SAND2011-3433C

Planning for Emergency Worker and Public Radiation Protection

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Amman, Jordan

June 14, 2011

Emergency Planning Purpose

Failing to PLAN means PLANNING to Fail?

Useful Reference Documents

- NCRP Report No. 52, *Cs-137 from the Environment to Man: Metabolism and Dose*
- NCRP Report No. 109, *Effects of Ionizing Radiation on Aquatic Organisms*
- NCRP Report No. 116, *Limitation of Exposure to Ionizing Radiation*
- NCRP Report No. 154, *Cs-137 in the Environment: Radioecology and Approaches to Assessment and Management*
- NCRP Report No. 159, *Risk to the Thyroid from Ionizing Radiation*
- NCRP Report No. 161, *Management of Persons Contaminated with Radionuclides*

Useful Reference Documents (cont'd)

- ***Commentary No. 10*, Advising the Public about Radiation Emergencies**
- **Commentary No. 19, *Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism***

Topics to Address

Texts should be available to convey basic facts, *i.e.*, potential hazards and options for radiation protection. Other recommended topics include the following:

- description of radiation types
- radiation sources
- interactions of radiation with matter
- radionuclide generation
- radioactive decay
- environmental movement of radioactive materials
- modes of exposure (external, inhalation, ingestion)
- behavior of radiation radioactive materials within the body
- levels of measurable effects on humans and the environment
- limitation of exposure by time, distance and shielding

Exposure Pathways
(Data Collection Objectives)

(Not all pathways may be of concern. Prioritize target pathways to fit budget.)

