

# Niigata as a temporary water works relay base: support for teams in a major seismic disaster

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## Abstract

Water works support in Niigata for the Great East Japan Earthquake in 2011 allowed us to find a new role as a temporary relay base connected water works support teams from areas far from the disaster area. In this study, we report on the role of Niigata as a temporary emergency support relay base for water works bureaus for the Great East Japan Earthquake and discuss its role as an ideal temporary relay base for subsequent disasters.

Following the emergency support for the Southern Hyogo Earthquake in 1995, new emergency rules for emergency water supply and emergency restoration work were put in place to ensure a speedy recovery from major disasters. However, in the Great East Japan Earthquake, because a widespread area was so seriously damaged, these rules were found to be insufficient, resulting in chaos in the primary period after the disaster. As emergency recovery efforts were established, new roles, which had previously not been needed, were determined for Japanese disasters. One of these new roles was the establishment of temporary relay bases for water works support teams that needed to be located between the disaster area and the areas the teams came from. Niigata was chosen to be one of these temporary relay bases because of its location and its convenient transportation system.

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## **1 THE DISASTER SUPPORT SYSTEM IN JAPAN**

### **1-1 The 1995 Southern Hyogo Earthquake**

The largest natural disaster in Japan since World War II, the Southern Hyogo Earthquake, struck in the Hanshin area on 17 January 1995 with a seismic intensity of 7. The earthquake killed more than 6,000 people, destroyed more than 100,000 houses and resulted in a total financial damage of about 10 trillion yen. Lifelines, such as roads, railways, electricity, water works, gas lines and telephone services were cut off by the earthquake. Furthermore, congested roads leading to the disaster area interfered with emergency support and the supply of necessary goods. Water was cut off from 1,270,000 houses, with 4,700 water works emergency support man-days needed to repair the system. Niigata Water Works Bureau also sent water works support teams to Ashiya city. For the emergency water supply and emergency restoration work, the Japanese Water Works Association allocated support areas for the water works support teams throughout Japan. However, it is difficult to judge the efficiency of this support work. The Japanese Water Works Association represents water works bureaus from across Japan and is divided into seven local branch associations, each of which is managed by a prefecture association organised by the prefecture water works bureau. Ideally, when planning for a major seismic disaster, it would be more effective for emergency activities to be organised by a prefecture association unit or a local branch association unit. However, in the initial response to the emergency activity at this time, this rule was not considered.

To take advantage of lessons learned from this major disaster, in 1996, the Japanese Water Works Association published *Reports about emergency correspondence in case of disasters such as earthquakes*, which describes the emergency activity rules for water works bureaus in Japan.

### **1-2 The 2007 Niigata Prefecture Chuetsu Earthquake**

On 23 October 2004, the Niigata Prefecture Chuetsu Earthquake struck with a seismic intensity of 7 and was followed by many aftershocks. Because the epicentre was not downtown, the death and destruction toll was small compared with the Southern Hyogo Earthquake. However, there was serious damage in the mountainous areas such as in Yamakoshi village, which was forced to shelter as a group as all roads to the village had been destroyed by the earthquake. Lifelines, such as electricity, water, gas and telephones, were cut off and the railways and roads were also destroyed. According to the water works bureau, 130,000 houses had no water supply and more than 150 water works bureaus and private companies provided emergency support. The Japanese

Water Works Association and the Chubu local branch association, which represented nine prefecture associations in mid-Japan, coordinated the emergency support and information between the disaster area and the support water works bureaus, meaning that in this case, the emergency water supply and emergency restoration work were effectively completed. Niigata city assigned emergency support water works support teams in Niigata prefecture, in its role as prefecture association chief bureau. Furthermore, emergency support teams were dispatched to Nagaoka city, Odiya city and Kawaguchi town to assist in providing emergency water supplies, emergency restoration work, pipeline surveys and restoration planning.

### **1-3 The 2007 Niigata Chuetsu-oki Earthquake**

On 16 July 2007, the Niigata Chuetsu-oki earthquake of seismic intensity 6 plus, caused the suspension of water to 59,000 houses in seven cities, towns and villages. Most damage was concentrated in the downtown area of Kashiwazaki city, and even though lifelines, such as electricity, water, gas, telephone, cellular phone and internet services, were seriously damaged, the recovery was much faster than in the Southern Hyogo Earthquake because the emergency water supply and emergency restoration work rules functioned well.

