

The NSC views on, and future actions to take for, the impacts due to the Niigata-ken Chuetsu-oki Earthquake in 2007

NSC Decision No. 17, 2007
30 July 2007

The Niigata-ken Chuetsu-oki Earthquake in 2007¹ (the Earthquake) on 16 July 2007 has strongly shaken the Kashiwazaki-Kariwa Nuclear Power Station of the Tokyo Electric Power Company, Inc. (TEPCO). The impacts caused include a fire breakout of the Unit 3 transformer, and water spills containing small amount of radioactive materials at Unit 6 and its subsequent release to the non-radiation control area and to the environment. A joint of the driving shaft of the overhead crane of the Unit 6 reactor building has been also found to have damaged.

No serious concerns about the environmental impacts have been identified so far. Nevertheless the Nuclear Safety Commission (NSC) of Japan believes that the damages suffered by the systems and equipment at the station leave us with big lessons in ensuring seismic safety of nuclear power plants.

Thorough investigations of the impacts on the nuclear power plants due to the Earthquake are intensively underway, whereas the growing interests are being raised among stakeholders overseas and in the country. Following are the NSC views, as of today, on the Earthquake impacts and future actions to take.

1. Immediate impacts of the Earthquake

(1) Ensuring major safety functions such as automatic reactor shutdowns

The Earthquake shook the plants with the maximum seismic accelerations exceeding the values assumed in the design, but all the units in operation or in power ascension (Units 2, 3, 4 and 7) were automatically shut down under control. Together with other units in the maintenance mode (Units 1, 5 and 6), all seven units at the Kashiwazaki-Kariwa Nuclear Power Station are now brought to the stable cold standby mode. Therefore, the emergency requirements of "shut-down, cool and contain" have been successfully met for ensuring nuclear safety.

(2) Investigation of impacts due to the Earthquake, and future actions

The incidents caused by the Earthquake are now under in-depth investigation and the total 64 cases on Units 1 to 7 (except four cases of automatic shutdowns due to the Earthquake) have been reported. Fifteen cases out of them are reported to be relevant to radioactive materials, but no cases have caused concerns of environmental impacts.

Thorough investigations are due for the reactor pressure vessel internals and other major

¹On July 16, 2007, at 10:13 (JST) there was a M6.8 (preliminary) earthquake at a depth of approximately 15km in the off-shore Chuetsu region, Niigata prefecture. Source: http://www.jishin.go.jp/main/chousa/07jul_chuetsu_oki/index.htm (in Japanese)

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safety-related components. Comprehensive evaluation of the impacts due to the Earthquake should follow incorporating such investigation results. The NSC will keep its awareness of the progress for necessary evaluation, receiving the relevant reports from NISA as their evaluation develops.

2. Ensuring seismic safety

(1) Requirements of the revised Seismic Safety Design Examination Guide and safety checks of existing nuclear power plants

a) Requirements of the revised Seismic Safety Design Examination Guide

The NSC revised in September last year (2006) the "Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities (Seismic Guide)." The revised Seismic Guide (the New Seismic Guide) requires the operators: (1) to investigate in detail the conditions of the active geological faults using latest technologies; (2) to analyze the ground motions with latest methods; and (3) to upgrade the formulation of the "Earthquake ground motions without the site specific epi-center." In doing so, the New Seismic Guide requires the operators to define the ground motions bigger than those by the earlier version of the Seismic Guide, using the latest knowledge and data, and to ensure the safety functions thereto.

b) Seismic safety checks of existing nuclear power plants (back checks)

Upon authorization of the New Seismic Guide in September last year (2006), the NSC requested through NISA all existing nuclear power plants, which had been designed based on the earlier version of the Seismic Guide, be reevaluated for seismic safety, referring to the New Seismic Guide (the so-called "Back checks") by the operators. In response, the back-check work is ongoing by the operators, and some of their results are being reviewed by NISA.

In this reevaluation processes, the complete and earliest checks are important, pursuant to the New Seismic Guide, on the formulation of the Design Basis Earthquake Ground Motion (DBEGM), reliabilities of the analytical models used in the design, and the use of latest knowledge made available after the original design. The operators' evaluation results are subject to the review by NISA and further by the NSC.

c) The effectiveness of the New Seismic Guide

It is important to make concluding judgment in the seismic safety, without any prejudices, based upon the scientific knowledge and facts. The necessity of revising again the New Seismic Guide should be judged after the new DBEGM be formulated in the back-check process and verified against the actual impacts due to the Earthquake. It is not the time to contend its necessity now. The NSC will judge its necessity appropriately, in view of these verification results as well as the external experts' opinions.

