PNPP-1: THE ISSUE OF NUCLEAR RADIATION AND WASTE*

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The Philippine Nuclear Power Plant (PNPP-1) in Bataan is a convergence of some of the most important issues that confront Philippine society today. On one level are the basic economic, social, political and moral questions and on another, are the many scientific and technical matters that directly affect the nuclear power plant. Furthermore, because of the global significance of the anti-nuclear movement, the PNPP-1 question has become an issue of international importance as well.

A rational and comprehensive assessment of the PNPP-1 issue then must address all these questions satisfactorily. Because of the inherently complex nature of nuclear energy and because many of these issues are interdependent, it sometimes becomes difficult to address each question separately on its own merit. Oftentimes, basic knowledge concerning nuclear energy, its benefits and its dangers have been relegated to the background behind the more emotional, though certainly important, political, social and economic issues. And yet it is important that nuclear energy and its associated fields as complex and scientific and technical endeavors should also be addressed.

More specifically, this paper will attempt to address the technical issue of nuclear radiation and nuclear waste of PNPP-1. The health and safety situation of nuclear reactors abroad, which is a debatable issue in itself, is of no consequence to us unless we can guarantee safety for our people.

One often-heard argument favoring nuclear energy is the apparent trend, though this is debatable, of many nations to go nuclear. In answer to this, I pose this analogy: if someone were to ask a group of us to jump into the river, two questions would immediately arise – first, can we handle swimming in the river and second, what is the river like? To apply the analogy to the nuclear issue – first, are we capable of safely handling all the technical and scientific demands of a nuclear power plant and second, do we really know and understand the advantages and disadvantages of running a nuclear power plant in the Philippines? This paper is divided into three main topics: the technical issues regarding nuclear radiation and waste management; the trade-offs between conventional and nuclear energy; and the regulatory role of Philippine Atomic Energy Commission (PAEC).

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THE TECHNICAL ISSUES OF NUCLEAR RADIATION AND WASTE MANAGEMENT

The dangerous and long-lived decay of radioactive nuclei remains one of the main drawbacks of nuclear energy. Radioactivity is a type of nuclear energy released by unstable atoms. There are four important aspects of radioactivity: 1) the type of emission; 2) the energy of the emission; 3) the lifetime of radioactivity; and 4) the chemical behavior of the radioactive element.

1) type of emission. There are three principal types of radioactivity, each with its own properties and dangers. The Alpha particle, which is equivalent to the doubly charged Helium 4 ion, is the most massive form of nuclear radiation. Because it does not travel far in the air, and because of the large amounts of energy that it carries, it is particularly dangerous if it ever finds its way into the body. It can do substantial damage to internal organs and cell material. Radioactive atoms that release Alpha particles are called "internal emitters". Incidentally, scientists study the structure of matter by bombarding them with energetic Alpha particles.

Beta particles, which are identical to electrons, can likewise be destructive to the body, both externally and internally. Gamma radiation is energetic radiation similar to X-rays and should be considered as dangerous as X-rays.

2) energy of emission. Radioactive emissions are released with different amounts of energy. The greater the energy, the more dangerous is the emission. Radiation is classified as "ionizing radiation" meaning that it can destroy chemical matter by breaking chemical bonds. In this way, nuclear radiation can destroy protein material, cell membrane, chromosomes, etc. The effects of nuclear radiation range from death due to severe exposure, to cancer, to genetic mutation. At high levels of exposure, death can result. However, even at low levels of radiation exposure, even below the so-called "safe dose limit", radiation damage to chromosomes can result.

3) lifetime of radioactivity. The lifetime of a radioactive nucleus depends on the rate of disintegration it undergoes. The lifetime, measured in "half-life", ranges from fractions of a second to hundreds of years. The shorter the half-life, the more intense is the radiation. In general, radioactive nuclei with half-lives of around one year to about a hundred years are the most dangerous because these emit nuclear radiation at a sufficiently destructive rate and are present for significant lengths of time.

4) chemical properties of the radioactive elements. Each element has its own set of chemical properties. Depending on its chemical behavior, some elements have very efficient pathways by which they can reach humans. For example, Iodine forms air-borne compounds, as well as water-soluble salts which can then reach humans via the water supply, or through the crops and animals which humans consume. Krypton is a heavy gas which humans can breathe in. Tritium exhibits behavior identical to Hydrogen. It may therefore be found in radioactively contaminated water. Iodine, Krypton and Tritium are only three of the many radioactive elements that are produced.

As a result of these different properties, some elements are more potentially harmful than others because of the ease with which these can reach humans. In connection with this, it is sometimes irresponsibly claimed that because there is a certain amount of natural or background radioactivity present anyway, then the presence of the additional source of man-made radiation will not significantly alter the existing situation. In nature, according to the argument, there is no such thing as "zero level radiation". Such a justification, however, is untenable for three reasons:

1) The elements involved are different and, therefore, one should not simply dismiss their dangers as being the same. Furthermore, the type of radioactivity, i.e., whether it is Alpha, Beta, or Gamma radiation, may be different. Finally, as pointed out earlier, the different elements do have different chemical behavior and therefore, these have different biological effects.

