SECY

TERA

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

September 19, 1979

MEMORANDUM TO: G. Eysymontt, OCM
T. Gibbon, OCM
V. Harding, OCM
D. Hassell, OCM
J. Stephens, OCM
A. Kenneke, OPE
L. Bickwit, OGC
J. Becker, ELD
H. Denton, NRR

FROM: Joseph D. Lafleur, Jr., Deputy Director
Office of International Programs

SUBJECT: MEETING ON PHILIPPINES NUCLEAR POWER PLANT (PNPP), BETHESDA, SEPTEMBER 18, 1979

About close of business on September 17, 1979, I learned that Lindsay Mattison, Center for Development Policy (CDP), had made an appointment to see me at 9 A.M., September 18. I called him about 5:30, and he said that a Mr. J. Guerrero, lawyer for the Bataan Bar Association, one of the three "opposition groups" in the Puno Hearings, was in town and would like to meet me and leave some documents. I told him that it was too late to set up a meeting with all the staff who would like to attend. He said he realized this but would like to come to NRC and to start with me, leaving off some documents, with additional meetings, as required, to be held later. Mattison also invited Vickie Harding of Commissioner Ahearne's office. Early September 18, I invited J. Shea and H. Schechter of IP, and Joanna Becker of ELD, all of whom attended. I expected two visitors, Mattison and Guerrero. About 9:45, five visitors (Enclosure 1) appeared. The following is a brief summary of the meeting, with an explanation of the enclosed documents furnished by the visitors.

Mr. Guerrero was the main speaker and made the following points:

1. Three key opposition "panels" were recognized by the Puno Commission:

   a. Bataan Chapter of the Philippine Bar Association, composed of lawyers of various Bataan towns. (Guerrero is counsel of this panel, which is referred to below as the "Guerrero Panel.")

   b. Tañada panel, headed by Senator Tañada, with Arroya as counsel.

   c. National Society for Seismology and Earthquake Engineering of the Philippines (NSSEEP).

2. CDP and Guerrero want to show NRC that Westinghouse and Ebasco had sufficient contradictions in their positions to cast doubt that they were acting in good faith. In light of questions about the safety of the Philippine reactor, CDP wants NRC to conduct its own public hearing on the PNPP Export Licenses.

3. The first phase of the Puno Hearings involved technical facts concerning equipment design. Though they have no technical background, the Guerrero group became interested, since they are from towns near the plant. They were surprised that PAEC still was unable to get full answers to questions raised by the IAEA, even though Ebasco said they had done 70 manyears of work. Petitions of the Guerrero panel and NSSEEP are at Enclosure 2.

4. The first position which Mr. Guerrero noted to be contradicting that of Ebasco was that of the Society of Volcanologists, saying that volcanic eruption was a possibility (Enclosure 3). Guerrero was concerned that disagreement on this point existed. Guerrero questioned Mr. Tilford, Chief Ebasco Geologist, who he said gave some answers about the eruption potential of some possibly volcanic terrain features that were inconsistent with statements in some Ebasco reports.

5. There appear to be differences in the estimates of likelihood of eruptions as derived from various estimation methods. Differences were not explained satisfactorily in the hearings.

6. IAEA said an eruption of Mt. Natib must be considered a possibility. Ebasco said an eruption on the west side of Mt. Natib (toward the plant) is incredible. The report of the IAEA mission in July 1977 said the volcanology and seismology of site should be carefully considered (Enclosure 4).

7. Ebasco said they were in close touch with experts of the Philippine Bureau of Mines (PBM) and these PBM experts agreed with Ebasco that all suspected active faults at the site had been investigated. However, a PBM letter of July 18 stated a position contradictory to this Ebasco statement. These two statements are given in Enclosure 5. Later, Willis of PAEC, an Ebasco representative, and a PBM representative went to the site; Willis and the Ebasco representative then submitted a paper supporting this Ebasco position. The PBM man would not sign this paper. The PBM has not taken a position on this paper, nor has it been asked to.

8. Guerrero was puzzled by the following: An Ebasco statement in the record said that the site was "aseismic." Leeds, the Tañada-CDP seismic consultant, in the Puno hearings said the definition of what is an "aseismic" site depends on the time interval between earthquakes, how close they occur to the site, etc. Ebasco obviously did not consider the site to be aseismic, since the plant is being designed to resist a certain earthquake force. In a press interview, just before leaving the Philippines, Tilford of Ebasco said Ebasco had never said the site is aseismic.

9. Guerrero and Leeds contend that Ebasco has ignored possible large fault lines east of the site (Enclosure 6). Residents of the area know well the dangers of earthquakes on this line east of the site from historical reports of damage from earthquakes in 1852 and earlier.

10. A serious concern of Mr. Guerrero's came to light during the Puno Hearings, about quality of the concrete in the PNPP containment structure. Apparently, PAEC had not been informed of a clash between NPC and Ebasco-Westinghouse on honeycombing of the concrete. Honeycombing occurred at one level almost all around the structure, mostly near the reputed site of a gushing water spring. At one point, some voids were one foot in depth, in a 5-foot thick wall. Guerrero feels unsure that there have been adequate repairs of this honeycombing (Enclosure 7).

11. Guerrero believes there is a strong effort by the Puno Commission to come to an honest decision, but noted that it had almost run out of money and had stopped its hearings while apparently looking into establishing an international group of experts to advise it on the plant. CDP is concerned that the Puno Commission will not be able to come to a correct decision. Both Guerrero and CDP feel that the opposition is underfunded and has not had long enough, in view of the long period of "imposed silence" before Puno, to prepare and present its case adequately. Guerrero says the people of Bataan need an NRC approval before they will be happy with the safety of the plant.

Joseph D. Lafleur, Jr.
Deputy Director
Office of International Programs

Enclosures:
1. List of Attendees
2. Petitions of Guerrero Panel and NSSEEP
3. Letter of June 28 on Volcanology
4. Report of 1977 IAEA Mission
5. Statements on Position of Philippines Bureau of Mines
6. Brochure Showing Fault Lines
7. Reports on Concrete Honeycombing

cc w/encls: S. Chilk, SECY (for PDR)
L. V. Gossick, EDO
J. R. Shea, IP
H. Schechter, IP
G. Helfrich, Dept. of State

ENCLOSURE 1

MNBB Sept 18, 1979 / 7pm

Meeting on Philippines

James R. Shea — Director, NRC Office of International Programs

Joseph D. Lafleur, Jr — Deputy Director, Office of Intl Programs

Hans B. Schechter — OIP

Jasmina M. Becker — ELD

Vicki R. Harding — Legal Assr. - Commissioner Ahearne

Thomas R. Asher — Attorney (1272 17th St, NW, DC 20036) for CDP

Lindsay Gathman — DIR. of CDP — 225 4th St SE. DC 20002

JAIME L. GUERRERO — Attorney, Manila, Philippines

HEHERSON ALVAREZ — MOVEMENT FOR A FREE PHILIPPINES

VIRGINIA FOOTE — Center for Development Policy

Encl 1

ENCLOSURE 2

Exh C

SANGGUNIANG BAYAN PANLALAWIGAN
BATAAN

EXCERPT FROM THE MINUTES OF THE REGULAR MEETING OF THE SANGGUNIANG BAYAN PANLALAWIGAN HELD AT BALANGA ON JULY 16, 1979

PRESENT:

Hon. Efren D. Huscmil, Governor & Presiding Officer
Hon. Crisostomo G. Sanzon, Representative
Hon. Remigio R. Sacdalan, Rep. of Abucay
Hon. Geronimo C. Ursulo, Rep. of Dinac
Hon. Alfredo D. Jurado, Rep. of Dalungo
Hon. Jaime D. Ocampo, Rep. of Dinalupihan
Hon. Martin R. Manalansan, Rep. of Hermosa
Hon. Josue T. Ricafrente, Rep of Mariveles
Hon. Teodorico D. de Jesus, Rep. of Morong
Hon. Jose A. Dugay, Rep. of Orani
Hon. Antonio U. Mariano, Rep. of Orion
Hon. Rustico T. Concunji, Rep. of Samal
Hon. Nelson J. Cruz, Rep. Rep. of KBP

ABSENT:

Hon. Jesus C. Sanchez, Representative
Hon. Irene G. Flores, Representative
Hon. Arturo S. Roxas, Rep. of Limay
Hon. Paulo D. Roman, Jr., Rep of KB

RESOLUTION NO. 111

WHEREAS, the Governor and Presiding Officer brought to the attention of the Body the current investigation being conducted relative to the construction of the nuclear plant in Napot, Morong, Bataan;

WHEREAS, the Governor also sought the individual opinion of all members regarding the matter;

WHEREAS, all the members except the representative of Dinac, Mr. Geronimo Ursulo, were very vocal in their opposition to the continuation of the nuclear project for the following reasons;

1. While this Body do not pretend to be fully conversant with the attendant technicalities to consider the safety of the nuclear plant it could easily be gleaned that even the designers have their doubts as to the safety of the plant by their reluctance to assume liability from any accident that may arise from the operation of the nuclear plant. That the plant is very vulnerable to accidents due to human error, malfunctions and defects in design was clearly illustrated in the recent incident in Three Mile Island in the United States where we have to admit nuclear technology is far advanced than ours.

NATIONAL SOCIETY FOR SEISMOLOGY AND EARTHQUAKE ENGINEERING OF THE PHILIPPINES
LL Bldg., 169-A Panay Ave. Cor. E. de los Santos Ave.
Quezon City, Philippines
Tel. [illegible]

24 July 1979

POSITION PAPER OF (NSSEEP)
NATIONAL SOCIETY FOR SEISMOLOGY
AND EARTHQUAKE ENGINEERING OF
THE PHILIPPINES

A. GENERAL : The general position of NSSEEP on the design and construction of the Bataan Nuclear Plant is neutral, but NSSEEP would like to be enlightened on the seismicity, seismological and engineering studies, analyses, assumptions, design methodology and considerations especially as related to seismology and earthquake engineering and to comment on the information relevant thereto submitted by all parties concerned.

B. SPECIFIC : On questions Nos. 5, 6, and 7, NSSEEP submits the following position in relation to seismology and earthquake engineering of the Bataan Nuclear Plant.

1. On question No. 5:

(a) On seismicity of the site: With reference to the seismic risk map, NPC, PSAR Figure 4, if as stated elsewhere, this map was prepared on the basis of a three-month micro-earthquake or micro-tremor observations, we doubt its validity as a seismic risk map for use as design data or assumption for spectrum response analysis especially for a very important and extremely expensive project like the Bataan Nuclear Plant. We submit that micro-tremor observations are used to confirm site geology and geologic profiles in relation to seismic wave propagation characteristics and dynamics of ground motion and that there is no correlation between micro-tremors and strong motion earthquakes. The return period of 10,000 years stated in the seismic risk map tends to give a false sense of security to a layman. The three-month micro-earthquake observations cannot possibly be used for statistical projection on seismic risk or even on return periods of significant earthquakes.

July 25, 1979
Proof of service

Doc. No. 25

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LL Bldg., 106-A Pasay Ave. Cor. E. de los Santos Ave.
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The source, data, methodology of preparation, the number and location of observations are not indicated on the map so that we cannot check the analysis or even the relevance of the source materials with risk analysis of strong motion earthquakes with ground accelerations of 0.25g or 0.35g or even higher as indicated on the said seismic risk map.

We note here that in the case of the Prince William Sound, Alaska, earthquake which occurred on March 27, 1964 (local time), accurate records from 1899 to 1963 showed no occurrence of earthquakes of 8 or greater magnitude on the Richter scale within a 200 kilometer radius, and yet this earthquake took place with a magnitude of 8.4 to 8.6 on the Richter scale. We also mention that Alaska, California, Japan and the Philippines in world seismicity maps are on the same circumpacific seismic belt, that is, along the edges of the great Pacific tectonic plate.

(b) On earthquake engineering: We are still studying the information on the design assumptions and procedures and design spectrum system and will appreciate more information so that we can submit a position paper or memorandum on this matter.

2. On question No. 6:

Even if the Bataan Nuclear Plant is definitely not on any fault, it does not follow that it is free from any future earthquake surface faulting. The point is: even though faulting is generally regarded as cause of earthquakes, faulting is also a result or effect of strain disturbance due to the thrusting mechanism, which in turn, is due to "subduction" in plate tectonics. It is not so much where the faults are, but where the "subduction" zones are, that determines the location of the

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focus or hypocenter of the strongest earthquakes, and in Bataan, as indicated and shown in the "Schematic Model of Sequential Subduction Central Luzon Tectonic Province Cross-Section" NPC, PSAR, Fig. 2.5.1 - 13, the "subduction" zones No. 1 and 2 are directly under the Bataan Nuclear Plan.

To postulate a "floating" earthquake of 4.5 magnitude and a 7.9 maximum magnitude is in our opinion not conservative enough on such an important, expensive and critical structure as the Bataan Nuclear Plant and this postulate even implies acceptance of risk of dangers of failure of the plant and its component parts in the event of earthquakes of magnitude 8 or greater which are not only possible but in plate tectonic theory probable.

3. On question No. 7:

Even if one can establish that within the last 400 years, there has definitely been no large earthquakes whose epicenter is in Bataan, it does not follow that there will be no large earthquake there in the future. The explanation is: Seismologists speak of "seismic gaps" relating to periodicity, that is, regions along a chain that could be quiescent for even thousands of years, but meanwhile are accumulating strains for a large earthquake. Many large earthquakes which have occurred in seismic regions which have been quiescent for hundreds of years prove this.

We wish to reserve a further position paper, memorandum or comment on the Report of the IAEA Safety Mission of 1978.

Respectfully submitted,

Andres O. Hizon
Committee Chairman,
NSSEEP

Attested:

Angel Lazaro, Jr.
President, NSSEEP

27 August 1979

MEMORANDUM NO. I OF NSSEEP

We begin by stating that the records will show that NSSEEP was subjected to two days of intensive and comprehensive interpellation by a team of Ebasco experts composed of, among others, Messrs. Tilford, Gupta, Healy and their legal counsel on the first position, Position Paper No. 2 and Position Paper No. 3 of NSSEEP. Given every opportunity to question, given every opportunity to challenge, given every opportunity to submit direct proof against, no question, challenge or specific direct proof was made or submitted during the interpellation on Position No. 5(c) of POSITION PAPER No. 2 of NSSEEP which reads as follows:

"Position No. 5(c)- In line with the apparent concern of the President regarding the Bataan Nuclear Power Plant and in the interest of the Filipino people, we believe that an earthquake of at least 8.0 magnitude on the Richter scale should be postulated on all capable faults and competent geologic and tectonic structure at, under or near this Nuclear Plant. We submit that the aproper approach is to postulate on 8.0 magnitude earthquake on all capable faults and geologic structures competent in generating such earthquake, compute the resulting ground acceleration, analyze probabilities and then make the necessary reasonable judgments. The approach of Ebasco is: dismiss the possibility of 8.0 magnitude on all but the most distant tectonic structures, postulate and select lower magnitude earthquake based on a nine-year selected NOAA listing (nature may not agree with their se selection), use selected attenuation curves not based on Philippine seismicity on nearby capable faults and tectonic zones, analyze with their opinion of probabilities, come up with a low seismicity risk map and then use this map for judgment on critical design considerations. We submit that the Ebasco approach is inaccurate, unreliable and biased. (Underlining ours)".

Under the rules of evidence, therefore, we consider this position fairly well-established and admitted by Ebasco. We can even state that we felt sure that the Ebasco experts were apprehensive that we could marshal grave and incontrovertible proofs which would then be more forceful in the record of the proceedings. But admitted and established, we were satisfied.

We have also noted but not presented to the Commission grave doubts on several of the IAEA concerns which, we believe, were not satisfactorily attended to by Ebasco and possibly even by PAEC, since we wished to avoid lengthy discussions which require considerable study and time and a piling up or disarray of our own private concerns, but we are willing later to voice our doubts to the proposed International Panel.

In our cross examination, many inconsistencies, contradictions, inaccuracies and biases were brought out and, we believe, also fairly well-established and proven.

We now turn to the long litany of contradictions, misleading statements, artificies and even what seems to us blatant prevarications too tiresome to enumerate but we may mention same examples:

1. Mr. Tilford: On Bataan peninsula being clearly stated in their position paper as "aseismic" stated that they never said Bataan was "aseismic" and even denied it specifically in the interpellation of Mr. David Leeds. He even argued the same in a press interview on the matter. On being shown up by Atty. Guerrero and Engineer Hizon, he flip-flops and said Ebasco made a mistake, stated a very late correction because he no longer had any choice, When asked to present athe asserted mistake and correction in writing, he kept silent, no promise.

2. Mr. Tilford: In order to support a Gupta error and contradiction, stated that the Bataan Nuclear Plant is on rock foundation so that the predominant period of the ground, T_p, was as Gupta stated computed on the Kanai equation on rock. If this were so, the IAEA report would not mention "strain softening" of the foundation which could not occur on rock. He probably assumed and knew that the Commission would not understand.

Sangay ng Bataan
SAMAHAN NG MGA GURO SA MORONG
Morong, Bataan

Morong, Agosto 6, 1979

Presidente Ferdinand E. Marcos
Malacanang Palace
Metro Manila

Mahal na Pangulo,

Kami pong mga guro ng Distrito ng Morong, Bataan, ay nagpapahayag sa pagtutol sa pagtatayo o ng Nuclear Power Plant sa aming bayan dahil sa mga sumusunod na kadahilanan:

1) Ang possibilidad na magkaroon ng human at mechanical error sa pagpapaandar ng nuclear reactor.

2) Pagdedepende natin sa isang depletable energy source gaya ng Uranium.

3) Wala pang solusyon sa paglilibingan ng nuclear waste.

4) Di-tiyak na pagtatayuan ng planta ng nuklyer sa kadahilanang nasa "Pacific-rung-of-fire" ang Pilipinas at ang aktibong Bulkang Natib ay 14 na kilometro lamang ang layo sa planta.

5) Kakulangan ng mga ekspertong Pilipino na kayat na dudulog sa isang nasasaring maganap na nuclear accident.

6) Di-malawak na technological base na nakasangkap sa nasasaring maganap na aksidente gaya ng Three Mile Island (TMI).

Na ang aming pagtutol sa pagtatayo ng Nuclear Power Plant ay hindi nangangahulugan ng pagtutol sa administrasyon ng aming mahal na Pangulo, ibig lang, ang tanging kadahilanan ay ang mga nabanggit sa itaas.

Lubos na gumagalang,

Crisanto B. de Guzman
Carlos Medina
Cristina M. Bugayong
Nilda G. Cruz
Rosario S. Albayalde
Maria Paz D. Estacio
Elvira B. Jerondo
Jacinto Lyle
Leonor J. Latiza
Purita J. Aviles
O. Roma
Emmanuel P. Domingo

Luisa B. Manalo
Laurita N. Valayaga
Carmen N. Manlapaz
[illegible]
[illegible]
Angelita T. Lustani
[illegible]
Rosa N. Cayabyab
Lilia C. Reyes
[illegible]
Adelaida [illegible]

Guadalupe M. Rodriguez

Emilia Rodriguez

Nilda D. Perez

Norma G. Leyba

Olivia G. Bebel

Imelda R. Baldonado

Consuelo C. Maestas

Josefina V. Montoya

Margarita R. Medina

Felipe D. Quintana

Refugio F. Fentolo

Aurora C. Linares

2. Presently and within the foreseeable future, this body considers that the nuclear technology in the country cannot advance to the degree necessary to guarantee the safe operation and maintenance of the PNPP - 1.

3. In the event of a nuclear incident this body do not believe that the Philippines possess the necessary scientific resources to prevent the contamination that will ensue.

4. Testimonies presented to the Commission indicates the existence of geological faults in the area of the nuclear plant site and that there is also the danger posed by renewed volcanic activity of Mt. Natib. So far no assurance has been made that earthquake or volcanic activity will not cause damage or malfunction that could result in the leakage of radioactive elements. Waste disposal has not been satisfactorily explained. Improper disposal could pose a serious hazard to the health and lives to the residents in the area.

NOW THEREFORE, in consideration of the foregoing reasons, on motion duly made and seconded, be it

RESOLVED, that the Sangguniang Panlalawigan of Bataan express, as it vigorously do, its opposition to the continued construction of the nuclear plant in Napot, Morong, Bataan;

RESOLVED, FURTHER, that an appeal be made to His Excellency, President Ferdinand E. Marcos to cause the discontinuance of the nuclear project until such time as sufficient guarantee could be made relative to the safety of the nuclear plant;

RESOLVED, FINALLY, that this resolution be forwarded to His Excellency, President Ferdinand E. Marcos, Malacañang, Metro Manila and copies be furnished all parties concerned.

APPROVED BY VOTES OF ELEVEN IN FAVOR AND ONE AGAINST."

- -

I hereby certify to the correctness of the above-quoted resolution.

(Sgd.) TIRSO T. DAVID
Secretary

ATTEST:

(Sgd.) EFREN B. PASCUAL
Provincial Governor

True Copy:

Republic of the Philippines
Municipality of MORONG
B A T A A N

Office of the Secretary

EXCERPT FROM THE MINUTES OF THE SPECIAL OF THE SANGGUNIANG BAYAN, MORONG, BATAAN, MEETING HELD ON JULY 30, 1979.

PRESENT: Hon. Antonio S. Calimbas - Actg. Mun. Mayor
Presiding Officer

S B M E M B E R S

	Hon. Zosimo W. Perez	Hon. Bienvinido Vicedo
	Hon. Teodorico de Jesus	Hon. Pascual Pastolero
	Hon. Fortunato M. Perez	Hon. Mariano Barrantes
	Hon. Cesario G. Domingo	Hon. Adriano O. Chinte
	Hon. Jacinto M. Puzon	Hon. Bienvinido Reyes
ABSENT:	Hon. Rodolfo P. Duran	Hon. Clemente Evallo
	Hon. Policismo Ignacio	Hon. Democrito Paguio

Hon. Bonifacio Dulay, Jr.

x x x x x

RESOLUTION NO. 16

"WHEREAS, it is a great opportunity of this municipality that the Country's First Nuclear Power Plant is being constructed at Napot Point, Morong, Bataan, employment problems was solved and it will insure the development and progress of this municipality, but in the contrary, the Body is extremely frightened and worried due to the fact that the said project is 9 kilometer away from the town proper and the target area/site is surrounded by an active volcanoes such as Mt. Natib and Mt. Mariveles, both in the Province of Bataan;

"WHEREAS, on June 29, 1979 a public hearing was held at the National Power Corporation's Office at Napot Point, the government panel represented by P.A.E.C. and N.P.C., stated that presently there is no approved/proper place in the Philippines to dispose the wastes of the Nuclear Reactor;

"WHEREAS, the Body is not convinced of the safety claims of the builders of the Nuclear Reactor due to human and mechanical error that may happen, like what was happened or occured in 3 mile Island in Pensylvania;

"WHEREAS, it has been known that the effect of the radiation of the Nuclear Reactor to the health of the people is very dangerous, causing genetically defective babies, leukemia, cancer of the bones, and etc.;

NOW THEREFORE, on motion duly seconded by, Be it;

"RESOLVED, as it is hereby resolved, that this Body against the on-going construction of the Nuclear Power Plant at Napot Point, Morong, Bataan, because our country may not be ready yet and we have no experts to handle this kind of delicate project;

"RESOLVED FINALLY, to furnish certified copies of this resolution to His Excellency, Ferdinand E. Marcos, President of the Philippines, Manila, The Chairman, Committee on Investigation on Safety, Nuclear Power Plant, Manila, the President, National Power Corporation, Port Area, Manila, the Philippine Atomic Energy Commission, Metro-Manila and the Honorable Sangguniang Panlalawigan, Balanga, Bataan for their proper information.

"APPROVED UNANIMOUSLY"

x x x x x x x

I HEREBY CERTIFY to the correctness of the above-qouted resolution.

EMILIANO A. MENDOZA, Jr.
Sangguniang Bayan Secretary

REPUBLIC OF THE PHILIPPINES
COMMISSION ON NUCLEAR PLANTS
METRO MANILA

RE: INQUIRY ON THE SAFETY TO
THE PUBLIC OF THE BATAAN
NUCLEAR PLANT
x - x

[illegible] POSITION PAPER NO. 3 OF NOSREP

COMES NOW [illegible] NOSREP, represented by Engineers Manuel G. Hizon and Angel Lazaro, Jr. of NOSREP and unto the Honorable Commission most respectfully submits the attached POSITION PAPER NO. [illegible] of NOSREP. We regret that it had taken sometime to study and prepare data, curves and tables for this position paper.

Metro Manila, 14 August 1979.

[illegible] Philippine

By:

[illegible]

NATIONAL SOCIETY FOR SEISMOLOGY AND EARTHQUAKE
ENGINEERING OF THE PHILIPPINES
LL Bldg., 160-A Panay Ave. Cor. E. de los Santos Ave.
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POSITION PAPER NO. 3 OF NSSEP

NATIONAL SOCIETY FOR SEISMOLOGY AND EARTHQUAKE ENGINEERING OF THE PHILIPPINES
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14 August [illegible]

POSITION PAPER NO. 3 OF NSSEE

1. On question No. 5:

Position No. 5 (3a):

In order that inaccurate and irresponsible statements may be checked in the hearings before the Commission on the Bataan Nuclear Plant, NSSEE presents the following table of values based on the Richter equation:

$$\text{Log}_{10} E = 11.4 + 1.5 M$$

where M is the Richter magnitude and E is the energy released in ergs.

Maximum horizontal ground acceleration are also computed for different magnitudes based on (a) Kanai equation (California and Japanese earthquakes) and (b) the Manila Observatory equation (most probable values).

REFERENCES:

(a) Kanai equation:

$$y = \frac{5}{\sqrt{T_G}}\ 10^{0.61m} - F \log R + Q$$

From "Building Practices for Disaster Mitigation", Building Science Series 46, US National Bureau of Standards.

(b) Manila Observatory equation:

$$\ln A\ (\% \text{ of } g) = 3.19 + 1.27\ M_L - 2.095 \ln (R + r_o)$$

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(c) "The Alaska Earthquake, March 27, 1964 and Aftershocks". U.S. Department of Commerce, U.S. Govt. Printing Office. (xerox copy of p. xxxi attached)

(d) "The Skopje, Yugoslavia Earthquake" by Glen V. Berg. American Iron and Steel Institute. (xerox copy of p. 19 attached)

(e) The Earthquake Magnitude - by J. Krishna and [illegible]. (xerox copy of pp. 16 and 17 attached)

TABLE 1 (Notes)

Richter Magnitude	Energy released in Tons TNT	Energy released equivalent to a number of Hiroshima Bombs	Maximum horizontal ground acceleration in "g"		
			Kanai equation		Manila Observatory equation
			R = 30	R = 55	R = 30
6.0	7,000	0.35	.10	.08	.00
6.3	20,000	1 (Hiroshima(a)	.15	.12	.13
6.5	40,000	2	.20	.15	.18
7.0	220,000	11	.40	.33	.33
7.2	450,000	22	.53	.43	.43
7.5	1,250,000	63	.81	.66	.63
8.0	7 million	355	1.04	1.32	1.13
8.5	40 million(c)	2,000			

Position No. 5 (3b):

There is presented herewith Figure 4 (NSSEEP) showing a a comparison of Attenuation curves, Kanai (California and Japanese earthquakes) and Manila Observatory (Philippine earthquakes).

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Position No. 3 (3c):

There is presented herewith Neville C. Donovan curves taken from "Earthquake Hazards for Buildings" from previously cited "Building Practices for Disaster Mitigation" p. 39, Figure 5 (NSEEP).

Using the curve "mean + 2 standard deviations" meaning [illegible] we got

TABLE 2 (NSEEP)

Represented Distance in Km.	10	20	30	50	70	100
Peak acceleration in cm/sec^2	1100	830	640	530	340	240
Peak acceleration z-value	1.13	.85	.66	.54	.35	.24

Position No. 5 (3d):

There is presented herewith TABLE 3 (NSEEP) reproduced from TABLE 2, Donovan "Earthquake Hazards for Buildings".

TABLE 3 (NSEEP)

RETURN PERIODS FOR PEAK ACCELERATION
(copy from p. 95)

Respectfully submitted:

Andres O. Hizon
Chairman, NSSEEP Committee

Angel Lazaro, Jr.
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Introduction

Shortly after dusk on March 27, 1964 (local time or March 28 Greenwich Mean Time), an earthquake of unusual severity rocked the Prince William Sound area in south-central Alaska. With its magnitude recorded as between 8.4 and 8.6 on the Richter scale (see Seismological Operations: Aftershock Studies), it was the most violent earthquake of known time and one of the greatest natural disasters that has occurred in the recorded history of the United States. Estimates are that twice as much energy was released by this earthquake as by the one which struck San Francisco, California, in 1906. This release of energy was approximately equivalent to 80 megatons (80 million tons) of TNT.

The shock was felt over about half a million square miles. However, it was within a 50,000 square-mile area surrounding the epicenter that major damage to buildings, harbors, port facilities, and the railway and highway systems occurred. The damage resulted variously from violent vibratory ground motion; from cumulative vertical and horizontal displacements; the accompanying earthquake-generated tsunami (seismic sea-wave) which wiped out many waterfronts, their facilities, and industries; and from tidal inundations following subsidence of the land.

Although damaging effects of the earthquake-induced tsunami were felt as far away as Crescent City, California, the most severe damage associated with the earthquake occurred along the shores of Prince William Sound, Cook Inlet, and on the Kenai Peninsula in Alaska. This area of maximum damage comprises only 10 percent of the total land area of Alaska. However, it contains the economic heart of the State, about 50 percent of its population, and all major seaports. In addition, the major railroads and highways leading to the interior are within this area. Public and private property damage exceeded 300 million dollars, but there were only 114 casualties. Losses of property and life would have been far greater if the earthquake had struck earlier in the day when the business districts generally were crowded, when the schools were in session, and when the tide was at its highest.

The disaster focused attention on a danger long recognized in this part of Alaska where earthquakes are a recurring phenomenon. It has emphasized the need for man to improve upon exploit, and fully evaluate his accumulated knowledge to predict future earthquakes in order to lessen the loss of life and property whenever and wherever another major earthquake may strike.

Within minutes after the earthquake, the local, State, and Federal Governments started to organize a great humanitarian effort to bring relief and assistance to the people. Although normal civilian communications had been completed disrupted, the Alaskan Military Command quickly reestablished communications between Alaska and the rest of the United States, and in particular with Washington, D. C.

and

250 km. The felt areas of these earthquakes will have their radius equal to about 120, 500 and 700 km respectively. During the Koyna earthquake of Dec. 11, 1967, (M=6.5) the felt area had a radius of about 400 km and damage area was spread in a radius of about 60 km due to special geological features.

A relationship between strain energy released by an earthquake and its magnitude is given by Richter as follows:

$$\log_{10} E = 11.4 + 1.5\,M \qquad \ldots(1.6)$$

Energy released in earthquakes of different magnitudes is presented in Table 1.3, which would give an idea of their relative destructive power. Some of the past Indian earthquakes are presented in Table 1.4 which gives the location of their epicenter and their magnitude on Richter's scale.

TABLE 1.3

MAGNITUDES OF EARTHQUAKES AND ENERGY RELEASED

M (Richter)	5.0	6.0	6.5	7.0	7.5	8.0	8.4	8.6
E (10^{20} ergs)	0.38	2.5	14.1	80	445	2500	10000	20000

Note: Energy released by an earthquake of magnitude 7.0 would be of the order of 80×10^{20} ergs.

The maximum intensity of shaking attained during an earthquake of given magnitude depends upon the depth of focus as well as soil condition below the foundations of structures. For shallow focus earthquakes, of depth about 30 km or less, an approximate relationship may be expressed between Magnitude and maximum Intensity in the epicentral area. Representative values are given in Table 1.5.

On an average, 12 earthquakes having a magnitude of 7.0 or greater occur every year somewhere in the world. It is interesting to compare the energy of an earthquake with that of an atomic explosion. The energy released by Hiroshima type atom bomb is 8×10^{20} ergs or equal to an earthquake of Magnitude 6.33. Thus in terms of energy release, an earthquake of the size of Assam earthquake of August 15, 1950 (M=8.6) will be equivalent to 2500 such bombs exploded together.

Year	Place	Date	Lat. (N)	Long. (E)	M
1819	Kutch	Jun 16			8.0
1833	Bihar	Aug 26	27.5	87.5	7.7
1897	Assam (Shillong Plateau)	Jun 12	26.0	91.0	8.7
1900	Palghat (Kerala)	Feb 8	10.7	76.7	6.0
1905	Kangra	Apr 4	32.5	76.5	8.0
1930	Dhubri	Jul 1	26	90	7.1
1934	Bihar	Jan 15	26.6	86.8	8.3
1941	Andaman	Jun 1	13.4	92.8	8.0
1943	Assam (Kar.)	Oct 23	26.0	94.0	7.7
1950	Assam (Arc)	Aug 15	28.5	96.5	8.6
1956	Anjar	Jul 21	23.3	70.0	7.0
1956	Damodar Valley (Bihar)	Oct 13	23.1	87.7	6.7
1958	Andaman (Car.)	Dec 26	10.0	93.0	8.3
1959	Delhi	Aug 27	28.5	77.4	6.0
1961	Dadhpur (Himachal)	Sep 2	31.0	94.7	6.5
1966	W. Nepal	Jul 27	29.5	81.0	6.5
1966	Mandalgad (Maharashtra)	Aug 15	23.0	79.0	6.5
1967	Koyna	Jul 2	9.0	73.4	6.2
1967	Koyna	Dec 11	17.4	73.7	6.5
1970	Dhubri (Assam)	Apr 13	17.6	90.5	6.5
1970	Broach	Mar 23	21.7	72.9	5.7
1975	Himachal Pradesh	Jan 10	32.5	78.4	6.5

Table 1.5

MAGNITUDE AND MAXIMUM INTENSITY

Richter's Magnitude	5.0	5.5	6.0	6.5	7.0	7.5	8.0
M.M. Intensity (Near Epicentre)	V-VI	VI-VII	VII	VII-IX	IX-X	X-XI	XI

along the fault plane may be horizontal, vertical, or inclined. Tremendous vertical movement occurred in the great earthquake of 1899 at Yakatut Bay, Alaska. Movement on the San Andreas fault in California is horizontal, and field observations in the vicinity of the San Andreas fault after the 1906 San Francisco earthquake played a large part in the development of Reid's elastic rebound theory.

For those earthquakes where surface faulting can be observed, the evidence in favor of the elastic rebound theory is strong. However, there are uncertainties that have not yet been resolved in extending this theory to tectonic earthquakes in general.

The location in the crust of the earth where the fault movement commences is called the focus of the earthquake, or the hypocenter. The point at the surface directly above this is called the epicenter. Most of the earthquakes which occur are shallow, with focal depths of sixty kilometers or less.

Earthquake Measures

It is well to comment briefly on two measures of an earthquake -- magnitude and intensity -- for these are sometimes confused. Roberts[1] has suggested using the terms *energy factor* instead of magnitude, and *local damage rating* instead of intensity, to avoid confusion. The terms suggested by Roberts are more descriptive, but no general change in usage has resulted.

Magnitude

The magnitude of an earthquake is an index related to the amount of energy released. Magnitude was originally defined by Richter in 1935 as the logarithm (base 10) of the amplitude in microns of the trace written by a seismometer of a standard type at a distance of one hundred kilometers from the epicenter. Observations at distances other than one hundred kilometers can be corrected to convert them to the standard distance. Advances in the seismological sciences since the introduction of Richter magnitude have let the scale be extended to make it applicable to earthquakes occurring anywhere and recorded on instruments other than the type for which it was first defined.

The relation between magnitude and energy, as given by Richter,[2] is

$$\log_{10} E = 11.4 + 1.5\ M,$$

where E is the energy in ergs and M is the Richter magnitude. A difference of one degree in magnitude thus corresponds to a factor of $10^{1.5}$ or 32 in the amount of energy released. The energy released by an atomic bomb of the Hiroshima type is given by the Atomic Energy Commission as 6×10^{20} ergs, which is equivalent to the energy released in an earthquake of magnitude 6.3.

There is no upper limit to the Richter scale of magnitude. The largest magnitude ever recorded is 8.9. Physical limitations on magnitude are imposed by the strength and mechanical properties of the earth's crust, and although these limitations are not known, it is doubtful that an earthquake of magnitude much greater than 8.9 could occur.

Intensity

Intensity is a rating of the severity or damage-producing properties of the ground motion at a specific location. The scale of measurement is based upon the sensations of persons and upon physical damage to natural and manmade objects. Intensity scales came into being long before magnitude scales because intensity does not require instrumental observations. Two papers by Davison give thirty-nine different intensity scales.[3,4] The earliest is dated 1783 and is attributed to an Italian physician, Dr. D. Pignataro. The Pignataro scale had five degrees of intensity. Sieberg[5] makes note of two earlier scales, a deRoardi scale of 1627 and a Gastaldi scale of 1564.

