

Application of the earthquake early warning system for the OKI semiconductor factory

21/Apr./2009
Kenichi Takamatsu

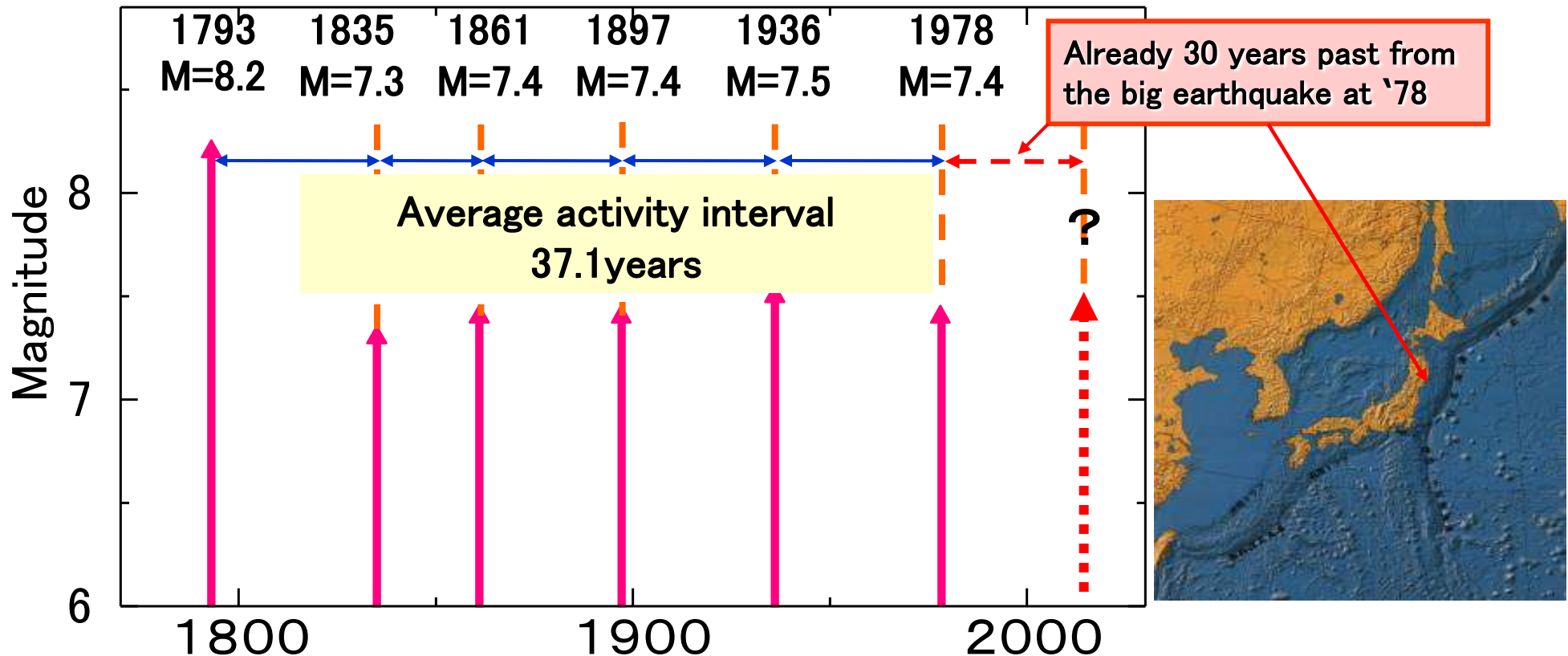
OKI OKI Engineering Co.,Ltd.

The Earthquake which brought Serious damage to semiconductor factory after '95 in Japan

17/01/1995	Hanshin Awaji big earthquake	M7. 3
21/09/1999	Chi-chi (Taiwan) Earthquake	M7. 7
24/03/2001	Geiyo earthquake	M6. 7
26/05/2003	Sanriku southern earthquake	M7. 0
26/07/2003	Miyagi-ken northern continuous earthquake	M6. 2
23/10/2004	Niigata-ken tyuuetu earthquake	M6. 8
16/08/2005	Miyagi earthquake	M7. 2
12/06/2006	Ohita-ken central earthquake	M6. 2
25/03/2007	Noto-hanto earthquake	M6. 9
16/07/2007	Niigata-ken Tyuuetu offing earthquake	M6. 8
14/06/2008	Iwate Miyagi inland earthquake	M7. 2
24/07/2008	Iwate-ken coastal northern earthquake	M6. 8

The Earthquake off the coast of Miyagi-ken is drawing near

Estimated from data in the past for 200 years, an average activity interval is 37.1 years. 30 years past from occurrence last 1978, and an earthquake investigation committee of a government is announcing event probability of the next Miyagi-ken earthquake about 99% within 30 years and about 60 % within 10 years.



