

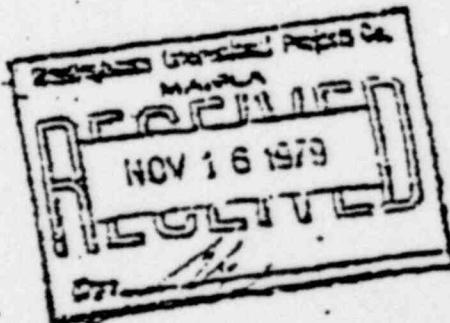
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REPUBLIC OF THE PHILIPPINES  
Commission on Nuclear Reactor Plants  
Metro Manila

In Re: Inquiry on the Safety  
to the Public of the  
Bataan Nuclear Plant  
(Per Exec. Order No. 539, June 15, 1979)

REPORT OF THE COMMISSION



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#### B. SUMMATION

P R E F A C E

The subject of the present inquiry, the Philippine Nuclear Power Plant 1, is under construction at Napot Point in the municipality of Morong, Bataan, by the Westinghouse International Projects Company for the operator.

The National Power Corporation, under the supervision of the Philippine Atomic Energy Commission as the regulatory body concerned under Republic Act No. 5207 as amended and other related laws, rules and regulations.

Construction commenced in 1977. While the work was in progress, an accident occurred at the Three-Mile Island Nuclear Plant in Harrisburg, Pennsylvania, U.S.A., on March 28, 1979.

On the basis of a letter dated May 10, 1979 sent to Ex-Senator Lorenzo Tañada by Mr. Augusto Almeda Lopez, a Filipino resident at Harrisburg, Pennsylvania, former Senator Tañada addressed a letter dated June 14, 1979 to President Ferdinand E. Marcos asking, among others, for the suspension of the construction of the Bataan nuclear reactor

plant, alleging that the completion and operation of the reactor plant will create a grave and present danger to the lives of many Filipinos, and urging the creation of a commission to review the advisability of continuing the construction.

In accordance with the suggestion, President Ferdinand E. Marcos issued Executive Order No. 539 on June 15, 1979 creating a commission to conduct an inquiry on the safety to the public of all nuclear plants in the country composed of former senator Lorenzo Tañada as Chairman, with Assemblymen Ricardo C. Puno (now Minister of Justice) as co-chairman, and such other members as the President may later appoint. In his letter to the President dated June 20, 1979, Tañada, however, declined the appointment. On June 22, 1979 President Marcos appointed two retired justices from the Court of Appeals, Justice Conrado M. Vasquez and Justice Jose G. Bautista, as members of the commission. Justice Vasquez took his oath of office on June 23, 1979, and Justice Bautista was sworn into office on June 25, 1979. The commission thus formed then commenced its work, with Assemblymen Puno as

Chairman and Justice Vasquez and Justice Bautista as members.

In his Letter of Instructions No. 876 issued on June 16, 1973, President Marcos directed the commission to obtain answers to the following questions:

1. What specific safeguards, if any, has been taken against repetition in the Bataan Nuclear Power Plant of the Three-Mile Island nuclear incident which occurred in Pennsylvania, U.S.A., on March 28, 1979?

2. Who are the people who will operate the Bataan Nuclear Power Plant and what are their qualifications?

3. In case there is an accident similar to the Three-Mile Island incident in the Bataan Nuclear Power Plant, what resources, both scientific and industrial, are available to prevent contamination of the surrounding areas and atmosphere as well as the people residing thereat? Who will finance and provide facilities to prevent contamination and how much would it cost? Who will pay for the damages and costs?

4. Are we exchanging with or obtaining information on nuclear safeguards from other countries, like the United States through its Nuclear Regulatory Commission which originally recommended the establishment of the Bataan Nuclear Power Plant in 1961? What are the maximum and minimum acceptable safeguards to prevent nuclear contamination?

5. 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 Richter scale, will the Bataan Nuclear Power 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 tectonic origin similar to the tsunami that hit Mindanao in August 1977?

6. Is the Bataan Nuclear Power Plant located in a fault in the earth's surface?

7. What is the history of earthquakes in the particular sites of the Bataan Nuclear Power Plant?

8. Where, how, and by whom will nuclear waste be disposed of and what are the risks involved in the disposal procedure?

9. About a week after the Three-Mile Island incident on March 28, 1979, I directed the Ministry of Energy to require Westinghouse to send experts to the Philippines to explain doubts that have arisen especially in the mind of the President about the safety of the Bataan Nuclear Power Plant. Why has not Westinghouse done so up to now?

The Commission started the inquiry on June 23, 1979 at the Philippine International Convention Center, Roxas Boulevard, Metro Manila. The participants who entered regular and special appearance at the initial hearings in their own behalf or in the names of their principals were: Atty.

Lorenzo Tañada, Atty. Jokar Arroyo, Assemblyman  
Antonio Roman, Jr., Mr. James S. Moore, Mr.  
Gerald R. Carroll, Mr. Walter Wilgus, Mr. James  
T. Cronin, Mr. James C. Woebber, Mr. John D.  
Hankowsky, Mr. Daniel W. Call, Mr. Raymond J.  
Sero, Energy Deputy Minister Gabriel Y. Itchon,  
Health Minister Clemente S. Gatmaitan, Dr. Segundo  
Roxas, Energy Minister Geronimo Velasco, Dr.  
Zoilo M. Bartolome, Dr. Carlito Aleta, Mrs. Nora  
Potines, Assemblyman Roque de Guzman, Atty.  
Domingo Allana, Engr. Angel Lazaro, Jr., Engr.  
Andres Hizon, Engr. Francisco Limata, Engr.  
Virgilio Calumna, Engr. Matias Arreola and Dr.  
Salvador Roxas Gonzales.

In its resolution of June 23, 1979 the Commission gave the participants who had entered regular appearances five (5) days from June 23, 1979 within which to submit their respective position papers containing the answers to the questions listed in Letter of Instructions No. 876, serving copies thereof to the other participants. In turn, the participants upon whom the position papers had been served were directed to file adverse position papers within five (5)

days from receipt, likewise containing their respective answers to the same questions.

The participants who submitted position papers were then grouped into panels, thus:

Westinghouse Panel:

Mr. James T. Cronin  
Mr. Walter Wilgus  
Mr. James S. Moore  
Mr. Gerald R. Carroll  
Mr. James C. Woebber  
Mr. John D. Hankowsky  
Mr. Daniel W. Call  
Mr. Raymond J. Sara  
Mr. William Howard Arnold  
Mr. Aura A. Simmons  
Mr. David Ferg

National Power Corporation Panel:

Mr. Gabriel Itchon  
Atty. Marcelino Ilao  
Mr. Higino Ibarra  
Mr. Josue Polintan  
Mr. Jose Torres

Philippine Atomic Energy Commission Panel:

Dr. Zoilo Sartolome  
Dr. Carlito Alata  
Atty. Gumerzindo Maniquis  
Mr. Ernesto Mejia  
Mr. Edilberto Cabalfin  
Dr. Charles Willis

Commission on Volcanology Panel:  
Dr. Gregorio Andal

Bureau of Mines Panel:

Dr. Romeo Luis  
Mr. Oscar Crispin

Ministry of Health Panel:

Former Minister Clemente Catmaitan  
Dra. Celia T. Anatalio  
Miss Agnetta Peralta

"EBASCC" Panel:

Mr. Norman Tilford  
Mr. James Gilmora  
Mr. Charles Healy  
Mr. O'Donnell  
Mr. John Helly  
Mr. Indra Gupta  
Mr. Gerry Stirewalt

"PAG-ASA" Panel:

Mr. Teodoro Macalincag  
Mr. Roldan Valenzuela

Tanada Panel:

Atty. Lorenzo Tanada  
Atty. Joker Arroyo  
Atty. Francisco Rodrigo  
Mr. Achilles del Callar  
Mr. Carlito Barril

Bataan IEP Chapter Panel:

Atty. Jaime Guerrero  
Atty. Wilfredo Dizon

National Society for Seismology  
and Earthquake Engineering of  
the Philippines ("NSSEEP") Panel:

Engr. Angel Lazaro, Jr.  
Engr. Andres Hizon

Samahang Pinika ng Pilipinas Panel:  
Dr. Salvador Roxas Gonzales

While the office of the National Science  
Development Board did not submit any position  
paper, Atty. Lilian Angeles and Mr. Marcial  
Diamante, under written authority of Mr.  
Segundo V. Roxas, Officer-in-Charge, actively  
participated in behalf of NSDB

The Commission met in sessions beginning

June 23, 1979. The hearings terminated on September 14, 1979.

Sixty-four (64) witnesses testified before the Commission, namely: Jose C. Torres, James Moore, Raymond Sero, Gerard Carroll, Walter Wilgus, Daniel Call, William Howard Arnold, Alfredo Orquia, James Hoeber, Tomas Dilig, Antonio Calimbas, Charles Smaney, David Ferg, Efigino Ibarra, Zoilo Bartolome, Fr. Romeo Mangatan, Conrado Lisanen, Aura Simmons, Norman Tilford, James Gilmore, Charles Healy, Josue Polintan, Tristan Calasanz, Francisco Galima, Gabriel Itchon, Atty. Cristobal, Carlito Aleta, Charles Willis, Atty. Gumersindo Maniquis, Ralph Blanco, John Healey, Reynaldo de Dics, Edward O'Donnell, Edilberto Cabalfin, Ernesto Mejia, Gregorio Andal, Teodoro Macalincag, Roland Valenzuela, Oscar Crispin, Romeo Luis, Minister Clemente Gatzaitan, Dr. Celia T. Anatolio, Agnetta Peralta, David Leeds, Engr. Andres Hizon, Indra Gupta, Salvador Roxas Gonzales, Jaime Guerrero, Achilles del Callar, Ernesto Sonido, Carlito Barril, Atty. Jokar Arroyo, Atty. Lorenzo Tahada, Olimpio Peña, Atty. Marcelino Ilao, Arturo Alcaraz, Rogelio Batarin, Ricardo Palabrica, James Cronin, John D. Hankowsky, Gerry

Stirewalt, and Atty. Wilfredo Dizon.

Voluminous documents and exhibits were presented by the participants as follows:

Westinghouse International Projects Company: 23 exhibits with several sub-exhibits.

National Power Corporation, as licensee, and its consultant, BEASCO: 73 exhibits with several sub-exhibits.

Philippine Atomic Energy Commission: 16 main exhibits with several sub-exhibits.

The Ministry of Health: 5 exhibits with several sub-exhibits.

The Bureau of Mines: 14 main exhibits with several sub-exhibits.

The "NSSEEP" panel: 9 exhibits with several sub-exhibits.

The Bataan IIP Chapter: 25 exhibits and several sub-exhibits.

The Tañada Panel: 92 exhibits with as many sub-exhibits.

Besides these exhibits submitted by the participants, 14 additional documents were marked and denominated as "inspection exhibits."

At the close of the hearings on September 14, 1979, the Commission gave the parties/participants a period of 30 days, to expire on October 15, 1979, within which to file simultaneous memoranda, and up to October 25, 1979 within which to file reply-memoranda.

Two world-renowned seismological and geophysical expert scientists came to the Philippines to assist and counsel the Commission on Nuclear Reactor Plants in the technical evaluation of the exhibits, testimonies, evidences, records and materials gathered by the Commission during its hearings, namely, Dr. Cinna Lomnitz, head of the Geophysics Institute of the National University of Mexico, and Dr. Jesse Carl Stepp of Los Angeles, California. Dr. Stepp arrived on October 20, 1979 followed by Dr. Lomnitz on October 22, 1979. Both left the Philippines on November 1, 1979. During that period, they participated in a series of consultative meetings with the Commission and conducted an ocular inspection at the Bataan plant site on October 27, 1979. On October 31, 1979, they rendered their respective written reports.

For a better perspective, we have divided the nine (9) concerns posed by the President in

Letter of Instruction No. 876 into two parts,  
namely:

- I. the nuclear plant construction safety  
design question (Questions 1 to 4, 8 and 9),  
and
- II. the safety of the site (Questions 5,  
6 and 7).

## II. THE BATAN NUCLEAR POWER PLANT

### A. BASIC BACKGROUND INFORMATION

The Philippine Nuclear Power Plant (PNPP-1) undergoing construction at Napot Point, Municipality of Morong, Province of Bataan and scheduled for operation in 1982, is a two-loop Pressurized Water Reactor System of Westinghouse International Projects Company (WIPCO), supplier, designer and manufacturer. It would provide steam to power a turbine generator with a net electrical output of 620,000 kilowatts. Full construction permit was granted by the Philippine Atomic Energy Commission to the National Power Corporation (NPC), applicant and proposed licensee of the one-unit nuclear reactor plant only on April 4, 1979, about seven (7) days after the "Three-Mile Island Incident." The Westinghouse Pressurized Water Reactor (PWR) is a standard design and all types, be they of the three-loop or four-loop kind, have allegedly the same safeguard systems. The only difference lies in the capacity or net electrical output, which simply means - the more the loops, the greater the generating capacity.

We now essay a description, even so briefly, of the fundamental operation of the question of safety of the plant. The reactor coolant system for the PNPP-1 consists of a reactor and two closed reactor-coolant loops connected in parallel arrangement to the reactor vessel, the plant's furnace, each loop having a reactor coolant pump and steam generator. High pressure water circulates through the reactor core to remove heat generated by the nuclear fission process. The heated water exits from the reactor vessel and passes through the coolant loop piping to the steam generators. Here it gives up its heat to the feedwater to generate steam for the turbine generator. After the steam enters the turbine, it is condensed into feedwater and pumped back to the steam generator to repeat its heat transfer cycle. The condenser is a large heat exchanger that derives its coolant from a once-through flow of seawater provided by the circulating water system. (Exhibit C - Westinghouse).

During normal operation of the nuclear power reactor, about 160,000 gallons of seawater per minute would be pumped in to provide cooling water to the condensers which are underneath the turbine. The water circulates and discharges

again to the sea, this time 12 to 15 degrees centigrade above normal temperature.

A large cylindrical structure known as the containment building surrounds the component vessel "serving as a missile and a biological shield." This building houses the reactor, steam generators and other major components. Its walls are 1.49 meters thick and heavily enforced with enough steel to produce a 6 mm bar 12,500 kilometers long. The containment building is 52 meters high from ground level, 30 meters in diameter and connected with and supported by a concrete foundation set up to 18 meters below ground level.

The containment building is designed to be airtight. No explosion is allegedly possible, as hydrogen by itself, without oxygen, does not explode. To obtain a possible ignition, hydrogen level in the containment building should reach 4 to 8 per cent, and oxygen present should be of approximate level (p. 13, t.s.n., June 25, 1979 a.m.). Moreover uranium 2.35 generally used in thermal reactor plants is not sufficiently enriched to create nuclear explosion like a bomb (p. 19, t.s., June 25, 1979 a.m.). But the component parts of the plant, the reactor itself, could be blown up by a strong

steam explosion (p. 1, t.s.n., June 25, 1979,  
11:10 a.m.).

The containment vessel, on the other hand, is a steel pressure vessel "38 mm thick designed and constructed to contain any radioactive discharge during normal operation and to maintain its integrity and function during and after any postulated accident."

