

FUKUSHIMA DAI-ICHI INITIATING EVENT SIGNIFICANCE

EARTHQUAKE

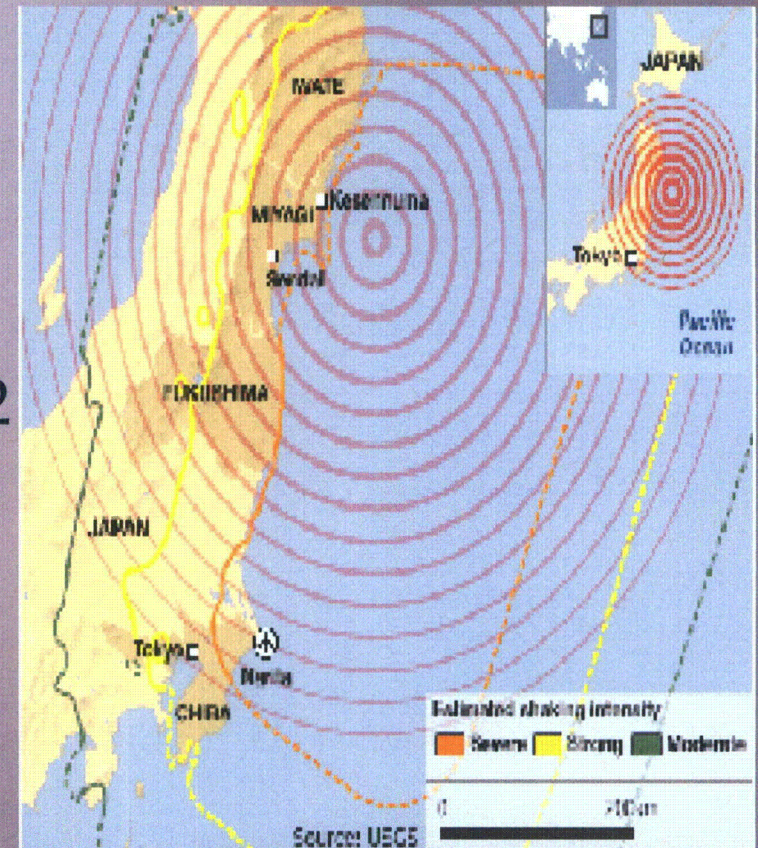
Plants were designed for:

- 440 cm/sec-squared horizontal (.45 g)
- 412 cm/sec-squared vertical (.42 g)

Seismic Acceleration measured at Unit 2

- 550 cm/sec-squared horizontal (.56 g)
(25% > design basis)
- 302 cm/sec-squared vertical (.31 g)

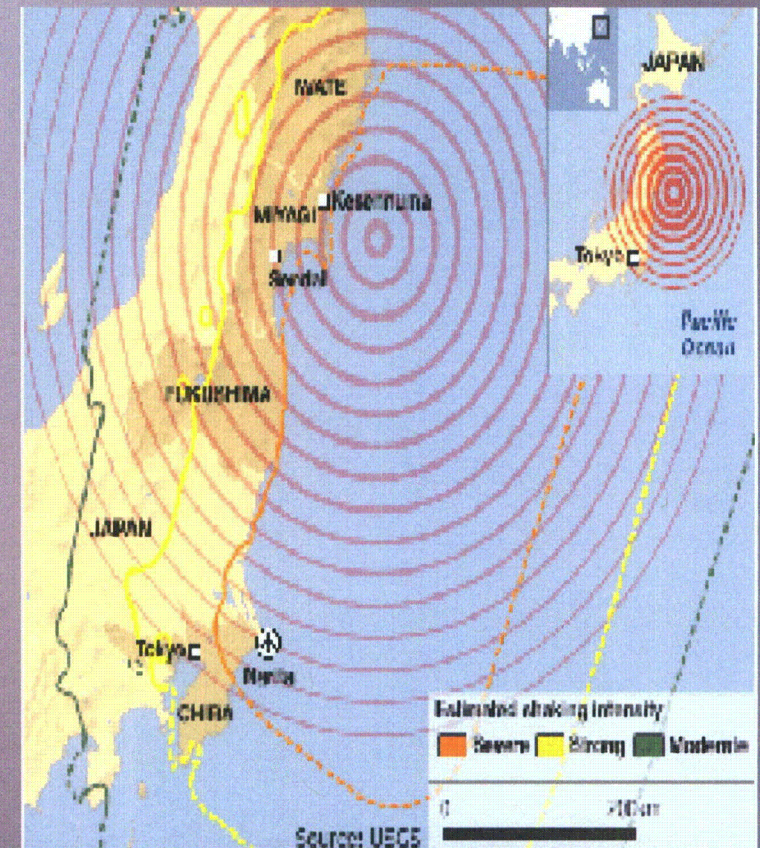
Plant elevation in relation to sea level
dropped 1-3 meters (3-9 feet)