(2) Detail understanding of shakes due to the Earthquake and additional investigation of geological faults around the plant site

The Earthquake has recorded at the Kashiwazaki-Kariwa Nuclear Power Station the inexperienced tremors far exceeding the values assumed in the original design. The operator should disclose the detail data, as early as possible, relevant to the Earthquake (seismometer recordings, etc.). The NSC will receive the report at its "Project Team on Seismic Safety Investigation (Seismic Safety PT, founded on 5 July 2007)" for necessary evaluation, as soon as the relevant information is made public.

Detailed investigation is needed concerning the active fault(s), which broke out the Earthquake at the Kashiwazaki-Kariwa Nuclear Power Station. As soon as the TEPCO investigation plan is fixed on the geological faults and seabed formations around the site, the NSC will receive the report at its Seismic Safety PT for its evaluation.

(3) Actions to take at all existing nuclear power stations

a) Confirmation of supporting capabilities of structures and systems

The New Seismic Guide prescribes in its basic policy "to install structures and systems on the ground with sufficient supporting capabilities." Namely, it requires them to be installed on the ground with sufficient supporting capabilities for design loads depending on their classes of importance, contrary to the earlier Seismic Guide, which had the similar requirements only to the safety important structures and systems. However, the uneven ground settlement due to the Earthquake has damaged quite a number of systems, components, piping and ducts, etc.

The NSC requests TEPCO to take necessary measures to meet the requirements of the New Seismic Guide, including the possible foundation improvement or reinforcement, for the structures and systems of Seismic Classes B and C in addition to those of Class S, after identifying the real damages due to the Earthquake.

This request should be applied to all existing nuclear power units in the back-check processes, not limited to those of the Kashiwazaki-Kariwa Nuclear Power Station.

b) Earliest back-checks and the disclosure of the results

The TEPCO back-check program made available in October last year (2006) foresees the completion of the work for the Kashiwazaki-Kariwa Nuclear Power Station by December next year (2008). However, the NSC requests the operators review their back-check programs and advance their geological investigation and formulation of the DBEGM. The NSC will receive the report on the results at its Seismic Safety PT for evaluation.

Further, for the Kashiwazaki-Kariwa Nuclear Power Station, the NSC thinks it important to disclose the results at the earliest practicality. The NSC requested NISA at its extraordinary

session on 17 July 2007 to instruct the operator to submit the evaluation results as soon as individual work packages are complete.

c) Setting up of seismometers and record-taking of seismic data

Seismometers installed at every reactor building at the Kashiwazaki-Kariwa Nuclear Power Station after the "Niigata Chuetsu Earthquake in 2004 (Mid Niigata Prefecture Earthquake in 2004²)" could collect a lot of valuable data. In the meantime, some of collected data were lost regrettably despite the experience at the Noto Hanto Earthquake in 2007³. The seismic data are extremely valuable in improving seismic safety of all nuclear power stations. It should not be limited to the safety checks for the subject specific earthquake. Adequate measures by all the operators are requested thereto. The NSC Seismic Safety PT will also check the status of seismometer installations at each nuclear facility and data keeping measures to prevent their losses.

d) Preparation of revising the safety examination guidelines concerning geologic and ground conditions

The "Safety Examination Guidelines Concerning Geologic and Ground Conditions (Geologic Guideline)" identifies the items to examine, concerning the geologic and ground conditions of the site for locating the nuclear reactor, when the safety examination is conducted pursuant to the Seismic Guide. The Geologic Guideline is being prepared for revision, as specified in the "Revision of relevant clauses on seismic guidelines for power generating nuclear installations (an earlier NSC decision on 19 September 2006). To this end, relevant information is being collected and analyzed. The work will be advanced and the preparatory revision work will be initiated at an appropriate timing for incorporating latest knowledge.

e) Earliest incorporation of latest knowledge

New knowledge obtained from the Earthquake should be evaluated at the earliest practicality and be incorporated in the back-check processes, as needed, including the lateral development to other existing nuclear power units.

