

Preface

A great earthquake of Magnitude 9.0 on the Richter Scale occurred at 2:46pm on 11th March 2011 over a wide area of East Japan. It induced several huge tsunami waves which hit land about 500km along the Pacific Coast in East Japan. The earthquake and tsunami killed about 15,000 persons and about 8,000 are missing. Of the victims, 92.5% were from the tsunami. There was a great deal of multimedia coverage of nightmare stories from survivors of the tsunami. These reports included many concerning how individuals managed to escape from the tsunami under critical conditions. An instantaneous decision often made the difference between life and death. No better lessons can emerge than those taken from the evidence of survivors. Part 1 of the book summarises these survivors' stories in eleven chapters. The author has tried to extract lessons from these stories. Some more detailed data and information relating to the stories has been added in the form of '**Memos**'. The objective is to hand down these lessons generation to generation in order to prevent such misery occurring again. As my great-grandfather died in the Tsunami that occurred in 1896 in North East Japan (the so-called Meiji Tsunami), it is my strong wish to transmit these lessons for our future children. My grandmother taught me repeatedly to evacuate from potential tsunami immediately after the shock of an earthquake, without looking after anyone but myself. This has been the advice of which we are repeatedly reminded in the teachings of the ancestors from tsunami-prone areas in northeast Japan.

Breakwaters constructed almost 300km long along the Pacific Coast of Japan were unable, but for a single instance, to halt the recent Tsunami. Number 1 breakwater, constructed offshore from Kamaishi Bay in Iwate Prefecture with a depth of 63m and total length of 2km, which has been registered in Guinness Book of World Records as the deepest breakwater, was destroyed by the Tsunami. On the other hand, there were many tragedies in

which many people died in spite of evacuation to the designated shelters, as shown in a hazard-risk map provided by local government. This was because the shelters were allocated on the assumption of a smaller tsunami than the one that actually occurred this time. It was an instantaneous decision and individual action that often lay between life and death, regardless of breakwater or hazard-risk map. My advice would be: “Don’t trust the breakwater” and “Don’t believe the hazard-risk map”.

Part 2 comprises two chapters covering follow-up on the accident, as well as two chapters citing lessons from the accident at Fukushima Nuclear Power Station (NPS). Although the accident is still ongoing and not yet stabilised at the time of writing, I have tried to summarise the critical situation and my comments relating to the accident. Though we Japanese people have always had a strong antipathy against nuclear weaponry and any nuclear-related matter, since Japan suffered catastrophic damage from the atomic bombs dropped on Hiroshima and Nagasaki in 1945, we had since the 1970s accepted nuclear power stations due to the propaganda or mythology of their ‘absolute safety’. Many people living near the Fukushima NPS had to evacuate to beyond a radius of 30km from the station, or farther still, and lost their homelands. The Fukushima NPS should as planned have been protected against a 5.7m tsunami, but this 13m-high Tsunami attacked the NPS, destroying emergency electric power generators and the cooling systems. The risk management on the part of central government and Tokyo Electric Power Company (TEPCO) was poor, so that the damage has escalated to Level 7 (most serious accident), the same as the Chernobyl accident that occurred in the former USSR (now Ukraine) in 1986. It should be described as a ‘manmade accident’. Through our experience of the accident and subsequently adopted countermeasures, my conclusion is that a country as disaster-prone as Japan should no longer have nuclear power stations, as we cannot guarantee our future generations ‘sustainable happiness’ with NPS. Since Japan may fall victim to similar or even larger earthquakes and tsunamis over the coming hundred or thousand years, it should be our duty to avoid catastrophic risk as far as possible for our children’s children.

I should like this book to be useful in preventing repetition of similar tragedy and misery.

Shunji Murai, Tokyo, August 2011

◆ MEMO 1

Heisei Earthquake and Tsunami 311

At 2:46pm on 11th March 2011, a huge earthquake of M9.0 occurred 200km offshore Sanriku (north east of Japan) with its epicentre 130km offshore to the east south east from Ojika Peninsula, Miyagi Prefecture and 24km depth covering a region 500km long (north-south) and 200km wide (east-west) in the Pacific Ocean. Accordingly, the damaged areas were also 500km in length, stretching from a part of Hokkaido (the north island of Japan) in the north to Tokyo in the south. We have had many big earthquakes in the past, for example Kobe Great Earthquake in 1995 with 6,000 victims, but the damaged area from this earthquake was limited to several tens of kilometres. A sea-bottom control point belonging to the Japan Coast Guard located at a depth of 1,700m near the epicentre of the most recent event proved to have moved 24m to the east and 5m vertically. The GPS station belonging to the Geospatial Information Authority (GSI) located at Ojika Peninsula showed a 5.3m movement to the east. This is the largest crustal movement ever recorded in Japan. More than 300 aftershocks have followed. The great earthquake triggered huge tsunami waves which struck seriously at three prefectures, namely Iwate, Miyagi and Fukushima Prefecture, in the so-called Sanriku Area. In this book the event is named the 'Heisei Earthquake and Tsunami', as the year of 2011 AD is the year of Heisei 23 of the current emperor era.