Adjacent to the containment building is the auxiliary building complex consisting of the "control building which serves as the nerve center of the entire facility, the diesel generator building which provides emergency electrical power in the event of loss of normal power supply, the fuel storage building for the storage of new and spent fuel, the intermediate building and the auxiliary building." These buildings are being built of heavily reinforced concrete similar in design to the containment building and would be supposedly provided with emergency safeguard systems and auxiliary equipment. The addition of a high cooling tower to the Batsan Nuclear Plant is alleged to be a major support in case of emergency, as this would assure supply of essential cooling water

to the primary safety-related facility components. The needed water would come from 13 deep wells within the nuclear compound complex. All structures in the plant are designed to withstand the horizontal acceleration of 0.4 times the force of gravity or 7.5 intensity

in the Richter scale (pp. 11-12, t.s.n., June 25, 1979 a.m.) A housing area for workers and nuclear technicians was constructed in Bagac, Bataan, about seventeen (17) kilometers from the nuclear plant site.

During the progress of construction of the containment building, honeycombs on Block 12 were first noted when the formwork was removed, and the reinforcing bars were seen showing portions of the surface of the concrete not fully covered as they should be. The discovery was reported in the Inspectors' Report of January 31, 1978. Block 12 is a reinforced concrete cylindrical wall, 1.49 meters thick, 3.69 meters high with an outside diameter of 36.88 meters. It is the second to the last block to be poured before the reactor shield building is erected on top of the foundation (p. 750, Vol. III, Rec.). The honeycombs

were found "at the interior face of the wall and not at the exterior face" (p. 695, Vol. II, Rec., p. 11, t.s.n.; August 30, 1979, 8:40 a.m., Exhibit 66-NPC).

The existence of the honeycomb in Block 12 does not appear to have been officially reported or disclosed by NPC to the Philippine Atomic Energy Commission (PAEC), and when the attention of the regulatory body was called after an audit by its regulatory staff on PNPP-1, Westinghouse had already scheduled the "grouting of the bottomhead of the steel containment, which would essentially cover the honeycombs."

Sometime in January 1979, a rough evaluation report of the "Concrete Repair Procedure for Block 12" was prepared by P. C. Liu of EBASCO Services Corporation (Exhibit 13-C, Bataan IEP Panel). From a visual inspection, the major or extensive void or honeycomb areas were at the interior phase of the wall and the defective areas were estimated to cover approximately 30% of the interior surface in the lower half zone of the wall of Block 12. The voids caused by air entrapment were extensive. The deepest were found to extend approximately 6 to 8 inches behind the first

layer of the vertical reinforcement but there was no exposure of second layer of vertical re-bars. Core samples were taken at Block 12.

By order of the Philippine Atomic Energy Commission, NPC was ordered to desist from grouting the bottom head of the metal containment and pouring concrete thereon until applicant shall have submitted proofs satisfactory to PAEC that internal voids do not exist within Block 12 of the reactor concrete shield and thereby maintain the structural integrity of the reactor building. Applicant was enjoined to submit plans for corrective action for the Commission's evaluation and approval before actual corrective work is undertaken (Exhibit 13-D, Bataan IEP).

The Philippine Atomic Energy Commission was then officially informed by NPC of the needed repair of Block 12 and of the dry packing to be used in the Block 12 repair. The procedure for repair and the repair itself were referred to experts and later approved by PAEC on June 4, 1979, after its inspectors had visited the complete activity and submitted their reports (p. 16, t.s.n., August 30, 1979, 9:30 a.m.).

At the hearings before this Commission, the Bataan/IBP Chapter Panel claimed that the repair of the extensive and major internal voids and honeycombs in Block 12 appear to be unprecedented in the field of nuclear reactor building construction because the procedures failed to cite any USNRC or PAEC rule or regulation as guide in the evaluation and repair of said damage. However, the procedure outlined above under the supervision and orders from the Philippine regulatory commission as supported by the exhibits (Exhibits 13-B to 13-E, Bataan/IBP; Exhibits 68 to 69 and ramifications) have not been successfully contradicted.

The Bataan/IBP Chapter lamented that PAEC made no further inquiries as to the actual cause or causes in the damage of Block 12, and that no explanation about the cause or causes of such extensive and major internal voids and honeycombs were offered or disclosed by NPC when the reactor building appears to be the most safety-sensitive structure in the Bataan Nuclear Plant. Oppositors alleged that external factors such as the seepage of water into the

hardening concrete from an underground spring undermine the foundation of the building as well as affect the stability of the soil on which the building rests. Except for hearsay information from workers on the existence of the supposed spring, the Batuan/TEP Panel failed to introduce competent evidence on the point (q. 2, t.s.n., August 30, 1979, 9:20 a.m.).

B. QUESTION NO. 1: - WHAT SPECIFIC SAFEGUARDS, IF ANY, HAS BEEN TAKEN AGAINST REPETITION IN THE BATAAN NUCLEAR POWER PLANT OF THE THREE-MILE ISLAND NUCLEAR INCIDENT WHICH OCCURRED IN PENNSYLVANIA, U.S.A. ON MARCH 28, 1979?

THE THREE-MILE ISLAND NUCLEAR INCIDENT

The subject incident happened at Three-Mile Island, Unit II of Babcock and Wilcox Reactors on March 28, 1979 in Harrisburg, Pennsylvania, U.S.A., a few months after initial operation. The cause was attributed primarily to: (1) operator error, and (2) malfunction and ambiguity of certain components.

As to No. 1, the operators turned off prematurely four (4) large pumps which circulate the reactor coolant in the reactor. This action damaged the nuclear fuel which had formed a substantial quantity of hydrogen gas. Furthermore, the operators prematurely terminated the high pressure injection flow apparently confused by the pressurizer level indication. This led to further reduction in primary coolant inventory.

As to No. 2, the malfunction in the main feedwater system caused the pumps to trip which,

in turn, caused the turbine generator to turn off and stop generating electricity. The flow of the water was blocked by a closed pressurizer electromagnetic relief valve. This valve opened as designed, but failed to close again when pressure decreased below actuation level. The core damage had formed a substantial quantity of hydrogen gas. Efforts were made to stop the intermittent gaseous releases by transferring the radioactive water into the primary containment building - and which water flooded the floor of this containment structure. Radioactive water was transferred to the nearby auxiliary building, and radioactive gases escaped in the two buildings and into the atmosphere. For a time NRC reported release of radioactivity to a level of 1200 rem above the reactor site.

Up to the close of the hearings before this Commission on September 14, 1979, or 169 days after the incident, no evidence was presented that the damage to the plant at Three-Mile Island has been repaired. Reports from the Senate Nuclear Regulation Sub-Committee mention a "hard to repair" leak which hinders clean up

operations and threatens further release of radioactive wastes. One million gallons of highly radioactive water are now stored at the site at TMI. Contaminated water from the damaged plant will exceed storage facility and capacity within 40 days and be released into the environment unless steps are taken soon to clean it up and to find additional means to store it (Daily Express, September 30, 1979 from Washington, U.S.A.).

SAFEGUARDS TAKEN AGAINST REPETITION  
IN THE FATAL NUCLEAR PLANT OF THE  
THREE-MILE ISLAND INCIDENT

In its position paper, Westinghouse claims that the "short term" modifications covering safeguards "xxx had already been incorporated into the PWR-1 design" even before the occurrence of the TMI incident (p. 155, Vol. I Rec.). We find it hard to believe that Westinghouse had long anticipated the deficiencies at the TMI plant, particularly in those components that malfunctioned on the March 28, 1979 incident.

The Task Force of USNRC reported among others, that:

"xxx. At Three-Mile Island, some of the safety systems were

challenged to a greater extent or  
in a different manner than was anticipated in their design basis. Many of the events that occurred were known to be possible, but were not previously judged to be sufficiently probable to require consideration on the design basis. Operator error, extensive core damage, and evacuation of large quantity of hydrogen from the reaction or zircaloy cladding and steam were foreseen as possible events, but were excluded from the design basis, since plant safety measures were provided to prevent such occurrences." (First Report, p. 18, Exh. 74-Tanada, attached to Memorandum for Bataan IEP Panel).

It would be overly candid and stretching the imagination too far to believe that the nuclear engineers of Westinghouse had been able to anticipate all such occurrences that happened at TMI and incorporate the mechanisms to remedy the then unforeseen deficiencies in the design of the

PNPP-1.

With respect to "long term" modifications or actions on design modification, all Westinghouse would and could say is that those recommended by the U.S. Advisory Commission on Reactor Safeguard (ACRS) and the U.S. National Regulatory Commission (USNRC) are not identified as reactor safeguards.

We directed Westinghouse to submit in columnar form the remote causes, the proximate causes of

the TMI incident, the long term modifications and the additional safeguards. Westinghouse complied by submitting Document No. 14-B-1 and 14-B-2 which obviously show under the column "Modification," the phrase "None identified at present time." Similarly, under the column "Additional Safeguards, if Any," the answer mostly given is "None identified At Present Time." But how could these long term modifications be unidentified when they refer to "more fundamental questions in the design and operation of nuclear power and in the licensing process" and grouped into general safety criteria, system design requirements, nuclear power plant operations, and nuclear power plant licensing (p. 16, First Report of TMI-2 Lessons Learned Task Force, Exhibit 74-Tanada)? Even in the USNRC report to Congress published January 1979, "seventeen (17) unresolved Safety Issues" addressed by 22 tasks in the NRC program were identified (p. 2, Exh. 90-Tanada). Some of the unresolved safety issues relate to the pressurized water reactor steam generator tube integrity (A-1, A-4, A-5), reactor vessel material toughness, fracture, toughness of

steam generator and reactor coolant pump supports  
(A-12), seismic design criteria (A-40), etc.

A few days later, Westinghouse submitted another document (Document No. 14-B-1 and 14-C-1, pp. 162-D to 162-J, Vol. 1, Rec.), but still appearing under the column "long term and short term modifications" is the usual answer given before - "none identified at present time."

Under the column "Additional Safeguards If Any," it is not clear to the Commission, - nor did Westinghouse explain - whether the answers given are additional safeguards, or safeguards already existing in the design of PSFP-1.

Apparently, Westinghouse has not provided or does not plan to include any additional safeguards because in its finished design all it can assure this Commission is that, if required or deemed necessary by the USNRC or the Philippine Atomic Energy Commission, it would incorporate any additional safeguards so required. Westinghouse alleges that any modification in their present design would be "out of the state of the art" or beyond the limits of present day technology; that the discovery of the latest safety device should come from other sources, not from

Westinghouse. Thus, James Moore, Westinghouse general manager on Nuclear Power Division, confirmed that Westinghouse would install the latest safety devices that may be discovered even after the signing of the contract with the National Power Corporation of the Philippines for the Bataan Nuclear Power Plant (pp. 88-89, t.s.n., June 23, 1979, p.m.).

How unknowing, unconcerned, or unaware Westinghouse can be on what are and what may be the nature of the additional safeguards, is indicated in its sweeping yet categorical assumption of liability and warranty for the safety of the plant, and is well demonstrated by the following portions of the testimony of Mr. Auer A. Simmons, Vice-President of Westinghouse International Projects Company:

"MR. TARADA. Without knowing the nature of the safeguards to be required, you are committing Westinghouse into the incorporation of these safeguards to the Bataan Nuclear Plant?

MR. SIMMONS. For those safeguards that may be promulgated as a result of the Three-Mile Island, it made a statement that Westinghouse will provide those.

MR. TARADA. Without at present knowing the nature and kind of those safeguards?

MR. SIMMONS. Yes, sir.

MR. TARADA. Suppose the additional safeguards to be required would need a radical change of your plant itself, would you still introduce those safeguards?

MR. SIMMONS. I believe that that was the statement. Yes, sir.

MR. TARADA: Now suppose the cost of that safeguard to be required would be around \$50 million, would you incorporate that?

MR. SIMMONS. I must answer it, yes, if it took that much to make the Bataan Nuclear Plant safe.

MR. TARADA. Thank you. And at whose expense would that introduction of those safeguards be?

MR. SIMMONS: In all probability, most of that expense would be to Westinghouse account - most if not all. (pp. 2-3, t.s.n., July 9, 1979, 2:30 p.m.).

THE CHAIRMAN. What you are trying to say is, if by the time between now and 1983 there should be additional safety requirements that will be required by the NRC, Westinghouse would install them in Bataan?

MR. SIMMONS. Yes, sir.

MR. CHAIRMAN. You are undertaking that as your responsibility?

MR. SIMMONS. Part of our responsibility yes, sir." (pp. 2-3, t.s.n., July 6, 1979, 8:15 a.m.).

Mr. Simmons in his own words admitted that:  
"the Bataan Nuclear Plant is not a new design";

that "it is an existing design or back fitted into the system design which if necessary they will be back fitted into the Bataan Nuclear Plant \*\*\*" (p. 8, t.s.n., July 9, 1979, 2:30 p.m.).

Mr. Simmons has committed Westinghouse with respect to the future requirements of USNRC and ACRS and to answer for the necessary adjustments on the plant for safety including the damages due to its demonstrated failure on quality assurance of components used.

"THE CHAIRMAN. Should experts of the same qualifications as your good-self look at the two systems and find certain safety measures in Kori 5, 6, 7 and 8 are added measures, would you be willing to install them in the Bataan plant?

MR. SIMMONS. Yes, sir.

MR. CHAIRMAN. Now, likewise, as a scientist you have an open mind and it is said that the more you know, the more humble a man becomes. And you are open to the possibility that what you say may not always be the ultimate truth.

Opening our minds to that contingency, if in your dissertation that all the possible consequences that you do not expect may arise or there are grounds to show that they would arise and there are safety measures that are proven to exist, would you be willing to make these adjustments?

MR. SIMMONS. I will speak for my company and the answer is yes, sir.

THE CHAIRMAN. Now, would that be a part of your undertaking in connection with this plant?

MR. SIMMONS. Yes, sir.<sup>a</sup> (pp. 4-5, t.s.n., July 6, 1979; 8:15 a.m.; also p. 3, t.s.n., July 6, 1979; p. 9, t.s.n., July 9, 1979, 2:30 p.m.).

Once again, Mr. Simmons far from satisfying the Commission by presenting credible proofs or additional safeguards, under his oath just made another express warranty as shown by the following:

"JUSTICE BAUTISTA. Now, with respect to these pumps that would be used at the Bataan Nuclear Plant, is it already designed and existing as of the present time?

MR. SIMMONS. Yes, sir. All the pumps are exactly the same in all of the plants.

JUSTICE BAUTISTA. Of what vintage are these pumps that would be brought here? Of what year?

MR. SIMMONS. They are in manufacturing now. I believe that the shipping date from the United States would probably be November or December, 1979.

JUSTICE BAUTISTA. Were those pumps included in those manufactured in 1976?

MR. SIMMONS. They are like the pumps that were manufactured in 1976. Yes, sir.

JUSTICE BAPTISTA. I have read articles which related that Westinghouse pumps that were being sold to Sweden in that year, 1976, were rejected because of lack of quality. Can you say anything to that?

MR. SIMMONS. Yes, sir, Mr. Justice. You are talking about two different sets of pumps today.

