

# Plutonium Investigation

Updated on 18 October 1999

## CRITICALITY ACCIDENT AT URANIUM CONVERSION FACILITY AT TOKAI-MURA, JAPAN

WISE-Paris, last modified on 18 October 1999 at 18h00

*Note: The following information has been assembled by WISE-Paris on the basis of a variety of sources. Wherever possible, we checked the information with local and scientific sources. However, much of the information still needs further confirmation. We would like to stress the particularly valuable and rapid information supplied by Dr. Komei Hosokawa of the Saga University by e-mail over the last days. Much of the following text is based on his input and some is taken directly from his "MagPieNews".*

Here is an appropriate forward stemming from the opening remarks of Mr. Philippe Savelli, OECD Nuclear Energy Agency'S (NEA) Deputy Director for Science, Computing and Development of an NEA sponsored International conference on criticality risks in nuclear installations, held on 20 September 1999, just 10 days before the Tokai-mura accident:

*"If nuclear energy is to play an important role in our economies in the future, then the fissile materials must be handled safely over the whole nuclear fuel cycle. Several fuel cycle options exist, and their advantages and disadvantages are being keenly debated at the technical, economical, political and public levels. (...) The objective is to pursue an accident-free goal, while keeping in mind the repercussions that a criticality excursion could have."*

### THE CHRONOLOGY

*Note: The Chronology on the Tokai elements will be frequently updated. The full text will be each time modified and extended (available also in pdf format). For readers who have already seen the full text, the Updates hereunder allow to quickly identify the principal changes to earlier versions.*

NOTE: time is given in 0h00 to 24h00 format in local Tokai time, unless otherwise stated; the hours given in ( ) in the format 0:00 indicate the time from the trigger point of the accident

30 September 1999

At around 10h35, a severe accident was initiated at JCO's uranium conversion facility at Tokai-mura, about 130 km north-east of Tokyo. JCO (apparently the name of the company is JCO, Inc., formerly known as the Japan Atomic Fuel Conversion Company, JCO not being an acronym, but the name itself) is a subsidiary of Sumitomo Metallic Mining Company one of major economic giants in Japan. JCO is one of the two only companies, along with Mitsubishi Nuclear Fuel Co., Ltd., to produce nuclear fuel in Japan. Mitsubishi specializes in fuel for pressurized water reactors, while JCO manufactures fuels for light water reactors and fast breeder reactors since 1980. According to Japan Atomic Industrial Forum, the JCO's Tokai

works plant is able to process 715 ton uranium for light-water reactor fuel , and three tons of uranium for FBR fuel. The conversion of fuel for Joyo was the first operation of that kind in three years and only began on September 22. JCO employs 154 persons

It appears that 16 kg instead of a maximum 2.4 kg of uranium, enriched by 18.8% of the fissile uranium isotope U-235, had been introduced into a precipitation tank. This led to a critical mass and an uncontrolled chain reaction. One possibility of why the JCO workers have mistaken the amount of uranium was that they might have used a check sheet for light water reactor fuel when actually handling fast breeder reactor fuel material. As the daily Asahi Shimbun reported, based on information by an inside source, the production process had been hastened by the employess under pressure by the plant management.

Light-water reactors, boiling or pressurized water reactors, utilize low-enriched uranium, i.e. 3 to 5% of fissile U-235 and in this case the criticality control mass could be of around 16kg. JCO officials later stated that, for unknown reasons, the operators had introduced the material manually rather than using the mechanical system which would have controlled the concentration of U-235. However, other sources indicate that the nuclear safety authority has never reviewed the facility from the viewpoint of criticality safety before it delivered the license to JCO. It has been suggested that the handbooks have been incomplete and that the company did not prepare for criticality accidents at all.

The uranium was added to a solution. It is still unclear in what form the uranium was added and what the exact solution was. It seems clear that the presence of water is explained by a cooling mode in the outer shell of the two wall cylindrical precipitation tank. Between the walls, water is circulating to remove chemical reaction heat.

