

# The Promotion of Earthquake Research

Basic comprehensive policy for the promotion  
of earthquake observation, measurement, surveys and research

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Headquarters for Earthquake Research Promotion

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## Foreword

The Special Measure Law on Earthquake Disaster Prevention (June 16, 1995, Law no. 111) was put into effect after the Hanshin-Awaji Earthquakes, and in accordance with this law, the Headquarters for Earthquake Research Promotion (hereinafter referred to as Headquarters for Promotion) was inaugurated in the Prime Minister's Office. The Headquarters for Promotion has as one of its missions the drawing up of a basic comprehensive policy for the promotion of observation, measurement, surveys and research (hereinafter referred to as "earthquake research").

As this basic comprehensive policy is of great importance, the task of setting it was to be taken on only after a careful and thorough examination of the issues at hand. Established with due consideration of solicited public opinion, this policy is a standard for the promotion of earthquake research, as well as a guideline for the activities of the Headquarters for Promotion

## Chapter 1 The Setting of a Basic Comprehensive Policy

The basic ideas behind the establishment of the basic comprehensive policy for the promotion of earthquake research are as follows.

### 1. Basic goals and character of the policy

The Special Measures Law on Earthquake Disaster Prevention, which is the basis for the establishment of the Headquarters for Promotion is to draw up a "basic comprehensive policy for the promotion of observation, measurement, surveys and research related to earthquakes".

The basic aim of the earthquake research to be promoted according to this basic comprehensive policy is, in accordance with the purport of the Special Measures Law on Earthquake Disaster Prevention, to contribute to a strengthening of earthquake disaster prevention measures, and especially to a reduction in damage caused by earthquakes.

This policy does not simply indicate a basic direction for earthquake research, it also includes measures necessary for the effective promotion of earthquake research and the application of research results. This policy will also be the basis for the promotion of earthquake research during the next ten years, and will be a guideline for work carried out by the Headquarters for Promotion, including administration of the budget, clerical work, the setting of measures for a comprehensive survey and observation plan, and public relations. As according to the Special Measures Law on Earthquake Disaster Prevention, the opinion of the Central Disaster Prevention Council must be taken into consideration in the drawing up of this policy, this policy must indicate measures for the use of earthquake research results in disaster prevention, as well as measures for ensuring that the requirements of people involved in earthquake prevention are reflected in the promotion of earthquake research.

### 2. Basic understanding for the establishment of the policy

Disaster prevention measures in Japan are carried out according to the aims outlined in the Basic Disaster Prevention Plan established by the Central Disaster Prevention Council, and earthquake disaster prevention measures are included in the same framework. The "Basic Disaster Prevention Plan (earthquake disaster measures section)" (June 1997) presents disaster prevention measures, disaster emergency measures, disaster relief and reconstruction measures, tsunami (tidal wave) countermeasures and wide-ranging earthquake disaster countermeasures, and it includes earthquake research. Thus, the policy for the promotion of earthquake research that is the subject of this report is one part of the earthquake disaster prevention measures as a whole. In order to reduce the damage caused by earthquakes, the promotion of more wide-ranging earthquake disaster prevention measures is necessary, and the results of earthquake research must be made use of in earthquake disaster prevention.

Earthquake disaster prevention institutions and earthquake researchers must work in cooperation with one another. This means that the requests that people involved in earthquake disaster prevention make of earthquake research must be appropriately

reflected in policies related to the promotion of earthquake research, and the results of earthquake research must be reflected in national earthquake disaster prevention measures. When planning directions for earthquake research, one must always consider which information about the results of earthquake research should be presented, and how it should be presented for it to be most useful for earthquake disaster prevention. Earthquake disaster prevention measures are for a large part dependent on the response of citizens. Therefore, at the time of the establishment of a policy related to earthquake research, it is necessary to keep in mind how citizens can make use of the results of earthquake research results. For this reason, it is necessary to give serious consideration to research related to earthquake disaster prevention carried out by local public bodies and institutions related to disaster prevention run by government and citizens, as well as to the practical application of its results.

As earthquake research promoted according to the present policy is to contribute to decreasing damage caused by earthquakes, it should be understood to include research of strong tremors and ground tremors.

Prediction is seen as an important means of minimizing damage caused by earthquakes. If research has been done on the history of earthquakes caused by faults that have repeatedly been active in the past and of deep-sea earthquakes, to a certain extent it is possible to predict the location and maximum magnitude of a future earthquake. However, of the three important factors in predicting an earthquake, which are time, location and magnitude, with the exception of "Tokai earthquakes", which can be predicted in the case of phenomena such as unusual changes in the earth's crust, time is difficult to predict accurately enough to be able to issue a warning. For this reason, in order for the results of earthquake research to be used in drawing up measures for the reduction of earthquake damage such as the strengthening of structures and facilities to make them earthquake-proof, the research must be promoted and its results disseminated. On the other hand, if it is possible to predict an earthquake just prior to its occurrence, so that a warning can be issued, if appropriate preventive measures are taken, human casualties, fires and the occurrence of secondary disasters can be greatly reduced. For this reason it is desirable for research on earthquake prediction to continue at a steady pace.