JUSTICE BAPTISTA. Yes... Will you clarify?

MR. SIMMONS. We have started to talk during this session about the reactor cooling pump and its model. Those are manufactured by Westinghouse. The pumps that were rejected by the Swedish State Board were the charging pumps in which we provided specifications to a vendor and bought them from a vendor. They are not Westinghouse manufactured.

JUSTICE BAPTISTA. Do you mean to say that those pumps that were rejected were not manufactured by your own company?

MR. SIMMONS. That is true.

JUSTICE BAPTISTA. How about the pump that you intend to sell for the Bataan Nuclear Plant?

MR. SIMMONS. The reactor cooling pump for Bataan are designed and manufactured by Westinghouse.

JUSTICE BAPTISTA. These are different from those that were sold to but rejected by Sweden?

MR. SIMMONS. Yes, sir. They are different pumps, different systems, Mr. Justice.

JUSTICE BAPTISTA. Should we find that they are of poor quality, would Westinghouse replace the pumps?

MR. SIMMONS. We have a system both Westinghouse, NPC and their consultants on quality assurance that at any time there is a defect from any matter of fact with component, that has to be remedied. And it is part of Westinghouse responsibility to remedy that because we do warrant workmanship and materials of all equipment.

JUSTICE BAUTISTA. That is only in accordance with what happened in Sweden where Westinghouse replaced the pumps.

MR. SIMMONS. That is correct and that is a part of the warranty.

JUSTICE BAUTISTA. Thank you.  
(pp. 5-8, t.s.n., July 16, 1979,  
1:30 p.m.)

From the above admission of warranty, we do not find it strange why Westinghouse would now insist that the additional safeguards needed are already incorporated in the facility, and that the stricter standards demanded after TMI refer to operating nuclear plants only. We find that the allegation is incorrect.

The Task Force Status Report (Exh. 74-Tahata) expressly states that the recommendations are applicable to "x x x pending operating license (OL) and construction permit (CP) applications." The report also states that:

"Actions recommended by the Lessons Learned Task Force and approved by the Director of NRC

or the Commission, as appropriate,  
will be assigned to the Divisions  
of Project Management (DPM), Systems  
Safety (DSS), and Operating Reactors  
(OR) and to the B & O Task Force for  
implementation on pending license  
applications and on operating plants."  
(p.2).

Indeed, if operating plants are required  
more exacting and more severe care, would that  
mean that the proposed design for PNPP-1 can  
afford to be careless?

At the hearings before this Commission, the  
Westinghouse design of the Bataan Nuclear Power  
Plant is attacked as inherently weak because it  
has not provided for additional safeguards.

There is truth in this assertion. Dr. Charles  
Willis, consultant of the Philippine Atomic  
Energy Commission, when interpellated by oppo-  
sitors, admitted that the recommendation con-  
tained in No. 3 of the Task Force of USNRC on  
the TMC incident has not been included in the  
design proposed for PNPP-1. Thus, Dr. Willis  
testified:

"ATTY. ARROYO: Your Honor, in  
other words, No. 2 is not fully incor-  
porated in the Bataan plant?"

DR. WILLIS: The valves have not  
been designed or they have not been  
built or ordered. They will be incor-  
porated in the PNPP-1 plant. It is

not clear to me on the basis of the materials submitted that the previous testing would have met this requirement, but I cannot say for sure, but certainly, it being incorporated that the valves would be tested according to the requirement and recommendation before they are installed in the PHPP-1" (Page 11, t.s.n., August 14, 1979, 8:45 a.m.)

Dx. Willis apparently refers to the pressurizer electromagnetic relief valve which failed to close during the Three-Mile Island incident. As an additional safeguard, an interlock and a containment isolation signal should be devised as recommended to prevent the valve from staying open when pressure is decreased below actuation level or to prevent transfer when high radiation exists. In other words, it is not in Westinghouse's design that such valve which used to remove steam be locked in their correct position.

We find therefore that both Westinghouse and TMI-2 designs do not have automatic signals to align valves which could be inadvertently left in an incorrect position. How can Westinghouse now rightly claim that all safety measures required by NRC short-term recommendations have already been incorporated in their nuclear reactor design even before the TMI-2 incident?

A more categorical admission was made by Mr. Simmons when interpellated by this Commission that Westinghouse has not adopted any additional safeguards, thus:

"JUSTICE VASQUEZ. So you are just drawing a conclusion, there was no specific finding that if certain safeguards were taken the TMI incident would not have happened and those safeguards were specified and you could show that the new designs which you have been adopting all along, they were all incorporated there and therefore there is no need of taking these additional safeguards?

MR. SIMMONS. That was not only the judgement of Westinghouse but it was also the judgment of NRC.

JUSTICE VASQUEZ. I am going back to my original question. Do you have any document that will really show that the changes or the differences in your designs comply with the safeguards called for by the USNRC?

MR. SIMMONS. I believe that there are, Your Honor, and we will look for that, try to submit them as documents.

JUSTICE VASQUEZ. Now, since you said all of the safeguards necessary to prevent the TMI incident from happening in Bataan are already built in your design, the answer I gather from your position paper for the first question is you have not adopted any additional safeguards?

MR. SIMMONS. That is correct, sir." (pp. 2-3, t.s.n., July 5, 1979, 3:30 p.m.)

As a matter of fact when Mr. Simmons testified

on July 5, 1979, he emphatically claimed that the PNPP-1 design is not being reviewed by the USNRC and therefore it could not have required Westinghouse to retrofit or adjust its design to meet the latest standards of safety. As far as Westinghouse is concerned, additional safeguards would be included in the design only upon orders of USNRC, but not on its own initiative. This is revealed by the following portions of Mr. Simmons' testimony:

"JUSTICE BAUTISTA. Just one or two questions in addition to the exhaustive analysis questions of the Commission.

It is reported that the United States Ambassador, Richard Murphy, on the occasion of the Fil-American Friendship Day, said that the reason for the delay in the processing of the export license for the equipment of the Bataan plant is that the engineers of the proposed plant have been required to adjust or retrofit their design to meet the latest standards of safety which have grown more severe and higher. My question is, conceding this statement to be correct, what does Westinghouse intend to do so that it could comply with these stricter, more severe and higher standards of safety?

MR. SIMMONS. Mr. Justice, I believe that the Ambassador was misquoted. However, assuming that he was not misquoted, then I will say he is wrong, for the simple reason that the application for the export license for the Philippines Bataan

Nuclear Plant is not and has not been reviewed by the NRC to this day. So how can you have retrofit on a license that has not been reviewed?" (p. 6, t.s.n., July 5, 1979, 3:30 p.m.).

Dr. William Howard Arnold, President of Westinghouse International, testified that while USNRC is responsible under the Nuclear Non-Proliferation Act for issuing export licenses after consultation with other government agencies, the precise safety review of the plant is not statutorily required by the USNRC and the design of PNPP-1 has not been approved by the U.S. Regulatory Commission (pp. 8-9, t.s.n., June 26, 1979, 1:30-2:00 p.m.). It may fairly be concluded from this admission that nuclear facilities exported out of the United States to other countries do not undergo the rigid tests given by USNRC to facilities constructed in the U.S. If we were to take public notice of contemporary events reported in the U.S. press as transmitted here, it is only now that USNRC would conduct some sort of an examination of the PNPP-1 design. The general clamor has been for an over-haul of the design for a radical increase in the margin of safety. Thus, the U.S. presidential commission on Three-Mile Island after public hearings recommended fundamental changes in the

way nuclear plants are built, operated and  
regulated (Bulletin Today, November 1, 1979  
citing Associated Press, Washington, October  
31, 1979).

With all the admissions of liability made  
under oath, Westinghouse in its memorandum  
(page 40) would now shirk responsibility. Thus,  
Westinghouse now considers the obligation to  
provide performance verification of all relief  
and safety valves as "a combined industry effort  
rather than an individual vendor effort."  
Westinghouse would also "pass the buck" to  
NPC stating that once the determinations of  
availabilities of test facilities and program  
definitions are made, Westinghouse will just  
"x x x advise NPC of a method or facilities  
available to them for verification of the re-  
actor coolant system relief and safety valves."

Yet again, while Westinghouse does not oppose the USNRC's recommendation that a primary coolant saturation meter be installed to provide online unambiguous indication of lant saturation condition, however, Westinghouse states that implementation of the suggested remedy should wait because Westinghouse considers

See Kerney  
Co-p. facs.  
Rec. 3.4.2.

that proper operator guidelines using existing instrumentation is sufficient for determining degree of sub-cooling." (Page 42, memorandum for Westinghouse).

The Commission finds from the constantly changing positions of Westinghouse that it would not accede to USNRC's recommendation if said recommendation would involve a change in its design. If Westinghouse would agree, it passes on the obligation to NPP. Westinghouse's revised position in its memorandum follows the enigmatic pattern, "x x x as new design criteria are established, systems will be examined to determine compliance and recommendations will be made to NPP for their action" (p. 17, memorandum for NPP). On top of all these, should NPP decide to incorporate any safety for operational improvements developed after its initial operation, Westinghouse will be willing to install the same but always on the basis of prevailing commercial rates (p. 53, Memorandum for Westinghouse). As shown earlier, Westinghouse made for the record, explicit and definite assumptions of liability when it comes to additional safeguards even if these would cost as much as \$50 million. These contradictory stands of

Westinghouse seriously affect its credibility.

We cannot with certainty and peace of mind assure the safety of Westinghouse's designed nuclear plant. The forty-one (41) problems or unresolved safety issues submitted in a report by USNRC to Congress (Exhibits 33, 33-A, Tab A) adversely affect Westinghouse manufactured nuclear plants. The appendix to said report describes some of the problems as investigated by USNRC experts as follows:

"Pressurized water reactor steam generator tube integrity can be degraded by corrosion induced wastage, cracking, reduction in the tube diameter (denting) and vibration induced fatigue cracks. The primary concern is the capability of degraded tubes to maintain their integrity during normal operation and under accident conditions (LOCA or a main steam line break) with adequate safety margins.

Westinghouse steam generator tubes have suffered degradation due to wastage and stress corrosion cracking. Both types of degradation have been nominally arrested, however, degradation due to denting which leads to primary side stress corrosion cracks is the major problem at present, and the principal focus of this technical activity." (p. A - 3/1)

"A. Licensee (B) of Westinghouse (W) Nuclear Facilities

At present all W plants experiencing tube denting will be monitored for

NUREG-0410  
Category A?  
(see E&G  
Report p. 15)

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the progress of denting. Each licensee will submit an analysis of the consequences of tube-denting on tube integrity and demonstrate that adequate safety margins exist for continued safe operation. The Turkey Point and Surry licensees will be closely monitored relative to steam generator replacement." (p. A - 3/9)

"Recent events at Millstone 2, Turkey Point 3 and 4, and Indian Point 2 and 3 involving the offsite power system have provided additional indication that the reliability of the preferred sources of emergency power may be less than what has been expected. A study is needed to assess this matter." (p. A-35/1)

The Turkey Point and Surry plants are Westinghouse designed nuclear power plants.

The letter of A. Schwancer, Chief, Operating Reactors Branch, Division of Operating Reactors, Nuclear Regulatory Commission to Mr. George T. Berry, General Manager and Chief Engineer, Power Authority of the State of New York dated May 12, 1979 (Exhibit 76, Tañada), is likewise revealing of the inherent weakness as to the safety of Westinghouse reactor components. In said letter of which is an appraisal or review of the licensee's responses to Bulletins of USNRC, the latter commented that:

"The Westinghouse advice is prescriptive on resetting of the

high pressure injection system and incomplete as to the need for keeping the reactor coolant pumps running.

"X x x It is clear that there are a significant number of technical issues yet to be resolved for a large number of Westinghouse operating plants."

"X x x To resolve the issues described above in a prompt and expeditious manner, we believe there is a compelling need to establish an owner's group for Westinghouse operating plants. We expect that such a group would be needed for the remainder of calendar year 1979."

In the reply-memoranda of Westinghouse, the attention of this Commission is called to the fact that Exhibits 76 - 89, inclusive, which have been attached to the memorandum of the Bataan IIP Panel, were not formally submitted, hence, should not be given due consideration. In this report, we have nevertheless taken public notice of and used Exhibits 76, 88 and 88-A because they are in the nature of public and official documents. As a fact finding body, this Commission would and should disregard technicalities of procedure if only to arrive at the truth.

It will be recalled that as early as February 13, 1978, Daniel P. Ford, Executive Director of the Union of Concerned Scientists wrote President Ferdinand E. Marcos calling the latter's

attention to an independent review carried out by said organization on the design of Westinghouse of the Bataan Nuclear Power Plant. It is the considered judgment of the scientists "that the Bataan Plant now under construction is plagued by poor design and hasty engineering" (P. 24, Exh. A-1, Westinghouse). Among the major subjects reviewed are the structural integrity of the reactor pressure vessel and primary cooling system piping; emergency core cooling system (ECCS) capability; reactor instrumentation and control systems; auxiliary feedwater control systems; steam generator tube cracking and corrosion, critical pump and valve performance capabilities, and the like. After a review had been conducted by the U.S. National Regulatory Commission, it is reported that USNRC has ordered the temporary closure of all Westinghouse plants in the U.S. because it is the only firm supplying nuclear reactors that does not have adequate emergency core-cooling system (Report No. 857-79 from the Ministry of Foreign Affairs dated 5 November 1979).

See E&I Report p.

On the whole, we find that the proponents have not sufficiently shown that the present design of the Bataan Nuclear Power Plant can

guarantee against repetition of the TMI accident.  
This Commission must ascertain itself on the question of safety, inasmuch as the President himself stated in his letter to the Chairman that "x x x this is a responsibility squarely resting on our conscience, for it concerns the welfare not only of this generation, but others to come"; that "we can not afford the merest doubt where the future of an entire nation is concerned" (Document No. 6-A).

We are, indeed, appalled by the frequency of accidents in nuclear reactor power plants including those designed by Westinghouse (Exhibit 21-A, Bataan). For one, the nuclear accident in Beznau, Switzerland, emanated from similar causes (Exhibit 71-A, Tahada) attributed to the TMI incident. The Commission cannot avoid taking public notice of them. If these nuclear incidents prove anything, they show that nuclear plants are not failure-safe. Consider the admitted fact owned by Westinghouse that the Philippine Nuclear Power Reactor Plant is an old design. Westinghouse admits that "x x x for PNPP-1, the code effectiveness date has contractually established as October, 1973."

p. 11, Memorandum for Westinghouse). If this is so, then said design does not have the benefits as to the latest safety systems of modern technology which changes quite rapidly. A 1973 nuclear reactor design, for that matter, would appear outmoded by 1982 or 1983, the scheduled date of operation.

Another big problem germane to safety arises if and when an actual emergency should happen in the Bataan nuclear plant. Accidents that develop in seconds or in minutes as did occur in the Three-Mile Island require immediate action. Assembling a group of experts from abroad and transporting them to the Philippines will take several days when the remedy is urgently needed in hours. In any event, we have to rely on our own team of experts. But we can not understand why the combined housing facilities of the workers and employees are located in Bagac, Bataan, seventeen (17) kilometers away.

