RESUMPTION OF SESSION

At 3:30 p.m., the hearing was resumed.

THE CHAIRMAN. A few preliminary questions from the Commission.

MR. CRONIN. May I interrupt you for a while, sir.

THE CHAIRMAN. You may.

MR. CRONIN. Inasmuch as Westinghouse has presented all of the informations that we wanted to and Mr. Simmons, Dr. Ferg and Mr. Wilgus all have jobs in the United States, could we ask for the same consideration that we did with Mr. Call, Mr. Sero and Mr. Arnold, that they be permitted to return to their regular jobs and that the presentation of Ebasco, NPC and Hayat, the physicist, to continue and if they can again be brought back after they have caught up with their day to day work.

THE CHAIRMAN. Mr. Cronin, the reception of these dissertations of the Ebasco gentlemen is only to fill in this gap. The Westinghouse Panel is still the panel on the rostrum, so we are not suspending actually the

Westinghouse presentation and interpellation. You will continue in fact tomorrow. This is only whenever the Westinghouse panel is not under interpellation. We are going to use the rest of the afternoon to useful purpose. We are not going to adjourn and we have many, many items that we can do whenever there is a suspension. So, tomorrow they will be back for further interpellation. We hope there is no misunderstanding about this. The Westinghouse panel is still under interpellation and this is merely to fill in the unused time for this afternoon, so that we can avoid any waste of time.

We are now going to listen to the Ebasco paper. May we have it. Is it in the rollo? Will you please come up and show us the page?

We are taking up now the elaboration of NPC responses to questions 5, 6, 7 by Ebasco Services, Incorporated, elaborating the NPC position paper. May we be informed who will defend this elaboration?

MR. ITCHON. Mr. Chairman, may we request that Mr. Charles Healy, who is the Project Manager of Ebasco for our nuclear power project be allowed to present the experts that came from the United States.

THE CHAIRMAN. Will it be only one or will it be a panel?

MR. ITCHON. This will be a panel of three, Mr. Chairman.

THE CHAIRMAN. Panel of three.

MR. ITCHON. Yes, sir.

THE CHAIRMAN. May we have them, please. Go to the rostrum so that they will be sworn in. Minister Itchon, we remind you that we have that standing directive that all of those who give statements and dissertations are to be sworn under oath and then they should submit a curriculum vitae showing their qualifications.

MR. ITCHON. Yes, sir.

THE CHAIRMAN. Please submit that as soon as possible. Let us have the gentlemen go to the rostrum and please state your respective names. The first gentleman is...

MR. HEALY. My name is Charles R. Healy. I am Project Manager of Ebasco Services, Inc. I am 45 years old, and I am married.

THE CHAIRMAN. Residence?

MR. HEALY. I am a resident of the Philippines.

THE CHAIRMAN. What particular place? Resident of what...

MR. HEALY. Manila.

THE CHAIRMAN. Street?

MR. HEALY I live at 29 Roosevelt in North Greenhills, San Juan, Manila.

THE CHAIRMAN. The next Gentleman.

MR. GILMORE. My name is James J. Gilmore. I am the Chief Consulting Civil Engineer for Ebasco Services, Inc. I am 51 years old, I am married; and I can give you either my business address or home address or both in New York.

THE CHAIRMAN. Both.

MR. GILMORE. Okay. Business address of Ebasco Services Incorporated is New York 10006, New York. My home address is 40 Gaylore Drive West, Amadee Bell 11701, New York.

THE CHAIRMAN. The other Gentleman.

MR. TILFORD. My name is Norman R. Tilford. I am a geologist. I am employed by Ebasco Services. My business address is 2311 West Netherview, Greensborough, North Carolina in the United States. My home address is P.O. Box 186 in Liberty, North Carolina, U.S.A. I am married. I am 44 years old.

THE CHAIRMAN. Please raise your right hands and all of you will be sworn simultaneously.

ATTY. ORQUICLA. Do you swear to tell the truth, the whole truth and nothing but the truth.

A We do.

THE CHAIRMAN. This is an elaboration of the NPC's responses to questions 5, 6 and 7. The question reads: "In case there should be an earthquake similar to that which hit Mindanao in August 1977— this seems to be inaccurate — we will refer back to the basic letter of instructions. I will call attention to that point. It says: "In case there should be an earthquake similar to the one that hit Mindanao in August 1977 which was of

7.2 intensity on the Richster scale, will the Bataan Nuclear Plant be able to withstand the shock without leak or spillage resulting in nuclear contamination; can it withstand a tsunami or tidal wave caused by earthquake of teutonic origin similar to the tsunami that hit Mindanao in 1977? That is our first question. You may proceed with your dissertation.

MR. HEALY. Mr. Chairman and members of the Commission, if you would please. I would like to give a few minutes background about Ebasco to help set the tone of expertise that we believe was brought to the Bataan Nuclear Power Plant site selection study.

THE CHAIRMAN. For the record this is Mr. ...

MR. HEALY. Healy.

THE CHAIRMAN. Mr. Healy, proceed.

MR. HEALY. Ebasco Services is an independent operated subsidiary of Insearch Corporation of Dallas, Texas. Ebasco is a full service consultant engineering construction organization dedicated to the needs of the electric utilities

throughout the world. Ebasco is experienced in all aspects of energy conversion and energy system development. Ebasco has been in the energy business for 75 years. We have been involved with more than 500 clients throughout the world and we have been involved in over 900 generating stations. Of the 900 generating stations over 700 have been fossil-fueled units with 200 of the 700 being overseas project.

Ebasco has been involved in just short of 200 hydroelectric projects of which approximately 100 have been overseas. We have been involved in total with about 120 million kilowatts of generation capacity. At present Ebasco was involved in two energy research projects in the United States. There are attempts to try to bring new types of generation to our society. One is a fusion test reactor at Princeton University in New Jersey and the second is a research project on coal-gas location for the Department of Energy and W.R. Grace Company. Ebasco currently has in excess of 5400 employees approximately which 60% are professionals. Our headquarters is New York City, United States, and we have principal

offices at Atlanta, Georgia; Newport Beach, California; Jerico, New York; Linburse, New Jersey. Ebasco also has a very special office in Greensville, North Carolina, which is our office that handles all geotechnical services of the earth sciences, which is the office that was primarily involved on the Bataan site selection work.

We have a petition with NPC to elaborate on Questions 5, 6, and 7. I would like to express our appreciation for your indulgence for allowing us your time this afternoon to do that and we will on your time schedule. We know it is short and we will finish by 5:00 o'clock. Our program is that on question No. 5, Mr. Tilford, our consulting engineer and geologist will handle Question 5; Mr. Gilmore, our chief civil consulting engineer will handle Question No. 6 and will return to Mr. Tilford to finish up with Question No. 7. Our estimated time will be about 1 hour and 5 minutes. With your indulgence I like to have Mr. Gilmore to take the same.

THE CHAIRMAN. Proceed, Mr. Gilmore.

MR. HEALY. Excuse me, Mr. Tilford.

THE CHAIRMAN. Mr. Tilford.

MR. TILFORD. I am Norman R. Tilford. I am identified as a geologist. I probably should give you a little more information about myself. I have some 22 years of experience as a professional geologist; I hold Bachelor and Master degrees from Arizona State University. Dr. Ferg attended a smaller rival school. (Laughter) I am registered as a Professional Geologist in the States of Arizona, California, Idaho and Georgia; I am a member of the Philippine Association of Geologists; the Association of Engineering Geologists in the United States where I am Chairman of the Carolina Section; I belong to the Geological Society of America; the International Association of Engineering Geologists and the U.S. Committee on Large Dams.

My primary areas of interest and expertise are in evaluation of geological hazards and economy and engineering projects. I have been with Ebasco for some 10 years; I have been associated with the geology seismology, siting and safety studies for the Philippine Nuclear Reactor No. 1 for some five years. Beginning in the fall of 1974 I have been involved in assessing

geological hazards for the Laguna Verde Nuclear Power Plant in Mexico; I have been a consulting geologist on Safety Studies on Preparation Reports for the PEPCO Douglas Point Nuclear Power Plant in Maryland; Washington Public Power System Satsop Nuclear Plants 3 and 5; Houston Power and Light Nuclear Power Plant at Allens Creek and Enrico Fermi Unit No. 3 for CPC.

I mentioned that I have spent now approaching some five years of involvement with PNPP unit 1. I have been present in the Philippines probably for a total duration of some nine months during that period of time. I want to inform the Commission and the Senator of the depth and intensity of the studies which were directed at finding a safe site in meeting the regulatory requirements with regards to safety for this nuclear power plant. In that connection, Ebasco has devoted 70-man years or some 810-man months or some 17,000 man-days of professional scientific effort supporting, resiting and safety studies related to the Philippine Nuclear unit. We have at one stage in 1975 and 1976 14 professional qualified earth scientists in the Philippines

working on this task for more than one year each. Some of those people were here for an excess of two years. In that connection and in support of the remaining responsibilities of Ebasco, Westinghouse and NPC, we have participated in the preparation and issuance of a number of reports, the first of which was an interim site report consisting of two volumes dated September 1975. We were responsible for the site confirmation report which was issued in January of 1976 that consisted of one volume. A preliminary safe site investigation report was issued in July of 1976 consisting of 4 volumes and our portion of the 18 volumes preliminary safety analysis report consists of 6 volumes, volumes 3 to 8; Jim would you hold up one of those, please. This is one of 6 volumes that covered the investigation related to the siting and safety studies in the earth sciences that is geology, seismology and geotechnical engineering. I believe I should go directly to the subject that I am supposed to be addressing which is Question 5. At this point, I would like to enter into the records two corrections that I believe are necessary regarding that question.

will be necessary to identify this for purposes of the transcripts. The first chart that you are exhibiting on the screen will be marked for purposes of identification. May we have the NPC exhibits? Are there any yet?

MEMBER OF THE STAFF. 1A.

THE CHAIRMAN. All right. Mark this as Exhibit II

A MEMBER. Roman number.

THE CHAIRMAN. No, the roman number are for the Roman panel. That is exclusive for the Roman panel.

REP. FROM THE NPC. NPC has one exhibit 1-NPC and Exhibit 1A.

THE CHAIRMAN. So, this will be Exhibit 2-NPC.

MR. TELFORD. Mr. Chairman, if you please may I insert a request that we would like to add another exhibit in advance of the exhibits that are going to be shown as slides with your permission.

THE CHAIRMAN. In that case you should proceed in an orderly fashion and we should number in the proper order.

MR. TILFORD. The article that I would like to enter as Exhibit 2 for NPC is an organizational chart which I would like to touch on very, very briefly.

THE CHAIRMAN. Mark the same as Exhibit 2-NPC. You don't have any projection on this.

MR. TILFORD. Be sure that there are copies that will go to the Commission members and to the panels, please.

THE CHAIRMAN. Mark your own exhibits, please, because the Clerk of the Commission is marking the exhibit for the Commission itself. Exhibit 2-NPC, an organizational chart. Will you please give four copies to the Commission?

(At this juncture the exhibits were marked by the Clerk of the Commission) Please proceed.

MR. TILFORD. Does the member of the Commission have a copy of this chart? It will be very helpful because I would like to go through it very quickly.

THE CHAIRMAN. Please mark the Commission document and then give them to the members.

MR. TILFORD. Charlie, be sure that the Commission Members have copies.

THE CHAIRMAN. Just a moment please, so we can follow.

(At this juncture copies were distributed to the members)

MR. TILFORD. This is simply an organizational chart, intended to illustrate for you the manner in which Ebasco approached the assignment of confirming the site for the Philippines first nuclear plant and I would like to point out very unusual features of this arrangement. (Illustrating from the Chart) The Chief Consulting Engineer who is at the top left of this exhibit is identified as J. J. Gilmore. He will be speaking following my presentation and he is here. I am identified under the box in the middle. We formed at the outset a technical review committee. The membership of this committee was determined by what we considered to be the important issues which would be involved in selecting and licensing such as site. Dr. Arturo Alcaraz who is well known to most of you as the former Chairman of the

Commission on Volcanology of the Philippines and who was here practically was a leading member of our technical review committee. A second member was Dr. Alex Mc Bernie whose book entitled "Volcanoes" was published last month and is a leading world authority on volcanism and is a professor of geology at Oregon State. Mr. Novades was a second member of our panel and the Chief Licensing Engineer of Ebasco was a third member and at present member of the panel. We kept this panel completely informed by means of frequent meetings during the course of the investigative and I believe that subsequently Dr. Alcaraz may help us to address certain questions that may be put to us. The senior position on geology and seismology in this chart illustrates the individuals and the organizat. n that was at work for Ebasco representing NPC here in the Philippines. We had a field office at Bagac. The following disciplines were represented: geological research, field reconnaissance, mapping and correlation, ground water hydrology, geophysical work, exploratory boring, stretching and geophysical surveys. There are other distinctions that can be made here. We carried with us also throughout this entire investigation an independent panel of

consultants in specialized earth science disciplines. Identified in this chart under geochemistry Dr. Paul Weiman who is the Chairman of the Department of Geology at Florida State; Dr. Yale Oxburn who was Chairman of the Department of Geology at Western University at that time was our expert in geophysics and in magnetics; geochronology or age dating, our consultant was Dr. Roy Wilson who teaches at Florida State; and remote sensing, Dr. Charles Wilby, who teaches at North Carolina. And we had other consultants who assisted us. Dr. Wygo was our consultant who worked with us in establishing the design. And I would like to point out that as this chart that I show ...

MR. TILFORD. ...shows we did consult at length with appropriate Philippine government agencies. I have special reference to PAGASA, to the Commission on Volcanology, to the Bureau of Mines and to the faculty of the University of the Philippines, the Philippine Coast and Geodetic Survey and Philippine Weather Bureau with respect to the graph. I simply entered this organizational chart into the record in the hope that it will illustrate for you in some details the organizational arrangement that will support the study documents, the safety of the site, and the things that are going to be presented to you. From that point then, we are going back to the slides, with your indulgence, and thresh out more completely Question No. 5.

This is a drawing which appears in our safety analysis report.

THE CHAIRMAN. We will mark this as Exhibit "3-NPC". Government panel, please take note so that there will be no improper interchange.

MR. TILFORD. The score of seismicity and tectonics in the Philippines have been considered thoroughly in the design of the Philippine nuclear plant in Bataan. In this study, it has been shown that Luzon, Mindoro and associated offshore areas can be divided into distinct coastal blocks. The contents of these blocks are 4 structural features that clearly separate different geologic provinces along major coastal lines or zones that have changeable attenuation

characteristics for earthquake wave generated outside that coastal unit. Each boundary separates three tectonic provinces: namely, Northern Luzon, Central Luzon and Southern Luzon and Mindoro. Bataan Peninsula, the site, is in Central Luzon tectonic province.

I would like to point out that the US Nuclear Regulatory Commission requires what we call a deterministic study to resolve what the safe shutdown earthquake value should be in the nuclear power plant site. Without complicating the issue more for you as to whether this is justified, let me tell you that in achieving this deterministic methodology, we identified the boundaries of the appropriate geologic and tectonic provinces in Luzon for the purpose of assessing the effects on the site of distant earthquakes. The methodology involved is that we must take the Mindanao earthquake from Mindanao moving a thousand kilometers and going ahead to the line identified here as the Taal Fracture Zone, which is a zone coastal extension, which has a favorable impression upon earthquake's motion generated on one side of the other with respect to the other side. We bring an earthquake, we place it along this boundary line at closest the approach of this boundary line feature through the site, and then we attenuate other quakes to the site in terms of what

the ground motion should be. That is true for anywhere around this entire region.

THE CHAIRMAN. Mr. Tilford, could you tell us why you particularly call it as the Taal Fracture Zone?

MR. TILFORD. Yes. It was identified as the Taal Fracture Zone, I believe, in a publication by Soviet and someone else in about 1938.

THE CHAIRMAN. What is the basis for it? Why that particular terminology?

MR. TILFORD. It is simply a descriptive phrase that is commonly recognized by investigators in this sort of study. Taal is the name of an active volcano which forms a part of this line. The fracture zone indicates that it is a line along which the earth's surface is broken commonly. And we know in this instance that this is a zone or coastal extension that is - two sides have fallen apart and therefore the motions from earthquakes generated on this side tend to be attenuated pretty markedly or reduced pretty markedly on a coastal line.

THE CHAIRMAN. In other words, Mr. Tilford, whenever there is an earthquake that arises, that usually is the line that would open. Is that correct?

MR. TILFORD. Yes, it may open during earthquakes associated with the zone.

THE CHAIRMAN. That would be where the crack would appear.

MR. TILFORD. Yes, sir.

THE CHAIRMAN. And that will be true also in connection with the other fracture zones?

MR. TILFORD. Yes, this is the Philippine fault which many of you know is one of the major active faults in the world. It forms a quite effective boundary for the distinction between the Northern Luzon tectonic provinces and Central Luzon provinces and the other feature up here is the Manila trench which is the location or site of the consumption or subduction of the ocean floor plate beneath the Philippine archipelago.

THE CHAIRMAN. The other fracture zones are entitled: Manila Bay Fracture Zone, San Antonio Fracture Zone and the Iba Fracture Zone.

MR. TILFORD. Yes.

THE CHAIRMAN. Now, the Taal Fracture Zone would be the approximate line that would crack or open if the Taal volcano erupted.

MR. TILFORD. It does not necessarily follow that the eruption of a volcano may or may not be accompanied by earthquake. In most cases, the earthquake associated with volcanic activity is very slow.

THE CHAIRMAN. But the point is if there is any crack this would be the usual line.

MR. TILFORD. It would be the usual line for earthquakes associated with this general alignment. The same is true with the others.

THE CHAIRMAN. The same general alignment. The witness was referring to the areas around the Southern Luzon, Mindoro tectonic province. Is that correct?

The point, Mr. Tilford is that this particular dissertation is being recorded in the stenographic notes and whenever you say "this" without specifying what particular reference, we would not be able to know in the stenographic notes. So, will you please repeat that portion so that when you say instead of this, you would specify the point of reference.

MR. TILFORD. I appreciate that comment. I must apologize for this.

The Taal Fracture Zone separates the Southern Luzon and Mindoro tectonic province from the Central Luzon tectonic province. The Taal Fracture Zone is an identified line along which earthquakes may occur. It is a zone or extension of the earth's crust and one in which seismic motions from one part to the other and are reduced or squelched or attenuated as

it cross that line. The Philippine fault separates the Central Luzon tectonic province, the area of interest, from the Northern Luzon tectonic province and it is that feature which dominates the geology of the Philippines which is an active fault and along which movement very commonly takes place during major Philippine earthquakes because they are the earthquakes occurring to release stress along that fault.

The third boundary to the Central Luzon tectonic province is the Manila Bay trench which separates the Central Luzon tectonic province from the South China Sea in a geological sense. Interior to the Central Luzon tectonic province are four identified zones of fracturing and faulting. From the North, they are the Iba Fracture Zone, the San Antonio Fracture Zone, the Manila Bay Fracture Zone, all of which trenched generally east-west and all of which represent presently active faulting along which earthquakes have taken place during the historical past.

There is one additional feature that is not shown in this particular PASR figure. It is called the West Luzon trough and it is found offshore of Bataan but not on the western side of the Manila trench. It is some 240 kilometers in length and for purposes of determination of earthquake motions at the plant site

is considered to represent an active geologic fault.

THE CHAIRMAN. All right, Mr. Tilford, we note from that sketch that we have two other fracture zones: the Iba Fracture Zone and the San Antonio Fracture Zone. In fact, there is a third one: the Manila Bay Fracture Zone. The line seems to go beyond the lands surface into the sea. Does it mean that the cracking of the earth would include not only the dry land but even the ocean or seabed?

MR. TILFORD. Yes, that is exactly correct. Now, once we have established that the geologic features which can produce earthquakes within this tectonic province, we must make an assessment of the largest earthquake which could occur on each of these features. And then determine what motion would be imparted into the foundation rock at the particular site in question. In this case, the location of the Bataan Nuclear Plant. That process is completed and the motion that would be delivered at that point from anyone of those maximum occurrences is expressed as a percentage of the exhilaration of gravity of the peorest out of the components to be more specific. Now, in that context, let me discuss the design factors of this plant as they relate to the Mindanao earthquake of August, 1976. To do that, let us look at a few more slides.

THE CHAIRMAN. Mark this diagram as Exhibit "4-NPC". Wait a minute. There has been a change. Which one are we going to mark? This one or that one?

MR. TILFORD. We can mark this one and identify it as the aerial view at the bottom.

THE CHAIRMAN. Exhibit "4-NPC" represents an aerial view. Government panel, please take note.

Please proceed.

MR. TILFORD. As I have mentioned to you, we went down to Mindanao to investigate the effects of the August, 1976 earthquake. This is a view which illustrates the general nature of the area where the earthquake produced the greatest damage, by specifying the earthquake as opposed to the tsunami which will be suffered. The earthquake did the greatest damage in this instance as it does in many other cases in the world where the land is flat, low-lined and composed of unconsolidated, unconsolidated, soft, mossy sediment which is saturated with water.

As you can see in the picture at the background of this particular view, the area around Cotabato is just such an area. It is low-lined, sedimentary, unconsolidated, saturated. This illustratration is an aerial view showing fissuring or cracking of the earth's surface near Cotabato.

THE CHAIRMAN. Just a minute. This is to be marked as Exhibit "5-NPC", showing an aerial view and depicting coconut trees.

MR. TILFORD. In the center of this photograph, you will see a crack in the ground that is a feature that is called fissuring. It occurs during earthquakes very commonly at even very low exhilaration values in unconsolidated alluvium materials which are saturated

THE CHAIRMAN. (Interrupting.) For the record, we would like to invite observations on this particular picture. The chairman's observation is that the crack is not a through-and-through crack. It extends and seems to end from the bottom of the picture up to about a third .. the crack seems to end at that spot.

Any observations from the part of the parties? Participants? Senator Tañada. No comment from Senator Tañada. The Commissioners? No observation from the commissioners.

MR. TILFORD. I confirm the chairman's observation. The observation is correct.

This is another illustration. It is an aerial photograph looking forth at Cotabato on the sea coast at the mouth of the river.

THE CHAIRMAN. Mark the same as Exhibit "6-NPC".

MR. TIFFORD. (Continuing.) I would use this slide to make a point regarding the tsunami. We overflew and looked very carefully at the entire coastal region for proper viewing of Cotabato and beyond. We landed on several locations to inspect various kinds of damage. It was our observation that most commonly nipa structures built on stilts or stands on shore at elevations of about one to two meters above, being high tide, were not displaced. That is a long technical way of saying that in most of the ridge of this coast line, the tsunami is not very large. The tsunami was exaggerated in coastal embadments between separated points or peninsulas of land where a bore is formed . A hard bore which is actually a large wave recurs during the approach of tsunami giant waves to the seashore and in open stretches of beach and particularly at the heads of peninsulas or points. There was no observable damage from tsunami. The damage from tsunami incurred in a bay and to that extent, I would point out to you that the nipa structures in the lower left of this photograph which you may have difficulty to see but which I can point out to the Commission, are in fact, and they are surely no more than two meters above high tide. I pointed out to you in this connection that the USNRC and their consultants - the US Geological Survey, are at present requiring a plant design grade on the coast of California in USA of 15 meters above sea level.

Now compare the California situation with that of the western side of Bataan. California has the full fetch or ridge of the Pacific from which tsunami giant waves can reach that shore. The Philippine coastline on the South China Sea has that reach or fetch only of the distance to the mainland China. It is an appreciable difference. The difference is between 8 thousand miles and 600.

The second feature that I think you have to be aware of is that the nuclear plant in Bataan has a plant grade of about 10 meters above sea level. So far as I am aware, that is the highest elevation above sea level at which a nuclear plant grade has been established for one's cooling in the world. And it was established at extreme economic penalty of pumping water for 50 years that distance in height simply because of the issue on tsunami between the safe-plant and safe-plant site. This is an aerial photograph of, I believe, Exhibit No. "7", Mr. Chairman.

THE CHAIRMAN. Exhibit No. "7-NPC".

MR. TIPTON. This is an aerial view of the dock site at Potogenia (?) shortly after the August, 1976 earthquake and tsunami. I want to make clear on this point. Although some water encroached on these plants, under the tsunami, there is an essentially one meter above sea level -no destruc-

THE CHAIRMAN. Just a minute. This is to be marked as Exhibit "5-NPC", showing an aerial view and depicting coconut trees.

MR. TILFORD. In the center of this photograph, you will see a crack in the ground that is a feature that is called fissuring. It occurs during earthquakes very commonly at even very low exhilaration values in unconsolidated alluvial materials which are saturated

THE CHAIRMAN. (Interrupting.) For the record, we would like to invite observations on this particular picture. The chairman's observation is that the crack is not a through-and-through crack. It extends and seems to end from the bottom of the picture up to about a third ... the crack seems to end at that spot.

Any observations from the part of the parties? Participants? Senator Tañada. No comment from Senator Tañada. The Commissioners? No observation from the commissioners.

MR. TILFORD. I confirm the chairman's observation. The observation is correct.