If the accuracy of long-term earthquake predictions is improved, in certain areas, if the time period until the occurrence of an earthquake that is predicted to cause great damage is known to a certain degree of accuracy, appropriate earthquake disaster prevention measures can be taken. Even if the time period is not clear, if the earthquake's magnitude and degree of probability can be predicted, various preventive measures can be taken.

Earthquake disaster prevention measures are only possible if information about the earthquake is accurately conveyed and accurately understood. Basic knowledge about earthquakes and new information must be disseminated by means of public information campaigns. At this time, an increased number of surveys and observations performed in a certain area, or an indication of an imminent earthquake must not lead people in other areas to the misunderstanding that a major earthquake will not occur where they are.

In the case of advances in science and technology related to earthquakes, or of a major change in the roles of related ministries

and government offices and institutions, or in public expectations of earthquake research, the present policy will be reviewed.

## Chapter 2 Measures for the Promotion of Earthquake Research

Earthquake research should only be promoted after a thorough examination of the latest earthquake-related findings. This chapter outlines the basic plan for the promotion of earthquake research and the application of its results.

### 1. Promotion of earthquake research and basic maintenance

#### (1) Promotion of basic research and observation related to earthquakes

Measures for the prevention of earthquake disasters, which aim to reduce earthquake-induced damage, will be strengthened through accurate knowledge and an increased understanding of earthquakes. For this reason, based on the "Basic Earthquake Survey and Observation Plan" (determined by the Headquarters for Promotion on August 29, 1997), which was drawn up as the core of a comprehensive survey and observation plan, earthquake observation by means of a highly sensitive inland earthquake seismometer (minute earthquake observation), earthquake observation by means of a wide-area inland seismometer, observation of earthquake movements (strong tremors), observation of changes in the earth's crust (GPS continual observation), and surveys of active inland and coastal faults will be promoted. Furthermore, in accordance with this plan, efforts will be made to perform other types of surveys and observations involving studies of the effectiveness of techniques, and how studies should be carried out.

In carrying out these surveys and observations, past surveys and observations conducted all over Japan, in-depth regional surveys and observations, and investigative surveys and observations will be taken into consideration.

Basic surveys and observation such as earthquake observation and observation of changes in the earth's crust (GPS continual observation) provide some of the most basic information needed for the evaluation of the state of activity of the earth's crust. Also, basic surveys and observation make possible an accurate understanding of the mechanism and aftershocks of major earthquakes, as well as contributing to research into earthquake prediction. As an example, they can elucidate the long-term series of processes that occurs when distortions accumulate in the earth's crust, are released, and then accumulate again.

#### (2) Promotion of accumulation and distribution of survey, observation and research data related to earthquakes

The data on observation, measurement, surveying and research of earthquakes collected by the national government is jointly owned by the citizens of Japan. With this understanding, as well as being widely used by related researchers, and effectively used to further research in various related fields such as earthquake surveying and research, and earth science, it is important for this data to be made available to the general public, so that it can deepen its understanding of the phenomenon of earthquakes. For this purpose, with the cooperation of all parties involved, a data center will be established to enable the collection, management and distribution of the results of earthquake-related surveys and observations to be carried out smoothly.



It is also important to improve the system to collect, organize and make available data from past surveys, observations and research.

### (3) Promotion of basic research

It is a well-known fact that distortions in the earth's crust, which cause earthquakes, result from plate movements of a global scale. Recently, improvements in observation techniques using space technology such as GPS have elucidated plate movement, and have provided new methods for continual observation of changes in the earth's crust. On the other hand, a succession of new discoveries made possible by a deepening of the understanding of earthquakes, has shown how complicated the subject is, and indicates a necessity to return to basic research. Furthermore, advances in earthquake research are dependent to a great degree on developments in a wide range of scientific and technical fields, including surveying and observation technology, information technology and simulation technology, not to mention earth science. For this reason, basic earthquake and earthquake-related research will be promoted.

Research based on the ideas and discoveries of researchers is especially important. Assuming that observation data is readily available to researchers who need it, the possibility of implementing a competitive research fund to make the most of researchers' ideas and opinions will be examined.

### (4) Division of roles, and cooperation between national administrative agencies, survey, observation and research institutions, and universities, as regards the promotion of earthquake research

Because earthquake research is very wide-ranging, it does not fit into the framework of independent ministries and government offices. Also, it takes on many forms, from research by universities and national testing and research institutions and investigative surveys and observation, to business-type surveys and observation by so-called "service government agencies". Accordingly, through the promotion of distribution and publicizing of information and data, it is important for all the related ministries and government offices to cooperate in line with the aims of the Headquarters for Promotion to further earthquake research. At this time it is necessary to consider the smooth execution of research based on the ideas of researchers at universities and other institutions.

Universities are expected to concentrate more on research and investigative surveys and observation, and widely publicize the results of observations as well as research, thus contributing to the promotion of earthquake research. In addition, it is expected that universities will actively contribute to the application of the results of earthquake research to disaster prevention by providing people involved in disaster prevention with leadership and advice. Furthermore, universities are well-equipped with observation

facilities, and for the time being, until as yet unobserved areas are observed, are expected to cooperate in the execution of basic surveys and observation. However, while taking into account factors such as the occasional financial situation, they should update their observation facilities as soon as possible.