FUKUSHIMA DAI-ICHI INITIATING EVENT SIGNIFICANCE

PLANT RESPONSE

- Automatic shutdown
- Loss of offsite power
- Emergency diesel generators powered safety busses
- Plant conditions stabilized and were controlled



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TSUNAMI

- Estimated water volume displaced by earthquake at epicenter = 125 cubic kilometers (4.4E12 cubic feet or 30 cubic miles (3.1³ miles))
- Plants were designed for 6 meters (20 feet) at the shoreline
- Latest estimates of height at site are 14 meters (46 feet) (250% of design basis)



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PLANT RESPONSE

- Station blackout
- Unit 1: Isolation condenser accommodating decay heat without shell makeup capability
- Units 2-3: RCIC accommodating vessel makeup and SRV's accommodating decay heat without suppression pool cooling
- Unit 4: Loss of spent fuel pool cooling
- Upon loss of RCIC/IC, the SRV's cycled on high pressure
- Suppression Pool reaches saturation temperature resulting in containment pressurization

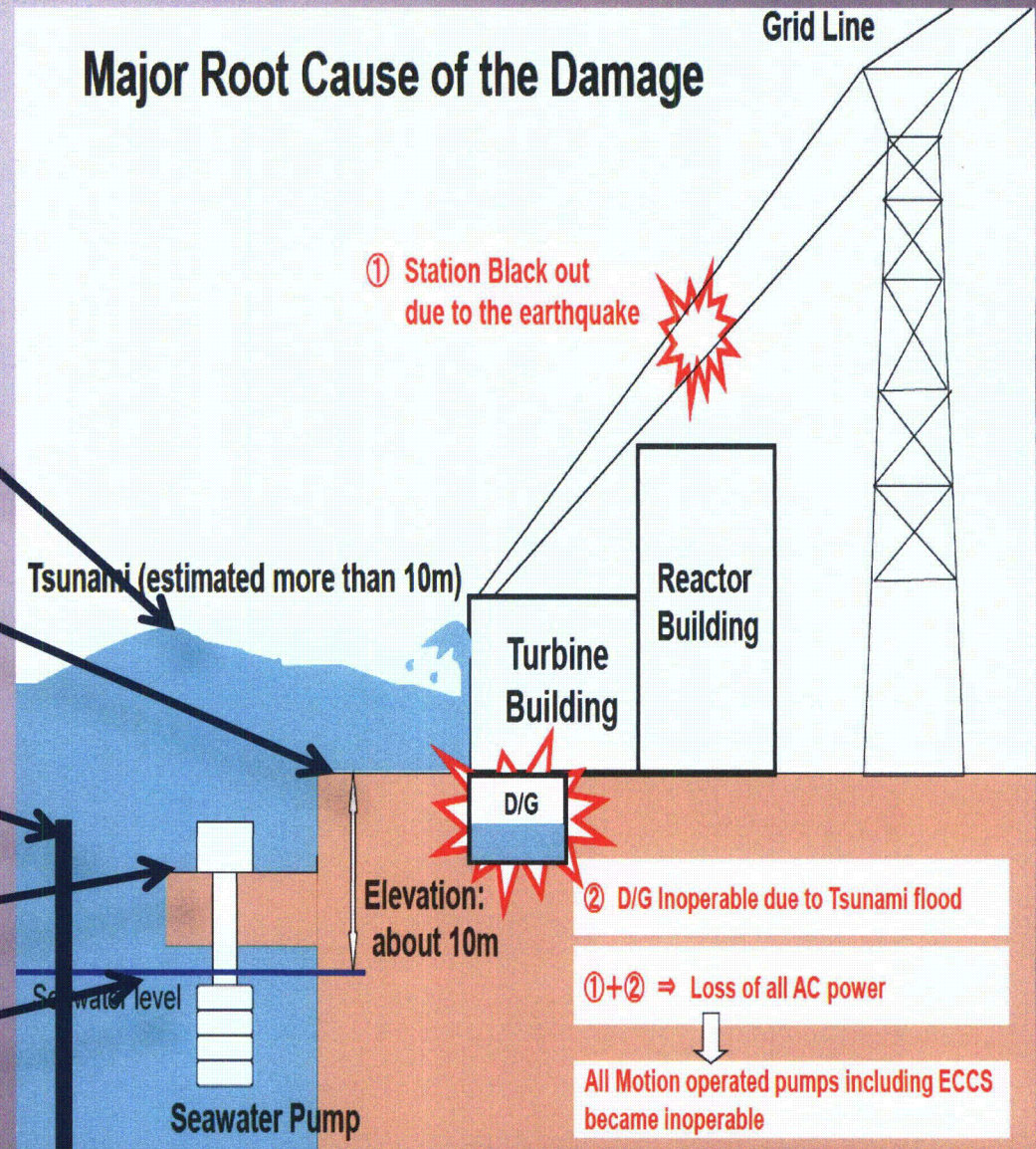


FUKUSHIMA DAI-ICHI FLOODING DAMAGE

Reference Levels

- 46 feet. Tsunami Peak Elevation
- 42.5 feet Ground elevation of Units 5-6 TB/RB
- 33 feet Ground elevation of Units 1-4 TB/RB
- 17 feet Assumed highest tsunami and elevation of break wall
- 13 feet Ground elevation of intake structure
- 0 Feet Sea level

Major Root Cause of the Damage



FUKUSHIMA DAI-ICHI HYDROGEN GENERATION

- Cladding exceeds $\sim 2500^{\circ}\text{F}$
- $\text{Zr} + 2\text{H}_2\text{O} \rightarrow \text{ZrO}_2 + 2\text{H}_2 + \text{heat}$
 - Exothermic reaction further heats the core
 - Generation of hydrogen
- Unit 1: 300-600kg**
- Unit 2/3: 300-1000kg**