OKI managed to minimize the damage from Earthquake on Business Continuity Management

premise	Seismic 6 (250 ~ 400 Gal)	Continuation of production activities
	Seismic 7 (>400 Gal)	Priority is the safety to an employee
Correspondence	Assumption earthquake	Earthquake off the coast of Miyagi-ken is drawing 90% within 30 years Assumption Earthquake is over Seismic 5
	Presumption of a prediction earthquake wave	Seismic parameter, Characteristic propagation, Foundation of Location Simulation of Earthquake wave reply
	Improvement of Earthquake resistance	Contain the damage of building and machine Building → high stiffness Machine → reconstruction and set the stopper Supply line → Backup Power, UPS for detector (Pure water, Exhaust, Boiler)

The Target of Restoration by seismic 6 at OKI semiconductor factory

■ Assumption of risk = seismic 6 (off the cost of Miyagi-ken)

■ Target of Restoration

Manufacturing process restart within 24 hrs to 16 hrs

Full product within 6 days to 3 days

■ Utility Zone& Supply Line

Two times of the serious damage by the seismic 5+ Earthquake in 2003

⇒ Shut down/off the special gasses/chemical by the Emergency bulletin
(Linked by Earthquake early warning system)

■ Product Machine

The product machine selected the reason why High cost / Long term to repair

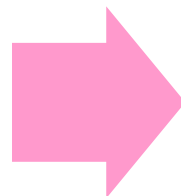
⇒ Reduction of Quake for building (Earthquake resistant construction)

Hold of Quake for Machine (Reconstruction, Stopper)

Machine soft landing (linked by Earthquake early warning System)

Reduction of Quake for building

before



Set 43's
Shear wall

after



Acceleration (Gal) at OKI semiconductor

	Before (26/07/2003)	After (16/08/2005)
Standard seismometer	2 2 5	2 2 8
1 st Floor	1 5 5	1 2 7
2 nd Floor	3 6 0	2 1 3

(Acceleration 40% reduction)

The target of Development “Real-time Earthquake Early warning System”

Emergency Earthquake bulletin / On site high-resolution Seismometer System Reliability improvement / Operation by vertical Earthquake

■ No false reaction

Emergency Earthquake bulletin/On site high-resolution Seismometer
(Use both Judgment)

■ Institutional improvement

Emergency Earthquake bulletin/On site high-resolution Seismometer
(Compare both Predicted value)