The first intensity scale to come into widespread use was the Rossi-Forel scale of 1883. It is a scale of ten degrees of intensity and is still frequently used in Europe. The Mercalli scale, which also has ten degrees of intensity, was first introduced in 1902. The Mercalli damage descriptions are more explicit than those in the Rossi-Forel scale, and the degree of damage associated with a given index differs somewhat for the two scales.

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[1] E. B. Roberts, "Magnitude and Intensity Scales," Bulletin, Seismological Society of America, Vol. 47, p. 13, January, 1957.

[2] From *Elementary Seismology* by C. F. Richter, San Francisco: W. H. Freeman and Company, 1958, p. 366.

[3] Charles Davison, "On the Scales of Seismic Intensity and on the Construction and Use of Isoseismal Lines," Bulletin, Seismological Society of America, Vol. 11, pp. 95-129, June, 1921.

[4] Charles Davison, "Scales of Seismic Intensity, Supplementary Paper," Bulletin, Seismological Society of America, Vol. 23, pp. 158-186, October, 1933.

[5] A. Sieberg, "Geologie der Erdbeben," HANDBUCH DER GEOPHYSIK, Vol. 4, p. 550, Borntraeger, Berlin, 1930.

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24 July 1979

POSITION PAPER OF (NSSEEP) NATIONAL SOCIETY FOR SEISMOLOGY AND EARTHQUAKE ENGINEERING OF THE PHILIPPINES

A. GENERAL : The general position of NSSEEP on the design and construction of the Bataan Nuclear Plant is neutral, but NSSEEP would like to be enlightened on the seismicity, seismological and engineering studies, analyses, assumptions, design methodology and considerations especially as related to seismology and earthquake engineering and to comment on the information relevant thereto submitted by all parties concerned.

B. SPECIFIC : On questions Nos. 5, 6, and 7, NSSEEP submits the following position in relation to seismology and earthquake engineering of the Bataan Nuclear Plant.

1. On question No. 5:

(a) On seismicity of the site: With reference to the seismic risk map, NPC, PSAR Figure 4, if as stated elsewhere, this map was prepared on the basis of a three-month micro-earthquake or micro-tremor observations, we doubt its validity as a seismic risk map for use as design data or assumption for spectrum response analysis especially for a very important and extremely expensive project like the Bataan Nuclear Plant. We submit that micro-tremor observations are used to confirm site geology and geologic profiles in relation to seismic wave propagation characteristics and dynamics of ground motion and that there is no correlation between micro-tremors and strong motion earthquakes. The return period of 10,000 years stated in the seismic risk map tends to give a false sense of security to a layman. The three-month micro-earthquake observations cannot possibly be used for statistical projection on seismic risk or even on return periods of significant earthquakes.

Doc. No. 25

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The source, data, methodology of preparation, the number and location of observations are not indicated on the map so that we cannot check the analysis or even the relevance of the source materials with risk analysis of strong motion earthquakes with ground accelerations of 0.25g or 0.35g or even higher as indicated on the said seismic risk map.

We note here that in the case of the Prince William Sound, Alaska, earthquake which occurred on March 27, 1964 (local time), accurate records from 1899 to 1963 showed no occurrence of earthquakes of 8 or greater magnitude on the Richter scale within a 200 kilometer radius, and yet this earthquake took place with a magnitude of 8.4 to 8.6 on the Richter scale. We also mention that Alaska, California, Japan and the Philippines in world seismicity maps are on the same circumpacific seismic belt, that is, along the edges of the great Pacific tectonic plate.

(h) On earthquake engineering: We are still studying the information on the design assumptions and procedures and design response spectra and will appreciate more information so that we can submit a position paper or memorandum on this matter.

2. On question No. 6:

Even if the Bataan Nuclear Plant is definitely not on any fault, it does not follow that it is free from any future earthquake surface faulting. The point is: even though faulting is generally regarded as causes of earthquakes, faulting is also a result or effect of strain antecedence due to the triggering mechanism, which in turn, is due to "subduction" in plate tectonics. It is not so much where the faults are, but where the "subduction" zone is, that determines the location of the

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focus or hypocenter of the strongest earthquakes, and in Bataan, as indicated and shown in the "Schematic Model of Sequential Subduction Central Luzon Tectonic Province Cross-Section" NPC, PSAR, Fig. 2.5.1 - 13, the "subduction" zones No. 1 and 2 are directly under the Bataan Nuclear Plant.

To postulate a "floating" earthquake of 4.5 magnitude and a 7.9 maximum magnitude is in our opinion not conservative enough on such an important, expensive and critical structure as the Bataan Nuclear Plant and this postulate even implies acceptance of risk of dangers of failure of the plant and its component parts in the event of earthquakes of magnitude 8 or greater which are not only possible but in plate tectonic theory probable.

3. On question No. 7:

Even if one can establish that within the last 400 years, there has definitely been no large earthquakes whose epicenter is in Bataan, it does not follow that there will be no large earthquake there in the future. The explanation is: seismologists speak of "seismic gaps" relating to periodicity, that is, regions along a chain that could be quiescent for even thousands of years, but meanwhile are accumulating strains for a large earthquake. Many large earthquakes which have occurred in seismic regions which have been quiescent for hundreds of years prove this.

We wish to reserve a further position paper, memorandum or comment on the Report of the IAEA Safety Mission of 1978.

Respectfully submitted,

Andres O. Hizon
Committee Chairman,
NSSEEP

Attested:

Angel Luzardo, Jr.
President, NSSEEP

27 August 1979

MEMORANDUM NO. I OF NSSEEP

We begin by stating that the records will show that NSSEEP was subjected to two days of intensive and comprehensive interpellation by a team of Ebasco experts composed of, among others, Messrs. Tilford, Gupta, Healy and their legal counsel on the first position, Position Paper No. 2 and Position Paper No. 3 of NSSEEP. Given every opportunity to question, given every opportunity to challenge, given every opportunity to submit direct proof against, no question, challenge or specific direct proof was made or submitted during the interpellation on Position No. 5(c) of POSITION PAPER No. 2 of NSSEEP which reads as follows:

"Position No. 5(c)- In line with the apparent concern of the President regarding the Bataan Nuclear Power Plant and in the interest of the Filipino people, we believe that an earthquake of at least 8.0 magnitude on the Richter scale should be postulated on all capable faults and competent geologic and tectonic structure at, under or near this Nuclear Plant. We submit that the aproper approach is to postulate on 8.0 magnitude earthqauke on all capable fualts and geologic structures competent in generating such earthquake, compute the resulting ground acceleration, analyze probabilities and then make the necessary reasonable judgment. The approach of Ebasco is: dismiss the possibility of 8.0 magnitude on all but the most distant tectonic structures, postulate and select lower magnitude earthquake based on a nine-year selected NOAA listing (nature may not agree with their se selection), use selected attenuation curves not based on Philippine seismicity on nearby capable faults and tectonic zones, analyze with their opinion of probabilities, come up with a low seismicity risk map and then use this map for judgment on critical design considerations. We submit that the Ebasco approach is inaccurate, unreliable and biased. (Underlining ours)".

Under the rules of evidence, therefore, we consider this position fairly well-established and admitted by Ebasco. We can even state that we felt sure that the Ebasco experts were apprehensive that we could marshal grave and incontrovertible proofs which would then be more forceful in the record of the proceedings. But admitted and established, we were satisfied.

We have also noted but not presented to the Commission grave doubts on several of the IAEA concerns which, we believe, were not satisfactorily attended to by Ebasco and possibly even by PAEC, since we wished to avoid lengthy discussions which require considerable study and time and a piling up or disarray of our own private concerns, but we are willing later to voice our doubts to the proposed International Panel.

In our cross examination, many inconsistencies, contradictions, inaccuracies and biases were brought out and, we believe, also fairly well-established and proven.

We now turn to the long litany of contradictions, misleading statements, artificies and even what seems to us blatant prevarications too tiresome to enumerate but we may mention same examples:

1. Mr. Tilford: On Bataan peninsula being clearly stated in their position paper as "aseismic" stated that they never said Bataan was "aseismic" and even denied it specifically in the interpellation of Mr. David Leeds. He even argued the same in a press interview on the matter. On being shown up by Atty. Guerrero and Engineer Hizon, he flip-flops and said Ebasco made a mistake, stated a very late correction because he no longer had nay choice, When asked to present athe asserted mistake and correction in writing, he kept silent, no promise.

2. Mr. Tilford: In order to support a Gupta error and contradiction, stated that the Bataan Nuclear Plant is on rock foundation so that the predominant period of the ground, T_p, was as Gupta stated computed on the Kanai equation on rock. If this were so, the IAEA report would not mention "strain softening" of the foundation which could not occur on rock. He probably assumed and knew that the Commission would not understand.

3. Mr. Tilford: On being pursued further, he coolly prevaricated and stated that the natural period of the ground was determined and was in an Appendix to the PSAR report. He even pointed out the Appendix reference to a volume of PSAR to Engineer Hizon. On being pursued further, the Commission requested that the indicated volume of the PSAR be brought in. When Mr. Tilford saw that the volumes of the PSAR were being brought in, he knew the jig was up, he reversed himself and said that the data was not in the PSAR.

4. Mr. Tilford: On being told by Engineer Hizon that if the natural period of the ground was not in the PSAR, then it could be found in the results of the three-month micro-earthquake or micro-tremor observations, Mr. Tilford again possibly prevaricated and stated that they did not determine the natural period of the ground. One of the principal elements determined in micro-tremor observations, in fact probably the principal element, is the natural period of the ground. Again, Mr. Tilford possibly deliberately prevaricated knowing that the members of the Commission, not being technical men, would not know. But he forgot that the oncoming International Panel would know and understand.

5. Mr. Tilford: When Mr. Leeds suggested that Philippine data and the work of Filipino Seismologists should be used and exploited, Mr. Tilford stated that they were in the PSAR. Mentioned, maybe yes; used, maybe not; but Mr. Tilford probably again hoped that the Commission would not understand and go further.

6. Mr. Tilford: Prattling Filipino seismologists like Reppetti, Mano and others, Mr. Tilford stated that their work was used. When challenged by Engineer Hizon to show any Filipino name in the long list of references used in the ~~Seismic Risk Analysis~~ Report by Ebasco, he could not name any. The only one contained in the Report was that records in the Philippines were unavailable, "unreliable" etc., and museum.

7. Dr. Gupta: On being shown by Engineer Hizon that the Kanai equation shown on Appendix 2.5.L "SPATIAL ATTENUATION OF STRONG GROUND MOTION AND VALIDITY OF SSE" was not the same as the Kanai equation published by Donovan in the "Building Science Series 46" of the U.S. Bureau of Standards, read the equation from a published paper. On being pursued further, the equation he used was good only on a Hitachi mine and on completely rock and and that the Donovan reported Kanai equation was good for any kind of ground. The next day, on being pursued by Engr. Hizon that the ground traversed by the attenuation (actually more than 200 km.) was not all rock, Dr. Gupta demonstrated that, like Mr. Tilford, he can also flip-flop, said the equation was not used. This, in the face of Appendix 2.5.L and its attached curves, is a direct contradiction.

8. Dr. Gupta: The second day of interpellation, he submitted a drawing with an indicated "Su-curve" without explanation. We learned later that the alleged "Su-curve" was not previously seen by Fr. Su and was not authorized by Fr. Su (See attached letter of Fr. Su).

9. Dr. Gupta: Dr. Gupta asserted that the curves and values used by Ebasco were conservative and the latest. Engr. Hizon showed him that "Building Science Series of 46" of the U.S. Bureau of Standards was dated only 1973. Engr. Hizon told him that the Housner curves and values used by Ebasco were obsolete and probably the lowest. (Exhibit 1- NSSEEP).

10. Dr. Healy: Mr. Gilmore stated that the practices and methods of Ebasco followed US and California practices. California seismicity is comparable with Philippine seismicity. Dr. Healy when he was questioned by Engr. Hizon whether he was familiar with the California Code stated that he practiced in New York State and that he was not familiar with the California Code. Engr. Hizon was therefore not able to question him.

11. Dr. Healy: stated that the Ang-Newmark Curve was for Diablo-Canyon (Exhibit 25-A NSSEEP). Engr. Hizon stated that the seismicity of Diablo-Canyon was of the same high order of seismicity as in the Philippines and that therefore the curve is applicable (see the latest U.S. Uniform Building Code and the Philippine Building Code).

12. Dr. Healy: suggested a 0.1 g SSE value for a nuclear plant in the U.S. When told by Engr. Hizon that that plant was situated in a low seismicity area in the U.S., he stated that it was a low SSEEvalue anyway and insisted on the comparison. Engr. Hizon rejected the comparison.

The attempt to avoid, to conceal and not use good, applicable and reliable data, the attempt to substitute low and definitely inferior and inapplicable data even to the extent of a continuous pattern of contradiction after contradiction, and making inaccurate assertions they knew were outside the technical knowledge of the Commission but which they must know are within our technical competence is readily apparent to any dedicated and impartial observer of Ebasco.

Any unbiased engineering firm in the long chain of analysis would have chanced and stumbled upon at least one of the many higher values needed for safe engineering. But we were astonished for find out that in the long chain of study and analysis involving many parameters and many steps, not one value which could be proven high or the highest by well-known authors was ever used. In fact practically unknown authors and researchers giving low values were assiduously searched for in publications not easily available in the Philippines, perhaps to conceal from Filipino eyes their inapplicability, and then assert the low risk and low seismicity values in the Western deserts and Eastern parts of the U.S. as applicable to the high Philippine seismicity.

The persistence and tenacity to use and apply low seismicity and low risk values even to the extent of a long train of contradictions can only be explained if a strong bias or motive existed, otherwise the applicable and safe values which NSSEEP presented would

have been readily accepted.

Paul A. Samuelson, economist, writing in Newsweek of August 13, 1979, page 46, about Corporate handouts in relation to the Chrysler petition for help has this to say, and we quote:

> "If I were Parkinson or Potter writing a handbook for Machiavellian managers, I'd remind them of the old saw: "Who steals a handkerchief goes to jail, who steals a county becomes a duke." If you are going bankrupt, be sure you go bankrupt on a big scale.
>
> Westinghouse must have learned from this school. After it rashly contracted to deliver uranium at a price that turned out to be commercially disastrous, the very magnitude of its loss was considered by some to be a mitigating factor. It reminded cynics of the Scot who, on trial for murdering his parents, threw himself on the mercy of the jury on the ground that he was an orphan." unquote.

We do not suggest that the quotation has a direct bearing on this present investigation of the Bataan Nuclear Reactor Plant but the very mention of "uranium" rings a bell, especially if uranium may be needed by this nuclear plant.

Mr. Willis, testifying before the Commission repeatedly stated and admitted that raising the seismicity design value and SSE value from 0.4g to 0.6g may mean about 70 million dollars difference, a difference that goes both ways, that is, lowering the design value of the ground acceleration from 0.6g to 0.4g would spell the same difference.

It is difficult to believe that the determined, persistent and tenacious effort to bring down the actual and correct seismicity value to a low level is not a part of a concerted effort and not in any way associated with a desire, intention or compulsion to create

an advantage of U.S. $70 million or more to the Contractor or owner of the nuclear reactor plant, to the great prejudice of the safety of the people of Bataan.

But even if it is alleged that this advantage or savings of U.S. $70 million or more will accrue to NPC, still this amount is a poor and inadequate price to measure against the higher risk imposed on the nuclear reactor plant and against the diminished safety of the people of the Philippines.

We note in passing that the conditions and arrangements imposed possibly by the foreign loan, that practically all the best Filipino earthquake engineers who are practicing outside the government service or teaching in the UP have been effectively shut off from the study and analysis of this nuclear plant to the great detriment and loss of technology transfer to the Filipino people. All this wealth of Filipino talent and even Filipino scientists and their world renowned data and records were not exploited and utilized. NSSEEP, by the merest chance, became interested and involved in a very small part of this investigation. We submit that in any arrangement for other loans, Philippine data and the best Filipino scientists and engineers, especially those outside the government service, should be fully utilized and exploited. All these should be imposed as conditions in the loan agreement and subsequent contracts.

In the case of the Binga Hydroelectric Power Plant, the conditions of the loan were that outside consultants, with joint Filipino and American experts (EDCOP-TAMS) were utilized with the Filipino team of EDCOP as the senior partner. In Japan, this arrangement is usually done in the first project, but the second and succeeding similar projects are always by purely Japanese experts, Example: Kamishiba Dam, Narugo Dam and subsequent arch dams.

We entered our involvement in this investigation in the spirit of civic consciousness without compulsion, obligation or remuneration, and we feel that we have done our part. We now bow out to attend to our own private concerns, but we wish to state here that we are willing to be called back only in private by the Commission or by the constituted and ~~interpational~~ Panel, or otherwise in open discussions and interpellations subject to our consent and convenience.

We again ask the indulgence of the Commission in some of our impatient outbursts in the face of what appears to us obvious prevarications.

With many thanks for the many courtesies extended to us, we respectfully submit this Memorandum.

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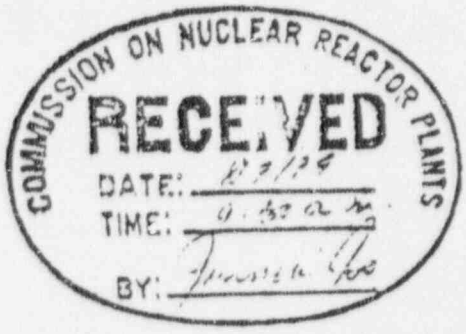
Chairman, NSSEEP Committee

Angel Lazaro, Jr.
Past President, NSSEEP

Dr. No. 25-B

REPUBLIC OF THE PHILIPPINES
COMMISSION ON NUCLEAR REACTOR PLANTS
METRO MANILA



RE: INQUIRY ON THE SAFETY TO THE PUBLIC OF THE BATAAN NUCLEAR REACTOR PLANT

x - x

POSITION PAPER NO. 2 OF NSSEEP

COMES NOW Engineers Andres O. Ilizon and Angel Lazaro, Jr. of NSSEEP unto the Honorable Commission and most respectfully submits the attached POSITION PAPER NO. 2 OF NSSEEP. We have received data on which to base our position paper only recently.

Metro Manila, 6 August 1979.

National Society for Seismology and Earthquake Engineering of the Philippines

by:

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Chairman, NSSEEP Committee

Engr. Angel Lazaro, Jr.

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POSITION PAPER NO. 2 OF NSSEEP

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6 August 1979

POSITION PAPER NO. 2 OF NSSEEP

Doc. 75-B-NSSEP

I. On question No. 5:

"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?

Position No. 5 (a) - The President identified the earthquake as hitting "Mindanao in August 1977, which was 7.2 intensity on the Richter scale".... (preliminary value of 7.2 published by the newspapers).

The World Data Center A (NOAA) at Boulder, Colorado, U.S.A. have the following final determination of this earthquake as follows:

> August 16, 1976 16:11:07.2 UTC in latitude 6.3°N, longitude 123.7°E, magnitude 8.0.

In all these discussions, therefore, the magnitude of this earthquake should be 8.0 Richter scale as meant by the President. This we hold as the meaning of the President, and we request a ruling of the Commission.

The difference between 7.2 magnitude and 8.0 magnitude is not according to the Richter sequence, 7.2 is equivalent to about 22 Hiroshima bombs and 8.0 is equivalent about 355 Hiroshima bombs.

Position No. 5 (b) - We hold that the question posed by the President translated to technical language is: "will the Bataan Nuclear Power Plant be able to withstand the shock of an earthquake of magnitude 8.0 on the Richter scale without leak or spillage resulting in nuclear contamination?" In other words, is the Bataan Nuclear Power Plant designed to withstand the shock of an earthquake of magnitude 8.0 on the Richter scale without leak or spillage resulting in nuclear contamination?

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Position No. 5 (c) - In line with the apparent concern of the President regarding the Bataan Nuclear Power Plant and in the interest of the Filipino people, we believe that an earthquake of at least 8.0 magnitude on the Richter scale should be postulated on all capable faults and competent geologic and tectonic structure at, under or near this Nuclear Plant. We submit that the proper approach is to postulate an 8.0 magnitude earthquake on all capable faults and geologic structures competent in generating such earthquake, compute the resulting ground acceleration, analyze probabilities and then make the necessary reasonable judgments. The approach of Ebasco is: dismiss the possibility of 8.0 magnitude on all but the most distant tectonic structure, postulate and select lower magnitude earthquakes based on a nine-year selected NOAA listing (nature may not agree with their selection), use selected attenuation curves not based on Philippine seismicity on nearby capable faults and tectonic zones, analyze with their opinion of probabilities, come up with a low seismicity risk map and then use this map for judgment on critical design considerations. We submit that the Ebasco approach is inaccurate, unreliable and biased.

Position No. 5 (d) - We submit attenuation curves of Philippine seismicity computed and plotted on the Manila Observatory formation:

$$\ln A\ (\%\ \text{of}\ g) = 3.10 + 1.27\ M_L - 2.00\ \ln (R + r_0)$$

We submit that these curves are more reliable and applicable. Figure 1 NSSEEP.

Position No. 5 (e) - We submit Figure 2 NSSEEP containing a comparison of attenuation curves on magnitude 6.5. We submit that if the Philippine attenuation curves are not used, the attenuation curves derived from California and Japanese earthquakes are more applicable than the ones used by Ebasco.

Position No. 5 (f) - We submit Figure 3 NSSEEP with Ang-Newmark [illegible] the Ebasco curve (worst case) and suggest that the maximum

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ground acceleration to be considered on the U.S. Geological Survey return period of 10,000 years should be 0.75 g and not 0.35 g, based on Ebasco seismic risk analysis. We believe a design of the Nuclear Plant based on 0.35 g would be unsafe.

Position No. 5 (g) - We submit that a proper safe shut down earthquake (SSE) should have a g-value more than or at least equal to the design earthquake acceleration and that an SSE value of 0.35 g against the design value of 0.40 g is poor engineering. Any design value such as 0.40 g, whether by working stress analysis or by ultimate strength analysis, has a safety margin above the design value, and it is good engineering to utilize this safety margin which has already been paid for very dearly, in safely shutting down the plant in case of high acceleration earthquakes. The additional cost in having better valves and fittings, more fastenings, better protection for the fuel rods, etc., should be minimal compared to the huge cost of the structure.

Position No. 5 (h) - Since Ebasco has testified that a safe shut down earthquake of 0.35 g lower than the design acceleration of 0.40 g is in accordance with current U.S. practice in California, we suggest that Ebasco be required to submit a list of all SSE and all corresponding design earthquakes of nuclear plants in California, built or in the process of construction. We have a copy of a published paper on the San Onofre Nuclear Plant, California, the design acceleration was 0.25 g working stress, and the safe shut down earthquake was 0.50 g.

Position No. 5 (i) - We expect that our position and the NRC-Ebasco position will not agree. Therefore, we suggest that the two positions be submitted to a panel of world-renowned seismologists and earthquake engineers. The U.P. engineering professors can suggest names.

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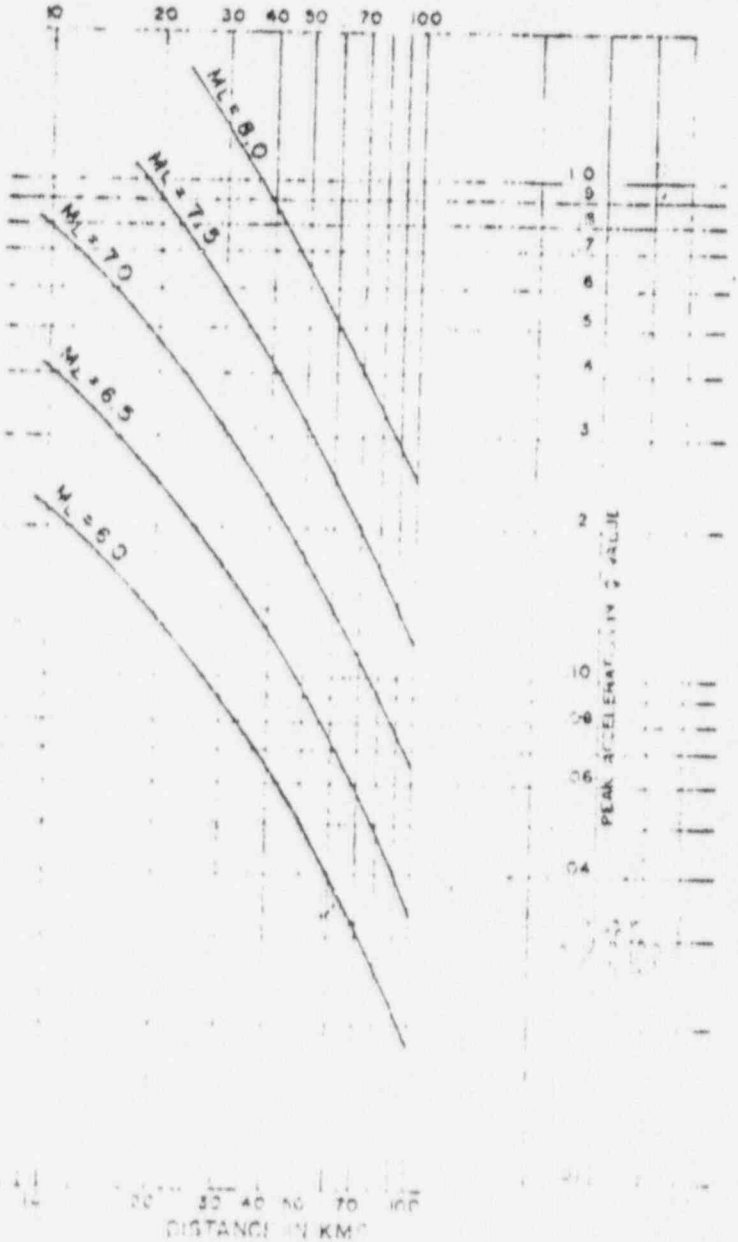
We intend to submit a further position paper on the seismic risk analysis as soon as our studies are completed.

Respectfully submitted:

Andres O. Hizon
Chairman, NSSEEP Committee

Angel Lazaro, Jr.
President, NSSEEP

Figure 1 (NSSEEP)



Attenuation Curves Philippine Seismicity

Ln (Acc. of G) = 3.10 + 1.27 ML − 1.095 Ln(R + ro)

ML = local magnitude, R = distance in km, ro = 0.05 km,

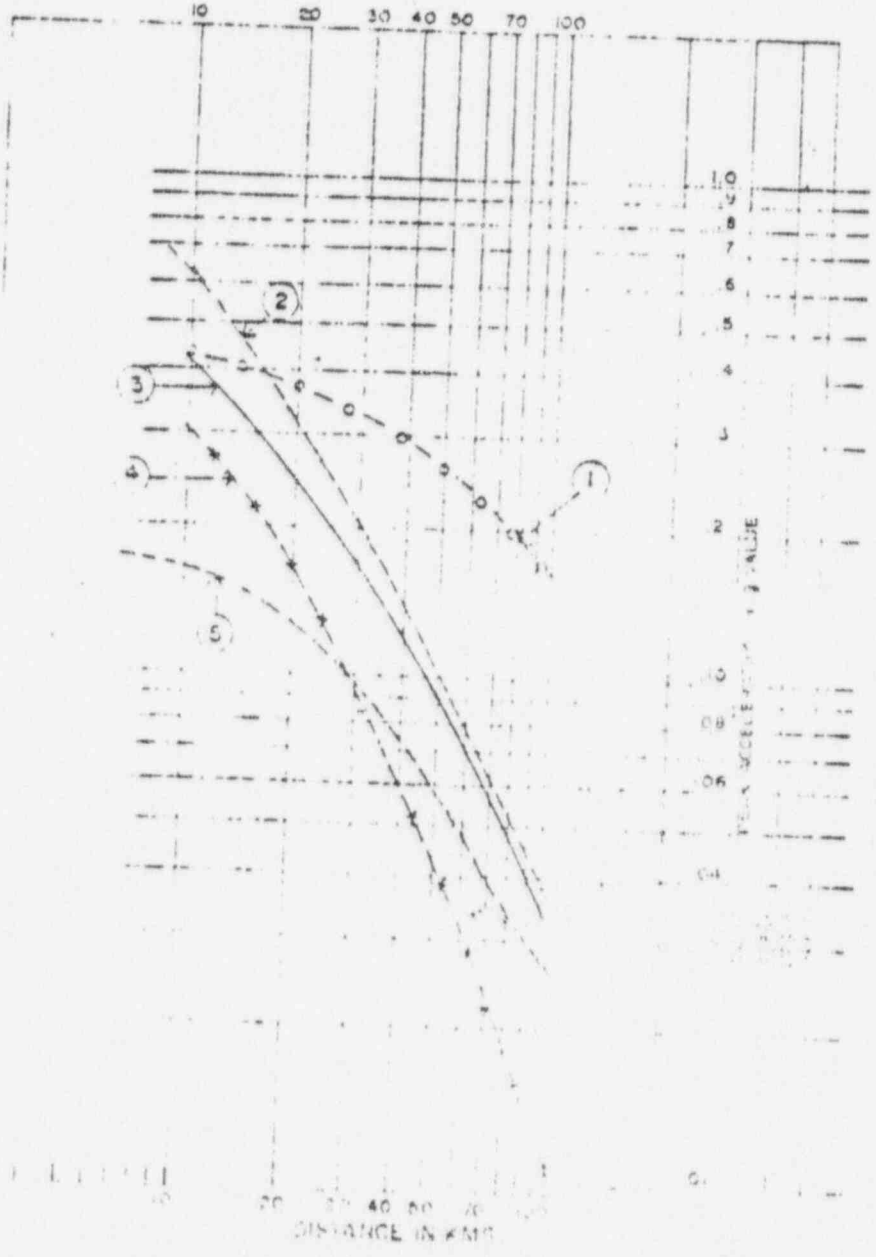
B and coefficients of acceleration equation [illegible]

from Philippine earthquakes by Dr. Jorge C. Gr[illegible]

Ateneo de Manila University to give regression from each station

Prepared by [illegible]

Figure 2 (NSSEEP)



① U.S.C. & G.S. (Cloud & Perez)

② Kanai (California & Japanese Earthquakes)

③ Su - Hizon (67 Philippine Earthquakes)

Schnabel (11 Selected Records)

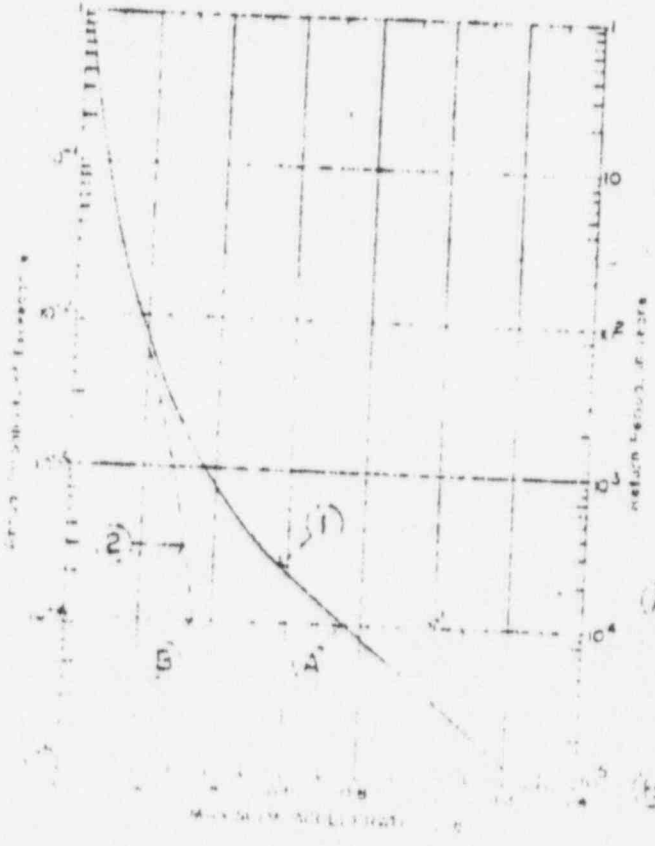
Donovan (Western U.S Records

Comparison of attenuation curves for magnitude 6.5

All curves scaled from U.S. National Bureau of Standards, Building Science Series 40, Seismic Risk for Disaster Mitigation, p. [illegible]. "Except Philippine [illegible] for magnitude 6.5 Low risk [illegible] and [illegible], not as [illegible] and certainly not [illegible] geology, [illegible] factors, were used. [illegible]

Prepared by: A.O. Hizon

Figure 3 (NSSEEP)



(1) Ang - Newmark

(2) Ebasco
(Worst case)

(A) From Ang - Newmark curve:
Return Period, 10,000 Years,
Max. acc. = 0.45 g

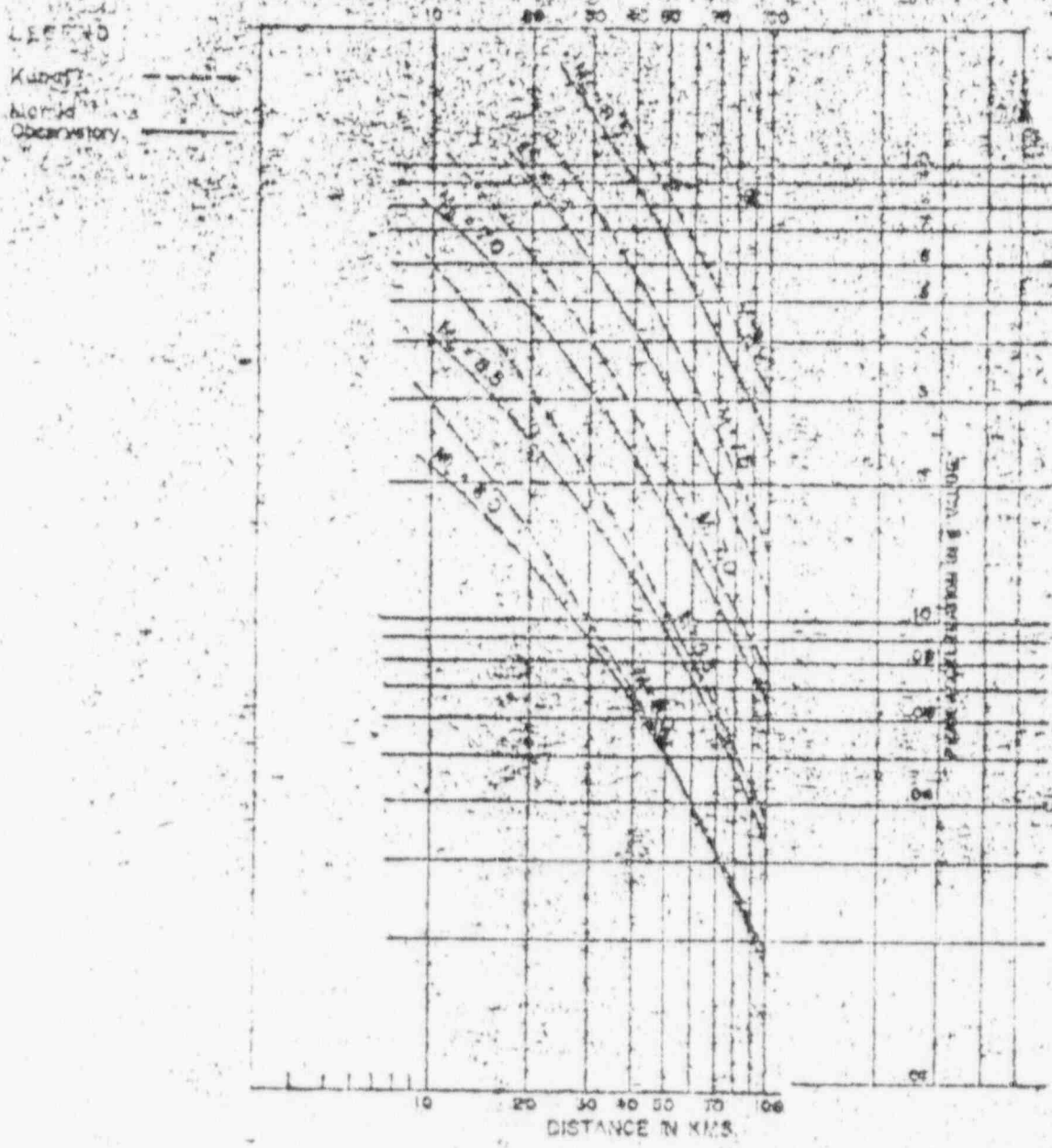
(B) From Ebasco curve:
Return Period, 10,000 Years,
Max. acc. = 0.35 g

Ang - Newmark curve taken from Proc. of U.S - SE Asia
Engineering for Natural Hazards Protection, p. 16

Ebasco curve taken from Ebasco Seismic Risk Analysis

Prepared by: A.O. Hizon

Figure A (NSSEEP)



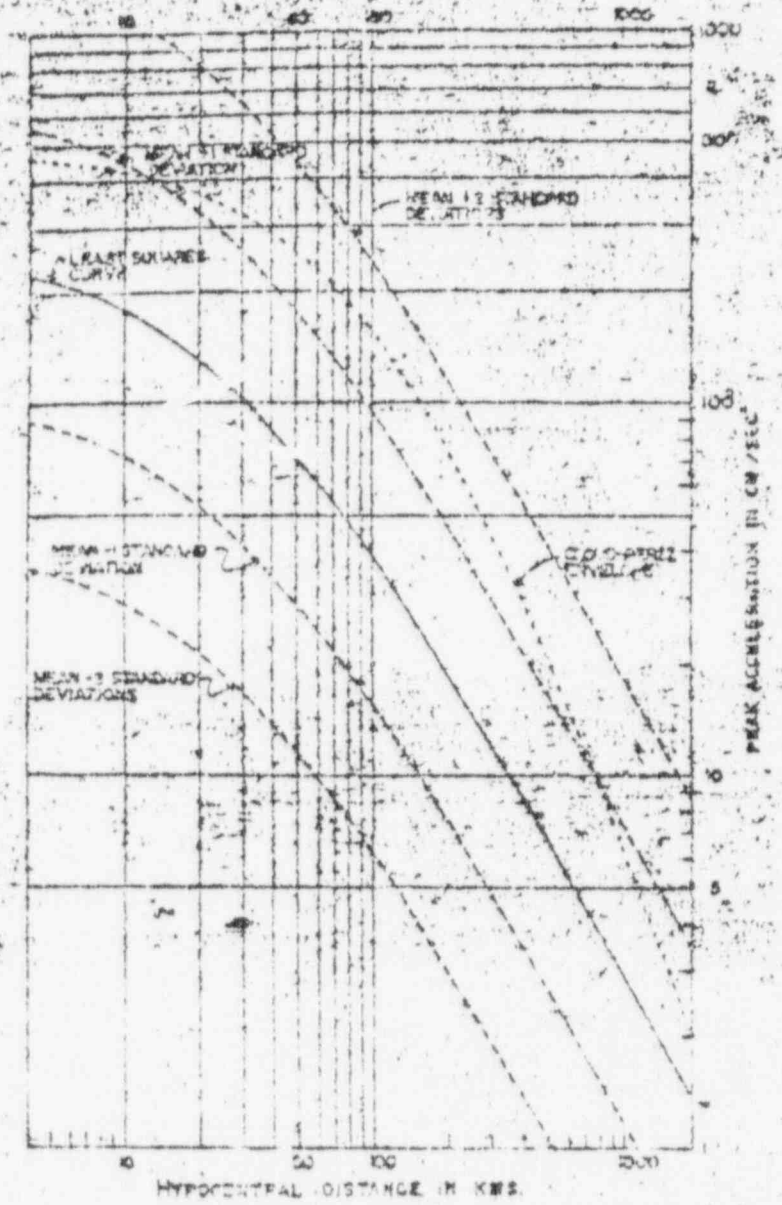
COMPARISON OF ATTENUATION CURVES:

Kanai (California and Japanese Earthquakes)

Manila Observatory (Philippine Earthquakes)

Prepared by A. D. HIZON

Figure 5 (NSSEED)



PEAK GROUND ACCELERATION IN TERMS OF DISTANCE FROM CAUSATIVE FAULT

WORLDWIDE SET OF 518 STRONG MOTION RECORDS
WITHOUT NORMALIZATION OF MAGNITUDE

(Copied from Fig. 4 of Duke, Earthquake Hazards for Buildings, Building Science Series 46, p 98)

Prepared by A. D. HIZON

Table 3 (NSSEEP)

RETURN PERIODS FOR PEAK ACCELERATIONS

Acceleration g	Return Period (Years) Surface Motion Competent Soil	Rock Motion
0.05	4	8
0.10	20	30
0.15	50	60
0.20	100	100
0.25	250	200
0.30	450	300
0.40	2,000	700

(Copied from Table 2 of Cornell, Earthquake Hazards for Buildings, Building Science Series 49, p 95)

Prepared by A O HIZON

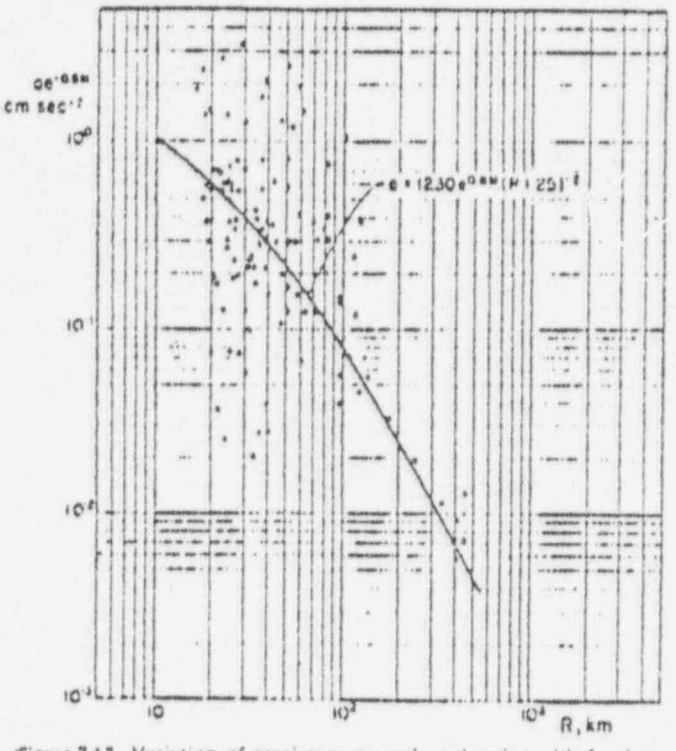


Figure 7.17. Variation of maximum ground acceleration with focal distance. *After Esteva (1969).*

necessary to adopt functional relationships different from those of Eq. 7.4. Still these expressions have already been adjusted from an earlier version (Esteva and Rosenblueth, 1964) so that they predict finite values of a, v, and d as R tends to zero.