This is another illustration. It is an aerial photograph looking forth at Cotabato on the sea coast at the mouth of the river.

THE CHAIRMAN. Mark this next as Exhibit "6-NPC".

MR. TILFORD. (Continuing.) I would use this slide to make a point regarding the tsunami. We overflew and looked very carefully at the entire coastal region for proper viewing of Cotabato and beyond. We landed on several locations to inspect various kinds of damage. It was our observation that most commonly nipa structures built on stilts or stands on shore at elevations of about one to two meters above, being high tide, were not displaced. What is a long technical way of saying that in most of the ridge of this coast line, the tsunami is not very large. The tsunami was exaggerated in coastal embodiments between separated points or peninsulas of land where a bore is formed. A hard bore which is actually a large wave recurs during the approach of tsunami giant waves to the seashore and in open stretches of beach and particularly at the heads of peninsulas or points. There was no observable damage from tsunami. The damage from tsunami incurred in a bay and to that extent, I would point out to you that the nipa structures in the lower left of this photograph which you may have difficulty to see but which I can point out to the Commission, are in fact, and they are surely no more than two meters above high tide. I pointed out to you in this connection that the USNRC and their consultants - the US Geological Survey, are at present requiring a plant design grade on the coast of California in the [illegible] of 15 meters above sea level.

tion - complete or outright destruction on highly-built, lightly-constructed and unengineered buildings. The people who were injured in this tsunami, and there were probably thousands of them who were killed, were killed because they lived in nipa stilt-supported structures built over the bay. They lived over the water and the poor joists of those structures are commonly installed about 25 centimeters above mean tide.

THE CHAIRMAN. (Interrupting.) The Commission would like to ask a question. That center portion of that picture, Mr. Tilford, does that actually show a collapsed roof?

MR. TILFORD. Yes, sir. It shows a collapse resulting from a kind of fissuring or gushing and boiling of the unconsolidated mud that you saw in the earlier photograph. But in this particular picture, I am showing you the edge of the docks and wharves and cargo piers and showing the extent of the damage. Just within two miles of this site thousands of people were killed in their homes at midnight in small lightly-constructed nipa huts built over the bay.

THE CHAIRMAN. Besides the central part of this picture, Mr. Tilford, are there any other instances of any collapsed roof of any houses besides the center portion?

POOR ORIGINAL

MR. WILFORD. Given the degree of care with which I look at the picture, I would say No. I don't think there is.

THE CHAIRMAN. So, it is only the center portion of the picture that represents collapsed roof?

MR. WILFORD. Yes, that is correct.

THE CHAIRMAN. Thank you.

MR. WILFORD. Now, let us look at the Bataan Nuclear Plant site from the point of view of tsunami.

THE CHAIRMAN. That is Exhibit No. "8-NPC".

MR. WILFORD. This is a view of the exact point of the selected site of the nuclear plant in Bataan. Before any site-related work is completed you see that this site is a peninsula; and I tell you that the site is a peninsula. We selected a peninsula in large part because it [illegible] naturally occurring, God-given, non-man-made resistance to tsunami. This is Exhibit No. "9-NPC", Mr. Chairman?

THE CHAIRMAN. Exhibit No. "9-NPC".

MR. WILFORD. This is another aerial view of [illegible] there is [illegible] construction activity. And I would like to point out once again the point essentially [illegible] of the ship would break aside any wave that came in the direction and any appreciable

runup is going to occur in the area in the bottom of that photograph where the embayment is closed on two sides, you cannot see the left side, by peninsulas of land.

THE CHAIRMAN. A few observations before you go on, Mr. Wilford. We see in this particular picture barren lands. Is it not? There seems to be a very very large area where there are no trees and no vegetation. Is that correct?

MR. WILFORD. That is correct. It is the result of, I understand, extensive logging of the [illegible] peninsula subsequent to World War II.

THE CHAIRMAN. Is this material to the damage that can be wrought by tsunami, the fact that there are no trees, no vegetation?

MR. WILFORD. No.

THE CHAIRMAN. Would not the trees stem the tide of the tsunami as it flows inland?

MR. WILFORD. That seems the reasonable, but the observations that I made of coastlines where tsunami have occurred indicate that the trees seem to offer little protection. The waves seem to overpower the trees.

THE CHAIRMAN. By overpowering, do you mean that they rise higher than the top of the trees.

MR. TILFORD. The highest recorded tsunami in the world in history occurred in 1964 on the coastal Chile in South America not recorded in actual meters. So, actually, the answer generally to the question is No. That is not the case; there is simply so much water involved in this way that it goes through the trees the water simply passes.

THE CHAIRMAN. But would not the water go farther inward when there are no trees?

MR. TILFORD. Sure.

THE CHAIRMAN. So, it has an effect.

MR. TILFORD. Within the elevation ranges there are commonly of concern, but the effect is usually small. But I agree it has an effect.

THE CHAIRMAN. Thank you.

MR. TILFORD. This is another view looking in the other direction at Napot Point during the gruelling part of the excavation for the Bataan Nuclear Plant..

THE CHAIRMAN. Mark it as Exhibit "10-NPC".

MR. TILFORD. May I show this again to illustrate the natural protection of the site against tsunami.

THE CHAIRMAN. Could you turn that back again just so we can make some observations.

This is Exhibit No. "10-NPC".

COM. VASQUEZ. That mountain up above that picture, is that Mount Natib?

MR. TILFORD. No, that is Mount Mariveles.

COM. VASQUEZ. Is it also a volcano?

MR. TILFORD. Yes, it is also a volcano.

COM. VASQUEZ. May we know the distance between the volcano and the site.

MR. TILFORD. From memory, I think it is fifteen (15) kilometers.

COM. VASQUEZ. By air.

MR. TILFORD. Yes, sir.

COM. BAUTISTA. But behind that is Mount Natib. Behind Mount Mariveles is Mount Natib.

MR. TILFORD. Excuse me, sir. Mount Natib is to the left of this photograph on a path point. Beside the power plant is a deposit of rocks built up over more than one-and-a-half million years ago by the eruption of Mount Natib. Mount Natib is directly to your left as you look at the picture.

Sen. TAÑADA. But not very far from Mount Mariveles is Mount Natib although it is at the left.

MR. TILFORD. Yes, sir.

THE CHAIRMAN. On the right part of this picture, Mr. Tilford, could you tell me if my observation is accurate. There seems to be a sign of erosion in this right part of the land jotting out.

MR. TILFORD. Yes, sir.

THE CHAIRMAN. How extensive is that erosion? Did you observe?

MR. TILFORD. Erosion actually is by cliff-forming waves primarily during storm activity do encroach upon the entire seacoast and the sculpturing of the entire seacoast is the result of this wave action. The erosion you see is the erosion there at the present time. In the past it has extended farther up to the sea and is represented in the extreme right part of a small outflow from there where you cannot see here. These are the subsea contours of the land and this point extends up to the right ...

MR. TILFORD. ... to the right as a soft seafloor point for approximately one kilometer.

THE CHAIRMAN. Mr. Tilford, how material is that to the stability of the structure of the land than this area?

MR. TILFORD. The fact, that the land is presently a peninsula is in effect a proof test of stability. The land adjacent to it has succumbed to the forces of erosion, whereas this land has shown its strength and stability by remaining available to us for years.

THE CHAIRMAN. Notwithstanding the signs of erosion that you just pointed out.

MR. TILFORD. Erosion is a constant and ongoing process in essentially all parts of the earth surface. The land masses that were formally adjacent to this point on both sides and extending as far as the eye can see have eroded away, whereas this point remains.

THE CHAIRMAN. Let us go to the next Exhibit.

MR. TILFORD. Now, we come back to Cotabato and I want to show you how a school particularly we have photographs and records of many failures at Cotabato but this is the Terrace Grammar School.

THE CHAIRMAN. Mark this as Exhibit 11-NPC.

MR. TILFORD. This structure failed as a number of other structures in Cotabato, all of the failures we observed were reinforced concrete structures rather than wooden or metal structures and this building in which you see in aerial view offers an excellent lesson in earthquake engineering and in how the research structure failed. Let me point out again that where you see them in we were not more than 2 meters above sea level, all over many many miles inland and the ground is saturated. When I took the pictures associated with this on the ground I was standing in water. So, the school and all of the other structures you see here are built on unconsolidated saturated sand.

THE CHAIRMAN. Please bring that back again. On the left of center we find the difference between the appearance of the roof at that part, which is different from the roofs of the building on the right which seemed to be intact. What happened to

this portion? Let of center, Mr. Tilford.

MR. TILFORD. This is the school structure which in fact was in a progressive state of collapse. The rear of this building is down essentially on the ground, the front of the building here remains almost intact. The external structure of walls of the rear of this building have been thrown out and are lying here in broken condition for the largest part. The next illustration is a view of this fell structure from ground taken at about where I am pointer.

THE CHAIRMAN. Witness referring to the right bottom corner of the picture.

MR. TILFORD. Thank you.

THE CHAIRMAN. We go to the next Exhibit. Exhibit 12-NPC. Please describe it, Mr. Tilford.

MR. TILFORD. Here you see the view - I promise you of this building. You have just seen an aerial view. Here the back of the building is down. The front of the building remains primarily in its original condition. The initiating failure in all of these structures in Cotabato, and all of the failures

are on saturated and consolidated sand is initiated by shearing or breaking of the lower floor beam or support at the base slab of the first floor above. These are all generally open structures, they have no interior walls and they, therefore, succumb at the top fairly easily to shaking. What has happened in many other buildings is that this collapse has continuted; the lower floor has collapsed completely that has buckled the second floor consequently that has collapsed buckling the third floor which has collapsed; buckling the 4th floor which has collapsed. There were in excess of 25 reinforced concrete structure of this type. In Cotabato all of which failed in the same way; in the same orientation and in the same configuration. And in many cases people were then living on what have been the roof at the 4th floor and you can step upon to it by a height almost not much higher than the height of the stairs... Now, I welcome your comments or and questions on this exhibit.

THE CHAIRMAN. No comments from the Commission.

MR. TILFORD. Now, let as look at what building

did not collapse in Cotabato in this earthquake.

THE CHAIRMAN. Mark this Exhibit 13-NPC.

MR. TILFORD. The illustration and I could have picked any of several hundreds of photographs I have of wooden structures which were essentially intact shows dramatically the relationship between type of construction material and result. (Pointing to a church in the slide.) This is a church in Cotabato and the main section of the church is a wooden construction. It stands. The entire remainder of the church excepting the door joist are masonry and cement block. None of them stand. The door joist for the front entrance which is of wood is intact. Now, it could be argued from this photograph on this situation that we should build power nuclear plants of wood but I think probably we have a fire problem.

Now, let me make what I consider to be the most dramatic point to be made from a study in that of the results of the Mindanao earthquake in August of 1976. The failures you see, and I could have shown you

hundreds more. Those failure occured at ground accelerations of .085G., .085 less than 1% of the force of gravity. May I remind you that the Bataan Plant is designed to safely withstand and operate during an earthquake producing ground shaking measured a 40% of all acceleration. These failures occurs at less than 1%. This plant is designed to continue to function through strong shaking in over 40 times as strong as the shaking which fell these structures. Your comments or questions, Mr. Chairman.

JUSTICE BAUTISTA. What is your participation in the making of the design as a geologist?

MR. TILFORD. We participate very strongly in the selection of the site, in the studies related to provision of water supply; studies related to geological hazards, earthquakes volcanic activities in this case, landslides; slope failures; sinking of the grounds and things of that sort. We have absolutely nothing to do with the design of the plant beyond establishing the design condition, which we do in specifying the earthquake motions, their strength, their duration, and their frequency content and at that point we turn this facility with that earthquake working on its foundation over to the structural

engineers who designed the plants.

JUSTICE BAUTISTA. He would like to be clarified what you mean by the Bataan Plant being designed to withstand the horizontal acceleration of 4.0G?

MR. TILFORD. 40% of the gravity that 4.0, if I mistated it myself, I am sorry. 4.0

JUSTICE VASQUEZ. How can you say that the plant to be installed is in Bataan is of that kind when it is our understanding that it is a typical plant, it is the same plant that they put up anywhere irrespective of geological conditions.

MR. TILFORD. We have imposed upon the plant design for 35% of gravity, the designer and constructor of the plant has elected to construct the plant to a value of 40% of gravity or 4.0G. I can offer you no assurances of my personal knowledge that this design condition is in fact met. I can't offer you assurances that the establishment of the design condition has been done safely and conservatively.

JUSTICE VASQUEZ. Your recommendation is supposed to be translated by the maker of the plant as part

of the design of the plant itself.

MR. TILFORD. That is correct and any questions on the design of the plant should of course be properly addressed to the designer.

JUSTICE VASQUEZ. Do you, for instance, say or tell them that you have to make the walls as thick as a meter or several feet.

MR. TILFORD. No, sir, we specify the motion that that plant must withstand. It is the job of the structural engineer to translate that motion into a design which is safe under those conditions.

JUSTICE VASQUEZ. You do not tell them exactly what to do?

MR. TILFORD. No, sir.

JUSTICE VASQUEZ. Are you aware, if your recommendations have been followed in the preparation of the design of the Bataan Plant.

MR. TILFORD. I am sorry I don't understand the question.

JUSTICE VASQUEZ. Your recommendation about what to do in order to withstand an earthquake of that

magnitude.

MR. TILFORD. In this instance, our company is capable of doing what we do plus design the plant plus build it, plus operate it. But in this instance we have done a site related studies, safety studies and we have established certain design condition, and one of those designed conditions is the force let's say force of the earthquake that the plant must be designed to withstand. We turn that recommendations and those criteria and conditions over to the designer of the plant by way of the National Power Corporation who participates and reviews and approves those conditions. The designer of the plant is the one who decides how thick the concrete will be; how much reinforcing steel we we are going to .... and so on. That is subject to review by the National Power Corporation.

THE CHAIRMAN. What Justice Vasquez, I believe, wanted to ask is did you check whether your specifications and recommendations were carried out in the Bataan Nuclear Plants?

MR. TILFORD. I personally am not qualified to

judge whether the plant will continue to function. I am not qualified.

THE CHAIRMAN. Mr. Tilford, the question is very very very simple. You laid down certain specifications. You gave various recommendations. The only question is, did you go the Bataan Plant and check, verify whether these specifications and recommendations were in fact carried out?

MR. TILFORD. Given a way the question is put the answer is "no".

THE CHAIRMAN. Would you want to explain your answer?

MR. TILFORD. It is impossible for me to determine if the recommendation is being followed. I am assured by the National Power Corporation, Westinghouse, that those recommendations are implemented. But I personally am incompetent to determine, if they are being implemented.

THE CHAIRMAN. Did anyone in your organization in Ebasco checked or verified whether this recommendations and specifications are being carried out?

MR. TILFORD. As an expert and not an official

of the company I would defer that question to someone who would testify as an official of the company.

THE CHAIRMAN. Well, the question is whether there is anyone, if you can just identify if there is anyone who did make that verification and that checking.

MR. TILFORD. I personally am not able to make that determination.

THE CHAIRMAN. Is there anyone in your panel who can answer that question? (Silence) No one can answer that question. Nobody present in this hall, anyone not present in this hall who can answer that question from EBASCO.

MR. HEALY. Yes,

THE CHAIRMAN. The answer is "yes", The answer given by Mr. Healy. Who is that person. Mr. Healy?

MR. HEALY. Mr. Commissioner, there are three people here on this panel from Ebasco and Norman Tilford the geologist and he has already given his explanation of his understanding of how it gets translated. The other person is Mr. James Gilmore and myself, I am a project Manager. None of the

three of us, and I believe that I speak for Mr. Gilmore.

THE CHAIRMAN. Is that correct?

MR. GILMORE. That is correct.

THE CHAIRMAN. Will you repeat your answer, Mr. Gilmore?

MR. GILMORE. That is correct.

MR. HEALY. None of the three of us here can give you a statement that we understand from personal knowledge that that was checked. I believe that within Ebasco that there are people that can give a statement on that, but they are not here now.

THE CHAIRMAN. Who are they?

MR. HEALY. It would be somebody from the engineering side of the house, the name of the person is very difficult for me to give to you right now.

THE CHAIRMAN. We will give you your table of organization, exhibit .....

MR. HEALY. That will not tell us.

MR. GILMORE. Excuse me, Commissioner Pond. Perhaps, I clarify the safety situation a little bit. This

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organization chart is the organization chart for the Consultant's Civil Engineering Group who are participating in the Site Selection Studies. The organization chart for the entire company would be necessary to identify the group or individuals who might have participated in design or design review. As a company we are divided into departments and the different departments have different responsibilities. The Consulting Engineering Department selects the sites for all types of power plants; establishing design criteria, etc. The Design Engineering Department is the group that is responsible for the actual design of the buildings or the review of the design of the buildings if that is a contractual obligation.

THE CHAIRMAN. Do you mean to say, Mr. Gilmore, that this table of organization you have marked Exhibit 2-H C is only a part of a larger table of organization?

MR. GILMORE. That is correct.

THE CHAIRMAN. And in that larger table of organization you would have certain officials

that would go higher up in the hierarchy of echelons in your organization.

MR. GILMORE. The other departments that I referred to, Mr. Chairman, are in a parallel level.

THE CHAIRMAN. Yes, precisely, but they are all united under a higher authority.

MR. GILMORE. That is correct.

THE CHAIRMAN. Well, what answer can you give the Commission now. Are you just telling us that you do not know whether there has been a verification and a check on the faithfulness of the construction to the design and recommendation that Ebasco made?

MR. GILMORE. Ebasco has a contract with NPC. There are very many groups in our company who are working with NPC in implementing the contract. The questions 5, 6, and 7 were designed to address the Mindanao earthquake, faulting, seismology and the department that is responsible for those questions is the departmebt that is repsesenting the company here today.

THE CHAIRMAN. Mr. Gilmore, the point is statements

have been made here that all these volcanic and seismic phenomena have been taken into consideration in regard to the design and the recommendations of the Bataan Plant. That is clear. So far, we have been told that none of the three gentlemen here made any check or verification to determine whether those specifications and recommendations had been carried out. And this is asking a simple question. Would there by anyone if you cannot specify him by name can you at least specify him by the Office that he occupies so that we can seek his statement or testimony regarding this very important point.

MR. GILMORE. For myself I will have to defer that to Mr. Healy and to NPC.

THE CHAIRMAN. Does the NPC wish to answer the question.

MR. TORRES. Mr. Chairman, part of the Ebasco consultancy services for the NPC is a design review. This is service performed principally by the engineering group of Ebasco in New York. And this is the group that has done the checking.

THE CHAIRMAN. So, there is a group that checks?

MR. TORRES. Yes.

THE CHAIRMAN. Where are they?

MR. TORRES. They are based in New York.

THE CHAIRMAN. In New York. Why are they in New York when the plant is being constructed now?

MR. TORRES. I refer to the design because the design of this is being done in the United States by Westinghouse.

THE CHAIRMAN. Yes, but Mr. Torres, the design in regard to the recommendations and specifications have already been submitted by EBASCO and actually these designs are supposedly being carried out in the present construction stage of the Bataan Plant. Is there no Ebasco representative overseeing the construction to see to it that these specifications are being carried out?

MR. TORRES. For the construction checking that is being done at the site, I refer to the checking of the design by Ebasco.

THE CHAIRMAN. So, you have one Ebasco man here.

MR. TORRES. We also have Ebasco man here.

THE CHAIRMAN. Making the verification.

MR. TORRES. Yes, together with the NPC.

THE CHAIRMAN. Who is that ? Who is that man?

MR. TORRES. Mr. Les Elliot.

THE CHAIRMAN. Mr. Les Elliot of Ebasco.

MR. TORRES. Of Ebasco.

THE CHAIRMAN. He is in the Philippines?

MR. TORRES. Yes, sir.

THE CHAIRMAN. In Bataan?

MR. TORRES. Yes, sir.

THE CHAIRMAN. Checking whether these specifications are being carridd out?

MR. TORRES. Yes, sir.

THE CHAIRMAN. Can you bring him before this Commission?

MR. TORRES. Yes, sir.

THE CHAIRMAN. Please do so. Thank you. Continue.

MR. TORRES. I would like to give a little clarifi-

represented here are the ones who makes the study on the site and determine the perimeters as they called it. This is a specification on what is the earthquake that the plant should withstand; and what can you expect in the site and therefore design the plant in accordance with their findings. Now, the design itself of the plant is made by the engineers of Westinghouse in the United States and that design has to be counter-checked by Ebasco to make sure that the design conforms with the perimeter. Now, once the design is completed, construction begins. And therefore, again a review has to be made whether the construction is in accordance with this design and so there are three stages there. It is not only a two-stage affair.

THE CHAIRMAN. Yes, but while it is being constructed some Ebasco representatives is there to see that these recommendations are being carried out.

MR. TORRES. Yes, sir. And also from PAEC.

THE CHAIRMAN. We await the production of that Gentleman before this Commission.

Mark this next diagram or sketch as Exhibit 14-MPC.

MR. TILFORD. You have seen that we have scientifically divided Luzon into appropriate segments concerning earthquake activity. We have completed an exhaustive deterministic process which is that process which satisfies the requirements of the US NRC in establishing the acceleration value of the design safe shut down earthquake as it is called. A way of checking this deterministic evaluation is to an attempt a probabilistic evaluation to see if the results are comfortable. In such a process you study the historical seismisity of the region you count all of the earthquakes that have occured and you determine to the extent possible the energy released during those earthquakes and keep in mind that in the Philippines you have a record that is longer than 400 years and that record is almost twice as long as the record that is available to us in the United States. So, using that 400 years of record, you can establish the areas which our earthquakes-prone and you can draw what is called a least square feet computermeter, create a drawing which shows contours or lines of equal value for certain free selected data. This is a procedure authored by a scientist of the U. S. Geological Survey

in 1976, and we have essentially followed his procedure in producing what we call the seismic risk map, which is projected before you. We can make this as complicated or simple as we like. Let's try to keep it simple depending on your questions. In short, these contours or lines show the magnitude or values of acceleration which are to be expected in this particular locations one time in the next 10,000 years. The maximum value of horizontal acceleration of each area or point that would be expected to occur one time in each 10,000 years. Okay? Now, each of these little squares has a number and that number represents that acceleration value that we would expect to happen one time in each 10,000 years period. For those of you who are further away including unfortunately the members of the Commission, green is good, white is not quite so good; and red in general is pretty bad. The acceleration that this method predicts will occur once each 10,000 years at the Bataan Plant Site is .28G. Let's compare that ...

THE CHAIRMAN. Once every 10,000 years?

MR. TILFORD. Yes, sir.

THE CHAIRMAN. When did it last happened in Bataan?

MR. TILFORD. We don't have any assurance as yet that it has ever happened. The procedure which we followed to produce this evaluation simply predicts that this level of acceleration may be experienced once in 10,000 years. This is another way of saying that the probability of the occurence of that acceleration at that point is about 99.5% probably that it will not occur in any given 50-year period /...

MR. TILFORD.

We have no information, there is no evidence on the site or near the site that it has experienced extreme strong motion in the past. We were satisfied as geologists will probably have in the past, but those evidences are not available.

THE CHAIRMAN. Mr. Tilford, in the course of the interpellations before this Commission, it was admitted that the life of the plant before decommissioning or recommissioning would be from 30 to 40 years. You just mentioned that you do not expect any such upheaval within the next 50 years.

MR. TILFORD. For the record, I would make it clear that this is a graph of probabilities showing that this value would not be exceeded during any 50-year period at the level of confidence of 99.5% per cent. Now, that is the same way of saying that we expect that this cycle experienced 26 per cent seismographically once in any given 10,000-year period. The exhilaration value is .4G. We are saying that this indicates that this methodology show that it may expect about 2/6 once in about 10,000 years the deterministic approach would afford a considerably established value of .35G. So,

within the levels we are talking about the deterministic method and probabilistic method do achieve this objective of checking one another. For your information, some other values that this predicts once in 10,000 years at Manila about .34, the highest values on this graph are in excess of .5 may be associated with the active faults particularly. So, within Central Luzon unless you go far offshore up to the China Sea, the area close to the Bagac site is one of the least at risk from earthquake hazard which is similar to an area north of the Zambales range which is also most likely to feel a very strong motion.

THE CHAIRMAN. That is very good, Mr. Tilford. But now, please answer my question. Will there be an earthquake or any upheaval of that kind within the next 50 years?

MR. TILFORD. It is extremely improbable.

THE CHAIRMAN. Not impossible. You cannot guarantee.

MR. TILFORD. Nothing is impossible. There are levels of probability or likelihood. It is unlikely in the extreme that any strong shaking, not to mention 40 per cent of gravity, will occur

during the next 50 years at the Bataan site.

THE CHAIRMAN. Contrary to your appraisal of probabilities and possibilities this earthquake occurs within the expected lifetime of the plant which is 30 to 40 years, what liability would EBASCO undertake in view of the assurances that it has committed itself?