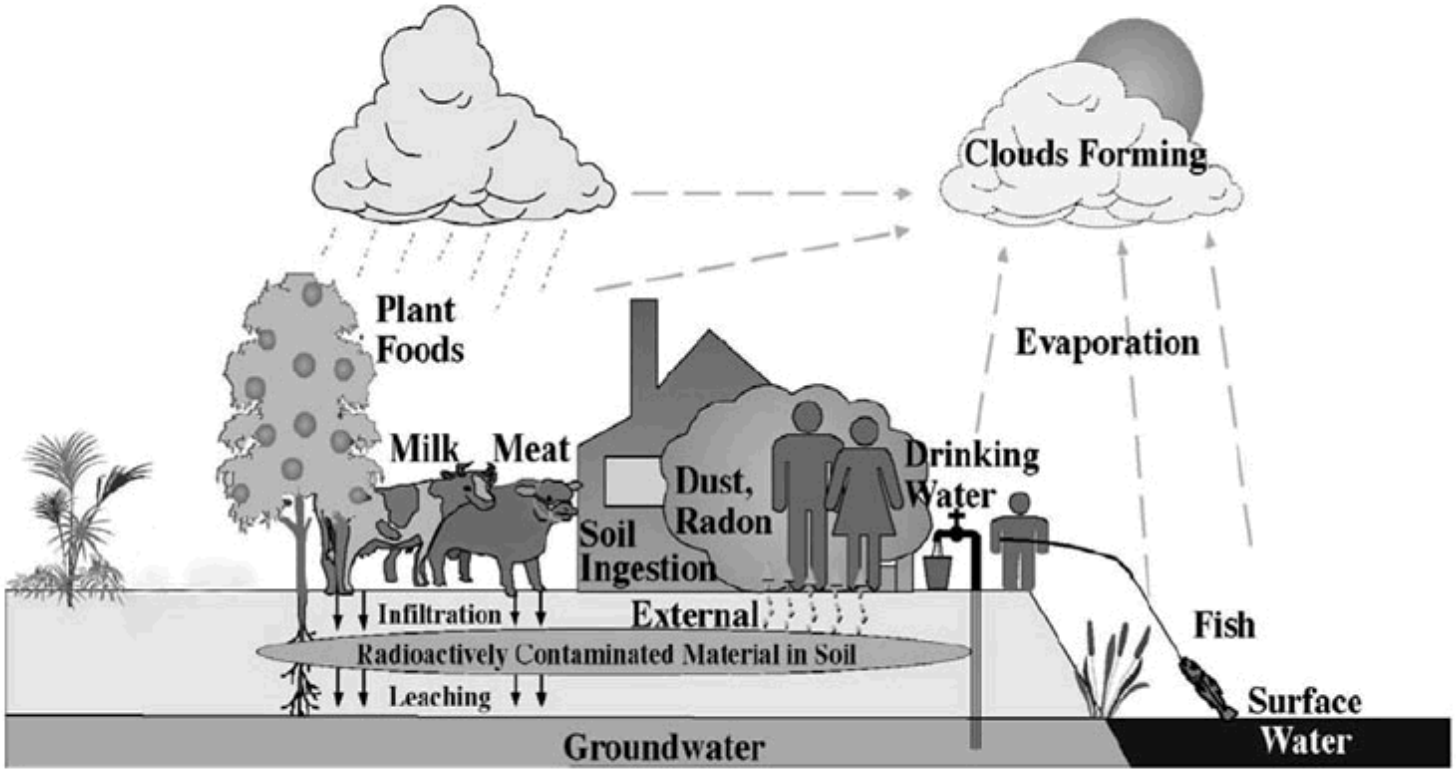


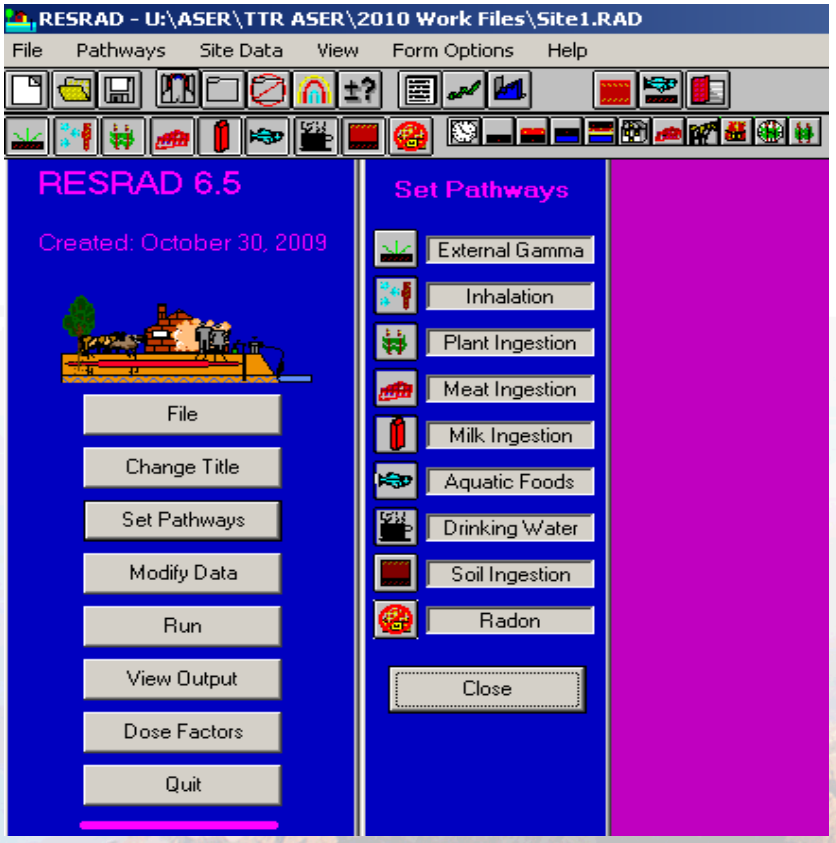
FIGURE 1.1 Exposure Pathways Considered in RESRAD

Exposure Pathways
(Data Collection Objectives)

- **Direct exposure to external radiation from the contaminated soil material;**
- **Internal dose from inhalation of airborne radionuclides, including radon progeny; and**
- **Internal dose from ingestion of**
  - Plant foods grown in the contaminated soil and irrigated with contaminated water,
  - Meat and milk from livestock fed with contaminated fodder and water,
  - Drinking water from a contaminated well or water body,
  - Fish or shellfish from a contaminated water body, and
  - Contaminated soil.