The proponents tried to explain that the complex housing area was constructed in Bagac, Bataan because it was originally the site chosen for the Bataan Nuclear Reactor Power Plant; that since it was already excavated, levelled,

and some of the houses were already constructed, SPC would save substantial expenses in not having to construct a new housing area.

The explanation is a poor excuse considering that the safety of the plant is of more paramount importance. Logically, it is premature to have developed a housing area when the most acceptable site had not yet been selected. There is evidence that the pattern both in the United States and Europe is to construct the houses of key men adjacent to the power plant. The purpose is that in case of any incident, concerted action can be made available especially by the technical experts needed. The team of trouble-shooters must always be on the spot to avoid a major catastrophe.  
is  
This is not the situation in Batzaan.

C. QUESTION NO. 2. WHO ARE THE PEOPLE WHO WILL OPERATE THE EASTMAN NUCLEAR PLANT AND WHAT ARE THEIR QUALIFICATIONS?

In fairness to the proponents, it must be said that the selection and training of highly skilled man power started since 1976. In an open competitive recruitment examination, 1,240 applicants took the initial tests conducted by the National Power Corporation of which 812 passed. After other tests conducted by engineers of NPC and an independent psychologist-consultant, the number of 812 aspirants was trimmed down to 173.

Part of the training is the "Pressurized Water Reactor Course." The first batch of operating personnel composed of 39 engineers had undergone both courses. While further training has been continuing here at home, already a top management group of 121 left on June 12, 1979 for the Westinghouse Nuclear Training Center in the Pittsburgh, Pennsylvania.

In the overall training program, Westinghouse would train 187 trainees in 16 different disciplines. The trainees have to master an exceedingly complex system run by instrumentation. A moment of inattention can cause enormous damage

to persons and property.

For the first eighteen (18) months of initial operation of the Bataan Nuclear Reactor Plant, Westinghouse men with Filipino trained employees of the National Power Corporation will man the plant. Westinghouse may give an additional ten (10) months period to train and help the Filipino engineers before leaving operation of the plant entirely to Filipino hands. However, "once construction and performance testing are completed and PNPP-1 is accepted by NPC, commercial operation of PNPP-1 becomes the responsibility of NPC." (p. 11, Memorandum for Westinghouse). This position of Westinghouse is rather unfair. For eighteen (18) months, the Filipino operators would be under Westinghouse men. Suppose an incident should happen due to human error of the trainer and not the Filipino trainee, would it then be just and equitable that NPC alone should shoulder the responsibility for the ensuing damages? Should not Westinghouse be responsible for its training staff?

The Philippine Atomic Energy Commission (PAEC) has assured us that it would carry out its plan to station at the plant round-the-clock

trained experts of the regulatory body. The regulation would permit manipulation of the controls of a facility only by persons holding an operator's permit at that facility. Only after passing a written examination and operating test prescribed by PNEC shall an operator be issued a license. Unlike in the United States where high school graduates may become supervisors and/or operators, those in the NPC group undergoing training abroad are all Bachelor of Science in Engineering graduates. Extra assurance is thus given the Bataan Nuclear Reactor Plant of better qualified operators with diverse ranges of required expertise in power generation, environmental protection, engineering and construction, and of quality assurance in management and administration.

It is not correct to say that the Filipino engineers would be trained only in simulators and not in actual operation of nuclear reactor plants. This Commission inquired into this matter and found that while the trainees would indeed initially train on simulators, thereafter they would be required to pass certain tests and examinations and obtain a license in the United States. With the required license, they

would than be allowed under United States laws to work in a nuclear reactor plant. It thus results that the people who will operate the Bataan Nuclear Power Plant would not only be trainees but would have been duly licensed trainee-operators in the United States.

QUESTION NO. 3. IN CASE THERE IS AN ACCIDENT SIMILAR TO THE THREE-MILE ISLAND INCIDENT IN THE BATAN NUCLEAR POWER PLANT, WHAT RESOURCES, BOTH SCIENTIFIC AND INDUSTRIAL, ARE AVAILABLE TO PREVENT CONTAMINATION OF THE SURROUNDING AREAS AND ATMOSPHERE AS WELL AS THE PEOPLE RESIDING THEREAT? WHO WILL FINANCE AND PROVIDE FACILITIES TO PREVENT CONTAMINATION AND HOW MUCH WOULD IT COST? WHO WILL PAY FOR THE DAMAGES AND COSTS?

The Philippine Atomic Energy Commission would require the National Power Corporation to incorporate in its Final Safety Analysis Report prior to the issuance of the license to operate, an emergency action plan. Minimum requirements for such emergency plan should include:

- a) organization for coping with radiation emergencies,
- b) procedures for notifying the public and other protective measures,
- c) emergency first aid and personal decontamination procedures, and
- d) provision for training employees.

In the position paper of the Ministry of Health, an organizational pattern of the action plan is determined. The Director of the Radiation Health Office created under PD 480 is the head of all coordinating teams with the Chief Radiation

Protection Office who would act in the absence of the Director. Each Health Physicist Team is composed of one Senior health physicist, or health physics technician and an aide. A medical team is also provided for with their duties enumerated in the action plan. Aside from medical technologists, the Bio-Medical Engineering Team and Liaison Officers, the plan would entirely involve the Barangay Captains. The Ministry of Health would be acting in close collaboration with the Philippine Atomic Energy Commission and, of course, the National Power Corporation, the operator of the Nuclear Plant, to carry out an evacuation plan and relative emergency procedures for areas surrounding the Batangas Nuclear Power Plant. All these agencies are preparing their respective budgetary layouts for such emergencies.

This Commission finds the plans above-mentioned noteworthy. But it must be said in passing that at the Three-Mile Island Incident, hundreds of the best scientists and experts came from the large number of people in the licensee's organization, the State of Pennsylvania, the NRC, other Federal and State agencies, and industry groups. Collectively, they tried to maintain and improve the

conditions in the areas affected. Can we say that at present, or ~~in~~ the years to come, we can have such extensive variety of resources, and the depth and breadth of American technology? It behooves NPC and PAEC to maintain the highest degree of competence and dedication in its employees for this serious and delicate task.

In case of nuclear accidents, the damages and costs will be shouldered by NPC. For this purpose, NPC has been organizing a Philippine Nuclear Insurance Pool with the Government Service Insurance System as lead insurer. It is planned to make the insurance policies effective prior to the arrival of the fuel assemblies in the Philippines set for February 1982.

On the limitation of liability of the installation operator, our law (Sec. 42, Republic Act No. 5207, as amended by P.D. No. 1434), provides that "the liability of the installation operator for nuclear damage under this Act shall be limited to an amount in Philippine pesos which is equivalent to five million dollars, United States currency, for anyone nuclear incident, exclusive of interest or costs which may be awarded by the Court in actions for compensation of such nuclear damage."

similarly, the liability of the Republic of the Philippines on Indemnity Agreements with contractors or suppliers of goods or services for an atomic energy facility has been limited to US\$120 million. This is contained in Presidential Decree No. 1484 which took effect on June 11, 1978. Said decree in part amends Section 52 of Republic Act No. 5207 and which reads:

"Section 5. Section 52 is hereby amended by the addition of a new paragraph which shall read as follows:

"THE REPUBLIC OF THE PHILIPPINES ACTING THROUGH SUCH OFFICER AS MAY BE DESIGNATED BY THE PRESIDENT SHALL ENTER INTO AGREEMENTS OF INDEMNIFICATION WITH CONTRACTORS OR SUPPLIERS OF GOODS OR SERVICES FOR AN ATOMIC ENERGY FACILITY OWNED OR OPERATED BY THE GOVERNMENT, ITS AGENCIES, INSTRUMENTALITIES OF CORPORATIONS OWNED OR CONTROLLED BY THE GOVERNMENT PURSUANT TO WHICH THE GOVERNMENT AGREES TO INDEMNIFY AND HOLD SUCH CONTRACTORS OR SUPPLIERS HARMLESS FROM ANY LOSS OR LIABILITY ARISING OUT OR IN RELATION TO A NUCLEAR INCIDENT OCCURRING IN THE PHILIPPINES IN EXCESS OF THE YIELD OF THE INSURANCE OR OTHER SECURITY HEREIN SET FORTH, PROVIDED, HOWEVER, THAT SUCH INDEMNITY SHALL IN NO CASE EXCEED THE AMOUNT OF PHILIPPINE PESOS WHICH IS EQUIVALENT TO ONE HUNDRED TWENTY MILLION U.S. DOLLARS."

Even before the plan for insurance pool shall have materialized, insured trend in the U.S. is worth observing. Mr. Simmons of Westinghouse admitted that homeowners' policies bar claims

for nuclear accidents. Actual damages sustained in a single nuclear accident could be ten times more than the limited liability of \$560 million (pp. 6-7, t.s.n., July 9, 1979, 3:30 p.m.). Insurers feared that damage claims could bankrupt them. Hence, they refuse now to provide full coverage. If liability coverage in the U.S. will increase, it is because of the more than 100 nuclear plants now operating and would hereafter operate. The Price-Anderson Act, as amended, allows the ceiling of \$560 million to increase as the number of operating nuclear plants in the U.S. also increases. Each utility with an operating reactor must pledge \$5 million U.S. to cover potential liability claims by the public due to an accident at any one nuclear plant (Exhibit N-Westinghouse). With only one nuclear plant proposed for the Philippines, we cannot improve or increase liability coverage in favor of potential liability claimants. Further study on this matter with a view to increase this coverage is thus hereby recommended.

E. QUESTION NO. 4. ARE WE EXCHANGING WITH OR OBTAINING INFORMATION ON NUCLEAR SAFEGUARDS FROM OTHER COUNTRIES LIKE THE UNITED STATES THROUGH ITS NUCLEAR REGULATORY COMMISSION OR THE INTERNATIONAL ATOMIC ENERGY COMMISSION WHICH ORIGINALLY RECOMMENDED THE ESTABLISHMENT OF THE BATAAN NUCLEAR POWER PLANT IN 1961? WHAT ARE THE MAXIMUM AND MINIMUM ACCEPTABLE SAFEGUARDS TO PREVENT NUCLEAR CONTAMINATION?

In its position paper, the Philippine Atomic Energy Commission admitted that it is receiving information on nuclear energy matters, particularly on health and safety problems related to power reactor. Under the 1968 Bilateral Agreement between the Republic of the Philippines and the U.S. Government, exchange of information on the civil uses of nuclear energy and related matters is provided for. The USNRC has been furnishing PAEC through the U.S. Embassy in Manila, copies of its bulletin and day-to-day issuances on developments regarding the TMI incident. PAEC also used to receive from USNRC information or news releases on Regulatory Guides and Codas.

As member country of the International Atomic Energy Agency, the Philippines through PAEC has been a recipient of IAEA Bulletins, technical publications including those on nuclear energy.

Additionally, Westinghouse has been providing PAEC topical reports to aid it in understanding the design and analysis of Westinghouse pressurized water reactors. Safety "updates" by experts involved with licensing U.S. plants are also provided by Westinghouse to give PAEC opportunity to discuss licensing problems in the U.S. These statements of PAEC and Westinghouse on the obtaining of information on nuclear safeguards have not been disputed by the other parties/participants.

On part 2 of question No. 4, as to maximum and minimum acceptable standards to prevent nuclear contamination, all PAEC could say in a general way is that ~~nuclear reactors are~~ designed on a defense-in-depth, multibarrier concept, hence, there would be an extremely low probability of any radioactive release from happening; and that the design is in accordance with acceptable standards, codes and regulatory guides.

On its part, the Ministry of Health, as heretofore stated, has set up an organizational plan which shall be carried out by the Radiation Health Office of the Ministry of Health in coordination with PAEC. On the limitation of activity releases, the Ministry of Health submits that: 1) an agreed

dose limits shall be respected, and 2) all doses should be kept as low as is readily achievable; that an acute radiation injury is not caused unless the radiation dose exceeds some hundred rads in a single dose, and much higher values if the exposure is prolonged over a period of years. The Ministry of Health then states that inasmuch as the possibility that exposures might be received under a much wider variety of conditions and circumstances, it is impossible to lay down any recommendation for action levels that would generally be applicable. Thus, except for the organizational plan outlined by the Ministry of Health, NPC and PAEC, no definite standards, maximum or minimum, have been shown to prevent nuclear contamination. The reason can also very well be as aptly stated by U.S. Secretary of Health Joseph A. Califano, Jr. during the investigation of the Three-Mile Island incident before the U.S. Senate Committee on Health and Scientific Research:

"Even when the facts of radiation exposure seem clear, the significance of those facts is often hard to determine for scientific theory about radiation is also bedeviled by uncertainty. Scientist as yet, do not know precisely how dangerous exposure to low level radiation is.

P.

QUESTION NO. 8. WHERE, HOW, AND BY WHOM  
WILL NUCLEAR WASTE BE DISPOSED OF AND  
WHAT ARE THE RISKS INVOLVED IN THE  
DISPOSAL PROCEDURE?

Anti-nuclear adherents base their strongest argument against nuclear reactor power plants on the problem of nuclear waste disposal. Several states have passed laws prohibiting transportation or disposal of radioactive waste within the State borders (Exhibit 65-B, Tahada). Even those from the Pacific Islands reportedly refused to allow their ocean floors to be the dumping ground of nuclear waste.

In the design for PNPP-1, provision has been made for temporary storage only of used fuel and other nuclear waste classified into:

- 1) the low-level waste which consists of bulky, slightly contaminated materials, such as clothing, industrial trash, sweepings, rags, paper, gloves, with only weak radioactivity;
- 2) the medium or higher level radwaste consisting primarily of process materials like resins, filters and effluents; and
- 3) high level radwaste which consists of radioactive elements contained in the used or spent fuel rods.

The low to medium level radwaste will be reduced in volume, mixed with cement and binder, and then placed in 55-gallon steel drums. This process would be done at great expense and imminent hazard to the personnel. These steel containers are then transferred to the storage building in the site "for about a year before being shipped to an off-site storage facility" (Doc. 16-A, NPC). "During normal operations, the Bataan Nuclear Power Plant would produce in one year alone from 800 to 1000 drums of 55-gallons of low and medium level waste" (p. 6, t.s.n., June 29, 1979, 2:25 p.m.). Considering that NPC has not provided for an off-site storage facility for low-level waste, the crucial problem of waste disposal will arise after only a year of normal operation.

In the case of the high-level waste or spent fuel, the same is stored in the used fuel storage building in the site. As designed, the spent fuel storage water pool for the Bataan Nuclear Plant is 8 meters wide by 16.5 meters long by 12.6 meters deep. The pit can allegedly accommodate storage of at least 15 to 20 years of spent fuel. According to Westinghouse experts,

each spent fuel element weighs approximately 1,200 pounds and forty such elements are removed from the plant every 18 months. The total weight of the spent fuel for one refueling is 24 tons. Thus, on the average, there would be 16 tons of spent fuel to be stored each year.

The spent fuel may also be shipped to a reprocessing facility abroad for recovery of uranium and plutonium and the treatment of the high-level radwaste. Incidentally, the only reprocessing plant in upstate New York is now closed (Exh. 26-A, Tafada). Even if reprocessed, the high level waste produced from the reprocessing are then compacted into solid form in glass or ceramics and returned from the reprocessing center to the Philippines where the final burial or repository of this radioactive waste would be located in a salt or granite formation. It is not denied that nuclear waste remains radioactive for thousand of years.