According to a survey by the University of Tokyo and Tohoku, the highest Tsunami wave running uphill was 40.4 metres above sea level at Shigemo Aneyoshi District, Miyako City, Iwate Prefecture, a little higher than the 38.2 metres of the Meiji Tsunami in 1896. The number of victims was 15,413 persons (confirmed dead) and 8,069 missing (reported by family or relatives) as of 11th May, just three months afterwards. There will be more, unreported, missing persons. The number of evacuees was 460,000 persons to start with, a number which fell to 124,000 persons after three months. This figure includes about 70,000 evacuees from Fukushima NPS.

The number of devastated houses was 219,555 and the number of fires 357. The number of completely destroyed houses was 120,000, of which 78,000 were swept away completely. The Tsunami-devastated areas was in total 535 square kilometres, excepting the area of Fukushima NPS, of which 40% were inundated to a depth of more than 2 metres. The Tohoku Shinkansen (bullet-train railway) was destroyed at about

1,200 points, which were restored by 29th April, about 50 days afterwards. Japan Railway (JR) lines were cut off at 600 points. As the JR Joban Line incurred serious damage from the Heisei Earthquake and Tsunami and in addition passed through areas evacuated around the Fukushima NPS, there is no hope of recovering the full line for long years to come. The Tohoku Highway connecting Tokyo and many cities in the Tohoku Area (northeast Japan) was less damaged, which made it the only transportation link apart from helicopters to have provided rescue materials and personnel in the direct aftermath of the disaster. National roads were destroyed in 161 trajectories. Sendai Airport was struck by the Tsunami and 1,600 persons were evacuated to the second floor of the building. A huge number of parked cars and some aeroplanes were washed away. Some of the most serious damage was sustained by ports and harbours, including many fishing ports. All 326 fishing ports were completely devastated, which included the loss of 18,800 fishing boats. The inundated areas of agricultural land totalled 13,600ha which were seriously affected as seawater was introduced into rice fields. Many water canals and channels were destroyed by the earthquake, including by liquefaction. According to the Government, the total estimated loss is 169 Billion US Dollars, including 130 Billion US in buildings, 16 Billion US in lifelines, 28 Billion US in social infrastructure, 24 Billion US in agriculture and fisheries and 13 Billion US in other form.

Most of the electric power stations in the devastated areas had to stop operations, which reduced the power supply from 52 million KW to 31 million KW under TEPCO power-supply networks. TEPCO stopped the operation of 7 out of 11 NPS, including Fukushima NPS, and 8 out of 15 Fuel Power Stations after the earthquake. But, after a month, TEPCO recovered 50 million KW by installing new gas-turbine generators and repairing the existing halted fuel power stations. However, people in the Tokyo Metropolitan area are being forced to economise on power consumption as the total supply is insufficient.

Many daily necessities such as toilet rolls, masks, water bottles and other things were immediately sold out at all supermarkets and convenience stores for about two weeks after the earthquake. The most serious situation was lack of petrol, as the oil-refinery factories were damaged and transportation networks such as shipping were cut off. Even in Tokyo Area we had to queue for an hour to buy just a limited quota of petrol: 10 litres only for the first two weeks. Delivery services were suspended due to the lack of light and diesel oil.

Because of the accident at Fukushima NPS and its radioactive contamination of air, water and soil, particularly after the bent and hydrogen-gas explosions took place on 12th to 15th March, the drinking water supply was suspended in many areas, including a part of Tokyo. Green vegetables, milk, fish, beef and other foods were forced off the market, as the radiation value was over the safety limit. In addition, groundless rumours that such products should be avoided near the Fukushima area spread not only within Japan but also overseas. All residents within a 20km radius of Fukushima NPS were forced to evacuate to beyond it, and those residents living between 20km and 30km radius were recommended to stay in their houses. The evacuation is now increasing as radiation expands to areas further afield, depending on wind direction. According to a survey by the Geospatial Information Authority (GSI), the maximum crustal movement of the land was 5.3 metres to the east, and there was 1.2 metres settlement at Ojika Peninsula, Miyagi Prefecture. The origin of Japanese longitude and latitude, as well as the levelling origin located in Tokyo, moved several ten centimetres and a few centimetres, respectively. Even three months after Heisei Earthquake, the Island of Japan was still moving, which resulted in stopping the use of the national control points. GSI expects the control points to stabilise after six months.

One of the GPS wave-height recorders which were installed offshore of the coastlines by the Port and Airport Research Institute succeeded in recording the Tsunami waves 15km offshore of Kamaishi Bay, Iwate Prefecture. It recorded the first ebb of 0.5m 11 minutes after the earthquake (at 2:46pm), and the first Tsunami wave of 6.6m high at 3:12pm, 26 minutes after. At 3:30pm the tide receded 3m: the pulling eddy. Then the second Tsunami wave of 2m high came at 3:45pm, while the third of 1.2m high arrived at 4:30pm and the fourth of 2.0m high at 5:55pm, the six of 1.2m high at 7:40pm and the seventh of 1.0m high at 8:40pm. The Tsunami wave offshore will be raised up by two or three times when it makes landfall, depending on the topography and shape of the bay. The record showed amazingly that the total of seven Tsunami waves came in about six hours. Actually, the height of the Tsunami at Kamaishi Coast was 9.3 metres (1.4 times high) while the Tsunami wave ran up to 21.4 metres (3.2 times high) on the land.
