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# Toward the Whole-hearted Involvement in the Potential of Nuclear Energy:

### Dealing with the danger of just "filch & eat"

In the August 2003 issue of "Atoms in Japan," I began outlining to our overseas readers the real truth behind Japan's continuing to dawdle — more than any country in the world — in its making inquiries into and remedies of the direct and indirect causes of the various "incidents" (breakdowns, accidents, scandals, data cover-ups, data falsification, you name it) that have occurred repeatedly in the domestic nuclear industry over the past decade. I also asked you then to look forward to my essay at the end of the year. However, it turned out that I had to publish this essay in our new year's issue for 2004. Here I would like to take the opportunity of the first year of the second half-century after the beginning of nuclear energy development in Japan to issue my warnings about the future of such development, while remaining faithful to my theme in the August issue and summarizing the past 50 years.

#### We might have deviated from the real meaning of nuclear science, as seen from the history of humankind

Human civilization, from the beginning of the past century, has marched ahead bearing so-called super-scientific "genies" of its own creation in its arms. One of those has reached a stage that can be described as "the final basic science" based on the realities of relative variability of time and space (in the outer space understood by humans — something totally unexpected insofar as previous human cognition was concerned). Based on one of the fruits gained therein, we humans have acquired nuclear science, allowing us to change matter itself through our own skill. Its applications have included nuclear weapons and energy and radiation utilization, based on nuclear fission and nuclear fusion.

This editorial is limited to a discussion of nuclear energy, but I believe that humankind has not clearly demonstrated that it can even properly and fully grapple with the possibilities of nuclear energy. There are two reasons for that, broadly speaking, and they are interconnected in a cause-and-effect fashion. In other words, the utilization of nuclear power generation has — thanks to several instances of godsends — attained a rapid expansion in numerical terms (e.g., some one-sixth of the world's electrical power is now nuclear).

The fact that I used the phrase "godsends" rather than just "good luck" has a deeper meaning. Let us review the historical background accompanying those instances of sheer chance. First, the timing of the "Atoms for Peace" speech of 50 years ago, launching the era of peaceful utilization, corresponded exactly with the beginning of the full-fledged Cold War, i.e., the launch of competition to develop the atomic and hydrogen bombs. After that, the oil crises occurred, hiking the cost of petroleum. When the Chernobyl disaster cast shadows on the industry, the problem of global warming through fossil fuels emerged, making people reevaluate their opinion of nuclear energy to a certain degree.

Dazzled by such relatively problem-free development, the people in the nuclear industry have come to delude themselves that it was all right to engage in its development (i.e., its peaceful utilization) while maintaining the thought processes of the civilization existing before nuclear energy emerged. A symbolic example of that — particularly in Japan — is the way that nuclear interests always welcome the electoral victories of conservative candidates for the national parliament and gubernatorial posts — strange, if you think about it (a deep-rooted phenomenon, in my humble opinion, but beyond the scope of this essay). In that way, it seems that people fail to notice — or have forgotten — that humanity must develop in true coexistence with this "super-science," which also represents a deep challenge to the reform of civilization.

#### How should that reality be viewed?

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With nuclear energy confined within the bounds of pre-existing civilization, a great distortion has occurred in both the development of nuclear energy and peripheral matters. It goes without saying that quite a few "reforms" have taken place within various social systems as a result of handling nuclear energy development. For example, most countries that have developed nuclear power now separate the promotion of that development from safety regulations. Also, Japan and other countries have arranged a third-party damage compensation system for nuclear accidents, and there are systems protecting whistleblowers.

However, nowadays, against the background of economic deregulation worldwide, extensive "reform" is progressing afoot in all the institutions of economy and society — in other words, it is not just the nuclear industry and the surrounding systems that have evolved. As a matter of fact, people engaged in Japan's nuclear industry have gradually realized the need to grapple wholeheartedly with the backwardness of the system that surrounds the industry, having taken notice how that reality has produced numerous scandals, and by extension, mistrust among society.

In this regard, JAIF's Committee on Revitalization of Nuclear Industry requested, in haste, opinions on structural reform from a so-called external committee made up of learned persons outside the nuclear industry, and that committee's conclusions are being incorporated in the broad reforms that are being pursued. However, that fact in itself exposes the limitations of the system, as it simply regards the repair and maintenance of light water reactors (LWRs). However, if those problems are overcome, expectations are high that at least just the country's LWRs will have gotten back and track.

#### Being aware of nuclear energy's potential is a prerequisite

Let me clarify what I mean here by "nuclear energy's potential." I will then contrast my explanation with a couple "comments" based on today's common sense, after which I will respond to them so as to illustrate the problems.