Contradictory indications were given as to the nature of the solution and the chemical process. Probably uranium oxide (reconverted U<sub>3</sub>O<sub>8</sub>) was dissolved in nitric acid in order to make uranyl nitrate. Further processing into UO<sub>2</sub> is then necessary before sintering into fuel pellets. The facility produces uranyl nitrate for the experimental fast breeder reactor Joyo, which can use uranium fuels as well as mixed oxide plutonium-uranium (MOX) fuels. The uranium fuel facility is said to have a capacity of two to three tons of uranium fuel per year.

The exact events which led to the desaster are still unclear. We have screened many different accident accounts. None of them seem to make sense from A to Z. We prefer to wait for further confirmation before indicating any details.

However, the following points seem to be conclusive:

1. the accident took place in a precipitation tank;
2. the operator action involved manual introduction of uranium;
3. the operators were under stress by plant management to speed up the process;
4. the operators were not or insufficiently trained and were working outside internal and regulatory manuals;
5. the licensing procedure of the installation did not require the qualification against criticality accidents and there was no procedure for the event of a criticality accident;

there was no neutron counter at the installation; it has been brought in from another part of the facility; its presence could have greatly accellerated the identification of a criticality accident and therefore the protection of workers and the public.

The situation was basically that of a small nuclear reactor, the water reflecting the neutrons and thus acting as moderator increasing the chain reaction. The difference with a reactor is that the reaction at Tokai was uncontrolled and that neither the fuel

was contained in any cladding (as a first barrier) or in an appropriate tank (second barrier) nor was the building (third barrier) suited to contain the effects of fissile material going critical. In particular the emission of radioactive gases could not be contained in this facility.

At least two of the three operators have been exposed to lethal doses of radiation. The doses, re-evaluated on the basis of blood analysis, received by the three men exposed to the highest levels were respectively 17 Sv (age 35), 10 Sv (age 39), 3 Sv (age 54). The doses are equivalent or even worse than that of the ground zero at Nagasaki or Hiroshima. Various medical teams are working hard to save their lives. Three ambulance staff members who rescued the three workers also received high doses. The dose calculations are based on sodium-24 concentrations, not only in the blood but also in the vomit of all three men. The 35-year man was transferred to the Tokyo University Hospital, arriving there at 16h30 on Saturday, 2 October 1999. Doctors were preparing for either umbilical cord blood or haematogenous tissues transplantation, rather than bone marrow transplantation.

In addition, 18 workers who carried out the work outside the facility to destroy the cooling water pipes leading to the precipitation tank - operation carried out in order to get the water out which functioned as moderator during the accident - received doses estimated between 20 mSv and 103 mSv, most of them in 2 to 3 minutes only. Some of the workers also went inside to put neutron absorbing boron water into the tank. The legal limit for workers in Japan is 50 mSv per year. In case of emergency, the limit is exceptionally 100 mSv for a single operation.

Six workers who worked on the cooling circuit of the accidented tank have received neutron+gamma radiation beyond the 100 mSv emergency limit prescribed by IAEA. NSC decided to take that measure "beyond the law". Workers should operate under an special limit of 200 mSv, said one member of the NSC.

In total the number of exposed workers rises with the accident management teams working on site to 55 people (as of 2 October 1999), including 39 JCO staff members and subcontractors, the 3 ambulance staffers and 7 construction workers who were involved in renovation work in the commercial golf course directly adjacent to the JCO plant.

At 11h15 (40 minutes after the start of the event, time laps after accident start indicated in the format +0:40) on 30 September 1999, JCO mentioned the possibility of a criticality accident in its first notification of the event to the Science and Technology Agency (STA).

At 11h33 on 30 September 1999 (+0:58), JCO informed Tokaimura's municipality of an accident that occurred in their facility.

At 12h19 (+1:44) on 30 September 1999, JCO in its 3rd notification requested the evacuation of the general public around the plant. The city of Tokaimura established an "anti-disaster" head-quarter.

At 12h30 on 30 September 1999 (+1:55), the head of the Prime Minister's office receives the first report on the accident. It takes almost one hour before he takes action. In the same time, Tokai's officials broadcast informations about the accident via the local radios and ask people to stay indoor.

At 12h41 on 30 September 1999 (+2:06), the police circumvent a 200 m radius area and stop all traffic in it.