MR. TILFORD. There are two parts to the answer to that question. One is the part which would define what it mean by the spread of waiver. If the spread of waiver you mentioned is 40 per cent gravity strong motion that is the defined safety shutdown earthquake this requires that the plant be shut down for examination. And there are requirements frankly which we are not terribly committed with. Then the next part has to do with what is EBASCO's liability. And to that, I would speak as an expert and not as an official of the company.

THE CHAIRMAN. Who would that be?

MR. TILFORD. I can't tell you. I don't consider myself in a position as an official of the company. In fact, I am not an officer but I can tell you what our contract liability is. And our contract liability is re-performance of the work and not con-

sequential damage.

THE CHAIRMAN. In other words, you will not answer if any damage occur as a consequence of an earthquake or a similar disaster contrary to your prognostications.

MR. TILFORD. That is correct, unless there is something wrong with the work we performed.

THE CHAIRMAN. Thank you. Are we through with this graph?

MR. TILFORD. Yes, sir.

THE CHAIRMAN. It is 5:07, so we will adjourn up to tomorrow at 1:30 p.m. We still have two panels on the stand: the Westinghouse and EBASCO panel. We will continue with the EBASCO dissertation and then we go back to the Westinghouse for the continuation of the Tañada interpellations.

The session was adjourned at 5:08 p.m.

For the Transcript:

DESIDERIO SORIANO NICANOR SISON

MINDANAO P. SABAYLE JOSEFINA Z. MORALES

Tilford

PUBLIC OF THE PHILIPPINES
COMMISSION ON NUCLEAR REACTOR PLANT
Philippine International Convention Center Building
Metro Manila

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TRANSCRIPT OF THE STENOGRAPHIC NOTES TAKEN DOWN DURING THE SESSION OF THE ABOVE-ENTITLED COMMISSION BEFORE THE HONORABLE RICARDO C. PUNO, CHAIRMAN, HELD ON JULY 12, 1979, AT ROOM 4, PICC BUILDING, METRO MANILA.

MEMBERS PRESENT:

Hon. Ricardo C. Puno -- Chairman
Hon. Conrado M. Vasquez -- Member
Hon. Jose G. Bautista -- Member

APPEARANCES:

Atty. Lorenzo M. Tañada
Atty. Joker Arroyo
Assemblyman Antonino Roman, Jr.
Mr. Walter Welgus
Mr. James Woeber
Mr. John Hankowsky
Minister Gabriel Itchon
Minister Clemente Gatmaitan
Dr. Zoilo Bartolome
Dr. Carlito Aleta
Mr. Aura A. Simmons
Dr. David Ferg

ABSENT:

Mr. James Moore
Mr. Gerald Carrol
Mr. David Call
Mr. Raymond Sero
Dr. Segundo Roxas
Minister Geronimo Velasco
Dr. William Howard Arnold
Mrs. Nora Petines
Mr. Angel Lazaro
Dr. Salvador Roxas Gonzales

OPENING OF SESSION

(The session commenced at 1:30 p.m. with the Honorable Ricardo C. Puno presiding.)

THE CLERK. Ladies and gentlemen, please rise. The Commission is now in session. Everybody is enjoined to observe silence and proper decorum.

THE CHAIRMAN. The session is now open.

Call the roster of regular appearances.

THE CLERK. (Reading)

Atty. Lorenzo M. Tañada	Present
Atty. Joker P. Arroyo	Present
Hon. Antonino P. Roman, Jr.	Present
Mr. Walter Wilgus	Present
Mr. Gerald R. Carroll	Absent
Mr. James C. Woeber	Present
Mr. John Hanskowsky	Present
Mr. Daniel W. Call	Absent
Mr. Raymodd Sero	Absent
Minister Gabriel Itchon	Present
Minister Clemente Gatmaitan	Present
Dr. Segundo Roxas	Absent
Dr. Zoilo Bartolome	Present
Dr. Carlito Aleta	Present
Mr. Aura A. Simmons	Present
Dr. David Ferg	Present
Mr. James Moore	Absent
Mrs. Nora Petines	Absent
Minister Geronimo Velasco	Absent
Mr. Angel Lazaro	Absent
Dr. Salvador Roxas Gonzales	Absent
Dr. William Howard Arnold	Absent

THE CHAIRMAN. May we know if there are any other additional exhibits to be presented by Westinghouse panel among those to be amended or corrected or otherwise submitted?

MR. FERG. Mr. Chairman, I would like to resubmit the third page of Exhibit "14-B". I failed to include the footnote on the copy I turned in yesterday. I want the footnote to show that that information was reconstructed, using the U.S. NRC report NUEG-0560.

THE CHAIRMAN. So, this is an amendment to the third page of "14-B-1".

MR. FERG. "14-B-1".

THE CHAIRMAN. Mark it as "14-B-2". Is that a "14-B-2"? There is no "14-B-2" yet. "14-B-2". Is that all? No other papers?

We are still awaiting the North Ana Nuclear Plant

report.

MR. FERG. I would like to ask you again if I could have the Nuclear Ana report which you have referred to when you brought that right.

THE CHAIRMAN. We shall deliver that during the recess.

MR. FERG. Thank you.

THE CHAIRMAN. For this afternoon, we shall first continue with the EBASCO dissertations after which we shall resume with the Westinghouse panel interpellations.

Mr. Stilford still has the floor.

MR. TANADA. What is the footnote there?

THE CHAIRMAN. May the Commission inquire if the exhibits thus far indicated yesterday have already been reproduced and marked for marking for today's

hearing?

MR. FERG. They are in the process of being prepared.

THE CHAIRMAN. So, they are not yet ready?

MR. FERG. They are not yet ready. We have our Exhibit "14" which is the seismic risk map which is ready. And perhaps, it might be useful if we were to serve that particular exhibit so that the Commission and others would look at that for a moment because I would like to make that a point.

THE CHAIRMAN. Very well, reproduce that Exhibit "14", NPC.

MR. TORRES. Mr. Chairman, in yesterday's proceedings, there was a question on the role that EBASCO plays with respect to ascertaining or verifying that the design site characteristics and parameters that they have developed from the NPC are being used

in the design and construction of this plant.

THE CHAIRMAN. And carried out.

MR. TORRES. And carried out. And if the Commission pleases, since I furnished the answer to that question, I would like to make a short statement to further clarify those made yesterday.

THE CHAIRMAN. You may do so.

MR. TORRES. In assuring the safety of the plant after the site characteristics are determined and furnished to the designer, the owner — that is the NPC — the designer, manufacturer and the constructor of this plant — that is the Westinghouse — the regulating agency, the Philippine Atomic Energy Commission and the operator which will be the NPC, in order that they may assure that the installation can be constructed and operated without posing undue risk and hazard to the health and safety of the public,

must right from the beginning assure that these processes of utilizing the parameters developed from the site investigation are indeed inputed and utilized by the designer. The way this is done and the way the consultant plays its part can be briefly described as follows:

Before the regulating agency — that is, the Philippine Atomic Energy Commission — grants the owner a construction permit, the owner has to submit a document which shows that among others the design of the structures, the components, equipment and system will comply with the design criteria that the regulatory body has issued and which must be complied with. This document is part of a more extensive one that covers other subjects. And in the preparation or submission of this proof to the regulating body that such is the case, this is embodied roughly in one volume of a 16-volume

report that we have submitted. In this particular volume, which is also one of the chapters, we show that we have —, that is, the National Power with the assistance of its consultants, EBASCO — determined and confirmed that the identification, description of the systems and the utilization of the data and, in particular, with respect to the question yesterday, the use of the seismic information that has been established will be reflected in the design and that the right kind of design analysis and design procedures and methods will be used. On the basis of this document which had been submitted to the Philippine Atomic Energy Commission and the evaluation of this report, the National Power Corporation has been issued a constructive permit.

Now, during the course of the design and construction

of the facility itself, the National Power Corporation has in its organization units that continuously monitor and assure that these are being done in accordance with our commitment embodied in this document submitted to the regulatory body. In this respect, EBASCO advisers are also utilized.

And yesterday, I think, the question was directed to the particular activity going on in the field on how EBASCO plays a role in this process of seeing to it that the construction will be inaccordance with the criteria and conditions that are imposed on the design of this project. At the field, it is not the EBASCO man alone who does this. It is really NPC's responsibility and it has a construction group that performs this. However, because we have available to us the expertise of EBASCO, we see to it that they have a man assigned through the field so that we have advisory services

available on a day-to-day basis. It is with respect to this that we have brought this afternoon, Your Honor, the EBASCO man in the person of Mr. Elliot, who will be also available if the Commission pleases to question him.

THE CHAIRMAN. Will you please verify if Mr. Torres has been sworn in connection with his position paper? (After a pause.) Not yet. He was sworn in connection with the dissertation.

MR. TORRES. Dissertation.

THE CHAIRMAN. Please swear Mr. Torres.

CLERK. Do you swear to tell the truth, the whole truth and nothing but the truth in this investigation?

MR. TORRES. I do.

THE CHAIRMAN. Do you confirm under oath what you just stated prior to this?

MR. TORRES. Yes, sir.

THE CHAIRMAN. You stated that there is an EBASCO man and there is an NPC man charged with the verification and checking of the construction to see to it that it complies with the EBASCO recommendation?

MR. TORRES. There is an NPC organization, not only one man.

THE CHAIRMAN. Mr. Elliot is the EBASCO man?

MR. TORRES. Yes, Your Honor.

THE CHAIRMAN. And who is the head NPC man?

MR. TORRES. We have at the site, under our site manager whom you have met before under a construction division headed by Mr. Eleuterio Gatus.

THE CHAIRMAN. Eleuterio Gatus.

(At this juncture, the Chairman is spelling the name "GATUS".)

MR. TORRES. Gatus.

THE CHAIRMAN. All right. So, Elliot and Gatus.

Now, Mr. Tilford, you may continue with your dissertation. May we have the exhibit? The Commissioners here have not been given any copy. We have the figure marked as Exhibit "14", NPC, being flashed on the screen.

Please proceed.

MR. TILFORD. Since the news media did not put my records to this figure correctly, Mr. Chairman, I thought of the possibility that their misunderstanding might be more widespread. If I can refer to the lower left of the figure to the note that you have, that note reads:

"Contours and numbers at ridge point represent horizontal acceleration expressed as presented gravity with 99.5% probability of not being exceeded in fifty (50) years. This is equivalent to a return period of

10,000 years."

I would like to explain that that means that an earthquake affecting the site with accelerations greater than .26g has a return period of 10,000 years. This does not mean that smaller accelerations can occur during shorter time spent, that is, an earthquake could occur next week, yielding an acceleration of .1g. But this simply means that at a high level of probability, these values will not be exceeded in fifty (50) years, and that is another way of expressing a return period of one in ten thousand years.

Before we move on away from this figure and this subject, I would like to correct something that I mis-stated yesterday. I reported to you that the horizontal accelerations experienced in Cotabato during the August 1976 earthquake represented .085% gravity. I indicated to you that this was exactly 140th, the

design value of the horizontal acceleration of gravity at Napot point. That is not correct. In fact, it approaches one-fourth (1/4 to one-fifth (1/5) of the design value at Napot point. That in terms of energy involved, the statement that this is essentially 140th of the energy that will be involved remains close to be incorrect.

Before I move on away from the issue of seismicity, I would like to make one other point. The 197/ additional, the National Structure of Code for Buildings in the Philippines which was after the 1976 Mindanao earthquake, would require that in compliance with the Code, if you are building a one or two-story building on Bataan, the horizontal design acceleration would be between .08 and .1g, depending on the type of bracing system being used, and I simply point this out to suggest in one more way that

the design acceleration for the Napot point plant being a factor of four greater than that Code requirement is an essentially quite conservative design basis.

I think that concludes my remarks on the subject of seismicity and I am sure that there may be questions which I should try to address at this point.

THE CHAIRMAN. You are concluding your dissertation, Mr. Tilford?

MR. TILFORD. I am concluding the discussion of seismicity. I am going to proceed briefly to discuss volcanic activity and I thought perhaps there might be questions related to seismic issue or seismicity though, and I would like your attention that that was the end of it.

THE CHAIRMAN. Justice Bautista.

MR. BAUTISTA. May I ask if you know if this is the first site that you were asked to make a study with respect to nuclear plants in the Philippines?

MR. TILFORD. With respect to nuclear plants in the Philippines, this is the first nuclear plant and, therefore, this is the first site.

MR. BAUTISTA. You are referring to the site at Napot point, Morong, Bataan?

MR. TILFORD. We earlier contributed to a study of a number of potential sites in Central Luzon. The site that was finally selected and that we actually confirmed was the Napot point site.

MR. BAUTISTA. Did you not study another site somewhere in Bagac or seventeen (17) kilometers away from Napot point?

MR. TILFORD. If you will give me twenty seconds,

I will get you a list of sites that were, in fact, studied.

(At this juncture, Mr. Tilford refers to his papers.)

We did study to one level of completion of the other fairly large number of sites. The more complete history of the siting plant will be covered under Mr. Gilmore's discussion to follow. But in the immediate area, we studied the southern tip of Zambales peninsula; we studied the southern tip of Bataan peninsula, which was typified in that study by San Jose point; and we studied the area within ten (10) kilometers of the Barrio of Bagac. That included a number of locations that could be designated as peninsulas or points, and also included a number of other locations, primarily low-laying locations associated with rice cultivation.

MR. BAUTISTA. So, you made a study of the Bagac

point, that is where the housing site is now located?

MR. TILFORD. It was fairly close to the present housing site. This was the site that was considered to be the primary site at the time EBASCO was engaged to complete the siting evaluation. We call that Bagac 1. That site was near, as I said, let us say, three (3) kilometers at the existing housing site.

MR. BAUTISTA. Why did you choose the Bagac site?

MR. TILFORD. That site from the point of view of the development of a nuclear plant has a number of ailments.

MR. BAUTISTA. Will you enumerate what are these ailments?

MR. TILFORD. First, the site ground surface was an elevation of two (2) meters above sea level, sir. That is an entirely unacceptable great level for a nuclear plant in this kind of condition because of Tsunami. This site was located in flood point of two rivers which

discharge into the South China sea between the present housing area and that site. The flooding in those rivers during the monsoon season is a continuing major problem for ready access to any site. Asie, it is located on that flat plane which would have created a need to develop an enormous system of devotion around the site. The site was located in a saturated ground with essentially twenty (20) meters around consolidated sediment underlying the land surface. It was some six hundred (600) meters from the seashore.

I have asked you to visualize then an excavation twenty (20) meters deep and unconsolidated luvium which would leave you eighteen (18) meters below sea level at the founding level of the plant. They were not only the safety issues associated with that, but of course, the very real construction and design problems that would be associated with it. You would be trying to pump

the South China Sea dry in order to keep such an excavation dry. The site was located, as I mentioned, in rural valley which was eminently exposed to volcanic ash flow. The site was not a highly desirable site from many points of view.

MR. BAUTISTA. When you made that study at Bagac Point, was the housing site already under construction?

MR. TILFORFD. With the cooperation of NPC, we were able to get constructed for our use and study six (6) temporary pre-cast buildings which we used to house our geology-seismology and environmental staff which at one time are occupied with some twenty (20) of our people. There was no permanent construction at the existing housing area at any time during the carrying out of the study.

MR. BAUTISTA. That is all.

THE CHAIRMAN. Please proceed to your next one.

MR. TILFORD. I will make reference now to the CONVOL response to the Commission.

THE CHAIRMAN. Is this a new exhibit?

MR. TILFORD. Yes, sir. This is a new exhibit. I believe it will be No. 15.

THE CHAIRMAN. Is that the correct number, Exhibit "15", NPC?

MR. TILFORD. You can identify this exhibit as "Site-looking air-blown radar museum". The Commission is most welcome and, of course, invited to look at this more closely. There is a lot of information in it.

I would like first, just briefly, to address one of CONVOL's most important comments as we view it. We will address each of their comments, but let us go to their response No. 5 initially.

"CONVOL believes that eruption from any of the volcanic complexes in the area is possible not only from

the presently observed craters and vents but virtually from any point in the peninsula, Bataan having formed by the coalition of two dormant volcanoes - Mt. Natib and Mt. Mariveles. This possibility is exemplified by Taal. It did not only erupt from the main crater in 1911 eruption but also recognized numerous parasitic craters; for example, Benintiang Munti and Benintiang Malaki alternately erupted before 1749 but was able to make open its southwestern plank and posted the eruptions from 1965 to 1977."

Now, let us move at Taal for a moment. I regret that in this particular response, we are unable to agree with CONVOL. CONVOL mentions that the main crater of Taal on volcano island was the site of the 1911 eruptions. This was confirmed. There are ...

MR. TILFORD. There are numerous siliceous on volcano island and off volcano island associated with the Taal caldera. The point associated with the eruption of Taal is that they all take place within the main caldera of the volcano. None of the eruptions had moved out of that caldera within the period recorded history. And in fact if you look around the region of Taal even on this radar image you will find that there are not what you would strictly call auraghenic volcanic structures immediately associated with the caldera. My point here is that everything that has happened in Taal in historic times has happened within the Mt. Natib caldera.

We go up here to Mt. Natib -- the caldera of which is shown right here -- and I will show that to you in a larger scale on another radar image in a moment. What COLVOL is saying about Taal is that from 1911 the 1936 and 1976 vents moved about 300 meters in a southeasterly direction. That is perfectly true. But all of that activity remained within the main caldera and the development in Mt. Natib of an eruptic cone on the western plank is not considered by us to be a credible event and I will define that as an event with a probability of occurrence greater than once in one million years. Let me explain why. And if I may, I will read some of these materials because it is probably more lu-

did than I am.

Recent scientific studies of areas like Luzon have demonstrated that the distance between the subduction site -- which in this case is the Manila trench -- and the first line of volcanoes, and this is Mt. Natib and Mt. Mariveles in this case, always increases with time and the present case means that new volcanic vents must be formed eastward of the existing vents further and further from the plant site. This pattern has been established on Bataan where the latest 70,000 years old volcanic vent on Mt. Natib was formed east of the main caldera. This bring you a little closer to Bataan, here is Correjidor which is a ground volcano, Mariveles harbor which is a ground volcano, Mariveles mountain proper, Natib volcano complex.

Let me point out to you that the oldest volcanic rocks in the peninsula are of the order of 5 million years in age. Let me point out to you that the eruption rate during the last half million years has been for the entire peninsula in the order of five to 10 events per million years. Let me show you that in the five million years that this whole peninsula has been under construction, as it were, every parasitic vent , this being the main crater of Natib, this being the main crater of Mariveles, every parasitic vent is

east of the center line of the peninsula, that is during 5 million years of the opportunity to erupt on a west plank the volcano have elected not to do so. And it is our opinion they will continue that election.

Here is Sta. Rita, a parasitic cone, here are two dome-like structures formed 70,000 years ago on the east plank of Mt. Natib, Orion, Samat here, I have forgotten the name of this cone. I have mentioned Mariveles Harbor and I have mentioned Corregidor. What those features all have in common as I have mentioned, and I think it is an extremely critical point, is that they are east of the center line of the peninsula.

MR. CHAIRMAN. Mr. Tilford, may we interrupt. You have actually begun a rebuttal of what is contained in the Commission on Volcanology's position paper Document no. 17 which, specifically, is mentioned in the last paragraph of the first page of this position paper and I quote: COMVOL shares the view of IAEA Safety Mission that the danger posed by a renewed volcanic activity of Mt. Natib volcanic complex exists. Is this the sentence that you are trying to dispute?

MR. TILFORD. I am sorry, Mr. Chairman, no. I am addressing No. 5 on the following page.

MR. CHAIRMAN. COMVOL believes that eruption from any of the volcanic complexes in the area is possible. Don't you

think that before you go to No. 5 we should go to the antecedent paragraph which lays the predicate for the succeeding paragraph?

MR. TILFORD. We certainly can. In fact we can go back easily to No. 1

THE CHAIRMAN. But the most important statement here of COMVOL is the admission that it makes -- No. 3. It shares the view of the IAEA Safety Mission that the danger posed by a renewed volcanic activity of Mt. Natib volcanic complex exists.

MR. TILFORD. Mr. Chairman, would you also read COMVOL No. 4? Because in COMVOL NO. 4, you will see that they eliminate eruptions from the Mt. Natib caldera as hazards to the site other than for ash fall.

THE CHAIRMAN. Just a few background questions, Mr. Tilford. When you made your studies, did you coordinate with COMVOL?

MR. TILFORD. I think I have mentioned, Mr. Chairman, the former commissioner, the Chairman of the Commission on Volcanology, is listed as one of our [illegible] consultants and thru Dr. [illegible] we have been in contact with COMVOL to wrap up the course of study.

THE CHAIRMAN. Are you trying to say then that Mr. Gre-

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gorio Andal, who was later appointed as Commissioner, had no access or did not know of the collaboration between your company and CONVOL?

MR. TILFORD. I cannot personally answer your question. I have not personally interviewed Mr. Andal.

THE CHAIRMAN. So you do not know the reasons and the bases for the statements made by Commissioner Andal in Document No. 17?

MR. TILFORD. I have not discussed his findings or his statements with him -- no, sir.

THE CHAIRMAN. You have not inquired into the basis of this statement?

MR. TILFORD. I believe that he states the basis for his statements fairly clear in the initial paragraph of his letter.

THE CHAIRMAN. But these are the conclusions of his premises and the premises will involve the studies that were made.

MR. TILFORD. That is correct.

THE CHAIRMAN. You did not have access to these studies?

THE CHAIRMAN. We have had access, I believe, to all of the CONVOL information that are available.

THE CHAIRMAN. Do you have them with you?

MR. TILFORD. No, sir, I do not.

MR. CHAIRMAN. The point, Mr. Tilford, is in order that there will be a meeting of the minds, in order that we can pinpoint the areas of dispute it might have been better to set forth the bases of these COMVOL conclusions. I will ask a similar question in connection with IAEA Safety Mission because this Document No. 17 states that COMVOL merely shares the view of IAEA Safety Mission. Did you have access to the studies made by IAEA Safety Mission that prompted them to make those conclusions with which COMVOL agrees?

MR. TILFORD. We have appeared before the IAEA Safety Mission during a 3-day meeting in Vienna in 1978. The IAEA Safety Mission visited the site one day during their initial 9-day visit to the Philippines in 1977. We have, I believe, full access to the data considered by the IAEA Mission. The IAEA Mission concerns have been resolved in the stipulations on a construction permit placed by the NRC who were the bosses or the clients of the IAEA Safety Mission.

MR. CHAIRMAN. Well, Mr. Tilford, after your dissertation and after the ACRS panel has completed their statements, Commissioner Kendal will be called upon to defend his position paper. And we just call attention to the fact that his task should be rendered easier by exact references to these conclusions that he derives. So, may we suggest that

you go back to No. 3 so that we will proceed in proper order as the numbering indicates.

MR. TILFORD. With your permission, sir, I will be happy to go back to No. 1.

THE CHAIRMAN. No. 1 merely says that volcanology is not an exact science. Maybe we can concede that and go to the more exact conclusion because the conclusion is more precise in No. 3, the renewed volcanic activity in Mt. Natib volcanic complex exists.

MR. TILFORD. Yes, sir, and you will note that in question No. 2 the COMVOL has indicated that our work is considered by them to be at the standard with the present state to be had.

THE CHAIRMAN. Yes, we have No. 2, but in No. 7 they disagreed with your conclusions.

MR. TILFORD. We noted that the Commissioner seems to wish to agree with every one.

THE CHAIRMAN. That is a very unkind statement, Mr. Tilford.

MR. TILFORD. I am sorry.

THE CHAIRMAN. We shall not [illegible] except to make that observation.

MR. TILFORD. It was not intended as an unkind comment, sir.

THE CHAIRMAN. Mr. Tilford, please reciprocate with the same hospitality that we have shown you the same courtesies to which you have been subjected.

MR. TILFORD. I appreciate your comments, Mr. Chairman, and will attempt to honor them.

THE CHAIRMAN. This Commisnion has not indicated any agreement with anyone, that is precisely the function of this Commission to find out what is the truth and when we make statements they are merely invitations for gentlemen who are participating here to enlighten us. When we say that a certain commissioner or a certain official made a statement, it does not mean that we agree to that statement. We invite you to give your opinions, your explanations with respect to that statement.

MR. TILFORD. I appreciate the sense of the Chairman's comments and will truly attempt to honor them in spirit as well as in fact. The response No. 3 of CONVOL which we are addressing can be read and states that CONVOL shares the view of the IAEA Safety Mission that the danger posed by renewed volcanic activity of the Mt. Natib volcanic complex exists. Our response would be, we refer to our comment above on response No. 1 and I wish that we had made some comments in response to No. 1 regarding the uncertainties of volcanic prediction. To go on, it has been concluded

as a result of our studies that the next to strong ground motion during seismic shaking volcanic events represent the most credible geological hazard to the plant.

As a geological hazard, volcanism differs from seismicity in that volcanic events have no recognized upper limit of destructiveness and develop catastrophic effects over much smaller areas. Furthermore, volcanic vents lasts much longer than seismic vents. Any structure located at a point where a volcanic vent develops would be destroyed. The likelihood of occurrence of this event is extremely small for any given point.