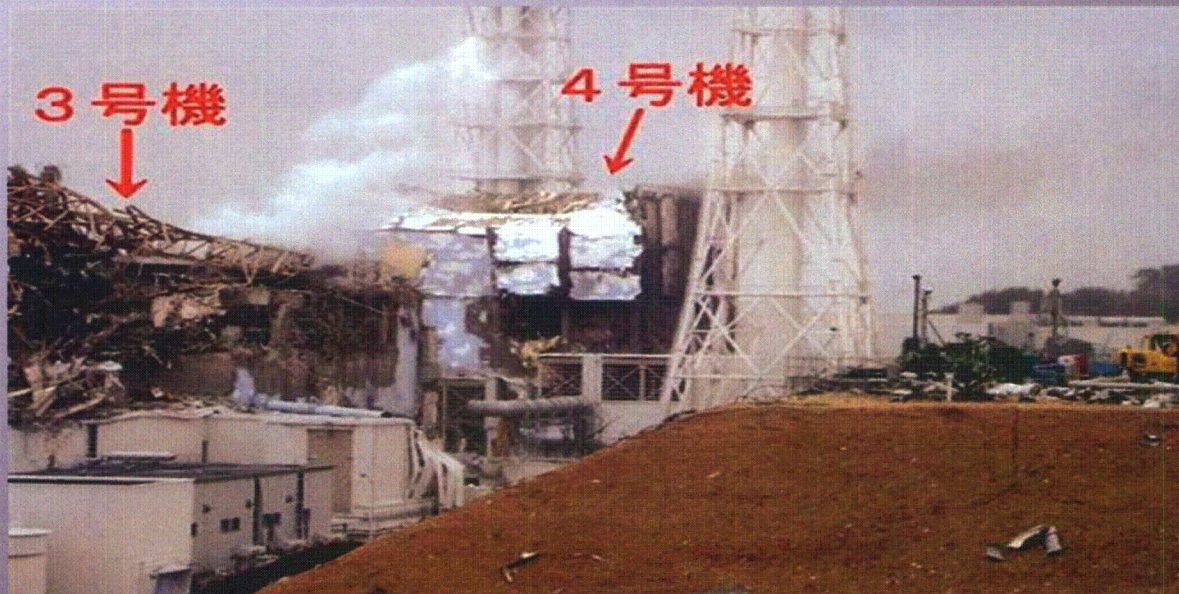
FUKUSHIMA DAI-ICHI HYDROGEN EXPLOSIONS



UNIT 1



UNIT 3

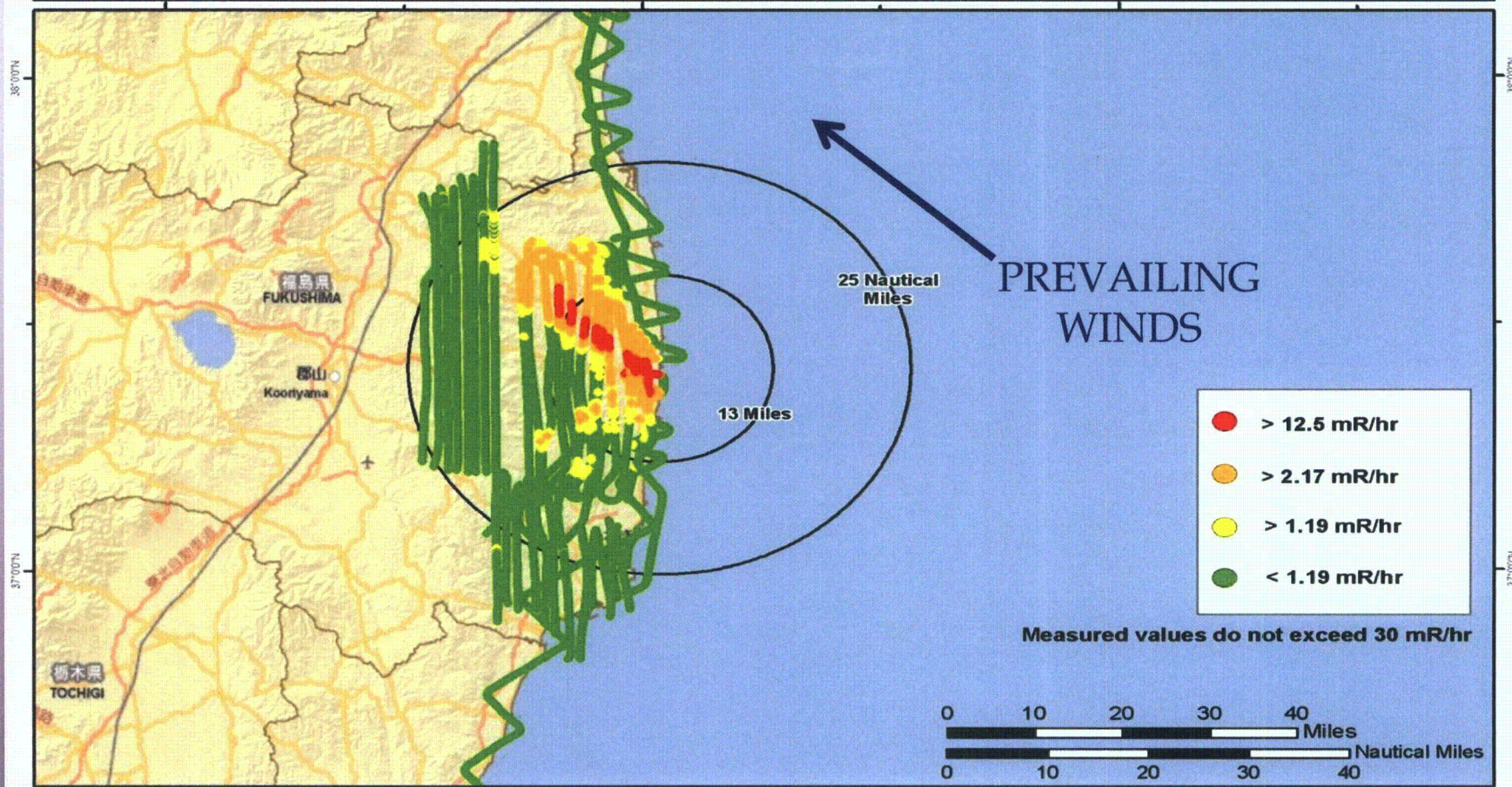


FUKUSHIMA DAI-ICHI RADIOLOGICAL RELEASE



Aerial Monitoring Results - C-12
Survey Date - 17, 18, 19 March 2011

FUKUSHIMA DAIICHI
JAPAN

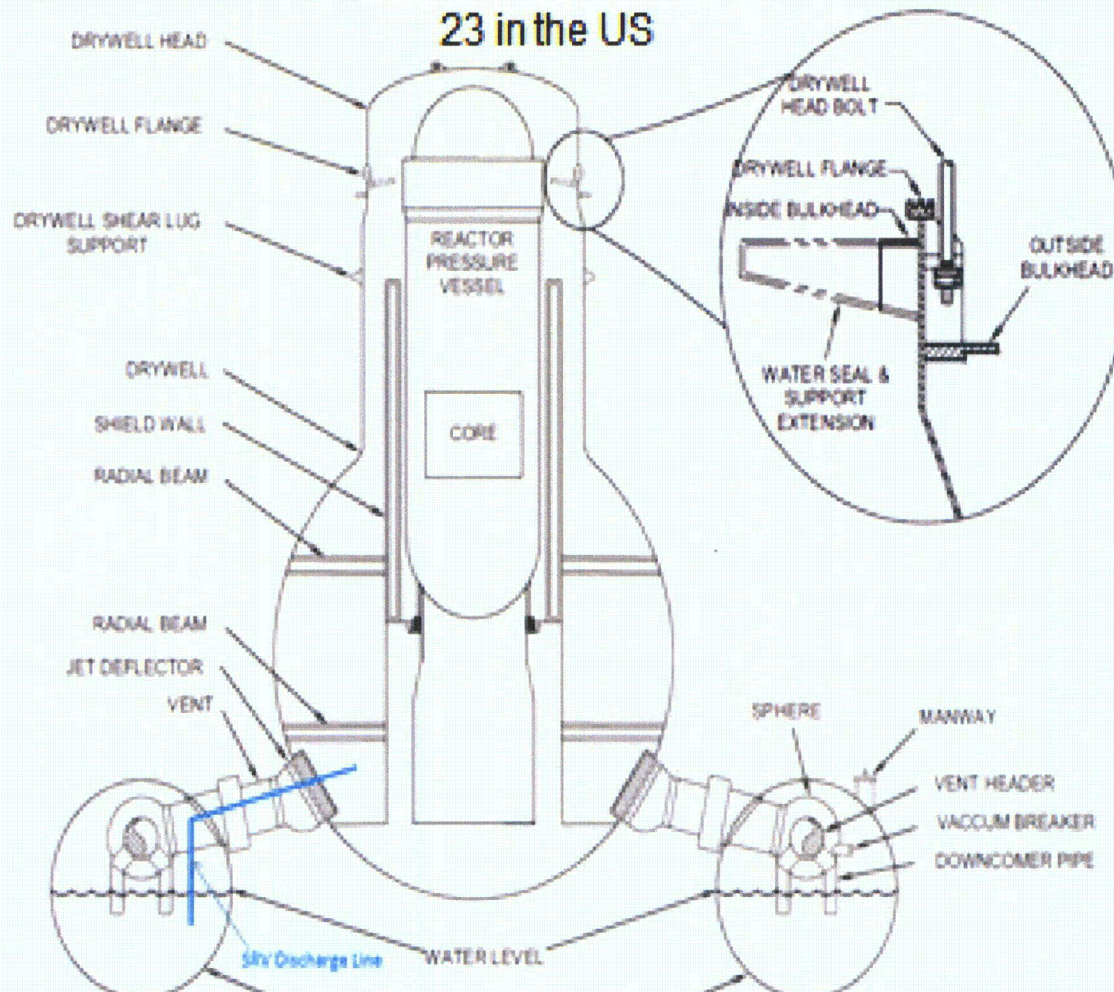


Map created on 03232011 0210 JST

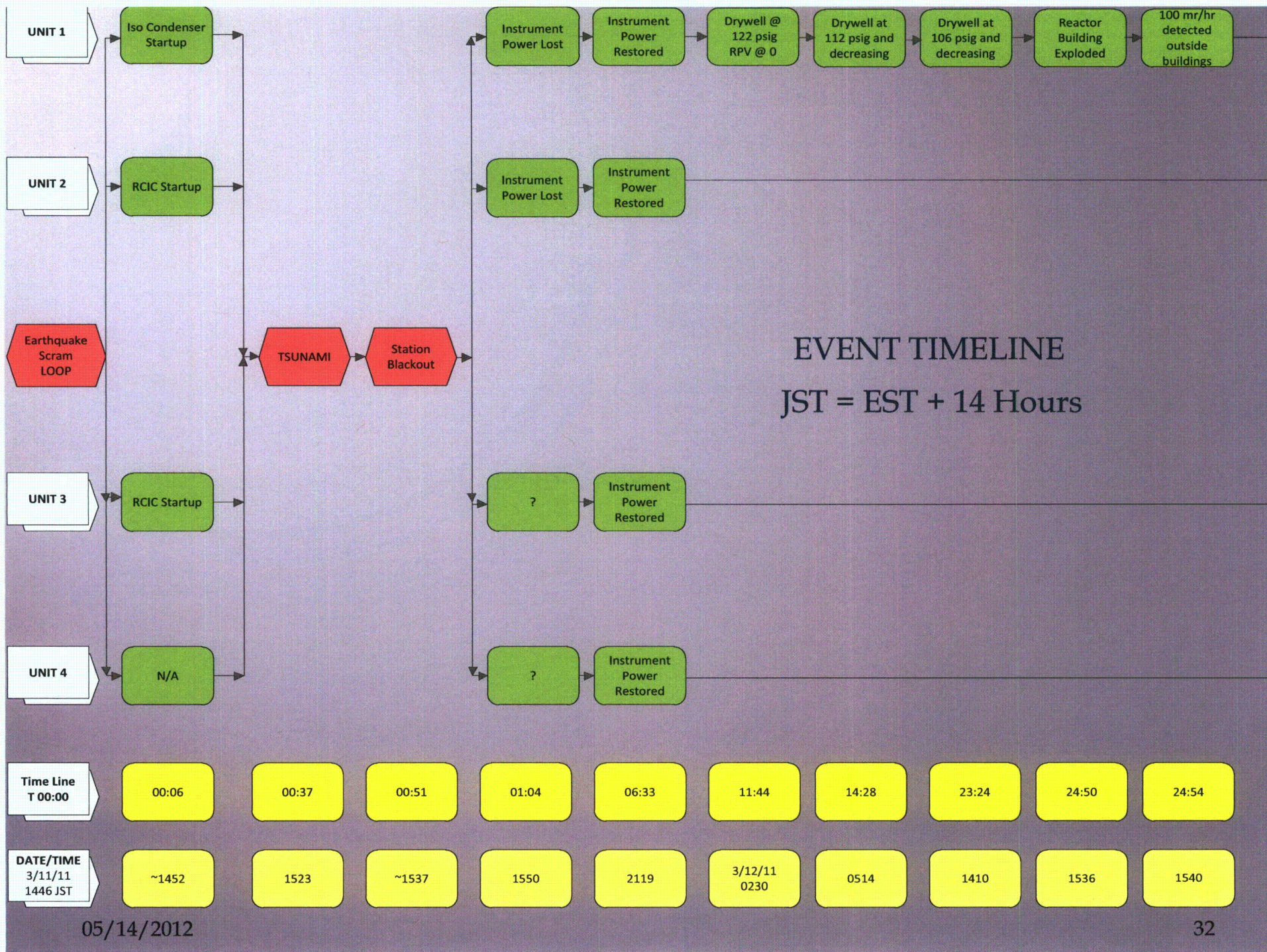