In between, the Chemical Warfare Unit (which belongs to Ground Self-Defense Forces) stationed at Omiya, Saitama prefecture, is mobilized and sent to Tokaimura. "However, the unit is unable to cope with this kind of nuclear accident", would have said the Chief Cabinet Hiromu Nonaka, according to Yomiuri Shimbun. At 13h35 on 30 September 1999 (+3:00), Tokai-mura ceased to take water from Kuji river.

At 13h50 on 30 September 1999 (+3:15), the industry directorate of Tokaimura township has increased the rate of intake from Naka river from 1.440 m<sup>3</sup> à 7.560 m<sup>3</sup> per day.

At 14h50 on 30 September 1999 (+4:15, Naka-machi township ceased to take water from Kuji river, while waiting for results of sampling.

At 15h00 on 30 September 1999 (+4:25), Tokaimura municipality issues an evacuation request area for the resident in the the area inside the 350 m radius of the plant.

At 15h30 on 30 September 1999 (+4:55), the actual order to evacuate was issued to about 150 residents from 50 households in a 350 meter radius around the plant (actually not really in a circle but rather the supposed downwinders). They were brought with 9 bus to the 1,5 km near-by Funaishikawa Community Center. The radiation level was at 0.84 mSv/h at the site boundary.

At 16h00 on 30 September (+5:25), building of a Government emergency response headquarter while STA and JAERI (Japan Atomic Energy Research Institute) experts staffs are on the site and start their measurements. Traces of cesium-138 are detected from the ground inside the complex of the JAERI, located next to the accident site.

At 17h00, on 30 September 1999 (+6:25), radiation counts on the edge of the Tokai plant premises was around 4mSv/h level.

At 17h45 on 30 September (+7:10): first meeting of the Government emergency response headquarter

At 18h00 on 30 September (+7:25), the industry directorate of Tokaimura township has increased the rate of intake from Naka river from 1.500 m<sup>3</sup> to 4.800 m<sup>3</sup> per day.

At 18h30, on 30 September 1999 (+7:55), the neutron dose rate is said to have been at 4.5 mSv above the site in the air.

At 22h30 on 30 September 1999 (+11:55), the first announcement (by what means?) is made to the 310.000 residents of a 10 km zone to stay home or confined where they are.

At 2h00 on 1 October 1999 (+15:25) radiation levels went slightly down to 3.3mSv/h. STA experts estimate that the uncontrolled criticality still continues, or at least it is being repeated intermittently.

Chief Cabinet Secretary, Mr Nonaka, said that we are faced with an unprecedented crisis of the nation. The government was considering seeking help from the U.S. military in the country to help cope with the situation Prime Minister, Mr Obuchi, decided to postpone the reshuffling of his Cabinet that had been proposed for the same day 1 October 1999.

According to Reuters, "*as of late Thursday night [30 September - 1 October 1999], 3.1 millisievert of neutrons per hour, or about 15,000 times the normal level of radiation, was detected two kilometers (1.2 miles) from the accident site,*" an Ibaraki Prefecture official told Reuters.

At 2h58 on 1 October 1999 (+16:23), according to STA (the Science and Technology Agency), department responsible for nuclear power within the Ministry for Industry and Trade (MITI), JCO staff started the work to extract cooling water from the outer shell of the tank in which the criticality is suspected to take place. The water reflects neutrons inwards, helping the chain reaction to be maintained. Due to high levels of radiation, workers had to take 3-minute turns in order to try to operate the valves.

At 3h30 on 1 October 1999 (+16:55), in a press conference, the Ibaraki Prefecture advised the over 310,000 residents of a 10 km radius around the Tokai plant including Tokai Village (Tokai-mura) districts and parts of Mito City, Hitachi City, Hitachi-Ohta City, Hitachi-Naka City, Naka Town, Urigura Town, Ohmiya Town and Kana, as follows:

- Stay indoors. Shut all the windows and switch ventilation off.
- In case of travelling in cars for unavoidable circumstances, keep all the windows of the car shut and avoid using the ventilation fan.
- Tap water is safe, because the source of water supply has been changed.
- Do not drink well water or rain water.
- People who had voluntarily took refuge to any downwind refuge point are advised to take further refuge, leaving the downwind area.