The Niigata Prefecture Chuetsu Earthquake, the Japanese Water Works Association and the Chubu local branch association collaboratively worked to ensure the emergency support, resulting in the water suspension being repaired within 15 days. Niigata, in its role as prefecture association chief bureau, assigned emergency support to the water works support teams in Niigata prefecture and assigned other bureau support teams from outside Niigata city in cooperation with Nagoya city, which is the Chubu local association chief bureau. Niigata city also participated in the determination of the emergency water supply plan, the emergency restoration plan and information collection management for the damaged water works facilities. It also assisted in the emergency water supply activities and emergency restoration works for Kashiwazaki city.

In 2008, the emergency support water works rule was reviewed in light of the experiences and lessons learnt from the great disasters in Niigata prefecture. The *Reports about emergency correspondence in case of disasters such as earthquakes* was also revised.



Photo.1-3-1

A crushed house—Niigata Prefecture Chuetsu Earthquake in 2004



Photo.1-3-2

Restoration work—Niigata Chuetsu-oki Earthquake in 2007

## **2 GREAT EAST JAPAN EARTHQUAKE CHARACTERISTICS**

### **2-1 Earthquake damage characteristics**

Due to the subsequent tidal wave caused by the earthquake and the accident at the Fukushima Nuclear Power Plant, the Great East Earthquake (GEE), with a seismic intensity of 7, caused serious damage across east Japan. A characteristic of this earthquake was the broad-based catastrophic damage caused in the areas hit by the earthquake-generated tsunami. The Japanese Water Works Association local branch chief bureau and the prefecture chief bureau, which were responsible for assigning water works support teams, also suffered serious damage, with communication systems such as cellular phones out of order and food and gasoline shortages. Due to this and the never-before-experienced radiation hazards, it was difficult to conduct effective and efficient emergency activities.

### **2-2 Influence on emergency activities**

Before the GEE, water works bureaus had carried out emergency water supplies in cooperation with the Self-Defense Forces. However, because the Self-Defense Forces had to deal with the disaster areas near the seashore where the tsunami had destroyed houses and there were missing people, Niigata had to provide the emergency water supplies. In the primary period immediately after the GEE, a shortage of supplies, especially in fuel for generation systems, stopped the water supply in some cases. Therefore, because it had not been decided as to which bureau was in charge of which area, there was significant chaos as many water works bureaus had come to support the disaster water works, but they did not know where they were needed. Because of the

Fukushima Nuclear Power Plant accident, many water works bureaus went to the disaster area via Niigata city, which is on the opposite side of the disaster area. Therefore, it took considerable time for them to reach the disaster area, especially for those bureaus that had come from the western areas of Japan.

### **3 ACTIVITIES IN THE PRIMARY DISASTER PERIOD**

#### **3-1 The initial response in Niigata city**

For the prefecture association chief bureau, the most important activity in the primary disaster period was to check the damage in its own water works facilities and to obtain information about the disaster area. In Japan, the water works are run by the public; therefore, emergency support is expected to be provided by the public.

On 11 March 2011, there was a long periodic seismic wave for several minutes in Niigata city. Just after the wave settled, water works facilities damage from the earthquake was checked, and no damage was found in the water filtration plants, distribution plants or pipeline construction fields. Because no information related to the Tohoku area could be obtained, it was assumed that this area had sustained serious damage; thus, the Niigata prefecture water works association emergency response headquarters was established so that information collection could be started and emergency support teams prepared. It was not possible to obtain reliable information; thus, in cooperation with Nagoya city, it was necessary to dispatch an advance emergency support team to collect information. Additionally, based on the mutual support agreement for disaster relief between ordinance-designated cities, Sendai city called for an emergency water supply from Niigata city.



Photo.3-1-1

The departure of Niigata water works advance support team on 11 March 2011



Photo.3-1-2

The damage caused by the tsunami

On 11 March at midnight, the Niigata city advance emergency support team and two water trucks departed for Sendai city. They reached Sendai city the following morning and started collecting information and performing emergency water supply activities. From the report of the advance emergency support team, we found that the water supply was widely cut off in Miyagi prefecture. On 12 March, an advance emergency support team from the Chubu local branch association went to Miyagi prefecture to survey the support needed by the water works bureau in the disaster area.

### **3-2 Prior arrangements between disaster water works and support teams**

In the primary period after an earthquake, it is most important to confirm the water works bureau's damage level in the afflicted areas and assess the scale of support needed as soon as possible. If the damaged area is wide enough, it is necessary to divide the disaster area into several blocks and decide which bureau is in charge of which block.