Name: NIT_C-12 23Mar2011 v4

Nuclear Incident Team DOE NIT

**TYPICAL
BWR MARK 1 CONTAINMENT**
23 in the US

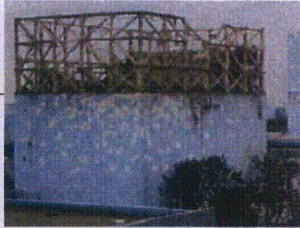


- SRV operation vents RPV internals to Suppression Pool
- Hydrogen accumulates in Suppression Chamber
- Hydrogen vents to Drywell atmosphere
- Containment failure or intentional venting passes hydrogen to the Reactor Building atmosphere
- 4-78% hydrogen in air is flammable/explosive



UNIT 1

Detectable
Iodine on Site



UNIT 2

RCIC Lost on
Pump Failure

RPV Level at
TAF
RPV/ED

RPV Level at
BAF
32mr/hr at site
gate

D/W @ 47 #
Torus @ 36#

EVENT TIMELINE

JST = EST + 14 Hours

UNIT 3

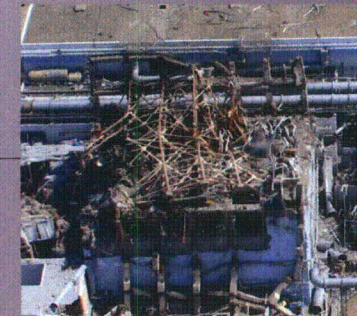
HPCI/RCIC lost
on Battery
Depletion

RPV Level at
TAF and
Lowering

RPV Level near
BAF
Torus at 49 #

RPV/ED
Torus at 86#
D/W Pressure
Lowering

Reactor
