

## Development of Science and the Human Being: Implications for Japan after Fukushima

By Kenichi Matsui\*

The accident at the Fukushima Daiichi Nuclear Power Plant of the Tokyo Electric Power Company (TEPCO) can be divided into two phases. The first phase is what happened before the occurrence of the power station blackout; the second phase is what happened thereafter.

At the first stage, the plant was immediately shut down and the automated power system worked as expected when the earthquake hit. It proved safe against an earthquake of magnitude 9. However, after the blackout at the power station, as primary water inventory was lost, core degradation occurred through some combination of zirconium oxidation and clad failure. Hydrogen produced from zirconium oxidation was vented from the containment chamber into the reactor building. Hydrogen in the reactor building exploded causing the building to collapse around the containment chamber. A decision was made to inject seawater into the reactor pressure vessel. However it could not stabilize the reactor at a low temperature. In this process, delayed decision making was repeated by TEPCO. Lack of Government leadership and miscommunication with TEPCO made the situation worse which resulted in the worst nuclear power plant accident in the world with the same INES level 7 as the Chernobyl accident.

This accident was induced by a serious natural disaster but what made the situation worse was the human factor: mismanagement by TEPCO and the Government. It was really unlucky for the Japanese people that both TEPCO and the Government were led by people lacking proper leadership at the time of this misfortune.

Judging from what happened in this accident, I will say, it was a unique Japanese accident, which will not happen in other countries.

To understand the background of this accident, we need to look back at the unique historical relation of the electric power companies and the Government. For more than 100 years, many small private electric power companies had operated, but they were nationalized before the Second World War into one State Electric Power Company. This was an unforgettable and bitter experience for them. It created the so called "Allergy to Government Control" for the electric power companies.

After the Second World War, there was much contention as to the structure of the postwar electricity industry. Government wished to keep a single integrated State Electric Power Company and the private electric power companies wanted a regional, monopolized, integrated private system. Finally, the latter idea was chosen with the support of the General Headquarters of the U.S. Army, and the current electricity supply system was introduced. This system worked. However, the Government tried to erode the system and strengthen State control whenever there was a chance. Private power companies tried to keep their independence, avoiding intervention by the Government as much as possible. The weak point of the private electric power companies has been the need for Government approval of the electricity tariff, which assures them of 6% rate of return on investment.

So, private electric power companies follow a policy of cooperating with the Government but still trying to keep as independent as possible.

This policy affected the development of nuclear power plant construction. Both the companies and Government wished to expand construction as much and as quickly as possible. Companies choose a policy of relying on foreign established reactors, especially those of General Electric (GE) and Westinghouse (WH). They trusted these reactors. The Government wanted to develop Japan's own nuclear power plant technology and asked (1) for a financial contribution from the private companies and (2) for them to use the developed technology even if it were more expensive. The electric companies cooperated but they didn't wish success for this effort because they trusted the technology of GE and WH and didn't trust the technology developed in Japan. Also, the success of these efforts, they feared, would strengthen the control and power of the Government over the private electric power companies. When nuclear power plant engineers advised the electric power companies to strengthen the safety of their power plants by changing some parts, companies requested GE or WH's concurrence for the changes and often rejected the advice. And when Japan's own technology showed signs of succeeding, the companies tried to prevent the success.

This policy of the companies resulted in disdain for the engineers and created obstacles to the development of Japan's own technology and ignorance of safety arrangements.

Through the Fukushima accident, we learned the importance of our own

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technology to operate nuclear power plants safely. One can not manage or will have difficulty managing borrowed technology during emergencies.

As mentioned, I think the accident of the Fukushima Nuclear Power Plant is a uniquely Japanese situation and the world will understand it when the investigation reveals precisely what happened. In this sense, this accident is a Japan-specific one and nuclear power plants in the world need not worry about the possible occurrence of this type of accident especially where there is no earthquake or tsunami.

What are the implications of the Fukushima accident for the future of energy in Japan? It is obvious that the anti-nuclear movement is now strengthened and the operation and construction of nuclear power plants face a very severe situation. Renewable energy, specifically solar and wind, is booming in the media. But that is an illusion for Japan.

I believe in the power of science. The 20<sup>th</sup> century was the era of mechanics based on Newtonian physics and the 21<sup>st</sup> century will be the era of technology based on the relativity theory and the quantum theory. That is, nuclear energy, photovoltaic technology and information technology.

We should continue to develop nuclear power plant technology. We know there already exists very safe, pro non-proliferation nuclear power plant technology, like small reactors and thorium reactors, which can be applied to most developed countries where the future growth of electricity demand will be small and also to many developing countries with small electricity demand.

The future of nuclear power plants will not be as simple as in the past, overwhelmed by large scale light water reactors, but will be more diverse in terms of reactor type, size and familiarity. Japan should develop a new dimension of nuclear power plant technology, different from an extrapolation of the past. There will be no other way for a country like Japan to survive, with almost no fossil energy resources and having around 100 million people.

Civilization has been led by science. Those who reject the nature of science will not survive. The nature of science is not a thing to be decided by majority vote. Those who reject nuclear power by majority vote will have to pay some time in some way.

Science and technology have two sides; a very large benefit and a very large destructive power. Human beings have coexisted with the development of science and technology whatever the dangers they pose. Humans made many mistakes. But humans are not stupid. They know where stupidity should be stopped. I don't make any ethical judgment on the development of science. But the difficulty caused by technology has been overcome with more advanced technology in the past and it will be repeated in the future. I believe there is no other way to live.

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