According to Reuters, "*Tokaimura, with a population of 34,000 with 15 nuclear facilities, into an eery ghost town where police in white protective suits roamed the streets.*"

A case of external contamination was detected among the evacuees.

Local governments are preparing to distribute iodine tablets.

The Self Defence Forces (SDF, i.e. the Japanese Army) is being mobilized to control traffic and public order. SDF's Chemical Protection Unit has also been called to stand by at Katsuta SDF Base.

At 5h40 on 1 October 1999 (+19:05) in a press conference, the Science and Technology Agency (STA), admitted there was a possibility of expanding the evacuation area (350m radius at the moment) if the situation did not improve.

STA said that the radiation monitored at the JCO site had reached 18mSv/h (neutron) and 20mSv/h (gamma), roughly five times the level measured 12 hours earlier at the site boundary.

STA also revealed that the valve work on the tank to extract cooling water failed and they coolant pipes had to be destroyed to take the water out. 18 workers were involved in the operation which lasted for three hours.

At 7h00, on 1 October 1999 (+20:25), STA declared that the criticality no longer continued. Boron water had been injected into the tank (how?), successfully slowing down the chain reactions. Neutron monitors on site now indicate a rapid decrease of radiation levels.

At about the same time Japanese authorities forwarded information to the International Atomic Energy Agency (IAEA) in Vienna. On the basis of that information the IAEA stated that "*it is known that it [the accident] occurred when workers were transporting a mixture of liquid nitric acid containing 19% enriched uranium to a precipitation container*". No other source speaks of the "transporting a mixture". All other sources suggest that the chain reaction started inside the precipitation tank. The

IAEA also states in a press release: "*At its highest point, the dose rate at the facility boundary was measured to be around 4 millisievert/hour. As of 4a.m local time, the measured dose rate was decreasing,*" This is also in contradiction with the declarations of the STA officials at the 6h00 press conference in Japan.

At 9h00, on 1 October 1999 (+22:25), JCO officials declared that the workers had handled the uranium nitrate solution "*in a manner that was incompatible with safety regulations*".

## **OTHER MEASURES AS OF EARLY 1 OCTOBER 1999**

All 135 schools within the 10 km-radius area stayed closed for the day.

All the roads within 1km radius around the JCO plant have been closed. No traffic except emergency vehicles is allowed there.

Japan Railways (JR) is suspending all the train service between Mito and Hitachi stations. Ibaraki Traffics (Ibaraki Kohtsuh), the dominant bus company in the region, has decided to suspend all the services in the 10 km area.

Japan Highway Services has closed the Mito/Hitachiminami-Ohta section of the Joban Highway, which connects Tokyo and the Tokai region.

The Prefecture is advising farmers in the Tokai-Naka region not to harvest until safety of the land is confirmed. Rice harvest in the region has almost been finished, and it is the sweet potato harvest time now.

All the Hitachi factories in the Tokai-Mito area decided to suspend their operations, with 8,700 workers laid off.

Tokai Village, with a population of around 34,000 people, suspended taking drinking water from Kuji River for fear of radioactive contamination. The water is now supplied from Naka River, which is further away and is therefore unlikely to be contaminated.

All the 50 post offices in the area are closed for the day. Major courier services, such as Kuroneko Yamato and others, suspend their services at least for the day.

The Marine Safety Agency's Region-3 headquarter in Yokohama issued a warning to the vessels entering the waters of Tokai coast.

MITI's Resource and Energy Agency established an emergency office to deal with the Tokai accident and sent 14 expert staff members to the site.

The Ministry of Agriculture, Forestry and Fishery also set up their emergency office in order to investigate radioactive contamination of food products.

The Fishery Federations of Ibaraki, which is the umbrella body of fishery unions in the Prefecture, issued a temporary ban on coastal fishing activities for an unspecified period. They had a head-of-unions meeting on 2 October 1999 to consider further measures.