It is difficult to set an upper limit to a at the focus. On the basis of the strength of most rocks, Housner (1965) concludes that the maximum acceleration cannot exceed $0.5g$ (g = acceleration of gravity) after admitting that the earthquake-generating mechanism is always fault slippage. This limit is not acceptable and should be raised to at least $1.0g$, and perhaps even to $1.5g \simeq 1500$ cm/sec^2, if reports of vertical accelerations greater than g during the 1897 Assam earthquake (Richter, 1958) are trustworthy. Or possibly the focal acceleration should vary with M.

The maximum possible ground velocity near the surface of the earth can be established approximately on the following premises. The most violent portion of an earthquake is the S phase. The corresponding waves satisfy the expression

$$x = \alpha(R + v_s t) \tag{7.6}$$

Figure 7.18. V

where x denotes tran
It follows that

Because $\partial x/\partial R$ can withstand, $\partial x/\partial t$ a shear strain of the sion). Hence, with a approximately (see

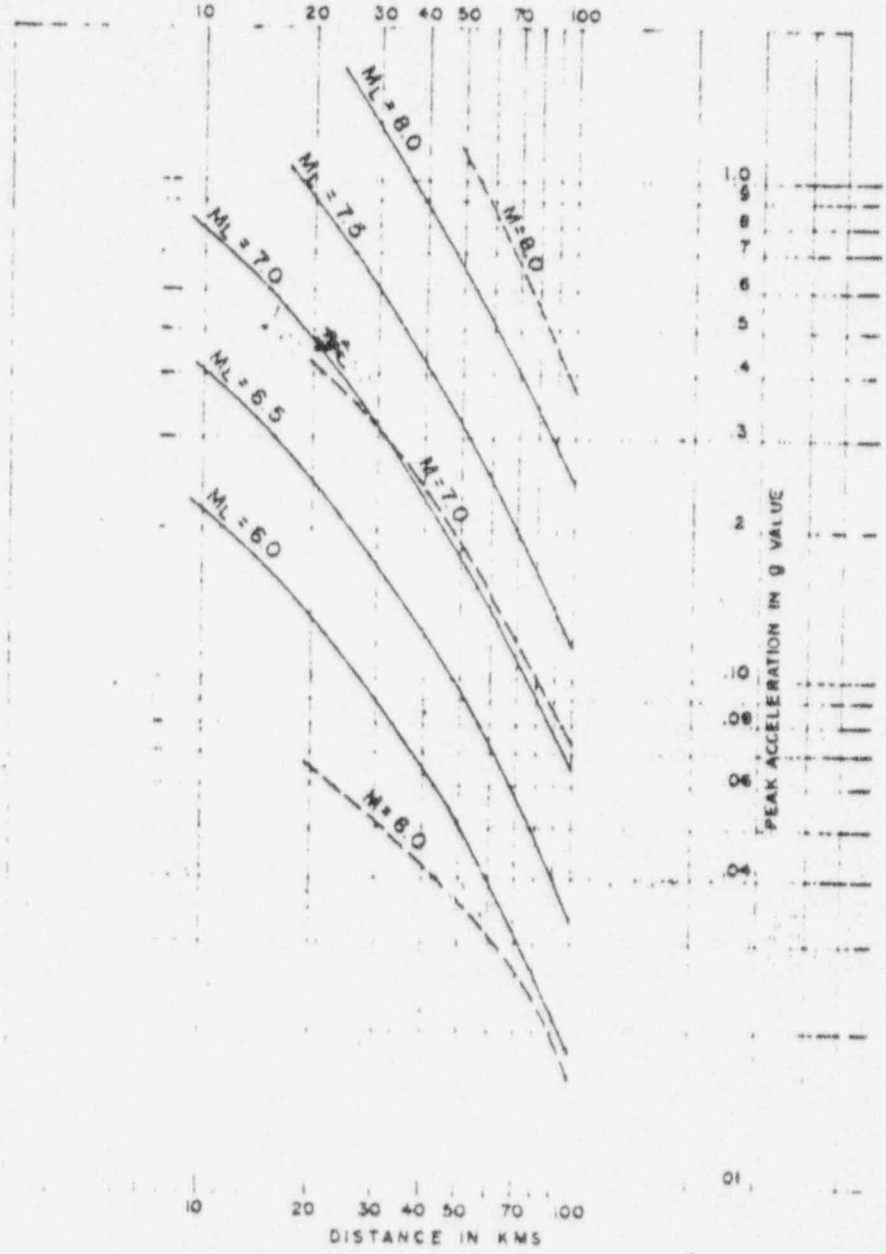
This limit on the t of 11 according to velocity being exce spread of the correl properly estimated a

Some data indicate

Figure 6 (NSSEEP) Exh. 2-NSSEEP

1 Su ----- Sept. 1977

2 Su-Hizon ——— Aug. 1979



Attenuation Curves – Philippine Seismicity

1 Fr Sergio S. Su - From Proc. U.S - SEAsia Symposium, Sept 1977

$$\text{Log } a_h = .333\, I_{mm} - .5$$

Derived from isoseismal maps of 40 Philippine earthquakes compiled by Fr M Saderra Masó, S.J. ( )

2 From Fr Sergio S Su, Aug 1979

$$\text{Ln } A\ (\%\text{ of } g) = 3.19 + 1.27 M_L - 2.095 \text{ Ln } (R + r_0)$$

M_L = local magnitude, R = distance in km, r_0 = 30 km

Prepared by A.O HIZON

TABLE 1

ATTENUATION EQUATIONS

Data Source	Equation	Reference
1. San Fernando Earthquake February 9, 1971	$y = 186706\ R^{-1.83}$	--
2. California Earthquakes	$y = \frac{961\ y_o}{1 + \left(\frac{R'}{h}\right)^2}$ where $\log y_o = -(0.41) + 0.81m - 0.027m^2$ h is a site factor	Blume (1965)
3. California Earthquakes	Graphical Presentation	Housner (1965)
4. California & Japanese Earthquakes	$y = \frac{b}{T_G^2}\ 10^{0.61m - P \log R + Q}$ where $P = 1.66 + \frac{2.60}{R}$ $Q = 0.167 - \frac{1.83}{R}$ T_G = fundamental period of site	Kanai (1966)
5. Cloud (1963)	$y = \frac{6.77\ e^{1.64m}}{1.1e^{1.1m} + R^2}$	Milne & Davenport (1969)
6. Cloud (1963) Housner (1965)	$y = 1230\ e^{0.8m}\ (R+25)^{-2}$	Esteva (1970)
7. U.S.C. & G. S.	$\log_{10} Y = 6.5 - 2 \log_{10} (R'+80)$	Cloud & Perez (1971)
8. 11 Selected Records	Graphical Presentation	Schnabel & Seed (1972)
9. 183 Instrumental Values	$y = 1300\ e^{0.67m}(R+25)^{-1.6}$	--
10. Western U. S. Records	$y = 10.9\ e^{0.8m}\ (R'+40)^{-1}$	--

y in cm./sec.^{2}
R is kilometers (distance to causative fault)
R' is miles (epicentral distance)
h is miles (focal depth)
m is magnitude

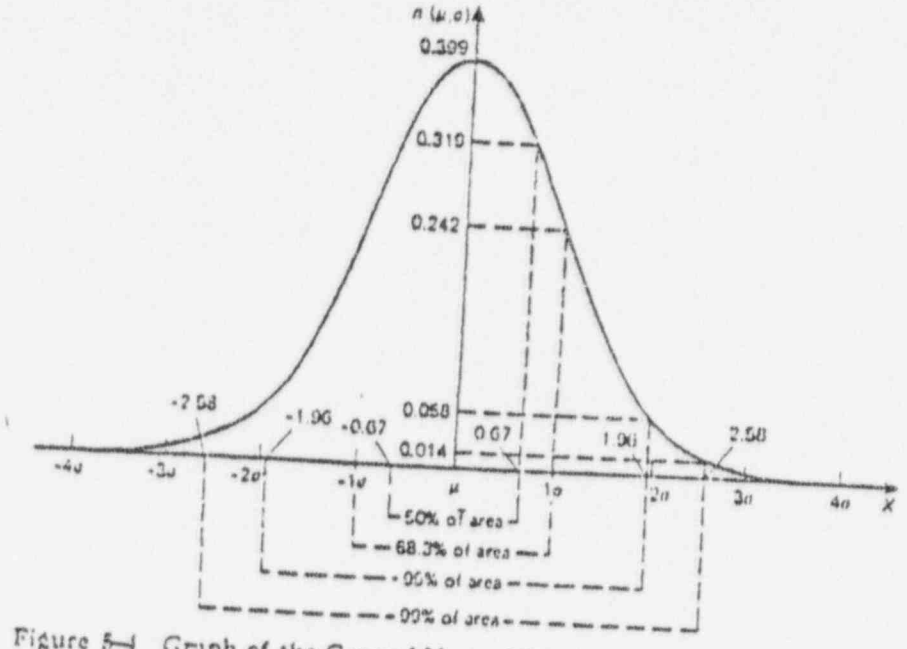


Figure 5–4 Graph of the General Normal Density Function

graph of the normal density function as shown by Figure 5–4 and as discussed in the following paragraphs.

First, a normal distribution has as its parameters μ and σ (or σ^2) in the sense that the area under its density curve (normal probability), given the magnitude of σ, is completely defined by the distance between μ and a specified value of σ. As such, the working part of the normal density is the exponent $-(x-\mu)^2/2\sigma^2$ because it contains a particular value of the normal variable, X, and the parameters μ and σ^2 of the distribution. The greater the deviation of a particular x from μ, the greater is the numerator of this exponent. However, this deviation is a squared quantity; and so two different values of X showing the same absolute deviation from μ have the same probability. This reflects the fact that the normal distribution is symmetrical with respect to μ. That is, $n(\mu + x) = n(\mu - x)$. For example,

$$P(\mu - 0.67\sigma < X < \mu) = P(\mu < X < \mu + 0.67\sigma) \doteq 0.2500, \text{ or}$$
$$P(\mu \pm 0.67\sigma) \doteq 0.5000;$$

$$P(\mu - \sigma < X < \mu) = P(\mu < X < \mu + \sigma) \doteq 0.3413, \text{ or}$$
$$P(\mu \pm \sigma) \doteq 0.6830;$$

$P(\mu - 1.96\sigma$

$P($

$P(\mu - 2.58\sigma$

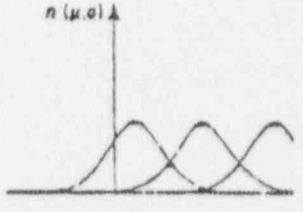
$P($

Second, the fact that t
that the greater the dev
ability density of X. Th
ence decreasing density.
of the density function ca
the value of X is identica
reduced to $1/\sigma\sqrt{2\pi}$, the
normal distribution is un

Third, the curve for
distance of σ from either

Fourth, the normal dis
curve never touches the
will have nonnegative
deviations from μ is negl
density curve falls off
enclosed by $\mu \pm 3\sigma$. This
to approximate other dis

Fifth, a change in the
while a change in the v
reference to a fixed scale.
is really a family of distr



(a)

Figure 5–5 (a) Normal
Different Means; (b) Nor
Standard Deviations

Earthquake Levels for Design

A thorough review of all data collected by consultants was made and agreement reached upon earthquake design levels to be used for the San Onofre site.

In taking a conservative approach, it was decided that the following two maximum horizontal ground acceleration levels be used for the design criteria:

1. 0.25 g - Nuclear plant component stresses do not exceed working range.

2. 0.50 g - Plant can be safely shut down.

CATEGORIES OF COMPONENTS, SYSTEMS & STRUCTURES - "A", "B" and "C"

The objective of the seismic design of the plant was to verify that the most adverse conditions of stress and deflection resulting from the combined influence of normal and earthquake loads will not impair safe operation or orderly shutdown of the plant under the applicable earthquake design levels. It can be readily realized that all components, systems, and structures are not equally important for plant safety; therefore, in order to insure a consistent approach to the design of the plant, it was decided to classify all plant items into one of 3 categories.

Category "A": Components, systems and structures that are important to the nuclear safety of the plant. These were designed in accordance with the dynamic response spectrum approach outlined below which was prepared by consultants.

Category "B": Components, systems and structures that are important to the continuity of power generation or whose contained activity is such that release would not constitute a hazard. These were designed for a maximum horizontal acceleration factor for gravity loads of 0.2 g in accordance with criteria used for non-nuclear steam power plants on the west coast. Lateral forces are applied statically for analysis.

Category "C": All remaining structures not directly associated with power generation, such as warehouse buildings, were designed in accordance with the "Uniform Building Code". This specifies a maximum horizontal acceleration factor for gravity loads of 0.133 g with lateral forces applied statically.

ASEISMIC DESIGN CRITERIA FOR CATEGORY "A" ITEMS

Category "A" items were designed for earthquake in accordance with written criteria prepared in conjunction with consultants. These criteria were presented in an addendum to the Preliminary Safety Analysis Report referred to earlier. They were approved as acceptable by the staff and consultants of the Atomic Energy Commission resulting in the issuance of a construction permit.

Ex 2. 6-N58EEP

Manila Observatory
August 25, 1979

Engr. Andres O. Hizon
National Society for Seismology and
Earthquake Engineering of the Philippines

Dear Mr. Hizon:

In answer to your letter of the 24th, let me first make a general clarification, and then later go back to your individual questions. The equation I furnished you:

(1) $\ln A = 3.19 + 1.27 M_L - 2.095 \ln (R + 30)$

was derived from three equations:

(2) $I = I_o + 10.83 - 2.73 \ln (R + 30)$

(3) $I_o = 1.66 M_L - 2.167$

(4) $I = (3/\ln 10) \ln A + 4.5$

Equation (2) is my results, based on regression analysis from 67 Philippine earthquakes, 45 of which are from Maso. The curves shown in the proceedings of the 1977 Symposium were based only on Fr. Maso's data. Hence, even though they are fairly close to equation (2), I put more confidence on the latter.

Equations (3) and (4) are from Gutenberg and Richter (BSSA, 1942) based on U.S. data. The scatter of these curves is considerable. It is this that gives the coefficient of M_L (1.27) a margin of uncertainty. You will recall that I suggested to you that you try a factor of 1.07 instead of 1.27, because this would make the curves for different magnitudes come closer together, and hence, would not make the curve for magnitude 8.0 anomalously high as the NPC people claim.

My regression results, i.e. equation (2), are in fairly close agreement with the Ebasco results (PSAR, Amendment 3):

(5) $I(R) = I_o + 4.359 - 3.479 \log R$

or alternatively in the Ln R scale:

(6) $I(R) = I_o + 4.359 - 1.51 \ln R$

The answers to your individual questions therefore are:
Ans. to Q 1: affirmative
Ans. to Q 2: affirmative
Ans. to Q 3: negative, except with the suggestion of changing 1.27 to 1.07 as stated above.
Ans. to Q 4: negative
Ans. to Q 5: the explanation I had above had been discussed with Dr. Gupta; we were in agreement.
Ans. to Q 6: I assume Dr. Gupta presumed that he was free to present the results of our discussion.
Ans. to Q 7: negative

Sincerely,

F. Sergio S. Su, S.J.

Fr. Sergio S. Su, S.J.

NATIONAL SOCIETY FOR SEISMOLOGY AND EARTHQUAKE
ENGINEERING OF THE PHILIPPINES
LL Bldg., 160-A Panay Ave. Cor. E. de los Santos Ave.
Quezon City, Philippines
Tel. 98-63-54

24 August 1979

EQ-7-NSSEEP
Genl.

Father Serio S. Su
Manila Observatory
Metro Manila

Dear Father Su:

Sometime ago I consulted you about attenuation curves applicable to Philippine seismicety and you gave me in your handwriting the following equation:

$$\ln A\ (\%\ of\ g) = 3.19 + 1.27\ M_L - 2.035\ \ln (R + r_o).$$

based on 67 Philippine earthquakes.

Subsequently in our talks, we talked about the attenuation curves presented by you in the September 1977 US-SE Asia Symposium and you confirmed the statement in your paper that those curves were derived from isoseismal maps of 40 Philippine earthquakes compiled by Fr. Saderra Maso S.J. (1895).

May I, therefore, request in writing the answers to the following questions:

Father Su's answers

1. Did you furnish me the equation above? Affirmative
2. Did you state that the 40 Philippine earthquakes compiled by Fr. Maso were also included in the subsequent 67 Philippine earthquakes and that the attenuation curves from both studies would be more or less the same? Affirmative
3. You were furnished copies of the attenuation curves drawn by me and we talked about those curves. In fact I showed you all three position papers of NSSEEP. Did you state to me that any of those curves were in error? Negative
4. Did you tell me that the curves published by you in the 1977 Symposium were in error? Negative
5. Dr. Gupta testified that you used several steps in deriving your formula. Apparently he used one or two of your steps then used his own derivation and submitted a curve designated as Su curve. Did he submit and show you the curve he designated as Su curve?

Explanation above in the letter

6. Did you authorize Dr. Gupta to use part of your derivation and continue the derivation or presentation and submit a curve to be designated as Su curve? See answer in Fr. Su's letter.

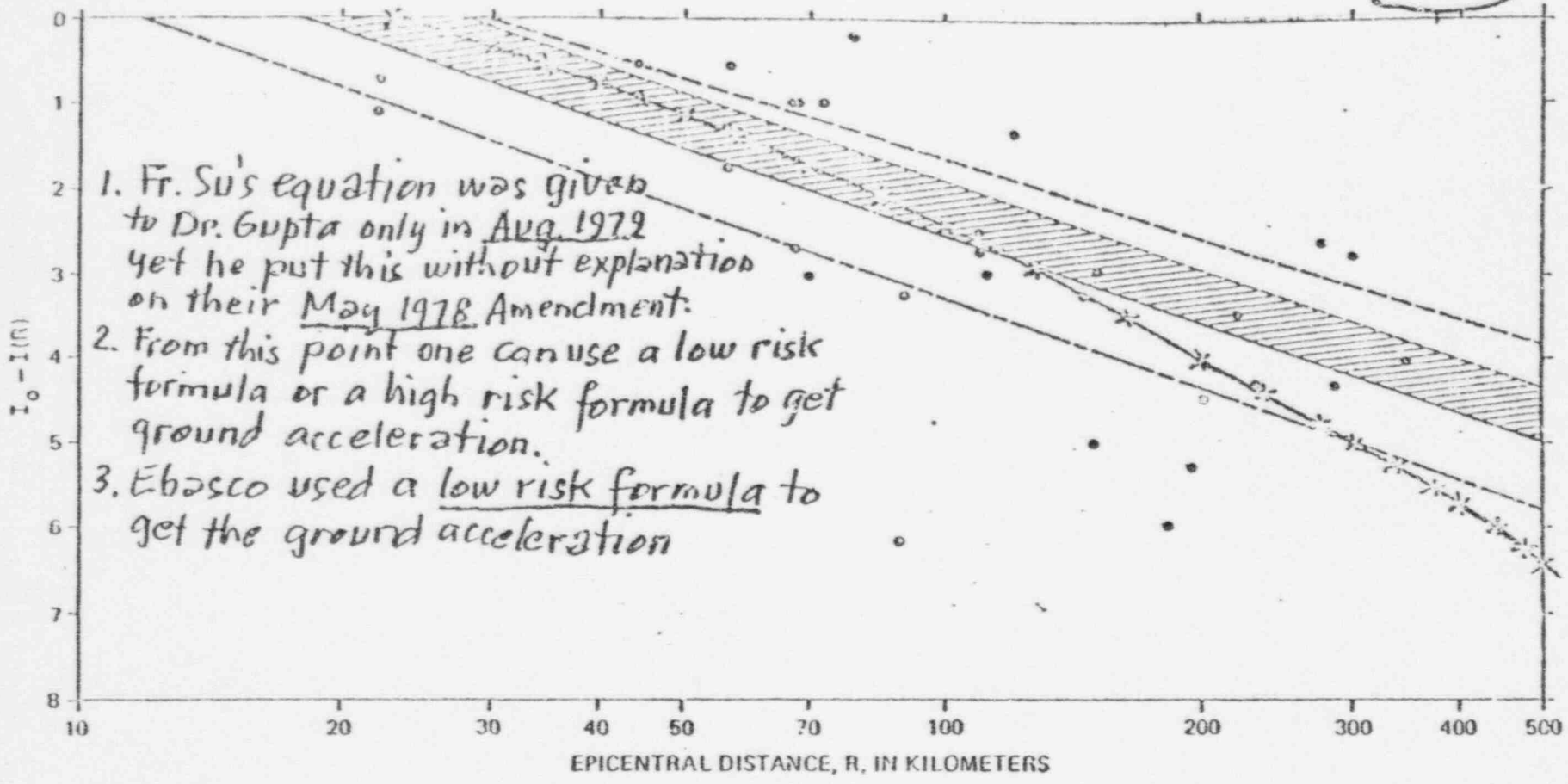
7. If Dr. Gupta showed you the curve as presented by him; did you authorize him to state that his new curve is more reliable than the ones published by you and should therefore be corrected in substitution in any investigation he may be involved in ? Negative

Thanking you for the many courtesies you have extended to me, I am

Very truly yours,

Andres O. Hizon

Amendment No. 3
May 1978



1. Fr. Su's equation was given to Dr. Gupta only in Aug. 1979 yet he put this without explanation on their May 1978 Amendment.
2. From this point one can use a low risk formula or a high risk formula to get ground acceleration.
3. Ebasco used a low risk formula to get the ground acceleration

Ebasco & NISSEEP dual.

EXPLANATION

- Data from Philippine earthquakes
- Philippine data, mean curve
- Philippine data, mean + RMS error curve
- Western U. S. data, mean curve
- Eastern U. S. data, mean curve
- SU'S EQUATION $I(R) = I_o + 10.83 - 2.73 \ln (R+30)$

FIGURE 2.5.1-1

INTENSITY ATTENUATION RELATIONSHIPS BASED ON PHILIPPINE AND U.S. DATA

ENCLOSURE 3

Encl 3

Received 7/5/79

June 28, 1979

Doc No. 17

The Honorable Ricardo Puno
Chairman, Commission on
Inquiry on Safety of Bataan
Nuclear Power Plant
Room 309, PICC, Metro Manila

THRU: The Deputy Minister
NSDB, Bicutan, Taguig
Metro Manila

S i r :

This is in connection to the volcanic and seismic risks relative to the PNPP-1 site at Bataan and which were among the hazards considered during its selection.

While volcanic risk is not mentioned specifically under LOI 876, the Chairman of the Committee mentioned during the first day of the hearing, that the Commission on Volcanology (COMVOL) should submit a position paper on volcanic and seismic risks on the area in question. In compliance thereof, COMVOL respectfully submits this paper.

We would like to make it clear at this point that COMVOL has very meager data of the area in question. This is because the volcanoes located in the Bataan Peninsula are considered dormant and COMVOL, because of limited resources, has to give priority to active volcanoes like Taal, Mayon, Bulusan, Canlaon and Hibok-Hibok and to geothermal fields associated with dormant volcanism, unless requested for special studies on particular areas in which COMVOL may respond favorably.

In view of the above request of the Commission, COMVOL conducted a quick ocular inspection of the area in question and gathered reports of other agencies that conducted surveys in the area (e.g. Ebasco Services Inc., IAEA Safety Mission, NPC, PAEC) and other literatures pertinent to the subject matter. With these as bases, COMVOL submits the following comments:

1. COMVOL admits the fact that Volcanology is not an exact science and as such rooms for doubts have to be given considerations.

2. Ebasco Services Inc. has made an in-depth study of the area and is at standard with the present state of art.

3. COMVOL shares the view of the IAEA Safety Mission that the danger posed by a renewed volcanic activity of Mt. Natib volcanic complex exists.

4. COMVOL believes that should an eruption take place at the main crater (caldera) of Mt. Natib sufficient natural barriers (e.g. drainage channels and ridges) exist to protect the plant site from the direct effects of pyroclastic flows, glowing avalanches, lava-flows and direct impact of volcanic ejecta.

5. COMVOL believes that eruption from any of the volcanic complexes in the area is possible, not only from the presently observed craters and vents, but virtually from any point in the peninsula, Bataan having formed on the coalition of two dormant volcano Mt. Natib and Mt. Mariveles. This possibility is exemplified by Taal. It did not only erupt from the Main Crater (1911 eruption) and the recognized numerous parasitic craters (e.g. Binintiang Munti and Binintiang Malaki alternately erupted before 1749) but was able to make oper its southwestern flank and hosted the eruptions from 1965 to 1977.

6. COMVOL agrees with the IAEA suggestion to install a volcano monitoring system in Mt. Natib and possibly in the adjoining volcanoes for the purpose of predicting future activities. With this, it is expected that timely warnings could be issued before any impending eruption thereby allowing time for the immediate shutdown of the power plant.

7. In conjunction with item 6, the suggestion of IAEA to establish an off-site fuel storage wherein radioactive materials could be deposited in the event that the plant is endangered by volcanic activity should be considered.

8. COMVOL believes that the problem on volcanic risk has been sufficiently discussed and studied by parties concerned and that it is just a matter of implementing recommendations.

With regards to seismic risk, while COMVOL has some data on tectonic earthquakes in connection with its study on relationship between tectonic earthquakes and volcanic eruption, same data may have been used in the study of seismic risk conducted by the proponent. The study on tectonic earthquakes falls under the responsibility of PHIVOLCS. However, COMVOL believes that the problem has been well discussed and recommendations by IAEA mission on this regard should be considered.

Very truly yours,

GREGORIO A. ANDAL
Commissioner

CP/asb

ENCLOSURE 4

Encl 4

~~Encl-13-PAEC~~ dtd-

REPORT AND RECOMMENDATIONS OF THE IAEA
SAFETY MISSION TO THE PHILIPPINES

(July 5 - 22, 1977)

M.C. Burke (Nuclear Regulatory Commission, U.S.A.)

J.D. McCallen (International Atomic Energy Agency, Vienna)

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P R E A M B L E

At the request of the Philippine Atomic Energy Commission (PAEC), a Safety Mission organized by the International Atomic Energy Agency (IAEA) reviewed the Preliminary Safety Analysis Report (PSAR) for the Philippine Nuclear Power Plant Unit No. 1 (PNPP-1). The Mission consisted of W.C. Burke of the United States Nuclear Regulatory Commission, J.D. McCullen and M. Rosen of the IAEA.

The Director General of the IAEA would like to place on record his understanding that upon completion of its work the Mission may make to the Philippine authorities and to the organization responsible for the construction and operation of the PNPP-1, such recommendations as the Mission considers desirable regarding the measures that should be taken for ensuring the safety of the nuclear plant, the plant personnel and the public. The Mission's recommendations will be made on its own expertise and will not engage the IAEA in anyway or imply any commitment on the part of the IAEA.

1. Introduction

The IAEA Safety Mission engaged in discussions with members of PAEC, the National Power Corporation (NPC), Westinghouse, and their consultants and contractors. The major technical meetings of the Mission were during the period 5 July -22 July 1977 although the Mission members were in the Philippines for somewhat varying periods of time. The schedule of principal meetings and the list of participants are presented in Appendix A and B, respectively.

The Mission report presents the significant items discussed and appropriate recommendations which it is hoped will facilitate further review of the PSAR and issuance of necessary permits by the responsible authorities of the Philippines. In presenting its report and recommendations the Mission must emphasize that due to obvious limitations on time and manpower it is not possible for the IAEA through this Safety Mission to perform a complete safety review, but only a review of the more significant safety related issues. The Mission emphasizes the importance of an independent and on-going regulatory review since it is the authorities of the Philippines who must take full responsibility for the adequacy of the complete safety review of which this Mission's work is only one phase.

This report consists of discussions and recommendations on general as well as specific technical items. Principal emphasis

was placed on establishing the safety standards to which the plant will be constructed and to comparison with similar plants. The Mission noted that all recommendations are made on its own expertise and do not necessarily represent the views of any other organization.

2. Background

The PNPP-1 nuclear power plant is located at Napot Point, Bataan. The National Power Corporation has contracted with Westinghouse Electric Corporation on a turn-key basis for construction of a 1876 MWT (621 MWe) pressurized water reactor with two coolant loops and with commercial operation scheduled for 1987. The PNPP-1 is similar in design concept and has been referenced in the contract to the nuclear power plant "KRSKO" currently being constructed in Yugoslavia by the Westinghouse Electric Corporation and scheduled for operation in 1979. The KRSKO plant had been previously referenced to the 2-loop Angra plant in Brazil which had been referenced to a 2-loop plant in Puerto Rico. The plant in Puerto Rico was never constructed due to seismic considerations at the site and thus some features of that plant and the subsequently referenced plants have not been thoroughly reviewed by a large regulatory organization. The referenced KRSKO plant is also seismically designed for a 0.2 g horizontal acceleration compared with 0.4 g for PNPP-1

and in addition has a different architect engineering firm from that being used in the Philippines.

3. Regulatory Organization

The PAEC is the Regulatory Organization responsible for the issuing of construction and other permits for the PNPP-1. While having an extensive experience in the research reactor field gained over the last 15 years, this nuclear plant is of course the first power generating plant that it has had to deal with. It is, therefore, no implied criticism for the Mission to note that the PAEC lacks experience in many of the areas required for the effective review and regulation of the PNPP-1. To carry out its functions effectively, more staff will have to be recruited and trained (an Inspection Group is urgently required). The Commissioner of the PAEC intends to seek continued assistence from the Agency. In this connection, it might be noted that a resident IAEA safety expert will take up his post with the PAEC in the next month or so.

Because of the importance of the inspection function, the Mission recommends that PAEC investigate the possibility of having several of its personnel assigned to a USNRC Regional Office for training purposes in the areas of enforcement and inspection (perhaps through IAEA fellowships). Such training should include accompanying USNRC inspectors on inspections of plants under construction and in operation.

4. PSAR Review and Major Recommendations

NPC as the eventual operating utility is responsible for the safety of the PHPP-1 and for the submittal of the Preliminary and Final Safety Analysis reports to the PAEC. Westinghouse as the turn-key contractor had prime responsibility for preparation of the PSAR. However, several important sections were prepared by NPC with the assistance of their consultants, EBASCO of the U.S.; namely, Sections 2 and 17. Burns and Roe, the Architect Engineer also developed many sections not directly involved with the Nuclear Steam Supply System, principally, sections involving the Balance of the Plant.

It is the opinion of the Mission that the submitted PSAR follows the "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (Revision 1)" issued by the USAEC in October, 1972. The Mission review indicated that in general the PSAR is comparable in content to those that have been submitted by domestic utilities in the United States using the Standard Format Document and appears to be based on the Westinghouse Reference Safety Analysis Report. There are however sections, tables, and figures of various chapters that have not been submitted. There are some errors and inconsistencies which should be corrected by an errata sheet. A particular deficiency is that many of the conclusions that must be obtained from Figures and Tables are not discussed in the text of appropriate sections. More specific deficiencies are contained in Section 5 of this report, where the

Mission discusses each of the PSAR Chapters.

For the situation in the Philippines where construction (foundation work) is scheduled to begin in about 3 months, it is recommended that only revision and updating of specific sections of the PSAR be undertaken and emphasis be placed on the Final Safety Analysis Report (FSAR). The Mission urges that the FSAR, which is not due to be submitted for several years, be carefully prepared taking into account the recommendations of this report and any additional comments from PAEC. In general the FSAR should be prepared with principal emphasis given to establishing the safety standards to which the plant was constructed by specifying in each section the regulatory guides which have been used and should contain more detailed comparison to other similar plants, systems and equipment than now appears in the PSAR.