Building
Exploded



UNIT 4

Time Line

25:14

35:14

37:29

40:59

42:17

68:15

70:39

70:48

78:44

79:54

DATE/TIME

05/14/2012 1600

3/13/12
0200

0415

0745

0903

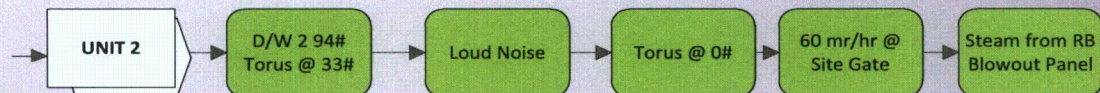
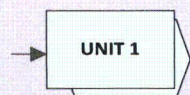
3/14/11
1101

1325

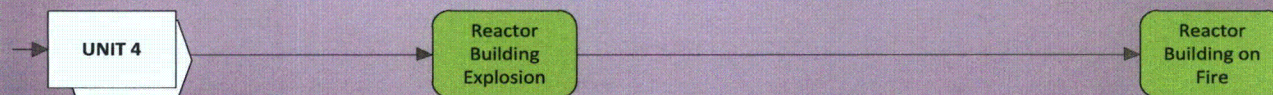
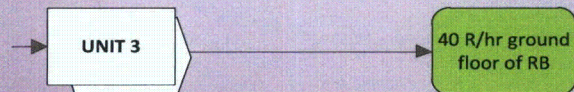
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2130