First, there are around 300 isotopic elements in existence on the earth — each of which holds a great potential. In the past 50 years, we have only dealt with one of those: the nuclear fission of uranium. For some reason, the earth's crust contains much uranium, so much so that it cannot be explained through theories of the genesis of the universe or of the earth. The mineable amount of uranium at current prices is 5 million tons. If burned in LWRs using the once-through cycle, that would save the equivalent of 50 billion tons of petroleum. If the nuclear fuel cycle is completed, it would correspond to several trillion tons of petroleum. Uranium is found everywhere, and as a corollary, humans receive natural radiation. But even Japan's annual imports of mineral phosphates, for example, contain some 300 tons of uranium, and that would be extractable if the world uranium price jumped five times (even the phosphate fertilizers sprinkled on fields around the world annually contain some 10,000 tons of uranium). Moreover, some 3 billion tons of uranium exist in the world's oceans (the basic extraction technology for which has been verified). Even if just one-tenth of that were used in LWRs (once-through), that would correspond to 30 trillion tons of petroleum, or a staggering 1.5 quadrillion tons of petroleum if the nuclear fuel cycle is completed. In addition, there is also thorium available, whose reserves are nearly three times that of uranium. In other worlds, nuclear energy, if "properly used," can serve humankind's energy needs for at least the next 10,000 years.

**Comments:** "But for the time being, can't we just stick with once-through LWRs (whose technology has been completed already somehow), and then start thinking about other options once uranium or petroleum prices start to rise? That would be cheaper." "We should think about the nuclear fuel cycle very carefully."

**Response:** "It is not a case of whether the nuclear fuel cycle will be practicable soon in technological or economic terms. The development of nuclear energy cannot be treated on a case-by-case basis" — which, however, seems to be the think-ing especially of the Japanese populace.

Despite the fact that Japan had suffered atomic bombings, the public has actually been supportive of nuclear energy as long as it was being used for peaceful purposes in a "bona fide" manner. The first time that a fatality ever occurred in Japan's nuclear energy development was the JCO criticality accident a few years back, but as far as industrial disasters go, the fatality rate in the industry is extremely low. Nonetheless, the giant backlash expressed by the public toward Japan's nuclear industry after the JCO accident was in response to the frivolous attitude taken by the company and the poor level of safety inspections — in other words, a reaction against the system that tried to assign all the blame to just the company involved. A similar reaction is seen to BSE fatalities: the whole world is up in arms if one person dies of BSE, but nothing much is made of the thousands of deaths yearly due to salmonella poisoning. It is interesting that the reason for the rigid attitude of our society toward nuclear power is somewhat similar to the reason in regard to BSE, but I will address that at another time. No matter how much one bandies about risk theory in the explanation of nuclear safety, the public will never be convinced.

Well then, even seen scientifically, what would happen if we just thought about the present and left troublesome things like the fuel cycle for the future? Humankind would excavate all the uranium worldwide, using it for just one type of energy, after which there would be piles upon piles of waste material: a mixture of high-level radioactive waste (HLW) and plutonium easily convertible to bombs. Let me just point out here that my definition of the nuclear fuel cycle is the repeated recycling of plutonium from reprocessed fuel burnt in LWRs in several cycle, and its use in fast reactors (FRs) once all the minor actinides have been separated and burnt. If that is done, all the excavated uranium would, in the end (depending upon when FRs become commercialized), be turned in waste containing only short-lived FPs (which, incidentally, would be much safer than the natural uranium found in the earth).

That is the ultimate ideal form of the nuclear fuel cycle, and to complete it, several decades of earnest and wellplanned efforts may be required. However, once that is completed, humankind will have fulfilled its responsibility it assumed when it started the utilization of nuclear science. If we leave the pursuit or contemplation of that "ideal" to future generations, persons involved in the nuclear industry will have to endure the backlash of society for having just given "a momentary bit of comfort" to the world in the final years of petroleum-based civilization.

## Where is the group that can engage in this super-long-term challenge?

Is it really possible for today's economy and society (or

those of the near future) to aim for the development of the ideal system of the nuclear fuel cycle (as well as the associated development and commercialization of reactors)? Some people say it can be done "through international cooperation," as if they were praying for divine aid. However, considering the difficulty of the project, as well as the long time and the infinite patience necessary, the time needed to completely master a reactor system, for example, would far exceed the time elapsed between an individual person's graduation and his retirement.

I wonder whether it really possible for any human group to build upon such efforts to carry out the work necessary. Excuse my rough words, but such a group would have to be made up of completely selfless human beings who would work feverishly toward a goal that just might be appreciated in the long-range future. Indeed, such individuals or groups have existed in the past history, and humankind has benefited from their work. However, they have been found mainly in the fields of philosophy and religion. In the fields of science and technology, though, such people, as a group, have virtually been non-existent, or at least as "rare as hen's teeth."

Looking at our current world, we see politicians whose primary concern is to get one more vote, or business executives who are only interested in quick results. And it is not only such "leaders" who think that way — the younger generation is also strongly affected by those trends. While we cannot avoid the current challenges posed by the deregulation of the electricity market, that goal alone will provide no springboard whatsoever to solve the long-term issues I have mentioned here. In the long run, our "group" — composed of everyone from managers to workers in the nuclear field — must be prepared to give an explanation to society how we are grappling seriously with the deeper meaning of nuclear energy, thereby gaining society's trust. That is the only way, and the main way, left to us in the industry.

> Editor in Chief (K. Mari