

Earthquake loss control programs

- **Country-wide**
- **Industry-wide**

Supporting Earthquake Risk Management Programs

Efficient Large Scale Earthquake Risk Reduction (Management) Programs are the most effective future actions for both country-wide and specific public units and private companies to reduce on a large scale both existing and new earthquake risk.

I will discuss two types of risk reduction programs:

- Large scale government programs, such as those set up by the World Bank
 - ISMEP, Turkey Program
- Specific programs for individual companies

Key challenges for countrywide earthquake risk management

- Update the earthquake hazard zoning of the country,
- Update the building code and include requirements and guidelines for the strengthening of existing buildings,
- Improve the quality of engineering with additional training and licensing; tighten inspection of construction,
- Start strengthening vulnerable structures using the experience gained by other countries like the ISMEP project in Turkey (summarized below).

Starting countrywide and regional Earthquake Risk Management Programs

1. **Risk audit** of a specific sector (public schools or bridges)
2. **Detailed risk assessment including cost-benefit analysis** for the particular sector and prioritization of assets to strengthen
3. **Implementation** – reducing the risk through strengthening of the prioritized buildings and contents. This is mostly construction and is usually about 90% of the total cost of strengthening

Best Practices: The Istanbul Seismic Mitigation and Emergency Preparedness Project (ISMEP)



ISMEP - School strengthening: Before (left) and after (right) -Istanbul



Best Practices: ISMEP. So far more than 730 collapse-hazard mostly school buildings strengthened and 22 rebuilt.

BUILDING TYPES	RETROFITTED		# of PEOPLE	ONGOING RETROFITTING		# of PEOPLE	TENDERS		# of PEOPLE	TOTAL		
	CAMPUS	BUILDINGS	BENEFICIAR	CAMPUS	BUILDINGS	BENEFICIAR	CAMPUS	BUILDINGS	BENEFICIAR	CAMPUS	BUILDINGS	# of BENEFICIAR
SCHOOLS	464	581	700,735	11	15	10,950	-	-	-	475	596	711,685
HOSPITAL	8	24	6,188 (*)	1	2	1,831 (*)	-	-	-	9	26	8,019
POLICLINIC & HEALTH CARE CENTERS	10	10	3,900 (*)	30	30	4,588 (*)	-	-	-	40	40	8,488
ADMINISTRATIVE BUILDING	16	30	6,251	5	8	4,442	-	-	-	21	38	10,693
DORMITORY&SOCIAL SERVICE BLDs	15	36	4,707	-	-	-	-	-	-	15	36	4,707
TOTAL	513	681	721,781	47	55	21,811				560	736	743,592

BUILDING TYPES	RECONSTRUCTED		# of PEOPLE	ONGOING RECONSTRUCTION		# of PEOPLE	TENDERS		# of PEOPLE	TOTAL		
	INSTITUTION	BUILDINGS	BENEFICIAR	INSTITUTION	BUILDINGS	BENEFICIAR	INSTITUTION	BUILDINGS	BENEFICIAR	INSTITUTION	BUILDINGS	# of BENEFICIAR
SCHOOLS	13	13	25,550	-	-	-	-	-	-	13	13	25,550
HOSPITAL	-	-	-	-	-	-	1	1	6,973 (*)	1	1	6,973
POLICLINIC & HEALTH CARE CENTERS	1	1	486 (*)	-	-	-	-	-	-	1	1	486
ADMINISTRATIVE BUILDING	1	1	250	-	-	-	-	-	-	1	1	250
DORMITORY&SOCIAL SERVICE BLDs	2	6	200	-	-	-	-	-	-	2	6	200
TOTAL	17	21	26,486	-	-	-	1	1	6,973	18	22	33,459

(*) total patients (inpatient and outpatient) per day										TOTAL BENEFICIARIES		777,051
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ISMEP, Oct. 2012

Best Practices: ISMEP

- Turkish treasury secured a World Bank loan to reduce the earthquake vulnerability of public buildings in Metropolitan Istanbul.
- Established a separate government unit – the Istanbul Project Coordination Unit (IPCU) to run the project. Staffed by experienced engineers and supported by international consultants.
- IPCU conducts all procurement, and assures quality through independent designs, design-reviews, and construction.

