and talked to representatives of the interested groups and the press. I am enclosing a copy of the transcript of that press conference which Dr. Seaborg sent me and which I believe will be of interest to you.

I am very much in agreement with you that those whose duty it is to act in the public interest should consider the long term as well as the short-term effects of these actions. A reasonable solution to this problem must be based on a balance between our long-term interest in preserving the natural beauty of the Nation's landscape and the equally important consideration of meeting our immediate needs in the most economic and efficient manner. I found Dr. W. K. H. Panofsky's March 28 letter to you, as you probably did also, very succinct and informative in this regard. I thought that Dr. Panofsky's analysis of the factors involved was an excellent one.

Based upon your letter of March 26 and your conversation with me, I again brought this matter up in an executive session of the Joint Committee on April 16. It was the unanimous opinion of the members that any additional committee hearings or visits to the area would be redundant since they have already been done. It was the consensus of the committee members, based upon the facts developed at the committee hearing in January 1964 and subsequent meetings, that the committee should not attempt to interfere with the decisions of Dr. Seaborg and the others in the AEC.

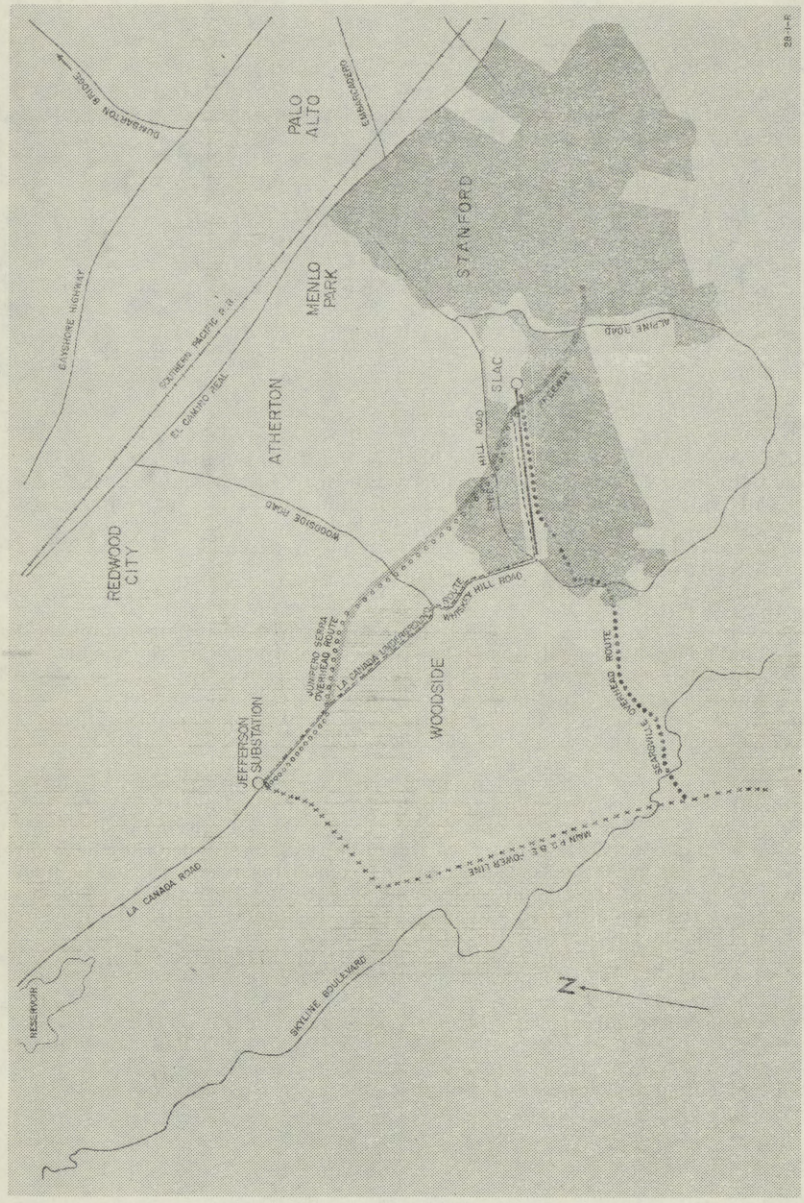
Please be assured of my continuing interest in this matter. I sincerely share your hope that a fair and equitable solution can be reached.