Furthermore, the national government must support earthquake research such as surveys of active faults conducted by local public bodies to promote local disaster prevention measures, and the training of researchers.

(5) Influence of the requirements of earthquake disaster prevention institutions on the promotion of earthquake research

In order to effectively apply the results of earthquake research to earthquake disaster prevention measures, earthquake research must be planned, drawn up and actually conducted, taking into account the requirements of people involved in earthquake disaster prevention. For this purpose, dialogue and cooperation must be promoted between earthquake disaster prevention institutions and people involved in earthquake disaster prevention associated with national and regional public bodies such as the Headquarters for Promotion and the Central Disaster Prevention Council, and people conducting earthquake research.

The Headquarters for Promotion and the Central Disaster Prevention Council must cooperate further in working toward the common goal of reducing the damage caused by earthquakes. In order to do so, concrete methods of increasing cooperation between people involved in earthquake disaster prevention and earthquake researchers will be examined, so that the requirements of the earthquake disaster prevention side will be reflected in earthquake research. One such method could be the establishment of a place for holding meetings for information exchange between the Central Disaster Prevention Council and the policy planning committees of the Headquarters for Promotion.

As well, in order for the results of earthquake research to be applied to earthquake disaster prevention measures implemented by disaster prevention institutions, efforts will be made to provide disaster prevention institutions with required information such as the whereabouts of the results.

## 2. Promotion of cooperation on a wide range of levels

(1) Promotion of earthquake disaster-prevention engineering research and cooperation between engineers conducting research on earthquake disaster prevention and earthquake researchers

The results of earthquake research can sometimes be directly applied to earthquake disaster prevention measures, but in many cases the results can only be used for earthquake disaster prevention measures after having an engineering application. In this way, in order for the results of earthquake research to be useful for concrete earthquake disaster prevention measures, the role played by earthquake disaster prevention engineering is very important, and it is necessary to promote earthquake disaster prevention engineering research in cooperation with earthquake research. For this purpose, cooperation between earthquake researchers and researchers involved in earthquake disaster prevention engineering will be increased, workshops on common issues will be held, and joint research will be actively promoted.

As a concrete example, in order for findings resulting from improvements in methods of strong tremor prediction to be applied to the improvement of earthquake resistance of structures and facilities, improvements in methods of predicting strong tremors which take into account applications in the field of earthquake disaster prevention engineering, and the provision of required fault parameters, cooperation between earthquake disaster prevention engineering and earthquake research will be promoted.

As for the prediction of strong tremors, the skill and knowledge in the private sector is important. It is important to further earthquake research by gathering skill from the public, and academic and private sectors, by such means as requesting the cooperation of related councils.

Also, as the damage caused by earthquakes affects the life and property of the public, in order to apply the results of earthquake research to earthquake disaster prevention measures, it is important to have an understanding of social science-related subjects such as people's mentality, behavior and economic activity. For this reason, cooperation between fields related to social science, and earthquake research will be promoted.

(2) Dissemination of information deemed necessary to gain public understanding in the application earthquake research results

The results of earthquake research can only contribute to a decrease in damage caused by an earthquake if they are correctly understood by the public and people involved in disaster prevention. It is also important for the inhabitants of a region to have an "earthquake image" consisting of information such as the type of earthquake most likely to occur in their area, the types of earthquakes that have occurred in their area in the past, and the type of earthquake predicted to cause damage in their area in the future, as well as for them to be always ready to take appropriate preventive measures and to deal with the aftermath of an

earthquake.

In order for each individual citizen to respond appropriately to an earthquake, the latest findings about the phenomenon of earthquakes must be disseminated and fully understood. It is therefore important for information about earthquake activity, changes in the earth's crust, tremors, etc. in Japan, to be clearly conveyed to the public in various ways.

For this purpose, the information about all kinds of earthquakes that is presently known will be classified according to region and used to revise the "Earthquake Activity in Japan - Characteristics of Destructive Earthquakes by Region" compiled by the Earthquake Survey Committee, which will be widely distributed. Periodicals such as "Weekly Earthquake and Volcano Outlook", published by the Meteorological Agency, are provided to the press, and in order for the public to have more opportunities to see this type of information, journalists will be asked for their understanding. Furthermore, public information based on the results of earthquake surveys and observation, including observation data for a basic survey and observation network presently being improved, on comprehensive assessment results regarding earthquakes based on survey and observation results, and on probability assessment results for aftershocks will be used to reduce earthquake damage.

In order for earthquake research results to be easily understood by the general public, to enhance disaster prevention awareness and concrete disaster prevention activity, and to have an effect on the concrete disaster prevention measures of national and regional disaster prevention institutions, a place for the policy committee and the earthquake survey committee to cooperate and hold discussions on public information based on a comprehensive assessment of earthquake activity, and on an effective distribution policy for earthquake research results, will be established at the Headquarters for Promotion. The discussions held there will enable the diffusion of clearly explained public information. At that time, in light of information from the Meteorological Agency, consideration will be given to the smooth execution of business based on the Meteorological Affairs Law.