Best Practices: ISMEP

- Enhanced quality of design engineering and construction through requiring Joint Ventures with internationally recognized earthquake engineering design companies for all projects
- Ensured technology transfer through hiring of international consultants to conduct third-party review of all work
- The World Bank provided an additional level of technical design review and construction quality compliance
- The program is expanding through additional international funding

Earthquake loss control programs

- Country-wide
- Industry-wide

Loss Control and Risk Reduction Programs for Industry:

Step 1 - Quantify the risks using engineering

- Estimate vulnerabilities (PMLs)

- Identify main opportunities to reduce loss efficiently

Step 2 - Detailed risk assessments and cost-benefit analyses

- Outline available risk mitigation options (reduced PMLs) and costs

Step 3 - Final Design and Construction

- Brace and anchor all important equipment

- Strengthen buildings, as necessary

The best “Disaster Risk Control” is Pro-Active Risk Management

The Anheuser Busch Brewery - 1994



Two buildings near the AB plant

- In epicentral area; Largest industrial facility
- Facility value: \$1.3 billion (1993)
- Retrofit cost: \$10 Million
- Avoided loss in earthquake \$1.0 billion
- Business Interruption: Actual 4 days; Avoided 18 months
- Benefit/Cost Ratio >100:1 (without insurance payback)

Some of the key strengthened buildings at Anheuser Busch shortly after the earthquake.

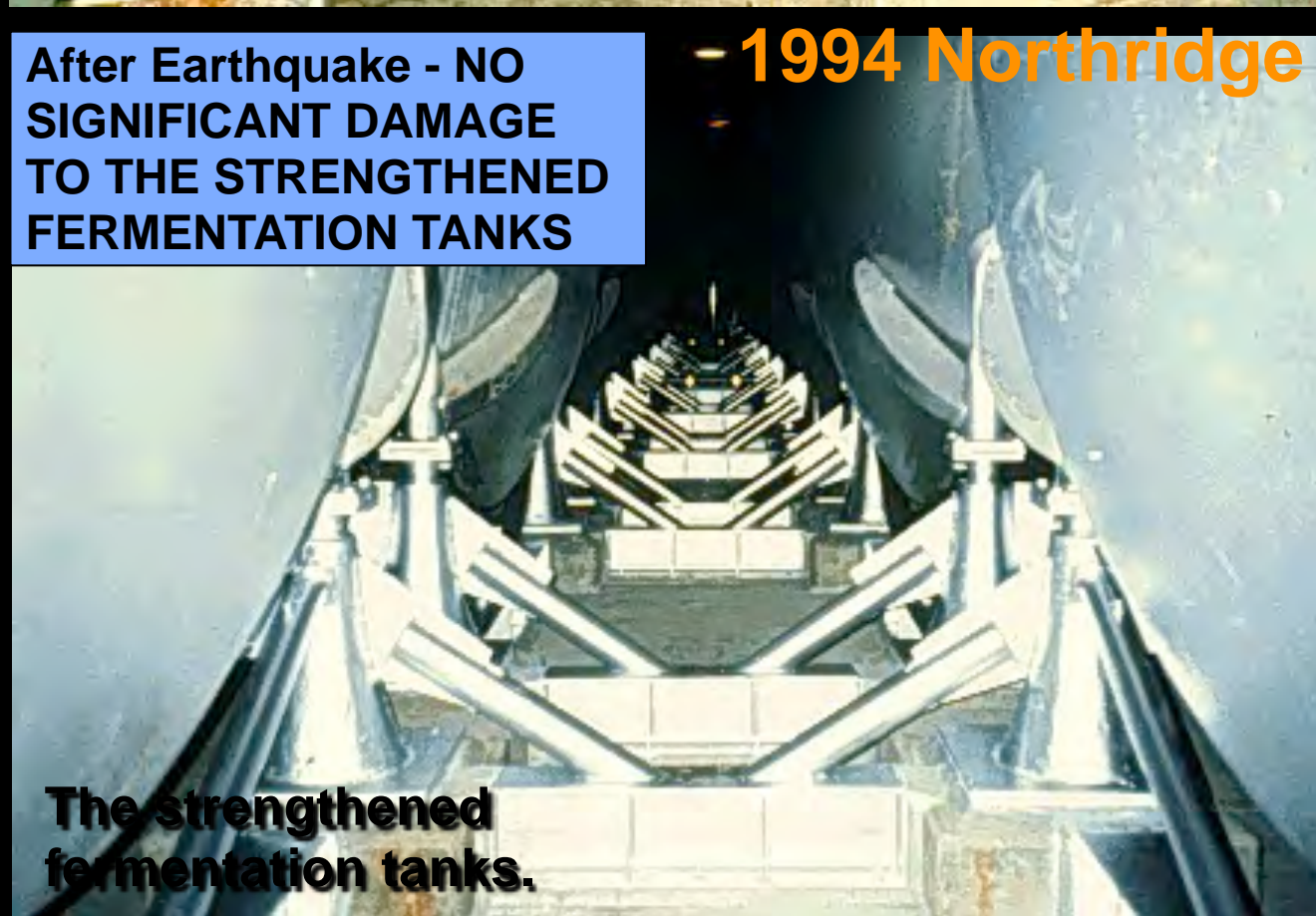
No significant building and equipment damage.