The Minister of Foreign Affairs, Mr Kohmura, requested USA and Russia to send an expert team to Japan in order to help domestic staff deal with the situation and investigate into the cause of the accident. US secretary of Department of Energy (DOE), who was happened to be in Moscow, replied that they were willing to prepare.

Prefectural Police now has a 3,000-membered emergency response group to control the state of affairs.

Tokai Village and Naka Town agricultural cooperatives called back the agricultural products which they had shipped to Tsukiji (the Tokyo Central Food Market). In total 8.7 t of products harvested in the 10 km-radius area were retrieved from the Tokyo central market. Those were sweet potatoes, spinach, leeks and others. Ibaraki branch of JAC (Japan Agricultural Cooperative) decided not to remove the ban on new harvest in the area.

Fukui Prefecture (in west Japan), which has 15 reactors in their jurisdiction, decided to send their administrative staff equipped with monitoring devices to Tokai in order to carry out an independent investigation.

The Self Defence Forces have their special decontamination unit vehicle standing by at the Mito Red Cross Hospital.

More than 4,500 people visited hospitals in Ibaraki Prefecture for radiological screening and physical check up. Although no ascertained case of contamination has been detected, a mood of panic dominates.

There were several ascertained cases of contamination among the 350m-radius refugees. They claim no health abnormalities, however. Medical check-up is going on.

#### **PARTIAL LIFTING OF MEASURES AND FURTHER MEASURES DURING THE DAY OF 1 OCTOBER 1999**

At 8h00, on 1 October 1999 (+21:25), the closure of the Joban Highway, which runs very close to the accident site, was lifted. Later during the day the rail links were reopened to the public.

At 15h00, on 1 October 1999 (+28:25), the sheltering order for the general public residing within the 10km radius of the plant site was lifted by the Chief Cabinet Secretary, Mr Nonaka, representing the Government's emergency response headquarter, on the recommendation of the advice of the Nuclear Safety Commission (NSC) who scrutinized the updated radiation monitoring results.

The two victims in critical conditions at the National Institute of Radiological Sciences in Chiba City, east of Tokyo are now suffering from further decrease of lymphocytes --- less than 1% (the normal level is around 40%), rendering an extreme vulnerability to fatal infections. An edema of the lungs is also likely in one of the patients. It is now apparent that they suffer mainly from external exposure to high neutron and gamma radiation, rather than internal exposure. Principal treatments tried so far include various drip infusions, steroid medication, and dosage of a uranium antidote. Radiological doctors are now considering bone marrow transplantation in a slight hope of saving their lives.

Red Cross Japan has decided to send experts of the Nagasaki Atomic Bomb Hospital to Tokai to assist medical staff there. The team consists of doctors, a radiologist, and specialized nurses. The Nagasaki A-Bomb Hospital has long-standing experience in treating radiation-exposed hibakusha patients.

Schools were notified later in the day they could open as usual on Saturday.

Military vehicles deployed in case of a possible mass evacuation were taken off standby and sent home.

Officials said it was safe to drink tap water but warned against drinking water from local wells which was being tested for possible contamination, a process which would take days. At 22h00, on 1 October 1999 (+35:25), the evacuation measure within the 350m radius area is not yet lifted.

### **SITUTATION AS OF 2 OCTOBER 1999**

Schools in the 10km zone resumed in the morning. Some schools are conducting physical check-up of the children instead of normal class.

All the traffic, including bus and train services, is back to normal.

At 11h00, on 2 October 1999 (+48:25), the advisory expert meeting of the Nuclear Safety Commission started at the STA office in Tokyo, in order to decide whether to end the evacuation around Tokai or not.

At 13h15, on 2 October 1999 (+50:40)the closed meeting was continuing. Reportedly there were differences of opinion amongst the NSC experts as to the assessment of the danger. There is a possibility of contamination with radioactive fallout in the area. All the houses and buildings might have to be checked for radiation before the residents could return home.

At 18h30 on 2 October 1999 (+55:55), the Japanese government issued a "Safety Declaration" stating that there would be no contamination in the 350 m radius zone and lifted the evacuation. According to Kyodo News, Chief Cabinet Secretary Hiromu Nonaka, said that it is safe to consume farm produce in Ibaraki Prefecture. "Safety has been confirmed," top Nonaka said in a nationally televised news conference. "We pray from the bottom of our hearts that their lives can return to normal as soon as possible."