In order to spread basic knowledge about earthquakes, seminars and symposia for people involved with disaster prevention, and the general public will be held, and education and training related to earthquakes and earthquake disaster prevention will be provided.

In addition, support will be given to members of the general public who use earthquake survey and observation data for earthquake disaster prevention.

### (3) The role of the national government and the role of local public bodies in the application of earthquake research results

The Basic Disaster Prevention Plan points out that "In order to lessen disasters, permanent disaster countermeasures and effective response at the time of earthquakes are necessary, but these cannot be achieved overnight; they can be realized through planning

and mutual cooperation between the national government, public institutions, regional public bodies, the business community and the public".

For the results of earthquake research to be used for the reduction of damage caused by earthquakes, planning and mutual cooperation between the national government, public institutions, regional public bodies, the business community and the public are essential, and it is important for there to be liaison and cooperation with the national government and regional public bodies, as well as liaison and mutual cooperation among regional public bodies.

It goes without saying that the national government applies the results of earthquake research to its own earthquake disaster prevention measures. However, it is also desirable for regional public bodies, which have a central role in setting regional earthquake disaster prevention measures, to incorporate the results of earthquake research into their earthquake disaster prevention measures so that they can help to reduce injury and casualties among local residents. For this purpose, in addition to establishing opportunities for explanation the progress of earthquake research and its results to regional public bodies, the national government will support the activities of regional public bodies by providing expert guidance and advice as needed.

#### (4) Cooperation between the Headquarters for Promotion and councils related to earthquake research

It is necessary to deepen the cooperation between the Headquarters for Promotion and councils related to earthquake research, as well as to elucidate the division of roles between them.

The Headquarters for Promotion will work on drawing up a comprehensive basic policy regarding earthquake research, including earthquake prediction research, and drawing up a comprehensive survey and observation plan, while taking the proposals of Geodesy Councils into consideration. As it has been pointed out that "In the case of the government itself establishing a comprehensive survey and observation plan at the Headquarters for Promotion, it must stop playing the role it had played up until then in the earthquake prediction plan, and revise the plan. (January 1998 "Recommendations based on results of government inspection of earthquake disaster countermeasures"), the Headquarters for Promotion will be following the movements of future geodesy councils.

Because with the inauguration of the Headquarters for Promotion, the earthquake survey committee started to collect, organize and analyze earthquake survey results, and conduct comprehensive assessments based on these results, at present the earthquake prevention liaison conference does not conduct similar comprehensive evaluations related to earthquake prediction. However, at present an earthquake prediction liaison conference for the exchange of scientific information and opinions is still thought to be necessary. The earthquake prediction liaison conference itself is examining what form it should take in the future, and considering the state of progress, the Headquarters for Promotion will work towards a strengthening of cooperation with the earthquake prediction liaison conference, as far as a desirable level of information exchange and opinion exchange related to earthquake

research is concerned.

Based on the Special Major Law on Earthquake Disaster Prevention (Major Earthquake Law), regions where it is necessary to strengthen earthquake disaster prevention measures are designated as such after a review by the Central Disaster Prevention Council, and at present these are regions associated with "Tokai earthquakes". When a so-called "Tokai earthquake" is thought to be likely to occur, the director of the Meteorological Agency is obliged to report "earthquake prediction information" to the Prime Minister. A meeting room for the designation of regions where earthquake disaster prevention measures should be strengthened has been established at the Meteorological Agency so that the director of the Meteorological Agency can give reports as soon as possible. The Headquarters for Promotion endeavors to promote earthquake research while giving consideration to the smooth execution of this work.

#### (5) International cooperation

Because earthquakes are large-scale phenomena caused by changes in the earth's crust that accompany movements of the earth's interior, international joint observation and research, researcher exchanges, meetings of specialists and information exchange will be actively promoted with the cooperation of one or more other countries. Cooperation between two countries such as Japanese-American cooperation based on a Japanese-American partnership to lessen earthquake-caused damage, and cooperation with neighboring countries, and cooperation between several countries in organizations such as APEC will be furthered. Also, making widely available the results of earthquake research in Japan and other internationally useful data will contribute to a reduction in the damage caused by earthquakes and tsunamis all over the world.

### 3. Securing of a budget and fostering of talented personnel

#### (1) Securing of a budget and its efficient use

In order to efficiently and effectively promote earthquake research, ministries and government offices must cooperate closely, taking into consideration the comprehensive basic policy for earthquake research set by the Headquarters for Promotion, and, in accordance with the budget of the Headquarters for Promotion, endeavor to secure the necessary budget and to carry out surveys and research.

#### (2) Fostering and assurance of talented personnel

For earthquake research to produce results, it depends on the combined efforts of a wide range of researchers and technicians in

natural science and social science, and there are many interdisciplinary research and development issues. It goes without saying that each field requires outstanding personnel, and personnel who can deepen cooperation in research that straddles two or more fields, such as physical science and engineering, are required. For this reason, education and training offered by universities and national testing and research institutions related to earthquake research will be improved.