(4) Evaluation of "Residual risks"

The New Seismic Guide requests, in its commentary to the basic policy, the operators to pay due attention to the "residual risks (the risks of system damages causing dispersion of radioactive materials and radiation exposure of the public, due to the ground motions exceeding the assumed

² On October 23, 2004, at 17:56 (JST) there was a M6.8 earthquake with a maximum seismic intensity 7, at a depth of approximately 10km in the Chuetsu region, Niigata prefecture. Source: <http://www.jishin.go.jp/main/index-e.html>

³ On March 25, 2007, at 09:42 (JST) there was a M6.9 (preliminary) earthquake at a depth of approximately 10km near the west coast of the Noto Peninsula, Ishikawa prefecture. Source: <http://www.jishin.go.jp/main/index-e.html>

DBEGM)” and to make efforts to minimize them to the maximum practical extent. Upon request, the operators are currently evaluating them, as part of their back-check processes.

Probabilistic risk assessment of the “residual risks” still has rooms for future development for applications. But the quantitative evaluation is requested to the operators on the test trial, which will advance and facilitate future full applications.

(5) Strengthening of safety research relevant to seismic safety

Operators, regulatory bodies and other research institutions are requested to strengthen and reinforce their research programs on seismic safety. In particular, precision improvement in the fault investigation in the ocean and on the land, or that in predicting the magnitudes of earthquakes should be advanced. Collaboration with the Headquarters for Earthquake Research Promotion⁴ would be more than important.

The NSC will hold a nuclear safety research forum “Seismic safety and safety research” for the exchange of relevant information and knowledge as well as opinions on future research needs for seismic safety.

3. Trouble shooting of fires, etc. at earthquakes

(1) Trouble shooting frameworks for fires, etc. at earthquakes

The fire of the Unit 3 transformer at the Earthquake developed safety concerns among the public because of insufficient effectiveness of the private fire brigade, unavailability of fire control systems, and delayed notification to the external fire station, and as its consequence a lot of time needed to bring the fire under control. The operators are requested to establish a system, in which any necessary equipment and manpower are available at any time including holidays and nights, in preparation for unavailable assistance from external sources. Such systems should be prescribed in the respective safety rules of the operators. The NSC will conduct relevant subsequent regulation reviews in due course.

(2) Strengthening of fire protection measures at earthquakes

The Regulatory Guide for Reviewing Fire Protection of Light Water Nuclear Power Reactor Facilities (the Fire Protection Guide) requires the fire control systems to be designed so as not to lose seriously its capabilities under concurrent earthquake conditions, depending on the classes of safety importance of reactor facilities. The NSC takes the preparatory actions to revise the Fire Protection Guide, taking note that the fire control systems did not function properly at the Earthquake.

⁴ A special governmental organization, attached to the Ministry of Education, Culture, Sports, Science and Technology, was established in accordance with the Special Measure Law on Earthquake Disaster Prevention in July 1995 in the wake of the Great Hanshin-Awaji Earthquake Disaster. <http://www.jishin.go.jp/main/index-e.html>

4. Reporting system and information dissemination upon troubles

(1) Notification to the central and local governments and publicity

People point out that the notifications from the operator to the central and local governments were delayed, and the publicized contents were not easily understandable to the public. The NSC requests the operators and NISA to reconsider the notification and publicity system for improvement.

(2) Accountability to the nation

In order to mitigate nuclear safety concerns among the public, most important is for the operators and NISA to recover the public trust and foster their understanding. Their activities in this regard contribute to the further improvement of nuclear safety. The constant activities by the operators and NISA are requested to ensure the transparency of information, and to disseminate to the public relevant information on radiation safety. The NSC also accounts for proactively to the public on the ensuring of seismic safety.

(3) Information sharing internationally

NISA as well as the NSC have been promoting the information sharing with the IAEA and other nations. It is our nation's responsibility as one of the most earthquake-ridden countries to disseminate the new knowledge learned from the Earthquake to the world for improving safety. Japan shares the lessons with the IAEA delegation of investigation. NSC also takes actions to disseminate relevant information internationally.

5. Conclusions

The NSC is in a position to avoid any prejudices on nuclear safety, especially in the seismic safety. The NSC prioritizes the open-mind and learning attitudes of placing primary importance in the scientific knowledge and facts. The NSC adheres to its philosophy.