Compared to the broad areas catastrophically affected during earthquakes the areas seriously affected during short time periods by volcanic events is small, thus reducing the probability of occurrence of catastrophic effects at any given point. Compared to destruction during seismic ground shaking which occurs in a matter of seconds the destructive effect of volcanic events or episodes is commonly spread over weeks, months or years. A particular volcanic center may develop in weeks or months but major volcanic edifices most commonly evolve over periods measured in hundreds of thousands of years.

As stated in our comments on response No. 1 above, we have determined that only three major volcanic events are likely to occur in any 100,000-year period on Bataan. A level of risk we find acceptable in view of our agreement with the next CONVOL finding that the Mt. Napot site is protected from effects of Mt. Natib volcanism other than ash fall.

CONVOL's response No. 4 reads: CONVOL believes that should an eruption take place at the main crater (caldera) Mt. Natib's sufficient natural barriers, for example (drainage channels and bridges) exist to protect the plant site from the direct effects of pyroclastic flows, glowing avalanche, lava flows and direct impact of volcanic ejectment.

Our comment on this response: this conclusion is the same as that reached during our study and recorded in the preliminary safety analysis report. At this point, it is our understanding that both CONVOL and we are in agreement that there is some risk of renewed volcanic activity from Mt. Natib, which we qualify as being some part of an expected three volcanic events in 100,000 years or between; and that the Commission and we are in agreement that even should such eruption exists from the existing caldera, should it occur, that the site is naturally protected from volcanic hazards other than ash fall. I believe that is a correct statement of the agreement that exists be-

tween the chairman of COMVOL and ourselves.

It is in the area of Question No. 5 which we have earlier read, that there is some source of disagreement. And our basic position in that matter must be that the formation of a volcanic vent on the west plank of Mt. Natib near or at the plant site is not a credible event because it has not happened during the five million past years of the opportunity for the formation of such event.

I have elaborated the remainder of our reasoning on that particular hazard. COMVOL response No. 6 reads: COMVOL agrees with the IAEA suggestion to install a volcanic monitoring system in Mt. Natib and possibly in the adjoining volcanoes for the purpose of predicting future activities. With this it is expected that timely warnings could be issued before any impending eruption thereby allowing time for the immediate shut down of the power plant and our comment would be: at the direction of PAEC, NPC will design and install a monitoring system at Mt. Natib.

COMVOL's response No. 7 reads: In conjunction with Item 6 the suggestion of IAEA to establish an off-site fuel storage wherein radioactive materials would be deposited in the event that the plant is endangered by volcanic activity, should be considered.

Our comment would be: as directed by President Marcos, a government panel has been active for more than two years in the initial phases of selection of such a site.

CONVOL response No. 7. CONVOL believes that the problem on volcanic risk has been sufficiently discussed and studied by parties concerned and that it is just a matter of implementing recommendations.

We agree. PAEC, the responsible licensing and regulatory body, has resolved outstanding issues raised by resposible reviewers and has provided such stipulations in the construction permit as found necessary for compliance by NPC.

The final paragraph response by CONVOL reads: With regards to seismic risk while CONVOL has some data on tectonic earthquakes in connection with its study on relationship between tectonic earthquakes and volcanic eruption same data may have been used in seismic risk conducted by the proponent.

The study on tectonic earthquakes fall under the responsibility of PAGASA. However, CONVOL believes that the problem has been well discussed and recommendations by IAEA Mission on this regard should be considered. Our comment would be that PAEC has taken the IAEA Mission recommendations

into account in establishing stipulations to the project construction permit. Outstanding issues are, therefore, now resolved. That concludes the material I had.

I ask your indulgence. To present on the subject of volcanism, we have used the CONVOL response to the Commission primarily as a testing facility, as it were, in order to bring forward the issue of volcanic hazards which are on the minds of many. We are aware that volcanism has not been one of the nine questions posed, but we felt certain that the Commission would wish to be informed as to the various possibilities and positions related to such activity. With that I thank you for your courtesy and your time.

I now yield to Mr. Gilmore, if you have no more questions of me.

THE CHAIRMAN. Questions by Justice Vasquez.

MR. VASQUEZ. I believe you have mentioned earlier, I think it was yesterday, that you have made studies of sites for nuclear reactor plants in so many places in the world.. Is that correct?

MR. TILFORD. I believe that Mr. Healy indicated that the company has made siting studies, yes, sir.

MR. VASQUEZ. Are you aware of any nuclear plant anywhere in the world as close to a volcano as the one in

Bataan which is only nine kilometers away from Mt. Natib?

MR. TILFORD. The Trojan Nuclear Plant in the United States is very close to Mt. Hood which is a dormant volcano like Mt. Natib.

The issue is a very complicated one, but let me say that any plant located near an igneous rock body is close to a volcano. But the real factor is when that volcano was last active, and in most cases it has been many million of years since that time. I can probably develop a list of Japanese plants in their relationship to volcanoes and probably some others as well, but I personally do not know of a plant closer to a volcanic structure than Napot.

MR. VASQUEZ. In the paper submitted by the IAEA Safety Mission a statement was made to this effect: the Napot site is unique to the nuclear industry insofar as the risk associated with eruption of nearby volcanoes. The only modern plant which is designed to account for volcanic eruption is the Tabon spring plant in the United States. This point is located 128 kilometers from the nearest volcano and, consequently, ash fall is a consideration. At the Napot point site the nearest volcano is only 9 kilometers away. Do you have anything to say to that statement?

MR. TILFORD. Yes, sir. I appreciate the opportunity.

Tabon springs is not a plant which is under construction. It is a plant which was under design in the eastern part of the State of Oregon, just south of the Columbia River. The plant site is located, as stated, approximately 100 miles from active volcanoes which erupted within the last few years.

The statement that Mt. Natib is an active volcano is technically and completely erroneous. The last eruption of Mt. Natib, and I think we have a very clear record of that and we can demonstrate it, occurred 70,000 years ago.

In the United States we do not have regulatory text which covers requirements for investigation associated with volcanism. They approach volcanism as an issue on a case to case basis. However, by analogy the requirement for non-capability or inactivity as it relates to faulting is that faulting must not have occurred on a given fault within the last 35,000 years. If it has not occurred within the last 35,000 years, the entire siting and regulatory process ignores it. Therefore, within that context and using that analogy the last eruption of Mt. Natib was more than twice as long ago as is required in U.S. practice to demonstrate incapability.

MR. VASQUEZ. As a geologist, would you tell us if it is not a fact that dormant volcanoes can also erupt?

MR. TILFORD. Dormant volcanoes can erupt, yes.

MR. VASQUEZ. So, Mt. Natib may possibly erupt?

MR. TILFORD. Yes, it is possible.

MR. VASQUEZ. But nobody could say if and when?

MR. TILFORD. We have tried to assess the likelihood of that possibility. And that concluded through a set of complex studies that there are likely to be three major volcanic events on Bataan peninsula in each 100,000 years. That includes Mt. Mariveles, Mt. Natib, and all of the satellite or ancillary structures or volcanic edifices associated with them. We believe that we have made an appropriate assessment of the likelihood of an eruption from Mt. Natib.

MR. VASQUEZ. And you are basing that opinion only on probabilities?

MR. TILFORD. Probabilities associated with the past history of eruption on Bataan peninsula. We have sampled approximately 100 locations on the peninsula representing discreet volcanic flows or events and have determined their actual age. We have assumed that each one of these -- we have sampled all that are available -- represents a discreet and major event, although that is not necessarily true, but

it is the most conservative or safe assumption you can make. We have from the ages when those things occurred then assessed the number of events that have occurred in unit time, which I reported to you as during the last 100,000 years, probably, five to ten major eruptions. And the probabilistic aspect of this is numerically forecasting what would happen then in the future from that historical or geological data.

MR. VALDEZ. You were discussing only the probability of the eruption of Mt. Natib. You have not told us if the same thing is true with Mt. Mariveles.

MR. TILFORD. Our statements have been that we believe that there may be as many as three eruptions on Bataan peninsula in 100,000 years. We have not discriminated between Mt. Natib and Mt. Mariveles because our sample distribution was uneven. That is, we were able to recover more samples from Mt. Natib than from Mt. Mariveles. And, therefore, our result would be biased.

R. TILFORD. ... Mt. Mariveles, because our sample distribution was uneven. That is where we were able to recover more samples from Mt. Natib than from Mt. Mariveles. Therefore, our result will be biased in the direction of Mt. Natib. So, we just used all those samples and included all of the volcanic edifies on Bataan.

MR. VASQUEZ. You mean to say that you do not have sufficient data to tell us that Mt. Mariveles may not also in all likelihood erupt within the next fifty years?

MR. TILFORD. We have all of the data that we feel is available to be collected from the Bataan peninsula from both Mariveles and Mt. Natib. I said, we were able to collect more samples from Mt. Natib, that is true. But to eliminate a bias on the

data than we have considered the data representative of all volcanism on Bataan. That includes both Mariveles and Natib.

So, when we state that appeared to be the right probabilities, we cannot narrow those down to some of these are from Mt. Natib; some of these are from Mt. Mariveles; some of these are from Samat. But over the volcanic features there are on the peninsula we feel that we can make some legitimate statement and that is where we attempt to do it.

MR. VASQUEZ. Would you be in a position to tell us which of the two volcanoes, Natib and Mariveles, is more dangerous than the other, insofar as the possibility of eruption is concerned?

MR. TILFORD. No, sir. I really could not. The youngest eruption that has taken place on Mt. Mariveles

occured almost exactly two hundred thousand years ago. The youngest eruption on Mt. Natib blankets the eastern side from Vent 3. Let me point out that to you.

This is the material that was erupted from Vent 3. That this vent right here, you notice it is east of the main Cordero, during the event some seventy thousand years ago on Mt. Natib. The material that is the lower, smoother blanket material on the east side of Mt. Natib, is the material from the event seventy thousand years ago.

THE CHAIRMAN. From the record, the word "here" repeated many times was stated by Mr. Tilford, pointing to the central part of the picture.

MR. TILFORD. And the east, Mr. Chairman.

Mt. Mariveles whose crater I am not pointing at

last erupted from that central crater 190,000 to 200,000 years ago, at which time this valley which goes up to the center of the peninsula on this Exhibit, from Mt. Mariveles, Mt. Mariveles cone is bridged, this valley was formed and probably run up to the east of Manila Bay. As you can see that valley in a small region, has been filled in by the materials from the 70,000 yeqr old eruption of Center 3 on Mt. Natib.

THE CHAIRMAN. Mr. Tilford, will you please repeat that last paragraph and indicate what you mean by the words "this" and "that" in order to help the records.

MR. TILFORD. The Mt. Mariveles cone was bridged about 190,000 years ago forming a prominent valley or canyon which can be seen on this Exhibit, sir. I

believe we have not identified this exhibit.

THE CHAIRMAN. At this point, if you cannot described it, will you please point to where you were indicating when you said "this".

MR. TILFORD. The canyon, I think I said, this canyon. The canyon was formerly opened from the center of the peninsula to the eastern side of the peninsula entering into Manila Bay. It is now filled.

THE CHAIRMAN. Mr. Tilford, we are trying to explain to you that when you say "this" or "that" or "here", it does not mean anything in the record, unless what is meant by these prnounce is indicated. You can talk at length on this diagram. And, unfortunately, we cannot even mark any sub-markings on this, because the document has not been presented. So, if you wish to aid the Commission, will you please try

to make this understandable in the records. Will we try again, please, that last paragraph.

MR. TILFORD. My problem is that I don't remember exactly what the last paragraph was. I was attempting to describe the fact that Mt. Natib has erupted since the last major eruption of Mt. Mariveles. This is proven by the fact that material from the eastern flank eruption of Mt. Natib, which occured 70,000 years ago, fills a canyon which was scattered and eroded at the time of the last eruption from Mt. Mariveles.

I think that was the one I was trying to convey, sir.

THE CHAIRMAN. Proceed.

MR. VASQUEZ. I also noted from the position paper of theCONVOL that they have made these statements.

I wish you would tell us if you agree with them or not. That the Bataan is formed by the coalition of two dormant volcanoes?

MR. TILFORD. Yes, sir. That is correct.

MR. VASQUEZ. That eruption is possible from any point in the peninsula?

MR. TILFORD. Mr. Commissioner, that was the subject of my latest discussion of question of their statements.

MR. VASQUEZ. Yes. And I recall you said that if there will be such an eruption, it will be to the eastern side?

MR. TILFORD. Yes, sir.

MR. VASQUEZ. The side away from the Napot point.

MR. TILFORD. Yes, sir.

MR. VASQUEZ. Now, supposing such an eruption will

occur on the eastern side of the peninsula, are you implying that the plant site will no longer be in danger just because the eruption is to the east side of the peninsula and not to the west of the existing volcano?

MR. TILFORD. An eruption on the east will not produce lava flows or flows of hot doulders, ash and cinders which could engulf and cover the plant. And if such an eruption at an appropriate location on the western side on Mt. Natip could produce such an effect, the ultimate such condition would be the formation of a volcanic vent at the plant site, in which case, the plant would be completely destroyed. It is the eruption occuring on the western side of the peninsula including Mt. Natib, we consider to be not credible.

THE CHAIRMAN. The NPC panel is hereby instructed, when this Exhibit is finally reproduced and presented, to the place on this Exhibit, the names of the volcanoes or other material portions of this topography to help us understand the dissertation when we read the same anew in the records.

Minister Itchon, is that quite clear. Atty. Ilao. Any questions from ...

MR. VASQUEZ. I would like to ask one more question. I would like to go back to earthquakes which is the subject of your first part of the dissertation.

I recall the chart that you showed here. I think it was the first one which depicted the faults around Bataan peninsula.

MR. TILFORD. Would you like me to put that back on, sir.

MR. VASQUEZ. Please.

MR. TAÑADA. As Exhibit "3", NPC.

THE CHAIRMAN. Was this previously marked as Exhibit "3"? Make it of record that the picture being flashed on the screen corresponds to Exhibit "3", NPC, in connection with the questions of Justice Vasquez.

MR. VASQUEZ. I seem to notice that Bataan is almost enclosed by faults. There is one to the west which you call the Manila trench; one to the south which you refer to as the Taal fault; and two others to the north. Is that correct?

MR. TILFORD. The closest fault to the north is the San Antonio ravine. Closest fault to the west is the western Luzon trough , which is not identified on this particular illustration. And the closest to the south is the Manila Bay fracture zone and those others you mentioned are on the chart.

MR. VASQUEZ. Now, did I get you correctly that because of the existence of these faults, the earthquakes that might occur outside of this shaded area in the crag would be attenuated or lessened in severity once it would reach the faults?

MR. TILFORD. That is true of the Taal fracture zone. That is not necessarily true of any of the others. The taal zone is superbly unique zone and that it is a zone in which the crust of the earth is extending in this crust. And because of that earthquake shock is attenuated across that zone. The others are not necessarily in that condition.

MR. VASQUEZ. I wish you would really enlighten us on this point because it seems to be the common impression that if an area has several land faults, it is more dangerous for earthquakes.

MR. TILFORD. That is a correct impression, sir. The design acceleration for the plant at Bataan is one of the highest acceleration for any nuclear plant in the world. That is true because the plant is located in a region which is seismically active and in which there are faults. I have probably complicated the issue unnecessarily by stating that the Taal fracture line is a zone of extension which tends to reduce or attenuate earthquake motions. If you will forget, sir, that I said that because it is probably not material at this point. Then you can continue with your impression that the fact, that a region contains active capable faults thus, require more careful address to earthquake. That impression is correct.

MR. VASQUEZ. And it is a fact that Bataan peninsula is such an area?

MR. TILFORD. Yes. Bataan as a part of the Philippines and the Philippine archiepelago is generally considered to be one of the more active areas of the world as far as volcanism and seismisity is concerned. The fact remains that like California, in the western United States, it is possible to select sites where sensitive installations can safely be built. And the Bataan peninsula and, specifically, the Napot point site, in our professional judgment, is probably the best nuclear power plant site in Central Luzon, largely because of its relatively low historical seismisity.

MR. VASQUEZ. And that is precisely the reason why you recommended that the site of the plant be such that it will withstand the strongest earthquake?

MR. TILFORD. Yes, sir.

MR. VASQUEZ. I have no more question.

THE CHAIRMAN. Justice Bautista.

MR. BAUTISTA. Clarification, Mr. Tilford. In the Letter of Instructions 876 of the President, the Question No. 6, is the Bataan Nuclear Plant located in a fault in the earth surface? Will you answer that category?

MR. TILFORD. No.

MR. BAUTISTA. What would be the reason for your answer?

MR. TILFORD. That is a presentation of Mr. Gilmore has been prepared to make. If that is your only question of me, I would prefer to allow him to address that Question 6.

MR. BAUTISTA. So, your answer to the question is, the Bataan Nuclear Power Plant is not located in a fault in the earth's surface.

MR. TILFORD. That is correct.

MR. BAUTISTA. Now, just to satisfy questions from our common people, the man in the streets, and since you said, you were able to study different sites for a nuclear power plant in the Philippines, particularly, in Central Luzon, the common question is, why was not the nuclear site rather chosen the Sierra Madre Mountain or the Cordillera Mountain? What would you answer me?

MR. TILFORD. Firstly, the seismic risk in that region as shown on Exhibit "14", is higher than the seismic risk at Bataan.

THE CHAIRMAN. For purposes of this question, Exhibit "14", NPC has been flashed anew on the screen.

MR. TILFORD. I believe your question refers to the area east of Manila, is that correct?

MR. BAUTISTA. Yes, yes.

MR. TILFORD. As you can see on the illustration in the area to the east of Manila, the seismic risk is higher than it is in Battan. You really only have to be able to distinguish between the colors: red, white and green. Red is the area of higher seismic risk; white is an area of somewhat lower seismic risk; green is the area of lowest seismic risk in this area.

That is the primary reason, sir.

MR. BAUTISTA. So that when you made your recommendation that the Bataan site is the most logical and safe site for a nuclear plant, you have considered all the other sites or places in the island of Luzon?

MR. TILFORD. I believe, that Mr. Gilmore is better prepared to answer that question in detail than I. I think, he would like to discuss the other sites

that were proposed and have been studied by the earlier IAEA mission starting in 1965. With your indulgence, I would prefer to refer that question to his presentation.

MR. BAUTISTA. Thank you.

THE CHAIRMAN. You are excused Mr. Gilmore.

MR. GILMORE. Excuse me, Mr. Chairman. I will just retrieve some of my materials. Following the manner established by Mr. Tilfort yesterday in the expectation that that is the wish of the Chairman and of the Commission, I will make the following comments and elaboration of the many biographical data that was presented earlier.

I was educated at Manhattan College in New York City; received a Bachelor of Civil Engineering Degree in 1952; performed graduate studies in Civil Engineering during the period 1955-56 in the College of the City of New York; I am a registered Professional Engineer in the States of New York, Idaho Pennsylvania, Minnesota, Montana, Oregon, Utah and Washington; I am a member of the American Society of Civil Engineers;

United States Commissioner at-large, Association of Engineering-Geologist. I recently completed my 26 year with EBASCO and presently, I am chief consulting Civil Engineering and I have been in that position since the middle of 1971.

The question that I have prepared a response to, is, Question No. 6: Is the Bataan nuclear plant located in a fault in the earth's surface? Mr. Tilfort has answered that question by saying, no.

I would reiterate his answer by also saying, no. And in the sense that is a short answer, but we have prepared information to convey to the Commission and to others the reason why we say, no, with a certain degree, with a degree of confidence.

Since the very outset of the siting studies for PNPP No. 1, which were initiated during the middle 1965, it has been recognized by all investigators that geologic and seismological characteristics of any site in the Philippines, any site in Luzon would be the primary siting concerns. Pri-

mary parameters which would have to be addressed during the preceding studies.

During the latter part of 1964, under the auspices of the International Atomic Energy Agency, a pre-investment study on power, including nuclear power, in Luzon was undertaken. I acted in collaboration with the nuclear power study committee that selected four potential reactor sites. These sites are shown on the first figure -- Figure No. 1 -- in a paper which was offered by personnel of both EBASCO services and the National Power Corporation.

THE CHAIRMAN. Is this a new Exhibit, Mr. Gilmore?

MR. GILMORE. This would be a new Exhibit, Mr. Chairman.

THE CHAIRMAN. Mark it as Exhibit "16", NPC.

MR. GILMORE. May I interrupt, Mr. Chairman. Just a moment. This figure is a figure from this paper which I intended to enter as an Exhibit.

THE CHAIRMAN. Mark the .. Is that the text?

MR. GILMORE. I could give you the title of the paper and complete detail.

THE CHAIRMAN. The paper will be marked as Exhibit ... This is part of that paper?

MR. GILMORE. That is correct, sir.

THE CHAIRMAN. The whole paper itself would be marked as Exhibit "16", NPC. And this particular diagram, as "16", NPC. This depicts a map.

MR. GILMORE. Figure 1 from the paper depicts a map of Luzon and identifies the candidates' sites that were selected for consideration back in the middle of 1960's. The sites were located on Bataan peninsula and included Bagac and Limay. In Quezon province, sites identified as Padre Burgos and Atimonan, were also identified.

At an early phase of the siting considerations or studies in the Philippines, there was, of course, no sites, specific data available concerning population distribution, geology, seismology, surface and ground-water hydrology, ocean current patterns, typhoon severity, and this is very typical in the United States and in any parts of the world, at the very inception of siting studies, whether siting

studies for a nuclear power plant or for some other major industrial power generation facility.

The IAEA mission, however, did have made available to it regional data which was provided to them by the Philippine Atomic Energy Commission, by the Philippine Bureau of Mines, by the Weather Bureau and by the Bureau of Customs and Geodetic Survey.

Occasionally, the IAEA mission also visited each of the sites and made what I have learned to be called "ocular-inspection" although that was not the term I myself used. This advisory panel of experts met in Manila during the period 15 to 26 February 1965.

The conceptional question of safety was addressed by the mission by developing major questionnaires which would require detailed answers during later phases of the siting studies, which would be or which were anticipated to be required for the power plant. These later phases, these later studies, were to address questions of population, surface and ground

water hydrology, meteorology, seismology and foundation. From these recommendations and considerations, from reference to Exhibit "14", NPC and also, Exhibits "15" and "16", NEC which are the radar images, it is clear that seismosity, even in the very beginning, was being given careful attention by the original investigators. The results of the investigations in 1955...

THE CHAIRMAN. Is this still part of the text?

MR. GILMORE. This is still part of the text, Mr. Chairman.

THE CHAIRMAN. So, make that Exhibit "16 -B", NPC.

MR. GILMORE. At this stage of any investigation, the assessments, the evaluations of necessity have to be of a qualitative nature. The four sites that I have identified earlier on Bataan peninsula, Bagac and Limay are indicated at the top of this column. In Quezon Province, we have Atimonan and Padre Burgos.

The aspects of siting which were considered by the

mission included economic considerations and safety considerations. The economic considerations address questions of transmission, site development and transportation access which are, of course, the normal -- are a normal things that are considered in siting any major facility.

In addition, safety considerations will either be population centers as part of 1960 census; the average population density; surface and ground water hydrology, meteorological factor; geology; seismology; sub-soil structure were addressed once again, as I said earlier, in a qualitative fashion. Going through the list, the Bagac site had some advantages as did Limay, due to their proximity to the Manila load center. Atimonan also was comparable to the Padre Burgos site did not present any information and reports available. The site development does not really have a criteria other than Padre Burgos which has a very shallow off-shore facing on the sea. That of course, would in fact, negatively under the development of a cooling water system ...

MR. GILMORE. Transportation we find inadequate for Bagac, advantageous for Limay. There is an existing thermal power station located in Limay area and no information in the two potential plant sites of Quezon province. The population densities on Bataan were relatively or quite a bit lower than the population densities in Atimonan or in Padre Burgos. And the average population density reflects those numbers, both Atimonan and Padre Burgos defined as relatively high; average population density at Bagac in the report identified as 30 individuals per square kilometer, although it was not stated in the report, essentially the same for Limay. Atimonan was identified as facing a potential seismonic hazard. Also increased typhoon exposure there were thought to be possible unfavorable, unsure occurrence during the southwest monsoons for the Bagac plant; possible faulting was mentioned for the Bataan Plant. Atimonan on the other hand, was definitely near identified active faulting. With respect to the sub-

soil structure a bed rock and faulted in the Bagac area, more uncertain in Limay and the areas in Quezon province was somewhat doubtful.

In any event, on the basis of the inspections by the mission and on the basis of the regional information available to them, on the basis of their judgment, they rank these four sites in the following order: No. 1, Limay; No. 2, Bagac; No. 3, Padre Burgos; and, No. 4, Atimonan. You will forgive me, sirs, if I am pronouncing some of these local words incorrectly.

The second phase of the siting studies was essentially initiated on 23 June 1971, when President Marcos issued Administrative Order No. 293 creating a coordinating committee for nuclear power. This coordinating committee established a sub-committee which was established to formulate a site selection criteria to make site recognizance, to collect available site data, and, to render a report to the com-

mittee and to the International Atomic Energy Agency.