In order for the results of earthquake research to be reflected in earthquake disaster prevention measures, people involved in disaster prevention who have a deep understanding of earthquake research are essential. Accordingly, the national government will establish educational and training opportunities for regional public bodies and other people involved in disaster prevention to gain basic knowledge required for the understanding of the results of earthquake research.

In order for the results of earthquake research to be accurately conveyed to the general public, it is important for the necessary information to be transmitted through as many types of media as possible. Accordingly, the role of the press is very important, and the creation of opportunities for its members to receive training about earthquake research should be considered.

Also, education and training opportunities to foster the general public's understanding of the results of earthquake research and to enable them to apply the results to the way in which they handle a disaster, will be investigated.

#### 4. Assessment of earthquake research

Various ministries and government offices will evaluate research in accordance with the "General guidelines about the way assessment which is common to all research and development carried out by the national government should be conducted" established by the Prime Minister, based on studies presented at science and technology conferences.

The state of progress of surveys and observation based on the basic survey and observation plan will be assessed by the Headquarters for Promotion, and revision of the basic survey and observation plan, as well as the drawing up of a comprehensive survey and observation plan will be promoted.

Clerical work performed by the Headquarters for Promotion such as budget-related work, that has been assessed in this manner, will be carried out in consideration of the assessment results.

The Headquarters for Promotion will perform the necessary assessment of the whole scheme for the promotion of earthquake research, and if necessary revise the comprehensive basic policy.

## Chapter 3 Earthquake Research Requiring Immediate Promotion

The results of earthquake research must influence the activities that contribute to a lessening of earthquake-caused damage on the part of the general public and disaster prevention institutions. For this reason, the results of earthquake research must be given as information related to the concrete measures and actions taken by the general public and disaster prevention institutions.

From this point of view, the main issues related to the earthquake research that must be promoted by the national government in the immediate future are as follows. It is desirable for the results of this earthquake research to be successively applied to earthquake disaster prevention measures, while taking due consideration of the opinions of disaster prevention institutions.

### 1. Preparation of maps showing predicted earthquake activity which consolidate surveys of active faults, long-range assessment of the probability of earthquake occurrence, and prediction of strong tremors

As a part of the comprehensive assessment of earthquake activity by the earthquake survey committee, survey results such as activity intervals for major active faults, survey data related to underground structure, long-term probability assessment of earthquake occurrence, and methods of predicting strong tremors will be combined, and an earthquake tremor prediction map that surveys the whole of Japan, including probability information about predicted strong earthquake movements, will be created with the cooperation of related institutions. For this reason, related surveys and research will be conducted at survey, observation and research institutions. In particular (1) elucidation of the characteristics of inland and coastal earthquakes, and systematization of information, (2) elucidation of the characteristics of deep-sea earthquakes, and systematization of information, (3) long-term probability assessment of the occurrence of earthquakes, (4) improvement of methods of predicting strong tremors, and (5) underground structure surveys will be promoted. When the results of these types of earthquake research become even partially clear, they should, if possible, be applied to earthquake disaster prevention measures.

Because earthquake tremor prediction in the form of probability organically combines probability predictions for earthquake occurrences themselves and the prediction of strong tremors, if it is thought that there is a possibility that an area will be affected, all of the major earthquakes must be given consideration. All earthquakes and the probability of their occurrence, and the prediction of the distribution of tremors of each earthquake should be collected, and provide points of contact between earthquake research and earthquake disaster prevention engineering.

One example seen of the all-Japan earthquake tremor prediction map shows information predicted through the use of probability, about the possibility of a certain region being struck by strong earthquake tremors during a certain period of time. Generally, two of the three factors of period, tremor level and probability are fixed, and the distribution of the other factor is indicated on the map by means of an isopleth. It is expected that this type of map will enable the comparison of earthquake danger levels for different regions, and provide useful, easily understandable information about the national land plan and disaster prevention plans drawn up by municipalities.



However, information about the possibility of earthquake occurrence, including probability is not necessarily easy to understand. In order to raise the public's awareness of earthquake disaster prevention, and have it used for earthquake disaster prevention measures, the information should be carefully explained, and considered from the point of view of social science. As for the form in which information should be collected, it should be carefully considered, taking into account the intentions of disaster prevention institutions, other related parties, and the public. At this time, in order for the public to feel that the information is relevant, it should span a period of only several decades. However, for earthquakes caused by active inland faults, the probability of earthquake occurrence over a short period of only several decades will not be high, and care must be taken to ensure that it is not mistakenly interpreted as reassuring information.

In the beginning, the earthquake tremor prediction map will provide a general view of the whole country, and will probably be used mainly to raise the public's awareness of earthquake disaster prevention. In the future, the earthquake tremor prediction map will make predictions more precise, and if more detailed regional maps are made, they will have a key role in the creation of earthquake-resistant municipalities and regions (in land use planning, and for the setting of earthquake-proof standards for facilities and structures). The map will also be a reference for the strengthening of before-the-fact earthquake disaster prevention measures according to damage estimation. It is also expected to be used to evaluate the risks of establishing important facilities and enterprises in a certain area.

