Japan modifies plans for plutonium in wake of protests over shipments

Tokyo. Growing international concern over Japan's plans to ship large amounts of weapons-grade plutonium from Europe has encouraged the head of Japan's most powerful organization for research and development of nuclear power to suggest a new form of nuclear fuel recycling, avoiding the production of pure plutonium that could be diverted to nuclear weapons.

Last week, the president of the Nuclear Fuel Development Corporation (PNC), a semigovernment organization affiliated with the Science and Technology Agency (STA), proposed at a symposium in Tokyo that Japan should consider operating future nuclear power stations on unpurified plutonium, not on pure weapons-grade plutonium derived from reprocessed nuclear fuel (see below). The idea would mark a drastic reorientation of Japan's research and development of nuclear power, but it faces many technical hurdles.

PNC's idea is much more than just a measure to limit proliferation of nuclear weapons. If implemented, it would separate the technology for nuclear fuel recycling from its origins in nuclear weapons.

PNC is probably Japan's richest government-supported research and development organization, receiving about ¥150 billion (US$1.25 billion) a year from STA, or more than a quarter of the agency's total budget and an additional ¥50 billion from Japan's electric utility companies. The money goes for development of new types of nuclear fuel and nuclear power stations, including the prototype fast breeder reactor Monju, which is expected to go critical early next year after having already cost ¥600 billion.

Monju's appetite for plutonium is driving Japan's plans to start shipping tons of plutonium each year from reprocessing plants in France and Britain. But opponents argue that Japan already produces enough plutonium to meet Monju's needs. A Japanese freighter, the *Akatsuki Maru*, is on its way to Cherbourg to pick up the first shipment of over one ton of plutonium derived from spent Japanese nuclear fuel reprocessed in France.

The planned shipment has provoked outcry from South Africa to Malaysia to the tiny Republic of Nauru, a 3-km-wide island in the middle of the Pacific Ocean. All are concerned that the ship might be involved in an accident or hijacking on their doorstep.

Officials in STA's Nuclear Fuel Division, trying to distance themselves from the PNC proposal, say that it is simply an "idea" put forward by the semi-government corporation. A PNC official says that STA is awaiting a debate next year by subcommittees of the Atomic Energy Commission on Japan's next five-year plan for development of nuclear power. But PNC is clearly committed to this drastic reappraisal of Japan's plutonium policy.

PNC's idea would require new technology to use crude plutonium in unpurified form mixed with highly radioactive material that is now removed in the reprocessing of nuclear fuel. Present thinking calls for burning of purified plutonium in yet-to-be developed commercial breeder reactors and advanced conventional reactors fuelled with mixed uranium and plutonium fuel. The unpurified fuel would be a less efficient fuel and would require sophisticated robot technology to handle material much more radioactive than pure plutonium and uranium. But it would reduce the amount of high-level radioactive waste from nuclear power plants and could not easily be diverted into the production of nuclear weapons.

Japanese laws require nuclear power to be used only for peaceful purposes. Under its present constitution and international treaties, Japan cannot divert plutonium into production of nuclear weapons. But in less than 20 years the amount of pure plutonium in Japan, including imports from Europe and domestically produced plutonium, will rise from a few to nearly 100 tons.

Nuclear weapons require the extraction of pure plutonium that, being only weakly radioactive, fits into a light bomb casing. Highly radioactive elements must therefore be removed in the production of plutonium. As a result, the nuclear power industry has not yet tried seriously to develop the technology to handle and manufacture this more radioactive material into fuel.

The PNC proposal is long-term. It has taken Japan 25 years to reach its present level of capability to produce pure plutonium. Development of the proposed new nuclear fuel recycling process would take at least ten to fifteen years and it will not affect facilities already close to operation, such as Monju and the huge Rokkasho nuclear fuel recycling facility under construction in northern Japan. **David Swinbanks**

How to handle hot plutonium

Plutonium is extracted from spent nuclear fuel by dissolving fuel rods in nitric acid. Gases given off are collected or safely disposed of in the environment and the aqueous solution is then chemically treated to remove highly radioactive components. Disposal of this high-level radioactive waste remains a significant problem for governments and the nuclear power industry.

Japan's PNC has proposed that these highly radioactive materials need not be removed if robot technology can be developed to handle the material and form it, first, into pellets and then fuel rods. Once made into rods, the fuel could be used by existing nuclear power plants. The new technology would give these plants a second purpose apart from generating electricity: they would become facilities for the burning and reuse of high-level radioactive waste. **D.S.**

Mail-order notification would replace permits for US field tests

San Francisco. US biotechnology companies will be able to notify the government by mail of field tests of six major crops instead of waiting months for a formal permit under proposed regulations that could be announced this week. The new rules for field tests of genetically engineered organisms would apply to crops modified with specific genes to resist insects or disease or to tolerate stronger doses of certain herbicides.

For months, academics and members of the US Council on Competitiveness, which would prefer even fewer restrictions, have battled with an unusual alliance of environmentalists and the US biotechnology industry, which value continued review, over the contents of the proposed regulations. Earlier this week, the two sides met to settle their differences.

As written by the US Department of Agriculture (USDA), the regulations would exempt from the permit procedure crops and gene modifications already tested under the more than 340 permits issued for nearly 700 US sites over the past five years. Trials of tomatoes, corn, cotton, soybeans, potatoes and tobacco transformed using disarmed *Agrobacterium tumefaciens*, certain virus-coat protein genes, certain virus antisense genes and/or various noncoding regulatory DNA elements, could go forward after a simple notification. All field tests would have to comply with special management techniques, including destruction of the genetically altered plants in the field and moni-

toring the site afterwards.