The Niigata city advance emergency support team installed a booth at the Sendai water works bureau and, after consultation with Sendai city on timing and the support activity priorities, told the Niigata city headquarters the level of support needed for Sendai city. The Chubu local branch association advance emergency support team surveyed the water works facilities damage in Miyagi prefecture and, in cooperation with other advance emergency support teams from local branch association bureaus, decided on what was needed by the water works bureaus. In the Great East Japan Earthquake, the disaster area was so widespread that many water works bureaus sustained serious damage. Therefore, nation-wide support was needed. From the information supplied by the Niigata city and Chubu local branch association advance emergency support teams, the Japanese Water Works Association and the local branch association bureaus decided which local branch association was to be in charge of which prefecture.

## **4 SUPPORT ACTIVITIES IN THE DIASATER AREA**

### **4-1 The initial response towards the disaster area in the primary period**

The two-week period following a disaster is known as the 'primary period'. During this period, disaster water works bureaus require emergency water supplies. After the GEE, many water works bureaus across Japan were engaged in the supply of emergency water, with many going to the disaster area via Niigata prefecture to avoid the effluence from the Fukushima Nuclear Power

Plant accident and the turmoil of the earthquake in the Kanto area. Niigata city was not so far from the disaster area and had not sustained any damage from the earthquake; thus, it was given a new role as a temporary relay base.

In the primary period, water supplies were cut off in a wide area; thus, it was necessary to take water service balloons and temporary water service faucets depending on the disaster water works bureaus' requests. Each balloon has a capacity of 1 m<sup>3</sup> and has an efficient water supply, temporary water service faucets and a frame. At this time, 66 water balloon sets were sent to three water works bureaus, who told us that the balloons were efficiently used. From the Niigata prefecture association booth installed in the Sendai city water works bureau, we collected information about the disaster bureaus in Miyagi prefecture and accepted the water works support teams that had avoided the Fukushima Nuclear Power Plant effluence.



Photo.4-1-1

The headquarters for disaster recovery at Sendai City Water Works Bureau



Photo.4-1-2

Water service balloon with temporary water service faucets

#### 4-2 Activities in the post primary period

Two weeks after 11 March, as the water supply suspension area decreased, the need for emergency water supplies was also decreasing. As the needs of the disaster water works bureaus shifted from emergency water supply to emergency restoration work, the importance of our role as a temporary relay base also disappeared. However, the disaster water works bureaus indicated that there was a significant increase in the need for emergency restoration works, such as repair teams to fix leaking pipes and pipeline field survey teams to check the leak points on damaged pipelines and to confirm whether repairs had been completed.



Photo.4-2-1

Emergency restoration works—finding valves



Photo.4-2-2

Emergency restoration works—confirming pipeline functions after repair work

## 5 FUNCTION OF TEMPORARY RELAY BASE

There are three main functions of a temporary relay base.

- ①As a meeting point for water works support teams
  - Temporary waiting space for the teams coming from areas far from the disaster area
  - Temporary parking space for water trucks and other emergency vehicles
- ②A logistical base for bureaus supporting their teams working in the disaster area
  - A place for supplies, food and equipment
- ③As an information control base for every bureau conducting emergency recovery
  - Understand the needs of the disaster area and provide information to support teams in the disaster area
  - Management of the scale and content of the support

Niigata city has a convenient transport system, such as an airport in the city, a Shinkansen system and an advanced expressway. A report from the Ministry of Land, Infrastructure and Transport reported that traffic to East Japan going via Niigata prefecture greatly increased in the month following 11 March. The first function of a temporary relay base is as a meeting point for water works support teams, as the base can provide a temporary waiting space for the teams from areas far from the disaster area as they wait to go to the disaster area. At the Sinanogawa water filtration plant, more than 30 water works support teams, who had especially come from the western area of Japan, used our space and prepared themselves before going to the disaster area.

The Sinanogawa water filtration plant was an ideal temporary relay base because it was located within five minutes of the express interchange and had a huge car park. The second function of the temporary relay base was as a logistics base for the bureaus to support their teams. Niigata city is located in a suitable position for the support teams supplying food and essential equipment for the activities in the disaster area. In the primary period of the disaster, it was difficult to purchase food or equipment in the disaster area or in the Kanto area, which also faced a shortage of equipment. Some bureaus that came from the western area of Japan purchased winter tyres for the snow-covered roads, because ordinarily they do not require such tyres. The third function of the temporary relay base was as an information control base for every bureau conducting emergency activities in the disaster area. We collected information from the disaster area, organised the information and then, explained the information to the bureaus conducting emergency recovery away from the disaster area. Because it was difficult for the bureaus away from the disaster area to understand what kind of support was really needed, we arranged emergency activities for the support teams based on the latest information. Simultaneously, we sometimes advised the western bureaus about the equipment needed, such as the clothes or equipment necessary for the winter conditions.