If not reprocessed, the spent fuel could remain in the fuel storage pit. If already filled, according to Mr. Simmons, another pit may be constructed adjacent thereto, good for use for another 10 years, and still another for the next 10 years, until the normal duration of a

Out of context w/regard  
to Simons' statement

nuclear power plant shall have lapsed.

The statement is incorrect. As stated above, besides the high level waste (the spent fuel), there is the problem of low and medium level waste which must be transferred to an off-site storage after one year. For one year alone, about 1000 drums of 55 gallons have to be disposed of. If not disposed of, the storage building would not be capable of storing the processed low level radioactive waste after 4 years according to the Westinghouse position paper (Doc. No. 14-A, pp. 160-161. Vol. I, Rec.). NPP claims that the Batang plant is capable of handling low to medium drummed solid wastes for only "five years interim storage" (Exh. No. 16-A, p. 211, Vol. I, Rec.).

But this is not all.

Due to the dangerous handling and frequent transfers alone of these low, medium and high level waste, the plant's vulnerability to accidents cannot but be overemphasized. There is convincing evidence that the longest period of storage of high level waste is five (5) years, and this spent fuel would have to be solidified (Exh. 44-Tanada) at enormous expense and deposited in some other places. Where to locate its final

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repository is uncertain.

With respect to high level waste, our attention has been called to an ABC regulation in the United States that required that high-level wastes be solidified after 5 years' storage and shipped to a federal repository within 10 years. Said repository does not now exist in the United States (Exh. 44-A, Tadiada). In the Philippines, our predicament is even more acute as will further be shown below.

Since September 1, 1976, the President by Administrative Order No. 389 created the Inter-Agency Committee composed of the Commissioner of the Philippine Atomic Energy Commission or his representative, as chairman; the chairman, National Science Development Board or his representative, member; the Commissioner of the Budget or his representative, member; the Secretary of Industry or his representative, member; and the Director General, National Economic and Development Authority or his representative, member. After more than three years, this Inter-Agency Committee has not yet chosen the site or exact location in the Philippines where the nuclear waste may be stored.

Nuclear waste cannot just be dumped at the bottom of the sea or buried deep in the land. The repositories must be of salt or granite formation that are self-sealing in the event of an earthquake.

According to the IAEA Technical Reports series No. 177, appended to the Memorandum of NPC as attachment (d), there are two principal reasons for considering certain geological formations as suitable disposable sites for radioactive wastes, namely:

- (1) "They have existed in an undisturbed form over very extended periods of time, up to many millions of years. There is a very high degree of probability that, among them, some will remain stable in the future for similar periods of time;
- (2) "Locally, they can have large volumetric masses with no or negligible amounts of migrating groundwater." (at pages 19-30).

There is adequate proof that for lack of storage of nuclear waste, the Regulatory Commission banned the operation of nuclear plants in four states of the United States (Exh. 13-A, Tahada). The Philippine Atomic Energy Commission had made admissions that "x x x the country being situated in a volcanic belt, we cannot ensure long-term stability of the geologic structures"; that "there is no known stable salt-rock forma-

tion in any of the islands"; that "for this reason, our hopes for long term storage and ultimate disposal of nuclear wastes will be on the establishment of an international burial site" (Prospects and Problems of Nuclear Power in the Philippines by L. D. Ibe and C. R. Alata, Philippine Atomic Energy Commission, Exh. 25-Tahada). Obviously,  
the problem of nuclear waste management as far as  
the Bataan plant is concerned has not yet been  
solved.

NPC would want to simplify the serious problem of waste disposal by advertising to the IAEA Technical Reports Series No. 177 which enumerates several geologic formations other than rock salt also suitable for disposal of solid high-level wastes (p. G-I-9, Vol. 1, NPC Memorandum), NPC also places its reliance on the dissertation of Ernesto N. Mejia of DAEC, chairman of the Inter-Agency Committee on Radwaste Facility Siting. Mr. Mejia claims that the Committee has found possible sites in Palawan, Mindoro, Karanglan, Nueva Ecija, and in Arizaw, Nueva Viscaya, but these places should yet be subjected to seismological examination (p. 19, t.s.n., August 29, 1979, 8:40 a.m.).

The totality of the evidence on the site of the waste repository does not prove that a suitable place has been found. Even Mr. Majia admitted on interpellation that there is no solution in sight to a permanent disposal plan of nuclear wastes, but he is optimistic that technology will develop a solution to the problem (pp. 13-14. t.s.n., August 19, 1979, 8:40 a.m.). In the light of the above admission and the damaging statements of Dr. Aleta and Dr. Ibe of PAEC, it is only fitting and proper that a continuing study be further made of possible sites of nuclear waste in any of our more than seven thousand (7,000) islands.

G. QUEST DR. SO. OR ABOUT A WEEK AFTER THE THREE-MILE ISLAND INCIDENT ON MARCH 28, 1979, I DIRECTED THE MINISTRY OF ENERGY TO REQUIRE WESTINGHOUSE TO SEND EXPERTS TO THE PHILIPPINES TO EXPLAIN DOUBTS THAT HAVE ARisen ESPECIALLY IN THE MIND OF THE PRESIDENT ABOUT THE SAFETY OF THE BATAAN NUCLEAR POWER PLANT. WHY HAS NOT WESTINGHOUSE DONE SO UP TO NOW?

According to the Westinghouse Panel, Mr. Gordon C. Hurlbert, President of Westinghouse, received the letter of Minister Geronimo Velasco dated April 11, 1979, requesting clarification and assurance from Westinghouse. Mr. Hurlbert sent the reply by letter dated April 27, 1979 and directed the Westinghouse experts to proceed to the Philippines. It was only on June 22, 1979 that Westinghouse sent its panel of experts, Messrs. Moore, Sero, Call and Carroll, long after the President of the Philippines had already created this Commission by virtue of Executive Order No. 539 dated June 15, 1979. They presented the TMI-PNPP-1 information to the President on Friday, 22 June 1979\* (p. 102, Vol. I, Rec.).

The above facts have not been contested. They demonstrate unwarranted delay and lack of immediate concern over the safety of the Bataan Nuclear Power Plant under construction.

III

THE SAFETY OF THE SITE

A. BASIC QUESTIONS, ISSUES, POSITIONS AND ANTECEDENTS

A.1 BASIC QUESTIONS

"5. 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 Richter scale, will the Bataan Nuclear Power 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 tectonic origin similar to the tsunami that hit Mindanao in August 1977?

"6. Is the Bataan Nuclear Power Plant located in a fault in the earth's surface?

"7. What is the history of earthquakes in the particular site of the Bataan Nuclear Power Plant?"

The above-quoted questions in Letter of Instruction No. 876, which the Commission has been directed to obtain answers to, all deal with the safety of the site selected for the

construction of the Bataan Nuclear Power Plant  
solely from the point of view of seismicity.  
Question No. 5 asks if the Bataan Nuclear Power Plant can withstand an earthquake of 7.2 intensity on the Richter scale. The second sentence of the same question refers to a tidal wave or tsunami that can be caused by such an earthquake of tectonic origin. While Question No. 6 refers to the probable existence of a fault in the earth surface, the materiality of such finding is only with respect to faults it being the most natural source of earthquake. Question No. 7 expresses concern about the probability of earthquakes in Bataan as deduced from similar events in the past.

Considering that Executive Order No. 539 directs the Commission "to conduct an inquiry on the safety to the public of the proposed nuclear plant", the Commission looked into other factors that could affect the suitability of the site of the plant from the point of view of safety considerations. It received evidence not only on the matter of the effect of earthquakes at or near the plant, but also on related

matters, such as, the geological features of the plant site, its nearness to population centers, and the danger posed by nearby volcanoes.

#### A.2 THE SITE LOCATION OF THE BATAN NUCLEAR POWER PLANT

After an extensive analytical investigation by the agencies involved, it was decided by them to construct the nuclear plant at Napot Point, a small peninsula about 2 kilometer long and 400 to 500 meters wide, located on the West Coast of Bataan province, and within the jurisdiction of the town of Morong. There are two major volcanic centers nearby, Mt. Natib volcanic complex about 9 kms. northeast of the site, and Mt. Mariveles, approximately 22 kms. to the southeast. After Napot Point was graded from its original height of about 35 meters above mean sea level, the site area is now 18 meters above mean sea level.

The selection of Napot Point was arrived at after a process of elimination among several sites in Luzon, it being the intention to build one or two nuclear power plants near Manila to supplement the Luzon Grid. The selection process started in 1965 when the Philippine Atomic Energy Commission

(PAEC), with the assistance of an advisory panel of experts of the International Atomic Energy Agency (IAEA), considered several candidate sites which included Bagac and Limay in Bataan peninsula, and Atimonan and Padre Burgos in Quezon province. Two other candidate sites, to wit, San Juan in Batangas and Ternate in Cavite were later included in the evaluation. Even as of that time, it was considered that the most critical and important parameter in the selection of the site for a nuclear plant in Luzon was the question of seismicity. Of the candidate sites mentioned, the Bagac area was rated as the most favorable. It was, however, recommended that efforts should be undertaken to resolve its remaining seismological uncertainties and that further studies be made on the matter of geologic faulting potential and volcanism.

In September, 1974, the National Power Corporation (NPC) engaged the services of EBASCO SERVICES INC. of New York, U.S.A. for the latter to provide consulting services associated with the siting of the Bataan Nuclear Plant. Based on the report of prior investigations, the Bagac area was determined by EBASCO to be the most desirable, and six specific sites in the said area were

subjected to a siting analysis. On the basis of the several factors considered in said siting investigation, Napot Point was adjudged to be the most acceptable.

At the time Napot Point was definitely chosen to be the plant site, the development of the housing area near the town of Bagac, some 19 kms. away by road from Napot Point was well underway. This was because the original site was intended to be at a place located near the town of Bagac, but it was later abandoned due to its being vulnerable to floods and high tide. The housing area of the personnel to man and operate the plant is accordingly situated some 19 kms. away by road from the plant site itself.

A.3 THE ISSUES INVOLVED IN QUESTIONS NOS. 5, 6 and 7

As stated earlier, the principal issue raised by Questions No. 5, 6 and 7 of LOI No. 876 is on the effect of earthquakes on the nuclear plant in Napot Point. Earthquakes being of varying intensities and magnitudes. Question No. 5 postulates an earthquake of 7.2 "intensity" (should be "magnitude") on the Richter

scale or similar to the one that hit Mindanao in August of 1977. The plant having been allegedly designed to withstand the shock of the largest possible earthquake that can affect Napot Point, the issue arises as to whether the design value adopted in the construction of the plant was adequate enough to withstand the effect of such an earthquake. It being an admitted fact that earthquakes are generally produced by the movement of the earth crust in geological features known as faults, it further becomes necessary to inquire whether there are faults at or near the plant which are active or capable of producing large magnitude earthquakes. It being also admitted that earthquakes may occur on any area unrelated to a known fault, in which case it is called a "floating or random" earthquake, the further question is: Is there a possibility of a large magnitude random earthquake to occur at or near the plant site? The question of tidal waves or tsunamis is intimately related to the presence of faults and occurrence of earthquakes; they being usually generated by earthquake activity.

It is also undenied that earthquakes can

be caused by volcanic eruption. Aside from such an earthquake, it is further conceded that a volcanic event can cause ground shaking, tilting, as well as other volcanic hazards, such as, lava flow, mudflow, lahar, and ashfall.

We accordingly formulate the underlying issues raised by Questions Nos. 5, 6 and 7 in the following manner:

- (1) Is the occurrence of a large earthquake of at least 7.2 magnitude on the Richter scale a credible event at or near the plant site, whether associated with a fault or not, and if so, how would it affect the plant?
- (2) In the affirmative case, would the seismic design of the plant be sufficient to withstand the effect of such an earthquake?
- (3) Is there any possibility or probability of volcanic eruption from either Mt. Natib or Mt. Mariveles; and, if so, what would be its effect on the plant?
- (4) If a tidal wave or tsunami caused by an earthquake similar to the one that hit Mindanao in August, 1977 would occur at Napot Point, can the plant withstand its effects?

#### A.4 THE POSITIONS TAKEN BY THE PARTIES-PARTICIPANTS

All the major parties-participants that appeared before the Commission submitted position papers on the issues of seismicity and

volcanism; namely, the National Power Corporation and its consultant EBASCO Services Inc.; the Philippine Atomic Energy Commission (PAEC); Westinghouse; the Commission on Volcanology (COMVOL); the Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA); the Bureau of Mines; the Tanada Panel; the Batasan Chapter of the Integrated Bar of the Philippines Panel; and the National Society for Seismology and Earthquake Engineering of the Philippines (NSSEEP). The said parties-participants took well-defined positions on the aforementioned issues. They may be roughly classified into two groups: one, responding to the said issues in a manner to allay fears from earthquakes and volcanic eruptions (which we shall hereinafter refer to as the Proponents); and the other, contending the existence of the hazards arising from earthquakes and volcanic activity that can seriously affect the plant and cause nuclear accidents (which we shall hereinafter refer to as the Oppositors). The proponents include the National Power Corporation, EBASCO, Westinghouse and PAEC. The oppositors are composed of the Tanada panel, the Batasan panel, and the NSSEEP. The rest of the parties that actively participated in the issues of seismicity

and volcanism, namely, Bureau of Mines, CONVOL and PAGASA, have taken a neutral attitude and their views were selectively adopted by the proponents and the oppositors insofar as they appear to be consistent with their own respective positions.

B. THE STAND OF THE PROPOONENTS

B.1 On Seismicity

The proponents' position on seismicity was defended mainly by ERASCO which was the consulting firm that gave the go-signal for the siting of the plant at Napot Point. The rest of the proponents rely principally on ERASCO's view on the question of seismicity.