KEPCO (Kansai Electric Power Company) said the MOX (mixed uranium-plutonium oxide fuel) utilization in their Takahama thermal reactor will have to be delayed (perhaps by a month or two) because of the Tokai accident. Safety and security manuals will be reviewed in the meantime.

TEPCO (Tokyo Electric Power Company) decided to suspend the routine TV ads on the benefits of nuclear power.

### **ACCIDENT RATED LEVEL FOUR, COULD GO HIGHER - JAPANESE AUTHORITY PERFORMANCE ALSO...**

The government declared the incident to be "level four" on a scale of seven of nuclear accidents, making it Japan's worst accident ever. The IAEA in Vienna stated that the accident would be the worst worldwide since the Chernobyl disaster in 1986 and that it could be given a higher rating after a comprehensive investigation. For comparison: The 1979 U.S. Three Mile Island incident was level five, and the 1986 Chernobyl accident in the Ukraine, the worst in history, was at the maximum, level seven.

Preliminary calculations on the emissions of radioactivity, carried out by Dr. Jinzaburo Takagi, a nuclear chemist and founder of the Citizens' Nuclear Information Center (CNIC), suggest that the accident should be rated level 5 rather than level 4.

The Japanese government came under fire for its accident management in particular since it all happens on the same site that suffered a nuclear accident only two years ago (at the waste bitumen installation at the back end of the reprocessing plant).

Chief government spokesman Hiromu Nonaka admitted the government was slow to respond to the accident. "*As a modern nation, it's shameful that this kind of accident happened,*" Nonaka said in what has become a refrain from top officials after a string of similar disasters.

Prime Minister Keizo Obuchi claims that during the accident, governmental bodies, including the defense agency, the national police agency and the fire and disaster management agency have been directed by himself, to make concerted efforts to secure the safety of residents and to prevent the radiation hazard from expanding.

"We did not foresee that the situation could intensify and that is why we were late in responding," said Hiromu Nonaka, a government spokesman. "We have to acknowledge that we were lax."

## THE "AFTER ACCIDENT" MEASURES AND ISSUES

The STA inspection of the JCO plant (which is legally prescribed) on 3 October 1999 was the very first one in 10 years to be carried out. It was also revealed that STA had conducted no site inspection either at Tokai Reprocessing Plant (operated by JNC) or at Rokkasho-mura Enrichment Plant (operated by JNFL) over six years. STA claims they were too busy.

STA and several groups of independent scientists have carried out survey around the JCO Tokai plant, mainly in the 350 m area zone. Radioactive fallout of cesium-137, iodine-131, strontium-91 and sodium-24 have been (extensively for sodium-24) confirmed.

**On 4 October 1999, it is announced that various samples of a common local herb had been collected by citizens in the area on 2 October 1999, measured by the Research Reactor Institute of Kyoto University, were found contaminated with 23 to 54 Bq/kg Iodine-131.**

The environmental group Greenpeace investigated materials from around the site -- including soil from around the accident site as well as salt (which is a neutron neutron flow indicator) from the homes of local residents -- and concluded the government lifted its evacuation advisory too soon. According to Greenpeace, neutron radiation seems to have irradiated the environment at least 500 meters from the accident site, which would have reached a major nearby street and more than 170 homes as well as a golf course and farmland.

The following is an overview of fission products detected within 3 km of the accident site. The figures were taken from newspapers and TV reports, and have been compiled by CNIC. (Citizens' Nuclear Information Center, Tokyo:

- strontium-91 : 0.021Bq/m<sup>3</sup> in air, 900m southeast of the site
- strontium-91 (krypton-91) : unknown amount, location not specified
- iodine-131 : 54.7Bq/kg from mugwort leaves, 100 m from the site
- iodine-133 (krypton-91) : unreported amount, 100 m from the site
- cesium-137 : unreported amount, 7 locations
- sodium-24 : 64Bq/kg, 300 m west from the site
- sodium-24 : 1.7Bq/kg, 3 km west from the site
- xenon-139 : from the vomit of the exposed workers
- krypton-91 : from the vomit of the exposed workers

The mayor and the Governor of Ibaraki Prefecture jointly met the Prime Minister Obuchi on Monday (4 Oct). They firmly requested the suspension of JCO's

operations, and also stated that new legislation to guarantee safety in nuclear plants should be introduced.