The data and methods used to make the earthquake tremor prediction map are, as a rule, made public, and the details of the map-making can be verified by people in related fields. New knowledge and advances that have resulted from surveys of active faults, such as advances in surveys of underground structure, improvements in prediction of strong tremors, and an increase in the accuracy of earthquake prediction, have made it necessary to make the map more precise.

The items related to earthquake research that should be promoted for the drawing of the earthquake tremor prediction map are as follows.

(1) Elucidation of the characteristics of inland and coastal earthquakes and systematization of information

Information on the main locations of active faults and their degree of activity will be clarified by means of nationwide surveys of active faults.

For main inland and coastal active faults this consists of:

1. information on the precise position of the fault and its form,
2. in the case of the fault in question having been active, information such as the estimated magnitude of the earthquake, and
3. information on the history of the fault's activity, and the average activity interval.

Based on the "Basic Survey and Observation Plan", at the same time as surveys are promoted, archaeological and geological

surveys of earthquake vestiges will be promoted, historical documents and information will be systematically collected, organized and analyzed, and old earthquake records will be transferred to a data base.

At this time, while applying our knowledge of seismology, we aim to offer fault parameters in a form that can be used for the prediction of strong tremors.

Also, from data obtained from earthquake observation based on the basic survey and observation plan, we aim to accurately grasp the present state of activity and form of faults, and based on these, to assess their potential activity range. The results will form basic data for the prediction of strong tremors. Because it is possible for great damage to result from an earthquake caused by an active fault that is not presently known, methods of surveying "new" active faults will be examined.

## (2) Elucidation of the characteristics of deep-sea earthquakes and systematization of information

For deep-sea earthquakes that may cause damage in Japan, we aim to elucidate:

1. precise information on their location,
2. information on the estimated magnitude of the earthquake, and
3. information of the history of the earthquakes' occurrence,

and further survey and research, as well as historical data, the systematic collection of information, its organization and analysis.

At this time, while applying our knowledge of seismology, we aim to furnish fault parameters in a form that can be used for the prediction of strong tremors. We will also promote surveys and research that will improve technology for the prediction of the wave height of tsunamis.

## (3) Assessment of long-term probability of earthquake occurrence

Based on the results of nation-wide surveys of active faults, the systematization of information on deep-sea earthquakes, and data on past earthquakes, at present, using methods now under investigation by the earthquake survey committee, we conduct long-term probability assessments on the possible occurrence of regional shallow earthquakes and deep-sea earthquakes. In order for the public to feel the danger and imminence of an earthquake, it is desirable for them to be given information on the probability of occurrence, in increments of several decades, with the imminence index for as short a period of time as possible.

Also, because it is possible that an earthquake caused by a fault other than one which is presently known will cause great damage, long-term probability assessments of these will be carried out.

#### (4) Improvement of techniques for the prediction of strong tremors

In order to predict strong tremors that occur in special areas arising from earthquakes originating in a major active fault deep-sea, and from deep-sea earthquakes, methods for the prediction of strong tremors will be improved. Also, because records of earthquakes that originated in a fault are useful for the prediction of major tremors from an active fault, based on the results of earthquake observation, data bases will be created for each active fault. Based on the basic survey and observation plan, the usefulness of the observation data from strong tremor observation facilities that are spread over Japan is great, and we will work to collect and publicize maintenance and observation data.

In addition, in order for the results of strong tremor prediction to be used for the improvement of earthquake-proof buildings and structures, their use in the field of earthquake disaster prevention engineering must be kept in mind, and with earthquake researchers and earthquake disaster prevention engineers cooperating closely, it is necessary for methods of strong tremor prediction to be improved.

#### (5) Promotion of underground structural surveys

For the prediction of strong tremors, information about underground structure, in particular the way in which earthquake waves propagate underground, is very important. In order to make more accurate predictions, underground structural surveys will be promoted, with emphasis on densely populated plain areas. In this case it is necessary to carry out surveys using elastic wave investigation, but for the time being surveys will be conducted on an experimental basis, while investigating appropriate methods and topics for each region.

Also, based on the basic survey and observation plan, it is very important that related data, such as that obtained at the time of installation of highly sensitive seismometers through digging be collected, so it can be effectively used.

Basic surveys are to be conducted by the national government, and in order for the people who need the data to be able to make extensive use of it, it must be widely publicized and stored in a data base.

In addition, efficient and effective new methods of researching underground structure will be fostered.

## 2. Promotion of real-time transmission of earthquake information

If the survey and observation results for an earthquake that has occurred are quickly distributed to the national government,

regional public bodies and the public, as well as to earthquake disaster prevention institutions such as private enterprises, and appropriate emergency measures are taken, it is possible to prevent the damage caused by the earthquake from increasing. At the Meteorological Agency, the National Land Agency, the Fire Defense Agency, regional public bodies and private enterprises will soon be equipped with systems to accurately grasp the regional distribution of tremors after the earthquake starts. While making contact with these systems, real-time data from the highly-sensitive seismometer, wide-area seismometer, strong tremor gauge, cable-type submarine seismometer, and tsunami gauge for basic survey and observation is collected. Methods of improving the real-time transmission of detailed information on the earthquake to earthquake disaster prevention institutions and people who need it will be investigated.