Before Strengthening



**After Earthquake - NO
SIGNIFICANT DAMAGE
TO THE STRENGTHENED
FERMENTATION TANKS**



- 1994 Northridge

**The strengthened
fermentation tanks.**



1995 Kobe, Japan



The Hakutsuru Sake Brewery in Kobe was not retrofitted and was heavily damaged in the 1995 earthquake. The fermentation tanks collapsed causing an 8-month business interruption. The same type tanks (left photographs) at Anheuser Busch were undamaged because of the strengthening

Risk Assessment and Loss Control in Japan: Much remains to be done



There are several options for managing earthquake risk for an industrial facility or a portfolio of buildings.

These include:

1. Do nothing and accept the risk. This is typically the current situation in Japan.
2. Manage some of the risk exclusively through earthquake insurance coverage for potential damage and business interruption. Many foreign companies have taken this route. This was also the situation in California before 1980.
3. Assess the risk and reduce it to an acceptable level. This includes engineering analyses of the assets of the company and the strengthening of selected structures and equipment to reduce the risk and business interruptions to acceptable and predetermined levels.



Views of industrial facilities near Tokyo. These concentrations present some of the world's largest risks - including earthquake and fire-following earthquake, tsunami or a typhoon.

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Learning the positive lessons of earthquakes

