Disaster management planning against large-scale earthquakes and tsunamis in Japan

Disaster Management Bureau,
Cabinet Office of Japan
19 March, 2018
Anticipated large-scale earthquakes in Japan

The Nankai Trough Earthquake
- Tokai Earthquake (with possibility of prediction)
- Earthquakes of the Tokai, Tonankai and Nankai one earthquake or 2-3 earthquakes occur in a row, the largest class earthquake

Probability of occurrence in the Nankai Trough within 30 years of M8 to 9 class earthquake: appx. 70-80%

Damage to aged, primarily wooden urban areas and major cultural assets is of concern

The Chubu and Kinki Inland Earthquakes

Tokyo Inland Earthquake (M7)
Probability of an M7 class earthquake occurring in the southern Kanto area within 30 years: appx. 70%

M8 Class Trench-type Earthquakes
- The Great Kanto Earthquake in 1923

Probability of an M8 class earthquake occurring within 30 years: 0-5%

Probability of an earthquake (M 7.9) occurring offshore of the Nemuro Peninsula within 30 years: appx. 60%
Large scale earthquakes which occurred after 1600 (in Nankai trough)

A large-scale earthquake occurred roughly every 100-150 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Magnitude</th>
<th>Time After First Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1605</td>
<td>Keityou earthquake</td>
<td>M7.9</td>
<td>32 hours</td>
</tr>
<tr>
<td>1707</td>
<td>Houei earthquake</td>
<td>M8.0</td>
<td>102 years</td>
</tr>
<tr>
<td>1854</td>
<td>Ansei Nankai earthquake</td>
<td>M8.4</td>
<td>2 years</td>
</tr>
<tr>
<td>1854</td>
<td>Ansei Tokai earthquake</td>
<td>M8.4</td>
<td>90 years</td>
</tr>
<tr>
<td>1946</td>
<td>Nankai earthquake</td>
<td>M8.4</td>
<td>Blank 72 ~</td>
</tr>
<tr>
<td>1946</td>
<td>Tonankai earthquake</td>
<td>M7.3</td>
<td>Blank 164 years</td>
</tr>
</tbody>
</table>

3 earthquakes might be related
Earthquake intensity distribution (Simulation using a model)

According to the strength wave calculation

Basic case

East side case

West side case

Land side case

According to the empirical

<table>
<thead>
<tr>
<th>The relevant area</th>
<th>Estimation in 2014</th>
<th>Estimation in 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic intensity more than “6 lower”</td>
<td>About 71,000 km²</td>
<td>About 24,000 km²</td>
</tr>
<tr>
<td>Seismic intensity more than “6 higher”</td>
<td>About 29,000 km²</td>
<td>About 6,000 km²</td>
</tr>
<tr>
<td>Seismic intensity 7</td>
<td>About 4,000 km²</td>
<td>About 400 km²</td>
</tr>
</tbody>
</table>

Distribution map of the maximum earthquake intensity

- Basic case
- East side case
- West side case
- Land side case

Seismic intensity levels:
- About 71,000 km² (6 Lower)
- About 24,000 km² (6 Higher)
- About 29,000 km² (6 Higher)
- About 6,000 km² (6 Higher)
- About 4,000 km² (7)
- About 400 km² (7)
Scale and tsunami height
- Scale 7: in 127 municipalities
- Tsunami height more than 10m in 79 municipalities

Dead and missing persons, damaged buildings
- 323,000 people (in midnight, winter)
- 2.386 million buildings (Evening, winter)

Infrastructure
- Electricity loss: 27 million cases
- Communication network loss: 9.3 million cases

Impact on every day’s life
- Evacuees: 9.5 million people
- Food shortage: 32 million meals in 3 days

Economic damage
- Damage on assets: 1.49 trillion USD
- Damage on economic activities: 39.4 billion USD

※There are several scenario of damage level depending on when the earthquake occurs (season, time, etc.,), Those figures above are not from one scenario. The most critical figures were selected among different cases.
Damage in time series

【 Damage immediately after the event 】 Need to take actions further

・Low earthquake-resistant housings will fall down in most areas. Many casualties. Many people need to be rescued.
・Many housings will be washed away by tsunami. Those who heard tsunami warning will escape in higher places. However, many people will die and become missing.
・Fire occurs. Fire fighters are not able to reach the area due to damage on roads and traffic jam.

・For a blackout, information will not be available through TV.

Need to evaluate the amount of damage in time series in order to arrange necessary actions to cope with the situation.