In brief, the proponents contend that a large magnitude earthquake, or specifically one with a magnitude higher than 7 on the Richter scale, is an unlikely event in Napot Point. They base this conclusion mainly on the assumption that there are no active faults from which such earthquakes can originate which are close enough to the plant site. They advert to the fact that Bataan is located in the area called "CENTRAL LUZON TECTONIC PROVINCE", a tectonic plate bounded on the north and east by the Philippine Fault which lies somewhere north of Pangasinan going southeastward towards the Bicol peninsula; on the west by the so-called "MANILA TRENCH" located about a 100-km. west of Zambales and Bataan peninsula; and on the south by the Taal Fracture Zone which cuts

from the northwestern tip of Mindoro going north-eastward until it joins the Philippine Fault. Using as basis the lengths of the said faults, and assuming the rupture of the same to be 600 which is considered conservative enough, it is argued that the highest calculated earthquake magnitude from said faults could only be 7.9, and this is the one originating from the Manila Trench. The Manila Trench being the west boundary of the tectonic plate known as the Central Luzon Tectonic Province; it has a subducting zone that goes beneath Bataan Peninsula, at an angle estimated to be around 45 degrees. Assuming an earthquake of magnitude 8 on the subducting zone, and taking into account that fact that the nearest distance of the subducting zone to the plant site is about 70 kilometers, the maximum horizontal acceleration that can be produced by such an earthquake at Napot Point was rated only as 0.35g. This is what is known as the design value of the plant or the "safe shutdown earthquake" (SSZ), which is supposed to mean the kind of earthquake that could permit the plant to be shutdown without danger of causing an accident.) If there will be a movement on a 600-km. segment of the Philippine Fault and the same will

produce an earthquake with a magnitude of 8.4, its effect at Napot Point would only produce an acceleration value of 0.18g, inasmuch as the nearest distance to the site of the Philippine Fault is 160 kms. away. With respect to earthquakes that may be generated from the other known faults within the Central Luzon Tectonic Province, such as, the Iba Fracture Zone, the San Antonio Fracture Zone and the Manila Bay Fracture Zone, as well as the West Luzon Trough, it is not deemed probable that they would be of sufficient magnitude in view of their short lengths, such that, even if a 100% rupture is assumed in those faults, the acceleration value at the plant would be less than 0.35g. Although, theoretically, the West Luzon Trough (situated 30 kms. west of Napot Point) can produce an 8-magnitude earthquake, such event would only be possible if there would be a 100% or total rupture of the entire length of said fault, which is deemed unlikely.

The proponents discount the possibility of large magnitude random or floating earthquakes at or near the plant site, it being alleged by them that all the significant earthquakes that

have affected the area were traceable to one of the aforementioned known active faults. The proponents further contend that a study of the catalogues prepared by local experts, as well as information on earthquake data compiled by the U.S. National Oceanic and Atmospheric Administration, would show that, historically, only one earthquake was recorded to have been felt exclusively in Batangas and it was a light intensity earthquake of short duration located at Balanga which occurred on August 9, 1961 at 1:00 A.M.

Proponents point out that, although the design value of the SSE assigned to the Batangas Nuclear Plant was only 0.35g, Westinghouse designed the plant on the basis of 0.4g SSE as a measure of conservatism and added safety factor. It is claimed that no earthquake can occur at the site or be felt therein that could produce an acceleration value higher than 0.35g.

#### B.2 On volcanoes

Proponents give the assurance that there is no threat to the safety of the plant arising from the presence of nearby volcanoes, particularly Mt. Matib which is just 9 Km. away from the plant site. It is claimed that Mt. Matib, as

well as Mt. Mariveles, are already extinct, their large activity, as determined by the age of the volcanic rocks in the vicinity being over 70,000 years ago. It was further opined by EBASCO that should there be any activity of Mt. Natib or Mt. Mariveles, such eruptions would occur only on the eastern flank of Bataan Peninsula, there being no historical evidence of any activity on the western flank for several hundred years. It is further claimed that, even if Mt. Natib shall erupt, the plant would not be affected by rock projectiles nor by lava flow because of the distance, nor of mudflow and lahar because of the natural barriers that would protect the plant site from the same; and that with respect to ashfall, it is not expected that it would be of such intensity or thickness as to damage the plant.

#### B.3 On Tsunamis

Proponents allege that, even if a tsunami similar to the one caused by the earthquake in Mindanao of August, 1977 shall occur at Napot Point, the same would not damage the plant. This is because the plant site is 18 meters above sea level, and the records show that the tsunami produced by the Mindanao earthquake had been esti-

nated as having maximum heights of between 7 to  
17 meters only.

### C. THE STAND OF THE OPPONENTS

#### C.1 On Seismicity

It is the contention of the opponents that large magnitude earthquakes can occur at or near the plant site. This conclusion is deduced from several factors, namely, (1) the history of earthquakes in Bataan shows that the said province had been hit by several large earthquakes in the past; (2) there are several faults at or near the plant which can cause large magnitude earthquakes, the existence of some of which are admitted by the proponents, while the others have not been subjected to sufficient investigation to verify whether or not they are faults or whether they are seismogenic faults; (3) the occurrence of random or floating earthquakes at or near the plant site may not be summarily dismissed due to the lack of adequate study made on the matter; (4) the design value or SSE of 0.4g is erroneous, inadequate and not conservative enough, the same having been derived by considering misleading data and inapplicable factors; and (5) even if the earthquake that can be felt at the plant site would not be large enough to exceed the SSE, it can seriously damage the plant and its

delicate mechanism, especially if the tremor is of sustained duration, and thereby cause a nuclear accident.

C.2 On volcanism

Opponents expresses the view that Mt. Matib constitutes a constant threat to the safety of nuclear plant at Napot Point. The said volcano is not extinct or dead, but merely dormant. Opponents likewise disagree with the opinion of EBASCO that volcanic activity from the two volcanic complexes in Bataan Peninsula may only occur in the east flank or away from Napot Point.

C.3 On Tsunamis

Opponents contend that even if the tidal waves that can hit the shores of Napot Point will not rise higher than the 18-meter elevation of the plant site, a possible danger arising from a tsunami could arise in the event of "withdrawal" of the tidal wave to the sea, which event would expose the pipes which are intended to draw about 20 million gallons of sea water per minute as part of the cooling system of the plant. It is argued that, if the said pipes shall fail to draw water, serious injury may result to the operation of the plant.

D. THE EVIDENCE PRESENTED BY THE PARTIES

D.1 On Seismicity

The safety of the plant sites, from the point of view of seismicity, has been the prime concern of all of those involved in the said project ever since its inception. The LMEA Siting Mission, which had been requested by PAEC to conduct a feasibility study for a nuclear plant in Luzon, had expressed the view that "the most important and critical parameter in the siting and design of the nuclear plant in Luzon was seismicity" (Exhibit 16-NPC, p. 3). The said Siting Mission further observed "that it could be prudent to consider possible ground failures in the conclusion of a nuclear power plant unless investigations are carried out whose results would exclude this danger" (Ibid. p. 9).

The subsequent feasibility study recommended by the Siting Mission, as conducted by NPC-EMASCO resulted in the choice of the Bayac micro-region (which included Sapot Point). The said micro-region was considered most favorable allegedly "because no faults had been found in that area despite ongoing intensive investigations in the

"vicinity of Bagac; and that Bataan Peninsula has an area of low seismic activity in comparison to other regions in the Philippines" (Ibid, pp. 17, 18).

Not satisfied with said finding, PABC requested the IAEA to send a Safety Mission to the Philippines to review the geological and geotechnical aspects of the site and its environment. This Mission visited the Philippines from May 1 to 9, 1978 and met in Vienna from July 3 to 7, 1978. In its Report (Document No. 12-B), the Safety Mission expressed the view that, upon a review of the data contained in the PSAR, "certain of the postulated maximum earthquakes should be more conservatively interpreted". It was opined that a magnitude 7.5 to 7.8 earthquake can reasonably be postulated to occur in the San Antonio Fracture Zone. A magnitude 8 earthquake can also be reasonably postulated to occur directly on the top of the subducting slab at its closest approach to the site in a depth of 50 to 70 kms., contrary to the view expressed in the PSAR that a magnitude 7.9 event can occur only at a distance of 100 kms. west of the site or, approximately, where the Manila Trench is located. It was further averred by the Safety

Mission that a 7.5 magnitude earthquake could reasonably be postulated to occur on the Manila Bay Fracture Zone. It was accordingly recommended that additional work should be done to determine particularly the occurrence of the postulated earthquake beneath the site on the subducting slab of the Manila Trench which goes beneath Bataan peninsula and which might control the earthquake design basis for the plant. The Safety Mission disagrees with the opinion of EPC-BEASCO that a floating earthquake of a magnitude greater than 4.5 may not occur at the plant site (at p. 4).

The Safety Mission Report made reference to discussions with Dr. Ernesto Sonido, the PAEC consultant on geology, who expressed the possibility of a shore parallel fault system approximately 15 to 20 km. offshore the plant, which fault, in the opinion of the Safety Mission, should be taken as a source of a maximum earthquake in developing the seismic design basis for the plant (*Ibid.*, p. 6). The Safety Mission observed that additional effort should have been made to study the micro-earthquakes in the region as well as in the assessment of faults and overall seismic risks, citing as particular examples

the minimal investigations of some of the linearas as well as thermal springs in the area.

After studying the IAEA Safety Mission Report and its recommendations, several consultative meetings were held between PAEC and NPC regarding the concerns expressed by the Safety Mission. The issues were defined to be on the vibratory ground motion, random shallow earthquakes, and foundation engineering as well as that concerning volcanism. Evaluating the responses of NPC on the concerns expressed by the Safety Mission, it was concluded that the said concerns had been satisfactorily addressed by NPC and that PAEC feels reasonably assured that the 0.4g SSZ value could be adequate (Document No. 12-C).

The occurrence of earthquakes that will be felt at the plant site is not disputed. It is a generally known fact that the Philippines lies in a region of high seismicity, it being on the direct line or the so-called "CIRCUM-PACIFIC BAND OF FIRE" which had been the source of destructive earthquakes in the west coast of South and North America, Northern Pacific, Japan, and down to the Philippines. Dr. Alcaraz of NPC has opined that, relatively speaking, the Philippines

- has the highest seismicity among the ten countries in the world most visited by earthquakes during the 19th century (Exhibit 36-Taneda). The controversy on this point is whether a high magnitude earthquake can occur or be felt at the plant site and damage the plant and its components, despite its having been designed to withstand an earthquake with a maximum horizontal acceleration of 0.4g. It is the opponents' position that such an earthquake is a credible event due to the probable existence of capable faults near or at the site, as well as the possibility of earthquakes originating from a subduction slab just beneath the plant site, as well as the probability of random or floating earthquakes in the area of the site. It is not denied that earthquakes are generally generated by the movement of active faults and that they can also be occasioned by the movement of a subduction slab. Neither is it disputed that earthquakes may not be associated with any fault or tectonic feature, in which event it is called a "random" or "floating" earthquake.

The opponents do not to the claim of the proponents that the only large magnitude earthquakes that can affect Batsan peninsula are

those originating from the faults constituting the boundaries of the Central Ilocos Tectonic Province, namely, the Philippines Fault, the Manila Trench, and the Teal Fracture Zone. They contend that the other faults within the Central Ilocos Tectonic Province, the seismogenicity of which is minimized by the proponents, may just as well produce large earthquakes, namely, the Iba Fracture Zone, the San Antonio Fracture Zone, and the Manila Bay Fracture Zone (Exhibit 3-NPC). In addition, there is a 400-kilometer fault running north to south along the eastern part of Zambales Mountain to Mindoro and passing just 25 kms. east of the plant site. This fault was not considered at all by ERASCO and is not mentioned in the PSAR prepared by it. Its existence is deduced from the published studies of Dr. Arturo Alcaraz, former head of COMVOL and who is presently a consultant of NPC. In the article entitled "MAJOR STRUCTURAL LINES OF THE PHILIPPINES" published in the PHILIPPINE GEOLOGIST, issue of March 1947, Dr. Alcaraz listed among the said major structural lines the aforementioned fault which he designated as "Line E-E" on the map, Exhibit 36-C-Tanada. In the same article, Dr. Alcaraz stated that a major structural line is one along which major diastrophic

movements had occurred and may yet occur; and that the Philippines is "seismically active", having experienced in the past both minor and destructive earthquakes and will do so in the future, the Philippines being crisscrossed by many planes of weaknesses along which faulting has occurred or may occur.

With respect to the existence of faults at the plant site itself, the oppositors advert to the showing made by the Bureau of Mines in its position paper (Document No. 22), which revealed the existence of three "lineaments" traversing Napot Point. While it is true that lineaments do not necessarily show the existence of an active fault, it is also admitted that it is a manifestation of such a fault. This suspicion is heightened by a noticeable ~~slippage~~ in a portion of Napot Point identified as Outcrop "B", and a "slickenside" in another ~~area~~ identified as Outcrop "A" located just 100 meters from the plant site. A "slickenside" manifests movement of the ground and is technically a fault although, by itself, cannot be considered an active fault that can produce earthquakes.

Reliance was further placed by the oppositors on the position paper of the PAGASA (Document No.

20) which listed 17 earthquakes felt in Bataan since November 30, 1965 up to April 7, 1970 with intensities ranging from 4 to 10. Of the first 7 earthquakes listed, which had been rated with intensities of 8 to 10, the epicenters were not identified nor the felt intensity in Bataan specified due to the lack of instrumentation when those earthquakes occurred. The last 10 earthquakes, the first of which was in 1937, had the benefit of instrumentation and the corresponding magnitudes at the epicenters were stated, as well as their effects or intensities in Bataan. The listing shows that the earthquake in Alabat Island in 1937 with a magnitude of 7.5 on the Richter scale; the Verde Island earthquake of April 8 1942 with a magnitude of 7.7; and the Casiguran earthquake of August 2 1968 with a magnitude of 7.3 produced intensity 6 in Bataan Province, with respect to the earthquake of September 15, 1952 which affected Manila and adjacent provinces and was assigned Intensity 9, the damage produced in Bataan was considerable. It ruined the church and the parish houses of Orani, with the tower completely demolished, and produced extensive damage in the churches and parish houses of Abucay, Linza and Balanga. A record of the same also.

revealed that an Island in Subic Bay sunk as a result of that earthquake.

Through the testimonies of its expert witnesses, Mr. David J. Leeds and Dr. Ernesto V. Sonido, the oppositors sought to confirm the existence of geological features, both onshore and offshore Bataan Peninsula, which are indicative of the probable existence of active faults at or near the plant sites. No definite conclusion could, however, be deduced as to the actuality of those features being active or capable faults, such a determination being only possible after a thorough and extensive investigation of the matter which had not been sufficiently been undertaken.

On the question whether the plant at its sites could withstand an earthquake with a horizontal acceleration force of 0.4g, the oppositors avail of the position paper and the testimony given by Capt. Andres O. Rison of the NSSEXP who expressed the view that the site design value is inaccurate and inadequate. His principal reasons for this conclusion are that the magnitude of the earthquakes that can occur at the plant site is much higher than the one utilized by the proponents in calculating the design values; that the magnitude of

the postulated earthquake is incorrect, inasmuch as the Mindanao earthquake of August 1977 was of Magnitude 8 and not Magnitude 7.2, in which case if the computation was based on Magnitude 8, the design value would at least be 0.65g; and that the formula used in arriving at the design value of 0.4g is inapplicable to the Philippines, it being based on conditions existing in Eastern United States, instead of those obtaining in California and Japan which are more analogous to the Philippines. Capt. Hizon further declared that he devised a formula for arriving at the acceleration value in collaboration with Mr. Sergio Su of the Manila Observatory based on Philippines' conditions, pursuant to which, the design value or safe shutdown earthquake (SSE) would be much higher than 0.4g.

Opponents cite a book by four American authors entitled "GEOLOGICAL HAZARDS" to show that peak acceleration is not necessarily dependant on the magnitude of the earthquake, as exemplified in the 1972 earthquake in the San Andreas fault (California), which had a magnitude of only 4.7 but yielded a ground acceleration of 0.69g. 10 kms. from the source; and by the earthquake in Arizona, Italy with a magnitude of 4.5 but gave a recorded

peak acceleration of 0.6g (Exhibit 67, 67-E, Tañada). It was further pointed out that in estimating the design earthquake value, it is not enough to consider maximum acceleration alone, but also the duration of strong shaking (*Ibid*). The computations made by the proponents on the design value do not appear to have taken into account the duration of earthquakes felt in Bataan, such factor not having been recorded in any of the catalogues of earthquakes in the Philippines presented before the Commission.