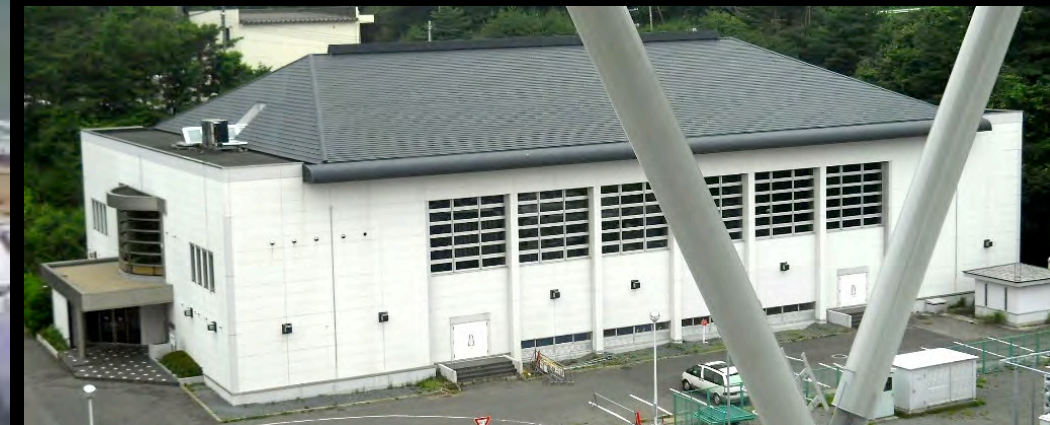
- **Fukushima NPS vs. Onagawa NPS**

The best “Disaster Risk Control” is Pro-Active Risk Management



I have observed that consistently for more than 40 years and more than 100 earthquakes plus many floods and typhoons.

Risk management was also the basic difference between Onagawa and Fukushima NPS - Under the same regulatory conditions.



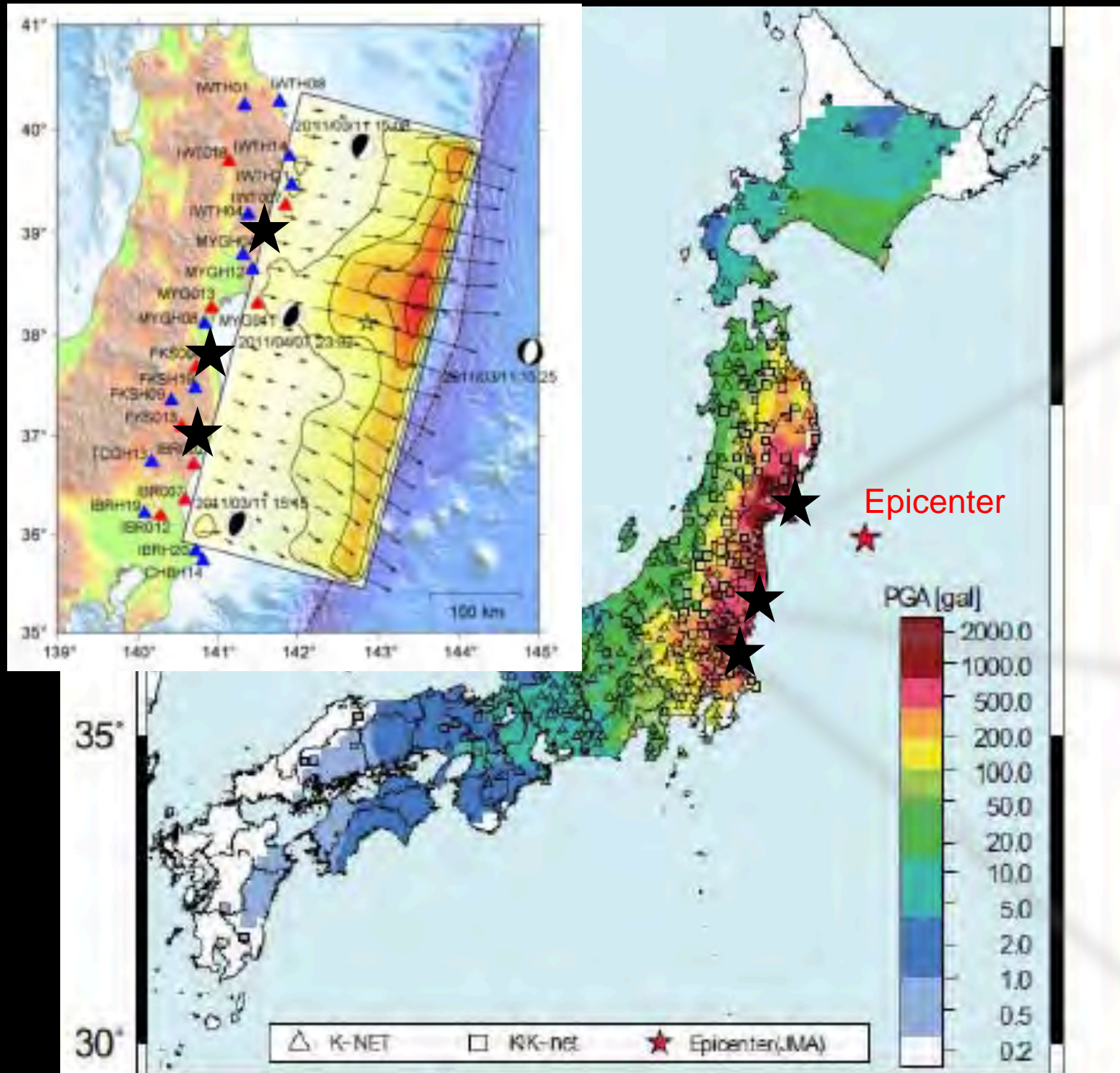
The Onagawa NPS gymnasium that housed refugees that had lost their homes to the tsunami