As subsequently noted several amendments will be necessary to the PSAR which is currently under review since some significant safety related information has not been included. One of the more important amendments should be resubmitted Appendix 3A which contains the discussion of Regulatory Guides and where special attention must be given to clearly stating the use of those guides in the PNPP-1 plant design.

The Mission has abstracted the following recommendations from its report and believes these have special significance for granting the construction permit for PNPP-1 (additional recommendations are contained in the specific discussions of each PSAR chapter):

1. Table 1.3-1 containing comparison of PNPP-1 to other facilities and the Appendix 3A discussion of Regulatory Guides must be substantially improved and be resubmitted.
2. The Safety aspects of nearby military facilities are not discussed in the PSAR. This information should be submitted in accordance with section 2.2 of the Standard Format Document.
3. The proposed use of cooling towers for essential services is not discussed in the PSAR. This information should be submitted in accordance with section 9.2.5 (ultimate heat sink) of the Standard Format Document.
4. The detailed information used for determination of the seismic design horizontal acceleration values be given to the IAEA in Vienna for advise as to the need for additional evaluation.
5. A report should be submitted describing changes in safety related structures, components, and systems in the PNPP-1 design compared with the KRSKO plant as a result of the increased seismic requirements.
6. Design considerations due to the potential effects of volcanic activity are not discussed in the PSAR. This information should be submitted as part of Chapter 3.
7. A report discussing the unfavorable orientation of the turbine (missile problem) should be submitted - Included should be comparisons with other plants having this orientation and the structural barriers they use.

8. A system to monitor loose parts should be installed and the proposed system described.

9. Consideration should be given to installing a seismic scram switch connected to the reactor safety circuits and with sensors at appropriate locations.

10. A report should be submitted discussing proposals to increase the capacity for spent fuel storage.

11. A report should be submitted evaluating the USNRC review group report of the fire at Browns Ferry to determine any modifications required at PNPP-1.

12. Consideration should be given for some provisions to assure the habitability of the control room in the event of a chlorine release even if they are not in full compliance with the applicable regulatory guides.

13. The doses due to liquid and gaseous effluents should be calculated in accordance with Appendix I (10 CFR 50) and submitted.

14. A clear discussion be submitted to explain the low off-site doses calculated for the LOCA (including the significant assumptions and their justification).

15. A report be submitted presenting a more detailed discussion of the Westinghouse on-site QA program including current and future staff requirement and qualifications.

16. The technical specifications provided for the FSAR should be in conformance with the USNRC Standard Technical Specifications.

17. The FSAR should be prepared with principal emphasis given to establishing the safety standards to which the plant was constructed by specifying in each section the applicable standards and guides and to more detailed comparisons of systems and equipment with similar plants.

5. Discussion of PSAR Chapters

Chapter 1 - Introduction and General Description of Plant

It will be necessary for the PAEC to do much of its review by comparison of major systems and components to the KRSKO plant and other U.S. domestic plants. Table 1.3-1 of the PSAR contains comparisons of PNPP-1 to other facilities. This table is not complete and requires further explanation of the significant similarities and of the significant differences shown. The mission recommends that this important table be improved and re-submitted as an ammendment to the PSAR in conformance with the suggestions made by the Mission during the technical meeting between PAEC, NPC, and Westinghouse.

Chapter 2 - Site Characteristics

This chapter has been essentially written in accordance with US Standard Format Document, Revision 1. It contains much of the information which is required for a useful knowledge of the site area.

A somewhat unique problem at the Napot Point site is the proximity of volcanic complexes. In Section 2.5.1.1.6.5.4.1 of the PSAR, the statement is made that the potential effects of possible volcanic activity must be considered. Hazards which must be addressed, in decreasing order of probable effect upon the site, are volcanic ash, glowing avalances, mud flows, lava flows, air shock waves and volcanic earthquakes. As noted in our discussion for Chapter 3, there is no presentation in the PSAR related to design considerations for volcanic activity. In view of this potential volcanic activity NPC should also submit plans to monitor volcanic activity in the region in conjunction with other agencies.

Section 2.2 of the PSAR is titled "Industrial and Other Uses". The U.S. Standard Format Document title for this section is "Nearby Industrial, Transportation, and Military Facilities". Considering the proximity of Clark Air Force Base and Subic Bay a description of these military bases including locations of any military firing ranges, nearby airplane low level flights, holding and ~~heading~~ landing patterns, be submitted as an amendment to the PSAR. With regard to aircraft crash probability specific reference should be made to appropriate NRC Regulatory Guides.

PAEC staff noted that certain sectors around the site may exceed the NRC objective of less than 500 persons/square mile and 1000 persons/square mile projected population. The Mission recommends that NPC submit the bases for the demography data and verify the population density and that, if they are higher than NRC guidelines, additional attention be given to the area of emergency planning.

The PSAR refers to the South China Sea as the ultimate heat sink.

The Mission was informed that due to draw-down effects related to the probable maximum tsunamis, cooling towers would be used for essential services during normal, shutdown and accident conditions. The PSAR should be amended to reflect this change in design and a thorough discussion of the cooling towers should be presented in section 9.2.5.

PAEC staff asked some specific questions related to geology and seismology, some of which will require written responses by NPC. The Mission notes the importance of the correct determination of the safe shutdown earthquake for specifying maximum accelerations at the site for design purposes. Although a previous IAEA Safety Mission advised that a minimum horizontal acceleration of 0.5 g be considered, EBASCO has recommended 0.35 g(Westinghouse is using 0.4 g for design purposes). In view of the safety importance of this value, the Mission recommends that PAEC obtain the detailed information used for this determination and that it be forwarded to the IAEA for further review in Vienna. A recommendation may then be made which could suggest the need for additional independent evaluation of the design basis acceleration values to be used in the PNPP-1 design.

Chapter 3 - Design of Structures, Components, Equipment, and Systems

The Mission was informed that the resubmitted Appendix 3A (subsequently discussed) would show that essentially all current U.S. Regulatory requirements with regard to the design of safety related components, structures and systems would be met. This would include for example such areas as determination of break locations and dynamic effects

associated with postulated rupture of piping, and consideration of loads in pressure vessel support systems in the event of a loss of coolant accident (LOCA).

As previously noted, the proposed design horizontal acceleration value is 0.4 g for PNPP-1, this value is considerably higher than the 0.2 g value for the KRSKO reference plant and is the highest seismic designed Westinghouse 2-loop plant. Westinghouse stated that the seismic design will use techniques similar to those used for U.S. domestic plants. The Mission recommends that a report be prepared which discusses changes in safety related structures, components, and systems in the PNPP-1 design compared with KRSKO which have resulted from the increased seismic requirements. This should include items which were discussed at the technical meetings such as:

1. Shield building thickness
2. Steel framing for the fuel handling building
3. Stiffeners in the containment vessel
4. Reinforcing requirements
5. Relocation of equipment from the shield building annulus.

The mission was also informed that EBASCO would audit the seismic design of the plant for NPC.

The PNPP-1 plant is also sited in an area of high humidity and temperature conditions and any significant design changes in, for example, ventilation systems required by these conditions should also be included in the report on seismic changes.

The PNPP-1 plant design has a turbine orientation similar to KRSKO. This orientation is not favorable in regard to the potential effects of turbine generated missiles and damage probabilities to safety related structures (especially the containment). Westinghouse informed the Mission that the Byron/Braidwood stations currently under review in the United States have the same turbine orientation. If additional protection is required beyond that already offered by the present turbine orientation and structural barriers, the Mission recommends that they be considered for PNPP-1. Westinghouse should be required at this time to justify why the present design would be acceptable in accordance with NRC regulatory guides, and make comparisons with other plants having this orientation including comparison of the structural barriers.

As mentioned in Chapter 2, EBASCO has recommended that the plant design consider potential volcanic activity in the vicinity of the site. The Mission recommends that an ammendment to the PSAR be submitted which contains the modification to the plant design required for the potential effects of volcanic activity.

Chapter 3 - Appendix 3A (Discussion of Regulatory Guides)

A principal criticism of the PSAR is the lack of precise statements as to the safety standards and guides that are being used in the design. The contractual arrangement for PNPP-1 has October 1973 as a Safety criteria cut-off date. The mission would have some difficulty in accepting only 1973 standards for a plant which will first operate in 1982.

Appendix 3A which contains a discussion of the applicability of NRC Regulatory Guides to the design is unacceptable as written. The mission recommends that this important section be rewritten and include at least the following:

1. All regulatory guides issued to July 1976 (i.e. guide 1.120)
2. Revisions of regulatory guides issued to July 1976.
3. Precise statements as to what parts of the guide are being complied with and for those parts that are not, a differentiation be made as to generic Westinghouse positions applicable to all their designs and to those affecting only PNPP-1.

Chapter 4 - Reactor

The core design for the PNPP-1 reactor includes use of the 16 x 16 fuel rod array which is also to be used at KRSKO. This fuel design is a change compared to previous designs used in Westinghouse 2-loop reactors. To date, all Westinghouse 2-loop reactors operating in the U.S. have utilized a 14 x 14 fuel rod array. The planned start-up of KRSKO and the Angra plant in Brazil should be several years before PNPP-1 and thus there should be sufficient operational informational available for this new fuel design to assure satisfactory operation of the Philippine plant.

The Mission notes that both KRSKO and PNPP-1 have the highest power output of any 2-loop Westinghouse plant and some discussion related to the safety aspects of the increased power should be submitted. The Mission also recommends that the nuclear, and thermal and hydraulic comparison tables in this chapter be expanded to include the proposed North Coast plant in Puerto Rico and a recent 4-loop reactor.

Westinghouse stated that PNPP-1 would, similar to KRSKO, have part length rods. The Mission was informed that their use would be contingent on NRC acceptability of operation with part length rods in domestic U.S. plants.

Chapter 5 - Reactor Coolant System

Westinghouse stated that the reactor coolant system for PNPP-1 is essentially similar to that used in previous Westinghouse 2-loop designs. Adequate inspection of the coolant system is essential to safety. However, the PSAR contains only a general discussion of provisions for inservice inspection programs. NPC should submit the details of the inservice program including the provisions for access to the reactor coolant system, the equipment to be used, the documentation procedures and the organization that will provide the base-line measurements.

Small items such as nuts and bolts have become loose parts within reactor coolant systems and can damage other components within the system or produce undue wear or vibration. Recently in the United States loose parts monitoring systems have been developed and are presently in operation or being installed at several plants. These systems consist of accelerometers and associated data acquisition and presentation systems. Although not covered by a specific regulatory guide this system has also been recommended by the U.S. Advisory Committee on Reactor Safeguards. The Mission recommends that a system to monitor loose parts be installed in the PNPP-1 plant, and that an amendment to the PSAR be submitted describing a proposed system.

Chapter 6 - Engineered Safety Features

The Mission reviewed several aspects of the Engineered Safety Features and has concluded that in general, the design and performance characteristics for PNPP-1 are similar to those for 2-loop plants licensed in the United States.

The PSAR states that the design of PNPP-1 will include the use of hydrogen recombiners to limit the concentration of hydrogen gas in the containment in the event of a LOCA. Apparently, a hydrogen purge system will be included as part of the plant design in accordance with the requirements of Regulatory Guide 1.7. The Mission recommends that a description of this system be submitted in a supplement to the PSAR with some further explanation as to the time at which it would be used.

The PNPP-1 will contain a Reactor Building Negative Pressure Control System. This system may be somewhat modified from that at KEWKO due to space limitations resulting from the increased thickness requirements for the shield building at PNPP-1 due to the seismic design. The figures and tables which show the performance of this system as well as the containment heat removal systems have not been supplied in the PSAR. Although the calculations for the containment are somewhat routine, the determination of the annulus conditions after an accident are not simple. Additionally, since the containment and shield building concept is not common in the U.S., this type of calculation has not been recently reviewed by the U.S. NRC. The Mission recommends that NPC, perhaps through its consultant, verify the results of the calculations especially for the conditions in the shield building.

In Section 6.5.1, "Engineered-Safety Feature Atmosphere Cleanup Systems", the design criteria for the systems are not stated. These systems should meet the criteria contained in Regulatory Guide 1.52. A convenient way of showing conformance and deviations is by means of a table. Where non-conformance to an item in Regulatory Guide 1.52 is indicated in this table, justification for the non-conformance should be provided.

As discussed previously the plant will be designed for the potential effects of volcanic activity. This must include the potential effects of ashfall on the engineered safety features filter systems and any design features provided to mitigate these effects.

Chapter 7 - Instrumentation and Control

The Mission did not review details of The Reactor Protection System. However, checks were made to insure that the appropriate criteria, standards, and guides were being applied. In response to several questions, Westinghouse assures the Mission that the instrumentation and control system would meet current industrial standards used in the U.S. as well as NRC requirements and would be essentially similar to that supplied to domestic utilities. This included consideration of cable size and separation requirements.

The mission believes that in view of the seismic nature of the site and the specific safe shutdown earthquake for which the plant has been designed, seismic instrumentation be installed using Regulatory Guide 1.12 (Rev. 1) as a guide. The Mission also recommends that consideration be given to installation of a seismic scram switch, connected with the reactor safety circuits, and with sensors located at appropriate locations.

The Mission was also informed that the Post Accident Monitoring system would follow the latest version of Regulatory Guide 1.97.

Chapter 8 - Electrical Power

The Mission did not review the details of the electric power systems. The PSAR states that criteria 17 and 18 of the U.S. General Design Criteria and appropriate regulatory and industrial guides will be met.

Westinghouse informed the Mission that the grid system was basically stable and that no unique conditions existed which would necessitate consideration of additional safety requirements beyond those used for domestic plants. It is noted that the Philippines operates on 60 cycles and not 50 cycles as required for KRSKO.

Chapter 9 - Auxiliary Systems

In answer to specific questions the Mission was informed that the capacity for spent fuel storage stated in the PSAR (presently one and one-third cores) would be increased to four and one-third cores. This could be accomplished by substituting the present racks in the spent fuel pool with others of smaller pitch or with re-designed storage racks, and by increasing the size of the pool. Alternate methods of storing the fuel, such as on site or off site facilities could also be considered. The Mission recommends that some more definitive position be taken by NPC and that an amendment be submitted discussing the alternatives and the latest date by which a decision is required.

As mentioned in Chapter 2 the South China Sea is specified as the ultimate heat sink in the PSAR. However, cooling towers will now be used for essential services during normal, shutdown and accident conditions. The design criteria for this system should be supplied as an amendment to the PSAR.

The Mission discussed the implications to the PNPP-1 plant design of the fire at the Browns Ferry Nuclear Plant in the U.S. Westinghouse stated that this generic issue was still under consideration in the U.S. The Mission recommends that the special USNRS review group report of the fire at Browns Ferry which discusses the adequacy of smoke detectors, breathing apparatus, etc., in various plant areas be evaluated to determine any implications of the fire to the PNPP-1 design and that a report be submitted to PAEC on this subject.

The control room heating, ventilation, and air conditioning system design will not consider the effects of chlorine releases on the habitability of the control room as required in the U.S. The Mission recommends that this position be reconsidered and that some provisions be made even if they are not in full compliance with the applicable regulatory guides.

Chapter 10 - Steam and Power Conversion System

The steam and power conversion system is of conventional design, similar to plants previously approved in the U.S. PNPP-1, similar to KRSKO, is designed to accommodate 100% load rejection. This will be accomplished by bypassing 85% of fuel load to the condenser through the turbine bypass system. The Mission's recommendation regarding the turbine orientation problem has been discussed previously.

The Mission was concerned about recent steam generator problems experienced at Westinghouse designed plants. A report should be submitted concerning these problems, including any implications for the PNPP-1 design.

The Mission notes that Westinghouse stated that information on the steam generator blowdown systems will be submitted by October 1977.

Chapter 11 - Radioactive Waste Management

Systems are provided for the treatment and controlled handling of radioactive liquid, gaseous and solid wastes and leakage that results from normal plant operation and during anticipated operational occurrences. Except for the solid radwaste system, these systems are

of comparable design to those installed in the Farley nuclear plant. The solid radwaste system will be one of several similar designs presently under consideration, and the system will utilize cement-sodium silicate as the solidification agent with the system being operated in a remote control manner. The liquid and gaseous radwaste systems will be designed to meet the requirements of 10-CFR Part 50, Appendix I.

In its review, the Mission found some deficiencies in this Chapter and recommends that these deficiencies be removed. The calculation of radioactive effluent quantities from the plant during normal operation were not performed utilizing the PWR-GALE code and NUREG-0017. A complete table of all the parameters used in the calculation of the radioactive effluent quantities should be provided in order to permit evaluation of any differences between the radioactive effluent quantities presented in the PSAR and those which could be calculated by PAEC utilizing the PWR-GALE code and NUREG-0017.

In the sections on the liquid and gaseous waste management systems, the calculated doses should be provided and compared to the dose design objectives in Section IIA, IIB, and IIC of Appendix I to 10-CFR Part 50. The design criteria to which the systems will be designed should be stated, and included in these criteria should be Appendix I of 10 CFR Part 50, Regulatory Guide 1.109 and Regulatory Guide III, as appropriate. The systems quality group and seismic classifications exceed those presently accepted by the USNRC for radwaste system. Since the most recent revision to Regulatory Guides 1.26 and 1.29 do not address

radwaste systems and the present USNRC Branch Technical Position ETSB 11-1 will not be utilized, the appropriate revision to Regulatory Guides 1.26 and 1.29 which have been used should be stated.

In Section 11.2-22, "Estimated Doses", in the last paragraph on Page 11.2-22, it is not clear whether the radionuclide concentrations and dose contributions are prior to plant construction or as a result of plant operation. This ambiguity should be eliminated.

The RHR pumps will be located in the auxiliary building. If seal leakage should occur during their use, a large volume of water with primary coolant activity would leak into the auxiliary building. This water will most likely be processed through the liquid radwaste system. The procedures by which this large volume of water will be processed should be described in the PSAR.

Section 11.2.6.3 describes the steam generator blowdown system as a 15 gpm per steam generator system with treatment by demineralization and with all treated blowdown being returned to the condenser hotwell. Table 11.1-6 of Section 11.1 indicates that the fraction of blowdown that will be discharged is 1.0; Section 10.4.8 Steam Generator Blowdown indicates that the information on this system will be supplied later. The information in these sections should be made consistent.

In Section 11.4, Radiation and Process Monitoring, no design criteria are specified. General Design Criteria 60, 63 and 64 and Regulatory Guide 1.21 are the criteria to which conformance should be indicated.

Chapter 12 - Radiation Protection

The Mission did not review details of the shielding design features and the health physics program to control radioactivity within the limits of 10-CFR Parts 20 and 50. The shield design is based on normal plant operations with 1 percent failed fuel which is the U.S. NRC requirement.

PAEC staff asked several questions related to missing information and the lack of references to appropriate regulatory guides. This latter point is a general criticism for many sections of the PSAR.

The health physics program should receive special attention from PAEC. This should include review of provisions to maintain exposures as low as practicable and to insure the adequate qualifications of key personnel.

Chapter 13 - Conduct of Operations

The Mission emphasized the importance of the overall training program for the station staff (operating, maintenance and technical support personnel). Westinghouse stated that the training program meets the requirements of Regulatory Guide 1.8. They further stated that they believe the overall program is more extensive than that usually applied to their foreign projects. This includes additional training in areas such as instrumentation and control, and maintenance.

The Mission notes that importance of emergency planning. Specific details of this plan will be submitted with the FSAR. The FSAR will also contain details of the review and Audit functions of NPC. Consideration should be given to assuring that some members of the proposed review and audit committee be independent of NPC.

Chapter 14 - Initial Tests and Operations

In general, a comprehensive testing program is established to ensure that equipment and systems will perform in accordance with design criteria prior to fuel loading. The PSAR contains a listing of tests which was stated by Westinghouse to be the same as those used for domestic U.S. plants.

Additional data is of this program will be supplied at the operating license stage of the review.

Chapter 15 - Accident Analysis

In the accident analysis section of the PSAR, a full range of postulated disturbances and accidents are considered including the design basis loss of coolant accident (LOCA). The Mission had some difficulty with this section since many tables have not been included which usually show a summary of the important assumptions used in the dose estimates.

Of particular significance are the results for the LOCA which usually result in the highest whole body and thyroid doses at the exclusion area and low population zone. The values presented on page 15.4.10 are 4.8 rem whole body and 0.77 rem to the thyroid. These values are unusually low but may result from the "double" containment concept, the 1 mile exclusion area, and the high assumed filter efficiencies of 99% elemental and 90% organic. The Mission recommends that a clear explanation be given to explain the low calculated doses along with a complete listing of all significant assumptions and their justification.

A section should also be added to this Chapter entitled "Postulated Radioactive Releases Due to Liquid Tank Failures". This section should address the consequences of a tank failure located

outside of reactor containment that could result in release of radioactive liquid to the environs. The evaluation should consider (1) the radionuclide inventory in the tank assuming 1% operating power fission product source term, (2) a tank liquid inventory equal to 80% of its design capacity, (3) the mitigating effects of plant design including overflow lines and drain systems, and (4) the effects of site geology and hydrology. The concentrations of radionuclides in the nearest potable water supply should not exceed the limits of 10 CFR Part 20, Appendix B, Table II, Column 2, for unrestricted areas.

Chapter 16 - Technical Specifications

The Mission recommends that in the FSAR technical specifications be provided that will be in conformance with the USNRC Standard Technical Specifications. Included in Appendix A of those technical specifications should be the radioactive effluent technical specifications in the format that is current at that time. Any specification which is not included or deviations from those in use should be clearly noted and discussed in the FSAR.

It is noted that the Technical Specifications in the PSAR as written do not make any reference to the Reactor Building Negative Pressure Control System which is part of the PNPP-1 design.

Chapter 17 - Quality Assurance

The PSAR states that the 18 quality assurance criteria of Appendix B to 10 CFR Part 50 will be followed. The Mission believes that implementation of many aspects of these criteria to a plant being constructed outside the U.S. will be difficult. Therefore, of special importance is the ability, independence and authority of the quality assurance group of NPC.

NPC stated that it is in the process of preparing a detailed quality assurance program including a manual which is expected to be completed before issuance of the construction permit. The Mission emphasizes the importance of the quality assurance area and the need for scheduled and well documented audits of all safety related activities at the site. Although the contract allows NPC to conduct only 2 full audits at the site per year, Westinghouse stated that smaller "mini" audits would be allowed frequently.

NPC will utilize Ebasco for some training of quality assurance personnel and has the services of one Ebasco consultant full time on quality assurance in Manila. The Mission discussed the possibility of having NPC staff assigned to work with the Westinghouse site quality assurance group as a means of on-the-job training.

Westinghouse stated that their site quality assurance staff will be the largest for any of their foreign plants. The present staff of 3 will increase to about 11 during the next 3 years. The Mission recommends that Westinghouse submit a more detailed discussion of its QA program at the site, including information about the number of current and future staff as well as their qualifications.

Appendix A

Working Schedule for IAEA Safety Mission

June 28 - July 4	- Review of PSAR
July 5 - July 7	- Preparation of Questions for Technical Discussions
July 9	- Site Visit
July 11	- Technical Discussions at PAEC with NPC Westinghouse and EBASCO
July 12	- Technical Discussions Continued
July 13	- Technical Discussions Continued
July 14	- Drafting of Report
July 15	- Drafting of Report
July 16	- Discussions at PAEC of Questions to be Submitted to NPC
July 19	- Final Draft of Report Completed
July 20	- Final Draft Edited
July 21	- Site Visit
July 22	- Discussion of Final IAEA Report with PAEC
July 23	- Discussions Continued

APPENDIX B

PARTICIPANTS AT THE TECHNICAL MEETINGS AT PAEC WITH NPC, WESTINGHOUSE AND EBASCO

PAEC

L.D. Ibe
B.C. Fernando
C.R. Aleta
R. Letul
M. Yoshisaki
D.B. Bomocon
L.R. de la Paz
E. Caballin
L. Manalastas
O.L. Amparo

NPC

C.T. Ibalde
R.B. Blanco
J.C. Torres
D.H. Ibarra

WESTINGHOUSE/EBASCO

W.S. Wilgus
E. Stoffel
M. Tilford
J. Feigl
A. Peters
J. Hankowsky
F. Loceff
R. Stark
R. Saro
M. Corcoran

IAEA

W.C. Burke
J.D. McCullen
M. Rosen

ENCLOSURE 5

Encl 5

Doc. 16-E

11 JULY 1979

POSITION OF GAF - ELBEX

WITH RESPECT TO THE PETITION

PAPER OF PARESA DATED 5 JULY 1979,

AND THAT OF COMMAL DATED 29 JUNE 1979.

Question No. 5 (PAGASA)

Based on calculations using magnitude-distance-acceleration relationships developed by foreign authors, an earthquake of magnitude 7.2 (RICHTER SCALE) with shallow depth will have approximate ground accelerations of 0.5g - 0.3g near the epicenter up to about 15 kms., 0.2g - 0.01g at about 50 kms., diminishing further to almost zero (0) value at 300 kms. from the epicenter. In the questions used in these calculations, the effects of site conditions were not taken into consideration.

The resistance of buildings/structures to earthquake of any magnitude depends upon the design of the structures and is determined by the structural engineers.

NRC - BECHTEL COMMENT:

WE AGREE WITH PAGASA THAT ACCELERATION CALCULATIONS REPORTED UPON BY SOME AUTHORS YIELD VALUES IN THE RANGE 0.5 TO 0.3G NEAR EARTHQUAKE EPICENTERS UP TO 15 KM FROM THE ACTUAL EPICENTER WHEN THE EARTHQUAKE MAGNITUDE IS 7.2 R AND DEPTH OF FOCUS IS SHALLOW. ALSO, WE AGREE THESE HORIZONTAL MOTIONS MAY BE IN THE RANGE OF 0.2G TO .01G AT ABOUT 50 KM FROM THE ACTUAL EPICENTER.

OUR STUDY, REPORTED UPON IN PNPP REPORTS PRIOR TO THE PSAR, THE PSAR ITSELF, AND SUBSEQUENT DOCUMENTATION IN RESPONSE TO REGULATORY QUERIES, HAS DEMONSTRATED CONCLUSIVELY THE LACK OF ANY GEOLOGICAL FEATURING TO CAUSE EARTHQUAKES LARGER THAN 7.5 R CLOSER THAN 30 - 35 KM FROM THE PROJECT SITE. THEREFORE, PAGASA WOULD CONCLUDE, BASED ON OUR DATA, THAT ACCELERATIONS AT THE SITE CAUSED BY AN EARTHQUAKE LOCATED 30-35 KM

DISTANT WOULD BE BELOW 0.2G. THIS REINFORCES OUR CAUTIOUS ASSIGNMENT OF THE SSE VALUE AT 0.35G.

WITH RESPECT TO THE SECOND PARAGRAPH OF PAGASA, IT IS OUR POSITION THAT SCIENTISTS TRAINED AND EXPERIENCED IN THESE PHENOMENA MUST DETERMINE THE NATURE, SIZE AND FREQUENCY CONTENT OF MOTIONS TO BE DELIVERED TO STRUCTURES AT THEIR BASE AND THAT DESIGN OF THE STRUCTURES IS THEN THE RESPONSIBILITY OF THE STRUCTURAL ENGINEER.

Questions No. 6 (PAGASA)

The study of geologic faults falls under the Bureau of Mines. The U.P. Department of Geology also undertakes studies along this line.

NPC - EBASCO COMMENT:

DURING THE COURSE OF OUR INVESTIGATION WE CONSULTED CLOSELY WITH SCIENTISTS OF THE BUREAU OF MINES AND STUDIED THEIR MAPS AND REPORTS. UP TO THIS TIME, OUR CONCLUSIONS AND THEIRS REGARDING FAULTING NEAR NAPOT POINT ARE THE SAME. DURING THE COURSE OF OUR INVESTIGATION WE ALSO INTERVIEWED GEOLOGY FACULTY MEMBERS OF THE U.P. AND BELIEVE OUR FINDINGS ARE CONSISTENT WITH THEIRS.

Question No. 7 (PAGASA)

WE DID NOT COPY THE LENGTHY RESPONSE OF PAGASA TO THIS QUESTION AND REFER THE READER TO THEIR DOCUMENT DATED 5 JULY, 1979.

DURING THE COURSE OF OUR INVESTIGATION WE CONSULTED CLOSELY WITH THE STAFF OF PAGASA AND SCREENED, EVALUATED AND INCLUDED THEIR RECORDS (PROPERLY REFERENCED) OF EARTHQUAKE ACTIVITY WITH OURS. WE ARE FAMILIAR WITH ALL THE RECORDS THEY NOW PRESENT AND HAVE TAKEN THEM INTO ACCOUNT IN OUR ANALYSES.

NPC - EBASCO COMMENTS ON THE RESPONSE OF COMVOL INCLUDED IN THE COMVOL LETTER OF 28 JUNE TO THE CHAIRMAN OF THE COMMISSION.

Please note that COMVOL did not respond directly to the questions before the Commission. We must therefore address the COMVOL responses in their own order:

COMVOL Response No 1

COMVOL admits the fact that Volcanology is not an exact science and as such room for doubts have to be given considerations.

NPC - EBASCO COMMENT:

WE AGREE WITH THE CONCLUSION OF COMVOL AND HAVE THEREFORE RESOVED THESE DOUBTS BOTH DETERMINISTICALLY AND PROBABILISTICALLY. APPLICATION OF TIME SERIES ANALYSIS TECHNIQUES YIELDS THE RATE OF LARGE-SCALE VOLCANIC ERUPTIONS ON BATAAAN PENINSULA TO BE ABOUT 3×10^{-5} (3 TIMES PER 100,000 YEARS) PER YEAR. THIS VALUE IS IN APPROXIMATE AGREEMENT WITH THAT DERIVED BY MCBIRNEY (1.88×10^{-4} OR TWO TIMES IN 10,000 YEARS IN THE PHILIPPINES AND INDONESIA) ON THE BASIS OF THE HISTORIC RECORDS OF LARGE ERUPTIONS WITHIN THE PHILIPPINES AND INDONESIA. BY CONSIDERING THE ASH FALL DISTRIBUTION FROM THE MT KATMAI ERUPTION OF 1912 AND THE REGIONAL WIND DATA, THE ANNUAL PROBABILITY OF VARIOUS ASH FALL THICKNESSES FALLING AT THE SITE HAS BEEN ESTIMATED. THE RESULTS INDICATE THAT ASH FALL MUST BE TAKEN INTO CONSIDERATION IN THE DESIGN OF THE PLANT.

COMVOL Response No 2

Ebasco Services Inc has made an in-depth study of the area and is at standard with the present state of art.

NPC - EBASCO COMMENT:

WE THANK COMVOL FOR RECOGNIZING OUR WORK AS BEING OF THE BEST QUALITY POSSIBLE TODAY. IN THIS REGARD WE FURTHER HOPE THE COMMISSION WILL BE INFLUENCED BY A STATEMENT IN THE PAEC CONSTRUCTION PERMIT FOR THE PLANT

"Site studies for the PNPP-1 is noted to be the most comprehensive and exhaustive ever made in a developing country, per Status Summary Report on Resolution of Issues Raised by the 1978 IAEA Safety Mission to the Philippines of Charles A Willis, IAEA Nuclear Reactor Safety Expert from the USNRC."

Only because of the controversy re IAEA concerns

AND OF THE IAEA SAFETY MISSION, WHOSE REPORT CONTAINS THE STATEMENT

"The review of related sections of the PSAR and of the additional data combined with the discussions held in July 1978 indicates that a comprehensive series of investigations have been conducted towards establishing suitable seismic design bases and considering the need to design for surface faulting. The techniques and methods used in the investigation are generally regarded as state-of-the-art and consistent with those used in the United States, Europe and elsewhere."

COMVOL Response No 3

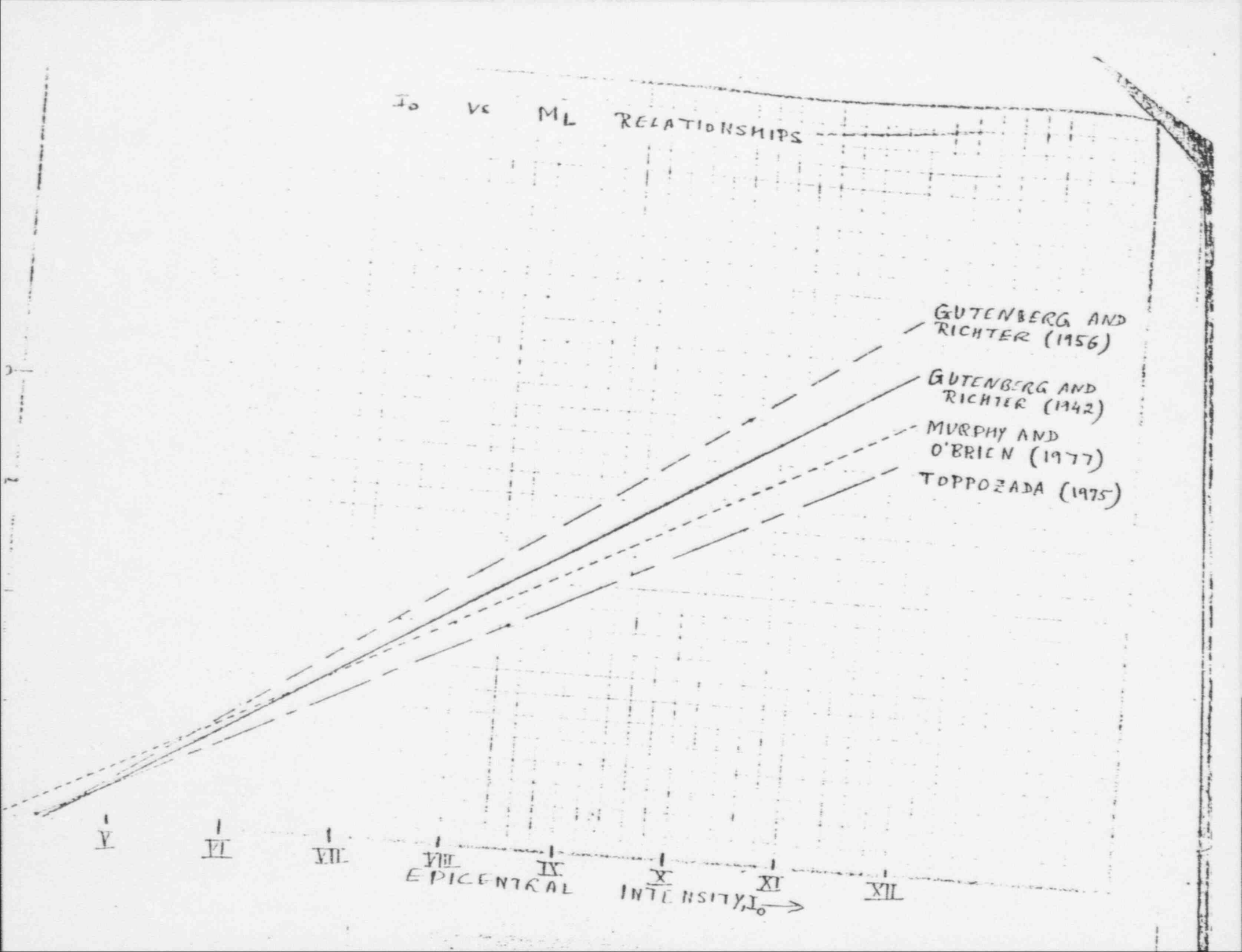
COMVOL shares the view of the IAEA Safety Mission that the danger posed by a renewed volcanic activity of Mt Natib volcanic complex exists.

NPC - EBASCO RESPONSE

WE REFER TO OUR COMMENT ABOVE ON RESPONSE 1. IT HAS BEEN CONCLUDED AS THE RESULT OF OUR STUDIES THAT NEXT TO STRONG GROUND MOTION DURING SEISMIC SHAKING, VOLCANIC EVENTS REPRESENT THE MOST CREDIBLE GEOLOGICAL HAZARD TO THE PLANT. AS A GEOLOGICAL HAZARD, VOLCANISM DIFFERS FROM SEISMICITY IN THAT VOLCANIC EVENTS HAVE NO RECOGNIZED UPPER LIMIT OF

DESTRUCTIVENESS AND DEVELOP CATASTROPHIC EFFECTS OVER MUCH SMALLER AREAS. FURTHERMORE, VOLCANIC EVENTS LAST MUCH LONGER THAN SEISMIC EVENTS. ANY STRUCTURE LOCATED AT A POINT WHERE A VOLCANIC VENT DEVELOPS WOULD BE DESTROYED. THE LIKELIHOOD OF OCCURRENCE OF THIS EVENT IS EXTREMELY SMALL FOR ANY GIVEN POINT. COMPARED TO THE BROAD AREAS CATASTROPHICALLY AFFECTED DURING EARTHQUAKES, THE AREA SERIOUSLY AFFECTED DURING SHORT TIME PERIODS BY VOLCANIC EVENTS IS SMALL, THUS REDUCING THE PROBABILITY OF OCCURRENCE OF CATASTROPHIC EFFECTS AT ANY GIVEN POINT. COMPARED TO DESTRUCTION DURING SEISMIC GROUND SHAKING, WHICH OCCURS IN A MATTER OF SECONDS, THE DESTRUCTIVE EFFECT OF VOLCANIC EVENTS OR EPISODES IS MOST COMMONLY SPREAD OVER WEEKS, MONTHS, OR YEARS. A PARTICULAR VOLCANIC CENTER MAY DEVELOP IN WEEKS OR MONTHS, BUT MAJOR VOLCANIC EDIFICES MOST COMMONLY EVOLVE OVER PERIODS MEASURED IN HUNDREDS OF THOUSANDS OF YEARS.