Related Input Parameters Needed

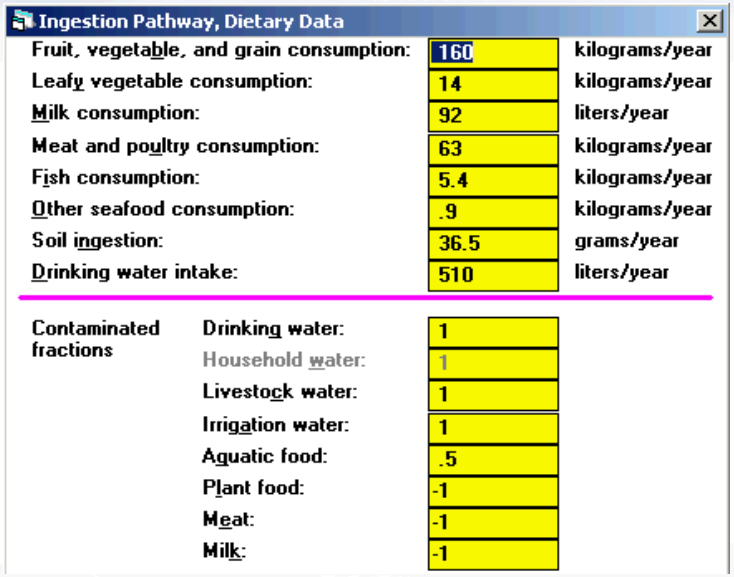
- **Seafood Consumption Rates**
- **Meat / Dairy / Vegetable Consumption**

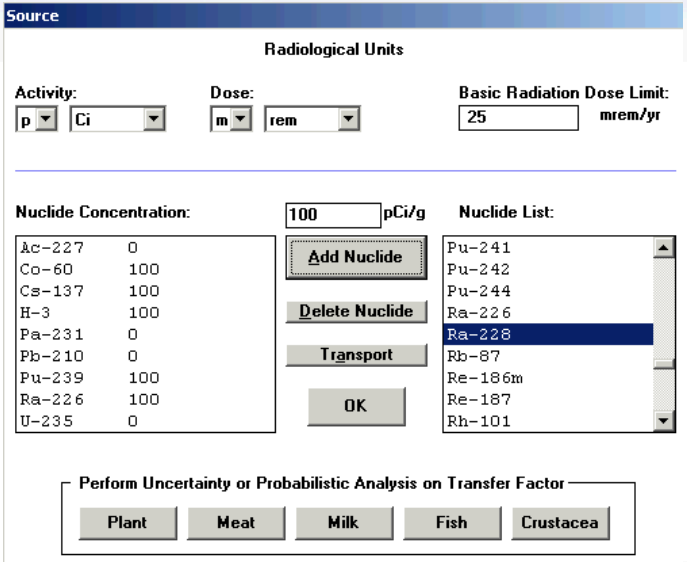


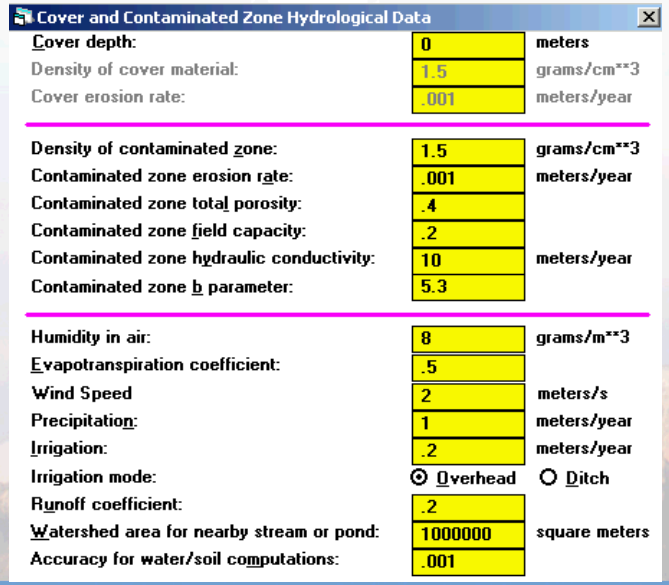
» **Many Others (RESRAD provides default values than can be over-ridden by user.)**

