

# Fukushima Daiichi Ongoing Lessons Learned

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**\*IN 84-69 1983 Ft St. Vrain- Complete loss of AC power (Offsite and EDGs)– cause high winds and snow**

**\*IN 84-69 1984 Grand Gulf - Complete loss of AC power (Offsite and EDGs) – cause high winds and rain**

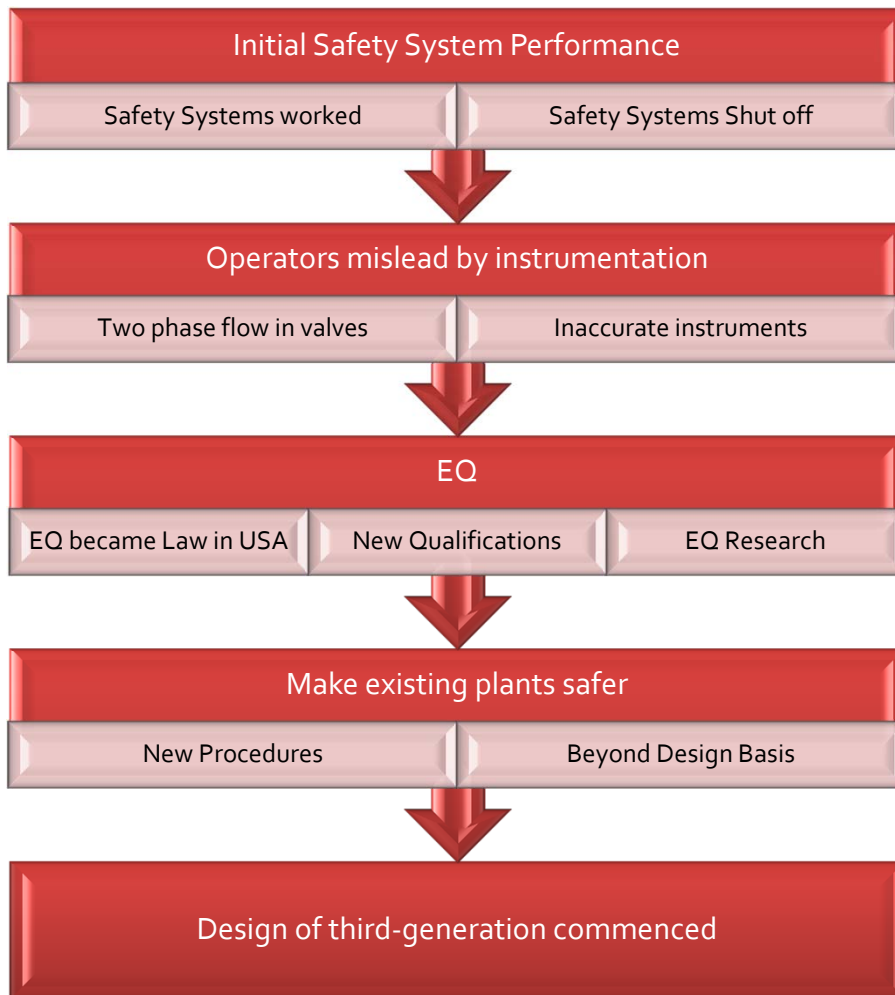
**\*IN 2006-18 2006 Sweden Forsmark Complete loss of all AC (Offsite and EDGs) and ½ of DC power– cause human error and design error**