AS STATED IN OUR COMMENT ON RESPONSE 1 ABOVE, WE HAVE DETERMINED THAT ONLY THREE MAJOR VOLCANIC EVENTS ARE LIKELY TO OCCUR IN ANY 100,000 YEAR PERIOD ON BATAAN; A LEVEL OF RISK WE FIND ACCEPTABLE IN VIEW OF OUR AGREEMENT WITH THE NEXT COMVOL FINDING THAT THE NAPOT POINT SITE IS PROTECTED FROM EFFECTS OF MT NATIB VOLCANISM OTHER THAN ASH FALL.


I_o vs M_L RELATIONSHIPS
GUTENBERG AND RICHTER (1956)
GUTENBERG AND RICHTER (1942)
MURPHY AND O'BRIEN (1977)
TOPPOZADA (1975)
V
VI
VII
VIII
IX
X
XI
XII
EPICENTRAL INTENSITY, I_o →

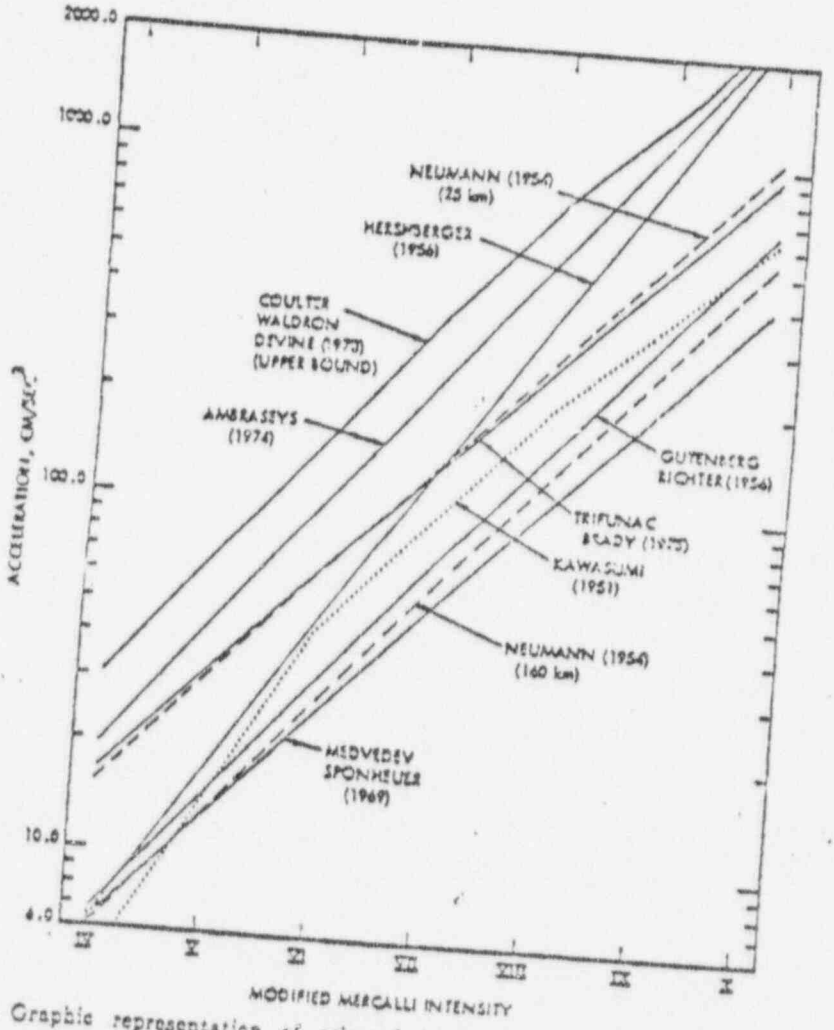


FIG. 5. Graphic representation of selected intensity/acceleration correlations.

SOURCE: MURPHY & O'BRIEN (1977)
BULL SEISMOL SOC. AMERICA

COMVOL Response No 4

COMVOL believes that should an eruption take place at the main crater (caldera) of Mt Natib sufficient natural barriers (e.g. drainage channels and ridges) exist to protect the plant site from the direct effects of pyroclastic flows, glowing avalanches, lava flows and direct impact of volcanic ejecta.

NPC - EBASCO COMMENT:

THIS CONCLUSION IS THE SAME AS THAT REACHED DURING OUR STUDY AND RECORDED IN THE PSAR.

COMVOL Response No 5

COMVOL believes that eruption from any of the volcanic complexes in the area is possible, not only from the presently observed craters and vents, but virtually from any point in the peninsula, Bataan having formed by the coalition of two dormant volcanoes - Mt Natib and Mt Mariveles. This possibility is exemplified by Taal. It did not only erupt from the Main Crater (1911 eruption) and the recognized numerous parasitic craters (e.g. Binintiang Munti and Binintiang Malaki alternately erupted before 1749) but was able to make open its southwestern flank and hosted the eruptions from 1965 to 1977.

NPC - EBASCO COMMENT:

BASED ON OUR EXHAUSTIVE STUDIES WE DISAGREE CATEGORICALLY WITH THIS FINDING BY COMVOL. THE FORMATION OF A VOLCANIC VENT ON THE WEST FLANK OF MT NATIB IS NOT A CREDIBLE EVENT. RECENT SCIENTIFIC STUDIES OF AREAS LIKE LUZON HAVE DEMONSTRATED THAT THE DISTANCE BETWEEN THE SUBDUCTION SITE (MANILA TRENCH) AND THE FIRST LINE OF VOLCANOES (MT NATIB AND MT MARIVELES) ALWAYS INCREASES WITH TIME. IN THE PRESENT CASE THIS MEANS THAT NEW VOLCANIC VENTS MUST BE FORMED EAST OF THE EXISTING VENTS - FURTHER AND FURTHER FROM THE

PLANT SITE. THIS PATTERN HAS BEEN ESTABLISHED ON BATAAN, WHERE THE LATEST (70,000 YEARS OLD) VOLCANIC VENT ON MT NATIB WAS FORMED EAST OF THE MAIN CALDERA. EVERY VOLCANIC EDIFICE FORMED DURING THE ENTIRE LIFE (MORE THAN 5,000,000 YEARS) OF THE BATAAN VOLCANOES IS EAST OF THE CENTERLINE OF THE BATAAN PENINSULA. THERE ARE, ALL TOLD, SEVEN SUCH PARASITIC FEATURES IN ADDITION TO THE PRIMARY VENTS OR CALDERAS. FORMATION OF A VOLCANIC VENT ON THE WEST FLANK OF MT NATIB IS NOT A CREDIBLE EVENT BECAUSE IT HAS NOT HAPPENED DURING THE 5,000,000 YEARS OF OPPORTUNITY.

COMVOL Response No 6

COMVOL agrees with the IAEA suggestion to install a volcano monitoring system in Mt Natib and possibly in the adjoining volcanoes for the purpose of predicting future activities. With this, it is expected that timely warnings could be issued before any impending eruption thereby allowing time for the immediate shutdown of the power plant.

NPC - EBASCO COMMENT:

AT THE DIRECTION OF PAEC, NPC WILL DESIGN AND INSTALL A MONITORING SYSTEM AT MT NATIB.

COMVOL Response No 7

In conjunction with item 6, the suggestion of IAEA to establish an off-site fuel storage wherein radioactive materials could be deposited in the event that the plant is endangered by volcanic activity should be considered.

NPC - EBASCO COMMENT:

AS DIRECTED BY PRESIDENT MARCOS A GOVERNMENT PANEL HAS BEEN ACTIVE FOR MORE THAN TWO YEARS IN THE INITIAL PHASES OF SELECTION OF SUCH A SITE.

COMVOL Response No 8

COMVOL believes that the problem on volcanic risk has been sufficiently discussed and studied by parties concerned and that it is just a matter of implementing recommendations.

NPC - EBASCO COMMENT:

WE AGREE. PAEC, THE RESPONSIBLE LICENSING AND REGULATORY BODY, HAS RESOLVED ALL OUTSTANDING ISSUES RAISED BY RESPONSIBLE REVIEWERS AND HAS PROVIDED SUCH STIPULATIONS IN THE CONSTRUCTION PERMIT AS FOUND NECESSARY FOR COMPLIANCE BY NPC.

Final Paragraph Response by COMVOL

With regards to seismic risk, while COMVOL has some data on tectonic earthquakes in connection with its study on relationship between tectonic earthquakes and volcanic eruption, same data may have been used in the study of seismic risk conducted by the proponent. The study on tectonic earthquakes falls under the responsibility of PAGASA. However, COMVOL believes that the problem has been well discussed and recommendations by IAEA mission on this regard should be considered.

NPC - EBASCO COMMENT:

PAEC HAS TAKEN IAEA MISSION RECOMMENDATION INTO ACCOUNT IN ESTABLISHING STIPULATIONS TO THE PROJECT CONSTRUCTION PERMIT. ALL OUTSTANDING ISSUES ARE THEREFORE NOW RESOLVED.

Copy for Atty. Diza

Republic of the Philippines
Ministry of Natural Resources
BUREAU OF MINES

COMMISSION ON NUCLEAR REACTOR PLANTS
RECEIVED
DATE: 7-19-79
TIME: 8:30 AM
BY:

July 18, 1979

The Honorable Ricardo Puno
Chairman, Commission on Safety
of Bataan Nuclear Power Plant
Room 309, PICC, Metro Manila

Sir:

The Bureau of Mines, responding to a directive to submit a position paper containing the answer to Question No. 6 of LOI No. 876 dated June 16, 1979, immediately made a study of the photograph of Bataan Peninsula taken by satellite (Landsat Imagery). Medium and low altitude aerial photographs were subsequently interpreted after which an ocular inspection of the area was conducted on July 14 - 15, 1979. Key areas, particularly those with lineaments interpreted on the photographs were closely investigated. A photo lineament is defined as "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" (Dictionary of Geological Terms, p. 229). Shoreline and road geologic mapping was also undertaken.

The results of the study are as follows:

1. In the satellite photograph (Landsat Imagery, scale 1:1,000,000) a conspicuous northwest (NW) trending lineament about 4 km northeast of the Nuclear Power Plant Site, and an inconspicuous northeast (NE) trending system of lineaments passing thru the vicinity of the plant site were interpreted (see Fig. 1).

2. In the medium and low altitude aerial photographs (scales 1:32,000 and 1:12,500 respectively), both the NW and NE trending systems of lineaments are quite clear (see Fig. 2).

On the ground, the NW trending system of lineaments was verified in two areas without seeing any movement.

4. A northeast trending fault dipping to the southeast was observed just southwest of the nuclear reactor (Outcrop A) and is apparently located at a point along the northeast trending lineament No. 1 (see Plate 1). According to NI [illegible] officials, this feature was recognized by their geologists and/or consultants who recommended the digging of a series of trenches perpendicular to the NE trending lineament. Accordingly, their observations from these trenches negates the presence of any major structural feature.

A northeast trending fault dipping to the northwest was found east-northeast of the nuclear reactor (Outcrop B) and apparently coincides with the interpreted northeast trending lineament No. 2.

A slump which dips generally to the south and whose easternmost segment is near the southernmost portion of lineament No. 2 was observed. It is north of Outcrop B.

5. The third interpreted northeast trending lineament is found between lineaments Nos. 1 and 2 (see Fig. 2) and is relatively close to the nuclear reactor. Due to thick soil cover and vegetation no field observation could be made along this particular alignment.

I hope that this short paper can help you in your inquiry.

Very truly yours,

SANTIAGO C. FERNANDEZ
Director of Mines

GEOLOGIC FEATURES INTERPRETED FROM LANDSAT IMAGERY OF BATAAN PENINSULA AND VICINITY

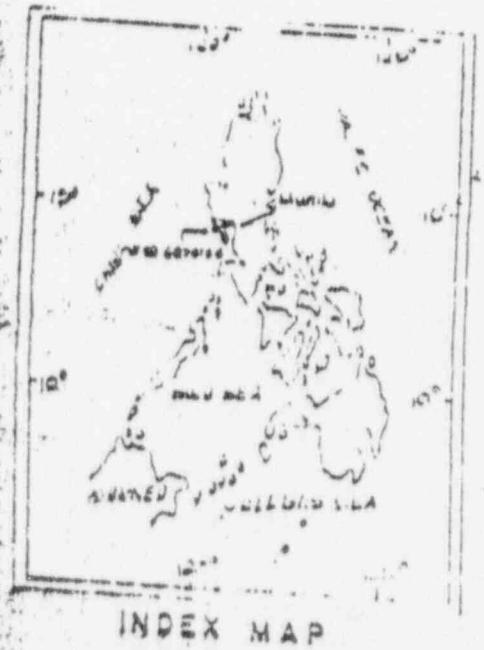


FIGURE 1
OVERLAY MAP
FRAME NO. IIIB-01

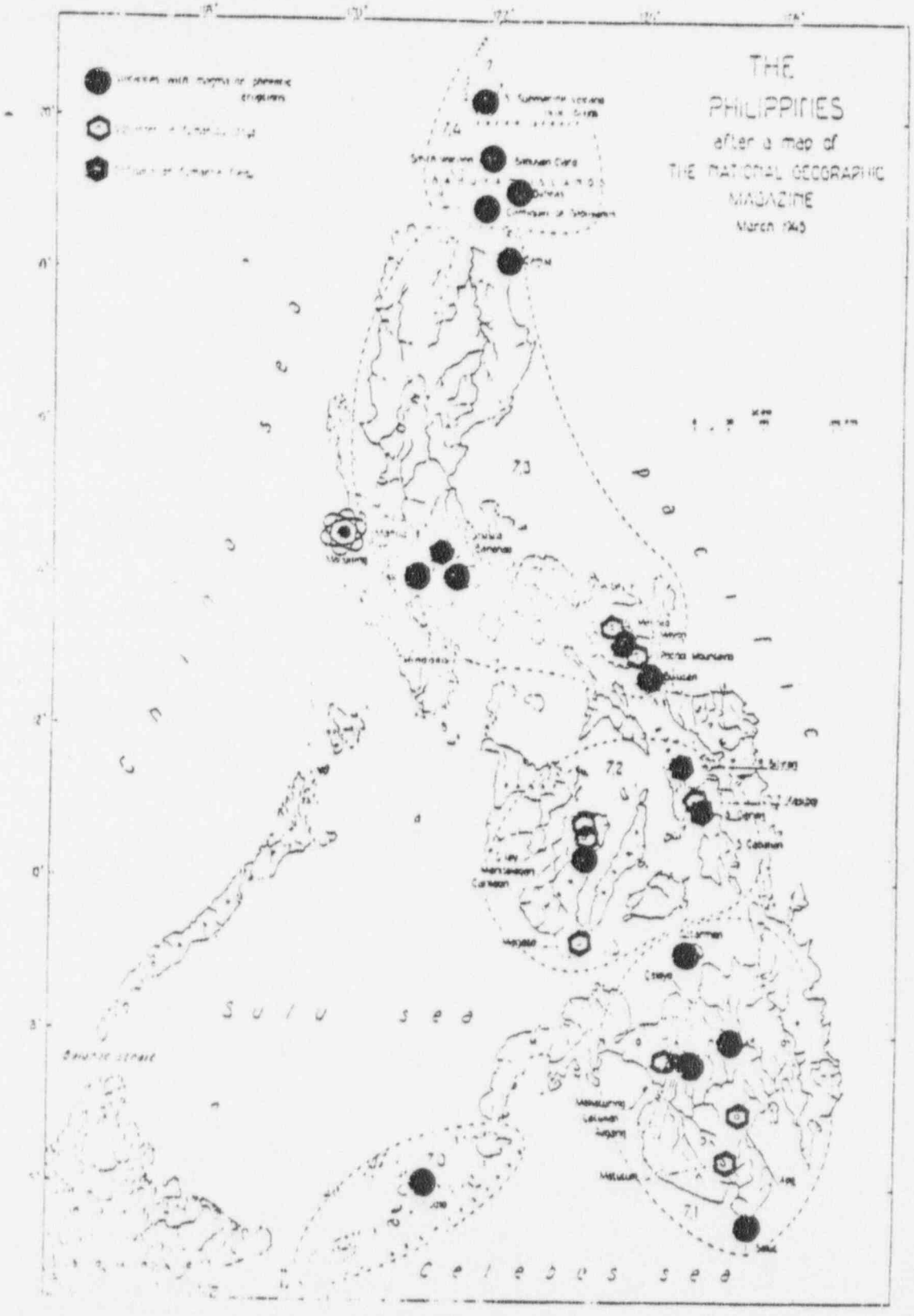

THE
PHILIPPINES
after a map of
THE NATIONAL GEOGRAPHIC
MAGAZINE
March 1945
S U L U S E A
C E L E B E S S E A

Fig. 1

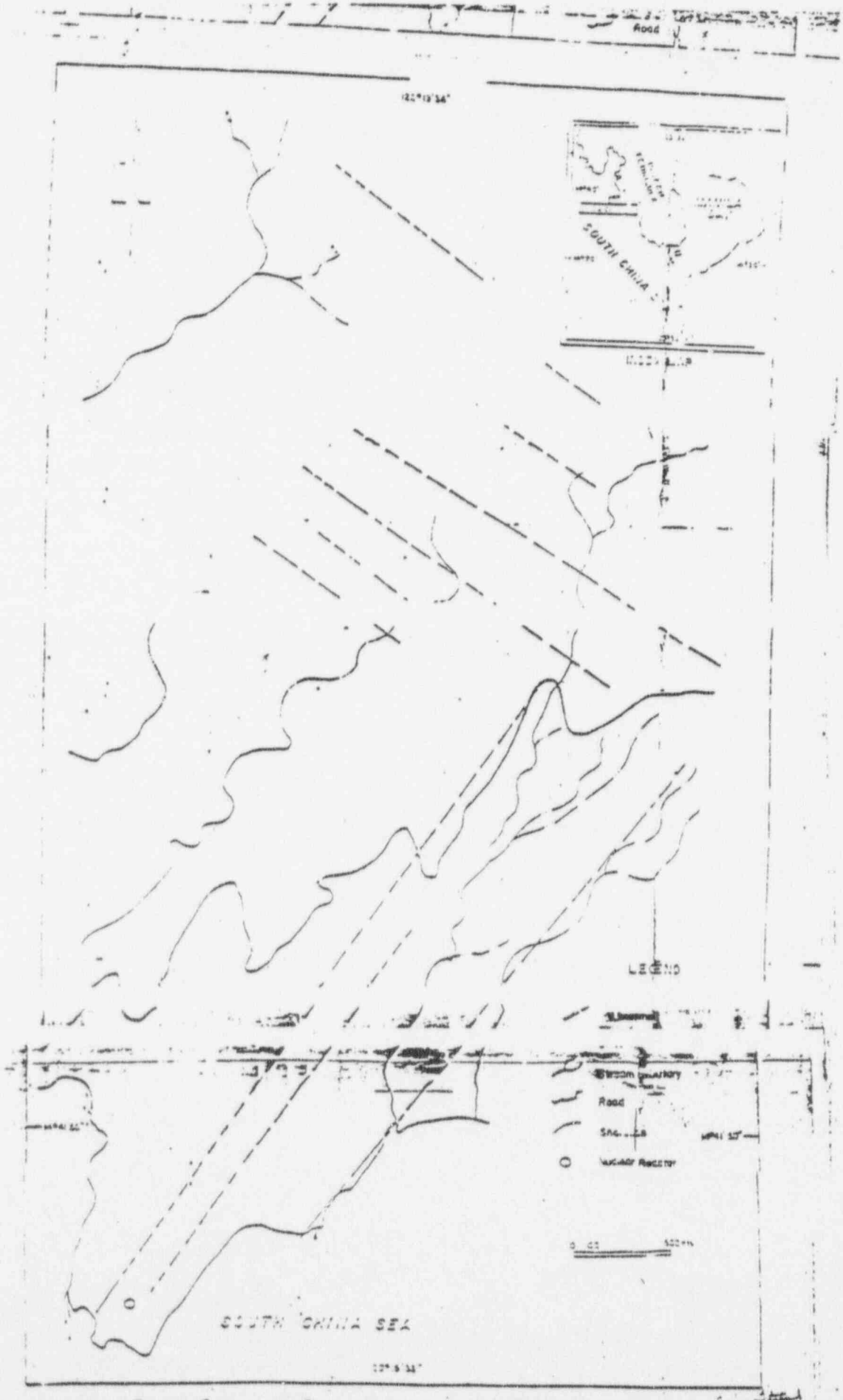
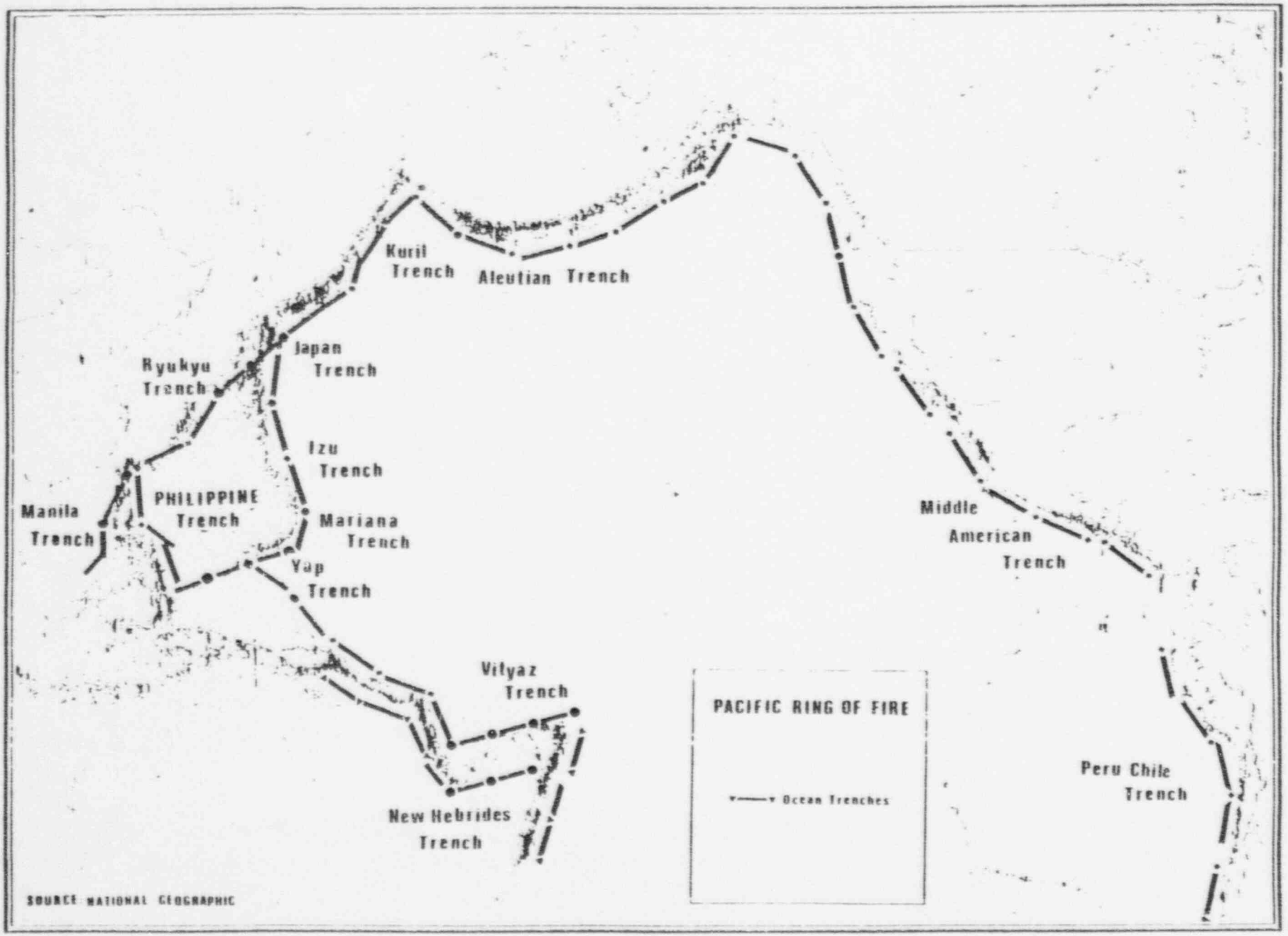
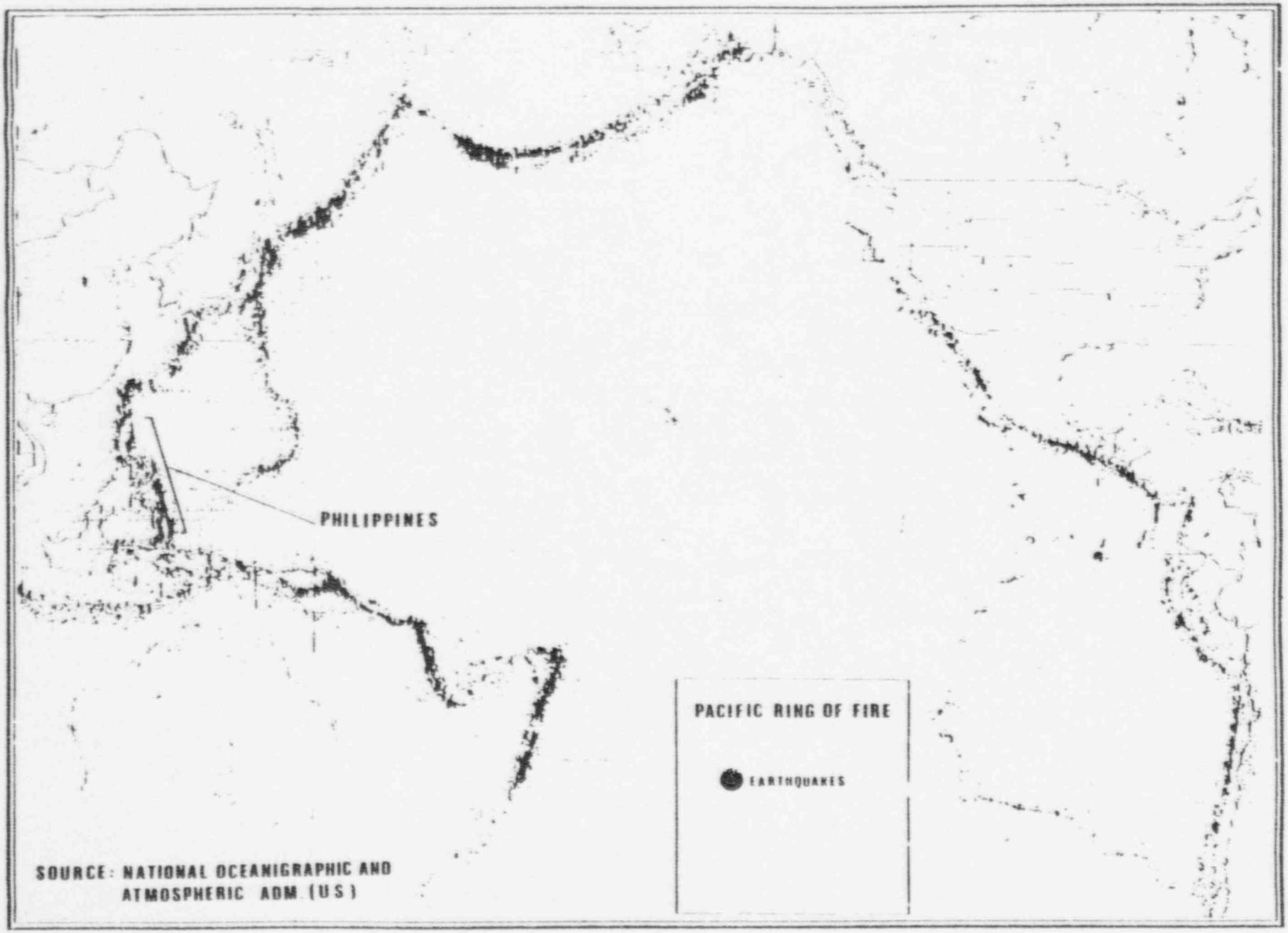


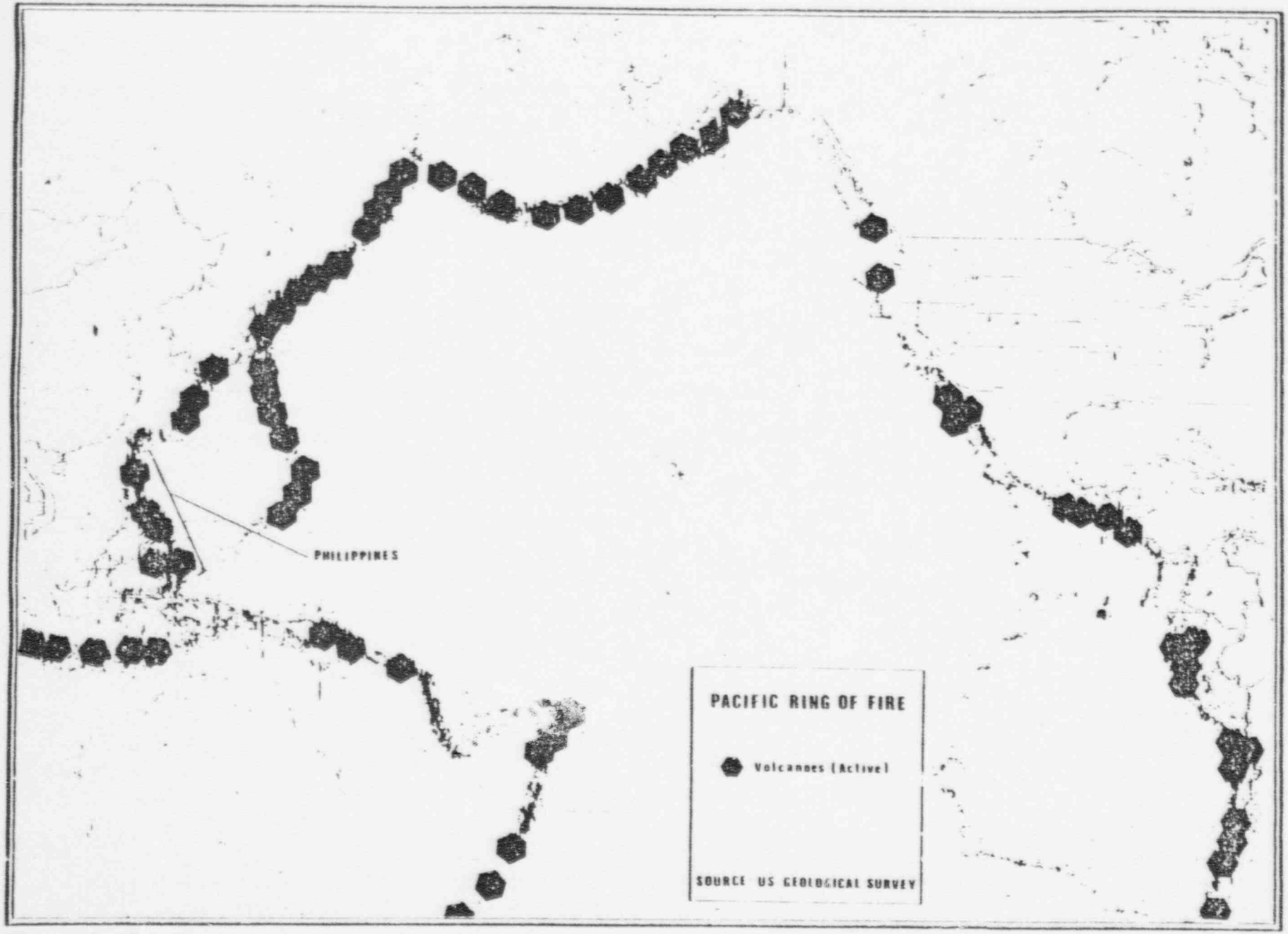
Figure 2 Cretaceous Structure Lineaments Interpreted from Aerial

ENCLOSURE 6

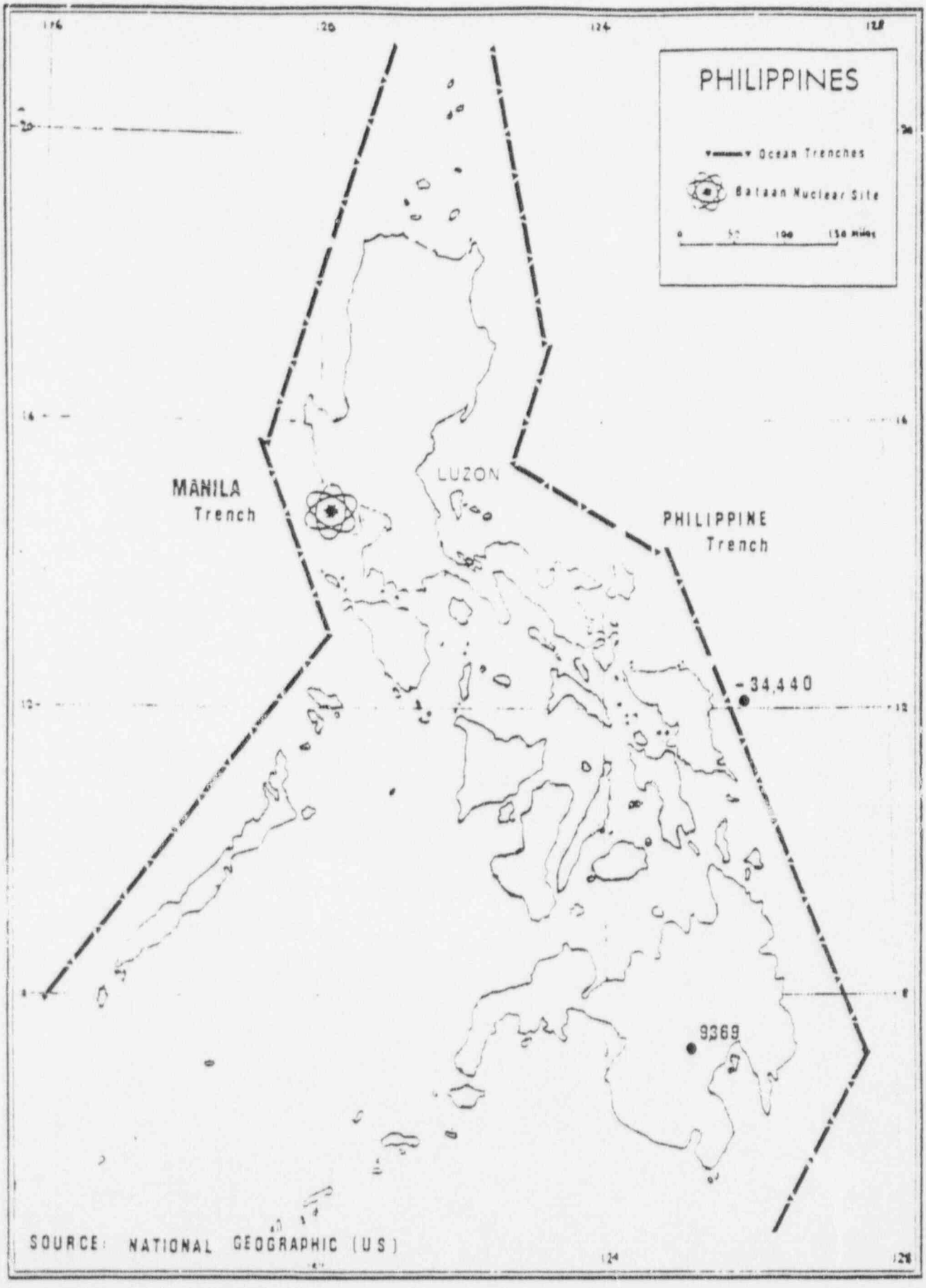

Kuril Trench
Aleutian Trench
Japan Trench
Ryukyu Trench
Izu Trench
PHILIPPINE Trench
Manila Trench
Mariana Trench
Yap Trench
Vityaz Trench
New Hebrides Trench
Middle American Trench
Peru Chile Trench
PACIFIC RING OF FIRE
Ocean Trenches
SOURCE NATIONAL GEOGRAPHIC