Learning the positive lessons of earthquakes (and other natural disasters)

A few comments from engineers from Japan:

- The success of Onagawa was discussed very few times in the 20 months after the Fukushima accidents.
- We did not discuss that many buildings designed after 1981 and using the new seismic design code did not collapse.
- Seismic-isolated buildings performed very well. Passive-control buildings also performed very well.
- Not only Japanese people but also American people do not want to say that their technology performed very well against the big earthquake in front of people who had severe damage from the same earthquake.

Of the three nuclear stations in the strongest ground motion areas of 3/11 Onagawa is closest to the epicenter.



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Learning the positive lessons of earthquakes

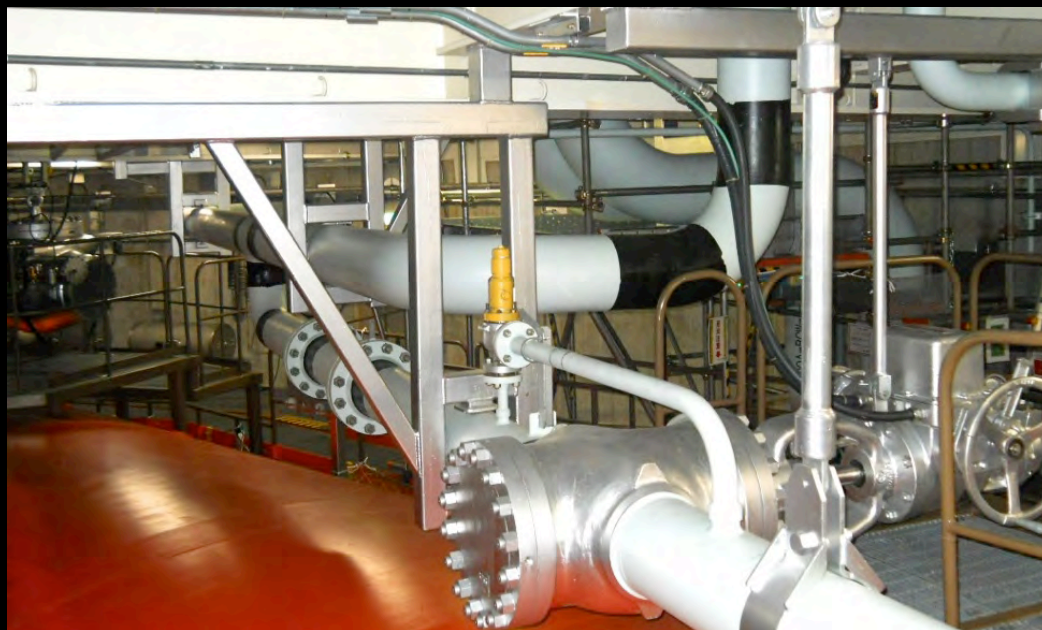
- Response to disasters consistently focuses on the negative lessons and neglects the positive lessons.
- Nothing demonstrates this more clearly than the earthquake-induced and tsunami-created Fukushima nuclear disaster in Japan that started on March 11, 2011.
- The two nuclear power stations (NPS) sites most affected by the 3/11 Japan earthquake were TEPCO's Fukushima plants and Tohoku Electric's 3-unit Onagawa plant.
- Onagawa was much closer to the epicenter and experienced stronger ground motion and a larger tsunami than Fukushima.
- Fukushima failed its flood (tsunami) test. Onagawa passed both its tsunami test and its real earthquake “**stress test**” - it survived the largest-ever full-scale shake-table test of a nuclear plant. The three units shut down safely and the world heard almost nothing about it, even in Japan, for over one year.