**\*POTENTIAL INDUSTRY PRECURSORS**

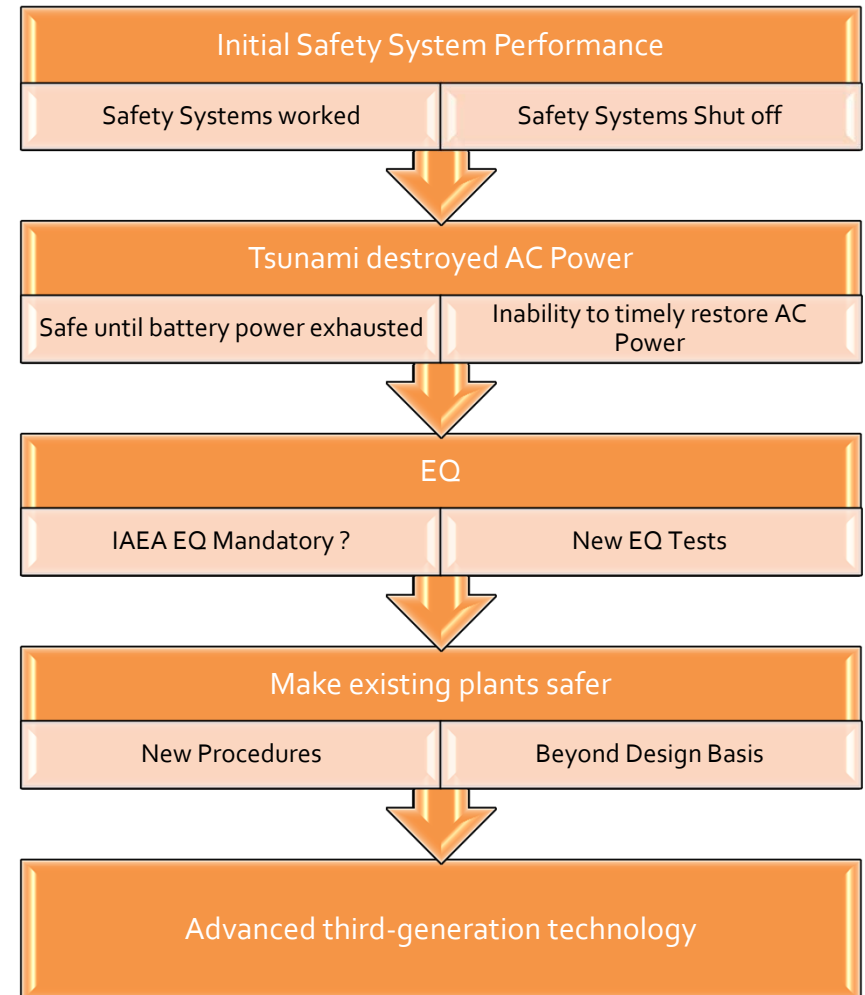
# EQ and Present Issues

Thirty years ago the accident at Three Mile Island focused attention on nuclear safety and EQ efforts increased dramatically. The accidents at the Fukushima plants will also accelerate implementation of third generation nuclear technology and EQ services