2) Nuclear fission reactors produce many radioactive nuclei which do not occur in significant amounts in nature. For example, a long-lived radioactive element such as Plutonium, which exists in negligible quantities naturally, is a major by-product of the nuclear fission of Uranium. Plutonium produces five radioactive isotopes (Pu 238 to 242), four of which are Alpha emitters. Plutonium can be deposited in the bones and the liver.

3) The quantity and distribution of radioactivity will be altered by the continuous man-made production of these dangerous materials. Such reasoning, that "the man-made nuclear wastes are negligible anyway", is reminiscent of the justification used by many countries with regards to the ecologically harmful chemicals which were once thought to be negligible as well.

Ecological effects tend to be specific to the area concerned. The ecological models in use today are based on temperate conditions and foreign dietary habits. For example, the PNPP-1 was developed based on a certain community of fish, animals and plants which are not found in Bataan. We have insufficient scientific knowledge of the ecology of Bataan. Therefore, if radioactive contamination were to occur, we will be insufficiently prepared to handle it.

The dietary profile is used to assess the pathways of nuclear contamination to humans. For example, many studies follow Iodine via the air-grass-cow's milk pathway to humans. This is obviously not an applicable model for Filipinos. Simply put, we do not know enough about our ecosystem to reach a scientifically valid assessment.

Even if PNPP-1 were to operate at 100% level of safety, nuclear contamination will occur. Nuclear power plants are designed to regularly release gas and evaporate and concentrate liquids, all of which are radioactive. This is part of its normal operations. Thus, the question of nuclear contamination should not refer only to accidents but to the very operation of the nuclear power plant.

The problem of nuclear waste can be divided into two main areas: 1) handling and temporary storage and 2) permanent disposal. Nuclear waste is classified into "high level" and "low level" radiation. The high level waste refers to the highly radioactive spent fuel. This thermally and radioactively hot waste contains the Plutonium by-products as well as many other highly radioactive compounds. The low level waste refers to all the liquids, equipment, discarded machines and clothes that are contaminated with radiation. Each year, PNPP-1 will produce about 20 tons of high level waste. The amount of low level waste produced each year can be expected to be more than 20 tons. Thus, the magnitude of the waste disposal problem is far from trivial and requires the utmost in technical expertise, financial investment and responsible attention.

However, in addition to these problems of handling and temporary storage of nuclear waste, the problem of the permanent disposal of the waste has not yet been solved. This problem can be divided into two parts: 1) finding a safe, permanent, and socially, politically and economically acceptable disposal site. It is unlikely that such a site exists in the Philippines. It is questionable whether other countries will willingly accept our waste. 2) developing a safe, permanent and economically feasible container for the radioactive material. Such a container should be impervious to external agents such as water and corrosive salts, as well as to internal stress such as the continuous barrage of ionizing radiation from the waste itself. In addition, it is scientifically questionable whether it is even possible to keep atoms which are constantly changing identity chemically bound in a stable compound. Scientists have been working on this problem for more than 25 years. All this time they have been only at the brink of a solution. Even as far back as 1959, US Rep. Chet Holifield said that "this is a field where a permanent solution has not been found . . . the problem of permanent disposal of high-level waste has not been solved". The "most promising" process which is vitrification (i.e., the incorporation of the radioactive nuclei into a relatively impervious glass) is still on the brink of success.

We should also include in this discussion the possibility that, after the claimed useful 30-year lifespan of PNPP-1, the contaminated reactor may have to be dismantled or entombed and kept under guard for a few centuries.

The attitude of Gabriel Itchon, chairman of the National Power Corporation (NAPOCOR), that we should just consider this problem when the 30 years are up, is simply not an acceptable answer. Pity our children. Besides, if an accident similar to Three Mile Island should occur at any time before then we would be saddled with a technically difficult, economically disastrous, and socially explosive dilemma.

We must consider all these questions now, before we commit ourselves to a "nuclear future".

THE TRADE-OFFS BETWEEN NUCLEAR AND CONVENTIONAL ENERGY

The PNPP-1 presents us with the choice of using nuclear energy or of staying with conventional power sources. Given the advantages and disadvantages of both nuclear and conventional energy, we must weigh all the factors carefully and decide on the trade-offs.

Even at this late stage of the PNPP-1, it is unwise and unjust to accept its operation as a foregone conclusion. Unwise, because 1) its economic feasibility is in question; 2) its construction and technical features have not been satisfactorily verified; and 3) its safety and waste problems have not been solved. It is unjust because we, who may be harmed by it, and who will most certainly shoulder the financial risk, have not been given the opportunity to study the situation and make the decision. Let us not use the reason that "we've already sunk money into it" as a justification for starting something so important so recklessly. Besides, one should not throw good money after bad. Worse, we should not risk our lives and our children's lives for something so dangerous.