In addition, a real-time earthquake disaster prevention system that makes possible emergency response in main facilities and other buildings, will be researched and developed for cases of the principal shock resulting from a distant earthquake.

The appropriate response of related institutions is expected to lessen the damage caused by the earthquake.

### 3. Improvement of observation and other research in the areas of intensified earthquake disaster prevention measures determined by the Special Major Law on Earthquake Disaster Prevention and their vicinity

Observation and measurement in areas which have strengthened their earthquake disaster prevention measures based on the Special Major Law on Earthquake Disaster Prevention, and in their vicinity will be improved, and small changes in the earth's crust that will precede the "Tokai earthquake" will be detected. At the same time, the results of observation and measurement will be used to improve the accuracy of prediction of the "Tokai earthquake".

### 4. Promotion of observation and research for earthquake prediction

Because it is possible to greatly decrease the number of human casualties and secondary disasters that result from an earthquake through prediction of the earthquake's occurrence, the geodesy council's proposals (August 1998 "A new observation and research plan for earthquake prediction") for 1. observation and research for the elucidation of movements in the earth's crust up to the occurrence of the earthquake, 2. observation and research for improvement of the earth crust movement monitoring system, and 3. development of methods of simulation and observation of movements of the earth's crust are will be implemented. The Headquarters for Promotion will consider concrete methods of implementation. Also, in the promotion of these issues, GPS observation of changes in the earth's crust, highly-sensitive earthquake observation, and wide-area earthquake observation, which are promoted as basic surveys and observation, play a very important role in forming a reliable observation network.

By grasping and understanding the whole aspect of movement of the earth's crust up to the time of an earthquake, we will be able to promote surveys and research that aim to specify the last step of the process that leads up to an earthquake.

## Conclusion

People tend to be less aware of the danger of earthquakes than they should be. The geographic situation of Japan is such that major earthquakes will continue to occur in the future. It is thus very important to try to reduce the damage caused by earthquakes by conducting surveys and research, and research into earthquake disaster prevention.

In order to do this, the latest earthquake research results should be used in earthquake disaster prevention measures, in an effort to save as many people and as much property as possible. Everybody involved in earthquake-related activities should work together, through the promotion of research and the application of its results, to prevent, or decrease earthquake-induced damage.



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## The Establishment of the Comprehensive and Basic Policies Subcommittee

August 23,1996

Policy Committee

In order to set a comprehensive basic policy for the promotion of earthquake research for the next five to ten years, in view of contributing to a decrease in the damage caused by earthquakes, a comprehensive and basic policies subcommittee will be established within the policy committee as follows.

### 1. Matters for consideration

- (1) Intentions and objectives of earthquake research
- (2) Effective means to promote earthquake research
- (3) Means of applying the results of earthquake research to earthquake disaster prevention measures
- (4) Other matters

### 2. Staff

- (1) The members and technical experts on the subcommittee are to be appointed by the chairman of the policy committee.
- (2) The chairman of the policy committee will designate the chairman of the investigation subcommittee from among its members.
- (3) The chairman of the investigation subcommittee may invite experts to meetings to solicit their opinions.

Policy Committee of the Headquarters for Earthquake Research Promotion

Progress of the Deliberation of the Comprehensive and Basic Policies Subcommittee

	Day of the meeting	Main matters for deliberation
Meeting #1	October 3, 1997	-Confirmation of particulars of the establishment of the subcommittee, the activities of the Headquarters for Earthquake Research Promotion up to this point, and related matters -Report reviewing matters such as the progress of the Geodesy Council's earthquake prediction plan -Outline of the activities of the Central Disaster Prevention Council, the Geodesy Council, the Earthquake Prediction Liaison Council, and the council for determining areas to have strengthened earthquake disaster measures, and discussions on matters for deliberation by the subcommittee and on the objectives and scope of earthquake research
Meeting #2	November 18, 1997	-Explanation of the Basic Disaster Prevention Plan (earthquake disasters) -Discussion of objectives and intentions of earthquake research conducted by the Headquarters for Earthquake Research Promotion
Meeting #3	January 20, 1998	-Opinions about items requested of earthquake research from the point of view of earthquake disaster prevention, given by committee members from disaster prevention institutions and municipalities, and discussion about these opinions
Meeting #4	February 19, 1998	-Discussion of the relationship between policies related to earthquake disaster prevention and earthquake research -Discussion of the main proposals of the subcommittee's report
Meeting #5	April 13, 1998	-Explanation and discussion of recent activities of the Earthquake Survey Committee, including methods of assessing probability of aftershocks, and methods of assessing long-term probability of earthquake occurrence -Discussion of the main proposals of the subcommittee's report
Meeting #6	June 4, 1998	-Report given on proposals of Specialist Committee for Earthquake Disaster Measures for Major Cities of the Central Disaster Prevention Council (Draft) -Discussion of the main proposals of the subcommittee's report
Meeting #7	July 3, 1998	-Progress report on Geodesy Council's Earthquake Prediction Plan for the following term -Discussion of the main proposals of the subcommittee's report

