

## Other examples of response to Earthquake Early Warning

- Control signal for elevators and annunciation in manufacturing areas -

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Oct-5-2010

### 1 Introduction

Earthquake Early Warning (EEW) service has been disclosed to the general public on October 1th, 2007 by Japan Meteorological Agency (JMA). The service is deliverable for JMA-certified providers over 100 companies and organizations offered as a commercialized service and selling their customized receivers and terminal monitors.[1]. Lower warning level information is permitted for a purpose of *Intensive use*, which is discriminated from personal use, with small magnitude<sup>1</sup> bringing us though it would be bottomed out at a lower seismic intensity<sup>2</sup>[2]. Total numbers of warning issuances reach around over 3000 counts per annum. Figure.1 shows the inter-annual change of total issuances delivered from JMA as green with excluding "EEW Alert" counts as red, during each twelve months at the date of August 1th 2006<sup>3</sup>. Figure.1 indicates that frequency of the warning issuances reaches around a centuple of the corresponding alerts at the same period.

We can use the warning level issuance to control a elevator system to prevent people from being trapped, also to annunciate workers on a manufacturing area especially with hazardous tasks to ensure safety.

### 2 Control Signal of Elevators

Elevator emergency controlled operation when earthquake occurred has been regulated at their installation period. For example, threshold-based control has to be applied for a base of condition with combination for a building height (under 60 meters, 60 - 120 meters , above 120 meters), acceleration of P-wave

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<sup>1</sup>Estimated Mj greater than 3.5

<sup>2</sup>Lower than estimated maximum seismic intensity 4, public noticed by JMA at December 1th, 2007

<sup>3</sup>The advanced system of EEW launched for intended users before the general public shall be available.

trigger and its installed floor level (lowver, middle, penthouse). In any of these cases, EEW information makes emergency control more effective when receiving before local P-wave sensor is activated. Figure.2 illustrates an advantage of EEW information to apply for a controlled elevator operation<sup>4</sup>.

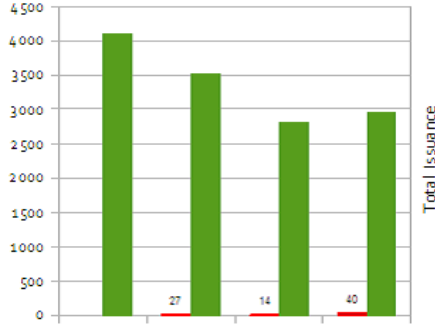


Figure 1: Total annual counts of EEW issuance aft Aug.1 2006

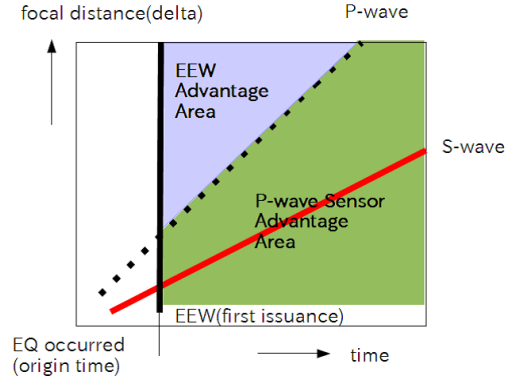


Figure 2: EEW advantage domain under controlled operation in t-delta map

Figure 3 shows a schematic flow in case of EEW information included in the current controlled system[3]. Processing of EEW will be inserted before executing the current operation. Estimated intensity becomes an entry signal for the EEW processing. Range of estimated elapsed time from EEW is a branch condition as which makes use of optimal operation for evacuation stop to a safety floor. Utilization of EEW should keep the functional safety<sup>5</sup> with current system.

Intended users can obtain a series of EEW issuance (warning level) each earthquake. First issuance is ultimately useful to bring us a largest elapsed time from EEW to S-wave arrival. However the accuracy of focal parameters, especially estimated magnitude might be insufficient for employing a target control. We should understand a feature of EEW issuances for typical large earthquakes with trade-off evaluation at accuracy and instantaneousness(Figure .4). Actually it takes estimated intensity 3 for a emergency threshold in an addition of avoidance (chattering) mechanism due to a longitudinal variation of estimated intensity and elapsed time. Also the same avoidance will be needed for the EEW/sensor reset competition.