The proposed rules are expected to keep a close watch on transgenic plants being developed for the production of therapeutic agents and immunologically reactive proteins. In one proposed field test in Oklahoma, for example, alfalfa plants with part of the cholera toxin gene would be tested for their ability to produce large amounts of biologically active peptide or protein used in the development of a vaccine.

Terry Medley, chief of USDA's biotechnology section, says that not enough is known about the interaction of genetically engineered crops with their environment to remove other regulations, but that the proposed changes should both help to allay public fears about the technology and maintain the competitiveness of new exports.

But some academics call Medley a government bureaucrat who is "bullying" the rules through the system to protect his regulatory turf. Suzanne Huttner, director of the Systemwide Biotechnology Program at the University of California, says the changes do not go far enough and that researchers working on the six crops should be permitted to notify US agriculture officials the day they plant. She would also like to exempt researchers from the need for a permit on new plants or other organisms not previously identified as plant pests.

In a letter to the White House Council on Competitiveness, Huttner and other university researchers asked for the removal of all special rules for biotechnology field tests. Huttner says that USDA rules add to the cost of research and to public fears of the technology by focusing on the process of genetic engineering. The proposal "definitely sells out basic research", Huttner says. "It guarantees that these products will sit on laboratory shelves and never see the light of day."

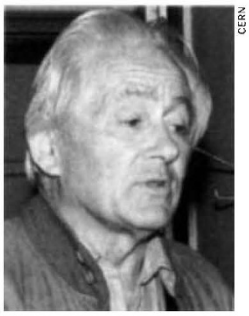
But environmentalists and industry, usually on opposite sides of regulatory questions, have joined to support the USDA proposal. The Industrial Biotechnology Association believes that continued federal review will help it to win public acceptance and stave off more restrictive state actions. North Carolina, Minnesota and West Virginia, for example, have enacted their own rules covering environmental release of genetically engineered organisms. "We believe [the USDA proposal] is a sound step and scientifically justified," says Alan Goldhammer, director of technical affairs for the US trade group. US companies should be able to notify USDA for most of their field tests, he predicts.

At the same time, environmental groups are now concerned that USDA may abandon its cautious approach to regulating genetically engineered plants and choose same-day notification, which would prevent environmentalists or states from commenting on field tests before they begin or replace a detailed list of exemptions with a broader rule. **Sally Lehrman**

Nobel Prizes go to Caltech chemist, CERN physicist

Physics prize

London. This year's Nobel Prize in physics has been awarded to a man whose inventions have formed the basis of high-energy particle detection for the past twenty years. Georges Charpak, 68, who has spent most of his career at CERN, the European Laboratory for Particle Physics, is cited in particular for the invention, in 1968, of the multiwire proportional chamber — a device whose descendants are active in most high-energy physics experiments operating today.


CERN

Georges Charpak

From the earliest days of nuclear physics, the identification and study of subatomic particles has relied on ways of making visible the trail of ionization created by an energetic particle as it travels through matter. Wilson's cloud chamber, Powell's high-quality photographic emulsions and Glaser's bubble chamber — all Nobel-prize-winning inventions — revealed a host of new particles from cosmic rays and accelerators, starting with the discovery of the positron in 1932.

But as physicists started to look for rarer particles, they needed an automated way to find exotic tracks among millions of more common events. They also needed speed: at only about one 'snapshot' per second, the bubble chamber could not keep up with increasingly intense accelerator beams.

Charpak's contribution was to see how to combine high spatial resolution with the speed and output offered by existing electronic detection methods. He returned to a device that had been used as early as 1908 by Rutherford and Geiger: the proportional counter, a gas-filled tube with a thin, high-voltage wire at its centre. The passage of an energetic particle ionizes the gas, triggering a pulse of electrons onto the wire. Charpak realized that an array of such wires, spaced 1-2 millimetres apart in a gas-filled chamber, would act as independent sensors and could thus be used to track a particle's path. The electrical pulses could be sent directly to a computer, with a detection rate as high as a million particles per second per wire.

In their 1968 paper, Charpak *et al.* also proposed an important refinement of the technique: measurement of the 'drift' time between the initial ionization of the gas and the arrival of the electron pulse at the wire, to provide even better spatial resolution. But Charpak has lately turned away from particle physics to apply his detectors to biology and medicine. His spherical drift chamber is a highly efficient detector for the X-ray determination of protein structures, and his imaging proportional chambers bring far greater sensitivity than photographic film to the autoradiography of biological samples. **Laura Garwin**

Chemistry prize

Pasadena. A theoretical chemist at the California Institute of Technology has won the 1992 Nobel Prize in chemistry for his contributions to the theory of electron-transfer reactions. Rudolph Marcus, 69, received the prize for a series of papers, published between 1956 and 1965, that explained puzzling variations in reaction rates in redox processes and made counter-intuitive predictions not verified experimentally until the 1980s.

One of Marcus's first contributions was to elucidate the role of surrounding solvent molecules in determining the rate of redox reactions — reactions that are fundamental in energy storage, transport and conversion. Marcus further determined that the relationship between the driving force of an electron-transfer reaction and the reaction's rate is described by a parabola. This implies that as more driving force is applied to a reaction, its rate at first increases but then begins to decrease in the so-called inverted region. Chemists greeted this surprising insight with considerable scepticism until its experimental verification in 1985.


CalTech

Rudolph Marcus

Although the royal Swedish Academy of Sciences cited only Marcus's electron transfer work, he has made contributions in several other areas. For example, his name is the M in RRKM theory (the others are Rice, Ramsperger and Kassel), an attempt to explain unimolecular reactions that has found wide application in chemical physics. He has also done important work in transition-state theory and in the theory of collisions and bound states. Marcus has continued his research in electron transfer, more recently turning his attention from simple reactions to reactions in complex molecules such as the proteins involved in photosynthesis. **Robert Finn**