■ Prediction Institutional improvement in Earthquake arrival time

Use First emergency earthquake bulletin & Location information

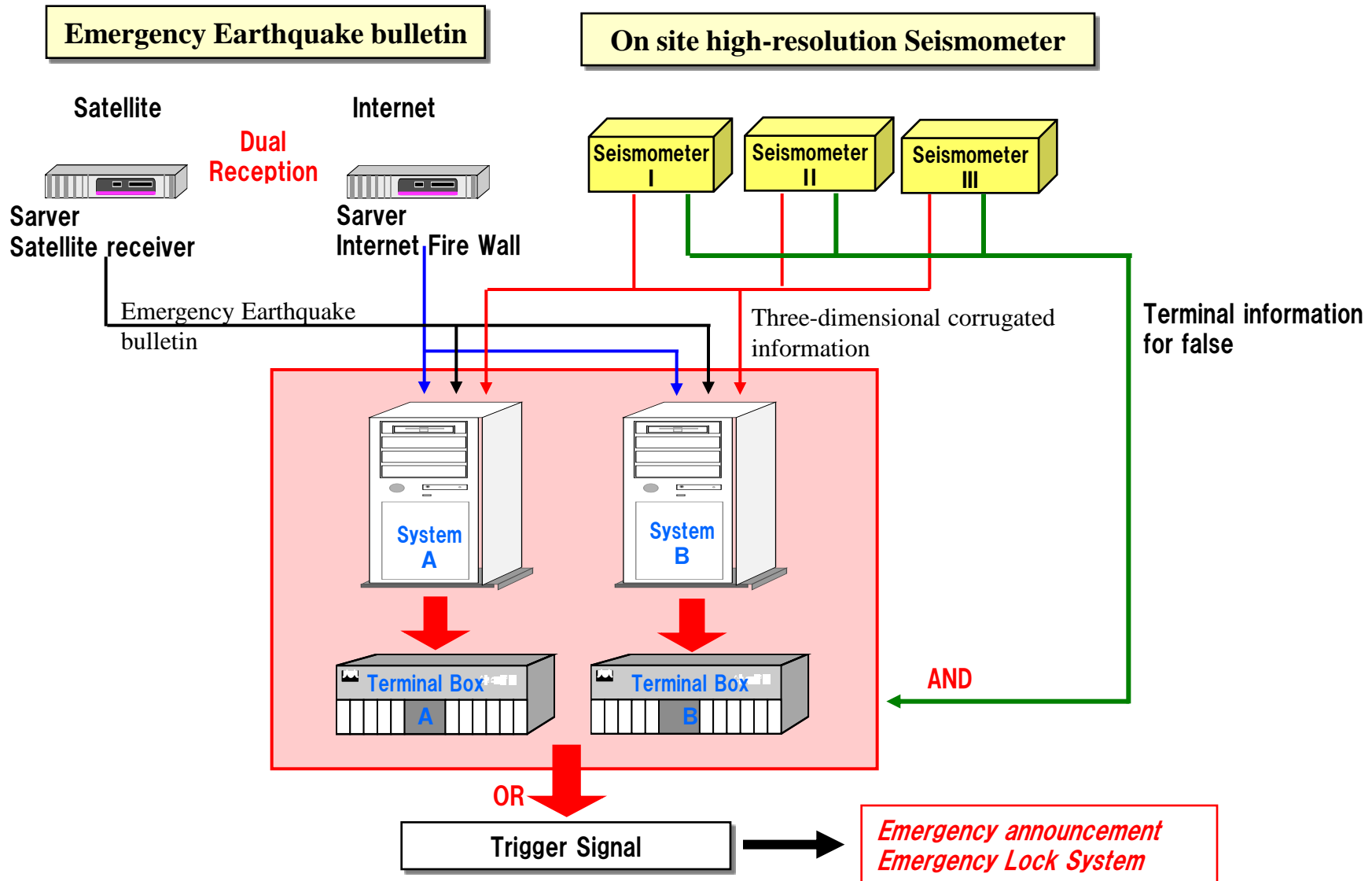
■ System Reliability improvement

Dual system
Dual Reception (Internet / Satellite)

■ Vertical Earthquake

Direct prediction in arrival time use the P wave of on site high-resolution Seismometer