Figure two, the next figure shows the sites that were identified by the sub-committee. These included the Phase One sites which had been discussed earlier and which had been selected by the 1965 commission or mission, and added a site at San Juan in Batangas province, and another site in Ternate located in Cavite province.

CHAIRMAN. Mr. Gilmore, the first one that you flashed was figure 1. Was it?

MR. GILMORE. Figure one, yes, sir.

CHAIRMAN. So this is figure 2. Mark this as Exhibit 16-C-NPC. Mark it. (Chairman addressing the request to Atty. Argüiola)

MR. GILMORE. The site selection sub-committee as I indicated in 1972, starting from the 1965 work of the IAEA Siting Mission added to the Bagac, Limay, Atimonan and Padre Burgos sites, the San Juan and Ternate sites. In addition to adding two sites in

implementation of their mandate, they identified or developed selection criteria for the evaluation of these candidate sites. This criteria included development costs for the considered site, one; No. 2, potentially disruptive and/or hazardous physical and environmental effects; No. 3, the socio-economic character of the study area, and, considered the impact of future detailed studies which would be required, including hydrographic surveys, accretion studies, erosion and siltation analysis, evaluation, consideration of present and future land use, and meteorological studies.

We now will show the next exhibit which is Table 2.

CHAIRMAN. Mark the same as Exhibit 16-D-NRC.

MR. GILMORE. Exhibit 16-D, Table 2 in the paper once again presents what is still a qualitative assessment or evaluation of the candidate sites by the sub-committee to the committee established by the

Presidential Order. The parameters have changed somewhat from the original 1965 work, now addressed accessibility by both land and sea, identified as poor for Ternate, San Juan 25 kilometers from a national road; Padre Burgos no feeder roads to the site; Bagac 2 kilometers off the nearest paved road; and, Limay not stated, although with some confidence I know there is road access to that area.

The sea access was not stated for the said sites, Padre Burgos, San Juan, nor for Limay, or Bataan, and was identified as being potentially good for both Bagac and Ternate. Cooling water supply for Bagac was thought to be good from the south China Sea; and with good potential for fresh water from rivers and wells. The same was pretty much true for Ternate. Padre Burgos on the other hand, while cooling water was thought to be plentiful from the ocean, fresh water availability which is of course of paramount importance, was considered to be scarce. As was also in the case at

San Juan, additionally the sub-committee felt that a major infrastructure would be required to meet some of the conditions I referred to earlier concerning shallowness of off-shore water. Limay, the report stated good cooling water from the ocean, Limay of course faces Manila Bay and the bay is quite shallow. Fresh water from wells was thought to be available. The transmission was not stated in several cases but not really of significance. Populations were identified, the minimum 3,000 within a 20 kilometer radius at San Juan; 35,000 Limay; 31,400 Ternate; 24,000 Padre Burgos; 16,400 Bagac. Some information concerning the site area and ownership is included in the evaluation. The geology was defined with four regional tectonic features defined at Bagac, five at Ternate, two at Padre Burgos, two, including the tow line at San Juan, and with no information for Limay.

Some information, very preliminary and elementary -- not elementary -- but relatively a limited information concerning seismology suggested that se-

veral earthquakes since 1907 Intensity V at the site, similar to Batangas where they recommended acceleration of .25 to .3g for Ternate, the 1968 earthquake which resulted in Intensity V at the site, also resulted in Intensity V at the site at Padre Burgos, 4 to 5 San Juan and not stated for Limay.

Foundations generally were thought to be good below the weathering level for Bagac, feasible for all the other areas. For some information concerning the present land use. And once again on the basic of observation in the field, experience, judgment, regional information made available to them by various Philippine Government agencies, the sub-committee ranked the sites in the following sequence: No. 1, Bagac; No. 2, Ternate; No. 3, Padre Burgos; No. 4, San Juan, and, No. 5, Limay. If we consider the completion of that phase of the sub-committee work as Phase 2-A, we can state that following that work, a phase which I have described as 2-B in the

paper, was initiated by the National Power Corporation who initiated studies, field studies in geology and foundations in seismology and in water supply -- fresh water supply, that is. These field investigations and studies resulted in a report in the January -- actually two reports -- and February 1972 area, and a recommendation was made that the Bagac area be given priority for future studies, including geologic mapping, drilling, test pits and a test well program with respect to the water supply.

Phase 3 began in 1972 when the International Atomic Energy Agency sponsored by the Philippine Atomic Energy Commission and with the assistance of the United Nations Development Program, implemented a feasibility study for a nuclear power plant in Luzon.

Phase One of this development program, this feasibility study, resulted in the visit of an IAEA siting mission to the Philippines during the period 1 through 17 March 1972. Their mission was to rank

in order of acceptance the sites which had been identified by the Site Selection Sub-Committee. The sub-committee formed in response to the Presidential Order, and the work of which had resulted in the six sites. I could list the six sites if it is important, for the record, sir.

CHAIRMAN. Please do so.

MR. GILMORE. I should say, five sites, sir. The Bagac area, the Ternate area, the Padre Burgos area, the San Juan area, and, the Limay area.

CHAIRMAN. Are you referring to Table 3?

MR. GILMORE. Excuse me for just a moment. (Mr. Gilmore referring to his papers.) We are not yet in Table 3, sir. I was just identifying the sites that the IAEA Mission was to rank in the order of preference. They were the sites that resulted from the Phase 2 investigations by the siting sub-committee which were later supplemented by work of the National Power Corporation on two of the sites.

Prior to the initiation of their activities, the International Atomic Energy Agency Siting Mission stated that they would place a hyroline on both International Atomic Energy Agency and United States Nuclear Regulatory Commission Requirements and observed -- as we have pointed out earlier and as many have pointed out -- that the most important and critical parameter in siting and design of the Luzon Nuclear Power Plant was seismisity.

The significant siting parameters which were addressed by this 1972 IAEA siting mission included the tectonic province, seismo-tectonic relationships, the seismic history of the site or the site area, the maximum ground accelerations, respond spectra and exceleograms, geologic faulting, volcanism, wind defects, tsumani and wind generated waves. Additional siting parameters considered to be important but of not necessarily the same critical degree of importance as those I have just enumerated, included site flooding, micro-

the same as the original figure 2, Mr. Chairman, so it should have the same number, 16-C. I show it again just to remind the Members of the Commission of the location of the five candidate sites.

This slide is Table 3 in the paper and according to EBASCO information should be 16-E.

CHAIRMAN. Page 10 of the text. Mark it as Exhibit 16-E-NPC.

MR. GILMORE. The IAEA Siting Mission in 1972 developed this ranking table for the five sites: Bagac, San Juan, Ternate, Padre Burgos, and, Limay. The siting parameters considered, the first was foundation, and across the board we see No. I which means most acceptable. That was the judgment of the IAEA Siting Mission. With respect to micrometerology, all sites other than Limay received No. 1, most acceptable, Limay was considered to be acceptable. With respect to volcanic activity or hazard, Bagac, Padre Burgos and Limay were considered to be most

acceptable, while San Juan and Ternate were considered to be acceptable. With respect to flooding the IAEA Mission was lacking in information concerning San Juan, Padre Burgos and Limay, but considered Bagac acceptable and Ternate least desirable. No information again was available to them on wind conditions -- Maximum wind conditions. With respect to population centers of densities, San Juan and Padre Burgos were considered to be most acceptable; Bagac and Ternate acdeptable; Limay was least desirable.

The ocean currents. The two most favored sites are San Juan and Padre Burgos; Bagac acceptable, Ternate least desirable, and Limay primarily because of the shallowness of Manila Bay is probably unacceptable. Tsunami hazard, most acceptable at San Juan, Padre Burgos and Limay; acceptable at Bagac and Ternate. Ground shaking -- another way of saying severity of earthquake -- are considered to be a problem across the board for all of the sites which once again is

consistent with the findings of both earlier and later investigators.

With respect to the effect on Manila, Limay was considered probably unacceptable; Ternate least desirable; Padre Burgos, San Juan, and Bagac, most acceptable. Faulting, for both Padre Burgos and Limay was thought to be sufficiently severed in the proximity of the site to render it probably unacceptable; Bagac was ranked as acceptable; and, least desirable, San Juan and Ternate.

The final ranking by the mission was in the order across the top of the table. No. 1, Bagac; No. 2, San Juan; No. 3, Ternate; No. 4, Padre Burgos; and, No. 5, was zero because the siting mission considered Limay to be unacceptable and eliminated it from further consideration.

CHAIRMAN. Now, Mr. Gilmore, as a University professor I am acquainted a little with what we call, tests and measurements, and this is a very important graph we would like to find out what guided you in your choice of Bagac. You see, one very simple way

of grading these tests and measurements, since you are grading the most ideal or the most perfect with the lowest grade, one way of doing it would be to just add the numbers. And if we were to do that, it would appear like San Juan has a total of 14; Padre Burgos has a total of 14; definitely Ternate and Limay have very high totals with 23 and 21 respectively. But Bagac has 17 which is much higher than San Juan and Padre Burgos. The difference which is notable is in connection with faulting where Bagac has No. 2 a higher rating than San Juan which has No. 3, and Padre Burgos which has No. 4. Could you enlighten us on the relative evaluations of your ratings which gave the nod in favor of Bagac.

MR. GILMORE. With your permission, sir, I would like to correct what I believe may be a mis-impression.

This is a table prepared by the IAEA Siting Mission in 1972. EBASCO at that point in time, had no participation in any of this work or in any of the

of gauging these tests and measurements, since you are grading the most ideal or the most perfect with the lowest grade, one way of doing it would be to just add the numbers. And if we were to do that, it would appear like San Juan has a total of 14; Padre Burgos has a total of 14; definitely Ternate and Limay have very high totals with 23 and 21 respectively. But Bagac has 17 which is much higher than San Juan and Padre Burgos. The difference which is notable is in connection with faulting where Bagac has No. 2 a higher rating than San Juan which has No. 3, and Padre Burgos which has No. 4. Could you enlighten us on the relative evaluations of your ratings which gave the nod in favor of Bagac.

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This is a table prepared by the IAEA Siting Mission in 1972. EBASCO at that point in time, had no participation in any of this work or in any of the

work I described up to this point in time. If you will bear with the dissertation, sir, during the later protions of this presentation, we do have an address to the question that you asked which will present the EBASCO ranking approach and will I think ...

CHAIRMAN. An explanation of your ratings.

MR. GILMORE. Right, sir.

CHAIRMAN. We shall await them.

MR. GILMORE. In addition to ranking the sites and eliminating the four sites and eliminating Limay, the IAEA recommended further studies. The studies were to include field investigations as per the graph IAEA report, earthquate guidelines for reactor sites, to include faulting and ground failure considerations, volcanic tectonic, volcanic history, and physio-chemical studies, and with that we pass to Phase 4.

Phase 4 was initiated upon completion of the IAEA siting assignment or mission assignment and during this phase a feasibility for nuclear power plant in

Luzon was developed and issued in 1973. This document was in depth document and considered the project feasibility from both financial and technical aspects.

Considered in the feasibility report, were electric load projections, the sizing and phasing of new generating units of all types, an inter-connected system analysis in the Philippines, and also some addressed to site considerations. With respect to site considerations this 1973 feasibility report considered only the two most acceptable sites -- that is, the Bagac site and the San Juan site. Completion of this phase, the feasibility report, led to the National Power Corporation initiation of exploratory drilling and the implementation of a test pit and geophysical programs at the Bagac site. The Bagac site has developed in the feasibility report which is shown in the next slide which is figure 5 in the paper.

MR. GILMORE. ... only an engineering problem. It is a process which must include nuclear licensing consideration and also environmental consideration. So, in effect, it becomes a multi-discipline activity. And in the Philippines, on the Philippine nuclear power plant, as is common in our country, all of these re-disciplines participated in the studies.

I will show you, without going into the detail or the description of the studies which I would say are rather fully covered in the report, a conceptional site development layout for each of the sites that we considered in the vicinity of ...

THE CHAIRMAN. Mr. Gilmore, so far, you have been summarizing what is already contained in this book that you marked as Exhibit "16", NPC?

MR. GILMORE. That is correct, sir.

THE CHAIRMAN. Am I to understand that for the rest of this dissertation, it will just merely be a verbalization of what is already contained here?

MR. GILMORE. I was trying to avoid that by showing you some exhibits with minimum verbalization, and then to show you the ranking methodology that was used to identify Napot Point.

THE CHAIRMAN. Perhaps, you can go straight to that ranking methodology, because what we intend to do is look over this Exhibit "16", NPC to see whether it is understandable and if we have any questions, we are going to ask those later. Would you go straight to your methodology and enlighten us on those points?

MR. GILMORE. I will be happy to do that, sir. A minor method of introductory commentary is, I believe,

necessary to make sure that the methodology is clear. By process described in the paper ...

THE CHAIRMAN. What page is this, please? Page?

MR. GILMORE. This is from a different report. This will require a separate marking.

THE CHAIRMAN. Mart that as Exhibit "17", NPC. Proceed.

MR. GILMORE. By a refinement of the work that have been done by others, EBASCO concluded that the most favorable location for construction of a nuclear power plant in Luzon would be located in the vicinity of Bagac. We identified in the vicinity the original Bagac 1 site; a Bagac 2 site; a site at Saysayin Point; a site at Mapalan Point; and a site at Napot Point. Conceptional development of each of these sites were

prepared for purposes of developing differential cost data.

THE CHAIRMAN. This is another documnt?

MR. GILMORE. This is another document.

THE CHAIRMAN. Mark it as Exhibit "18", NPC.

MR. GILMORE. This is Napot Pointconceptionalized and there are some similarities in the present deveelopment.

The next is the development of Napalan Point, conceptionalized also in a new document.

THE CHAIRMAN. Mark this as Exhibit "19", NPC.

MR. GILMORE. Bagac 1, a new Exhibit which once again is the original site.

THE CHAIRMAN. Mark it as Exhibit "20", NPC.

MR. GILMORE. Bagac 2, which was a modification of the original Bagac site is an attempt to overcome some of the problems identified by

Mr. Tilford earlier.

THE CHAIRMAN. Mark it as Exhibit "21", NPC.

MR. GILMORE. And finally, the Saysayin Point, the final of the new exhibit.

THE CHAIRMAN. Mark it as Exhibit "22", NPC.

MR. GILMORE. The first category of ranking of the sites was identified as in our lexicon list engineer cost related items. What would it take to develop this site as compared to another site? The results of those analysis and studies are contained on this table which is from the paper listing. It's on page 44 of the paper.

THE CHAIRMAN. Mark it as Exhibit "16-G", NPC.

MR. GILMORE. This table develops differential cost for the various aspects of site development including the civil engineering and other work associated

with the development of the site, the development of a circulating water system, transmission lines and engineer safety features. The comparative costs are included in the lines just about the bottom. By a process of inverse ratios, the sites were ranked on the basis of their economic cost of development and the results show that the Napot Point was the most favored site. Bagac 1, 2 and Saysayin Point were more or less of a kind with respect to cost, and that Napalan Point would be the most expensive of the five sites to develop.

The next phase or portion of the ...and these are quantified numbers. The next consideration is on page 49 of the paper and addresses in a quantitative way the various nuclear licensing considerations. And I think this is the first opportunity I will have

to try to address your question before.

THE CHAIRMAN. Table 6.

MR. GILMORE. Table No. 6.

THE CHAIRMAN. "16"-H. Proceed. Mrs. Orquiola, will you please mark my copy? Proceed.

MR. GILMORE. Under nuclear licensing considerations, we identified various main headings to the population and dosage under which we identified minimum exclusion radius; identified as that radius such that radiation does its use to human beings standing at that foundry, would not exceed regulatory guidelines.

The low population zone being defined as that zone being under the direct control of the National Power Corporation, with population characteristics permitting ready evacuation in the event of a maximum hypothetical accident in the population

center districts, which is the distance measured from the reactor to the boundary of the nearest population center with a projected population — projected during the life of the plant of 25,000. And the distance must be at least 1.33 times of the low population zone. These are all on Philippine Atomic Energy Commission requirements.

The other categories we included are regional land use, meteorology, hydrology and the subject of much interest to all of us, geology and seismology In an attempt to avoid just adding up numbers, we developed a ranking system in which relative weights were given to each of these five main categories.

As you will note, looking at Table 6 on the screen, the relative weight for geology and seismology was 30%. That was broken down into varia[illegible] — that is,

sub-weights site stability, as an example, has a weight of 4. If you will excuse me, I will have to go to the board and it will be easier. Of the sixty (60) points for geology and seismology, sites stability for those depth to groun water, four; foundation quality, four; electric action, four; except for down through this column. The sum of these adds up to six. The same is true for hydrology, 10; meteorology, 10; regional land use, 10; and population and dosage, 10.

Of the available points in this column and on the basis of multi-discipline discussions, I guess and maybe, they could be defined in some cases of arguments. We arrived at the number of points that should be awarded to each of the candidates of the available number and that is represented by the rest of the radius.

And we can see indications or situations and where some sites received zero point out of what was

available. Other sites received all of the available point in a particular category. At that point and time, after having assessed or attempted to rank or by weight or merit, the various parameters, then we went to more or less on an addition process, and the results are shown on the bottom here with Napot Point and Mapalan being the most favored sites; Saysayin Point next; Bagac 2, 4th; and Bagac 1, a rather poor 5th.

So, Mr. Chairman, you can say why 60. And in fact, we did ourselves why 60, so we performed what we called sometimes the sensitivity analysis or parametric analysis and we addressed these numbers. We said, well maybe, hydrology should have more importance and we give it initially and geology less. So, we went through this kind of an exercise and while it is not in the paper, we always came out with the same result. We thought that justified the selection of the relative weights.

The last section of the last evaulating factor in the paper is on page 52 and it is Table No. 7. A table is now on the screen and addresses environmental considera-tions. And those were divided into four (4) categories:

aquatic ecology, terrestial ecology, ocean hydrodynamics and fresh water usage. The relative weights to aquatic ecology, 35%.

THE CHAIRMAN. Just a moment please. Mark this as Exhibit "16-I", NPC.

Proceed.

MR. GILMORE. The terrestial ecology, 15%; fresh water usage, 15%; and the ocean hydrodynamics, 35%. The sum of the aquatic ecology and ocean hydrodynamics, a total of 70% out of this total of 100.

Going through the same process as addressed on Table 6, we see that Napot Point and Mapalan Point once again are very close contenders. Bugac 1 and 2 and Saysayin Point are in a photo-finish for third place or second place actually. Table 8 as shown on Page 53, will be the next and the last exhibit.

THE CHAIRMAN. Mark it as Exhibit "16-J", NPC.

Proceed.

MR. GILMORE. This last exhibit ranks the five (5) sites on the basis of the three earlier main topics: the engineering cost related items; the nuclear licensing considerations; and the environmental considerations. And in all cases, Napot Point ranks No. 1.

Consequently, therecommendation to the National Power Corporation for development of the nuclear power plant on Batuan was for Napot Point. And you can see by looking at the compositely reading just above the ranking line that the differences were relatively significant.

THE CHAIRMAN. We will suspend your dissertation for our own interpellation for tomorrow morning. We will recess for ten minutes after which we will resume with the interpellation of the Westinghouse panel by the Zañada panel.

We recess for ten minutes.

It was 3:45 p.m.

RESUMPTION OF SESSION

(At 4:00 p.m. the session was resumed with the Chairman, Hon. Ricardo C. Puno, presiding.)

THE CHAIRMAN. The session is resumed.

MR. TILFORD, the Commission understands you wanted to make a statement.

MR. TILFORD. I feel that I may have created an incorrect impression and I would like very much to correct that and to apologize for having created that impression. I made the remark at one point in our exchange that I felt the Commissioner of Volcanology, Mr. Andal, had attempted to agree with a number of positions and in so doing had placed himself in a position of agreeing with some folks who disagreed with each other. It was an attempt at humor and was certainly not intended to be offensive to the Commission -- to this Volcanology nor to this Commission nor to anyone else. I am fully aware of my status as a guest and I believe I do not have a reputation of stepping on the toes of my friends and I do apologize for the misunderstanding, sir.

THE CHAIRMAN. The word "Commissioner" was ambiguous. That is the reason why the reaction was in the manner it came. The word "Commissioner" was used, it did not specify Commissioner Andal.

MR. TILFORD. And I would not want even to be offensive to Commissioner Andal. My reference was intended to be a light one indicating that he had agreed with us in a certain case and with someone else in another case and have thus put himself in a position of agreeing with people who disagreed with each other. And I stepped right into a serious potential misunderstanding and I want to be sure that you accept my apologies, sir.

THE CHAIRMAN. Mr. Tilford, we shall not be any less generous and any less courteous. If we accept your explanation that by "Commissioner" you did not mean this Commissioner or any of the Commissioners, and if you are referring to Commissioner Andal, it was an attempt at humor, we shall take that explanation on its face value and we thank you for it. It takes courage to make a public apology. We thank you and we accept the same.

In compliance with the request of the Westinghouse Panel on the North Anna Nuclear Plant incident, we are handing over this item from the Plant Operating Experience and Economics, the pamphlet of the Nucleonics Week Special Report Series No. 5. For lack of copies we will only furnish the Westinghouse Panel and the Toñada Panel and we can give the NRC Panel, the government panel, one copy and we invite the Roman

Panel to visit us in our office for their own copy. Dr. Farg has his copy already, we will give the Roman Panel their copy.

We will make this, for purposes of the proceedings, as Document No. 14-D.

The Tañada Panel may proceed with the questions.

MR. TAÑADA. If Your Honors, please, it is with deep regret that we cannot undertake a cross-examination of the witnesses of Westinghouse for the following reasons: ...

THE CHAIRMAN. Were the graphs brought to the office of Senator Tañada?

DR. FARG. Yes, sir, they were brought to the office of the Senator yesterday morning.

MR. TAÑADA. It is only this afternoon that we received these stenographic notes, or transcript of the stenographic notes. The subject testified to is technical and highly complex. It is a matter of general knowledge and especially known to the Chairman and the Members of the Commission, that in matters like this, the opposing lawyer is always given a reasonable time to study the stenographic notes before he undertakes his cross-examination.

We believe, if Your Honors, please, that if we try to cross-examine the Westinghouse witnesses we will be waiving our right to reasonable time for cross-examination. We will

be waiving our purpose in coming to these proceedings, and that is, to adequately help in ascertaining the truth and nothing but the truth. We will be sacrificing the best interests of our people if we try to cross-examine these witnesses, considering the length of this transcript of stenographic notes. Considering also the changing position of Westinghouse -- I refer to only one and that is with respect to 14-E-1 -- I pointed out to this honorable Commission that in their opinion there was no hydrogen bubble. And to cross-examine them now with this change that they are now putting up -- a hydrogen bubble -- will be to us very difficult.

Furthermore, in the two-hour conference that we had this morning -- very exhausting conference from 9:00 o'clock to almost 11:45 -- with the representatives of Westinghouse, who were kind enough to unfold to us the plants, Messrs. C. Smaney and James Weber, I cannot still see practically what I want to see, and that is, the artistic illustration of the plant in Batasn. That is one of the most important evidence in these proceedings and it is not available. Dr. Simmons said that it will be available after two months and a half. We are willing to wait, if Your Honors, please.

So, we regret to announce that henceforth, we will not avail of the invitation to cross-examine witnesses unless we have been given a reasonable time to study the

testimony by reading the transcripts.

Finally, I would like to state that we also regret that MBAUCO has not given us a copy of the pamphlet on which Dr. Tilford has testified.

Thank you very much.

THE CHAIRMAN. Do you have an extra copy of that pamphlet, Mr. Tilford? You have given four copies to the Commission. Give one of the Commission's copy to Senator Tañada.

You are not going to cross-examine even on the basis of the stenographic notes that you received this afternoon, Senator?

MR. TAÑADA. I just received this. I have not read them.

THE CHAIRMAN. Would you expect to be reading part of that and then commence a few on the points at tomorrow's hearing? No matter how brief it would be.

MR. TAÑADA. A few questions, perhaps, Your Honor, just to accommodate the Commission.

THE CHAIRMAN. So, you can continue tomorrow?

MR. TAÑADA. Yes, Your Honor.

THE CHAIRMAN. Very well, for tomorrow then the con-

tinuation of the questioning on the Westinghouse Panel and the continuation of the dissertations for EBASCO.

Session is adjourned until 8:00 o'clock tomorrow morning.

It was 4:10 p.m.

CERTIFICATION

We hereby certify to the correctness of the foregoing transcript.