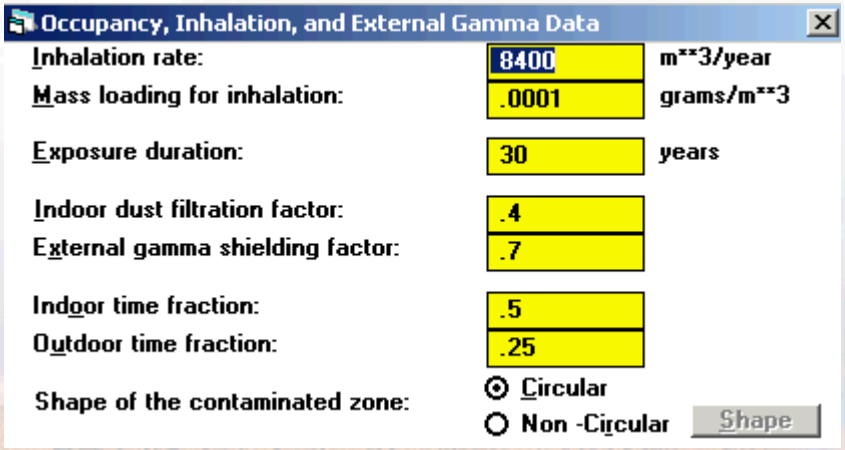
» **http://web.ead.anl.gov/resrad/home2/**

Example of RESRAD Parameters









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Source Term Considerations

- Bushehr Reactor in Iran 400 km N
- Braka Reactors in UAE 240 km miles SE
- Ocean Currents?
- Meteorological Patterns?
- Source depletion with distance?
- Water release?
- Air Release?

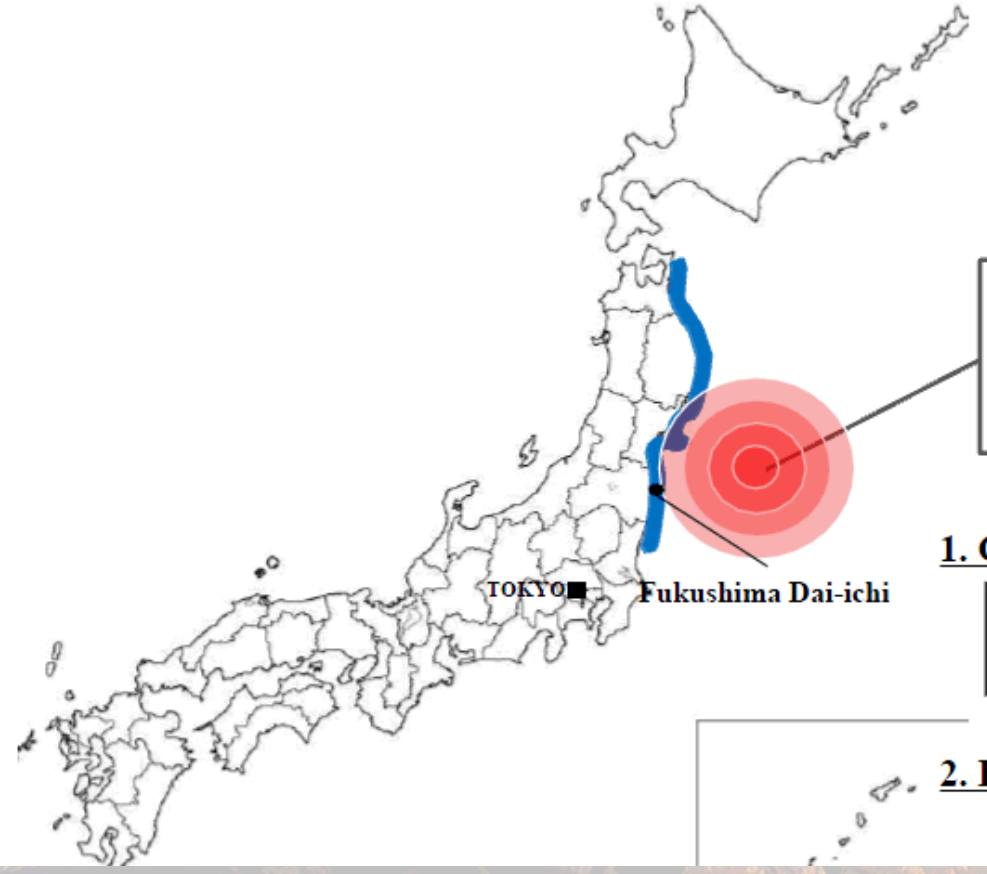
Nuclear Facilities in Gulf Region

A Real World Example

The M9.0 Tohoku
Earthquake and Tsunami of 11 March 2011
Impact on the Fukushima Nuclear Power Station