<table>
<thead>
<tr>
<th></th>
<th>Immediately after the event</th>
<th>the day ~ 2 days later</th>
<th>3 ~ 6 days later</th>
<th>1 week later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifeline damage</td>
<td></td>
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<tr>
<td>Transportation facility damage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on people’s every day's life</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Emergency response</td>
<td></td>
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Strategies for Disaster Risk Reduction of Nankai Trough Earthquake

To reduce damage by Nankai trough earthquake, a master plan based on special measures law was established. (2014)

Estimating the worst case damage, the disaster management measures and the emergency measures are developed. Those measures are being promoted steadily, contributing to reducing damage.

Set damage reduction goals for next 10 years

- Maximum number of estimated casualties
  Reduce roughly by 80% from about 332,000※

- Maximum number of buildings estimated to be fully destroyed or burned:
  Reduce roughly by 50%
  from about 2500,000※

※ The biggest damage was reconsidered for plan decision time (2012, 2013) from damage assumption time (2014).

Set specific goals for measures designed to achieve damage reduction goals

(1) Decrease casualties
(Example)

- Designation of Tsunami refuge facilities
  (Tsunami refuge buildings etc.)
  【 current 28% (2011) ⇒ 100% 】
- Introduction of the administrative radio (and other communication tools) for protection against disasters.
  【 current 83% (2012) ⇒ 100% 】

(2) Reduction in property damage
(Example)

- Seismic reinforcement of houses
  【 current 79% (2008) ⇒ 95% (2020) 】
Necessity of Anti-tsunami Measures

(Following the similar estimation procedure)
The largest class of Tsunami which may occur was estimated.

【Tsunami height】
(At a high tide)
Direct causes of people’s death in past major earthquakes

The Great East Japan Earthquake in 2011

About 90% Death by Tsunami

- Crushed, Damaged, others 4.4%
- Burned 1.1%
- Unspecified 2.0%
- Drawing 92.4%

As of April 11, 2011

Source: White Pater 2011, Cabinet Office

15,856 deaths
3,021 missing

As of June 4 2012

The Great Hanshin-Awaji Earthquake in 1995

About 80% Death by Building Collapse

- Burned 12.8%
- Unspecified 3.9%

Source: The autopsy statistics in Kobe city, 1995, Hyogo Prefecture Medical Examiner

8,434 deaths
3 missing

The Great Kanto Earthquake in 1923

About 90% Death by Fire

- Damage, Factory etc. 1.4%
- Washed away and burial 1.0%
- House complete destroyed 10.5%
- Unspecified 3.9%
- Fire 87.1%

Source: Japan Association for Earthquake Engineering, “Journal of JAEE, vol. 4 September, 2004”, Mortality Estimation by Causes of Death Due to Kanto Earthquake (September 1, 1923), Takafumi Moroi, Masayuki Takemura

105,385 deaths

missing

* The number of people deaths or missing is the numerical value of each organization’s announcement at that time, which is different from the latest value released by the National government.
When the Tokai region is severely damaged.

**Fatalities caused by the Tsunami**

- **About 230,000 persons**
- About 164,000 persons
- About 117,000 persons
- About 93,000 persons
- About 77,000 persons
- About 60,000 persons

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**Impact of Anti-tsunami Measures for the Nankai Trough Earthquake**

<table>
<thead>
<tr>
<th>Low Early Evacuation Rate</th>
<th>High Early Evacuation Rate</th>
<th>100% Immediate Evacuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speed up of starting evacuation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soft measures (Self-help/Mutual assistance)</td>
<td></td>
</tr>
</tbody>
</table>
Emergency Response Activities in the event of a Nankai Trough Earthquake

**Key issues**

1. Being aware of the importance of the first 72 hours when saving a human life, set a time line and target actions in each of the fields of emergency transport routes, rescue, medical services, goods, fuel in various fields (Example: Wide area movement routes are secured within 24 hours, wide area support units arrive one after the other, etc.)

2. Dispatch support units by mobilizing resources nationwide, in particular, to support areas where the damage can be the most critical.

**Rescue, emergency medical service, firefighting, etc.**
- Dispatch support units from 37 prefectures other than the selected prefectures to be prioritized for receiving support (maximum numbers)
  - Police: 16,000
  - Fire fighters: 17,000
  - Self-Defense Forces: 110,000, etc.
- Aircrafts 580, ships 520

**Medical treatment**
- DMAT (registered number of teams: 1,571 teams) provides medical support.
- Support recovery of medical institutions in the affected areas (human resources, goods and fuel supply, etc.).
- Provide region-wide support for critically ill or injured patients by transporting them to proper medical centers in the region.