2240
33



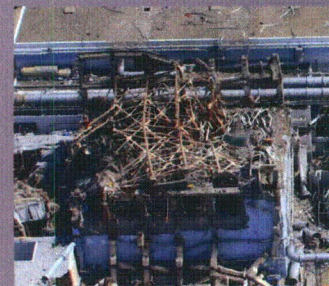
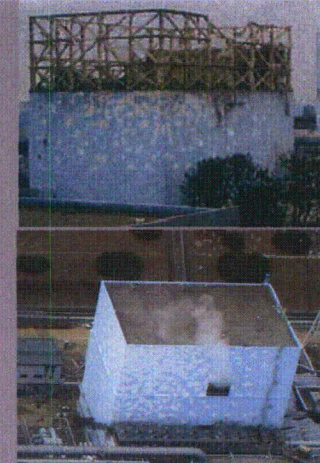
EVENT TIMELINE JST = EST + 14 Hours



Time Line	84:14	87:28	87:34	88:05	89:39	90:53
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DATE/TIME	3/15/11 0300	0614	0620	0651	0825	0938
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05/14/2012

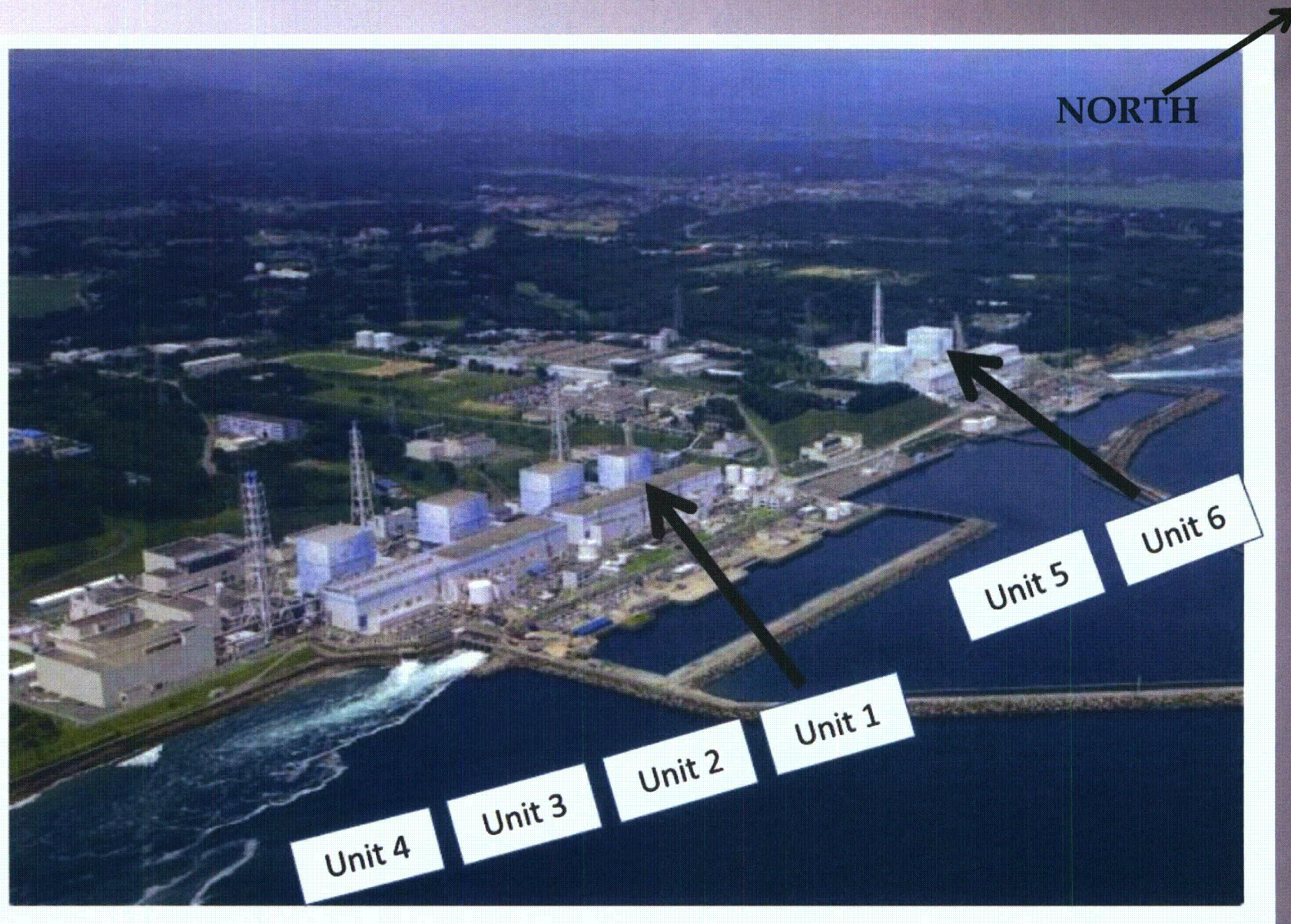


NRC EOC Update 5 May, 2011 1200 EDT

100 R/hr debris outside Unit 3 Reactor Building

UNIT	CORE DAMAGE ESTIMATE	CORE COOLING	PRIMARY CONTAINMENT	SECONDARY CONTAINMENT	DRYWELL RADIATION LEVELS	TORUS RADIATION LEVELS
UNIT 1	55% and uncovered	26 gpm fresh water via feedwater line	Damaged Leak rate est. at 3 cubic meters per hour	Severely damaged by hydrogen explosion	Unknown	114 R/hr 4 mR/hr at west gate
UNIT 2	35% and uncovered	30gpm fresh water	Damage suspected	Damaged	2070 R/hr	40 R/hr 4 mR/hr at west gate
UNIT 3	30% and uncovered	31 gpm fresh water	Damage suspected	Damaged	1260 R/hr	50 R/hr
UNIT 4	In spent fuel pool	N/A	Relaxed for outage	Severely damaged by hydrogen explosion	N/A	N/A
UNIT 5	None	N/A	N/A	N/A	N/A	N/A
UNIT 6	None	N/A	N/A	N/A	N/A	N/A

FUKUSHIMA DAI-ICHI SITE BEFORE EVENTS