Stenographers:

M. G. Pimentel
Miss M. G. Pimentel

P. B. Perez
Mrs. P. B. Perez

[illegible] HELD AT THE [illegible] 1979, AT [illegible]

x - - - - - - - - - - - - - - - x

PRESENT:

Justice Ricardo C. Puno - Chairman
Justice Conrado M. Vasquez - Member
Justice Jose C. Bautista - Member

APPEARANCES:

1. [illegible] PANEL
   a) Atty. Lorenzo M. Tañada
   b) Atty. Joker P. Arroyo

2. ROMAN PANEL
   a) Hon. Antonino P. Roman, Jr.
   b) Atty. Guerrero
   c) Atty. Dizon

3. WESTINGHOUSE PANEL
   a) Mr. James E. Moore
   b) Mr. Walter Wilgus
   c) Mr. Gerald R. Carroll
   d) Mr. James T. Cronin
   e) Mr. James C. Woeber
   f) Mr. John D. Hankowsky
   g) Mr. Daniel W. Call
   h) Mr. Raymond J. [illegible]ero

4. NPC PANEL
   Mr. Gabriel Y. Itchon

5. MINISTRY OF HEALTH
   Hon. Clemente S. Gatmaitan

6. ROXAS PANEL
   Dr. [illegible] Roxas

7. MINISTRY OF ENERGY
   Hon. Geronimo Velasco

8. PAEC PANEL
   a) Dr. Zoilo [illegible] Bartolome
   b) Dr. Carlito Aleta

WITNESSES:

1. Mr. James J. Gilmore - EBASCO
2. Mr. [illegible] Milford - EBASCO
3. Mr. J. [illegible] [illegible]aly - EBASCO
4. Mr. [illegible] Simmons - Westinghouse
5. Mr. David [illegible] - Westinghouse

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OPENING OF THE HEARING

(At 9:00 a.m., the hearing of the Commission on Nuclear Reactor Plants was convened)

THE CLERK. Ladies and Gentlemen, please rise. The Chairman and the members of the Commission.

The Commission is now in session. Everybody is enjoined to observe silence and proper decorum.

THE CHAIRMAN. Call the roster of general and special appearances.

THE CLERK: Attorney Lorenzo Tañada - present
Attorney Joker P. Arroyo - present
Hon. Antonino Roman, Jr. - absent
Mr. James S. Moore - present
Mr. Walter Wilgus - present
Mr. Gerald Carroll - present
Mr. James T. Cronin - present
Mr. Aura A. Simmons - present
Dr. David Berg - present
Mr. Daniel W. Call - present
Mr. Raymond Sero - absent
Minister Itchon - present
Minister Catmaitan - absent
Dr. Roxas (represented by Ms. geles)
Minister Velasco - absent
Dr. Bartolome - absent
Dr. Aleta - present
Ms. Nora Petines - absent
Mr. Tilford - present
Mr. Gilmore - present
Mr. Healy - present

THE CHAIRMAN. May the Commission inquire if there are additional documents or exhibits that will be presented by the Westinghouse?

MR. CRONIN. None, Mr. Chairman.

THE CHAIRMAN. The addendum is not yet finished?

MR. CRONIN. We have received the information from Pittsburg on the addendum.

THE CHAIRMAN. Mr. Gilmore, will you please go back to the rostrum for additional questions.

Questions from Justice Bautista?

JUSTICE BAUTISTA. Mr. Gilmore, will you please open this Exhibit "16", on page - "16-F"; I am referring to page 12, Mr. Gilmore.

MR. GILMORE. Page 12.

JUSTICE BAUTISTA. Exhibit "16-F-NPC". You will notice from the diagram of this conceptual plot plan of nuclear generating station in Bagac area, there are two rivers, one on the north and another on the south, and it says "river diversion". I suppose that those two rivers are the Bayong(?) river and the Kabayo river?

MR. GILMORE. That is correct, sir.

JUSTICE BAUTISTA. What I want to know is, do these two rivers extend to the present site at Napot Point, Morong, Bataan?

MR. GILMORE. No, sir.

JUSTICE BAUTISTA. What would be the significance of these two rivers if they were present at the Napot Point? Did you consider these factors in making Bagac the most acceptable site?

MR. GILMORE. Mr. Commissioner, we did not make Bagac the most acceptable site. We made Napot point the most acceptable site.

JUSTICE BAUTISTA. Yes, that was on the third page of the study. I think before you chose Napot point, there was a selection of Bagac as the most acceptable site.

MR. GILMORE. By earlier investigation, that is correct, sir.

JUSTICE BAUTISTA. Yes, by earlier investigation!

MR. GILMORE. In our selection and recommendation of Napot point as the most acceptable site, EBASCO did consider the impact of the Bayag (?) and Kabayo river on development of the Bagac site?

JUSTICE BAUTISTA. That means the two rivers contributed favorably to the selection of Bagac site?

MR. GILMORE. They contributed unfavorably.

JUSTICE BAUTISTA. Unfavorably?

MR. GILMORE. Unfavorably.

JUSTICE BAUTISTA. In what sense?

MR. GILMORE. In the sense that the rivers during monsoon season carry tremendous quantities of water and the development of the Bagac site would have had to face the very important risk of flooding during the construction. The adequate foundations for the Bagac site would have been developed or have had to have been developed at an elevation approximately 20 meters below the existing grave. The materials overlying the good foundation materials are fully consolidated materials and are saturated with water. Consequently, the stability of such materials would

An additional concern related to the potential for damage, hypothetical volcanic events as Mr. Tilford pointed, Napot point is on a peninsula at a relatively high elevation. The Bagac site is a valley between two peninsulas and is at a very low elevation. Consequently, any hypothetical materials which might be ejected from the volcano could be guided topographically as it flows down the side of the mountain into the valley.

Locating the power plant in a valley would have consequently exposed it to the possibility, in the highly unlikely event of any activity, to impact volcano materials. We have, in line with this answer, a model - a topographic model constructed of the Bataan area to a natural scale. It is designed to show the topography, the topographic control of the relationship of the mountain, the peninsulas, the valleys, to the power plant. That model will be received at Manila International Airport on Sunday, and we hope to be able to bring it to the Commission's meeting or hearing on Monday. But for the present, locating the power plant in valleys with respect to considerations of volcano materials, we felt would be quite hazardous, much more hazardous than the present location.

JUSTICE BAUTISTA. How many meters above sea level is Bagac?

MR. GILMORE. It is 18 meters above sea level.

JUSTICE BAUTISTA. I am referring to the original Bagac site, not the Napot point.

MR. GILMORE. The original Bagac site was some two to three meters above sea level.

JUSTICE BAUTISTA. How about the Morong Napot point?

MR. GILMORE. 18 meters; much higher, and much higher intentionally.

JUSTICE BAUTISTA. Let us turn to page 8 of this Exhibit "16". On the first paragraph, it speaks of a safety mission which met in the Philippines sometime March 1 to March 17, 1972 to evaluate the suitability of two sites for a nuclear power plant. I am not very clear if these two sites is for a nuclear power plant. Does it refer to two nuclear power plants to be established in one site?

MR. GILMORE. I would like to explain to the Commission that I personally and EBASCO were not involved at that point in time. But I believe that the situation was as follows: the feasibility report--- I am sorry. The site selection subcommittee had, as their mandate, ranked or actually selected the sites which have been shown already as Bagac, Ternate, Fr. Burgos, San Juan, and Limay.

JUSTICE BAUTISTA. You will notice in the end of the second paragraph, the last sentence of the second paragraph, it says: "the siting mission mandate directed the installation of a second unit of the same capacity should be considered a possibility at the selected site.

MR. GILMORE. That is correct.

JUSTICE BAUTISTA. Did I get you to mean in this report that when you selected the Bagac site originally and later on Napot point in Morong, your feasibility study sways to the establishment of two units of nuclear plant reactor?

MR. GILMORE. The siting work that have been done prior to EBASCO's participation and subsequent to EBASCO's participation anticipated the potential addition of a second unit to the site. That is quite a common procedure in siting analysis.

JUSTICE BAUTISTA. Two units in the same area?

MR. GILMORE. That is correct.

JUSTICE BUATISTA. We go now to... will you explain to the Commission how does this characteristic of off-shore ocean current patterns in the vicinity of the proposed site affect the selection of Napot point in Morong as the most acceptable?

MR. GILMORE. If you will bear with me a moment. I have to find the appropriate materials. Theocean hydro-dynamics impacts a particular site location, any site location, are basically two ways: first, is the ability of the receiving body of water to receive an anticipated wastage generated by the power plant, while at the same time causing the least amount of impact to the ecology of the area. As a second consideration, re-circulation potential does exist. And by re-circulating potential, I mean, the possibility of the discharge water returning at a short half to the intake area for use in cooling or condensing of the steam in the plant. This can lead to inefficient operation of the condenser cooling system, and would in addition, be detrimental to aquatic life.

These factors were given great weight in the selection of the sites and resulted in, as the evaluation shows, the Napot point site being considered superior to the other candidate sites with respect to that perimeter. All sites were evaluated on the basis of its receiving capability and re-circulation potential. The parameter is given a very significant weight in the ranking process and Napot point was considered to be the most favorable of all and Bagac II, which was the slight modification of the original Bagac site, was judged to be the least favorable; the next least favorable was the Bagac I.

JUSTICE BAUTISTA. When you conducted your feasibility study, did you envision the fact that the nuclear reactors proposed to be established would get water from the ocean; from the sea?

MR. GILMORE. That was the basic assumption, yes.

JUSTICE BAUTISTA. You were aware of that, that the reactors would need voluminous water?

MR. GILMORE. That is correct. We anticipated what is called a once-through cooling water system, drawing water from the south China sea and returning it to the south China sea.

JUSTICE BAUTISTA. Now, what would be the significance if the particular area of off-shore sea has ocean currents?

MR. GILMORE. I am not sure I understand the question.

JUSTICE BAUTISTA. You said that you were aware that this nuclear reactor plant would use voluminous water from the sea.

MR. GILMORE. That is correct.

JUSTICE BAUTISTA. All right, if the off-shore ocean current pattern in that vicinity is enormously discharged, would that affect the selection of the site?

MR. GILMORE. The quantities of water that we are speaking of and which you described as voluminous are, from the point of view of the plant, yes, very large. But from the point of view of the south China sea, they are relatively small, and a properly designed circulating water system with appropriately designed intake and discharge

facilities should result in minimum impact to the, minimum, if any, impact to the normally occuring ocean current pattern. You are super-imposing a relatively minor physical event on a very, very major regional system.

JUSTICE BAUTISTA. On your page 9 of Exhibit "16", there is a statement here regarding the suggestion of the International Atomic Energy Agency of the two main dangers in the site selection, and number one is the possibility that new volcanic cones could open up in the immediate vicinity of the plant and so endangering it with lava flows. What do you say to this finding of the IAEA when you conducted your study?

MR. GILMORE. With your permission, I would like to suggest that it was the suggestion by the IAEA and it was a suggestion that we truly agree with. As a consequence of the interpretation, the valuation by the IAEA, the siting mission recommended volcanic, tectonic, volcanic history and physical physiochemical studies of these. After the selection of Napot point, they were actually performed in extreme great depth by EBASCO.

Mr. Tilford reported earlier that the actual studies and the subsequent feasibility studies and responding to the questions raised by both the Philippine Atomic Energy Commission and others, I aggregated some 79 years of effort. The very major component of over-all effort was addressed to the two main dangers identified by the IAEA. Number one is the possibility that new volcanic cones would open up in the immediate vicinity of the plant and so en-

dangering it with lava flows. And number two is possibility that ash flows erupted from volcano would enmesh the plant.

The result of our studies, and they were indeed exhaustive, (in our view, at least that exhaustive, and probably more exhaustive than any study that have been performed anywhere in the world for this type of project) were that the topographic protections afforded by the peninsula location of the Napot point very effectively protected it from the very remote possibility of having to face the hazards of new volcanic flows of any type from the volcano.

JUSTICE BAUTISTA. From your answer, can we say that these two volcanos, nine kilometers from the site, the Natib and Mariveles Mountains, are not extinct volcanos?

MR. GILMORE. I did not say that. The volcanoes have been defined by COMVOL as dormat. As considered by EBASCO, and as reported on in the TSAR, we cannot preclude the possibility of volcano activity associated with the volcano. However, on the basis of very exhaustive sampling and scientific study, we have concluded that the probability of such an event is highly remote. In the unlikely event that any activity might occur associated with Mt. Natib, we believe that, that activity would have to be physically limited to the east side of the mountain where the last eruption occurred some 70,000 years ago. The materials ejected from the volcano on the east side of the mountain would pose no hazard to the site. The one volcanic hazard which we feel that -- we reported that the plant must be designed is for ash, and

that is not necessarily ash emanating from the nearby volcano ; it could be from other volcanoes in the vicinity. There are many volcanoes in the Philippines.

JUSTICE BAUTISTA. You were a member of the group that undertook this study on several phases? All the time you were a member?

MR. GILMORE. I was a member of EBASCO and SILAM and my work and the work of EBASCO with respect to PNPP-1 initiated in the late fall of 1974.

JUSTICE BAUTISTA. When you participated in that study, did you have in mind, in selecting Napot point in Morong as the site of the nuclear plant, the actual situation of Clark Field and Subic Bay?

~~MR. GILMORE — Clark Field and Subic Bay surely exist.~~

JUSTICE VASQUEZ. And what is supposed to be the scope of the work for which your services have been hired by NPC?

MR. GILMORE. I would have to...

JUSTICE VASQUEZ. Just tell us in brief.

MR. GILMORE. I may answer part of the question but for the complete scope of services, Mr. Healy would have to answer that question.

JUSTICE VASQUEZ. Let me limit it to site selection.

MR. GILMORE. We were assigned the responsibility for preparation of Chapter II of the Preliminary Safety Analysis Report or commonly called the PSAR. Chapter II defines the site characteristics and includes detailed discussion of geography, demography...

JUSTICE VASQUEZ. Well, I think we will be wasting a lot of unnecessary time if we go into technical details. We are just interested on this particular: whether you were hired to investigate one particular site or four or five other sites or to choose any other site which might be the most suitable for the establishment of the reactor plant.

MR. GILMORE. When EBASCO was engaged, we were engaged to prepare the PSAR, Chapter II for the site shown on Figure 3, page 13 of Exhibit "16-NPC."

JUSTICE VASQUEZ. I do not talk your language and apparently you don't talk mine.

MINISTER ITCHON. Perhaps, it will help the one making the testimony. The confusion seems to be that there has been a precise identification of a Bagac site and a Bagac area. So, the confusion arises possibly on this connection, and this is the reason why he has difficulty in saying that EBASCO was commissioned to investigate not only the area around Bagac, including Bagac, but also even adjoining areas beyond the initial Bagac site pinpointed by the IAEA and recommended by the IAEA. I think there is a confusion here, Mr. Commissioner, because the Bagac site is a specific site that was investigated.

JUSTICE VASQUEZ. I have always taken to mean the Bagac site that he was mentioning to include not only the Bagac-1 site but the general area to include Bagac-1, Bagac-2, Napot point and another point in the same area including the present site.

MR. GILMORE. That is, I think, possibly the cause of our misunderstanding.

JUSTICE VASQUEZ. Is that what you mean?

MR. GILMORE. I have been defining the Bagac site as that shown on Figure 3, page 12 in Exhibit "16-NPC."

JUSTICE VASQUEZ. But, at any rate, let us make this clear. You were hired by NPC?

MR. GILMORE. That is correct.

JUSTICE VASQUEZ. Not by PAEC?

MR. GILMORE. EBASCO services were engaged by NPC.

JUSTICE VASQUEZ. So, it is clear that it was merely the job of EBASCO to find out where in that general area of Bagac the plant would be, not to choose any other site. Is that correct?

MR. GILMORE. May I refer to a page in Exhibit "1o-NPC", page No. 13. In the center of the page, there are listed some of the concerns I presented in the earlier testimony and the paper states that while none of these concerns would in themselves automatically preclude development of the site, experience strongly suggested that implementation of the requisite engineering solutions could prove to be quite costly.

At that time, we recommended to the National Power Corporation that in implementation of the work associated with Bagac and to insure the availability of a variable site for development, we broaden the scope of our investigation somewhat to include confirmation of the Bagac site or, alternatively, identification of another suitable site in the vicinity. The National Power Corporation accepted our recommendation and the work proceeded on that basis.

JUSTICE VASQUEZ. I have not received a categorical answer to my question.

MR. GILMORE. I am trying to do the best I can, Mr. Justice.

MINISTER ITCHON. Mr. Chairman, may I please...

THE CHAIRMAN. Minister Itchon.

Bagac-1, Bagac-2, Napot point and another place there.

MR. GILMORE. Well, what I really mean is that we consider the area from the Zambales peninsula to the southern tip of Bataan. However, I would like to point out that in giving careful attention to that area, we did review all of the available work performed by the original investigators.

And we also reviewed all of the original data available through the auspices of the various Philippine agencies and concluded that the early work done in site investigation had properly located the power plant in the general vicinity between the Zambales peninsula and the Southern tip of Bataan.

JUSTICE VASQUEZ. You merely relied on their studies. You did not conduct personal examination and investigation of the other sites?

MR. GILMORE. Such as Atimonan as an example?

JUSTICE VASQUEZ. As those that you mentioned.

MR. GILMORE. We did not. I personally did not. Our staff, geological staff, had essentially travelled all over the Philippines and are quite familiar with the area; but the siting parameters relevant to the safe location of the nuclear power plant, the faulting, the seismicity are all relatively well defined in the literature and, on balance, the Bagac area is the least active area in the Philippines.

first Philippine Nuclear Congress was convened in Manila, actually, in this building.

Dr. Ibe, the Chairman of the Philippine Atomic Energy Commission, requested that EBASCO prepare a paper for presentation at that meeting describing the siting of the Philippine Nuclear Power Plant.

I personally prepared the paper and it is a historic document really defining the entire process by which the Philippine Nuclear Power Plant site was selected. Prior to 1974, it was my attempt to define history based on reports that were available to us.

JUSTICE VASQUEZ. So, it seems clear -- and you can correct me if this statement is wrong -- that when EBASCO came into the picture it was already a foregone conclusion that Bagac will be the site.

MR. GILMORE. When EBASCO came into the picture, the earlier work had identified Bagac as the site of the Nuclear Power Plant. That is correct.

JUSTICE VASQUEZ. And that is why you examined only Bagac as the possible site of the nuclear plant?

MR. GILMORE. We examined Bagac and really the Bagac area.

JUSTICE VASQUEZ. And by that you mean you include

of the Philippines, who had concluded that the Bagac site was the most favored site. EBASCO was engaged as a consultant by the National Power Corporation to prepare the necessary reg datory reports necessary to license outside.

JUSTICE VASQUEZ. You will pardon me, but I get more confused everytime you answer my question. My question simply is, when you were hired by NPC, your job was simply to examine and evaluate the Bagac site and no other site. Or, did you have a hand in choosing any other site aside from Bagac?

MR. GILMORE. At the time EBASCO was engaged by the National Power Corporation, it was assumed by the National Power Corporation and others that Bagac was the site. EBASCO did not participate in that decision at that point, or prior to that point.

JUSTICE VASQUEZ. Now, if you were only suppose to examine and evaluate the Bagac site, why is it that your charts show comparisons between the Bagac site and feel for other sites, like San Juan, Limay, Atimonan, Tarnate. What would have been the basis of the data that you put in those charts, if you did not examine them?

MR. GILMORE. The document, Exhibit "16-NPC", is not a formal report prepared as part of the PNPP work. Rather, in December of 1976, under the sponsorship of the Philippine Atomic Energy Commission and with the participation of the International Atomic Energy Agency, the

IAEA Mission in 1965. They were subsequently expanded by the subcommittee established by the Presidential Order and the Quezon Province and Batangas sites were identified by essentially the subcommittee.

JUSTICE VASQUEZ. When EBASCO came into the picture, those sites were already determined?

MR. GILMORE. They have been determined and the subcommittee and the 1972 IAEA Siting Mission had concluded that the Bagac area was the most favorable location for a power plant site.

JUSTICE VASQUEZ. If you will just answer my question as I asked the question, maybe it will take less time. I am just asking whether when you came into the picture -- I mean EBASCO -- you were already told these sites that you were supposed to study. You had no say in choosing other sites other than those mentioned?

MR. GILMORE. We were not told, to my knowledge, to study any site. We were basically initiating work at the Bagac site. Our original mandate was to develop a safety analysis report for Bagac.

JUSTICE VASQUEZ. You mean to tell us that you were only told to study the Bagac site, nothing else?

MR. GILMORE. No, we were not told anything of that type, Mr. Commissioner. We were entering into a site selection process that had been going on for 10 years by responsible agencies, both international and

subsequently a bunker which we rented in a barrio of Bagac, reconoitered the entire area and we selected the sites.

JUSTICE VASQUEZ. Which sites?

MR. GILMORE. The sites that were selected were actually six: Starting from the north and working south, they were Napot point, Mabalon point. Bagac-1 site was selected since it had been previously selected. Bagac-2 was included as a possible close alternative to Bagac-1 and Saysayin point.

In addition, another point or peninsula to the South, Caybobo point, was considered as a potential site but was eliminated relatively early in the studies and, consequently, is not included in the report.

That is the site, sir, in the immediate vicinity of Bagac selected by EBASCO.

JUSTICE VASQUEZ. I think we are not speaking the same language.

MR. GILMORE. I am sorry, sir.

JUSTICE VASQUEZ. I am only asking who chose the five sites that you mentioned in your paper here which included San Juan, Batangas, Tarnate...

MR. GILMORE. Oh, I am sorry.

JUSTICE VASQUEZ. ..Cavite, Atimonan in Quezon, the Bagac site, Limay.

MR. GILMORE. Both sites were selected either by

MR. GILMORE. I would have to say that they were chosen by myself and Mr. Tilford. I could explain possibly the earlier question concerning the suitability of the Bagac site with my service preamble to my answer to your question.

In February of 1975, Mr. Tilford and I came to the Philippines for the first time to make an ocular inspection of the site area and to review the results of the on-going field programs.

During that visit, we inspected the test pits that had been excavated. We observed the cores that had been recovered during the drilling process. We observed the fact that each of the holes that have been drilled was producing water under pressure at volumes in the order of 80 to 100 GPM. This water was heated, having an average temperature possibly in the vicinity of 115 degrees and was alkaline in nature.

I mentioned earlier that we had concerns regarding the suitability and stability of the materials. I had answered earlier that we were concerned about the flooding of the excavation by the Payong and the Cabayo rivers.

JUSTICE VASQUEZ. May I interrupt, Mr. Gilmore. I am just interested in finding out who chose the five candidate sites that you studied on the possible site of the PNPP-1.

MR. GILMORE. After our inspection, Mr. Tilford and I, using the National Power Corporation helicopter and

MR. GILMORE. Clark Field and Subic Bay surely exist. They were surely considered in the siting studies. They were considered by EBASCO from the point of view of impact of the aircraft on the site area.

In the United States, location of nuclear power plants in the airfield, as an example, is carefully considered; and, unofficially, the US NRC will not strongly question a site for a nuclear power plant as long as it is in excess of five miles from the nearest runway. This is an unofficial position, of course, but it is based on the results of very exhaustive probability analysis, studying the crashes of airplanes -- of landing and taking off from airstrips. And unofficially the NRC feels that if a plant is located more than five miles from the end of an active runway, either incoming or outgoing, there is no credible hazard for impact of an aircraft on site.

JUSTICE BAUTISTA. Thank you, Mr. Gilmore.

THE CHAIRMAN. Justice Vasquez.

JUSTICE VASQUEZ. Mr. Gilmore or Dr. Gilmore?

MR. GILMORE. Mr. Gilmore.

JUSTICE VASQUEZ. Mr. Gilmore, I heard you say there were about four or five candidate sites that you studied?

MR. GILMORE. That is correct.

JUSTICE VASQUEZ. Now, these sites, these candidate sites, were they chosen by you or by somebody else?

MR. TORRES. Mr. Chairman.

THE CHAIRMAN. Mr. Torres.

MR. TORRES. May I attempt to assist the questioning here? I think, to answer directly the question of the Commissioner, EBASCO was hired after the NPC had already chosen a site which was Bagac.

The services that were required of EBASCO would be to use this site to develop or proceed with the necessary investigations and come up with the required site characteristics that we have to define in the safety document we must submit.

In the process, EBASCO early enough had some findings which made them conclude that it would be prudent and not only necessary but also advisable that we do not end up with Bagac but to broaden the investigation while the opportunity still existed of investigating other areas in the vicinity because of problems that were already being manifested by the intensive investigation that proceeded.

This is how the studies of other points in the general area like Mapalan point, Napot, Saysayin came about.

The National Power Corporation accepted the recommendation of EBASCO to do a broadened site investigation which was not limited to Cabayo point in Bagac. And this is why we ended up with Napot point.

JUSTICE VASQUEZ. I think you still misunderstand what I am trying to drive at. This is the difference

between technical men and laymen like ourselves.

MR. TORRES. I am sorry.

JUSTICE VASQUEZ. Let me put it in another way. Maybe we can go to what I really wanted to arrive at. EDASCO had no say in comparing the Bagac site area -- that would include all of those points mentioned -- with other sites, for example, a site in Cagayan Valley, or in Central Luzon, or in the Bicol area. You have nothing to say about that?

MR. GILMORE. We were not involved in that.