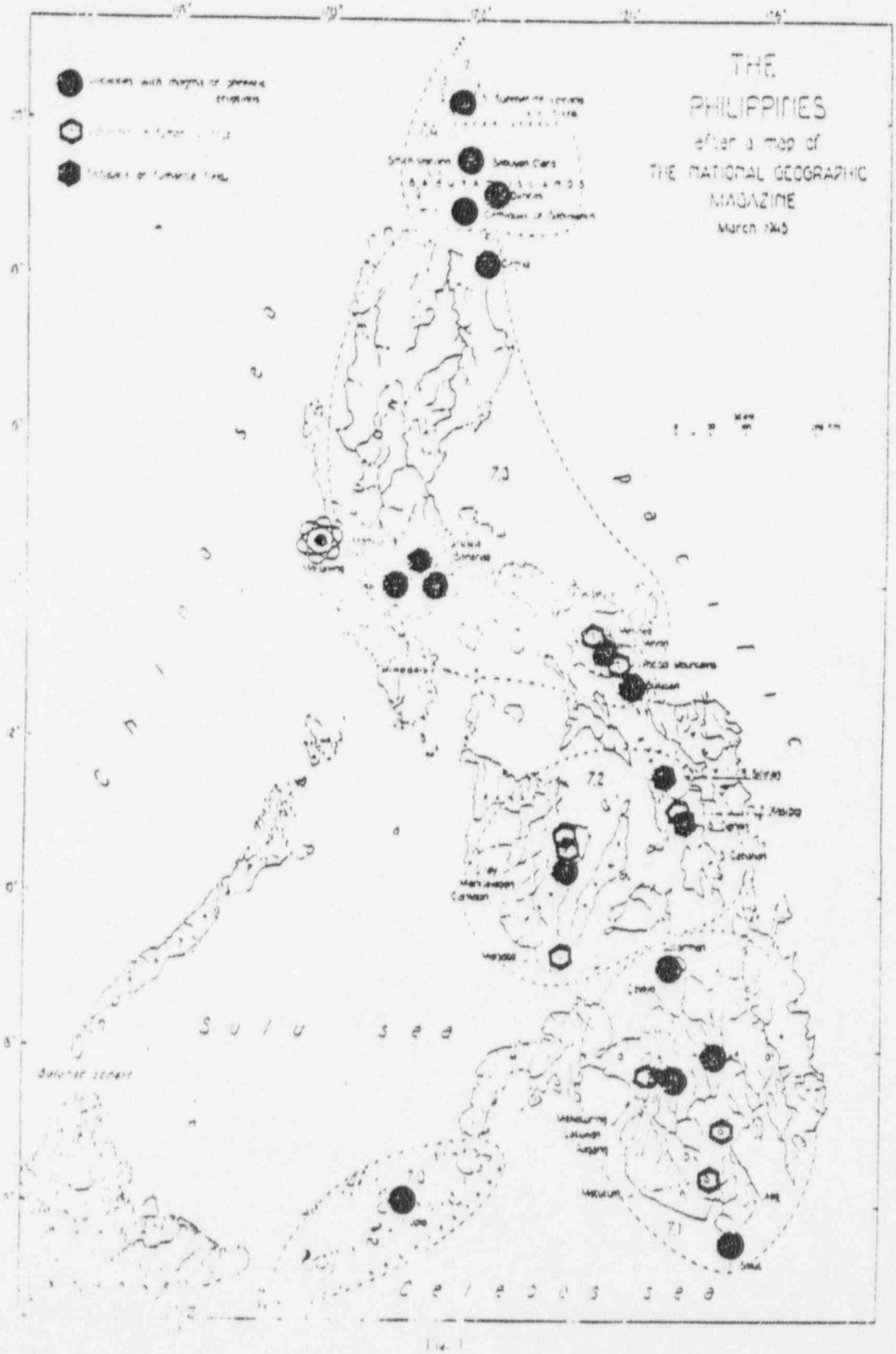
Center for Development Policy



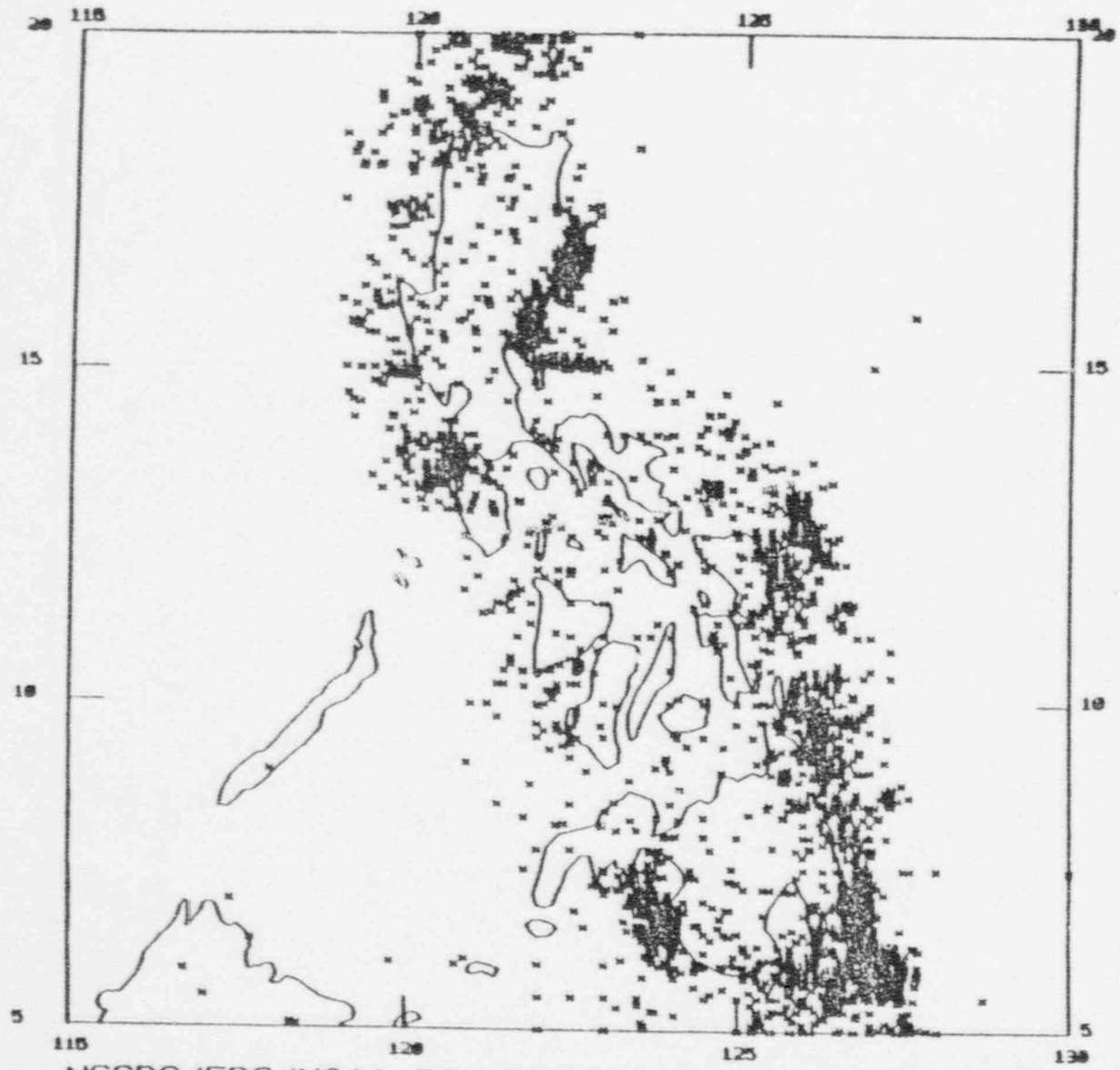
Center for Development Policy



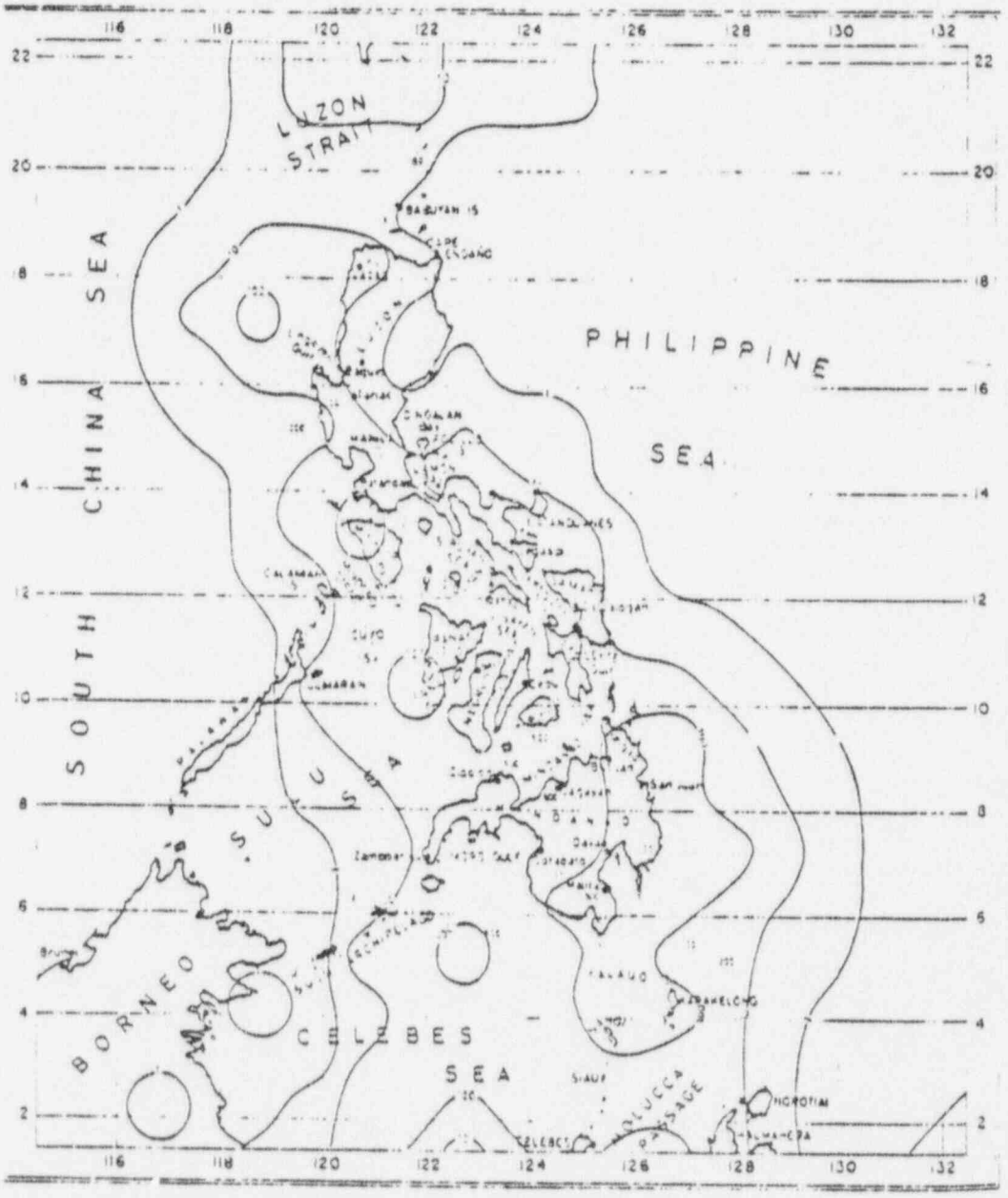
Center for Development Policy


THE
PHILIPPINES
after a map of
THE NATIONAL GEOGRAPHIC
MAGAZINE
March 1945
S u l u s e a
C e l e b e s s e a

PHILIPPINES EARTHQUAKES



NGSDC/EDS/NOAA BOULDER,COLORADO 2674 EARTHQUAKES PLOTTED
79/03/22. 08.46.44.



Map 18. Seismicity of the Philippines, Region 22. (Seismicity contours are numbered in 10^{11} ergs km^{-1} $year^{-1}$.)

Philippines (Region 22; Map 18; Table 15.2)

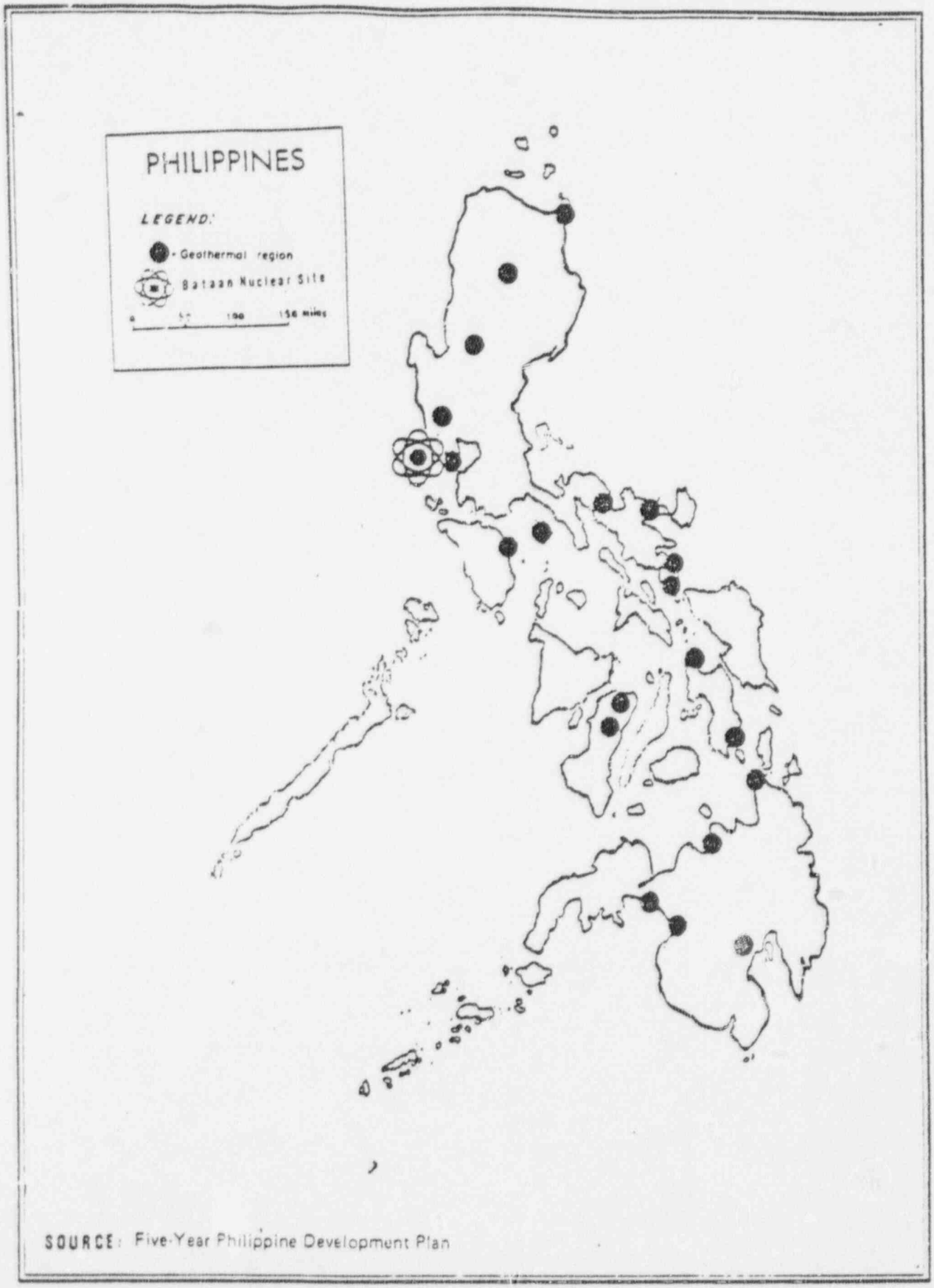
Extension and seismicity

The Philippines Archipelago is a large and complex region, which accounts for over 3.2% of the world's seismic activity. It consists of several arcs with associated rifts and areas of block tectonics.

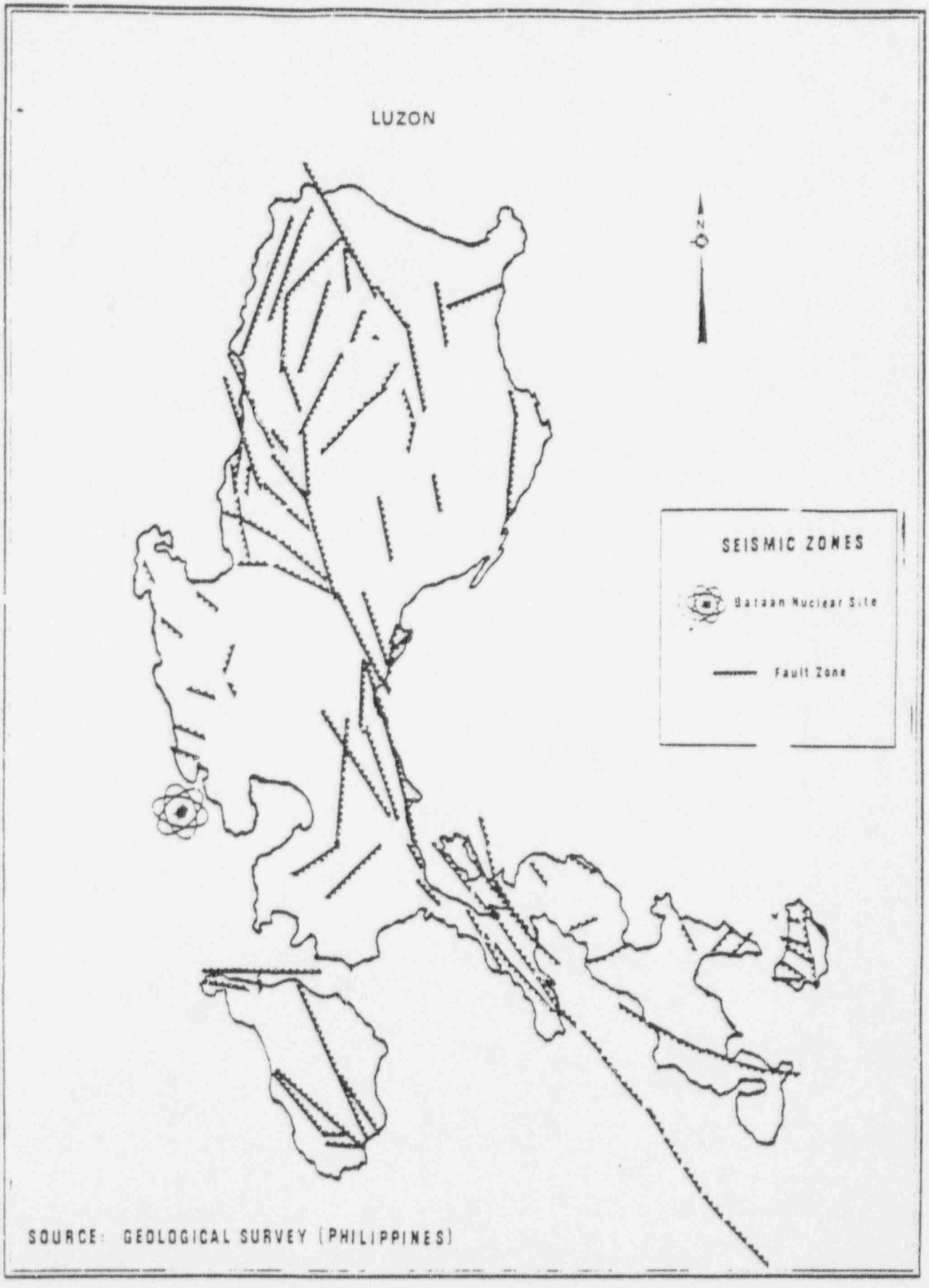
TABLE 15.2

Earthquakes of the Philippines (Region 22)

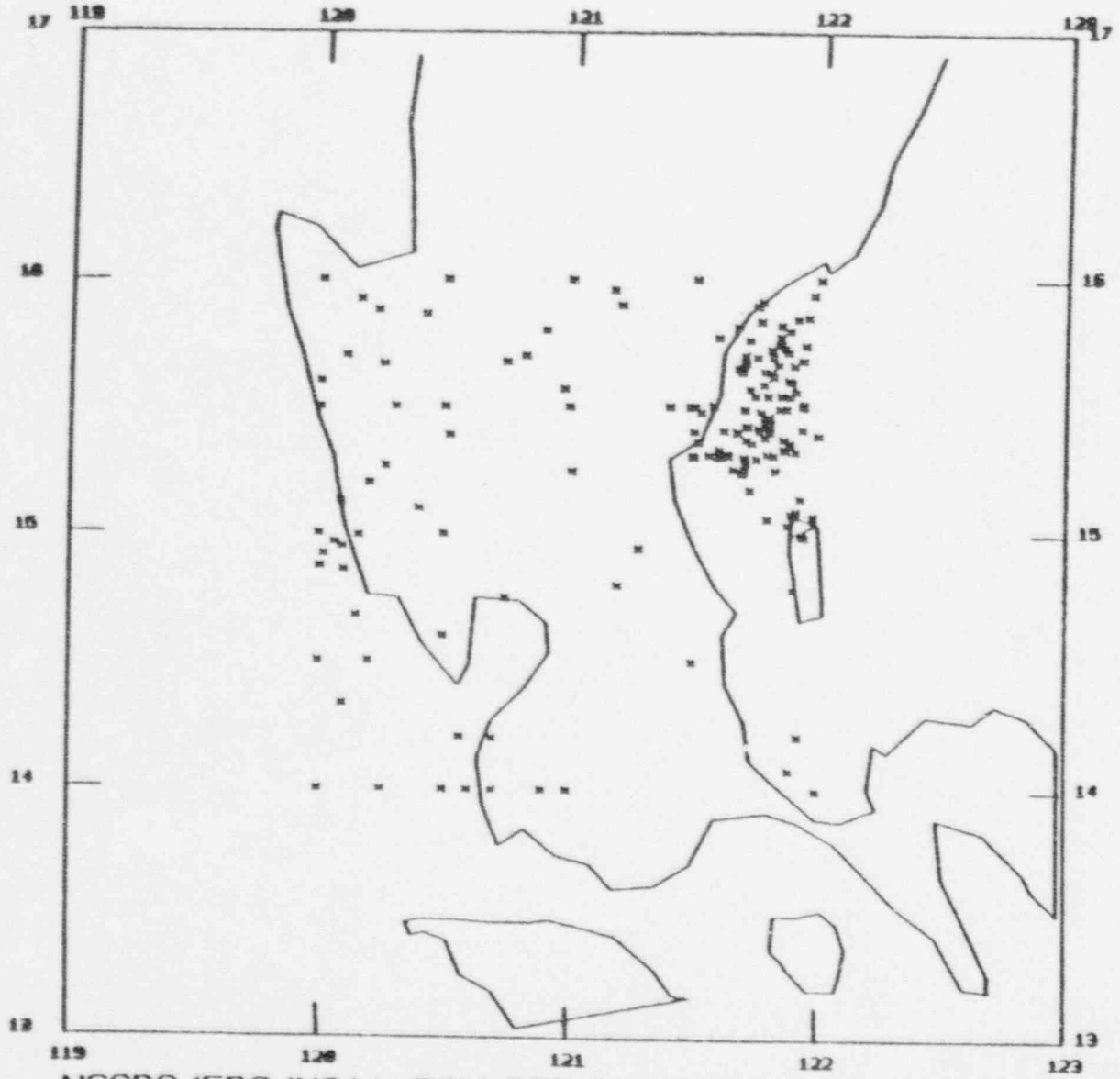
Date	*Epicenter*	*M*	*Comments*
1599 June 21	Manila		
1619 Nov. 20	N. Luzon		
1645 Nov. 30	Manila		several hundred dead
1658 Aug. 20	Manila		
1675 Mar.	Mindoro		
1743 Jan. 12	Tayabas, Luzon		
1787 May 13	Pangy		
1796 Nov. 5	Manila		
1824 Oct. 26	Manila		
1830 Jan. 18	Luzon		
1852 Sep. 16	SW. Luzon		
1863 Jun. 3	Manila		300 dead
1869 Aug. 16	S. Mindanao		
1871 Dec. 8	S. Mindanao		
1876 Jul. 26	N. Mindanao		
1878 Sep. 16	Mindanao		
1879 Jul. 1	Surigao, Mindanao		
1880 Jul. 18	Luzon		
1689 May 26	Batangas, Luzon		
1892 Mar. 16	Luzon		
1897 Sep. 20, 21	Bastian, W. Mindanao	8.6, 8.7	tsunami
1897 Oct. 16, 20	Samar	8.1, 7.9	
1901 Dec. 14	Batangas, Luzon	7.6	
1903 Dec. 28	off E. Mindanao	7.8	
1907 Apr. 18	S. Luzon	7.2	
1911 Jul. 12	N. Mindanao	7.7	
1918 Aug. 15	off S. Mindanao	8.3	
1924 Apr. 14	off SE. Mindanao	8.3	
1934 Feb. 14	off N. Luzon	7.9	
1937 Aug. 20	central Luzon	7.5	
1942 Apr. 8	N. Mindoro	7.9	
1943 May 25	off Mindanao	8.1	
1948 Jan. 24	S. Panay	8.3	20 dead
1949 Dec. 29	NW. Luzon	7.2	
1952 Mar. 19	off N. Mindanao	7.9	
1955 Mar. 31	Lanao, Mindanao	7.6	400 dead
1968 Aug. 1	Casiguran, Luzon	7.3	270 dead
1970 Apr. 7	Luzon		



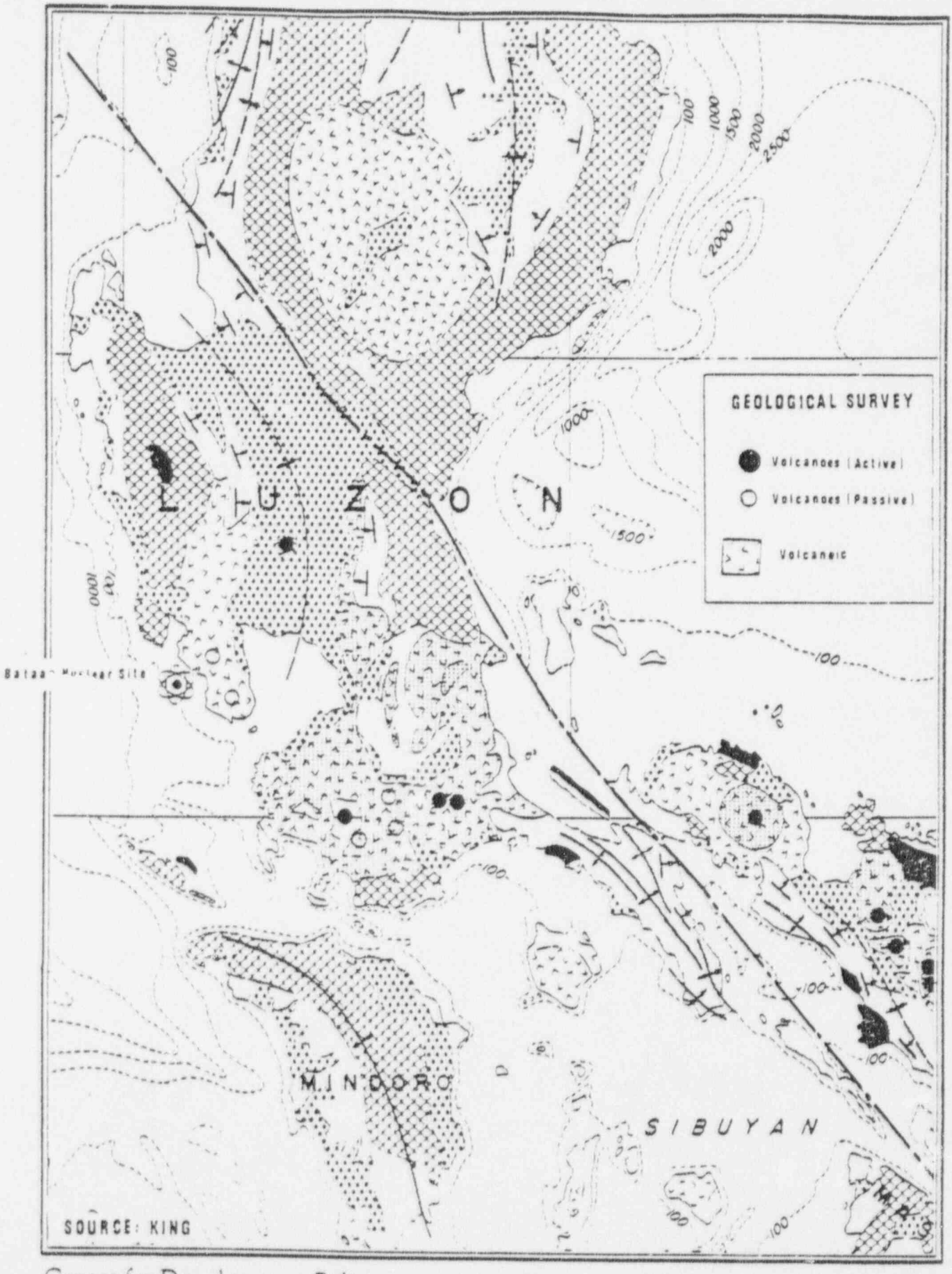
SOURCE: Five-Year Philippine Development Plan


LUZON
N
SEISMIC ZONES
Bataan Nuclear Site
Fault Zone
SOURCE: GEOLOGICAL SURVEY (PHILIPPINES)

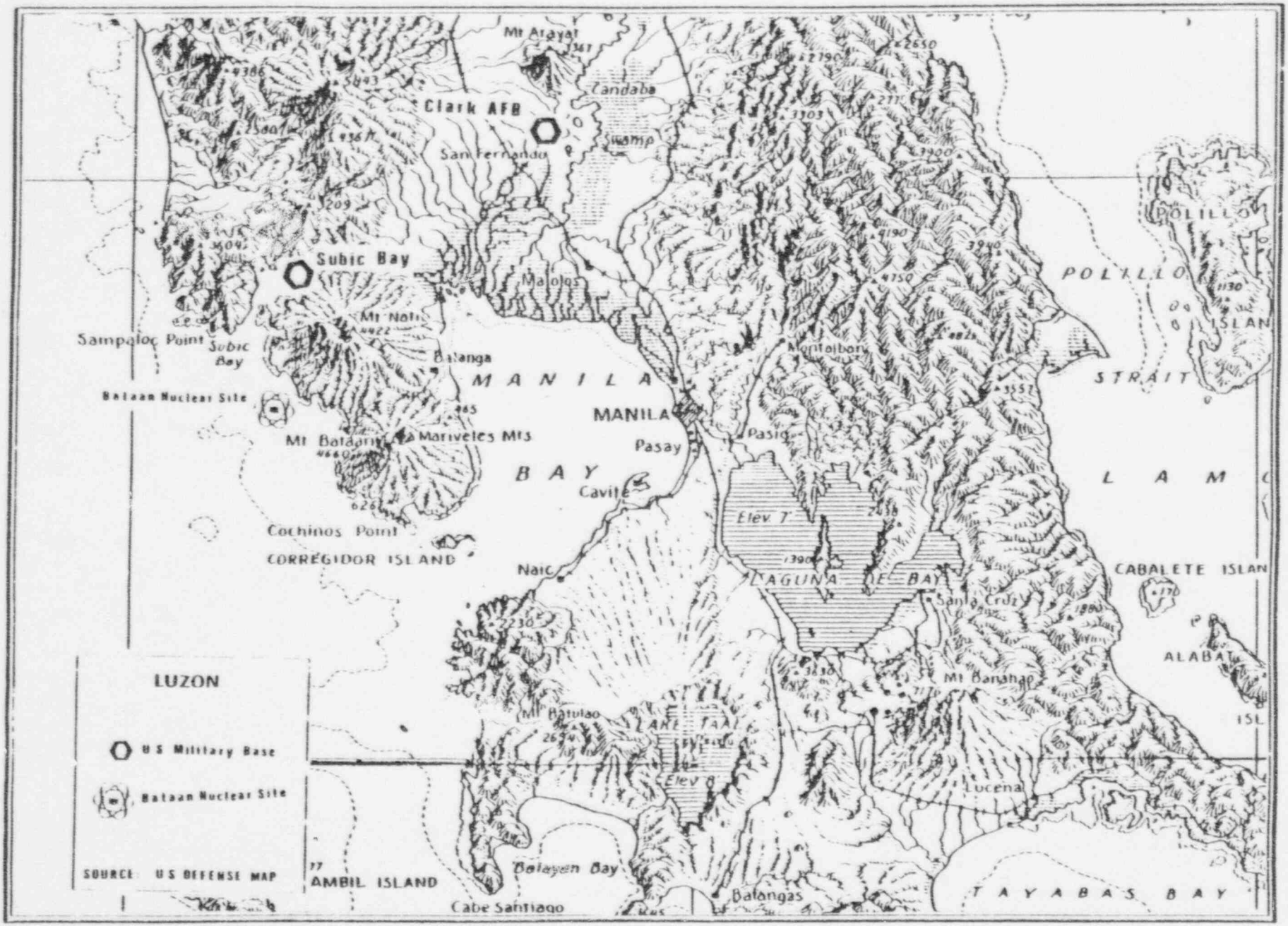
BATAAN PENINSULA EARTHQUAKES



NGSDC/EDS/NOAA BOULDER,COLORADO 171 EARTHQUAKES PLOTTED
79/03/22. 08.29.55.