Learning the positive lessons of earthquakes

- For over one year after the earthquake, there was no technical mention or discussion of the performance of the Onagawa NPS during the 3/11 earthquake and tsunami
- This is typical of engineering and the nuclear industry worldwide - they concentrate on studying the problems, fixing the problems, and learning from failures. Learning from success, good engineering, and what performed well was forgotten for a while
- We organized an independent multidisciplinary team to investigate the performance of the plant and convinced the IAEA to support us
- We conducted the Onagawa plant investigation in August of 2012, more than 17 months after the 3/11 earthquake
- The IAEA's team finding was that: **“The Onagawa Plant was remarkably undamaged”**

Learning the positive lessons of earthquakes

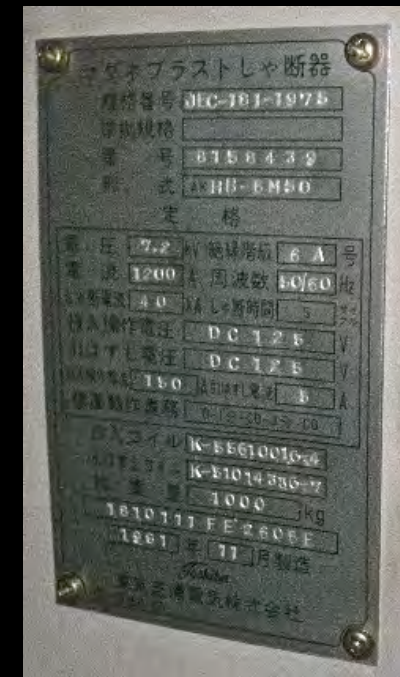
Onagawa Unit 1 Reactor Building



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Learning the positive lessons of earthquakes

Onagawa Unit 2 & 3 Reactor Buildings



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Learning the positive lessons of earthquakes

Typical Core Cooling Equipment - Onagawa Units 1-3



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Learning the positive lessons of earthquakes: It took more than one year, but the positive lessons were noted in the public media.

The New York Times

Alert Name: **Peter**
August 11, 2012 Compiled: **YANEV**

Japan: Inspectors Study Plant That Avoided Disaster
By THE ASSOCIATED PRESS (NYT)

The Onagawa plant was closest to the epicenter of last year's earthquake but was largely undamaged because it was designed with enough safety margins, nuclear inspectors said Friday.

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Friday August 10, 2012

Japan's Onagawa nuclear plant 'remarkably undamaged': IAEA

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By Associated Press (Reuters), August 10, 2012

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NATIONAL AUG. 11, 2012 - 10:30PM JST (7:45) Recommended

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Learning the positive lessons of earthquakes

We have not used at all the positive lessons of the success at the Onagawa Nuclear Power Station to make both engineering and political decisions.

- Some countries, like France, are beginning to use the success information that came out of Onagawa in addition to the lessons of Fukushima.
- It is incredible that three other leading countries in nuclear energy - the USA, Germany, and especially Japan - have not yet used this most valuable engineering information.
- **It is essential that the lessons learned at Onagawa be used in parallel with the lessons learned at Fukushima if we are to make the right engineering and political decisions.**

Discussion