As against the claim of the proponents that Bataan is "seismic" and that no large recorded earthquake had its epicenter in the said province, the oppositors presented a map prepared by the Office of the International Decade of Ocean Explorations of the National Science Foundation (1978) of the geophysical aspects of the East and Southeast Asian Seas (Exhibit 55-Tañada) which shows among others, that an earthquake had been recorded to be with its epicenter in Bataan peninsula, Exhibit 55-A-Tañada. This was confirmed in another map presented by Dr. Soaido (Exhibit 63-Tañada) which shows the same earthquake epicenter in Bataan peninsula to be with magnitude of between 4.6 to 5.5 with a depth of 70 to 150 kms.

Atty. Jaime Guerrero of the Batang Chapter of the Integrated Bar of the Philippines, one of the oppositors, declared that when he accompanied David J. Leads to Napot Point on August 15, 1979 in the company of some officials of the NPC, he noticed several disturbing features about the stability of the ground in the site area. There being a typhoon on that day, there were several landslides which caused some fatalities. A one-hectare land in Bagac sank by reason of an earthquake that hit Morong on August 10, 1979. Napot Point itself was isolated due to the road leading to it having been washed away, causing a 20-meter chasm which the party of Atty. Guerrero had to cross by going up and down stiff cliffs. He further declared that Grande Island in Subic Bay which used to be very closed to the mainland and could be reached by wading carabao is now about a kilometer away from the mainland.

The seismicity of the plant site is sought to be belittled by the proponents by showing that NEASCO conducted an extensive investigation of the site area, which investigation resulted in the finding that no capable fault exists at or near Napot Point. It was acknowledged that they

encountered signs of possible faulting and, for this reason, to ascertain the actuality of such possibility, several trenches were dug as well as other procedures adopted, all of which failed to show the existence of a capable fault at the plant site. The burden of the proponents' evidence on the probable occurrence of a large earthquake that could seriously affect the plant consists in expert opinion which tended to show that such an event is improbable and incredible. It is theorized by the proponents that large earthquakes could only occur on the known capable faults which lie on the boundary of the Central Luzon Tectonic Province and which are far enough, such that the effects of such earthquakes at the plant site would already be clearly reduced; that if earthquakes occur outside of the Central Luzon Tectonic Province, their force would be attenuated upon reaching the aforementioned boundaries; that while earthquakes may be produced in the minor faults located within the tectonic province, they are not expected to be of a magnitude that could damage the plant with its design value; and that the probability of floating or random earthquakes on the site area or in a nearby region is remote, considering the history of earthquakes in Bataan.

peninsula which showed that all of the large earthquakes that affected Batasan could be assigned to one of the known capable faults surrounding the Luzon Tectonic Province.

B.2 On Volcanism

The Oppositors presented no evidence of their own on the possible danger arising from the presence of volcanoes near Napot Point. They rely mainly on the statement expressed by COMVOL that it "shares the view of the IAEA Safety Mission that the danger posed by 'a renewed volcanic activity of Mt. Natib volcanic complex exists'" (Document No. 17).

As against the claim of ERASCO that any volcanic activity in the peninsula would only be on the east flank of Mt. Natib, or away from the plant, COMVOL expressed the belief "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, Batasan having formed by the coalition of two dormant volcanoes - Mt. Natib and Mt. Mariveles".

Further reliance is placed by the oppositors

on the IAEA Safety Mission Report (Document No. 12-B) which made the observation that the Nopote site is "unique" to the nuclear industry with respect to risks associated with volcanoes, it being the only nuclear power plant located 9 kms. away from a volcano; and that the only modern nuclear plant which had been designed to account for volcanic eruption being the Pebble Springs Plant in the United States located 123 kms. from the nearest volcano. While the Mission observed that ERASCO had done a creditable work in the investigation of the volcanism issue, it also believes that there is still a great deal of uncertainty as to the renewed volcanic activity of Mt. Natib, and that the formation of a new volcanic center on the west flank of Mt. Natib is not considered to be incredible. It was concluded by the Mission that the hazards associated with such an eruption, such as, ashfall, impact of volcanic ejecta, flow of avalanches, overflowing gas, ash emissions and gas accumulation, as well as laharic modification should be taken into account.

The oppositors, through the testimony of Atty. Guerrero, also showed that a thermal spring lies at the foot of Mt. Natib which, as admitted

by COMVOL, is a sign that the said volcano is not extinct. The existence of said thermal spring has also been noted by the IAEA Safety Mission Report and the PSAR.

The danger posed by volcanoes does not seem to be denied by the proponents. In the PSAR, it was stated that over two dozens volcanic centers had been identified within the boundaries of Central Luzon Tectonic Province. However, it is claimed that, except for Taal, Banahaw, and San Cristobal, all are inactive including Mt. Matib and Mt. Mariveles. It is further claimed that, judging by the examination of the sampled volcanic products in the region, it is theorized that if any volcanic eruption will occur in Bataan peninsula, it will be towards the eastern side, or farther away from Napot Point which is on the west coast of Bataan Peninsula. It is admitted, however, that "in view of the proximity of the Mt. Pinatubo, Mt. Mariveles and Mt. Matib volcanic complexes to the sites, and the volcanic activity at Taal, the potential effects of possible volcanic activity must be considered" (PSAR, Vol. 3, p. 2.5.1-38). Although it is admitted that earthquake can be caused by volcanic eruption, it is claimed that

they are relatively small not exceeding magnitudes 4 to 5, and would affect only a limited area. It was concluded that volcanic earthquakes are unlikely to be a hazard (Ibid, p. 2.5.1-41).

#### D.3 On Tsunamis

The proponents presented evidence to show that the highest tsunami produced by the August, 1977 Mindanao earthquake did not reach a level equivalent to 12 meter above mean sea level which is the elevation of the plant site. Photographs were presented to show that houses of light materials located along the seashores affected by the tidal wave were not seriously damaged by the same. The opponents failed to present any proof that could show that the tsunami produced by an earthquake near Batangas can affect the plant at its stated elevation. Nor was any evidence presented to sustain the fear that the withdrawal of the tidal wave would impair the functioning of the pipes laid out in the sea to draw water therefrom as part of the plant cooling system.

## E. DISCUSSION OF THE EVIDENCE

### E.1 On Seismicity

The concern voiced by the oppositors as to the safety of the plant site has evoked the need for a meticulous inquiry into the actuality of the hazards posed earthquakes, volcanic eruptions and tsunamis on the plant site. The Commission was confronted by a mass of evidence, both testimonial and documentary, which, quite expectedly, are as contradictory as the positions taken by the proponents and the oppositors on virtually all the questions asked in LOI No. 875. As one expert puts it, the whole question boils down to one of credibility.

The oppositors maintain that the plant can be seriously affected by a large earthquake with a magnitude of 7 or 8 on the Richter scale that can occur at the plant site. This claim is disputed by the proponents for the reason that their studies and investigations have failed to reveal the existence of a seismogenic fault within 10 kms. of Napot Point from which such an earthquake can originate, and there is no history of even a

medium-sized earthquake that had occurred in the area. The root question has become a determination of whether or not there are active faults close enough to the plant site from which a large magnitude earthquake can be produced.

There is no issue as to the existence of the faults which had been identified and admitted by both parties, to wit, the Philippine Fault, the Manila Trench, and the Taal Fracture Zone which constitute the boundaries of the tectonic plate known as the "Central Luzon Tectonic Province". Within the said tectonic plate, the proponents admit the existence of other faults, known as the Iba Fracture Zone, the San Antonio Fracture Zone, the Manila Bay Fracture Zone, and the West Luzon Trough. Proponents, however, contend that, considering the distance of the said faults to Napot Point, the nearest of which is about 30 kms. away, and the short lengths of the same, it is not imagined that they could produce large magnitude earthquakes to seriously affect the plant sites.

The oppositors, on the other hand, have opined that, in addition to the faults mentioned above, there are still unknown faults at the plant

site/close to the same which could be the potential source of large earthquakes.

The presence of visible manifestations of geological features which could be signs of the existence of a fault has been admitted by the proponents. ERASCO had accordingly conducted an examination not only of the known faults but also of the postulated ones and the lineaments within a radius of 200 kms. from the plant site. They identified the linear features by landsat imagery, aerial photography and by other sophisticated methods, after which, field investigations consisting of mapping, trenching, exploratory borings and other procedures were conducted. The result of said examination is reflected in several volumes of the PSAR. The study came up with the conclusion that there are no active faults within 10 kms. from the plant site.

On the question of the existence of the postulated faults, the Commission sees no convincing proof to warrant a categorical finding.

The oppositors could merely rely on geological features which could be a manifestation of the existence of a fault, such as, lineaments and slickensides. It is conceded, however, that

they are not necessarily indicative of the existence of faults, much less of active or seismologic faults, unless proper investigation and analysis shall have been conducted to verify their true nature. Such study has not been undertaken by any of the oppositors. On the other hand, a verification of the supposed faults had been done by EBASCO for a period of about two years which has involved six U.S. geologists and an equal number of Philippine counterpart geologists. Between one who merely suspects or postulates, and another who had actually verified the existence or non-existence of the supposed faults, the choice is not hard to make.

Oppositors capitalize on the showing made by the Bureau of Mines as to the existence of certain "lineaments" at Napot Point as determined by satellite photography. A photo lineament is said to be "any line on aerial photographs that is structurally controlled, including any alignment of separate photographic images, such as, stream beds, trees or bushes that are so controlled". The investigations and analysis of said lineaments had been previously undertaken by EBASCO and the result of such study is contained in the PSAV.

The Bureau of Mines, however, called attention to two other geological features which could be indications of faulting, which it had identified as Outcrop "A" and Outcrop "B" in separate places at Napot Point where a fissure and a slickenside had been noticed, respectively. To verify their true nature, a field inspection was conducted by PABC and NPC-ERASCO. In their joint report, it was stated that neither of the two outcrops could be considered a seismogenic or tectonic fault; they being very small in size and do not continue at depth. Mr. David J. Leeds, the expert witness presented by the oppositors who also inspected the said features during his visit to Napot Point, has admitted in his memorandum that neither of the two outcrops appears to be a seismic threat to the site.

With respect to the lineament or structural line which was postulated by Dr. Alcaraz in his paper published in 1947 and identified by him as Line "H-H" strating from Lingayen Gulf going southeast on the eastern flank of Zambales Mountain to Cavite, Batangas, Mindoro and up to Tablas Island, it had been explained by Dr. Alcaraz that his further studies on the matter

convinced him about the error in his previous theory regarding the same. Moreover, the said structural line was postulated some 30 years ago when geologists were unaware of the "trench system" which would make it impossible for such a structural line to cross known faults, like the San Antonio Fracture Zone and the Manila Bay Fracture Zone.

On the assumption that there are no known active faults at the plant sites, the only possibility of an earthquake located thereat would be what is know as a "floating" or "random" earthquake. No evidence was presented before the Commission to show that such a kind of earthquake with a magnitude that can produce an acceleration higher than  $0.4g$  has ever occurred at the sites. On the contrary, all the large and medium-sized earthquakes that had affected Bataan peninsula had been traced as having originated from one of the known faults aforementioned.

As aforesated, the largest earthquake that can occur from a known active fault that can affect the plant site is the one originating from the subduction zone of the Manila Trench which, at its nearest point, is 70 kms. below Napot Point. A magnitude 8 earthquake from this source has been

postulated in the computation of the SSE. The earthquakes that can originate from the other faults will be much weaker as felt at the plant site, either because of their distance or the relatively low capability of the faults of origin.

The possibility of earthquakes occurring at  
or affecting the plant site does not necessarily  
mean that a nuclear power plant may not be  
constructed thereat. There are several nuclear plants which had been established in places where earthquakes are a common occurrence, such as those in Japan, Mexico, and California, U.S.A. What matters is whether the plant is designed to withstand the effects of the largest possible earthquake that can occur at the plant site. A nuclear power plant is supposed to be designed to withstand, among others, the pressures that can be produced by earthquakes. It is assigned an earthquake design value otherwise known as the "SAFE SHUTDOWN EARTHQUAKE" (SSE), which is said to be the kind of earthquake that would permit the plant to be shutdown without damage to its component parts used in its normal operation.

The peak acceleration at the plant site was determined by EBASCO to be 0.35g. As an added

safety factor. Westinghouse increased the design value to 0.4g. The sufficiency of this design value was sought to be questioned by the oppositors who claimed that it should have been raised to at least 0.65g. The difference of opinion on this matter is due to the use of different formulas or attenuation curves in arriving at such acceleration value. The Commission has not been sufficiently convinced that the acceleration value used in the design of the plant was not adequate or conservative enough. It is an admitted fact that by raising the design value of the plant would mean an additional outlay of several tens of thousands of dollars which could prove totally unnecessary and would only make the plant to be overdesigned.

There is no historical record of a significant earthquake that had occurred in Napot Point. The evidence presented by the parties would tend to show that one or two earthquakes had been epicentred in Bataan Province, but they are of medium magnitude estimated to be around 4.5 on the Richter scale. The oppositors presented a recorded account of an earthquake that affected Manila and surrounding provinces on September 16, 1852 which caused

considerable damage in Manila and, with respect to the province of Bataan, resulted in the churches and parish houses of Abucay, Limay, Mariveles, and Balanga to sustain considerable damage, and in Zambales resulted in the sinking of a hill in Subic Bay. There was no account of the effect of the sand earthquake in Morong or in any other town in the western side of Bataan province. Neither was there proof of the location of the epicenter or the said earthquake, apparently due to the lack of instrumentation which did not become available in the Philippines until the early years of the American occupation. Opponents further rely on a map of the Philippines prepared by Father Indalecio Razo of the Philippine Weather Bureau, published by the Bureau of Census in 1904, showing the volcanoes and seismic centers in the Philippines, wherein it is indicated that Bataan is in the region where earthquakes were "very frequent". The accuracy of this map is readily open to question in the light of subsequent findings that earthquakes in the Philippines had been concentrated along the Philippine Fault and other known faults. The said map creates the misleading impression that there were more earthquakes in Bataan Province than in the places

-traversed by the Philippine Fault. Even the map identified by Dr. Ernesto Sonido of the U.P. Department of Geology, who was presented as witness by the oppositors, shows that only one earthquake of magnitude 4.6 epicentred in Batasan peninsula.

### 3.2 On volcanism

The only unrest posed by volcanism is a possible eruption of Mt. Natib located just 9 kms. from the plant sites. In its original position paper, the Commission on Volcanology had expressed the view that the danger posed by a renewed volcanic activity of Mt. Natib exists. In its memorandum, however, COMVOL gave the modified view that, while it admits the possibility of an eruption of Mt. Natib, "the probability of such an event to happen is very low". It also expressed its concurrence with the view of NPC-ERASCO that the probability of such eruption on the west flank of Mt. Natib is much lower than for such an event to take place in the east flank of said volcano. The parties are agreed that even if an eruption of the main crater of Mt. Natib shall occur, there are sufficient natural barriers to protect the plant site from the direct effects of pyroplastic flows.

glowing avalanches, lava flows and direct impact of volcanic ejecta. No evidence was presented disputes the claim of the proponents that the lava activity of Mt. Matib occurred at least 70,000 years ago.