With best wishes, I am,

Sincerely yours,

JOHN O. PASTORE, *Chairman.*

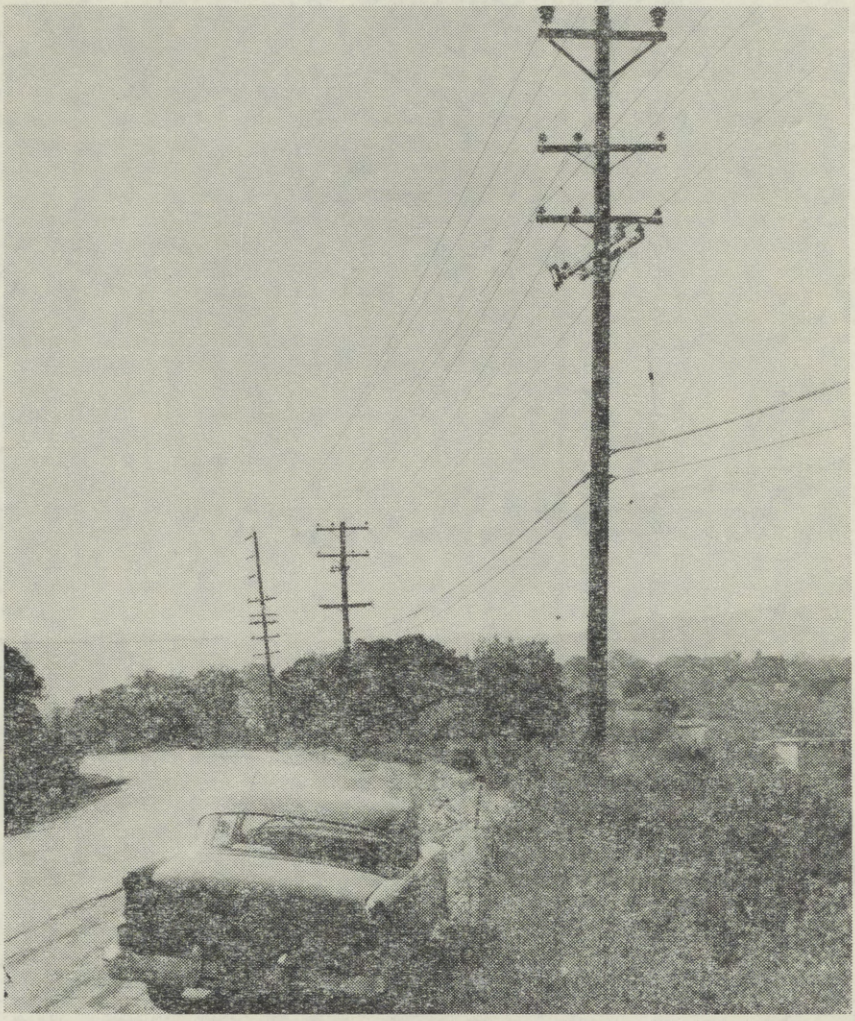
(For letter of Senator Kuchel to Senator Pastore, see p. 168.)