In the mean time the mayor of Tokai-mura issued an order of total suspension of the operation of JCO Tokai plant (all the work inside its Tokai facility) on the basis of the Safety Agreement between the company and the village administration. This is the first time in Japan in which a local government made use of this sanction power based on the nuclear safety agreement with a plant operator. It was also decided that the Tokai nuclear fuel reprocessing plant, of which the operation has been suspended since the March 1997 explosion and fire, would not restart for the time being. The reprocessing plant was about to restart. Its operator is Japan Nuclear Fuel Cycle Development Institute (JNC), former PNC.

On 6 October 1999, according to Kyodo News Agency, the Science and Technology Agency (STA) has decided to revoke the business license of JCO Co due to the "seriousness of the accident".

According to Reuters, on 6 October 1999, a police spokesman said that about 200 investigators raided JCO's headquarters in Tokyo and its office in Tokai-mura, searching for causes and responsibilities for the accident. It has been reported that STA and the Ibaraki Prefecture Police are involved in the investigations

Kyodo quoted government sources as saying that the authorities have confirmed during their investigations that JCO had changed the government-approved procedure manual and used the illegal one as "standard procedure." JCO officials have admitted the firm illegally revised a government-approved manual to allow workers to use buckets instead of a pump to transfer a uranium solution to a tank. It has been revealed that the three JCO workers, who were hospitalized due to massive radiation exposure, had not been wearing their film badges to measure radiation dose. This is another serious violation of the safety regulations.

The responsibility of the Tokai local government is also put into question since it did not conduct a nuclear emergency exercise for the last eight years.

According to news reports, at the time of the accident, there was not even any hot line between the prefectural government and Tokaimura's town hall. Tokai officials had to rely on busy public telephone lines when they tried to obtain radiation monitoring data from the prefectural authorities after the accident.

The approach of spokesmen for the companies involved seemed similarly focused on the need to provide swift reassurance and emphasised the culpable role of workers without examining that of managers, even those on the spot, let alone those higher up in the JCO company and its parent corporation, Sumitomo Metal Mining.

The Government's emergency response headquarter has been resolved, and now a Nuclear Accident Investigation Committee is to be set up. The PM's office ordered an ad hoc inspection in all nuclear facilities, including power plants, all over Japan.

A number of public meetings and protest actions are being organized all over the country by NGOs, trade unions and concerned citizens.

### **The Tokai-mura uranium was of French military origin**

The uranium which originated the criticality accident at Tokaimura on 30 septembre was of French origin, confirmed JCO Co spokesman, Norimichi Mori, to the French daily *Le Monde*. French sources indicated that the 18,8% enriched uranium was exported in december 1997. The 420 kg of uranium had been enriched by COGEMA in its military enrichment plant in Pierrelatte (shut down in 1996). The deal had been

organized by the German nuclear fuel broker NUKEM. COGEMA stressed directly after the accident that it had no agreement with JCO Co. In fact COGEMA's client is JNC Co, operator of the Joyo experimental fast breeder reactor, which subcontracted the conversion work to JCO.

According to insider reports, STA officials are going to rank the Tokai accident at Level 5 instead of Level 4 on the International Nuclear Event Scale (INES), in other words as severe as Three Mile Island accident 1979.

"While there may be some cracks, since we have not been able to enter the site, the plant does not appear to be destroyed from the outside," the STA told the IAEA. It added that it was not sure how much radiation may have escaped from the building.