## **6 PREPARATIONS FOR EFFECTIVE ACTIVITIES AS A TEMPORARY RELAY BASE**

The following preparations are necessary for an effective temporary relay base.

- ① Large carpark
  - Parking space for cars, water trucks and construction vehicles
- ② Facilities for support teams
  - A lounge, a meeting space and a lodging place
- ③ Ability to obtain necessities in an emergency
  - Foods and fuels, such as gasoline and kerosene
- ④ Manuals for the emergency
  - Places to receive support teams, parking areas, unified chain of command
- ⑤ Simulations about gigantic earthquake for heavily populated areas
  - Specific work/education programs about earthquake preparations and contingencies

Having adequate parking space is the most important of all the preparations mentioned above. It is important to beforehand arrange large car park at areas such as baseball grounds, athletic stadiums, soccer grounds or at the university or college campus. Having earthquake emergency agreements between water works bureaus and private companies such as hotels, restaurants, supermarkets and gas stations enable support teams to be received smoothly. In the primary period of the GEE, significant confusion and a shortage of equipment affected the efficiency and effectiveness of the emergency activities. Therefore, in the future, it is necessary to ensure that adequate preparations for emergencies are made in advance to ensure the provision of necessities in time by arranging agreements with those private companies. Furthermore, manuals need to be prepared that clearly outline the people responsible for the various emergency activities: a ‘who must what until when’ guideline. In Japan, there is a significant risk of large earthquakes, such as the Tokai Earthquake, the Tonankai Earthquake, the Nankai Earthquake, the Nankai trough Earthquake and the Tokyo inland Earthquake in the future. Therefore, if we wish to act as effective first responders, manuals are vital for effective and efficient operations. Agreements between Niigata city and other bureaus and private companies are shown in the following table.

Table.6-1 Agreements between Niigata City and other bureaus or private companies in case of disaster

Organization name	Agreement contents	date
Okayama City waterworks bureau	Mutual cooperation for emergency fuel	Jan. 2015
Kobe City waterworks bureau	Mutual cooperation for emergency fuel	Mar. 2014
Shizuoka City waterworks and sewage bureau	Mutual cooperation for emergency fuel	Feb. 2014
Yokohama City waterworks bureau	Mutual cooperation for emergency fuel	Aug. 2013
Sendai City water works bureau	Mutual support at the disaster	Nov. 2012
Niigata water service foundation	Emergency restoration work	Aug. 2014
Niigata City plumbing business cooperative	Emergency restoration work	Sep. 1997
Gosen City	Mutual water supply at the disaster area	Jan. 2000
Sanjo City	Mutual water supply at the disaster area	Mar. 2013
Gas stations in Niigata City	Emergency fueling agreement	Oct. 2013
Kirinzan Shuzo Co. Ltd	Emergency water supply at the disaster area	Mar. 2007
Kondo Sangyo Co. Ltd	Emergency water supply at the disaster area	2007

## 7 CONCLUSIONS

*The Niigata city local resilience plan in 2015* has two key policies: ‘emphasizing the reinforcement of relief and a substitution function’. This is a resilience plan, which aims to contribute to national resilience. Our city’s location and the results from our support during the Great East Japan Earthquake has shown that Niigata can be an essential coordination centre for devastating earthquakes on the Pacific Ocean side of Japan. In this local resilience plan, five areas need to be highlighted: wide-area traffic infrastructures, an accumulation of industrial functions, energy bases, food bases and cooperation between areas. The provision of water during such emergencies should be a high priority in this plan, the contingencies for which should be prepared in advance so that if such earthquakes occur again, there is a plan of action in Niigata prefecture.

In retrospect, the initial response in the primary period at the essential activities in the past earthquakes is the most important. In other words, the initial actions are directly connected to the success or failure of the emergency support. Moreover, when a major disaster occurs, with the support of the prefecture association unit or the local branch association unit, we can efficiently support the emergency activities as a relay centre. First, we need to collect information about the kind of support the water works bureaus in our prefecture can offer. Then, we need to give and discuss this information with the bureaus in the prefecture association or the local branch associations so that we can achieve an efficient initial response in the future devastating earthquakes.