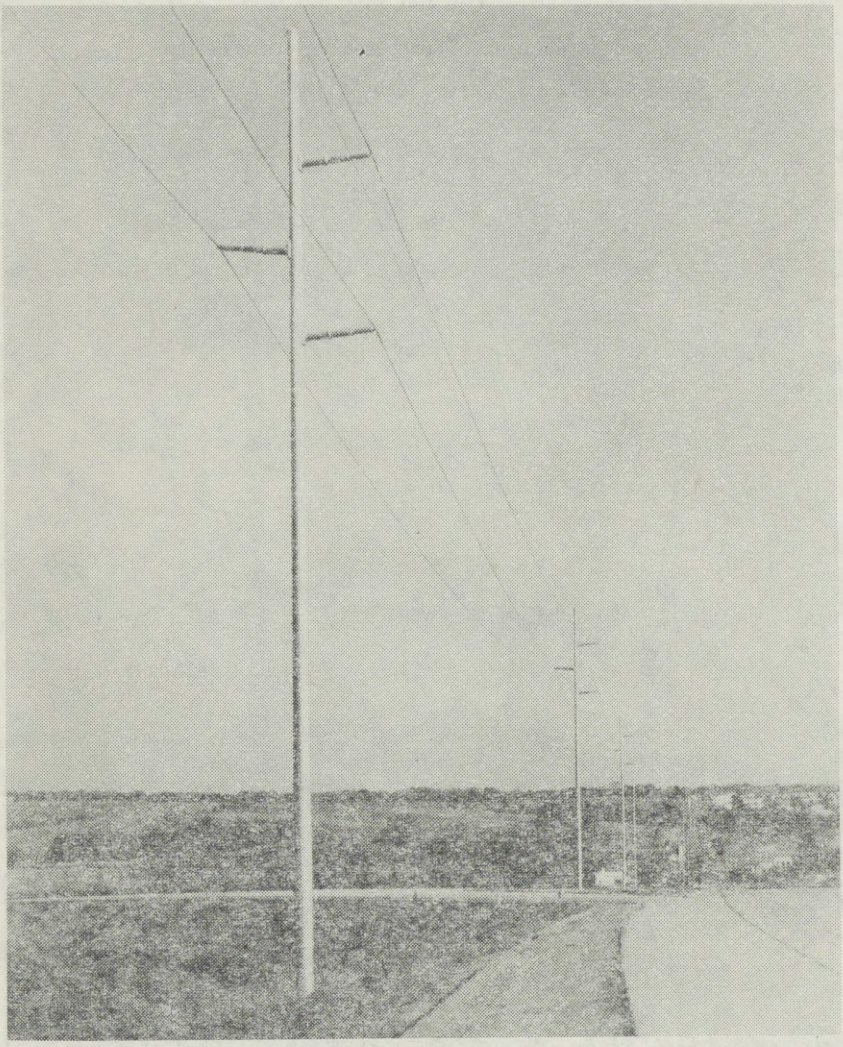
Appendix 14—Map of Powerline Area

APPENDIX 15

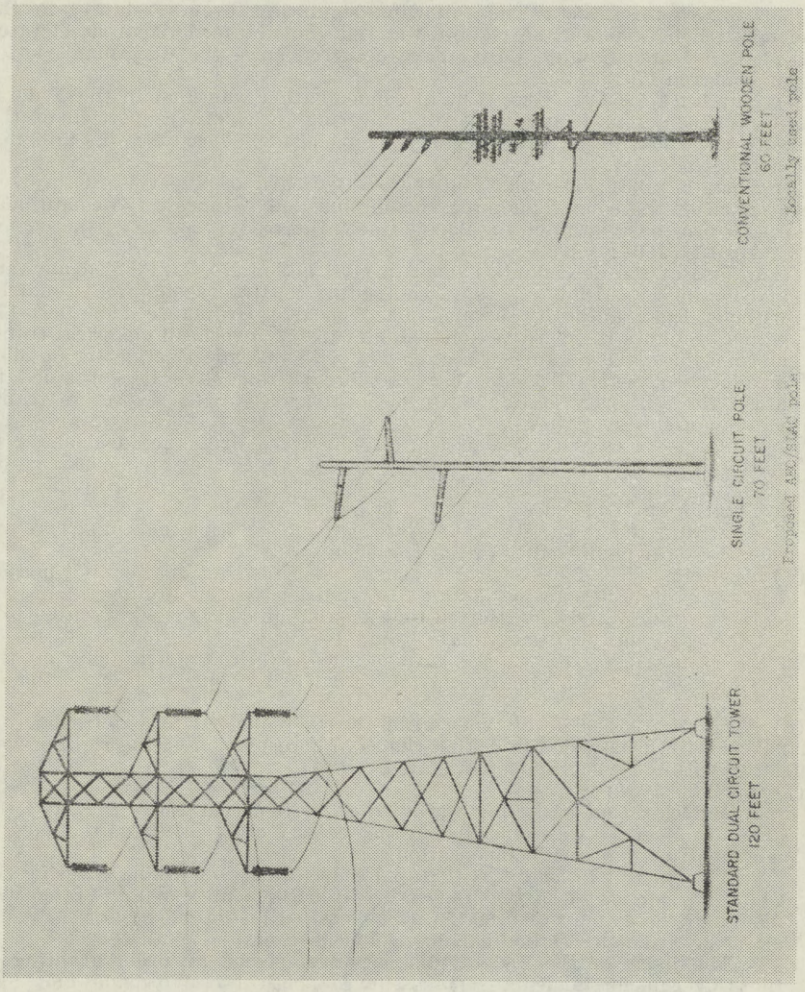
Photographs of area and proposed powerline design