The insurance program designed to cover damage from nuclear accidents is not likely to compensate people for lost sales of agricultural products because of the Tokaimura nuclear accident, sources said on thursday 4 october. Sales are expected to decline in Tokaimura and neighboring municipalities in Ibaraki Prefecture. Nor is the insurance program likely to cover the entire cost of other losses stemming from the nation's first accident involving nuclear criticality. These include losses related to the suspension of railroad services and temporary closure of private firms. The insurance system makes it mandatory for operators of nuclear facilities to buy insurance against possible accidents. Further, it allows the use of taxpayers' money--subject to Diet approval--to pay compensation if the responsible operator is not capable of paying for all damages, reported the daily Asahi Shimbun.

CNIC revised its estimation of the quantity of U-235 that underwent fission to "up to several tens of milligram of U-235". The Japanese Government's Nuclear Safety Commission (NSC), according to the daily Asahi, claims that the figure would be in the order of 0.001 mg (10E-6 grams).

NSC confirmed in an official report to the Government that the criticality in the Tokai accident continued for 17.5 hours; the judgement is based on neutron dose monitoring by different institutions.

The number of exposed people continues to increase, and reached 63 as of 9 October 1999.

Sumitomo Metal Mining company, of which JCO is a 100% subsidiary, now intends to totally withdraw from the nuclear fuel business. This means that quite a few of the Japanese nuclear reactors will have to find overseas suppliers for nuclear fuel assemblies (conventional uranium fuel). For instance, Kyushu Electric Power Company depends for 70% on JCO uranium fuel, and is severely affected by the suspension (and permanent shut down, which is now likely) of JCO operations.

The European Parliament voted for a total review of « all the nuclear facilities worldwide » by the IAEA. They require controls and check-up at the Tokaimura plant and ask the japanese officials for revised safety procedures. Hirofumi Nakasone, the new head of the Science and Technology Agency (STA) accepted IAEA experts to come to « increase transparency and recover international confidence »

On 14 October 1999, the visit of three IAEA experts in Japan comes a day after the Japanese Government admitted a ventilator at the plant had been mistakenly left operating for 12 days, allowing radioactive particles to leak into the atmosphere. The ventilator was only turned off on Monday 11 October 1999, three days after high levels of the radioactive substance iodine 131 were detected around the plant. Radiation levels at the accident site at Tokaimura are still dangerously high, so it is unclear how close the IAEA team will get.

Experts and scientists at a symposium held at Kyoto Seika University on 4 October 1999, said the government should be accountable for the nuclear accident at the uranium-processing plant in Tokai, Ibaraki Prefecture. They also expressed concern that the company as well as the government might be withholding information or releasing incorrect information about the nation's worst nuclear disaster. Seika University President Hajime Nakao said the fact that the country is continuing with plans to put the Joyo fast-breeder reactor back online makes him think that the government wants the ability to build nuclear arms.

As part of the reorganization of central government ministries and agencies, which will begin in 2001, the Nuclear Safety Commission (NSC) will operate under a newly created Cabinet office, with enhanced independence - being an advisory body, the NSC has no licensing authority - as will be the case with the Nuclear Energy Commission. The two commissions now belong to the Prime Minister's Office.

At a press conference on 15 October, JCO admitted that a « limited amount » (20 Bq/m<sup>3</sup>, twice the allowed quantity) of radioactive iodine-131 had been released into the atmosphere after the accident via the ventilation system of the building in which the criticality accident occurred. Prefecture and STA knew about the iodine release, but they took no measures considering the escaping quantity of radioactivity would be negligible. Concentrations of 0.04 Bq/m<sup>3</sup> of I-131 were detected 50 m southwest of the building (the monitoring point is still within the JCO premises).

One member of the first team who approached the building to take photographs of the pipe systems they were going to work on, according to a JCO statement, was initially dosed with 20 mSv. Now it is revealed that the workers wore 2-digit type neutron recorders (the meter is reset to "00" when the count is over 99). The "20 mSv" actually were 120 mSv (neutron plus gamma, mostly consisting of neutron dose.) The fact was reported by STA on 15 October 1999 to the accident investigation unit of NSC.

In the same report, STA confirmed that the number of the exposed persons now reached 69. This figure does NOT include the general public who had stayed very close to the plant for over 5 hours in neutron shower before they were evacuated. Dr Komei Hosokawa of Saga-University estimates that some 100 to 150 people were significantly exposed to neutron radiation.