<sup>4</sup>For example, Mitsubishi Electric Corporation, Press Release No.0602, May, 2006. <http://www.mitsubishielectric.co.jp/news-data/2006/pdf/0531.pdf>; ibid. No.0701 2007, March, <http://www.mitsubishielectric.co.jp/news-data/2007/pdf/0322.pdf>, in Japanese

<sup>5</sup>refers to IEC61508 (EN81-1)

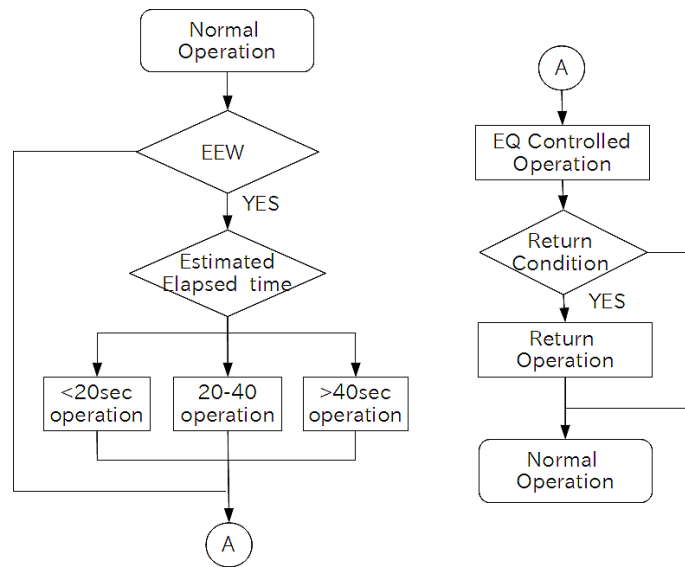


Figure 3: Schematic flow on controlled operation when earthquake occurred

### 3 Annunciation in Manufacturing Work Areas and DMC/CAO

The requirement of Disaster Management Center(DMC) for buildings with emergency elevators and underground shopping area over 1000 square meters is based on Building Standard Law. Also, Central Administration Office(CAO) has a requirement for a building over 11th. floors and over 10,000 square meter's gross floor on Fire Service Act. Consistent information should be needed on a making decision process for DMC/CAO and the controlled elevators when earthquake will be occurred.

Annunciation of the EEW alert is able to connect a contact signal for emer-

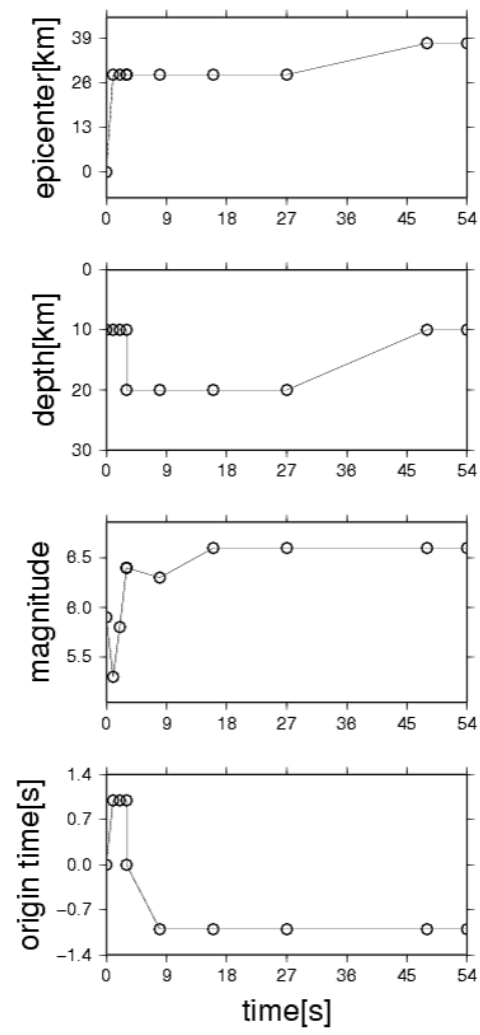


Figure 4: Estimated focal parameter for each issuance(2009 Suruga-wan earthquake)

agency broadcast facility at manufacturing areas and buildings. Several EEW terminal products have contact signal points to make use of this purpose. Several products guaranteed the operating range for outdoor or factory environment use. Also over 100,000 repeat for the contact module test should be done to ensure safe operation.