## Three Mile Island



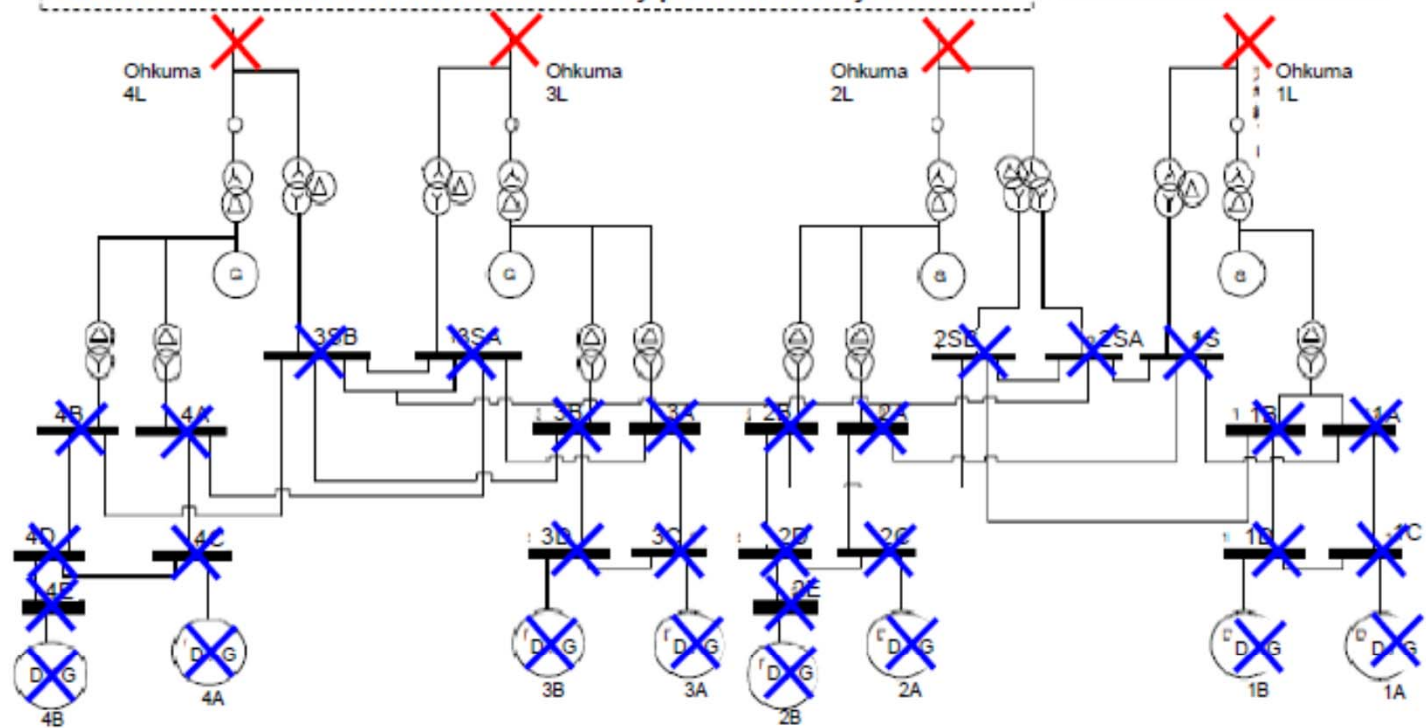
## Fukushima



## Power supply of Unit 1-4 @ 1F after Tsunami

- Okuma Line 1L, 2L: Receiving circuit breaker damaged in earthquake
- Okuma Line 3L: Renovation work in progress
- Okuma Line 4L: Circuit breaker shutdown by protection relay activation

✗ Shutdown by earthquake  
✗ Shutdown by Tsunami



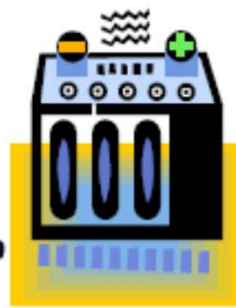
The DG lost the function due to either "M/C failure," "loss of sea water system," or "DG main unit failure."

## What were available for the recovery work after the tsunami?

There were only the following limited number of devices and tools available !

- Fire Engines: only a few people knew how to operate them.
- Flashlights
- Cable
- Tools (screwdrivers, etc.)
- Batteries taken from cars
- Engine driven Generators\*
- Engine driven Air Compressors\*

\*They were in the warehouses of the affiliated companies and difficult to find.



# Seismic Observed Data

(1g=981 Gal).

## Comparison between Basic Earthquake Ground Motion and the record of intensity

Observation Point (The lowest basement of reactor buildings)		Observed data (*interim)			Maximum Response Acceleration against Basic Earthquake Ground Motion (Gal)		
		Maximum Response Acceleration (Gal)			Horizontal (N-S)	Horizontal (E-W)	Vertical
		Horizontal (N-S)	Horizontal (E-W)	Vertical			
Fukushima Daiichi	Unit 1	460* <sup>2</sup>	447* <sup>2</sup>	258* <sup>2</sup>	487	489	412
	Unit 2	348* <sup>2</sup>	550* <sup>2</sup>	302* <sup>2</sup>	441	438	420
	Unit 3	322* <sup>2</sup>	507* <sup>2</sup>	231* <sup>2</sup>	449	441	429
	Unit 4	281* <sup>2</sup>	319* <sup>2</sup>	200* <sup>2</sup>	449	449	415
	Unit 5	311* <sup>2</sup>	548* <sup>2</sup>	256* <sup>2</sup>	452	452	427
	Unit 6	298* <sup>2</sup>	444* <sup>2</sup>	244	445	448	415
Fukushima Daini	Unit 1	254	230* <sup>2</sup>	305	434	434	512
	Unit 2	243	196* <sup>2</sup>	232* <sup>2</sup>	428	429	504
	Unit 3	277* <sup>2</sup>	216* <sup>2</sup>	208* <sup>2</sup>	428	430	504
	Unit 4	210* <sup>2</sup>	205* <sup>2</sup>	288* <sup>2</sup>	415	415	504

