

## Preparedness and required emergency measures in the face of the unprecedented Great East Japan Earthquake

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### Things can happen that far exceed what people envision

On the afternoon of March 11, I was listening to a young researcher's presentation as a judge at a meeting for reporting research results on the first floor of a four-storied building within the Aobayama Campus. The building wobbled, but the presenters, judges, and members of the audience just looked at each other with a feeling like, "Oh, is it another earthquake?" We were used to it, because in the preceding several weeks we had experienced a number of earthquakes with intensities of about 4 or 5 on the Japanese *shindo* scale. However, several seconds later the situation took a dramatic turn. The shaking became massively stronger in a way that was completely different from the recent tremors, and even though I was in the front row I had no time to escape, but instead crawled under a desk for the first time in my 60-odd years. (Mistake #1: I had gotten used to the earthquakes, and I decided that this one would be of the same level as usual; experience and expectations can actually be dangerous. Expectations are readily dashed.)

All I could do was to pray, thinking that the building is relatively new, being five or six years old, so it should hold up, that earthquakes usually end in one or two minutes, and that I wanted it to end soon. However, I also thought repeatedly about three times that when this massive earthquake is just about finished another one will come. It seemed to have continued for several minutes. When the shaking had somewhat relented and we quickly escaped from the building, there were already many people who had evacuated to the outside and were listening to the radio. The radio was running an emergency earthquake report and giving tsunami information, telling anyone near the coast to evacuate quickly because a tsunami of about six meters was coming. While I was impressed with the rapid media response, a gigantic tsunami far larger than the expected six-meter one struck and caused this tragic situation. (Mistake #2: When I heard that a six-meter tsunami was on its way, a feeling of doubt that such a huge tsunami would really come momentarily crossed my mind, since I myself had seen that past warnings did not always come true; the reliability and accuracy of advanced warning information is important, and although it is a difficult problem the key is whether people believe the information or not.)

### The damage conditions must be ascertained by direct viewing at the sites

As I was going to the chemistry building a few minutes' walk from there, I looked at the physics building for the Graduate School of Science and saw damage that was readily apparent from outside. Everyone from the Department of Chemistry had

already evacuated to the designated plaza. The chemistry building had sustained no damage as far as could be seen from outside, and at that time there were no fires. For someone who had seen the outbreak and continuation of fires in the chemistry building during the 1978 Miyagi Earthquake some 30 years prior on the 7-o'clock NHK News (at that time I was watching it from Kyoto), I had the impression that the damage to the chemistry building was so great considering the massiveness of this latest earthquake. However, I later learned that a fire had broken out in a room on the 7th floor not immediately after the earthquake but a little while afterward (fortunately it was limited to that room), and that the building had sustained extremely heavy damage internally. When I actually entered the building a few days later, I saw that the concrete had fallen off the pillars, leaving the steel beams exposed, and people were worried as to whether the damage could really be fixed by mere repairs. Inside the laboratories, chemicals, glass instruments, and documents were strewn about, laboratory tables and hoods had moved, and things were in a state of great disarray with extensive damage to expensive measuring devices. (Mistake #3: The damage to a building cannot be ascertained only by external appearances. The extent of the damage can only be grasped once the building is entered; this underscores the importance of having an on-site orientation and directly viewing the damaged sites. High officials from Japan's Ministry of Education, Culture, Sports, Science and Technology actually viewed the damage conditions at Tohoku University on the 17th by entering the buildings.)

To ascertain the damage situation at the Advanced Institute for Materials Research (WPI-AIMR), for which I am responsible, I immediately went to the Katahira Campus in the middle of the city to make sure everyone was all right. There was no conspicuous damage to buildings in the Katahira district and the conditions were quite different from those at Aobayama, and the atmosphere in the city in that area was calm considering that it was the first day of a massive earthquake. As embarrassing as it is for me to say this, at that time I had heard nothing of the gigantic tsunami or nuclear power plant accident. The situation changed completely on the following day. After spending a dark and cold night with the power, water, gas, and telephone services cut off, when dawn broke and it got lighter I first started to grasp the actual conditions of the massive earthquake disaster when I saw the photographs showing the devastation from the gigantic tsunami in a special edition of the local newspaper. I was completely unprepared, without a radio, candles, flashlight, or stored food. Fortunately I was able to contact my family in Kobe and Tokyo by phone the next day and let them know I was all right. Having to procure food to maintain my own life, I was in the same position as a student who lives day by day. I recommended the students to go home to their parents, the researchers who had a place to

evacuate to outside of Sendai to evacuate temporarily, and the foreign researchers to return to their home countries for the time being. (Emergency measure #1: The first priority for students and researchers besides those in charge is to ensure their safety and maintain their lives. Although resources need to be channeled into maintaining research and education activities and an early return to normalcy, initially the support of students, one's own safety, and cooperation with any requests from society must be prioritized.)