The only possible adverse effect of a volcanic eruption of Mt. Matib would be ashfall and volcanic tremors. Neither event is believed significant enough to seriously damage the plant. It is to be further remembered that, unlike an earthquake that can occur without warning, a volcanic eruption is preceded by signs before it actually happens. It has been said that the shortest period for a volcano to manifest activity is three (3) days prior to the actual eruption. It is expected, this being one of the conditions imposed for the licensing of the nuclear plant, that a monitoring system be installed for the purpose of predicting volcanic activities. Within the period thus allowed, proper safeguards could be taken to prevent the disastrous consequences of a nuclear accident.

### E.3 On Tsunamis

It is not denied that tsunamis may hit the shoreline on which the plant is located. This is

because the presence of the Manila Trench lying parallel to the west coast of Batangas peninsula a hundred kilometers away which is an active fault and which could generate a large-sized tsunami. However, if the tsunami will only be as high as the one caused by the Mindanao earthquake of August 1977, which was estimated to be seven (7) meters high, it would not affect the plant inasmuch as the plant site is on an elevation of 13 meters above mean sea level.. The computation made by ERASCO as to the size of the postulated tsunami that can hit Napot Point was a maximum of 16.5 meters based on the largest possible earthquake at the Manila Trench. Such a tsunami is believed unlikely to affect the plant at its stated elevation. It was further pointed out that, Napot Point being a narrow peninsula sticking out into the sea, the tsunami would not hit the tip of the said peninsula where the plant is located as hard as the shores of the mainland where its force would be diverted.

#### 3.4 THE OPINION OF THE CONSULTANTS

It has been realized that the issue of seismicity deserves maximum attention on the part of

the Commission with a view to arriving at a satisfactory resolution of the concern regarding the same. In the face of the conflicting theories opinions expressed by the parties-participants, and recognizing that the said issue requires his scientific and technical knowledge not within the peculiar competence of the members of the Commission, it has been decided to avail of the services of internationally recognized authorities on the subject of seismology and geophysics. Inasmuch as they do not represent any of the parties and have therefore no partisan interest to subserve, it is assumed that their opinions on said issues would carry the weight of credibility borne of impartiality and neutrality. From a list of twelve experts, the competence of everyone of whom is undisputed, the Commission directed the parties to indicate their respective choices for inclusion in an advisory panel of four or five members. By common agreement of the parties, five names were selected, all of whom were extended invitations by the Commission to serve in an advisory capacity. Although all of the five experts chosen by the parties expressed willingness to favor the invitation, only two were able to come to the Philippines, the others having been unable to come for one reason

or another. Those who were able to make it were Dr. J. Carl Stepp and Dr. Cinna Lomnitz. Dr. Stepp holds the degrees of B.S. Geology, M.S. in Geophysics, and Ph. D. in Geophysics. He was with the USNRC from 1973 to 1979 as Chief of its Geosciences Branch and is presently connected with FURGO, INC., a firm of consulting engineers and geologists based in Long Beach, California.

Dr. Lomnitz is presently a professor of Seismology at the National University of Mexico. He was formerly a director of the Institute of Geophysics of the University of Chile and later Associate Research Geologist of the University of California.

After going over the record of the proceedings conducted by the Commission, including the transcripts of the testimonies of the witnesses, and a review of the pertinent volumes of PSAR, the two aforementioned consultants expressed their concurrence in the findings of the Commission set forth above on the issues of seismicity, volcanism and tsunamis. They gave the view that the design value of 0.4g is conservative enough, and that the Bataan Nuclear Plant as designed can safely withstand the earthquakes reasonably expected to occur in the site.

area. It is also their opinion that the overall evidence, both geological and geophysical, strongly supports the interpretation of lack of tectonic activity in the vicinity of Napot Point during the past tens of thousands of years. They support the opinion expressed by ERASCO that the outcrops referred to by the Bureau of Mines, which they investigated during a trip made to the site area, do not show the existence of active faulting. They also agree with ERASCO and CONVOL that any possible activity of Mt. Matib would be on the east side and not on the west flank where the plant is located.

The consultants express satisfaction over the attenuation curves used by ERASCO in determining the concentration value, the same having been based on data derived from Ocean and Western United States which have more or less the same conditions as those obtaining in the Philippines. While both of them were not especially impressed by the methodology used by ERASCO which they believed could stand improvement, they are also of the opinion that the conclusions arrived at are correct. They are of the belief that if greater professionalism was shown in the evaluations made

by EBASCO, the result would have been a lower  
acceleration value than 0.35g.

On tsunamis, the consultants find that the computation made by EBASCO of a maximum height of 16.5 meters for the tsunami run-up at the plant site appears to be conservative. In short, they do not foresee any danger from this event.

IV

CONCLUSION

A. THE ANSWERS TO QUESTIONS NOS. 1 TO 9:

conformably to the above discussion, the Commission submits the following answers to the questions posed by Letter of Instructions No.

876.

Question No. 1:

1) The Bataan Nuclear Reactor Plant (PNPP-1) has been found with inadequate safeguards and could be a potential hazard to the health and safety of the public. It is admittedly not a new design. By 1982, date of scheduled initial operation of PNPP-1, the design (1973) is already much outmoded.

Westinghouse would not provide additional safeguards until ordered by the United States Nuclear Regulatory Commission. Westinghouse further claims, albeit erroneously, that the stricter standards demanded by the United States Nuclear Regulatory Commission after the Three-Mile Island incident, referred to operating plants only, not to PNPP-1. As far as Westinghouse is concerned, the National Power Corporation must have to accept the design of the Bataan Plant for what it is.

The categorical admission of liability by top officials of Westinghouse in the event radical and fundamental changes should be done in the design of the Bataan nuclear plant strengthens the conclusion that no additional safeguards on the PNPP-1 design had indeed been incorporated, as they had themselves also admitted.

Contrary to the contention of Westinghouse, the seventeen (17) unresolved safety issues addressed by twenty-two (22) tasks in the USNRC program and the forty-one (41) problems or unresolved safety issues submitted in a report by the USNRC to Congress were unidentified and should have been provided for. Some of the unresolved issues or problems relate to the pressurized reactor steam generator tube integrity, reactor vessel toughness, reactor coolant pump supports, toughness of steam generator, seismic design criteria, etc.

The frequency of accidents in nuclear reactor plants, not excluding those designed by Westinghouse, are ominous signals that safety is not assured and therefore additional safeguards are imperative. Express warranty on the part of the

supplier as to the safety of the plant including all its vital component should be required.

Question No. 2:

2) Westinghouse men with Filipino trainee employees of the National Power Corporation will man the plant temporarily. The Filipino hands will be composed of engineers in the different disciplines trained in the Westinghouse Nuclear Field Center in Pittsburg, Pennsylvania. Training started since 1976. After a little over a year, the operation of the Bataan nuclear plant will be left entirely to the Filipino engineers. These Filipino engineers would be duly licensed trainee operators in operating nuclear plants in the United States and not only on simulators.

Question No. 3:

3) The Philippine Atomic Energy Commission, the National Power Corporation and Ministry of Health each prepared emergency plans for coping with radiation emergencies. The plan would involve all government related agencies including the barrio captains.

National Power Corporation will shoulder the

damages and costs in case of nuclear accidents. National Power Corporation will organize a Philippine Nuclear Insurance Pool with the Government Service Insurance System, as lead insurer. Liability of the installation operator is however limited to five million US dollars for any one nuclear accident pursuant to Republic Act No. 5207, Section 42. This law was amended by Presidential Decree No. 1484, which limits the liability of the Republic of the Philippines in indemnity agreements with contractors or suppliers of goods or services for an atomic energy facility owned or controlled by the government to one hundred twenty million US dollars.

Question No. 4:

4) Under the 1968 Bilateral Agreement between the Republic of the Philippines and the United States Government exchange of information on the civil uses of nuclear energy and related matters is provided for. Our Philippine Atomic Energy Commission has been working on obtaining information on nuclear safeguards with the United States Nuclear Regulatory Commission through the United States Embassy in Manila. The Philippines is

also a member country of the International Atomic Energy Agency and has been receiving IAEA Bulletins.

In part 2 of Question No. 4, no definite standards, maximum or minimum, have been shown to prevent nuclear contamination because of the possibility that exposure might be received under a variety of conditions and circumstances; hence, it is impossible to lay down recommendations for action levels that would be generally applicable. However, the PAEC, NPC and the Ministry of Health have introduced organizational plans to prevent nuclear contamination.

Question No. 5:

5) The occurrence of an earthquake similar to the one that hit Mindanao in August 1977 (estimated to be 7.8 magnitude on the Richter scale) is a most unlikely event at Mapot Point. An earthquake of that magnitude may originate from the known active faults surrounding the Central Luzon Tectonic Province which are the Philippine Fault, the Taal Fracture Zone, and the Manila Trench. Only an earthquake from the subduction zone of the Manila Trench at its nearest point of about 70 kms. below Mapot Point can

produce significant ground acceleration at the plant site. That kind of an earthquake, as well as a postulated earthquake of magnitude 7 originating from the San Antonio Fracture Zone, had been duly considered in arriving at the acceleration value of 0.35g. Such a design value or SSZ is believed to be conservative enough, particularly so when it was increased to 0.4g in the plant design. There is, therefore, a reasonable assurance that the largest postulated earthquakes that can be felt at the plant site would not result in leakage or spillage resulting in nuclear contamination. No appreciable evidence had been found to indicate that a random or floating earthquake which could not be traced to one of the known faults will occur at the plant sites.

Considering the elevation of the plant site which is 18 meters above mean sea level, the plant would be safe from a tsunami or tidal wave resulting from an earthquake of tectonic origin similar to the one that hit Mindanao in August 1977, it having been shown that the said tsunami had the maximum height of only 7 meters.

Question No. 6:

6) There is no convincing evidence that the Bataan Nuclear Power Plant is located on an active or seismogenic fault. Some geological features, such as, lineaments, fissures and slickensides had been shown to exist, but all investigations and analyses so far conducted have yielded no positive sign that they are active faults.

Question No. 7:

7) There is no record of the history of earthquakes at Napot Point. The record of historical earthquakes as kept in church archives could only state the general area where the earthquake had been felt and the effects thereof. Before the proper instruments were procured, the epicenters of historical earthquakes could not be identified nor their magnitudes ascertained. PAGASA has a record of some earthquakes that had been felt in Bataan during the Spanish period, namely, the earthquakes of November 30, 1645, December 7, 1677, November 5, 1796, September 16, 1852, June 3, 1863, October 1, 1869, and July 18, 1880. The said record does not reveal the epicenters of said earthquakes nor the damage caused by the

same in Morong or any other portion of Western Bataan. Since 1900, only one earthquake had been instrumentally determined to have its epicenter in Batang Peninsula and it was of a magnitude estimated to be between 4 and 4.6 on the Richter scale, or much below the SSE or design value of the Bataan Nuclear Power Plant.

Question No. 8:

8) There is as yet no stable rock formation in any of our islands which could serve as a permanent burial site for nuclear waste. The Inter-agency Committee created under Administrative Order No. 389 has not yet chosen the site or exact location in the Philippines where the nuclear waste may be stored.

The low level waste will be reduced in volume and placed in fifty steel gallons sealed drums then transferred to the storage building. After one year they will be transferred to an off-site storage facility, which has not as yet been definitely located.

The high level waste or spent fuel is stored in the fuel storage building in the site. After four or five years, this spent fuel has to be

solidified and deposited at its final repository, the place of which is still uncertain. The dangers in the handling and frequent transfers of low, medium and high level wastes cannot be but over-emphasized and a very high degree of competence and care must be exercised by the operator.

Question No. 9:

9) Westinghouse officials, notwithstanding the request of the President in his letter dated April 11, 1979, have not made any clarification on doubts that arose about the safety of the Bataan Nuclear Power Plant since the Three-Mile Island incident of March 28, 1979. It was only on June 22, 1979, that Westinghouse sent its panel of experts to see the President, long after the President had already created the Commission on Nuclear Reactor Plants by virtue of Executive Order No. 539 dated June 15, 1979. This obviously demonstrates unwarranted delay and lack of immediate concern over the safety of the plant.

B. SUMMATION

1. The Bataan Nuclear Plant as designed is not safe. Admittedly, it is an old design - plagued with unresolved safety issues like other Westinghouse designs under review by USNRC. Thus, it is a potential hazard to the health and safety of the public.
2. The Bataan Nuclear Plant design needs fundamental changes and additional safeguards. It appears that Westinghouse nuclear reactors do not have, among others, adequate emergency core-cooling systems.
3. The frequency of accidents in nuclear power reactor plants, of which the Commission takes public notice, is an ominous sign that safety is not assured. It is imperative that the requisite safety devices be installed if it is decided to continue with the nuclear plant.
4. The crucial problem of nuclear waste disposal has not been solved, as the Inter-Agency Committee charged with finding a final repository for these wastes has yet to locate a suitable place. An international burial site as envisioned by the Philippine Atomic Energy Commission has

yet to be located and its establishment is not in sight. This is a universal problem.

3. On the question of whether the plant can withstand the effects of earthquakes, volcanic eruptions and tsunamis that may hit or occur at the plant sites, the Commission finds that there is reasonable assurance that any occurrence of such events, by itself, will not cause leakage or spillage resulting in nuclear contamination.

The seismic design of the plant (0.4g SSZ) has taken into account the strongest earthquakes that may be expected to occur or be felt at the plant sites. Some experts, including our consultants, expressed the view that said design value is in fact over-conservative.

An eruption of Mt. Satib is within the realm of probability but is considered remote, since it is virtually extinct and had not shown activity in the last 70,000 years. Should it erupt, the only likely significant hazard that it could cause to the plant would be ashfall.

The plant site appears to be safe from the effects of tsunamis due to its elevation of 18 meters

above mean sea level. The tsunamis caused by the Mindanao earthquake of August 1977 had a run-up of only 7 meters.

The suspected or postulated faults have not been proved to be real faults, much less active or seismogenic ones, as shown by the investigations and studies conducted regarding the same.

The Commission is accordingly of the view that, considering pertinent matters as they presently stand, it is to the best interest of our country and people that the project may continue only if Westinghouse agree to renegotiate its contract with NPC. Such a course of action should remedy the iniquitous and onerous stipulations of the contract, provide reasonable assurance of the safety of the nuclear plant, assure supply of uranium fuel, and allay the fears of the people about its possible hazards. More importantly, Westinghouse should, in that event, manifest and demonstrate that it shares the genuine concern of the government to safeguard the welfare of our people consistent with

the ever-pressing need for additional sources  
of energy.

Manila, November 13, 1979.

(Sgd.) RICARDO C. PUNO  
Chairman

(Sgd.) CONRAD M. VASQUEZ  
Member

(Sgd.) JOSE G. BAPTISTA  
Member

TRUE COPY  
November 16, 1979