Center for Development Policy



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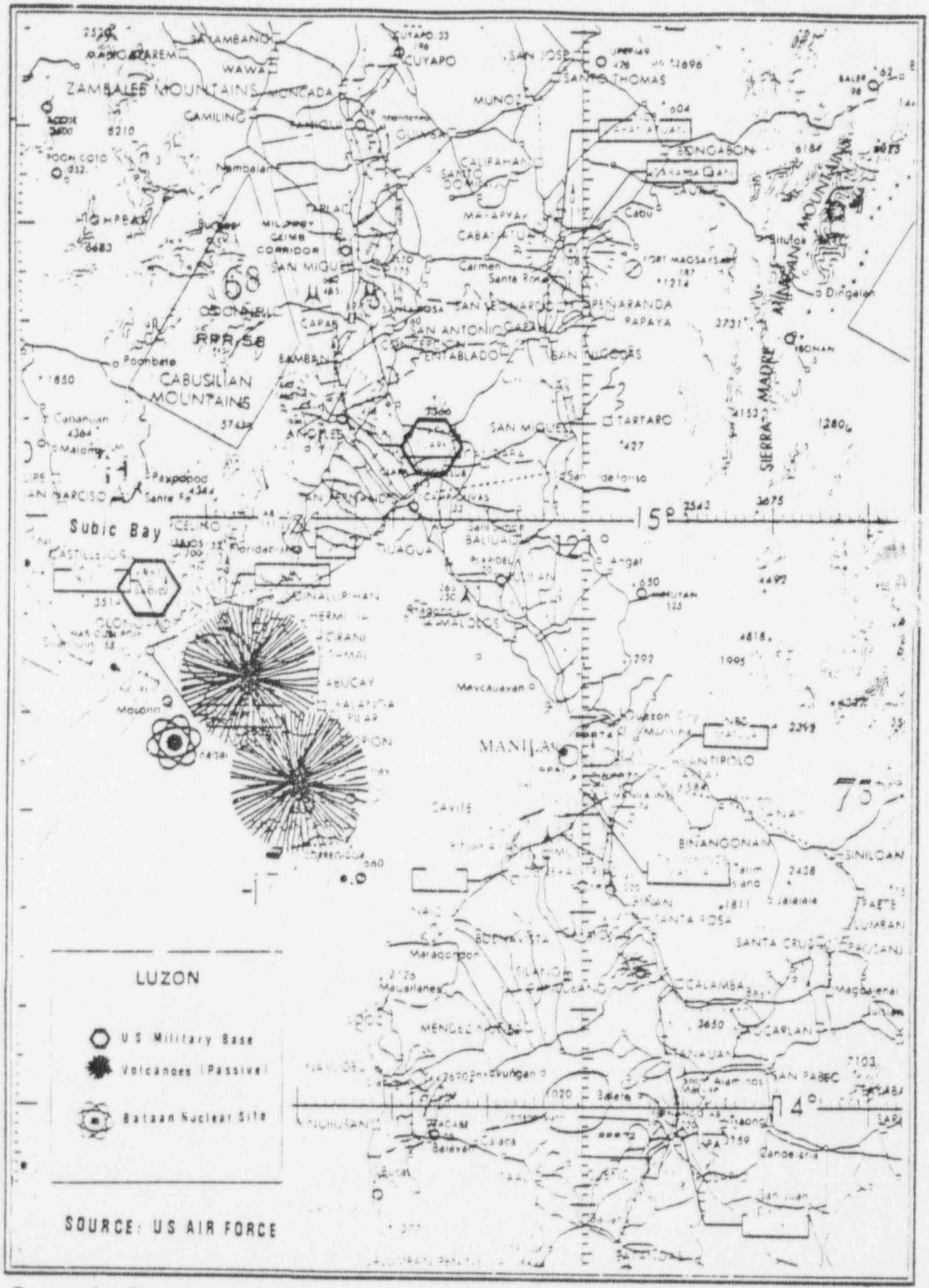
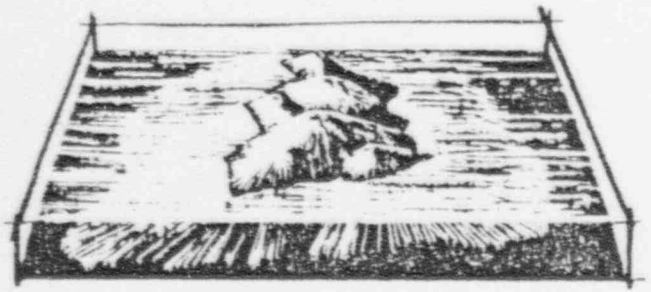
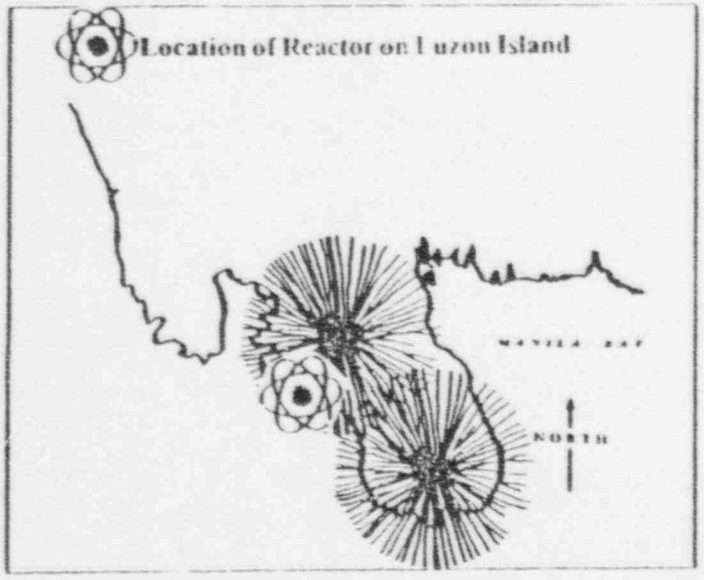
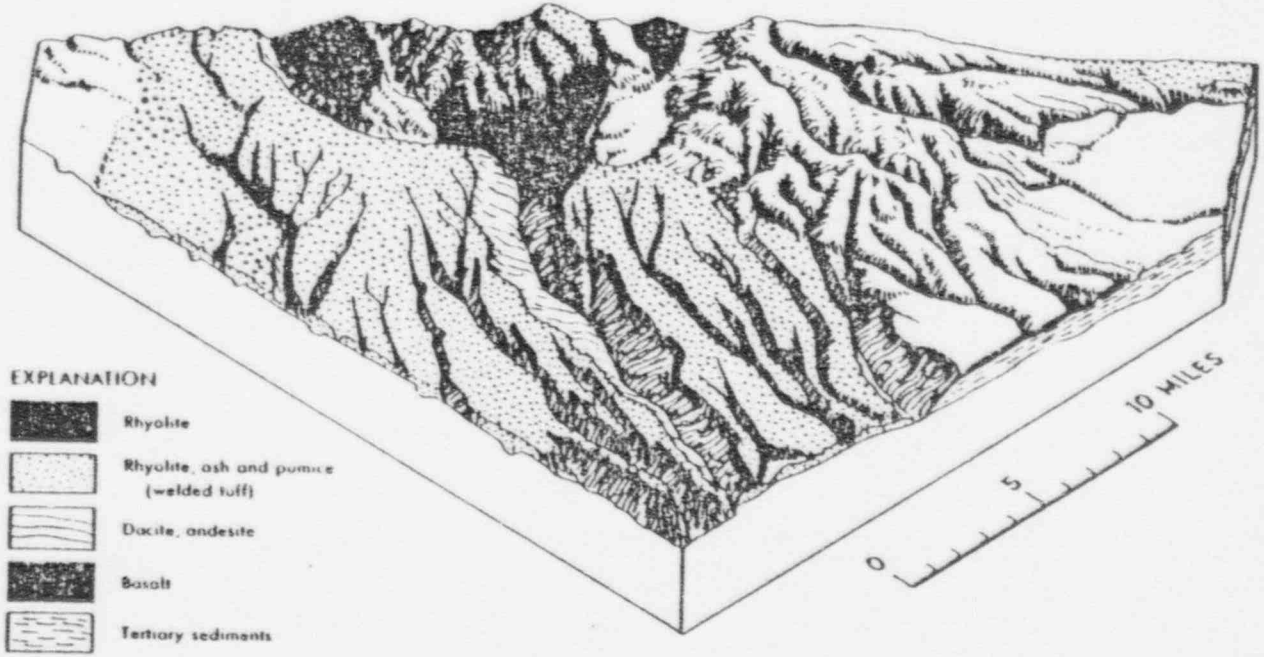


Center for Development Policy







Center for Development Policy

ENCLOSURE 7

Filed by NPC
5 Sept 1979

Encl 7

Westinghouse International
Projects Company

Quad A Building
2305 Pasong Tamo Ext.
Makati, Rizal 3117
PHILIPPINES
TLX 722274
ITT 7405206
TEL 85 28 51 10 55

WI-WTS/NPC - 0143
March 30, 1978
File No. 10.10.05
45.50

National Power Corporation
Napot Point, Morong
B a t a a n

Attention: Mr. C. C. Garcia

Subject : PHILIPPINE NUCLEAR POWER PLANT UNIT NO. 1
Site Problem Report Responses

Gentlemen:

Attached are the answers to your Site Problem Reports SPR.03.04-12, [redacted]

Very truly yours,

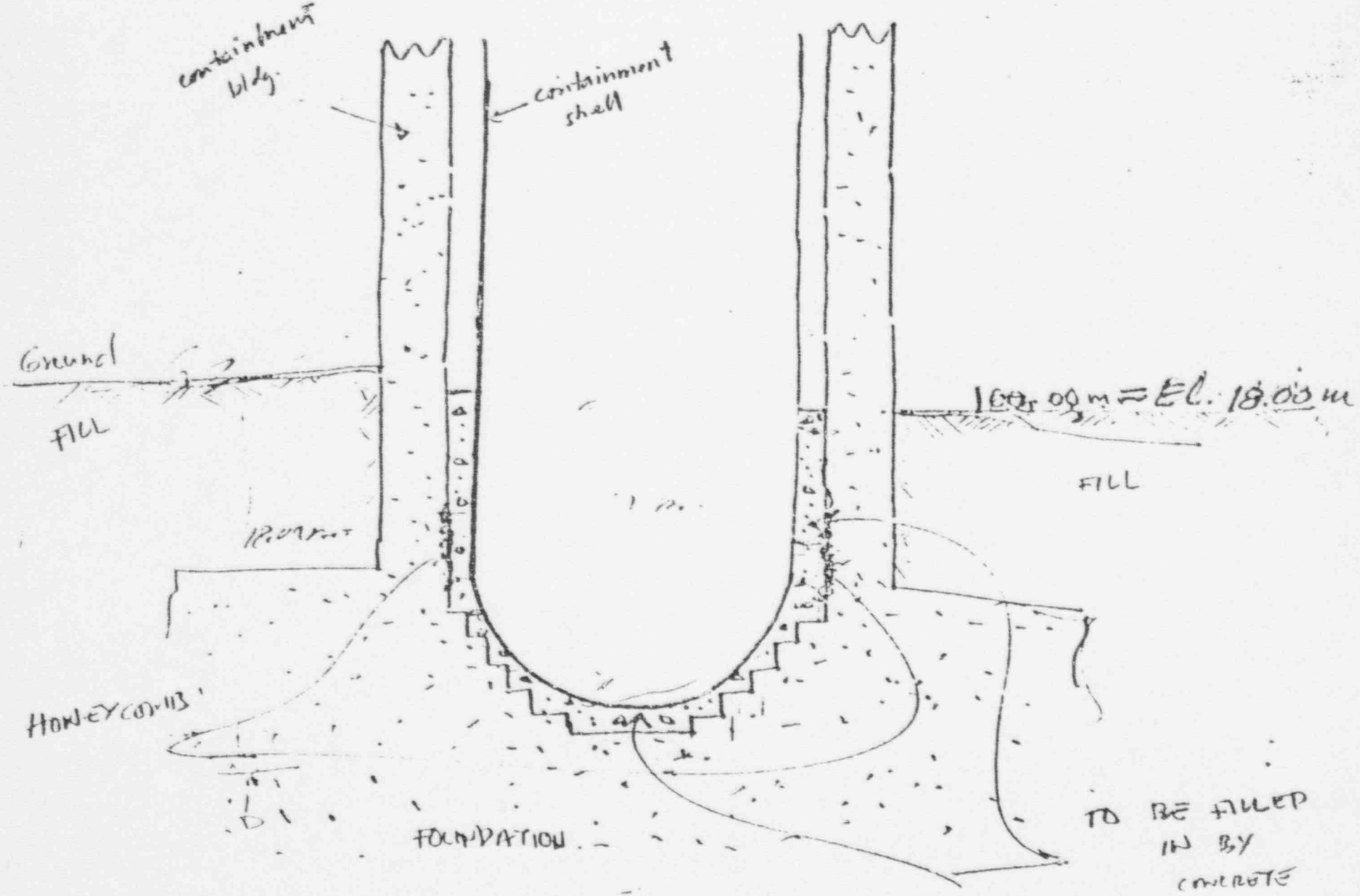
M. T. CORCORAN
Manager
Quality Assurance

MTC/nac

cc: W.S. Wilgus - w/a
W. Morrison - w/a
A. Orduia - w/a
J.C. Torres - w/a
R. Blanco - w/a

Attachments.

Exh. 19 - Bataan IBP
Seal.



Site Visit

Date Received in WPCO 2/7/78

Exh. 69-A
Chiel.

February 7, 1978
PL-NPC/MMS-0015

Mr. Mike T. Corcoran
Manager, Quality Assurance
Westinghouse International Projects Co.
PNPP Unit No. I
Morong, Bataan

Subject: Honeycombs and Voids left after Formwork Removal of Block No.12

Dear Mr. Corcoran,

Attach herewith, we are forwarding to you the generated Site Problem Report regarding the above subject (SPR-C11.03, 04-12).

Kindly inform us of the corrective action you intend to carry out for same and also the criteria for which Westinghouse bases its decision whether a safety-related concrete structure is to be rejected or repaired.

Thanks for your usual attention.

Very truly yours,

For F.

CONRADO C. GARCIA
Chief, Quality Assurance Div.
EPG, NPC, Manila

/hmc: ✓

a sound concrete and ... / requirements. Title 5/11/79

NATIONAL POWER CORPORATION

FORM NO. REV. NO.

DATE: 3 February 1978

"SITE PROBLEM REPORT"

SPR No. CON.03.04-12

Page 1 of 1

SUBJECT: CONCRETE PLACEMENT

SAFETY RELATED
NON-SAFETY RELATED
Initial Surveillance
Follow-up Surveillance
(No. of times previously performed & dates of previous surveillances

SYSTEM/COMPONENT REACTOR BUILDING CONCRETE SHIELD

Specification: PL-SP-J200-3344

Code:

Procedure:

NATURE OF PROBLEM: VOIDS AND HONEYCOMBS LEFT IN CONCRETE AFTER REMOVAL OF FORMWORK

EXCESSIVE VOIDS AND HONEYCOMBS WERE FOUND AFTER REMOVAL OF FORMWORK ON BLOCK NO. 12. THIS IS A VIOLATION OF PARAGRAPH 4.3.2.g of J200.

RESPONSIBLE ORGANIZATION: WIPCO/PCI

RECOMMENDED RESOLUTION: IF STILL REPAIRABLE, THE REPAIR OF SAID VOIDS AND HONEYCOMBS SHOULD BE IN ACCORDANCE WITH PARAGRAPH 4.12.3 of J200. ALSO, WE REQUEST THE REPAIR PROCEDURES AND SCHEDULE FOR REPAIRING SAME.

RESPONSE (RESPONSE REQUESTED within 10 DAYS):

cc: C. C. GARCIA/SEC QA
A. ORQUIA/SITE MGR., SEC

Originator: P.C. HERRERA, JR.

Approved by: E.M. SISON
Officer-in-Charge, Site A

This SPR is cancelled based upon verification of [illegible] results, chipping to sound concrete and epoxy/drypacking

	DATE OF REPORT 22 May 79
Phil. Nuclear Power Plant No. 2	QA ENGINEER F. A. Manlucu
SCT Repair of Block #12 Reactor Bldg.	HEAD, SURVEILLANCE & TESTING SECTION

ENGINEERING DOCUMENTS Spec. J-200

ALLOWANCE R	ALLOWANCE NA	ITEM	REFERENCE DOCUMENTS	FUNCTION
		1.0	J 200	4.12 Repair of Surface Defects and Rejected Concrete
				4.12.3 Honeycombed and rejected concrete shall be removed down to sound concrete, the area cleaned and dampened and a bonding mortar of one part cement to one part fine sand applied to the surface.
		1.1		4.12.4 A bonding mortar consisting of one part cement to two and one-half parts sand shall be applied and consolidated into place.

ITEM	REASON FOR REJECTION
	Not applicable

NPC

QUALITY ASSURANCE DIVISION
SURVEILLANCE SUMMARY REPORT

REPORT. NO. 7905-2-5

DATE OF REPORT 11 May '79

PROJECT PNPP-1 | AREA OF SURVEILLANCE Reactor Bldg. | Q A ENGINEER F. A. Manfuso

PROCEDURE Spec. J 207

SUMMARY OF SURVEILLANCE FINDINGS On May 11 at about 9:45 AM Mr. J. Saez, Mr. R. Mendoza and the undersigned visited Block 12, Reactor Bldg. to observe the filling up of the drilled holes from where core samples were taken. Drilled hole at azimuth 113°-18'-27" was observed being filled. The process of filling up consisted of wetting the hole thoroughly by wet cloth prior to the application of bonding mortar. When bonding mortar had been applied, filling mortar was introduced into the hole. Pictures were taken of the different steps taken in filling up the hole. Personnel contacted were Messrs. S. Lasso and J. Estrella, both QC engineers. No violation of Spec. J 207 was observed.

RECOMMENDED CORRECTIVE ACTION Not Applicable

VERIFICATION OF CORRECTIVE ACTION Not Applicable

☐ ACCEPT ☐ REJECT

Q A ENGINEER

11 May 79
DATE

Republic of the Philippines
NATIONAL POWER CORPORATION
Philippine Nuclear Power Project
Bataan, Bataan

E&C 69-B-NPC
Quad.

February 24, 1978
PL-QAC/MIS-

Mr. Mike T. Carreon
Manager, Quality Assurance
Westinghouse International Projects Co.
PNPP Unit No. 1
Bataan, Bataan

Subject: Site Technical Matters

Dear Mr. Carreon,

This is to call your attention to the Site Technical Reports we have forwarded to you on February 7 and 15, 1978 of which copies are attached herewith. This is our second request for you to respond to the said SPR's.

This request is made inspite of your assertion to take such matters up in scheduled meetings, since we believe that these SPR's are of major concern and require formal documented responses.

Very truly yours,

[illegible]
Chief, Quality Assurance Division
NPC, Bataan

cc: File's CO1.03.04-12
CO1.03.09-12
F.27 26.06 - 3
F.27 26.01 - 4

/ma

Cable Address
"NAPOCOR" Manila
P. O. Box 3128

February 17, 1970
PA-NPC/WTP-0066

Ltr. 69-C-NPC
Encl.

Mr. W. S. Gilgus
Project Director
Westinghouse International Projects Co.
[illegible]
[illegible] Interaction
[illegible] Manila

Dear Mr. Gilgus:

We are highly concerned over several situations which have developed at the PNPP-1 Construction Site and on new engineering problems which have intervened. We presume that remedial action of a satisfactory nature to the situation by your Corporation is immediately undertaken.

As can be seen by the photographs included in Attachment No. 1, numerous cavities have been observed in the concrete of the [illegible] of the reactor containment vessel. These cavities have been classified by WIPO and PCI [illegible] personnel as surface defects of a "honeycomb" nature.

We engineers who are equally familiar with the techniques of concrete are in serious disagreement with [illegible] opinion that these cavities are [illegible] to be accepted. It is our opinion that [illegible] repair according to the "Corrective Procedure" drawings and as such unfeasible, require the [illegible] of Block No. II (see Attachment No. 2).

In addition, Mr. W. Morrison, in a letter MP-WS/MC-0119 (see Attachment No. 3) stated that a N.C.R. will not be issued. The Babcock Power Corporation feels that this decision should be made by Contract Manager, Quality Assurance not the Acting Site Manager of Construction.

However, we are very concerned that if a non-conformance of the depth, type and nature as the voids/cavities in question can be considered as routine as a rejected weld on a pipe then we must ask that it be officially clarify in no uncertain terms, what are the non-conformance criteria which WESTINGHOUSE intends to use?

Very truly yours,

David Ted McCann
General Manager

March 6, 1970

Subject : MPC Quality Assurance Participation in the Makati Building, Block 12, Hongkong Bank's Evaluation Program.

[illegible]

[illegible]

[illegible] Data for the [illegible] Block [illegible], [illegible] Building.

[illegible] Quality Assurance [illegible] accomplished by the Civil QA [illegible], conducted several surveys of the testing and [illegible] of the cured samples, taken from the Nancy-Sasha location [illegible] Block [illegible], Nevada Building during the period February 24 to Feb. [illegible]. This surveillance was performed to verify proper compliance [illegible] as established in the [illegible].

[illegible]

[illegible]

[illegible] compressive strength results and the cured dimensions were [illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] core sample taken from the block 4 (above mentioned) failed the [illegible]. A retest was performed from a sound concrete sample, taken [illegible] adjacent to the first one (sample 7/b), and the results met the requirements.

The retest was performed in compliance with the ASTM-C42, paragraph 9.1.1 "..... when preparing strength test specimen of hardened concrete, samples that show abnormal defects or that have been damaged in the process of removal shall not be used."

Drilling core samples were taken from sound concrete surfaces of the "Longarone" and located in the lower part of them. The test results demonstrated that the concrete mix used in the block 12 was [illegible] and that the [illegible] is totally responsible for the [illegible] deterioration.

In any event, the repair work will be in accord with the latest revision of the W.C.O/a procedure whereby they shall be responsible to remove that every loose concrete surface the repair will be applied.

W.C.O/a will continue surveillance activities as required.

[illegible] contacted during the course of this surveillance:

[illegible] Xavier, Site Construction Manager.

[illegible], Site Construction Engineer.

[illegible] Laboratory [illegible] Supervisor

[illegible] and Technician.

[illegible], WCO Surveillance Engineer.

12.0 Test Control

Tests per this shall be established to ensure that all testing requirements are met, that the item will perform satisfactorily in service, and that properly calibrated test equipment is used. Test procedures shall include provisions for assuring that all prerequisite actions have been satisfied, that adequate test conditions are established, that the test is performed in accordance with applicable design documents, and that adequate records are maintained.

13.0 Control of Measuring and Test Equipment

Measures shall be established and documented to assure that tools, gages, instruments and other measuring and test equipment of the proper type, range, accuracy and tolerance are used for activities affecting quality. Such equipment shall be identified, controlled, calibrated and adjusted at specified periods to maintain accuracy within necessary limits.

[illegible]

[illegible]

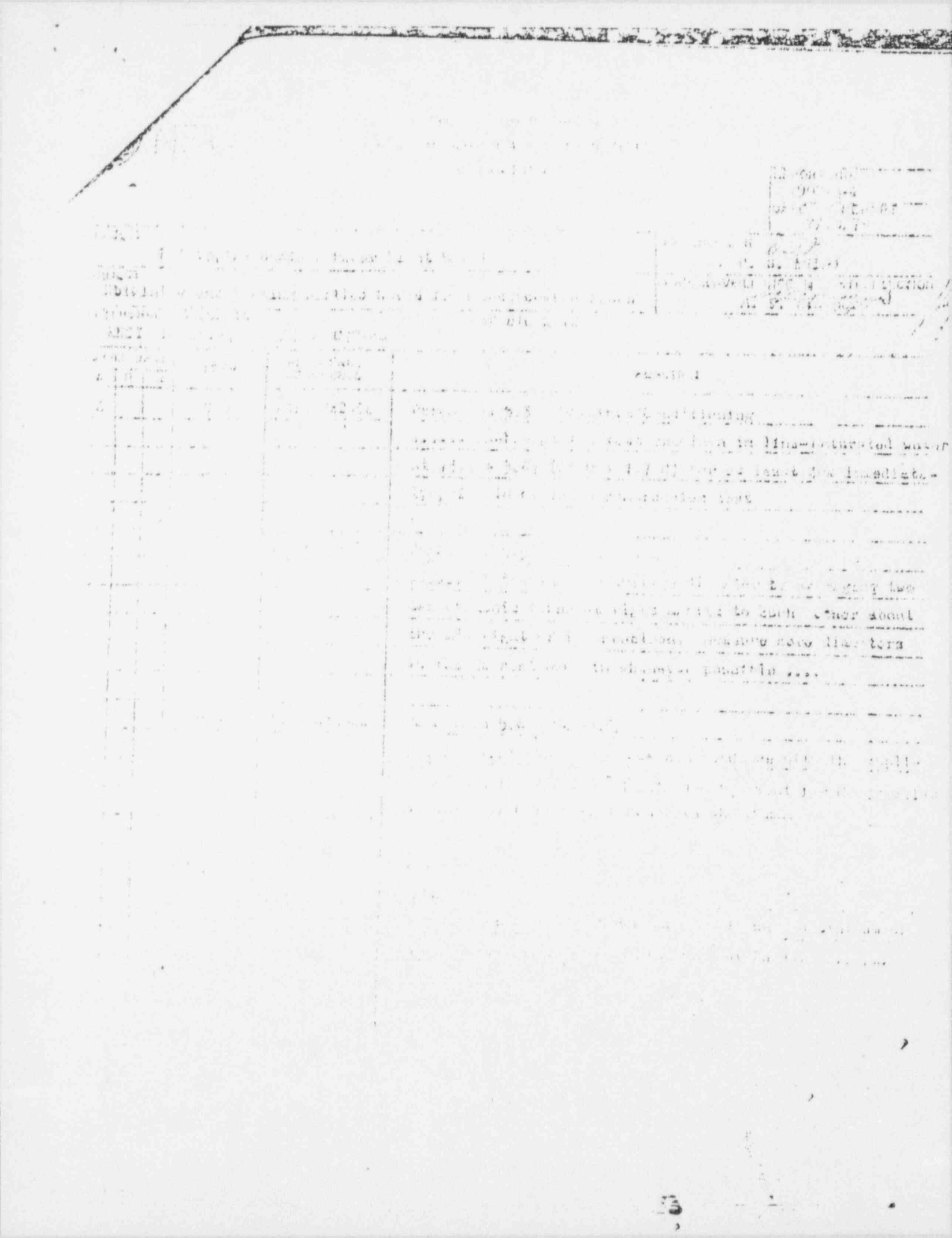
REPORT NO.
7002-4-2
DATE OF REPORT
2/20/79

Philadelphia Nuclear Power Plant No. 1

Obtaining and Testing Drilled Cores from Honeycombed Areas of Block 12

PREPARED BY: [illegible] ANIRO, R. P. Elba, Aro

[illegible]	[illegible]	[illegible]	FUNCTION
[illegible]	[illegible]	[illegible]	Paragraph 2.1
			...... for specimens taken by drilling in other directions or when the test specimen diameter is to be accurately determined for more precise calculation of compressive strength, a diamond drill shall be used.
[illegible]		[illegible]	Paragraph [illegible]
			...... A specimen [illegible] perpendicular to a vertical surface, or perpendicular to a surface with a batter, shall be taken from near the middle of a unit of deposit when possible and not near formed joints or obvious edges of a unit of deposit.
		[illegible]	Paragraph [illegible]
			[illegible]



EMBACO OVERSEAS

CORPORATION

WORLD CONSULTANTS - ENGINEERS - CONSTRUCTORS

PHILIPPINE BRANCH OFFICE
Villamor Building, 2nd Floor
1561 Roxas Boulevard
Pasay City
MAKATI METRO MANILA

CABLE ADDRESS: EMBACO MANILA

MAKATI COMMERCIAL CENTER
P. O. BOX 1018
MAKATI COMMERCIAL CENTER
MAKATI, METRO MANILA
PHILIPPINES

13 February 1979
79-EMB-PH-0

[illegible] Robertson
[illegible] Bar
[illegible] Development
[illegible] Power Corporation
[illegible], Manila

[illegible]

Re: [illegible] Consultancy Services for Mindanao Hydroelectric Development Projects - Study, dated January 13, 1978

Dear [illegible]:

[illegible] your letter dated January 13, 1978 [illegible] Mindanao Hydroelectric Development Projects - Study. [illegible] appreciate [illegible] your favorable consideration.

[illegible]

Contents

[illegible]

[illegible] surface, [illegible] and [illegible]

[illegible] - Between 90° - 120° [illegible]

Picture #2 - Between 225° - 240° ±

Picture #3 - Between 240° - 255° ±

Picture #4 - Between 255° - 300° ±

Picture #5 - Between 285° - 300° ±

B. [illegible] surface, well consolidated sound concrete surface

Picture #6 - Near El 96.[illegible]m, at 80°±

Picture #7 - Near El 93.[illegible]m, at 190° ±

[illegible] surface, [illegible]

[illegible] - [illegible] 210° - [illegible]

[illegible] - Location not [illegible] identified

[illegible] - Location not been identified

[illegible]

[illegible] - Concrete Repair Procedure, for Block No 11 - [illegible]-1, [illegible], dated August 15, 1978

[illegible]

[illegible]

3. Extent of Damage

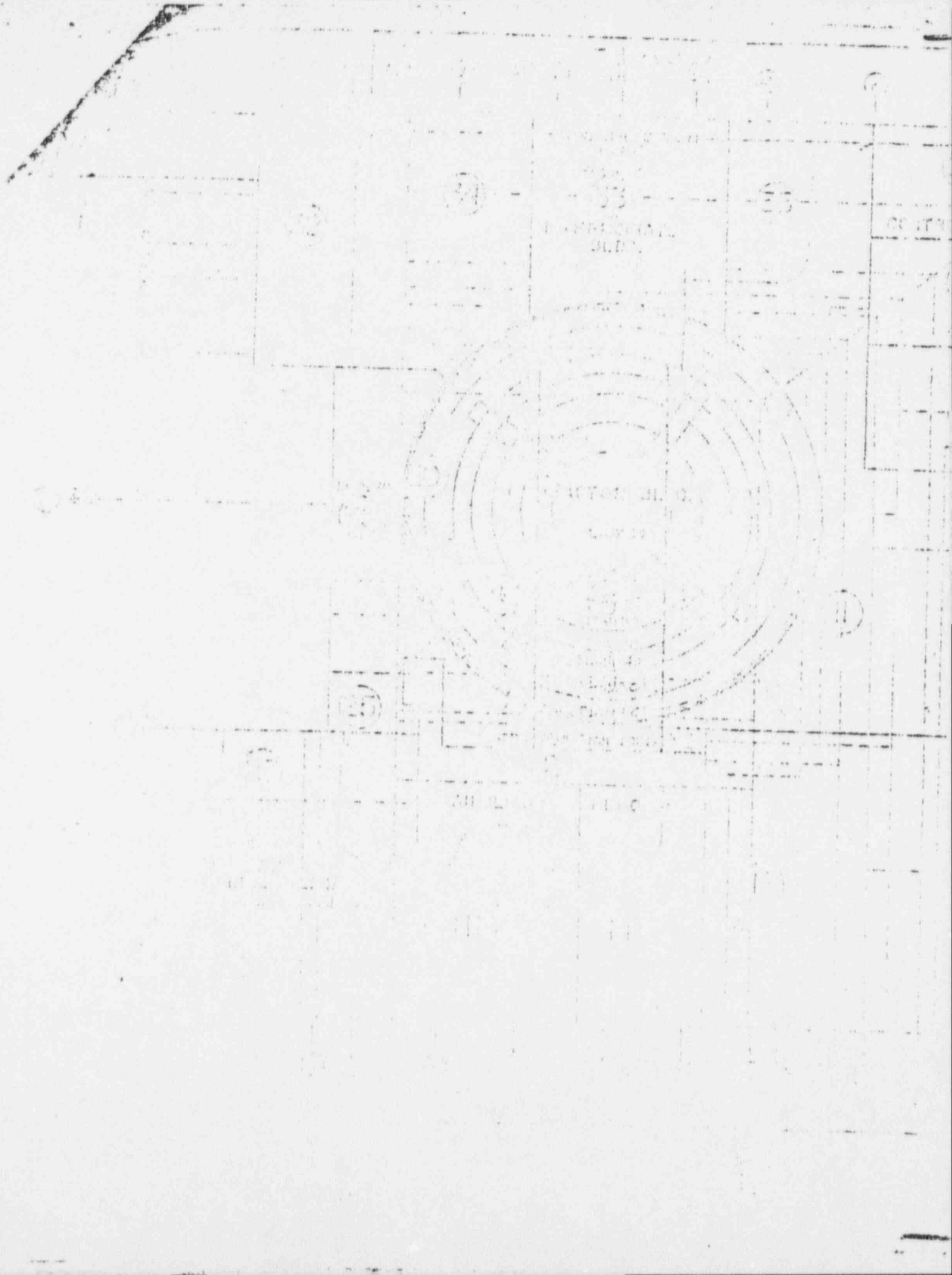
The major consolidation zone is at the middle of the wall. Therefore fresh concrete during consolidation would flow outward from the middle. Under such a concrete flow pattern, one can assume that if no exterior defects and fresh concrete behind the wall [illegible]

would depend on the results of the findings.

During the meeting held at NPC Manila office on February 7, 1979, ultrasonic method was discussed for detecting the defected concrete. According to Fluor's experience from field testing in one of our current nuclear projects, the ultrasonic method was found to be inconclusive in identifying the concrete defects such as honeycombs and cracks. Furthermore, the test will not establish the actual in-situ strength. With these considerations, the use of ultrasonic method is not recommended.

4. Concrete Replacement

To replace concrete by placing of abutting concrete is structurally unacceptable. This part of shield building wall is located well below the base mat concrete of reactor internal structure, and both will act as parts of an integral structure.



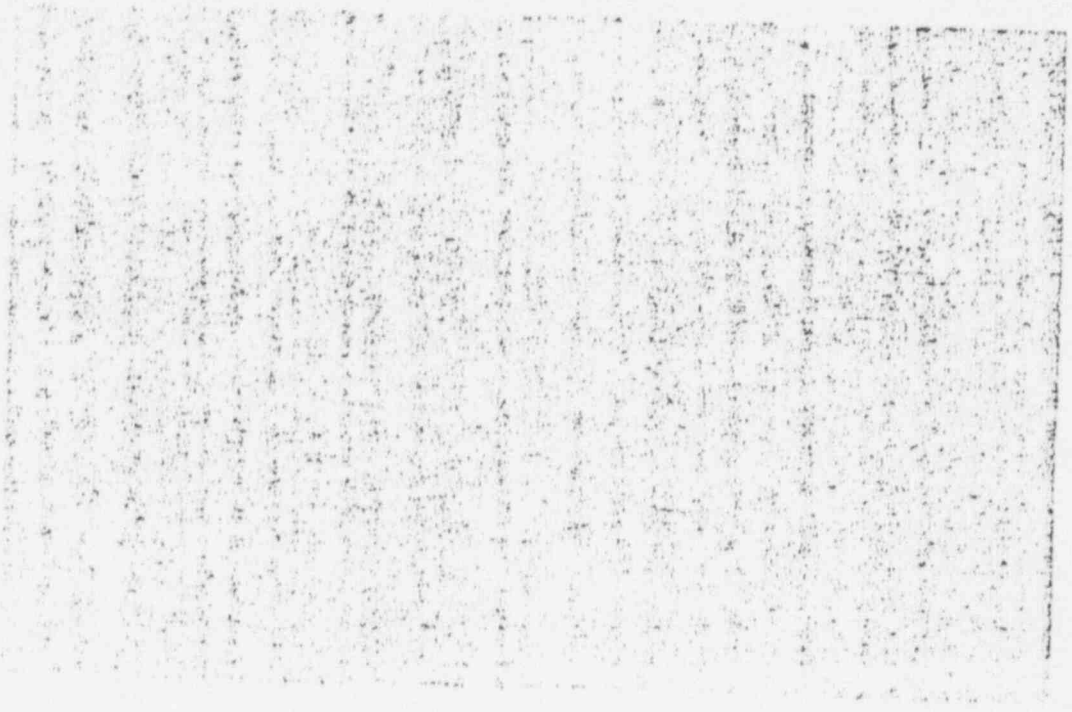


Figure 12 - Interface Surface, Volume and Gas Combustion Areas, Between 2 to the 2.5 Power

Picture #7 - Exterior Surface, Wall
Some Infrared Sound
New 1:1 95.6 m. at 0.0°C

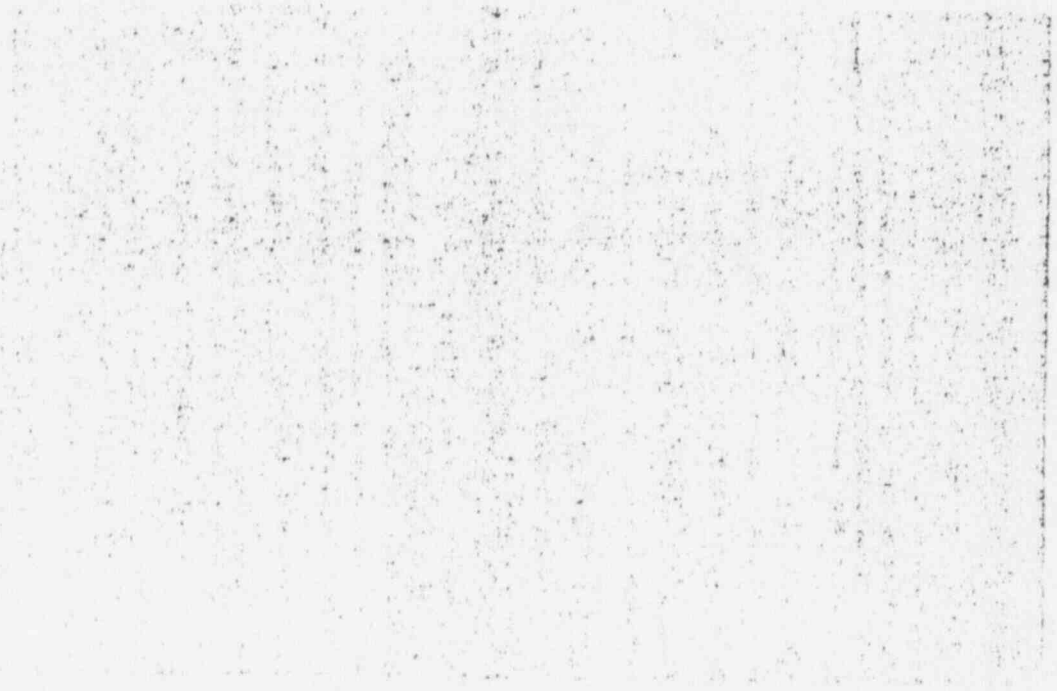


Figure 28 - Salado Canyon, Mexico
Arroyo Area, Location not been identified

Attachment A

WESTINGHOUSE INTERNATIONAL PROJECTS COMPANY

NUCLEAR POWER PLANT PROCEDURE

Number	NPP-1 Rev. 0
Effective Date	March 15, 1979
Supersedes	N/A
Page	1 of 4

Title: CONCRETE REPAIR PROCEDURE FOR BLOCK NO. 12

1.0 SCOPE

1.1 This procedure provides a method of repairing honeycombing defects in Block No. 12 of the Reactor Building. It is intended that this procedure be applied where reinforcing steel is exposed and the repair area is extensive. For minor surface defects, the procedure described in Specification PL-SF-2000-0344 shall apply.

2.0 RECORDS

2.1 Documentation of repair giving a description of the area under question, the repair performed and results from inspections of the prepared area shall be made in accordance with Westinghouse Quality Assurance Inspection Form. (See Attachment A).

3.0 REPAIR

3.1 Preparation of Area

3.1.1 If water seepage is encountered, the Field Quality Assurance Engineer shall be informed prior to repair work being started.

3.1.2 All concrete in affected areas shall be removed down to solid concrete attaining a rough surface. Removal of affected concrete shall continue until there is no question that sound concrete has been reached.

3.1.3 Final removal of affected concrete must meet the following requirements:

3.1.3.1 A minimum of spalling or feathering at the perimeter of cut.

3.1.3.2 Vertical sides and work will be [illegible] at the surface of the [illegible].

3.1.3.3 [illegible] surface [illegible] from [illegible]

3.1.4 [illegible] of concrete shall extend past the [illegible]

3.1.5 Surfaces must be thoroughly cleaned by hydroblasting.

[illegible]	[illegible]	[illegible]

3.0 [illegible]

3.1.5 Surface preparation shall be in accordance with paragraph 3.1.5. The surface shall be kept wet at least three (3) hours prior to placement.

3.2 Concrete Replacement for Affected Areas

3.2.1 In the affected areas, concrete shall be replaced upon pouring of abutting concrete placement as shown on Drawing No. PS-E-411-C70.

4.0 INSPECTION AND TESTING

4.1 All surface preparation shall be inspected to ensure compliance with this procedure. Inspection shall be documented on Westinghouse Site Quality Assurance approval inspection form.