0.20 g to 0.56 g

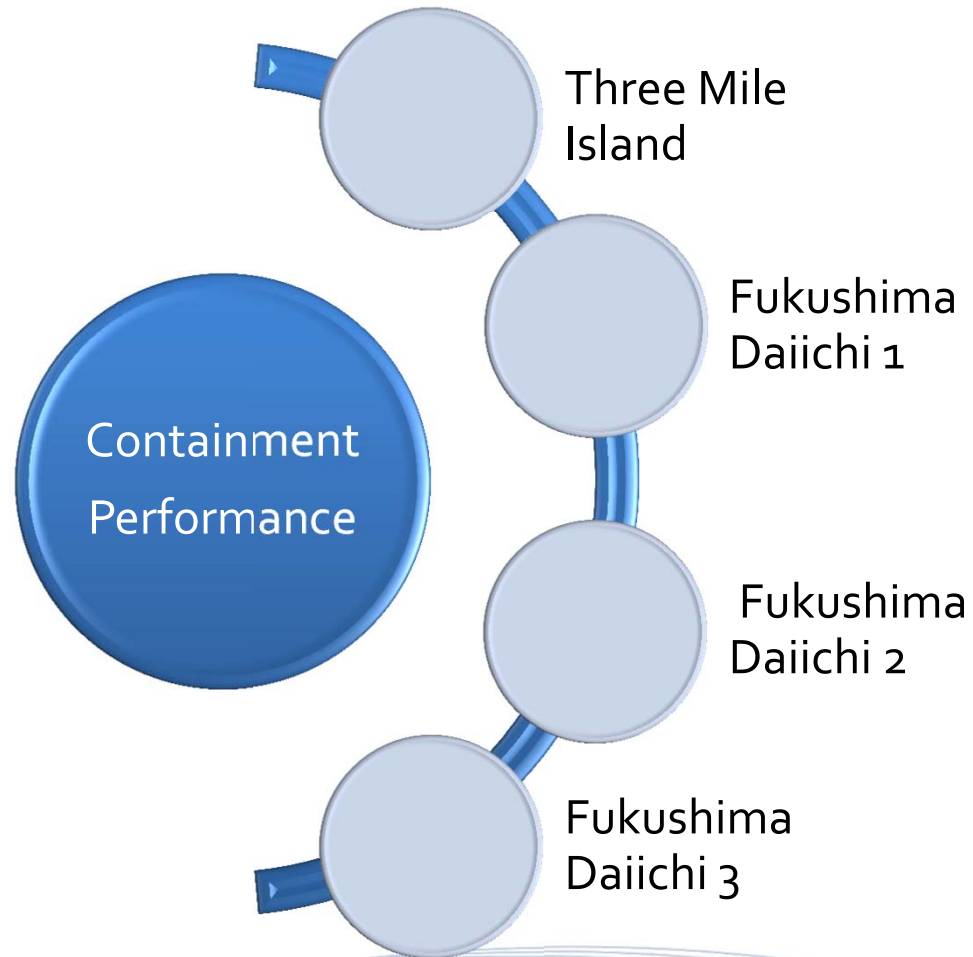
\*1: The data above is interim and is subject to change.