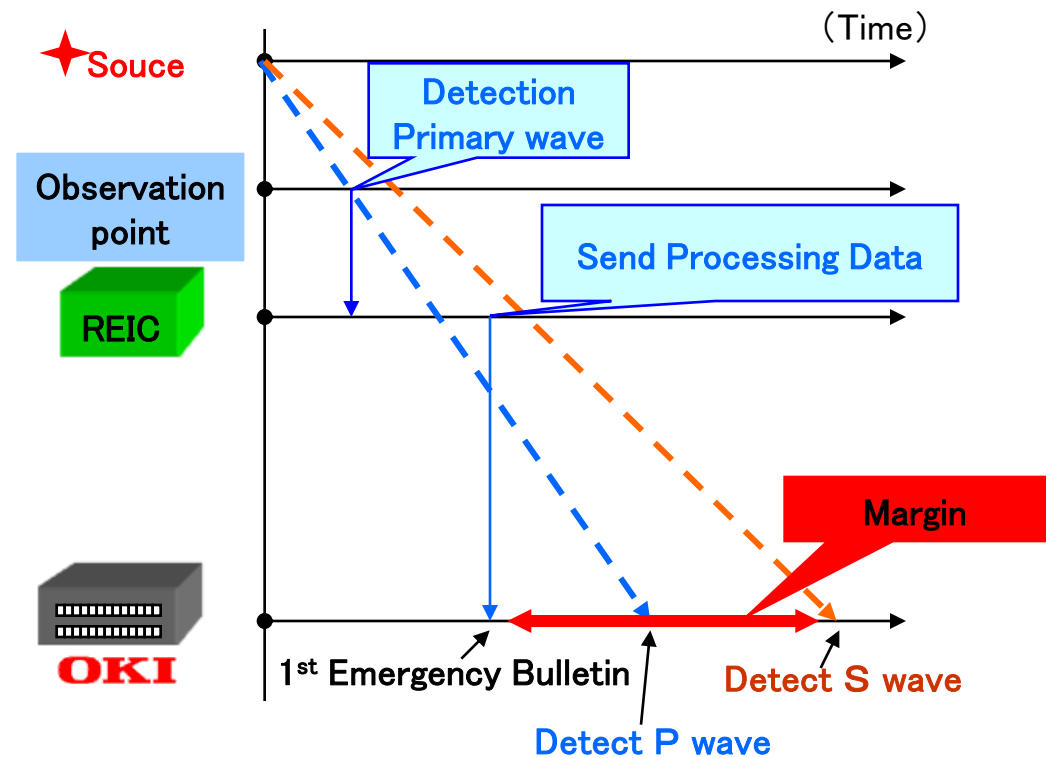
Dual System / Dual Reception



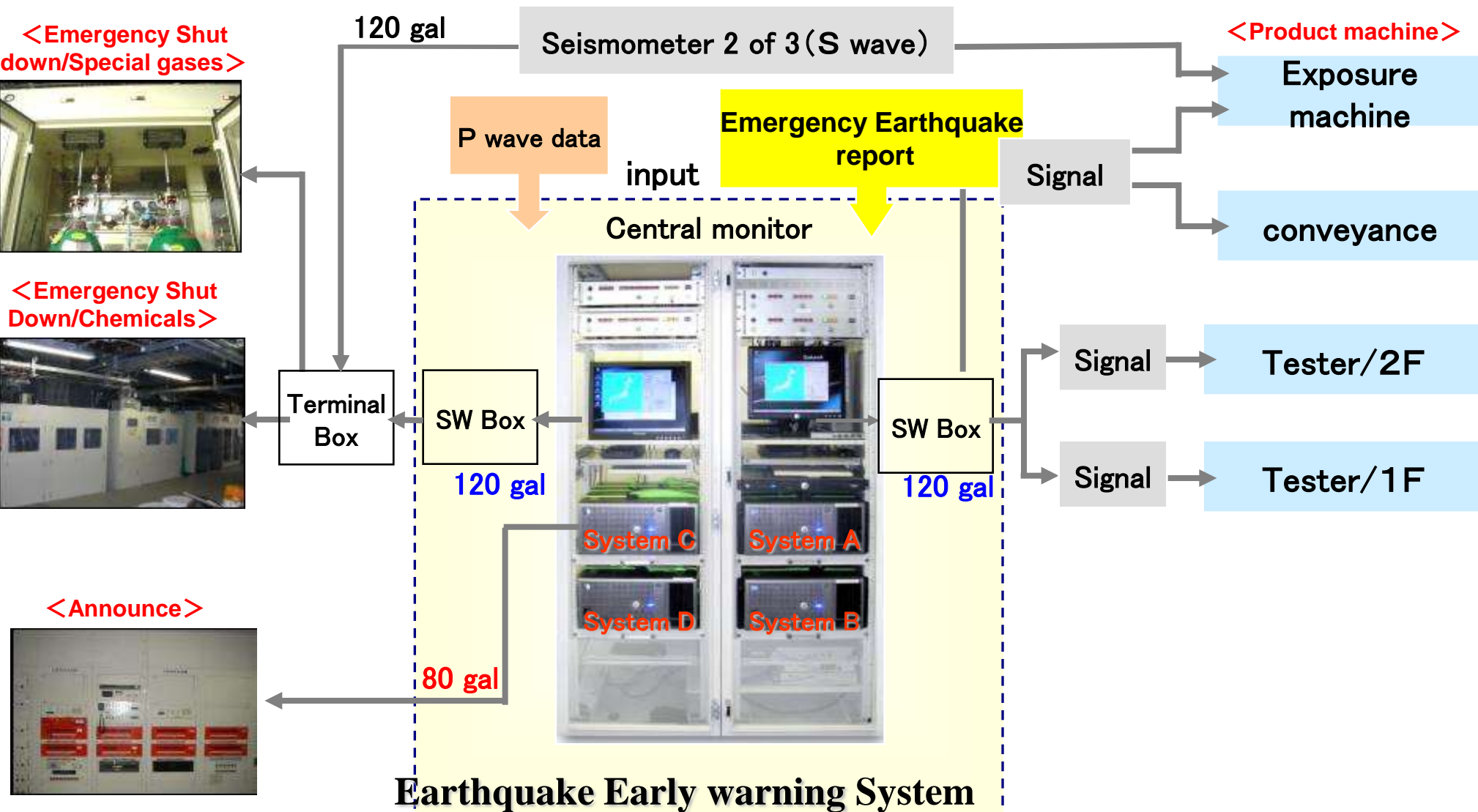
Using of Emergency Earthquake bulletin

In Advance, Inform the prediction of seismic intensity and time

Using the Margin, Reduction the Human suffering and the Business loss



OKI Real-time Earthquake Early Warning Control System



In Jun/2008, OKI semiconductor factory had the biggest Earthquake in Miyagi. Before arrival the S wave, the information of Japan Meteorological Agency reached OKI before 11 seconds, but there estimated value was below 80gal, so OKI can not announce the Emergency announcement for the employee, but OKI have the on site seismometer so OKI can announce before 5 seconds to arrival S wave, and OKI can shut down the gases/chemical supply system and soft landing the process machine before 3 second to arrival S wave. OKI can certificate the system is very effective to the semiconductor factory.

Time of occurrence	Margin (sec)	Events	Acutually intensity of S wave	Emergency earthquake information of Japan Meteorological Agency		JBS-01(Phase3) installed in OKI Semiconductor			Remarks
				Emergency Information	Estimated Value(gal)	Acutually intensity of P wave	Estimated Value of S wave	Output	
8:43:45	20	Occurrence of Earthquake							NO.20080614084350
8:43:54	11	Emergency announcement		1st Information	24.557				
8:43:55				2nd information	24.429				
8:44:00				3rd information	35.185			announcement >80 gal	P wave detection Start calculation
8:44:01	5	P wave arrival				47.778			According to announcement rufuge from factory
8:44:02	4					47.778	148.748		
8:44:02				4th Information	39.495				
8:44:02	3	Control signal output for System shut down				60.677	176.914	Signal output for System shutdown >120gal & befor 3sec	Shutdown Scanner,Prover, Transporter,gasses and Chemicl
8:44:03						93.706	383.501		
8:44:04				5th Information	62.27	93.706	285.002		
8:44:05	0			6th Information	62.27				
8:44:05		S wave arrival	251 Gal						by Local seismometer