Existing powerline in the town of Woodside on Woodside Road midway between the Whiskey Hill Road intersection and the Alameda



Existing 220-kilovolt line in Omaha, Nebr., on poles similar to those proposed


CONVENTIONAL WOODEN POLE
60 FEET
SINGLE CIRCUIT POLE
70 FEET
STANDARD DUAL CIRCUIT TOWER
120 FEET

APPENDIX 16

AEC LETTER TO JCAE CHAIRMAN PASTORE SUMMARIZING CONDEMNATION PROCEEDINGS DURING MARCH–APRIL 1964

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., May 5, 1964.

Hon. JOHN O. PASTORE,
Chairman, Joint Committee on Atomic Energy,
Congress of the United States.

DEAR SENATOR PASTORE: The following significant events relating to the condemnation of a powerline right-of-way for the Stanford linear accelerator project, San Mateo County, Calif., have occurred since the Chairman's letter to you of March 17, 1964:

(*a*) March 24, 1964: A complaint in condemnation was filed in the Federal district court in San Francisco, Calif., covering the 4.92-acre portion of the right-of-way which lies within the town of Woodside. The case was assigned civil action No. 42214.

(*b*) April 14, 1964: The San Mateo County Board of Supervisors reversed the decision of the county planning commission and withdrew the conditional use permit previously granted the Pacific Gas & Electric Co.

(*c*) April 14, 1964:

1. Two of the defendants named in civil action No. 42214 filed answers and motions to dismiss the suit, contending that the acquisition would be without legal authority because of Woodside Ordinance No. 1964–144 which prohibits the construction of high capacity overhead electrical transmission lines, and because of section 271 of the Atomic Energy Act of 1954, as amended, which provides that nothing therein shall be construed to affect the authority of any State or local agency with respect to transmission of electric power.

2. The town of Woodside passed an emergency ordinance designated as 1964–145 which in substance removed the prohibition against construction of "high capacity" overhead electrical transmission lines, and applied the prohibition to construction of all overhead electrical or communication lines within the town limits, unless the town engineer finds underground installation to be infeasible or impracticable.

(*d*) April 15, 1964: The town of Woodside also filed an answer and motion to dismiss in civil action No. 42214. In addition to the arguments in (*c*) above, the town of Woodside asserted that acquisition of the right-of-way would subject the community to irreparable injury because soil erosion would result from the removal of trees in the path of the powerline. A hearing on the motions to dismiss was originally scheduled for April 27 but has been postponed to June 4, 1964.

(*e*) April 27, 1964: The attorney general was requested to acquire by condemnation with declaration of taking the 24.57-acre portion of the right-of-way which lies within the county of San Mateo.

(*f*) April 30, 1964:

1. A declaration of taking was filed in civil action No. 42214, and the amount of $42,800 was deposited in the registry of the court as the government's estimate of just compensation.

2. A complaint in condemnation and a declaration of taking covering the 24.57-acre portion of the right-of-way within the county of San Mateo was filed, and the amount of $189,150 was deposited in the registry of the court as the government's estimate of just compensation.

3. The judge of the Federal district court signed an order granting to the Government immediate possession of both the Woodside and San Mateo County portions of the right-of-way, subject to service of the order on the affected property owners. The order is limited by stipulation of counsel for both sides to possession of the right-of-way for survey and design purposes.

We shall be pleased to keep your committee informed of further significant developments.

Sincerely yours,

A. R. LUEDECKE, *General Manager.*