4.2.1 Inspection and testing of concrete shall be performed in conjunction with the inspection and testing of abutting concrete placement.

[illegible]

[illegible]

[illegible]					SIGNATURE			[illegible]
					Q.A.	CIVIL	[illegible]	
[illegible]								
[illegible]								
2) Vertical sides.								
[illegible] top and bottom [illegible]								
Surface thoroughly cleaned by [illegible]								
Surface kept wet at least 3 hours prior to placement								
[illegible] design same as original [illegible]								
Each lift thoroughly [illegible]								
[illegible]								[illegible]
Day 1								
Day 3								
Day 4								
Day 5								
Day 6								
7								

[illegible]

[illegible] involved in discussions with P C [illegible]

[illegible] at NPC Manila Office

1. Mr Chuck O Pellinton - Project Manager, NPC
2. Mr Ralph B Blanco - Assistant to Project Manager, NPC
3. Mr [illegible] - Manager, Technical Services Division, NPC
4. Mr Constancio Peña - Section Chief, C E Section, NPC
5. Mr Charles R Manly - Project Manager, Bechtel
6. Mr Rosalino Uy Quieto - Secondary

[illegible] at the site

1. Mr Eduardo A Coquia - Site Manager, NPC
2. Mr Rolando A Dalisdo - Manager, Contracts Adm. Division, NPC
3. Mr Conrado C Garcia - Manager, QA Division, NPC
4. Mr Constancio M Peña - Section Chief, C E Section, NPC
5. Mr Fernando Singson - Section Chief, QA Section, NPC
6. Mr Kohandoyan S Celino - Section Chief, C E Section, NPC
7. Mr Esperidion C Ilano - Supervising Civil Engineer, NPC
8. Mr Leslie Elliott - Bechtel Construction Advisor
9. Mr [illegible] - Bechtel, QA Civil Engineer Consultant

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]

FILE COPY

REPUBLIC OF THE PHILIPPINES
COMMISSION ON NUCLEAR REACTOR PLANTS
Metro Manila

IN RE: INQUIRY ON THE SAFETY TO THE PUBLIC OF THE BATAAN NUCLEAR REACTOR PLANT.

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

M-O-T-I-O-N

The BATAAN IBP CHAPTER PANEL, respectfully states:

1. That on February 12, 1979, the Philippine Atomic Energy Commission, PAEC for short, at the instance of the Regulatory Staff, issued an ORDER requiring the National Power Corporation (NPC), to act on a safety issue concerning the structural integrity of the Reactor Building Concrete Shield of the Bataan Nuclear Plant; that a copy of said Order is hereto attached as ANNEX "I" for ready reference, the same document having been marked as EXHIBIT "13-D-BATAAN IBP Panel, during the interpellation by this Panel of PAEC officials before this Honorable Commission on August 30, 1979;

2. That the safety issue arose because of the possible adverse effects on the structural integrity of the Reactor Building of extensive honeycombs and probable internal voids in the concrete wall designated as Block 12, located at or near the base foundation mat of the Building; that the dispositive portion of said Order ANNEX "I", states:

> "Wherefore (sic), the foregoing premises considered and in view of the urgent nature of the matter, the Applicant is hereby ordered to desist from grouting the bottom head of the metal containment and pouring concrete thereon, until Applicant submits proofs satisfactory to this Commission that internal voids do not exist within Block 12 of the Reactor Building Concrete Shield, and if internal voids are present therein, that the presence of such internal voids and the honeycombs taken singly or together will not affect the structural integrity of the Reactor Building Concrete Shield. ~~Applicant is enjoined~~
>
> "Alternatively, if Applicant determines the presence of internal voids in Block 12 and that said internal voids and the honeycombs taken singly or together will adversely affect the structural integrity of the Reactor Building Concrete Shield, Applicant is enjoined to submit plans for corrective actions to be undertaken by it for the Commission's evaluation and approval before actual corrective work is undertaken.

"SO ORDERED

12 February, 1979, Quezon City, Metro Manila.

(S/T) LIBRADO D. IBE
Commissioner"

3. That from available records, it appears that the concrete in Block 12 was placed during January 15 to 17, 1978; (Ref: p. 2, ANNEX "4" Supra) that the honeycombs on this block was first noted on the Inspector's Report on January 31, 1978 of the Power Contractors, Inc. (PCI) as mentioned in a letter from Westinghouse International Projects Co., (WIPCO) to the NPC dated 10 May, 1979, a copy of which is hereto attached as ANNEX "2", the same document having been previously marked as EXH. "13-B BATAAN IBP Panel, during the same interpellation.

4. That a Concrete Repair Procedure for Block 12 numbered SRP.1, effective as early as August 15, 1978 has been prepared by WIPCO, and a copy was transmitted to NPC by letter dated 5 September, 1979; that a copy of the letter of transmittal is hereto attached as ANNEX "3"; and a copy of the Concrete Repair Procedure (CRP-1, as ANNEX "3-A";

5. That the existence of the honeycombs in Block 12 does not appear to have been officially reported or disclosed by NPC to PAEC, the regulatory body; that as stated in the Order, ANNEX I, PAEC became cognizant of the said honeycombs as a result of an audit by its Regulatory staff on PNPP-1 activities sometime in January 15 to 19, 1979, a year almost to the day after the concrete was place on Block 12; further, that when the damage was found by the PAEC audit team, WIPCO had already scheduled the "grouting of the bottom head of the steel containment, which would essentially cover the honeycombs";

6. That in February 1979, a Draft Evaluation Report of Concrete Repair Procedure for Block 12 was prepared by EC. LTD for EBASCO OVERSEAS CORPORATION, a copy of which is hereto attached as ANNEX "4", the same document having been marked during the interpellation of PAEC as EXHIBIT "13-C BATAAN IBP PANEL"; that a description of the visible damaged portion of Block 12 is given on page 4 thereof under the heading "Visual Inspection" as follows:

"2. Visual Inspection

Based on placement conditions discussed it appears logical to have found the major and extensive voided and honeycombed areas at the interior face of the wall and not at the exterior face (compare Pictures #1 thru #5 and #6 - #7). The defected areas are estimated to cover approximately 30% of the interior surface. They are almost all located in lower half zone of the wall where proper consolidation requires the most effort. The largest defected area is at the southwest corner, other smaller defective places are randomly distributed in the remaining areas (Figure 4). The voids caused by air entrapment at the keys are extensive (Pictures #4 and #5). The deepest voids are found to extend approximately 6 to 8 in. (0.150 - 0.200m) behind the first layer of vertical reinforcement, or approximately 0.300m from the general concrete surface (Pictures #8 thru 10). No exposure of second layer of vertical re-bars has been found."

That no copies of the pictures mentioned above are available to this Panel, and it appears from the Appendix to ANNEX "4" under the heading "Typical Record Photos", that at least ten (10) photographs of the damaged area were taken between 90° and 300° of the circumferential surface of the affected wall;

7. That only seven (7) core samples in six spots on the damaged concrete in Block 12 were taken and tested by the PCT Laboratory, and the test results were tabulated in an undated Report on Compressive Strength, Core Samples taken at Block 12, Elev. 93.61-94.00, a copy of which is hereto attached as ANNEX "5"; that the same data on ANNEX "5" is the subject of a telex message dated April 2, 1979, from Westinghouse, Pittsburgh, Pa., to WTCO at the Bataan Site, a copy of which is hereto attached as ANNEX "6", stating that the data was reviewed and they found no need for additional testing;

8. That in a letter dated May 22, 1979, NUC transmitted to PAEC, the documents pertinent to the repair of Block 12, all of which are hereinabove mentioned, namely, ANNEXES "2", "3" and "3-A", "4", "4" and "6"; PAEC was also informed about the dry-packing to be used in said Block 12 repair; that a copy of said letter is hereto attached as ANNEX "7";

9. That acting on an undated NPC Motion filed on May 23, 1979, PAEC in an Order dated June 4,1979 approved NPC's concrete repair procedure and set aside its Order of 12 February, 1979; that a copy of the Order dated June 4, 1979 is hereto attached as ANNEX "8"; the same document having been marked during the Interpellation as EXHIBIT "13-D-BATAAN IBP Panel; that a copy of NPC's said Motion is likewise hereto attached as ANNEX "8-A";

10. That from records available to this Panel, 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 steps or procedures proposed failed to cite any USNRC or PAEC Rule or Regulation as guide in the evaluation and repair of the said damage in Block 12;

11. That if the damage in Block 12 was repaired it is not known to this Panel if a report thereof was made by NPC to PAEC, as the Order of June 4, 1979, ANNEX "8", did not require NPC to render a report which would clarify the actual extent of the said damage;

12. That although PAEC in its Order dated February 12, 1979, ANNEX "1", opined that the honeycombs (and internal voids) in Block 12 could have proceeded from improper implementation of quality control procedure during concrete placement, no further inquiries were made by PAEC as to the actual cause or causes of such damage; that no explanation about the cause or causes of such extensive and major internal voids and honeycombs in the concrete of Block 12 was offered or disclosed by NPC or by any of the other entities involved in the construction of the said Reactor Building;

13. That the Reactor Building appears to be most safety-sensitive structure in the Bataan Nuclear Plant, for it would house the Reactor Vessel with its Nuclear fuel, the steam generators, and other equally vital components of the nuclear reactor complex; that its construction demands the highest attainable degree of structural integrity, such that any diminution thereof because of failure to implement quality control procedures could render the said

structure unsafe as a Nuclear Reactor Containment building, especially since Bataan is an area of high seismicity, not to mention the Nuclear Plant's nearness or proximity to several inactive volcanoes;

14. That as stated by PAEC in its Order dated February 12, 1979, ANNEX "1", the presence of the honeycombs and internal voids in the concrete in Block 12 could have proceeded from improper implementation of quality control procedures, a statement which can not favorably reflect on the capability of the builders of the Reactor Building, and provides a reasonable ground for apprehension and concern about the quality of the construction, and about the possible existance of other similar undetected defects adversely affecting the safety of the structure;

15. That in the Discussion of the Placement Details of Block 12, on pp. 2-3 of ANNEX "A", it appears that the concrete mix quality met specifications, and that the concrete was placed by means of concrete pumps and buckets, all of which would imply that the materials and means used in concreting Block 12 were in order; that since the extensive defects occured notwithstanding, NPC should have exerted efforts to determine the cause thereof, considering external factors, such as the seepage of water into the hardening concrete from an underground spring, because there are underground waters at Napot Point Peninsula as manifested in springs of which about five (5) are indicated on the Surficial Geology Map of the Peninsula, Figure 2.5.1-55 of the Preliminary Safety Analysis Report (PSAR); that such underground waters could undermine the foundation of the Building as well as affect the stability of the soil on which the building rests;

Additionally, an inquiry along this line would dispel (or confirm), long standing but unsubstantiated claims of some local critics of the Plant to the effect that there was an underground gushing spring somewhere at the Southwest corner of the foundation excavation of the Reactor Building where coincidentally the most severe damage seem to have been situated as indicated on the quoted portion of paragraph 6 above;

16. That the extensive and major internal voids and honeycombs in Block 12 required equally extensive and major repairs which have nullified and broken the essential continuity of the concrete structure; that the lines of contact between the old and new concrete are weak and liable to crack even at low magnitude tremors; that such cracks below the surface level would render the containment steel and reinforcing bars subject to corrosion from seepage through the years, and may eventually considerably weaken the structure, as well as contaminate the environment even after the life span of the Nuclear Plant.

WHEREFORE, in view of the foregoing, it is respectfully prayed:

(1) That NPC be required to comment on the damage to Block 12, informing this Honorable Commission of the cause or causes of such damage, the actual extent of the same, the procedure and extent of the repairs made, and furnishing this Honorable Commission pertinent and relevant documents, plans, maps, photographs, reports, etc., not yet part of the records of this Inquiry, and necessary for the understanding and evaluation of the said damage and repairs relative to the safety of the structure as a Nuclear Reactor Building;

(2) That if this Honorable Commission deems it proper, the advice of the International Atomic Energy Agency be requested as to the effects of the said damage and repairs in Block 12 on the safety of the Reactor Building;

(3) That if this Honorable Commission deems it necessary, to avail of the assistance of qualified and impartial Philippine experts to evaluate the safety of the said structure as a Nuclear Reactor Building, in the light of the damage and repairs on Block 12; and

(4) That such other steps be taken or ordered as this Honorable Commission may deem necessary and proper to resolve the concern over the safety of the Reactor Building by reason of the damage and repairs on said Block 12.

Manila, September 4, 1979.

BATAAN IN GOOD FAITH

By:

[illegible]

-and-

[illegible]

Copy hereof furnished to:

1. [illegible]
2. [illegible]
3. [illegible]

Republic of the Philippines
PHILIPPINE ATOMIC ENERGY COMMISSION
Quezon City, Metro Manila

ANNEX "I"

IN THE MATTER OF THE
APPLICATION FOR A CONSTRUCTION
PERMIT FOR THE PHILIPPINE
NUCLEAR POWER PLANT (PNPP-I)

NATIONAL POWER CORPORATION,
Applicant

ORDER

Exh. 13-D Baraan ISP 1-77

By the Regulatory Staff, in its Memorandum dated 8 February 1979, moves to enjoin the Applicant from proceeding with the grouting of Block 12 of the Reactor Building Concrete Shield and the pouring of concrete thereon.

The aforesaid motion is anchored on the findings of the Regulatory Staff in its audit and inspection on the PNPP-I activities, the last of which was the audit of WECO Subcontractors from 15 to 19 January 1979, in which was reported among others, the presence of extensive honeycombs in said Block 12 of the Reactor Building Concrete Shield as reflected in the I.R.s on the Report of the Audit Team dated 19 January 1979 (copy attached).

The Regulatory Staff avers that the observed honeycombs could be the result of improper implementation of quality control procedures during concrete placement and which could have also resulted in internal voids within Block 12.

The Regulatory Staff further avers that WECO has scheduled grouting of the bottom head of the containment which would essentially cover the honeycombs [illegible]

The Commission takes official notice of the fact that the audit and inspection of PSAR-I activities, the last of which was an audit of NUPCO subcontractors conducted by the Audit Team of the Regulatory Staff from 15 to 19 January 1979, was in the regular performance of their official duties and functions relative to the ongoing construction of the PSAR-I.

The Commission takes official notice of the fact that the finding of the honeycombs in Block 12 of the Reactor Building Concrete Shield by the Regulatory Staff was in the regular course of the aforestated audit and inspection conducted by them.

The Commission finds that the presence of honeycombs on Block 12 of the Reactor Building Concrete Shield could have proceeded from improper implementation of quality control procedures during concrete placement. On the other hand, improper implementation of quality control procedures during concrete placement of Block 12 could also produce internal voids in the block which are not visible to an ocular inspection. The presence of internal voids could in turn affect the structural integrity of the Reactor Building Concrete Shield, thus posing a safety issue that must be immediately resolved before Applicant proceeds with further work on the affected area, since the Reactor Building Concrete Shield is a Category I (safety related) structure which houses the containment vessel and performs a vital safety function in the nuclear power plant.

Wherefore, the foregoing premises considered, in view of the urgent nature of the matter, the Applicant is hereby ordered to desist from grouting the bottom head of the metal containment and pouring concrete thereon, until Applicant submits proofs satisfactory to this Commission that internal voids do not exist

within Block 12 of the Reactor Building Concrete Shield, and if internal voids are present therein, that the presence of such internal voids and the honeycombs taken singly or together will not affect the structural integrity of the Reactor Building Concrete Shield.

Alternatively, if Applicant determines the presence of internal voids in Block 12 and that said internal voids and the honeycombs taken singly or together will adversely affect the structural integrity of the Reactor Building Concrete Shield, Applicant is enjoined to submit plans for corrective actions to be undertaken by it for the Commission's evaluation and approval before actual corrective work is undertaken.

SO ORDERED

12 February 1979, Quezon City, Metro Manila.

LIBRADO E. TAN
Commissioner

/jcv

ANNEXURE "B"

ANNEX "2"

Westinghouse International
Projects Company

10 May 1979 ...
File ... 10.1...

National Power Corporation
Napot Point, Morong
B a t a a n

Exh. 13-B - Bataan IBP cal.

Attention: A. A. Orquia
Site Manager

Subject : Philippine Nuclear Power Plant Unit No. 1
Containment Concrete - Block 12

Gentlemen:

The Block 12 honeycomb was first noted on the PCI Inspector's Report on January 31, 1978. Since that time several inspections of this shallow but extensive honeycomb have taken place. Our Site Q/A, Construction, and Engineering Departments, the Project Engineers and a representative from Bechtel and Roe have also inspected the honeycomb. Your own consultants, EDSCO, inspected the problem area and published their own report.

Opinions and recommendations from all the meetings and reports have been considered and have resulted in the preparation of repair procedure WSRP-001) a copy of which was transmitted to you via WIS/NPC-0256.

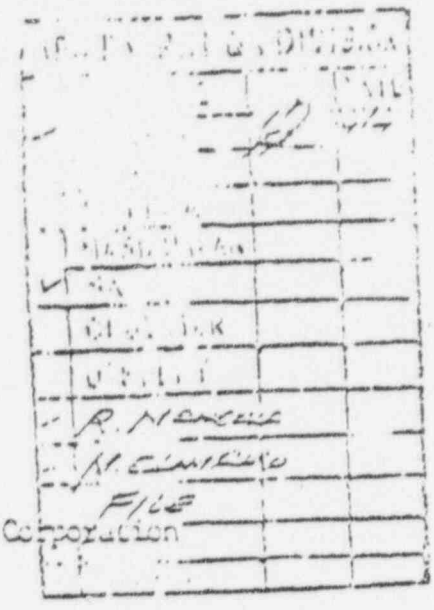
Copies of the chemical analysis of the mortar with concrete and the in-situ concrete tests reports are attached for your information. Project Engineering has reviewed the results of the in-situ core tests and has advised that the results are acceptable and that the concrete is structurally sound. This approval from Project Engineering allows us to continue with the repair and subsequent concrete placement.

There are certain areas within the honeycombed, which will require drypacking before concrete can be placed and these areas have been identified by a joint team from NPC/WIS-PCI.

- next page please -

ANNEX "D" (2)

Westinghouse International
Projects Company



PL-NPC/WIS- 0256
File No. 10.10.05
45.01

06 September 1978

ANNEX "3"

National Power Corporation
Napot Point
Morong, Bataan

Attention: Mr. C. C. Curia
Chief, Quality Assurance Division

Subject : PHILIPPINE NUCLEAR POWER PLANT UNIT NO. 1
Concrete Repair Procedure for block No. 12

Ref. : PL-NPC/WIS-0049

Gentleman:

For your information, attached please find a copy of the subject procedure which we intend to implement in repairing Block No. 12 at the Reactor Building Foundation.

We trust this will be to your satisfaction.

Very truly yours,

C. C. [illegible]
Site Manager

AAV/lrg
Attachment
cc:
W. S. Wilgus
J. R. Weaver
C. R. Smith
A. A. Mevlan

WESTINGHOUSE INTERNATIONAL PROJECTS COMPANY

PHILIPPINE NUCLEAR POWER PLANT PROCEDURE

Number	Rev
Effective Date	AUGUST 15, 1978
Title	CONCRETE REPAIR PROCEDURE FOR BLOCK NO. 12
Page	1 of 4

ANNEX "3-A"

1.0 SCOPE

1.1 This procedure provides a method of repairing honeycombing defects in Block No. 12 of the Reactor Building. It is intended that this procedure be applied where reinforcing steel is exposed and the repair area is extensive. For minor surface defects, the procedure described in Specification PL-SP-0200-3344 shall apply.

2.0 GENERAL

2.1 Documentation of repair giving a description of the area under question, the repair performed and results from inspections of the prepared area shall be made in accordance with Westinghouse Quality Assurance Inspection Form. (See attachment A).

3.0 PROCEDURES

3.1 Preparation of Area

3.1.1 If major repair is required, the WIPCO Quality Assurance Manager shall be informed prior to repair work being started.

3.1.2 All concrete in affected areas shall be removed down to solid concrete attaining a rough surface. Removal of affected concrete shall continue until there is no question that sound concrete has been reached.

3.1.3 Removal of affected concrete must meet the following requirements:

3.1.3.1 A minimum of spalling or feathereding at the perimeter of cut.

3.1.3.2 Vertical sides and horizontal top and bottom at the surface of the concrete.

3.1.3.3 Inside faces generally normal to the formed surface except that the top should slope toward the front at about a 1 to 2 slope.

3.1.4 Removal of concrete shall extend past the edges of the damaged concrete.

3.1.5 Surfaces must be thoroughly cleaned by hydrobrooming.

APPROVED BY:

Site Manager	Site Engineering Manager	Project QA Manager (Site)

3.2 Surface Preparation

3.2.1 Surface preparation shall be in accordance with paragraph 3.1.5. The surface shall be kept wet at least three (3) hours prior to placement.

3.3 Concrete Replacement for Affected Areas

3.3.1 In the affected areas, concrete shall be replaced upon pouring of abutting concrete placement as shown on Drawing No. PL-E-411-070.

4.0 INSPECTION AND TESTING

4.1 All surface preparation shall be inspected to ensure compliance with this procedure. Inspection shall be documented on Westinghouse Site Quality Assurance approved inspection form.

4.1.1 Inspection and testing of concrete shall be performed in conjunction with the inspection and testing of abutting concrete placement.

R E Q U I R E M E N T S								C O M M E N T S
Concrete in affected areas removed down to sound concrete attaining a rough surface.								
Edges of spalling or feather edging at perimeter of repair.								
a) Vertical sides.								
b) Horizontal top and bottom (at surface of repair).								
* Surface thoroughly cleaned by hydroblast.								
* Surface kept wet at least 3 hours prior to placement.								
* Mix design same as original concrete.								
Concrete well thoroughly vibrated.								
Curing Day 1								(Section 09 [illegible])
Day 2								
Day 3								
Day 4								
Day 5								
Day 6								
Day 7								

REQUIREMENTS	H.	S.O	FCI Q.C. SIGNATURE	FCI Q.C. DATE	WIPCO'S SIGNATURE Q.A.	WIPCO'S SIGNATURE CIVIL	WIPCO'S SIGNATURE O&M	COMMENTS
9. Required number of slumps taken (every 50 c/m or fraction.								
0. Compression cylinders cast as required (every 75 c/m or fraction.								
1. Temperature of concrete 20°C or less.								

- WIPCO hold point - WIPCO QA-CIVIL/YARD to be notified at this point for verification.

FORM APPROVED BY WIPCO QA

M. T. CORCORAN
Manager

ANNEX "A"

5

ANNEX "A"

Eth 13-C-Barzan I & P
dwl.

[illegible]

CONTENTS

APPENDIX

FIGURES

[illegible]

A. [illegible]

Photo #1 - [illegible]
Photo #3 - [illegible]
Photo #3 - [illegible]
Photo #4 - [illegible]
Photo #5 - [illegible]

B. Primary surface, wall [illegible]

Photo #6 - [illegible]
Photo #7 - [illegible]

C. Interior surface, mountain [illegible]

Photo #8 - [illegible]
Photo #9 - [illegible]
Photo #10 - [illegible]

[illegible]

1. - [illegible]
2. [illegible]

3 - [illegible]

4 - [illegible]

I - [illegible]

The Concrete Repair Procedure for Item No 12 of Deficiency [illegible] Building was revised to [illegible] the deficient [illegible] the damaged concrete with new concrete and reinforcing steel, to replace with acceptable concrete [illegible] acceptable manner, and to assure that the structural integrity is not impaired.

The report has included details and results of investigations of block [illegible] which included [illegible] core drilling, [illegible] record photos, drawing and [illegible] drawings, and reinforced concrete modification. The report also included discussions on the background, and method of concrete placement with personnel of National Power Corporation and Black Mcdonald Corporation (Attachment 2), and site inspections during February 8 and 9, 1979.

II - [illegible]

The [illegible] of the block walls [illegible] [illegible] [illegible] have been adequate [illegible] and the [illegible] the [illegible] [illegible] have been [illegible]. These observations have been recommended [illegible] and finally [illegible] in "Section IV Discussions".

III - [illegible]

The following modifications to the [illegible] concrete repair procedure are recommended:

1. For removal of deteriorated concrete, [illegible] to obtain [illegible] the [illegible] [illegible] [illegible].
2. The [illegible] chipping [illegible] [illegible] through [illegible], [illegible] [illegible] [illegible] and should be evaluated and [illegible] by the [illegible]. [illegible] [illegible] [illegible] should then be [illegible]

mixed based on acceptable in-situ concrete materials.

b. The Engineer should give direction as to the number, location and depth of exploratory cores to demonstrate the adequacy of in-situ concrete.

c. Test samples obtained through core drilling should be submitted for concrete prior to compressive testing.

d. Repairs should not commence until disposition of test evaluations are completed by the Engineer.

2. For replacing concrete, the procedure should include:

a. Provision for filling cavities which are deep and beyond the range of effective consolidation.

b. Provisions for replacing concrete in areas with congested re-bars. Limit of maximum aggregate size, and concrete slump for proper workability and consolidation of concrete should be designed.

c. Provisions for replacing voids and honeycombed areas which cannot be properly removed due to inaccessibility.

IV - [illegible]

1. [illegible]

Concrete placement of [illegible] the first lift of the Reactor Shield Building cylindrical wall above the base foundation mat (Figures 1- 3). It is 1.07 m in thickness with inside radius 19.150 m, and outside radius of 20.210 to 57.900 m. The concrete volume is approximately 600 m^3 which was placed during January 15 to 17, 1979 as part of 2,200 m^3 of concrete placement together with [illegible] 200 to 300 m^3 estimated permanent fill [illegible] approximately 40 to 60 cm, where a plan will have been [illegible].

[illegible] of the concrete is 210 kg/cm² (equal to 3,000 psi). The maximum aggregate size is one inch. Estimated concrete [illegible] at 2.20 - 2.40 cm, ratio of cement-sand-gravel mixture, water-cement ratio of 0.50 max. for [illegible]

2.4 - 2.29, with overrun of 2.73". All these cube show that the intents and requirements of the concrete specification have been met as far as concrete mixing may be concerned.

The concrete was placed using boom concrete pumps and buckets from platforms located on both sides of the wall near the top, approximate El 97.0m.

In general, there are three layers of vertical, and two layers of horizontal reinforcement for each face of the wall (all H bars, equivalent to #11 bar). The vertical corners located at every 0°- 30' (spaced roughly from 0.11m to 0.100m circumferentially). The distance between the vertical layers radially, for those of exterior face are more closely spaced as compared with those on the interior face. The minimum distance between the inside layer of vertical bars to the wall surface is 0.197m and 0.517m respectively for exterior and interior surfaces. The minimum distance between these two groups of vertical re-bars is 0.641m - the core space which could be utilized as the major concrete consolidation zone. The distance between the first and second layers of vertical reinforcing bars is 0.[illegible] - the secondary consolidation zone. However, in addition to the major reinforcements, the cross bar, (horizontal to be 70 at 0.45m c/c) may add to the difficulty for vibrator penetration, especially at the secondary consolidation zone.

All re-bars are lap spliced which also adds congestion, particularly in areas where additional local reinforcement was required.

At the interior concrete access niche are [illegible] 0.500 x 0.100m deep horizontal keyways located at [illegible] elevations. This again contributes to the keyways [illegible] vertical and also congestion.

2. Wall Inspection

Based on placement conditions described, it appears logical to have found the major and extensive voided and honeycombed areas at the interior face of the wall and not on the exterior face (compare Pictures #1 thru #5 and #6 - #7). The defected areas are estimated to cover approximately 20% of the interior surface. They are almost all located in lower half zone of the wall where proper consolidation requires the most effort. The largest defected area is at the southwest corner, other smaller defective places are randomly distributed in the remaining areas (Figure 4). The voids caused by the entrapment at the keys are extensive (Pictures #4 and #5). The deepest voids are found to extend approximately 6 to 8 in. (0.150 - 0.200m) behind the first layer of vertical reinforcement, or approximately 0.300m from the general concrete surface (Pictures #8 thru #10). No exposure of second layer of vertical re-bars has been found.

3. Extent of Damage

The major consolidation zone is at the middle of the wall. Therefore, when concrete during consolidation would flow outward from the middle. Under such a condition, it is not unreasonable that if no exterior influence, the forces the concrete behind the wall encountered would be with equal surface should be more sound and acceptable. As it has been found that no major honeycombing or defects has been identified on the exterior surface, therefore, it is reasonable to assume the extent of damage should not extend beyond the major consolidation zone of the defected areas. However, this assumption should be confirmed by the results of exploratory core drilling. Four to six locations should be randomly selected near the zones that of defected areas for core drilling to obtain 4 inch diameter cores for a preliminary evaluation. If the findings of the preliminary evaluation lead to an acceptable conclusion, no further core drilling should be made. On the other hand, if an unacceptable conclusion cannot be reached, then additional core samples should be taken for a thorough evaluation. It needn't be done while one the first evaluation

would depend on the results of the testing.

During the meeting held at NRC Region III office on February 7, 1979, ultrasonic method was discussed for detecting the defected concrete. According to Bechtel's experience from field testing in one of our current nuclear projects, the ultrasonic method was found to be inconclusive in identifying the concrete defects such as honeycombs and cracks. Furthermore, the test will not establish the actual in-situ strength. With those considerations, the use of ultrasonic method is not recommended.

4. Concrete Replacement

To replace concrete by placing of existing concrete is structurally acceptable. This part of shield building wall is located well below the base mat concrete of reactor internal structure, and both will act as parts of an integral structure.

ANNEX "5"

REPORT ON COMPRESSIVE STRENGTH
CORE SAMPLES TAKEN AT BLOCK 12
ELEV. [illegible]

CORE SAMPLE # 1

AZIMUTH	:	[illegible]
DIAMETER	:	[illegible]
LENGTH	:	[illegible]
COMPRESSIVE STRENGTH	:	2060 psi
*CORRECTED STRENGTH	:	2020 psi

CORE SAMPLE # 1

AZIMUTH	:	[illegible]
DIAMETER	:	[illegible]
LENGTH	:	[illegible]
COMPRESSIVE STRENGTH	:	[illegible]
*CORRECTED STRENGTH	:	[illegible]

CORE SAMPLE # 2

AZIMUTH	:	[illegible]
DIAMETER	:	[illegible]
LENGTH	:	[illegible]
COMPRESSIVE STRENGTH	:	[illegible]
*CORRECTED STRENGTH	:	[illegible]

CORE SAMPLE # 3

AZIMUTH	:	[illegible]
DIAMETER	:	[illegible]
LENGTH	:	[illegible]
COMPRESSIVE STRENGTH	:	[illegible]
*CORRECTED STRENGTH	:	[illegible]

CORE [illegible] / 4

AZIMUTH	:	111° - 116°
DIAMETER	:	4.175"
LENGTH	:	7.925
COMPRESSIVE STRENGTH	:	4799 psi
*CORRECTED STRENGTH	:	4760 psi

CORE SAMPLE # 5

AZIMUTH	:	142° - 147°
DIAMETER	:	4.20"
LENGTH	:	7.900
COMPRESSIVE STRENGTH	:	3345 psi
*CORRECTED STRENGTH	:	3329 psi

CORE SAMPLE # 6

AZIMUTH	:	206° - 211°
DIAMETER	:	4.175"
LENGTH	:	7.908
COMPRESSIVE STRENGTH	:	4960 psi
*CORRECTED STRENGTH	:	4938 psi

NOTE: Core Sample # 1 was believed to be disturbed during coring and was therefore resubmitted.

* Correction for L/D ratio to 2.0 in accordance to ASTM C-42.

Checked & Reported by:

DANILO C. ROXAS
Test [illegible]

Submitted by:

JOSE NICANDRO
MTL Superintendent

/epr

ANNEX F

REPÚBLIKA NG PILIPINAS
Pambansang Korporasyon Sa Elektrisidad
(NATIONAL POWER CORPORATION)

May 22, 1979

ANNEX "7"

Dr. Zoilo M. Salvaleon
Officer-In-Charge
Philippine Atomic Energy Commission
Diliman, Quezon City

SUBJECT: Repair Procedure for Block No. 12
Reactor Building

Gentlemen:

Transmitted herewith for your evaluation and appropriate action are the following:

1. Test Report on Compressive Strength Core Samples taken at Block 12 Elev. 90.61 - 94.00m.
2. Concrete Repair Procedure #BNPP-01 Rev. 0.
3. PE-TS/NPC-0361 dated 10 May 1979.
4. Telex from Greentree Pittsburgh PA, Re-Block-12 Engineering Evaluation
5. Mr. P. C. Liu Draft Evaluation Report of Concrete Repair for Block No. 12.

Please recommendation re-drypacking be being followed in the repair of Block 12.

Further please be informed that PEPCO and NPC agreed on the following prior to drypacking on Block No. 12:

a) All core samples, holes and dewn pits will be drypacked.
b) Areas where concrete can flow completely around reinforcing steel will not require drypacking.
c) Areas where complete flow of concrete around reinforcing steel is prohibited to be drypacked. Special attention should be given to cavities behind horizontal reinforcing.

In addition WEPCO and NPC are in agreement that WEPCO procedure SMP-01 shall be used for the repair of Block [illegible] 12. All drydocking will be completed in accordance with specification PL-JK00-J01A Paragraph 3.12.

We trust this will satisfy [illegible] concerns regarding Block No. 12.

Very truly yours,

JOHN C. TOALES
[illegible] Manager
Nuclear Power Department

cc: C. C. Garvin
A. A. Urquia
J. G. Jovellanos
J. D. Polintan

Republic of the Philippines
PHILIPPINE ATOMIC ENERGY COMMISSION
Quezon City, Metro Manila

ANNEX "B"

IN THE MATTER OF THE
APPLICATION FOR A CONSTRUCTION
PERMIT FOR THE PHILIPPINE
NUCLEAR POWER PLANT (PNPP-1)

- x -

LICENSING PROCEEDINGS LP 1-77

NATIONAL POWER CORPORATION,
Applicant
x----------x

Ex. 13-E-Bataan NPP dtd.

O R D E R

In a Motion received by this Commission on 23rd of May together with technical documents and reports marked as Annexes "A" to "F", Applicant moves for the lifting and setting aside of the Order dated 12 February 1979 on the ground that:

1. The results of the in-situ concrete tests conducted by Applicant and its Consultants show that the defected concrete wall is structurally sound;

2. Adequate repair procedures for the defected areas have been generated and which will be implemented therefor.

Upon evaluation of said submissions (Annexes "A" to "F"), the Regulatory Staff in its Memorandum dated 29 May 1979 concluded that:

1. The results of the tests for compressive strength conducted on the core samples are within the allowable strength required by ASTM Standards;

2. The Concrete Repair Procedure (Annex "B") is in order and conforms to good engineering practice.

WHEREFORE, premises considered, this COMMISSION hereby approves the Concrete Repair Procedure for the defected concrete wall which nonetheless is found to be structurally sound and consequently sets aside its Order of 12 February 1979.

SO ORDERED.

4 June 1979, Quezon City, Metro Manila

ZOILO M. BARTOLOME
Officer-in-Charge

/jcv

Republic of the Philippines
PHILIPPINE ATOMIC ENERGY COMMISSION
Quezon City, Metro Manila

ANNEX "B-A"

IN THE MATTER OF THE APPLICATION FOR A CONSTRUCTION PERMIT FOR THE PHILIPPINE NUCLEAR POWER PLANT (PNPP-1)

LICENSING PROCEEDINGS NO. 1-77

- x -

NATIONAL POWER CORPORATION,
Applicant
x - - - - - - - - - - - - - - - - x

MOTION TO SET ASIDE ORDER
12 FEBRUARY 1979

Applicant through its Acting Manager, Nuclear Power Department, assisted by the undersigned counsel withdraws its Motion of 19 February 1979 and respectfully moves this Commission to consider this instant motion to set aside its Order of 12 February 1979 for the reasons that:

1. The results of the in-situ concrete tests conducted by Applicant and its Consultants show that the defected concrete wall is structually sound;
2. Adequate repair procedures for the defected areas have been generated and which will be implemented therefor.

In support of the instant motion of Applicant, attached and made integral part hereof are:

a. Annex "A" - Test Report on Compressive Strength Core Samples taken at Block 12 Elev. 93.61-94.00m;
b. Annex "B" - Concrete Repair Procedure - SPP-01 Rev. 0
c. Annex "C" - PL-WIS-NPC-050, dated 10 May 1979;
d. Annex "D" - Telex from Greentree, Pittsburgh, PA, Re-Block - 12 Engineering Evaluation
e. Annex "E" - Evaluation Report on Concrete Repair Procedure for Block No. 11 submitted by Bechtel Overseas Corporation;

f. Annex "F" - Letter of Acting Manager, Nuclear Power Department, NPC, to the Officer-in-Charge, PAEC, dated May 22, 1979.

Wherefore, it is most respectfully moved that the Order of this Commission dated 12 February 1979 be set aside and lifted.

Counsel for Applicant

ATTY. C. C. ALCANTARA

NATIONAL POWER CORPORATION
By:

J. C. TORRES
Acting Manager
Nuclear Power Department