JUSTICE VASQUEZ. You were merely told to see if the site previously selected by NPC was good enough for a reactor plant. Is that correct?

MR. GILMORE. In a sense, yes, sir.

JUSTICE VASQUEZ. And were you free to tell them, if your investigation will so determine the existence of certain defects of the site, "Don't put it there." Or, were you only supposed to indicate in what particular place in the area you were supposed to examine the plant should be put up?

MR. GILMORE. We were free to make recommendations, yes. And in fact, we did.

JUSTICE VASQUEZ. To reject the entire area?

MR. GILMORE. No, we did not make that recommendation.

JUSTICE VASQUEZ. I mean, you could have told them that.

MR. GILMORE. We could have, yes.

JUSTICE VASQUEZ. And you came up with the finding that the site was good enough if you would put it at Napot point?

MR. GILMORE. We found thru our work that the site was the site defined, as you are defining it; and of all the points in the area it was most likely the best site in the Philippines.

JUSTICE VASQUEZ. The best site in the Philippines or the best site in the Bagac area?

MR. GILMORE. The best site in Luzon.

JUSTICE VASQUEZ. How can you say that when you did not examine the other places?

MR. GILMORE. This is on the basis of qualitative considerations. You will remember yesterday when I was describing the work of the earlier investigators, it was on a qualitative basis. Preliminary phases of siting investigation are done on the basis of available information and jugment and experience.

As an example, the Atimonan site is located very near to the Philippine fault. It does not require very much research of the literature to learn that the Philippine fault is one of the major tectonic structures of the world and very, very active in a seismic sense. Consequently, an engineer experienced in siting would never consider location of a nuclear power plant in an area like that.

JUSTICE VASQUEZ. But did you not say that you only

examined the Bagac area? What could be the basis of your comparison between the Bagac area and the four or five other sites that you are mentioning?

MR. GILMORE. It is related to the regulations of the US NRC, particularly Appendix A to 10-C FR 100.

In studying a nuclear power plant site, one, in point of fact, actually has to study the various levels of depth. An area having a radius of 200 kilometers centered on the site...

JUSTICE VASQUEZ. Let me interrupt, Mr. Gilmore. Your finding as to the Bagac area was because you or your staff actually examined that area. In other words, it is first hand knowledge. Now, your evaluation of the other sites was based on data not secured by your men but from the studies of other people. Is that correct? That is the impression I get.

MR. GILMORE. Much of the data available in the early phases was available from other people also -- in the case of the EBASCO studies. I am not trying to be difficult.

JUSTICE VASQUEZ. I only wish you could meet me head on with the questions that I am asking so we will be saving a lot of time, I am sure, Mr. Gilmore.

MR. GILMORE. We had significant literature, technical literature, available for all of the Philippine area in a radius of 200 kilometers centered on Bagac. That included all of the site areas; so, we did know

quite a bit about them.

We concluded on the basis of that review of the previous work that the Bagac area was, in fact, a very suitable location for siting a nuclear power plant. It is true that we did not drill holes or excavate trenches or pits at the other site areas. But that is not necessarily required in the early phases of siting investigation.

JUSTICE VASQUEZ. Now, when you recommended the Bagac site, was it because you think it was good enough or there is no better site in the Philippines?

MR. GILMORE. We believe that the Bagac site, as per your definition, is the most suitable site that has been identified in Luzon or, with all things being considered, for the development of a nuclear power plant project.

JUSTICE VASQUEZ. How could you say it is the best in Luzon when you did not examine any other site?

MR. GILMORE. May I refer to Exhibit "14-NPC," which is the colored photograph, as an example of a seismic risk analysis. That diagram, although not available at the time of the site studies in the detail that it is presently available, was generally available. And reference to Exhibit "14-NPC" will show that with respect to seismisity, we were quite knowledgeable concerning the seismic activity in Luzon. The same

could be said for other types of geologic knowledge.

In studying a site, Mr. Commissioner, you don't just study the site. You have to study the region in which the site is located so that you can understand adequately and completely the problems that might be associated with developing the site.

MR. GILMORE. ... developing the site.

JUSTICE VASQUEZ. Were you made to understand that the site must be within a certain distance from Manila?

MR. GILMORE. That was their stipulation.

JUSTICE VASQUEZ. In your study of the areas in the Philippines as to their - I cannot use the term that you are using - as to their possibility of being affected by earthquakes or volcanic activity, did you not find any other place in Luzon which is not as prone to be subjected to such activities compared to Bagac?

MR. GILMORE. As shown on Exhibit "14-NPC", there is an area of relatively light seismic activity located in northern Luzon, if that is the question you are asking. With the exception of that general area, all other areas in Luzon are much more active in seismic terms.

JUSTICE VASQUEZ. That is quite far from Manila?

MR. GILMORE. It is quite far from Manila, yes, and in an engineering sense, one has to consider where the power that will be generated is to be used.

JUSTICE VASQUEZ. In short, the plant must be somewhere near Manila for certain economic reasons?

MR. GILMORE. The Plant or a power plant would normally be located with respect to the power distribution system of the utility. It has to be located somewhere where it can be tied into the distribution network.

JUSTICE VASQUEZ. And of the places around Manila and near enough to Manila, Bataan is about the best?

MR. GILMORE. I am not sure I understand your geographical definition of "within the vicinity" or near to Manila".

JUSTICE VASQUEZ. Well, in a radius around Manila, as far as Bagac is to Manila.

MR. GILMORE. I would agree with what your statement is.

JUSTICE VASQUEZ. So, you have to take Bagac as is, with all its advantages and disadvantages; with all its volcanic possibilities; with all the faults lying in the ocean floor and other hazards?

MR. GILMORE. I have tried to explain that the hazards, the faults in the ocean floor, we are well aware of them. In fact, we located one of them during the study, the Manila fracture belt that have not previously been identified by anyone. All those faults, I have had associated with them, major earthquakes on a postulated risk and the acceleration/~~values~~ valuation that have been derived for design of the plant are based on the existence of the faults.

JUSTICE VASQUEZ. I will simplify the question. If the plant will have to be established around Manila or in the radius equivalent to the distance from Manila to Bagac, the only possible place, or I would say the best site would be Bagac?

MR. GILMORE. Yes, Sir.

THE CHAIRMAN. Atty. Ilao, you wish to say something?

ATTY. ILAO. Mr. Chairman, may we request for a suspension of five minutes because we would like to confer with Dr. Gilmore. I think he is all confused by the questions of Justice Vasquez.

THE CHAIRMAN. Session is suspended for five minutes.

It was 10:05 a.m.

RESUMPTION OF SESSION

At 10:11, the session was resumed.

THE CHAIRMAN. Session is resumed.

ATTY. ARROYO. Mr. Chairman.

THE CHAIRMAN. Yes, Atty. Arroyo.

ATTY. ARROYO. We just want to make this observation, namely, after the recess was called, Mr. Gilmore was surrounded by the NPC staff, NPC lawyers and they conferred. We thought there was a ruling here established in the case of Westinghouse, that when an expert testifies, he may not confer.

THE CHAIRMAN. That was the rule at the request of the Tañada Panel while they were cross-examining. Now, at this stage, it is the Commission that is asking the interpellation and we are taking the same view that Senator Tañada originally took in the beginning. If you will recall, in the beginning when there were dissertation, the original attitude of Senator Tañada was, they could confer -- anyone could answer because the only thing that they are after is the truth. You may set your own rules when you make your interpellation.

ATTY. ARROYO. No, we are not asking.... except that we thought that the understanding was, if a witness is unable to answer questions, then he may refer it to another witness, which we have no objection.

THE CHAIRMAN. Let us have the NPC panel make their own reply to the statement of Atty. Arroyo.

ATTY. ILAO. Mr. Chairman, this representation asked for the suspension of the hearing purposely to acquaint Dr. Gilmore of the nature of the proceedings and the way it should be answered. The NPC Panel just gave him the direction to which we believe that Justice Vasquez was leading to and no more.

THE CHAIRMAN. Any further remark from Atty. Arroyo?

ATTY. ARROYO. No remarks, Sir.

THE CHAIRMAN. We may proceed now with the interpellation. Is there a pending question or do you want to rephrase it, Justice Vasquez.

JUSTICE VASQUEZ. I think I have already been clarified enough. I have no more questions unless Mr. Gilmore would like to clarify himself.

MR. GILMORE. Atty. Ilao basically told me to stop acting as an engineer and just say "yes" or "no" as much as possible. I trust that I have clarified that you understand my answer, Mr. Justice.

THE CHAIRMAN. Further questions from Justice Bautista?

JUSTICE BAUTISTA. Just one question. If my memory serves me

right, I read from the newspaper about the time that this feasibility study of the site is being made that San Juan, Batangas is one of the candidate sites of the nuclear plant. The people of San Juan, Batangas objected to the construction of the site there. Now, Mr. Gilmore, during the time that you were conducting your studies, did this news item come to your attention?

MR. GILMORE. San Juan, Batangas?

JUSTICE BAUTISTA. Yes, that the people there did not like to have the plant constructed there.

MR. GILMORE. That was not brought to my attention.

JUSTICE BAUTISTA. Now, I will give you a last chance to answer what seems to be confusing your mind. The question is, since you did not make an actual study or ocular inspection of other places in the Luzon island where to construct the site, what could have been your basis in stating that this Napot point or Bagac site is the most acceptable among the candidate sites?

MR. GILMORE. Starting in 1965, local and international responsible agencies identified various candidate sites and concluded that the Bagac area as the most suitable. Therefore, other candidate areas in the Philippines must be less suitable. In the Bagac area, our work satisfied EBASCO that the Napot point site is the best area in the Bagac area. Consequently, for purposes of this study, the Napot point site must be concluded to be the best site in Luzon.

JUSTICE BAUTISTA. When you said you studied it, what reference is that to this document that you submitted, this Exhibit "16-NPC"?

MR. GILMORE. Our studies could be described starting on page 12 under "Phase 5-A". Essentially, from that point to the end of the paper, there is a description of the work that EBASCO performed.

JUSTICE BAUTISTA. That will be all.

THE CHAIRMAN. Do you have any concluding statement, Mr. Gilmore?

MR. GILMORE. I do have the slides of the rivers that you have requested, Mr. Chairman. I could show them to you.

THE CHAIRMAN. May we have them. You mean they are slides, not documents?

MR. GILMORE. They are slides.

THE CHAIRMAN. This was in answer to the question of Justice Bautista?

MR. GILMORE. That is correct. You asked for the slides; we have them here.

THE CHAIRMAN. Very well.

(First picture was flashed.)

MR. GILMORE. This is a photograph of the first exploratory drill hole by the National Power Corporation which was located at the central line of the containment building for PNPP-1.

THE CHAIRMAN. Mark this as Exhibit "23-NPC". Please give Justice Bautista time to interprot while each figure is flashed on

the screen before you go to another figure.

JUSTICE BAUTISTA. This photograph has connection to the question of the Commission on the two rivers?

MR. GILMORE. It is the two rivers and the ground water that we were discussing.

JUSTICE BAUTISTA. You may proceed and identify whether the river mentioned in the question of the Commission is reflected in that photograph.

MR. GILMORE. Unfortunately, one of the rivers is to the right, the other is to the left. They are not specifically included in the photograph.

JUSTICE BAUTISTA. You may proceed.

(Another picture was flashed.)

THE CHAIRMAN. Mark this picture as Exhibit "24-NPC". Will you please describe it for the record, Mr. Gilmore.

MR. GILMORE. This is a photograph taken looking upstream of what I believe would be the Kabayo river during the non-monsoon season.

THE CHAIRMAN. Is that a bridge?

MR. GILMORE. That is a bridge crossing the river leading to the office area of the National Power Corporation.

THE CHAIRMAN. Justice Bautista, any question?

JUSTICE BAUTISTA. And that is the bridge constructed by NPC?

MR. GILMORE. That is the bridge constructed by NPC.

JUSTICE BAUTISTA. What was the necessity of constructing the bridge when the site has not yet been selected as the most suitable site?

MR. GILMORE. The offices I am referring to, Justice, were the field offices. They were not permanent type of office facilities you may have seen during your field inspection. They were located by the NPC for what reason I do not know.

JUSTICE BAUTISTA. How big is this river reflected just behind that bridge?

MR. GILMORE. You mean the width?

JUSTICE BAUTISTA. The width. Are they big rivers?

MR. GILMORE. Not really very, very large - average size during the dry season.

JUSTICE BAUTISTA. Did you say the presence of these rivers would be disadvantageous for the wise selection of the site?

MR. GILMORE. I didn't catch all of the questions, Mr. Justice.

JUSTICE BAUTISTA. You said before that the presence of these two rivers do not add to the feasibility of choosing Bagac I as the site.

MR. GILMORE. That is correct.

JUSTICE BAUTISTA. Will you elucidate why, since the water supplied by these two rivers can help the project from a layman's point of view.

MR. GILMORE. May I elucidate by going to the next slide and then come back to this slide?

JUSTICE BAUTISTA. You may.

(Another picture was flashed.)

THE CHAIRMAN. Mark this as Exhibit "25-NPC". That is very obscure. Can we have some more light on that or is that how the photograph is?

MR. GILMORE. I believe that is how the slide is.

THE CHAIRMAN. Very well. Justice Bautista.

JUSTICE BAUTISTA. One of the factors mentioned in this Table I of Exhibit "16-B" is the presence of ground water - surface and ground water. Did that not include the presence of rivers?

MR. GILMORE. Yes, it included the presence of rivers.

JUSTICE BAUTISTA. And, therefore, the presence of a river is a factor in the selection of the site; it is a good factor; favorable to the selection of the site.

MR. GILMORE. I was attempting to answer your earlier question by showing this slide, Mr. Justice. This photograph is also taken from the bridge looking upstream to the Kabayo river showing the Kabayo river in flood during the monsoon season. What you recollect having seen earlier is a relatively small stream carrying approximately one cubic foot water per second or in the order of 500 gallons per minute in the dry season. During the monsoon, they are a very

much larger stream, carrying very large quantities of water.

JUSTICE BAUTISTA. That will be all, Mr. Chairman.

THE CHAIRMAN. Are those all the slides or you have others?

MR. GILMORE. I have two more.

THE CHAIRMAN. Go to the next slide. (Another picture was flashed.) Mark it as Exhibit "26-NPC".

JUSTICE BAUTISTA. What is depicted on that?

MR. GILMORE. This is a photograph taken from the same bridge looking downstream along the Kabayo river during the dry season.

JUSTICE BAUTISTA. How deep is this water level from the area above?

MR. GILMORE. It is very shallow. In fact, you can see to the right of the picture one of the local people working on the maintenance of his irrigation diversion scheme near the water.

JUSTICE BAUTISTA. Are there some more slides that you brought?

MR. GILMORE. There is one more. (Another picture was flashed.)

THE CHAIRMAN. Mark that as Exhibit "27-NPC".

MR. GILMORE. This is a photograph of the same spot on the same bridge looking downstream during the monsoon season.

JUSTICE BAUTISTA. What is represented here?

MR. GILMORE. This is a flood, tremendous amounts of water going towards the original site area.

JUSTICE BAUTISTA. That is all.

THE CHAIRMAN. Justice Vasquez, any question?

JUSTICE VASQUEZ. None.

THE CHAIRMAN. Next slide.

MR. GILMORE. The next slide is with reference to the ground water that you questioned.

THE CHAIRMAN. Mark this as Exhibit "28-NPC".

MR. GILMORE. This is a slide showing the first test-pit that was excavated in the original site area by the National Power Corporation. You will observe the alluvio material, unconsolidated alluvio materials that are referred to as the four-foundation materials and you will note that the pit is full of water. That is the ground water I was referring to.

THE CHAIRMAN. You said, Mr. Gilmore, that you were going back to another slide in relation to one of the questions of Justice Bautista?

MR. GILMORE. Justice Bautista has asked about the ground water. I can return to the first slide.

THE CHAIRMAN. We are now back to Exhibit "23-NPC".

MR. GILMORE. This is a slide showing the complete exploratory drilling, the first exploratory drilling which was located at the central line of the reactor building for the originally laid out power plant site. You will see that the hole is making water, I mentioned earlier, under pressure, at high temperatures and at large

quantities. You will also note that the gentlemen standing there - one of them a member of the NPC, one from EBASCO - are basically standing in water.

JUSTICE BAUTISTA. This drilling was made at the Napot point site already?

MR. GILMORE. No, this was made at the original Bagac site shown on Figure 3 of Exhibit "16-NPC".

JUSTICE BAUTISTA. And in spite of the finding that the facility of water is good, you did not select the site?

MR. GILMORE. Water can be good, Mr. Justice; it can also be bad. It is a servant of man just as is fire.

JUSTICE BAUTISTA. In this particular case, will you elucidate why this existence of good water, plentiful water would be bad for the site?

MR. GILMORE. It is related to constructability.

MR. GILMORE. It's related to constructibility. The construction of a major facility, such as a nuclear power plant, is an undertaking that takes years and would require the construction to proceed during several monsoon seasons.

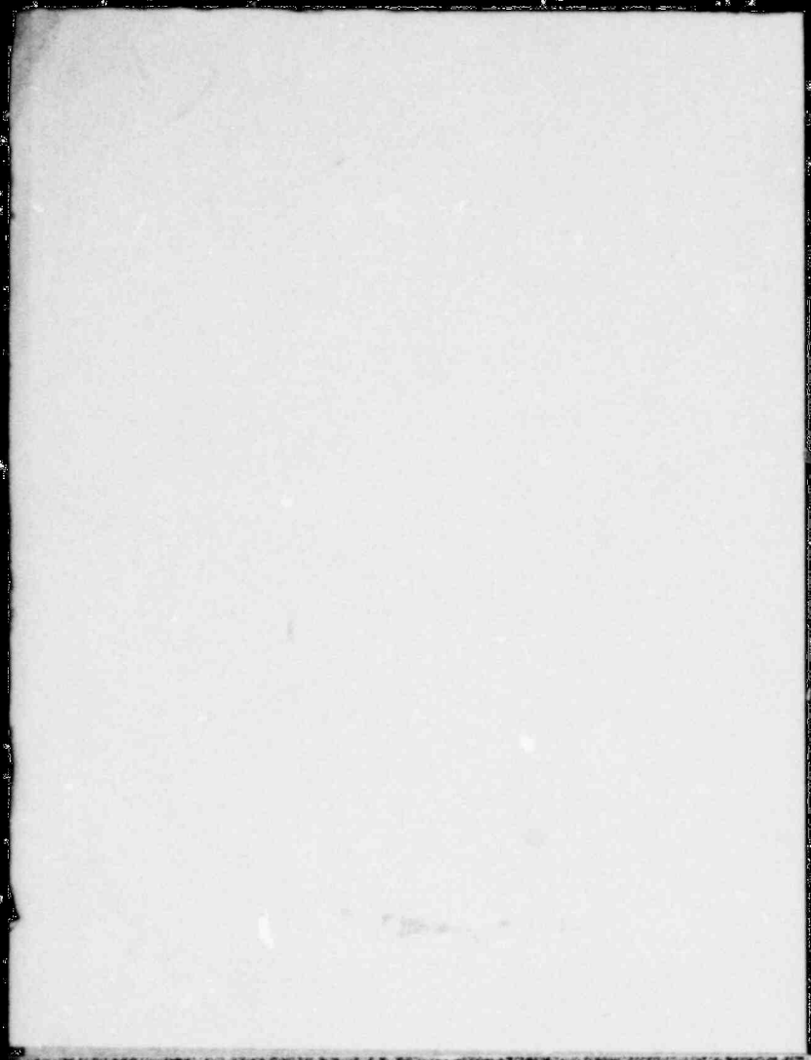
Consequently, the construction site would have been exposed to the flooding of the type that you saw on the slides, particularly, the one downstream of the bridge.

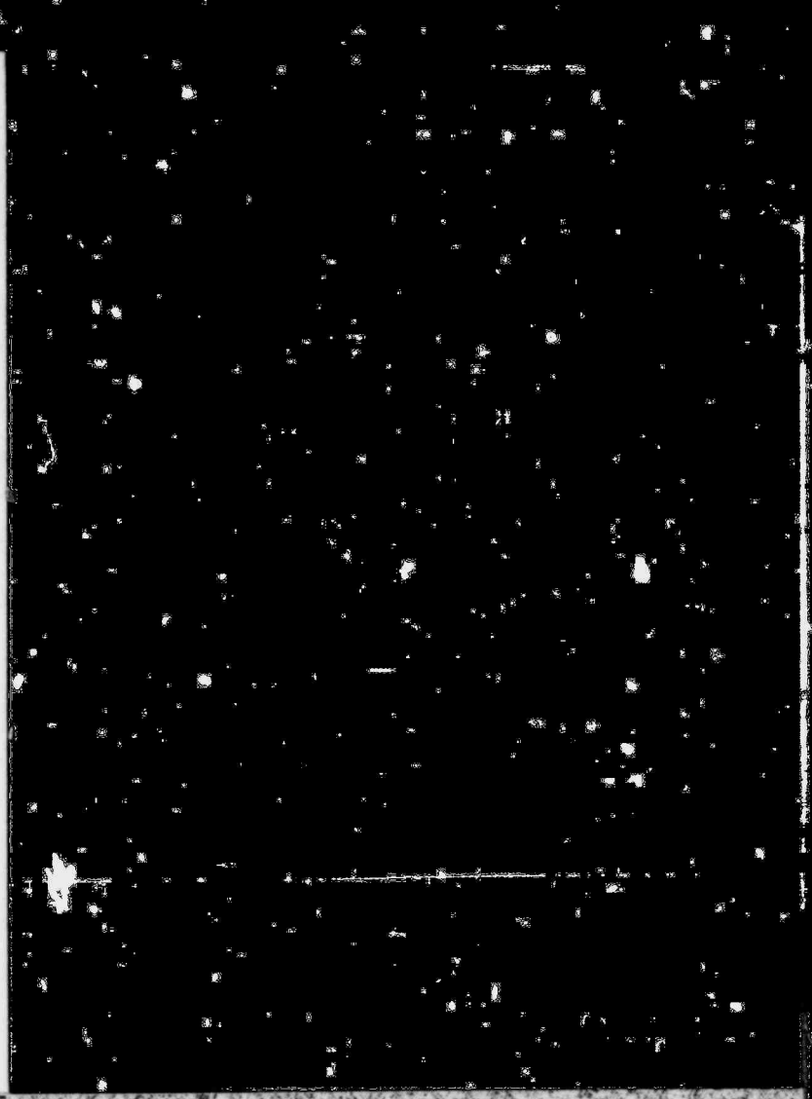
In addition, the existence of the types of material shown in the slide of the test pit, when saturated, is very unstable. In addition, the water shown in the pit would have to be removed from the excavation area down to a level some 20 meters -- actually more than 20 meters -- below the existing grade to permit the construction work to proceed.

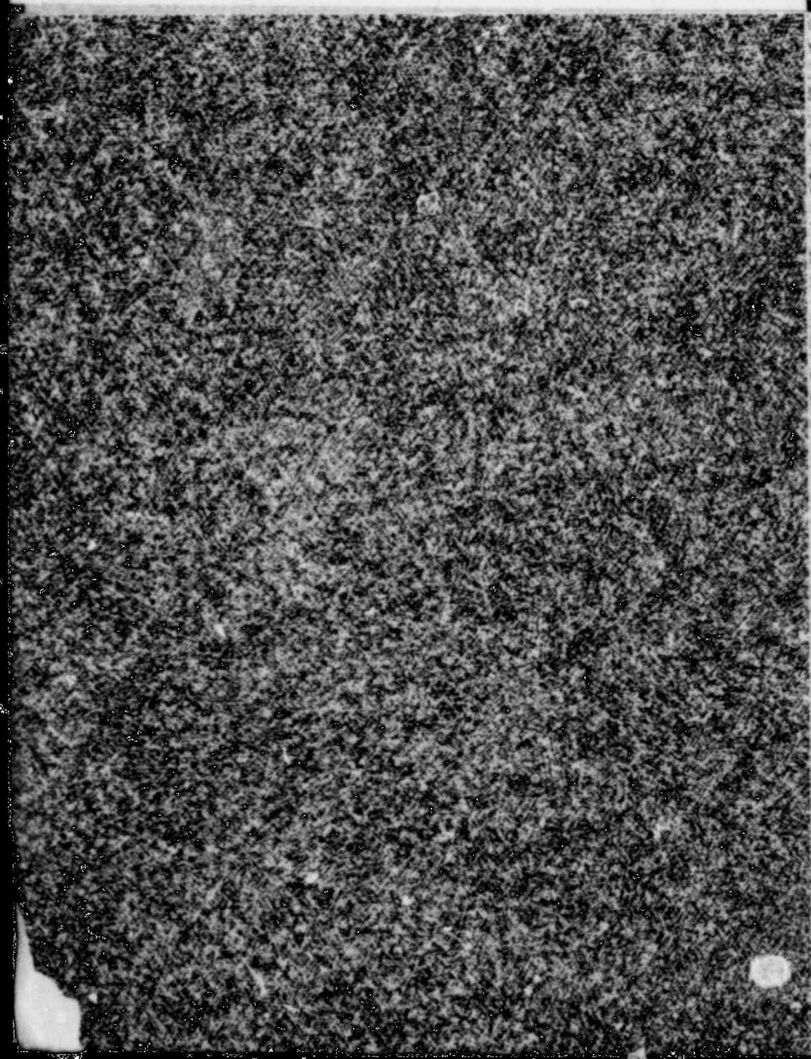
THE CHAIRMAN. No more questions, Justice Vasquez? You are excused Mr. Gilmore.