Fukushima Dai-ichi Unit 1 (airborne picture: TEPCO)

05/14/2012



Fukushima Dai-ichi Unit 3 (airborne imagery: TEPCO)

UNIT 4



05/14/2012

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OTHER PHOTOS



UNIT 4

UNIT 3

UNIT 2

UNIT 1



UNIT 1

05/14/2012

OTHER PHOTOS



05/14/2012

Unit 4

OTHER PHOTOS

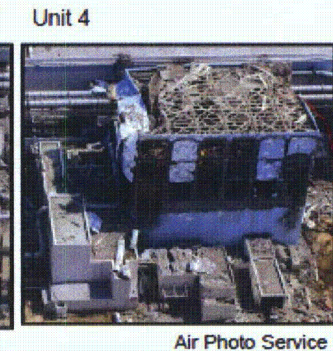
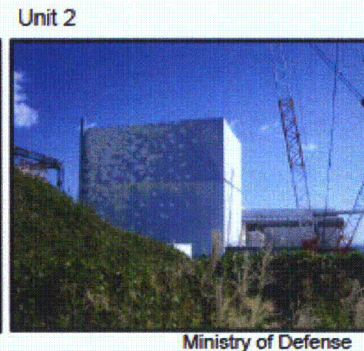
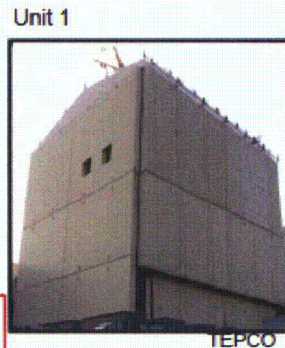
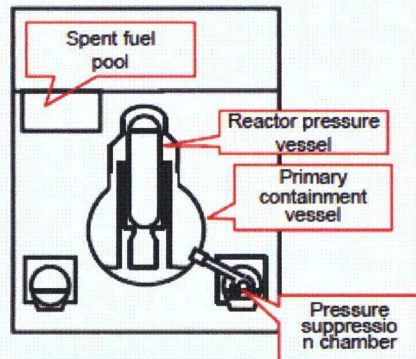
Unit 3



05/14/2012

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Current Status of Fukushima Dai-ichi NPP



Reactor Pressure vessel Temperature at reactor vessel bottom*	Circulating water injection cooling 24.3°C	Circulating water injection cooling 47.1°C	Circulating water injection cooling 51.4°C	No fuel
Primary Containment vessel Temperature of air in PCV*	Nitrogen injection 25.4°C	Nitrogen injection 54.3°C	Nitrogen injection 44.4°C	—
Fuel pool Temperature of pool water*	Circulation cooling 26.5°C	Circulation cooling 14.2°C	Circulation cooling 14.4°C	Circulation cooling 26°C
Highly-contaminated water in R/B and T/B**	14,100 m ³	22,000m ³	23,800 m ³	18,300 m ³

Effectively Cold Shutdown (100° C = 212° F)