Example of annunciation will be shown in an oral presentation. Different annunciation have two categories. One is a type of narrative announcement with female voice. The other is an utterance of "noun alignments" or "repeating a couple of nouns". Some kinds of workers require run over specific words: "An-zen"(emergency), "Ka-ku-ho"(protect yourself), "Chu-u-i"(caution), "A-shi-mo-to"(watch your step) and so on. Recommended EEW chime performs twice at the start time. However to prevent second disaster in a certain work performing case, initiation chime will be inserted before EEW chime starting<sup>6</sup>.



Figure 5: Examples of EEW Terminal (JWA showcase)

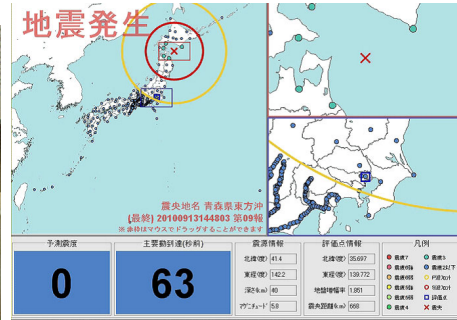


Figure 6: Example of EEW Terminal Monitor(Linux/windows), Sep. 13th, 2010(M5.7)

#### 4 Training for Disaster Prevention

JWA operated the broadcast training at the date of December 1st, 2009. Detail of EEW alert based on the scenario earthquakes around Japan. EEW alert for the general public had issued governmental scenario[5]. The intended user can use their customized scenario based on specific purpose and their business continuous program(BCP). Table 1 shows the summary of average use of practice for a whole of users with ANET and its alliance. This result suggest that the intended users perform practice twice use during one year, might be included with dummy run(See monthly details shown in Figure.7).

<sup>6</sup>emergency broadcast sets over 90 db magnitude with 1 meter distant from sound source

Table .1 Training Mode ("Kunrenhou")

Year	2006	2007	2008	2009	2010
Use Average[/YR/1 user]	2.05	3.32	2.26	1.52	1.86

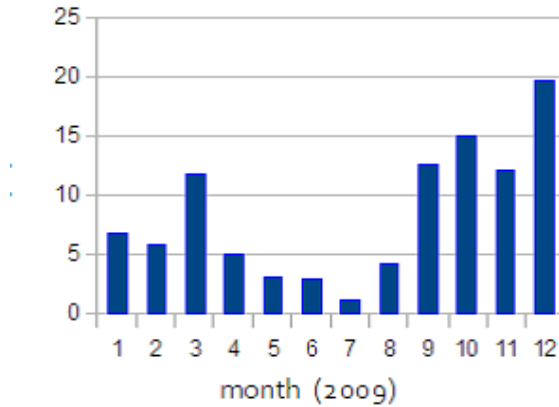


Figure 7: Percentage of usage in training mode during 2009

## References

- [1] <http://www.eewrk.org/> (Kinkyo Jishin Sokuho Riyousya Kyogikai *in Japanese*)
- [2] Meteorological Service Act "*Kisyo Gyomu Hou*", *in Japanese*, at December 1th, 2007 noticed.
- [3] Japan Building Equipment and Elevator Center Foundation, Commission Report of Utilization of EEW for Application of Elevator Control, March 2005, pp.11, , *in Japanese*.
- [4] Cabinet Office Government of Japan : DISASTER MANAGEMENT IN JAPAN, <http://www.bousai.go.jp/panf/saigaipanf.pdf>, *Bilingual(E/J) Leaflet pp.37*,2002.
- [5] <http://www.bousai.go.jp/oshirase/h21/091117kisyu.pdf>, *in Japanese*.