**Goods**
- Procure relief supplies needed for 4 to 7 days after the occurrence of the disaster. Transport them to the logistic centers in the affected prefectures.
  - Water: emergency water supply 460,000 m³ (first 1-7 days)
  - Food: 72 million meals
  - Blankets: 6 million
  - Diapers: 4.8 million

**Fuel, electricity and gas**
- Secure a supply system beyond the group of affiliated companies in oil industry. Priority supply to core SSs on the emergency transport routes. Priority supply to important facilities such as hospitals, etc.
- Priority supply to important facilities by power supply vehicles and mobile gas supply facilities.

The national government will respond immediately according to the arrangement by the crisis response headquarters, prior to requests from affected areas and regardless of scarce information on damage, (push-mode support).

- Designate “Emergency Transportation Routes” for personnel and goods in advance. Secure transport through the routes.
- Set up “Disaster Management Bases” for each activity by field and secure them.

Shizuoka Prefecture, Aichi Prefecture, Mie Prefecture, Wakayama Prefecture, Tokushima Prefecture, Kagawa Prefecture, Ehime Prefecture, Kochi Prefecture, Oita Prefecture, Miyazaki Prefecture
RECENT TOPICS 1

REVISION OF THE EARTHQUAKE OCCURRING PROBABILITY IN THE LONG TERM ASSESSMENT
Reporting the long term assessment on trench type earthquakes

- Earthquake Investigation Committee was established under the earthquake research promotion headquarter in the Ministry of Education, Culture, Sports, Science and Technology.
- This committee provided information which became a basis for disaster management policy planning regarding earthquakes in the Cabinet Office.
- The location, the scale and a probability of earthquake occurrence are assessed and report them to the public as a long term assessment of possible earthquakes.

Trenches that were investigated

The Nankai Trough Earthquake
(Simulation using a model & Estimating damage)
Revision of the earthquake occurring probability in the long term assessment.

- Event probability of an earthquake in long term assessment was statistically calculated by the seismic activity record in the past.
- Unless a new earthquake occurs, it will be increased along with the time passed.
- The probability as of its annual January 1 is recalculated by February.

**Main change point (2018)**

<table>
<thead>
<tr>
<th>Nankai-trough (M8 ~ M9)</th>
<th>The probability as of January 1, 2017</th>
<th>The probability as of January 1, 2018</th>
</tr>
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<tbody>
<tr>
<td>Within next 10 years</td>
<td>20%-30%</td>
<td>About 30%</td>
</tr>
<tr>
<td>Within next 30 years</td>
<td>About 70%</td>
<td>70%-80%</td>
</tr>
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</table>
RECENT TOPICS II
DIFFICULTY OF THE PREDICTION OF AN EARTHQUAKE (IN A SHORT TERM)
Future steps regarding the “Special measures law of large-scale earthquake” and new approaches

The occurrence of earthquakes can not be predicted with high accuracy according to the present science and technology. (concluded in 2017)

It is necessary to revise the current disaster management policies regarding Tokai earthquakes based on the special law.

the entire area of Nankai-trough.

○ Neuromas damage is expected, even though well prepared measures are taken

Estimated damage

without measures : About 323,000

causalities

with measures : About 61,000 people

causalities

○ Several patterns of earthquake occurrence are forecasted in Nankai trough.

1854 an earthquake occurred in the west side followed by an earthquake in the east side 37 hours later

1944 an earthquake occurred in the west side followed by an earthquake in the east side 2 years later

○ Various unusual phenomenon could be observed before a large scale earthquake. These observation information is important.

When unusual phenomenon are observed, what can be assessed scientifically? What actions can be prepared?

It is necessary to consider basic direction regarding immediate disaster management responses, based on the assessment of the most typical patterns.
Basic procedure of “Information related to Nankai-trough earthquake”

Occurrence of an unusual phenomenon

※In the case when an earthquake of magnitude more than 7 occurred around Nankai-trough, or when a significant change was observed in the strain meters installed.

Emergency information regarding Nankai trough earthquake

An estimation about the unusual phenomenon in “Investigation committee on earthquakes around Nankai trough area”

Emergency information regarding Nankai trough earthquake

When a possibility increased relatively never than before.

Emergency information related to Nankai trough earthquake

The phenomenon which occurred and the evaluation result are announced.

When the state of emergency is evaluated to be decreased, announce it as the end of the emergency information sharing.
Thank you

Prime Minister’s Office
Reconstruction following the Great East Japan Earthquake
http://www.kantei.go.jp/foreign/incident/index.html

Cabinet Office, Government of Japan Reports and Brochures
http://www.bousai.go.jp/kyoiku/panf/report_brochure/etc.html