# KAMEDO Report No. 78 Nuclear Accident in Japan, 1999

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## Abstract
A break in safety locks resulted in the release of high quantities of gamma and neutron radiation directly exposed three workers and indirectly exposed as many as 310,000 other persons. The two persons who received the highest doses ultimatley succumbed due to the latent effects of the radiation on the skin and mucous membranes. Improved protection of workers and responders as well as dosimeters are needed in areas where such events may occur. Careful attention must be paid to providing accurate information to the media and to the provision of competent psychosocial support.

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## Summary
On 30 September 1999, an accident involving nuclear technology occurred at a nuclear fuel plant at the JCO Company LTD in Tokaimura, Japan, about 120 km northeast of Tokyo. The accident, which took place during the production of enriched uranium, drew great international attention, and was followed closely by the mass media. Apart from the problems involving rescue and illness directly caused by the nuclear technology, misinformation provided to the public by the mass media also created problems.

The accident occurred when two workers poured a highly-enriched uranyl nitrate solution from a vat directly into a precipitation vessel containing a highly-enriched solution, which contradicted the defined safety provisions. A critical situation involving a nuclear fission reaction arose in the precipitation vessel. Gamma and neutron radiation were released, and the two workers were exposed to high doses of radiation. A third worker in a nearby room also was exposed.

All three workers first were transported to the local hospital, where they received first aid. At the hospital, it was difficult to determine what kind of accident had occurred and what doses of radiation to which they had been exposed.

The injured workers soon were transferred to the National Institute of Radiological Sciences (NIRS) Hospital in Chiba. After complicated physical and biological measurements of radiation doses released, it was possible to estimate the absorbed radiation doses for each of the patients. The measurement for Patient A was 24.5 Gy, for Patient B, 8.3 Gy, and for Patient C was

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3.9 Gy. The injured received advanced, multidisciplinary intensive medical care, which included the latest international treatment principles within the respective specialist area.

Workers A and B who were exposed to the higher radiation doses rapidly experienced nausea and vomited. Soon, they showed signs of effects on their blood and blood-forming organs, which possibly could have been treated with bone-marrow transplants. However, it was not possible to successfully treat the later complications from the exposure that involved the skin and mucous membranes of the stomach-intestinal tract and the airways. After long-term, intensive care, they both died of heart and lung failure.

Aside from the three workers directly involved, 229 people within the factory area, emergency and nursing personnel, and technical personnel were exposed to measurable radiation doses (0.07–48 mSv). The 207 people that lived within a radius of 350 meters of the factory also were exposed to lower radiation doses (0.01–21 mSv). The accident led to immediate consequences for the population in the community of Tokaimura. The local authorities evacuated the area within a radius of 350 meters of the factory. The regional authorities at the county level recommended that the population within a radius of 10 kilometers stay indoors. Schools and shops also were closed within this area. Approximately 310,000 people were affected by the accident. It took an entire day after the accident to stop the so-called critical reaction so that the production of the radiation was halted.

The accident in Tokaimura also received much international attention. In the flow of information, there were some misunderstandings, which are illustrated in an early press release from the National Institute of Radiation Protection. For example, there were some reports that there had been a major radioactive leak from a nuclear reactor of the type that occurred at the Chernobyl nuclear power plant in the former USSR. This underlines the importance of releasing and promulgating accurate and adequate information.

## Conclusions

1. Dosimeters should be located in risk areas in case of radiation accidents.
2. It is absolutely vital to have well-developed and rehearsed emergency plans for radiation accidents.
3. Personnel from companies handling radioactive materials should be provided with protective clothing in order to be able to provide first aid and to accompany any person damaged by radiation to a hospital. Thus, these personnel also may provide essential information about the accident and the possible doses of absorbed radiation.
4. First responders to such incidents should have special training and protective clothing.
5. For treatment and prognosis, it is important that the radiation dose absorbed can be estimated at an early stage. This requires complex laboratory technology, which should be available at selected hospitals in which continued treatment also can be provided.
6. Early signs that one has been exposed to a high dose of radiation are: loss of consciousness, feeling ill, vomiting, and diarrhea.
7. A high dose of radiation affects most organ systems. Some of these, such as changes in the blood morphology can be treated. Despite advanced treatment methods, changes in skin cells and mucous membranes, which currently occur later, cannot be treated effectively following exposure.
8. The slightest suspicion that someone has been exposed to radiation should result in calculation of the possible radiation dose absorbed and continued observation at the hospital.
9. The psychological effects on people affected by radiation and on the population living in the vicinity of a radioactive leak is great. Therefore, it is important that psychosocial care be provided at an early stage.
10. In the case of accidents involving radioactive material, it is extremely important that the public receives as accurate information as possible, via the mass media. Those who provide the information should have specialized knowledge within the field of radiation.

*A note on Gy:*
*When ionizing radiation interacts with the human body, it gives its energy to the body tissues. The amount of energy absorbed per unit weight of the organ or tissue is called absorbed dose and is expressed in units of gray (Gy). One gray dose is equivalent to one joule radiation energy absorbed per kilogram of organ or tissue weight. Rad is the old and still used unit of absorbed dose. One gray is equivalent to 100 rads. 1 Gy = 100 rads.*