Let us try to consider some of the trade-offs. Nuclear technology is a powerful, sophisticated and dangerous technology in search of use. From the time that the first commercial reactor was put into operation in Pennsylvania in 1957 up to 1980 when 238 reactors were in operation worldwide, one might say that the world has had a taste of what nuclear energy is. True, it has freed nations from the uncertain supplies of crude oil. But then, many of these countries have the ability to build their own reactors and obtain their own nuclear fuel. The advantage for the Philippines is doubtful.

The nuclear industry and the International Atomic Energy Agency (IAEA) often point to the above-average safety record of commercial reactors. They claim that nuclear energy is "cleaner" than conventional power generators. Certainly the pollution and ecological impact of many conventional power-generating plants have been unsatisfactory and definitely many problems have to be solved. The question then boils down to this – which do we prefer, air filled with soot and water polluted with oil, both of which are carcinogenic and unhealthy, or radioactivity in our environment and food? While no massive-scale leaks of nuclear radiation have occurred, it is misleading to compare the pollution that conventional power produces with radioactive pollution. To compare the volume of nuclear waste versus the volume of conventional waste is to make a misleading comparison. Rather, we should also consider the toxicity of these wastes. Since the nuclear industry claims that the total annual nuclear waste per person is only the size of a pill, we should qualify this by saying that this pill would have the toxicity of a cyanide tablet, and even this comparison would not do justice to its actual toxicity. And perhaps herein lies the crux of our fears with nuclear power.

Nuclear radiation is regarded as an invisible poison, and understandably so. It cannot be seen, smelt or touched. In this respect, it is a blessing in disguise that we can sense the presence of "regular" pollution. And yet, how does one guard oneself against an unseen poison unless we are all equipped with detection devices and safety apparatuses? Of course, one can always counter that unseen toxic chemical pollutants are upon us already.

Nevertheless, the present trend of the times is to be more careful and to backtrack and learn from our reckless technological mistakes. Given this mood of the times, many would perceive nuclear pollution as an unacceptable risk.

The long life-times of many radioactive nuclei should make people pause and think about the consequences of nuclear pollution for ourselves many years from now as well as our children and grandchildren. Again this danger is not exclusive to radioactive wastes, but also applies to the many non-biodegradable toxins and pesticides that we have already released.

The fearful prospects of nuclear destruction is directly linked to the spread of nuclear power plants. No doubt, nuclear power is seen as an heir and an accomplice to the initial destructive use and continued threat of nuclear weapons. Indeed the leading promoters of nuclear energy and the leading proponents of nuclear weapons are the same nations – the US, France and Russia.

Herein, we see the first set of trade-offs. Are we prepared to exchange the ill-effects of conventional power plants with the dangers of nuclear radiation, waste, and expanded nuclear weapons? Are the benefits of nuclear energy worth the risks? Are our present conventional sources of energy so inadequate?

THE ROLE OF PAEC AS REGULATORY AGENCY

The PNPP-1 is in the awkward situation of being owned by the government through NAPOCOR; at the same time, being regulated by the government as well, through PAEC. Since the government has committed itself to the PNPP-1, it is not an unprejudiced bystander in this affair. The government stands to lose a lot of political pride.

There are serious doubts that PAEC has been able to adequately monitor and check the various stages of the setting up of PNPP-1. PAEC does not have the clout that it should have over NAPOCOR. Thus the power of PAEC as a regulatory body overseeing PNPP-1 is questionable. PAEC, as it is, is vulnerable to political and economic interests.

The second serious shortcoming of PAEC is its lack of qualified manpower. The IAEA has listed the manpower requirements for various aspects of regulation. According to this list, a regulatory agency like PAEC needs at least 11 personnel with advanced training – at least masters level education plus 8 – 10 years actual experience in nuclear power plants. In addition, about 60 – 90 personnel with BS degrees and specialized training in nuclear power plants are needed. Without this manpower PAEC will not be able to properly regulate NAPOCOR even if it were to be given regulatory powers. Given the present sad state of many NAPOCOR generating stations, it becomes doubly important that PAEC does its job well.

ENDING NOTES

As had been said earlier, PNPP-1 has stirred up a host of inter-related controversies. Given the scientific and technical complexities of nuclear power, why have we not adequately prepared ourselves instead of relying almost exclusively on foreign expertise? In spite of the government's claims of support to Philippine science and technology, its commitment remains questionable.

The economics of nuclear power for the Philippines is highly problematic. The safety, waste management and technical manpower demands of PNPP-1, not to mention the uncertain nuclear fuel costs, will demand a heavy financial outlay. At the cost of about $2.1 billion, PNPP-1 already represents almost 10% of our total foreign debt. As yet, no credible, open and free discussion of this economic issue has been carried out. Most of the analyses have been carried out on the basis of conjecture because either NAPOCOR will not share the data, or the data are not available.

These are only a few of the issues that have been already raised; there will certainly be more questions as we understand the situation better. Given the importance of PNPP-1, we must not leave these questions unanswered.