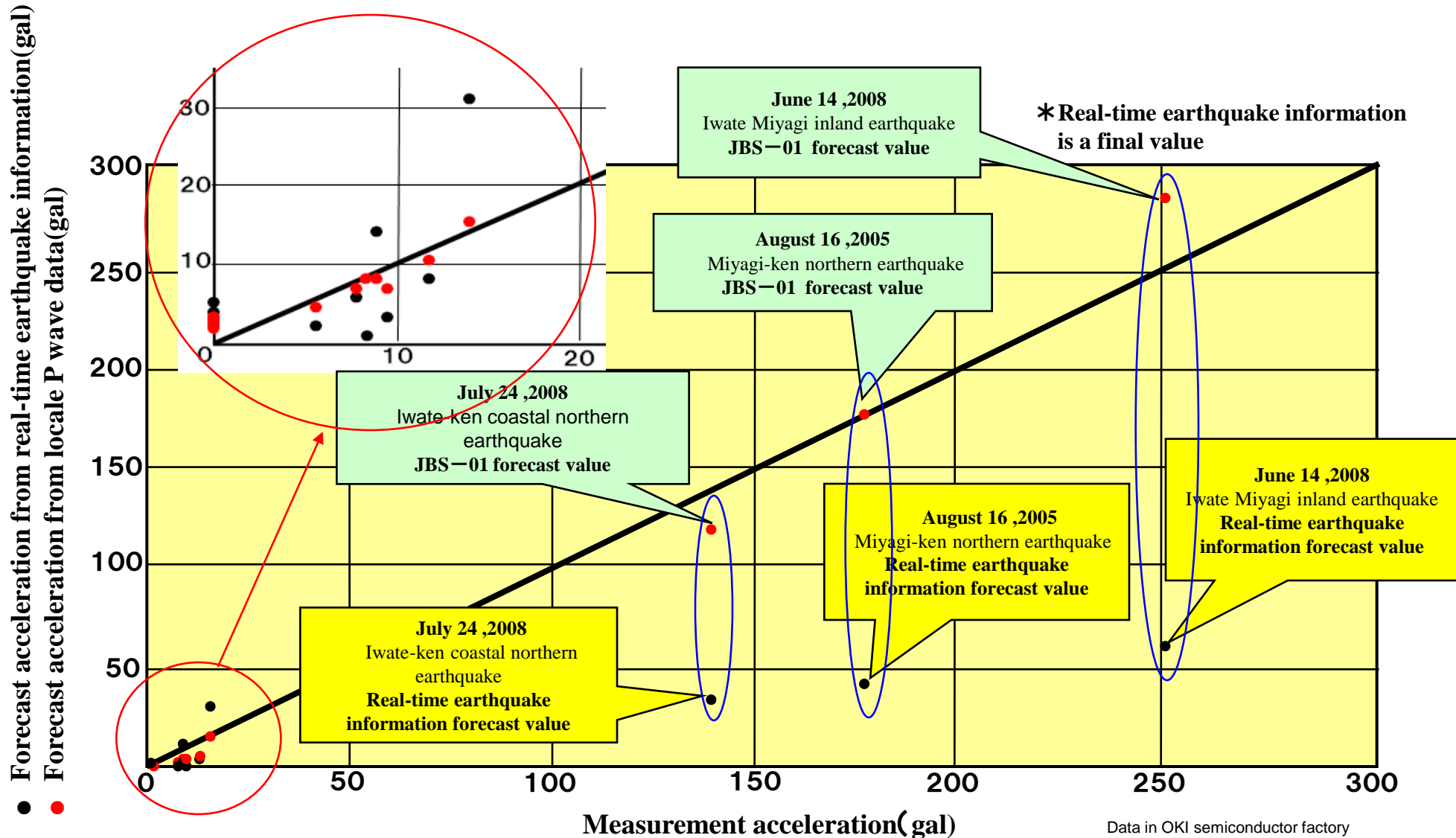
The Merit of using Real-time Earthquake Early warning System (ph. 3)

Content of measures	Measures unexecution	Earthquake-proof measures (STEP1)	Early Earthquake System introduction (STEP4:ph.3)
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Generation Day	May 26 ,2003	July 26 ,2003	August 16 ,2005	June 14 ,2008	July 24 ,2008
Generation Time	18:24	7:13	11:46	8:43	0:26
Earthquake name	Sanriku southern earthquake	Miyagi-ken northern continuous earthquake	8.16 Miyagi earthquake	Iwate Miyagi inland earthquake	Iwate-ken coastal northern earthquake
Epicenter	Miyagi Pref offing	Miyagi Pref northern	Miyagi Pref offing	Iwate pref southern inland	Iwate Pref northern coast
Magnitude	7.0	6.2	7.2	7.2	6.8
Epicenter Depth	71km	12km	42km	8km	108km
Seismic at OKI Semiconductor(※)	5(-)	5(+)	5(+)	6(-) (highest ever)	5(+)
Administration building			168gal	228gal	133gal
The first floor in S1	79gal	85gal	156gal	252gal	127gal
The first floor in S2		155gal	127gal	211gal	146gal
The second floor in S2		360gal	213gal	481gal	213gal
High-voltage substation(※)	189gal	225gal	228gal	332gal	191gal
Restoration	17 days Complete 90days	13 days	7 days	4. 5 days (Complete)	3. 5 days (Complete)

<Reference> Sismic 3:11~36gal、4:36~120gal、5(-):120~220gal、5(+):220~403gal、6(-):403~739gal

Predictive value comparison

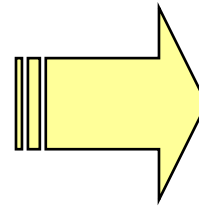


Data in OKI semiconductor factory

Example of preventing short-circuit in second transformer of electrical energy board