### Swift judgments and decisions during an emergency

Power was restored to the heart of Sendai about one day later. The university administration swiftly formed a task force the following day, and laid out all manner of steps that needed to be taken, such as safety confirmation, ascertainment of damage to buildings, and response to the nuclear power plant problem. We at the research organizations also took swift action on safety confirmation, verifying contact information and means of contacting each person, placing such information on the website, and other measures. When the power was restored, the televisions came back on, and I saw the miserable situation caused by the gigantic tsunami, I was at a loss for words in how to share the feelings of those struck by the disaster. What we were able to do was to check on the safety of those around us and restart research activities as soon as possible. After a while the water services were restored in the city center and life is gradually returning to normal, but there still remain the problems of food shortages and gasoline and other fuel shortages. The damage to the chemistry building at the Aobayama Campus is grave, and even now (at the end of March, some three weeks after the disaster) entry into the building is generally prohibited. Although persons affiliated with the university cannot contribute to the restoration of infrastructure, assessments of building damages are needed. That is to say, swift judgments are required as to whether each building can be repaired and how many months it will take to restore it to its original condition, or whether it must be rebuilt. (Emergency measure #2: Swift judgments are required regarding the restoration of buildings that suffered damages. The restoration of power was quick, but since the situation of not being able to enter the buildings persisted for quite a while, there were several days where nothing was done. Perhaps there is a need to transcend the rules in some cases and to some degree at the discretion of those who are responsible for the department during an emergency.)

There is a shortage of experts to conduct assessments of damaged buildings. Experts from the Ministry of Education, Culture, Sports, Science and Technology are unable to be dispatched to Tohoku University because they are busy assessing elementary schools, junior high schools, high schools, and other public buildings that suffered damages in eastern Japan, and there are not enough personnel in the construction department of Tohoku University to meet the demand. We are receiving the support of experts from several other universities, but even still there is a lack of personnel. Internationally and domestically many research institutions have expressed concerns about the stagna-

tion of research here, and we have received offers for temporarily taking in researchers and students. We are full of gratitude at such gestures of support. At the same time, it is also a fact that, if students and researchers do not stay at Sendai, it is not easy to restore research facilities to their original condition. If infrastructure is restored, buildings can be entered and the situation can be returned to normalcy within a few weeks, we need to have the students and researchers stay in Sendai. If restoration will take several months, there needs to be a temporary evacuation with a place for each laboratory to be taken in and the research restarted there, and if the buildings have to be rebuilt it will take perhaps one or two years so the chemistry laboratories will have to be moved to another location during this period. (Emergency measure #3: While expressing gratitude for the offers of taking in students and researchers, urgent judgments must be made as to which path will be taken based on the damage conditions of the buildings.)

Finally, regarding the nuclear power plant issue, I am concerned that overseas media may be lacking in accuracy and becoming overly nervous based on rumors. We in Sendai, which is near Fukushima, have the most interest in the situation, and we keep a constant eye on the radiation monitoring information. On the university website, we announce measured data twice a day. The radiation data are of a completely safety and unproblematic level, and the amount of radiation has generally remained constant since the accident happened. It seems that perhaps several organizations are releasing data with no coordination, including newspapers. At our organization, the university website data is sent to foreign researchers, they are being requested to return to Sendai, and in actual fact they are starting to return. (Emergency measure #4: To prevent damage from rumors overseas, the Japanese government needs to release data from reliable international organizations, such as the IAEA, for global consumption in a united fashion.)

Although of course the support of the government is necessary in facing this tremendous earthquake and its aftermath, each researcher can initially only employ his or her ingenuity and knowledge to the fullest extent and autonomously advance improvement and restoration efforts in his or her surrounding environment. There has been a great circle of support spreading internationally, and we have also received support and encouragement domestically. I would like to thank everyone for this support as we advance toward rebuilding.

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