Meeting #8	October 2,1998	-Report given on Geodesy Council's proposals -Discussion of the main proposals of the subcommittee's report
Meeting #9	November 10, 1998	-Discussion of the main proposals of the subcommittee's report
Meeting #10	December 16, 1998	-Discussion of the main proposals of the subcommittee's report
Meeting #11	February 26, 1999	-Discussion of solicited opinions regarding the main proposals of the subcommittee's report

## Special Measures Law on Earthquake Disasters (Excerpt)

(June 16, 1995)

(Law #111)

(Objectives)

**Article 1** This law, in order to protect the public from death, injury and loss of property resulting from an earthquake, requires the drawing up of a five-year emergency disaster prevention plan and the implementation of special national budgetary measures based on this plan. Also, by requiring a system for the promotion of surveys and research related to earthquakes, it strengthens earthquake disaster prevention measures, and aims to contribute to the maintenance of public order and public welfare.

(Omitted)

(The Establishment and office work of the Headquarters for Earthquake Research Promotion)

**Article 7** The Headquarters for Earthquake Research Promotion (hereinafter "Headquarters") will be established in the Prime Minister's Office.

2. The Headquarters will administer the business outlined below.

(a) Draw up a comprehensive and basic policies for the promotion of earthquake-related observation, measurement, surveys and research.

(b) Conduct business such as the administration of a budget for earthquake surveys and research conducted by government institutions.

(c) Establish a policy for comprehensive survey and research plans related to earthquakes.

(d) Collect, organize and analyze research results from government institutions and universities that conduct observation, measurement and surveys or research related to earthquakes, and conduct a comprehensive assessment of these.

(e) Conduct a publicity campaign based on the assessment of the previous provision.

(f) Business related to the Headquarters according to the provisions of the law, other than items (a) - (e) above

3. When the Headquarters conducts the business mentioned in (a) above, it must obtain the opinion of the Central Disaster Prevention Council.

4. According to the Meteorological Affairs Law (1952 Law #165), when performing office work, the Headquarters must take care to conduct its business smoothly.

(Organization of the Headquarters)

**Article 8** The director of the Headquarters is to be called "Director of the Headquarters for Earthquake Research Promotion (hereinafter "Director of Headquarters"), and is to be appointed by the Minister of State for Science and Technology.

2. The Director of Headquarters summarizes the affairs of the Headquarters.

3. Personnel from related government institutions are to be appointed to the Headquarters by the Prime Minister.

4. The general affairs of the Headquarters are to be summarized and attended to at the Science and Technology Agency. However, items that are the subject of a government ordinance are to be attended to jointly by the Science and Technology Agency and government institutions that are the subject of a government ordinance.

5. Matters other than those above which are necessary to the organization and management of the Headquarters, are to be decided by government ordinance.

(Policy Committee)

**Article 9** A policy committee will be established in the Headquarters in order to survey and deliberate on the business mentioned above in Article 7, clause 2. (a)- (c), (e), (f).

2. The members of the policy committee will be appointed by the Prime Minister from among the employees of related government institutions and people with education-related experience.

(Earthquake Research Committee)

**Article 10** An earthquake research committee will be established at the Headquarters in order for the affairs mentioned in Article 7, clause 2. (d) to be carried out.

2. When the Earthquake Research Committee judges it to be necessary, the affairs in the previous item will be reported to the Director of Headquarters.

3. The members of the Earthquake Research Committee will be appointed by the Prime Minister from among the employees of related government institutions and people with education-related experience.

(Collection of Information on Regional Earthquakes)

**Article 11** The Director of Headquarters may make a request to the Director of the Meteorological Agency for, among the affairs mentioned in Article 7, clause 2. (d), the collection of survey results of related government institutions and universities that conduct observation, measurement and surveys or research related to regional earthquakes.

2. When the Director of the Meteorological Agency receives a request as in the previous provision, and collects results, they must be

reported to the Director of Headquarters.

3. When conducting the business in clause 1, the Meteorological Agency and district meteorological observatories (including Okinawa Meteorological Observatory) will use the name "Regional Earthquake Information Center".

(Cooperation of Related Government Institutions)

**Article 12** The Director of Headquarters may request cooperation in the form of provision of data, or statement of opinion, from directors of related government institutions or other people, as deemed necessary, for the office works.

(Promotion of Surveys and Research)

**Article 13** The national government must establish a system for observation, measurement, surveys and research related to earthquakes, promote research and development necessary for the advancement of science and technology related to earthquake disaster prevention, and disseminate its results.

2. The national government must secure the necessary budget for the promotion of observation, measurement, surveys and research related to earthquakes.

3. The national government must provide the necessary technical and financial support for regional public bodies to conduct observation, measurement, surveys or research related to earthquakes, and for the training of researchers.

Supplementary Provision (Excerpt)

(Remainder omitted)