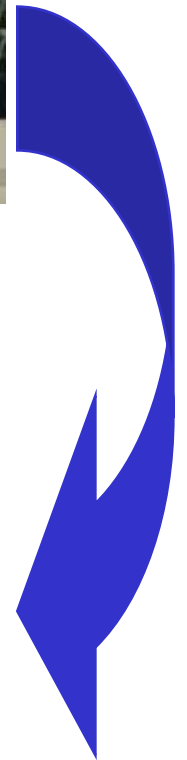
Reinforcement of copper bar



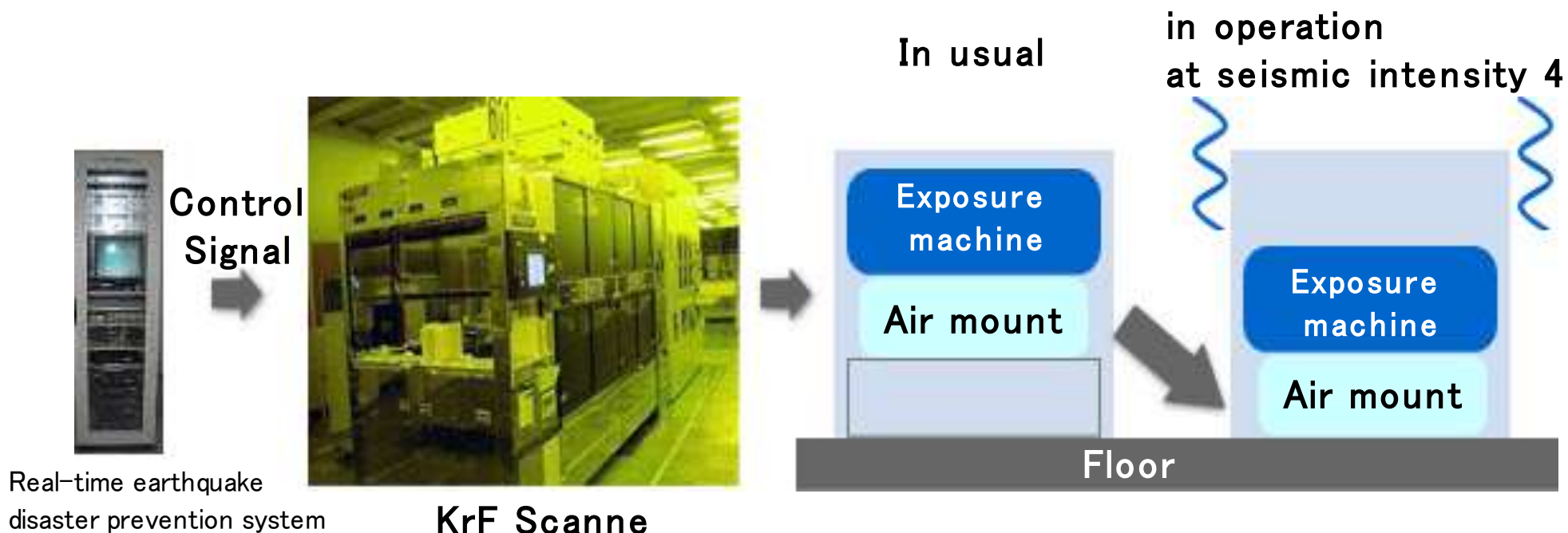
**Temporary disposal by cover
(tentative treatment)**



**Spacer Protector
(permanent measures)**



Example of countermeasures for KrF scanner



Flow of air-mount soft-landing of KrF scanner

KrF (krypton fluoride) light source is a kind of a laser light source which wavelength is 248 nm, and it is used to transcribe the circuit pattern on a silicon wafers. of 100 nm or less in ASML. KrF scanner, which is high center of gravity, increases the possibility to get damaged by generating large misalignment of the lens due to a shake of earthquake. KrF Scanner improves its damage protection, when an earthquake occurs (at the level of vibration level 4), by minimizing the equipment movement by a shake, using air mounting technic to land the equipment softly. A reinforced plan of KrF scanner from current earthquake-proof acceleration 100gal. to the acceleration 400gal. or more can be executed.

OKI Real-time Earthquake Early Warning System

<Emergency Shut down/Special gases>



<Emergency Shut Down/Chemicals>



<Announce>



120

The Specification of
the resupply Special Gases

80~119 gal···No Check

120~400 gal···Leakage check
by actual gas

Over 401 gal···Leakage Check
by pure N2

8L

Earthquake Early warning system