\*2: The recording time was about 130-150 seconds

# HERITAGE OF CLASS 1E

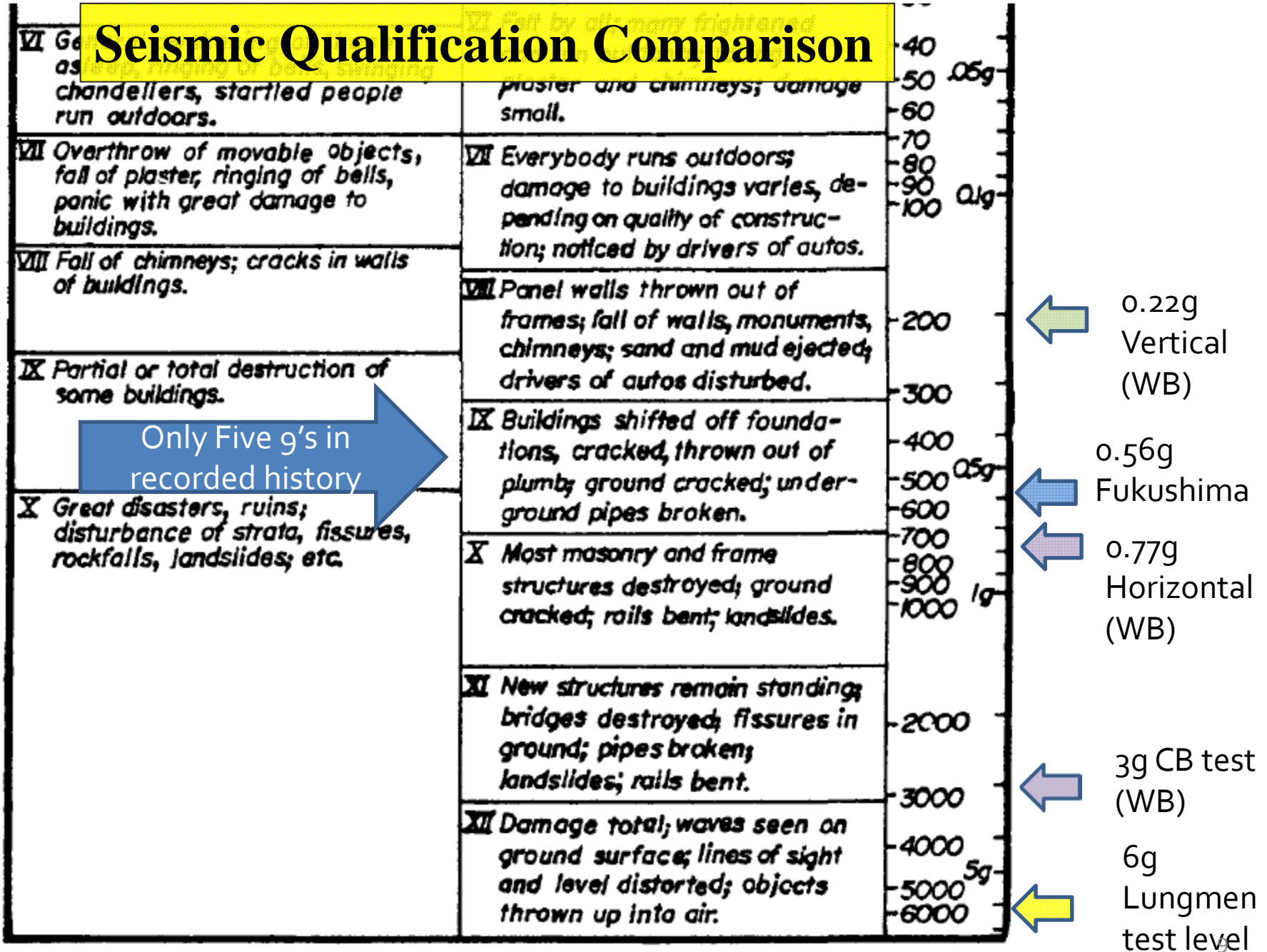
- **Class 1E:** The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

# ENVIRONMENTAL STEWARDSHIP





# Seismic Qualification Comparison



Only Five g's in recorded history

# QUALIFICATION MEETING IN GOTHENBURG SWEDEN JUNE 2011



EQ Standard  
IEEE 323

Initial  
Fukushima  
Enhancements

Considering  
Severe  
Accident  
Qualification

Considering Environments and  
Qualification Methods for  
Other natural phenomenon hazards:  
extreme wind, flood, tsunami, hurricane,  
and tornado

# US INDUSTRY AND NRC

FEMA: Nukes on their own for 72 hours

NRC Staff: New Rulemaking on Coping Time and 8 hours may not be enough

NRC Staff: To be Class 1E or Not to be Class 1E that is the question

# EXAMPLES OF NEW ASSESTS: NEW QUALIFICATION PROJECTS

## DC Power 9X

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- 72 Hour Batteries
- Auxiliary power

## Pressure 5X and GMT

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- Electrical Penetration Assemblies

## Environment Performance

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- Modified emergency diesel generators