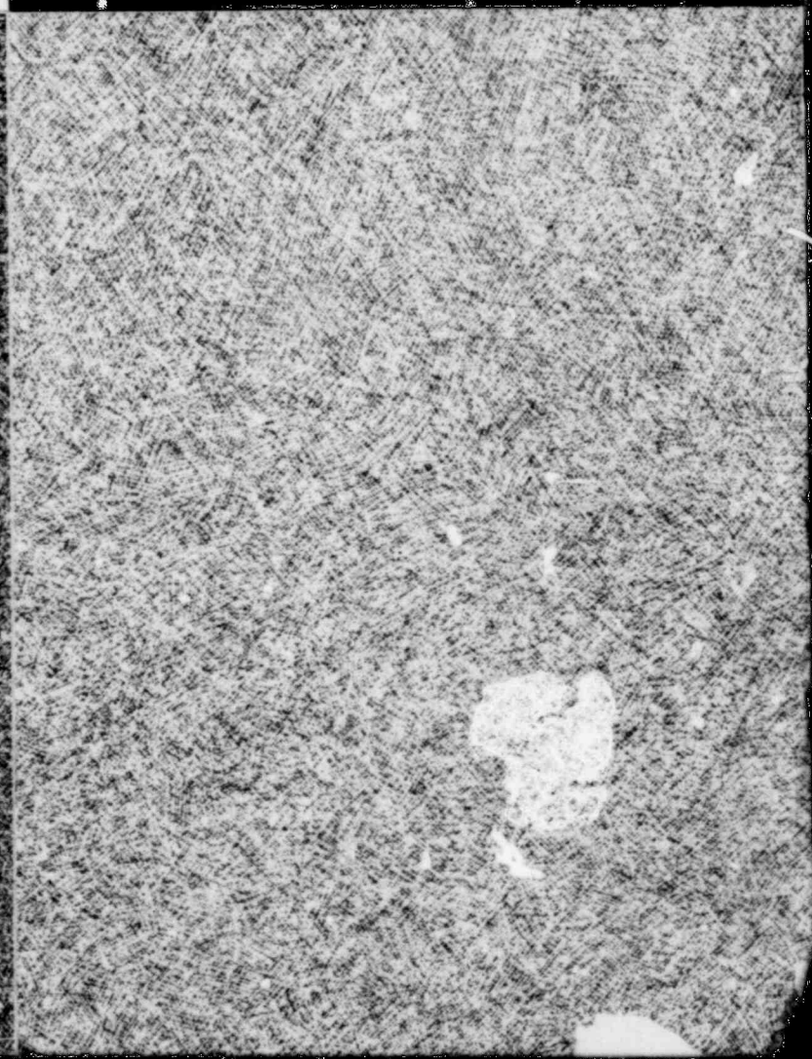
May we have Mr. Healy. May we inquire if the charts and pictures of yesterday have already been reproduced?

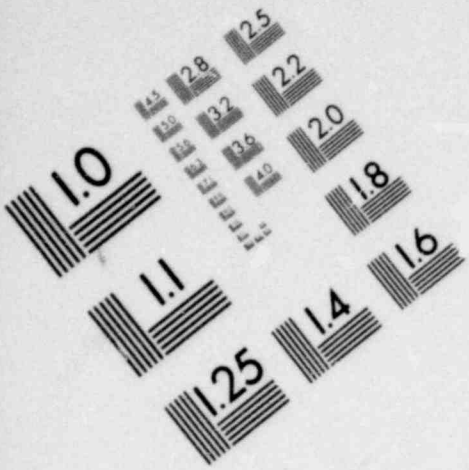
MR. HEALY. Mr. Commissioner, the charts have not been reproduced. We intend to take them to the reproduction facility following the session today and the reason that we haven't taken them yet, is, we thought in the interpellation that you might wish to go back to some of the exhibits and we wanted to have them here.

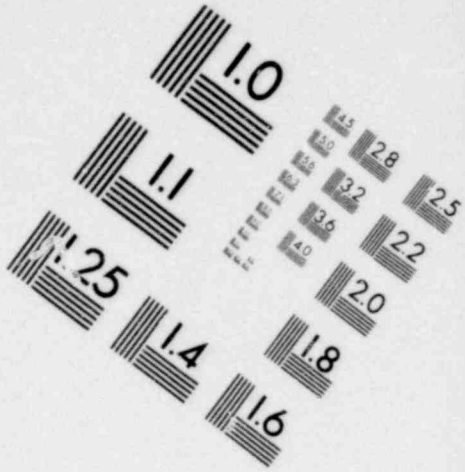












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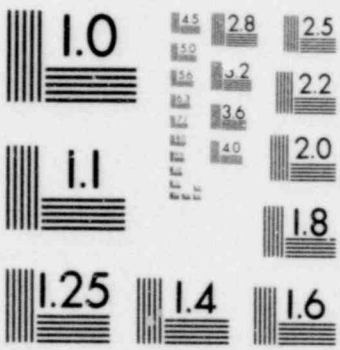

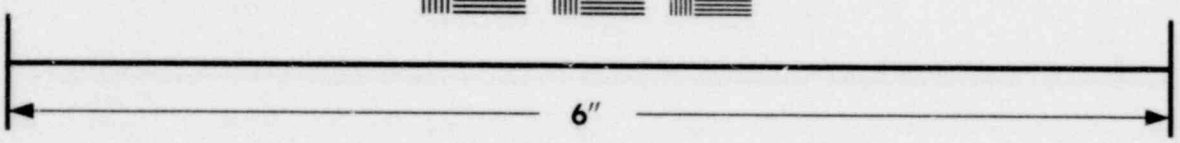

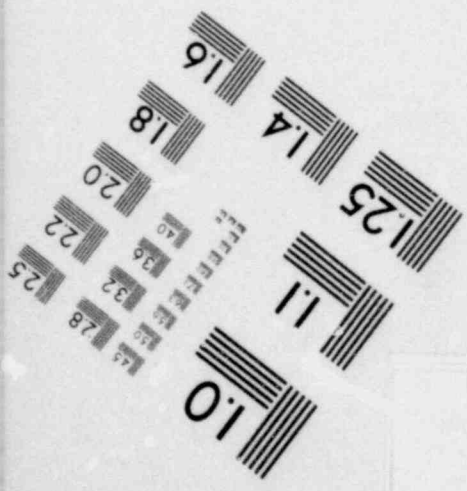

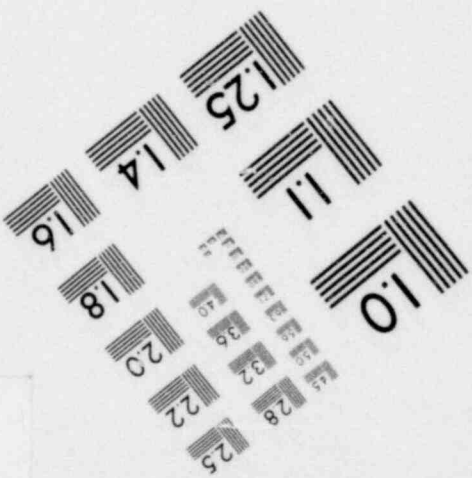

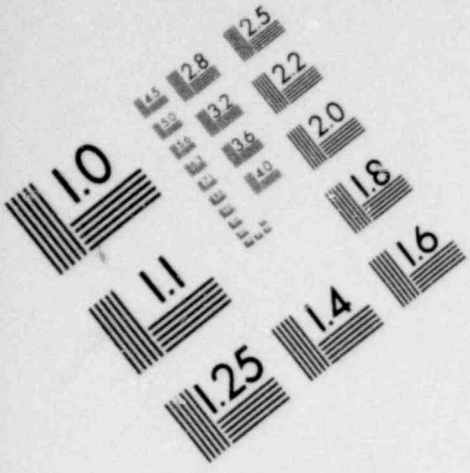

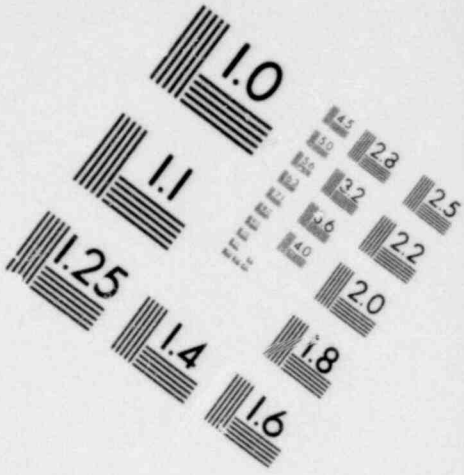

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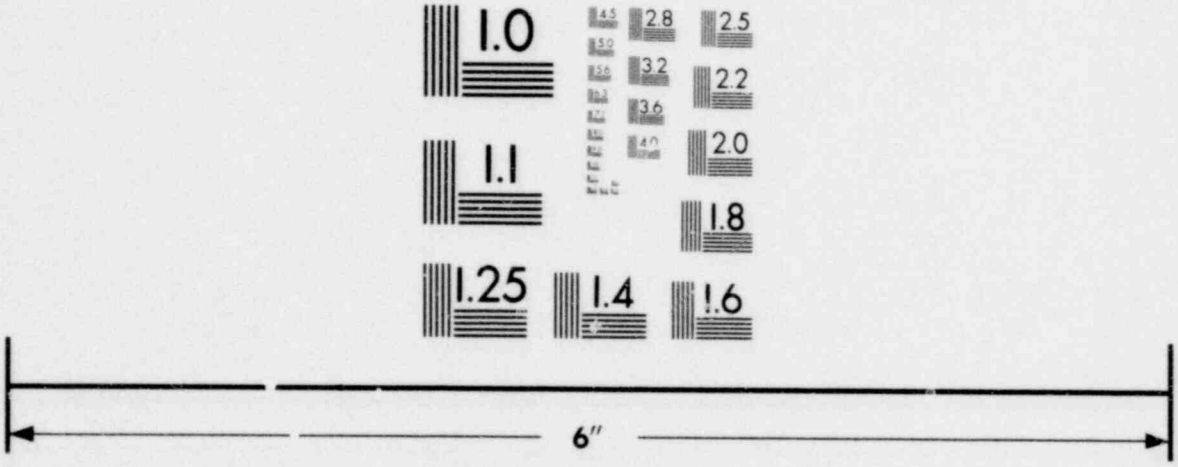
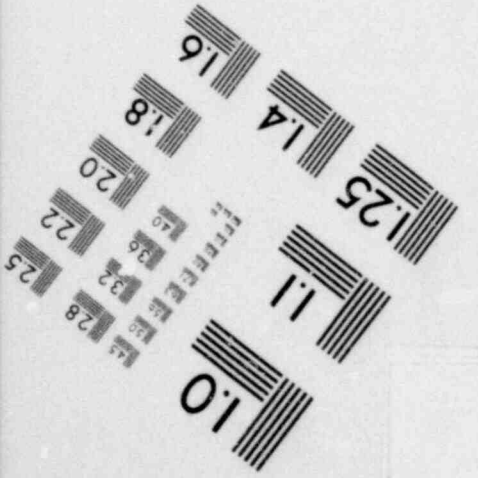
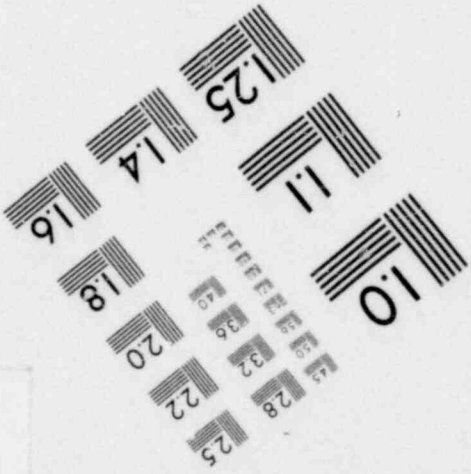
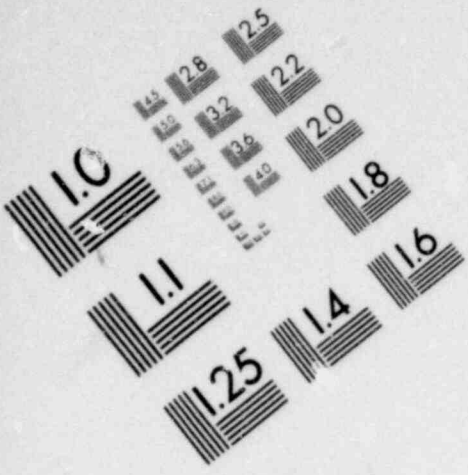








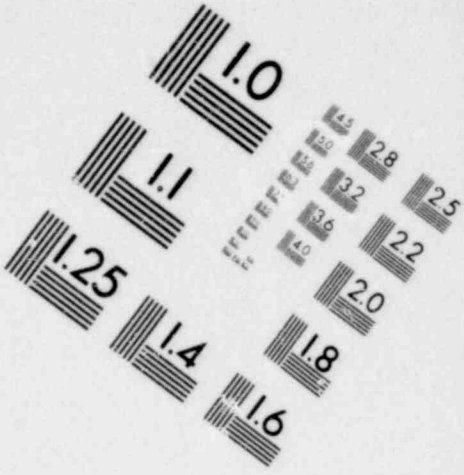
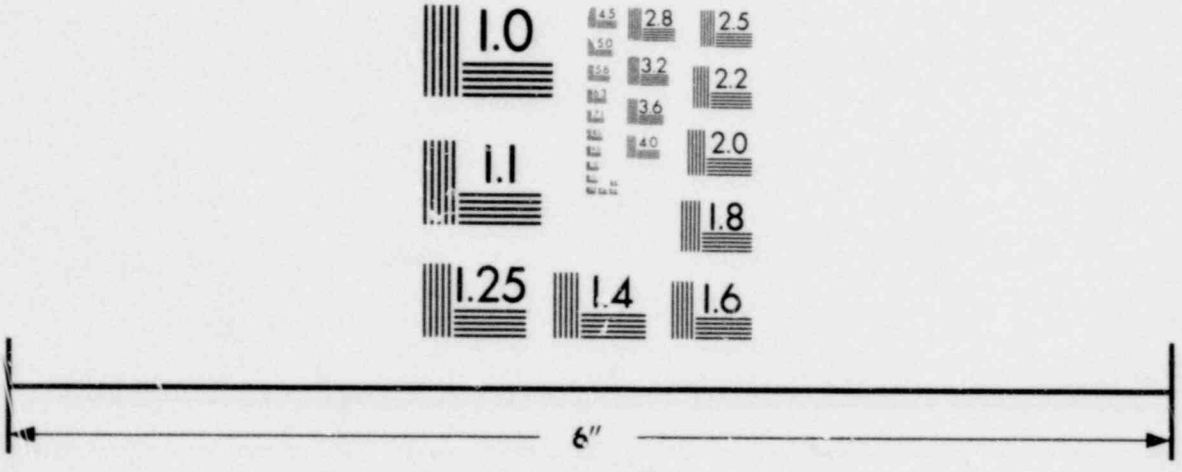
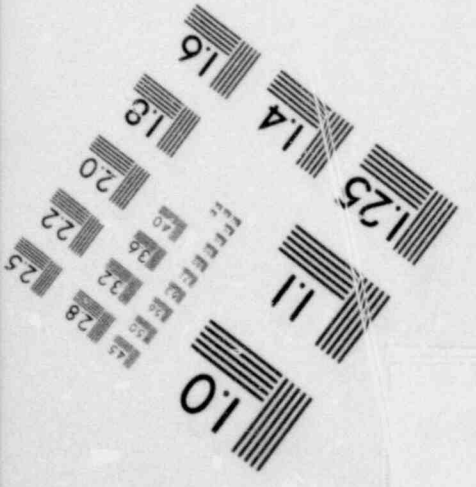
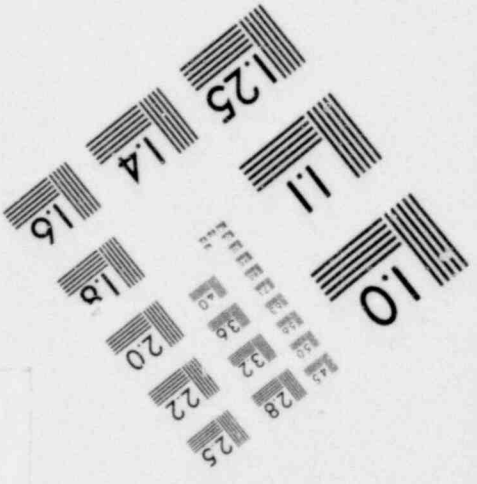


IMAGE EVALUATION
TEST TARGET (MT-3)







THE CHAIRMAN. You are going to dwell on question No. 7?

MR. HEALY. Yes, Mr. Commissioner. With your indulgence, Mr. Tilford is prepared to handle that question.

THE CHAIRMAN. Who is he?

MR. HEALY. Mr. Tilford.

THE CHAIRMAN. Oh, fine. We call MR. Tilford back to the rostrum.

MR. HEALY. Thank you.

THE CHAIRMAN. Proceed.

MR. TILFORD. I will try to honor the Commission's wish for brevity.

The historical earthquakes in the site region were examined to determine the seismic design basis for the nuclear plant site. We have used the early data, which we have mentioned earlier is unusual in the world, showing that you have a very long earthquake history, counting to some 400 years stretching back to the late 1500s, early 1600s. We have used all of that historical information in developing the seismic design basis.

We have also used all of the available instrumentally recorded data and we have included all of that data in our earthquake catalogue.

Basically, we concur with the list of locally felt earthquakes reported to you by the PAGASA response to the question to the extent that if there is any difference

between the list that they have given you within the last few days and the one which we have submitted to you, it is because of a definition.

We have listed only those which were listed as having been felt in Bataan and reported from Bataan or they have included a few events which were not specifically reported from Bataan but which could reasonably be expected to have been felt in Bataan and we concur in that approach as well.

Basically, the history of earthquakes in the particular site of this plant is very slight. The Bataan peninsula occupies what almost might be described as a window, an open space, in the historical record of seismicity in Central Luzon and is almost unique in Central Luzon in that aspect.

There have been very few earthquakes which have created any destruction on Bataan. Let me read you very quickly the description of the worst of those which we considered to be the 1852 earthquake of September 10th.

The report states that Balanga suffered considerably. The royal house had some cracks and fractures. The church tower and turret roof of Orion were ruined. The entire roof, the choir, and part of the tower of the church of Orani were down. The churches and parish houses of Abucay, Pilar, Mariveles and Balanga suffered considerable loss.

Our comment with respect to that report is that we believe that a great majority of the damage occurred because the structures were founded on soft mud and sand associated with Manila Bay. The nuclear plant is, of course, on the other side of the peninsula on hard competent rock.

I would conclude my remarks in the interest of brevity at that point and be happy to try to address any questions of the Commission.

THE CHAIRMAN. Questions by Justice Vasquez?

JUSTICE VASQUEZ. I have no other question.

THE CHAIRMAN. Questions from Justice Bautista?

JUSTICE BAUTISTA. No questions.

THE CHAIRMAN. Mr. Tilford, where did you get your materials relative to your response to Question No. 7?

MR. TILFORD. The information available on the earthquake history of the region comes primarily from the catalogue of Raffety and the subsequent catalogue, I believe, of Sobia and others, prepared by local people, primarily from records of the church.

That record begins, I think, with the first entry, which is 1599 or 1600, and is complete through the early part of this century.

Instrumentally recorded earthquakes are available from the US National Ocean and Atmospheric Administration tape files. We relied on that file a good deal in

developing the instrumental history, instrumentally recorded history.

We have also consulted with Fr. Sue in the Manila Observatory. We consulted with, of course, the PAGASA. We have consulted the catalogues of ISC and we have used some data that have recently become available from the Russian observatories for earthquakes recorded after about 1954.

I believe our earthquake catalogue is agreed by all to be a completely comprehensive one.

THE CHAIRMAN. Do you have copy of that catalogue?

MR. TILFORD. Yes, sir. The catalogue is contained in the Preliminary Safety Analysis Report. I believe it is volume VII.

THE CHAIRMAN. Already submitted?

MR. TILFORD. No, sir. In the sense that the entire Preliminary Safety Anlysis Report has not been submitted, that part of it has not. We can certainly have it available to you.

THE CHAIRMAN. When may we have this? We would like, Mr. Tilford, to have the documents -- either xeroxed copies thereof or whatever manuscripts you can supply this Commission for our guidance. Is that possible?

MR. TILFORD. We will supply you with Sections 2.1, 2.5, .1.1 of the PSAR which contains the entire discussion of the seismic design basis for the project.

In addition to that, we will supply you with the appropriate appendix containing our earthquake catalogue. Yes, sir. And that should be available to you by this afternoon. It surely can be available to you easily by Monday morning.

THE CHAIRMAN. Please present those so that we can mark them in evidence. No more questions?

ATTY. ARROYO. Mr. Commissioner.

THE CHAIRMAN. Just a moment. At this stage, before we declare another recess. After the continuation of our proceedings, we will commence with the last stages of the interpellation of Mr. Simmons.

We note that the adverse position paper of the Tañada Panel to the NPC and PAEC position papers has already been submitted. After the Westinghouse Panel has been questioned, if there is still time, we will begin with the elaboration of the NPC and PAEC Panels in the light of Tañada adverse position paper. We will declare a recess for ten minutes.

ATTY. ARROYO. Just a little clarification with respect to Mr. Tilford. It has nothing to do with this dissertation.

THE CHAIRMAN. Yes.

ATTY. ARROYO. With the permission of the Chairman, I would just like to ask Mr. Tilford whether he said that the Preliminary Safety Analysis Report, Chapter VII, has not yet been submitted.

MR. TILFORD. Not Chapter VII, Volume VII. But I said that to the best of my knowledge the Preliminary Safety Analysis Report has not been submitted to the Commission.

ATTY. ARROYO. has not been submitted. Thank you.

THE CHAIRMAN. To the Commission.

ATTY. ARROYO. No, no, to PAEC. I think, I am asking about PAEC.

MR. TILFORD. Oh, no. It was submitted to PAEC as one of a long series of reports that was submitted in July of 1977.

ATTY. ARROYO. Including Chapter VII?

MR. TILFORD. Including Chapter VII, yes.

SUSPENSION OF SESSION

THE CHAIRMAN. Is the procedure for the rest of the morning clear?

We declare a recess for ten minutes.

It was 10:40 a.m.

RESUMPTION OF SESSION

At 10:55 a.m., the session was resumed.

THE CHAIRMAN. The session is resumed.

Mr. Simmons, you may sit down. The Tañada Panel is not yet in the session hall.

(After a few minutes.) The Senator is coming.

Mr. Simmons, please take the stand.

JUSTICE VASQUEZ. Before the continuation of the interpellation, may I ask a few questions to Mr. Simmons?

THE CHAIRMAN. Yes. Proceed, Justice.

JUSTICE VASQUEZ. I just want to clarify this point about the hydrogen recombiner mentioned by Mr. Simmons in his paper marked as Exhibit "F". ...

JUSTICE VASQUEZ. Before the continuation of the interpellation, may I ask a few questions to Mr. Simmons?

THE CHAIRMAN. Yes. Proceed, Justice.

JUSTICE VASQUEZ. I just want to clarify this point at ut the hydrogen recombiner mentioned by Mr. Simmons in his paper marked as Exhibit "F"...

asking for further information in that regard, is difficult for us to understand, but if in the opinion of the Commission, it is important, our men will stay.

THE CHAIRMAN. Just a moment. (Conferring with the two members of the Commission) Senator Tañada, can you terminate this in about a day, on Monday? We will give you the entire afternoon on MOnday.

MR. TAÑADA. Possibly, Mr. Chairman. But certainly, I would like to inform Mr. Cronin that all my questions were based on their own statement because we cannot accept their statement on their face value.

THE CHAIRMAN. On MOnday then, we will begin from 1:00 until 5:00 for the continuation of the Tañada interpellation. The Chair would like to request that all the parties remain for a few minutes after we adjourn this hearing, to pick up their copies of three-rows resolution that the Commission has promulgated, one of which resolution deals with the motion to suspend the hearing filed by Attorneys Arroyo and Tañada.

We also would like to remind the BASCO Panel that in all probability, the questions on 5, 6, and 7 will be commenced on Wednesday, at which time we expect the Tañada adverse position paper to be submitted. That the NPC and PAEC Panels will be expected to present their position papers at the termination of the Tañada interpellations of the Westinghouse, which will either be on Monday, if Atty. Tañada finishes early or on Tuesday.