Fukushima Overview

A. Japan Faces an Unprecedented Challenge
(Enormous Earthquake, Tsunamis and Nuclear Accident)



Earthquakes:
- M - 9.0 quake (March 11)
- M - 7 class 5 times
- M - 6 class 72 times
- M - 5 class 423 times

1. Casualties : over 27,000

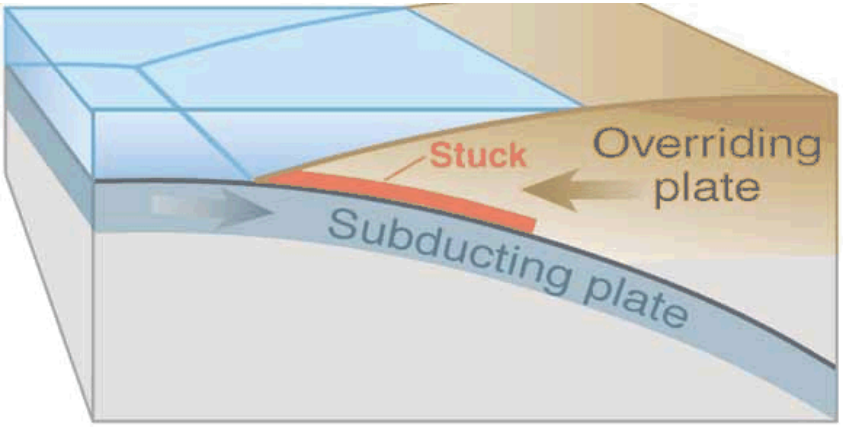
Dead	over 13,000
Missing	over 14,000

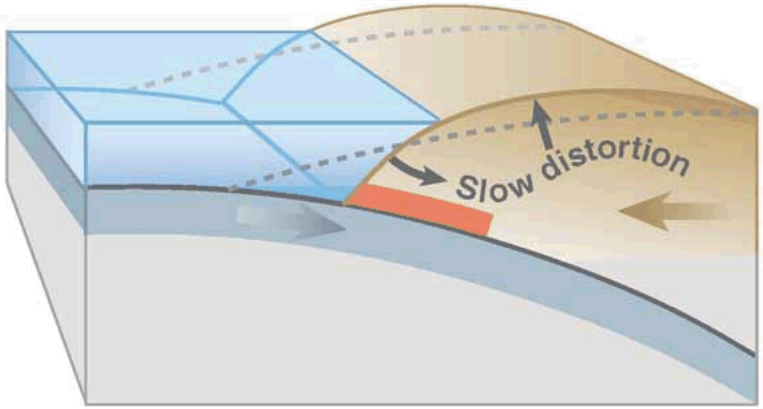
2. Evacuees : over 136,000

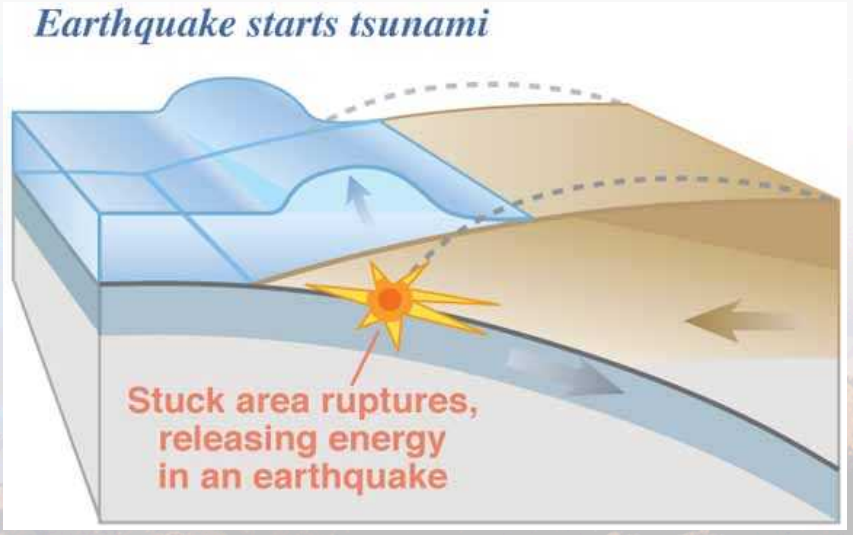
(As of April 17th)

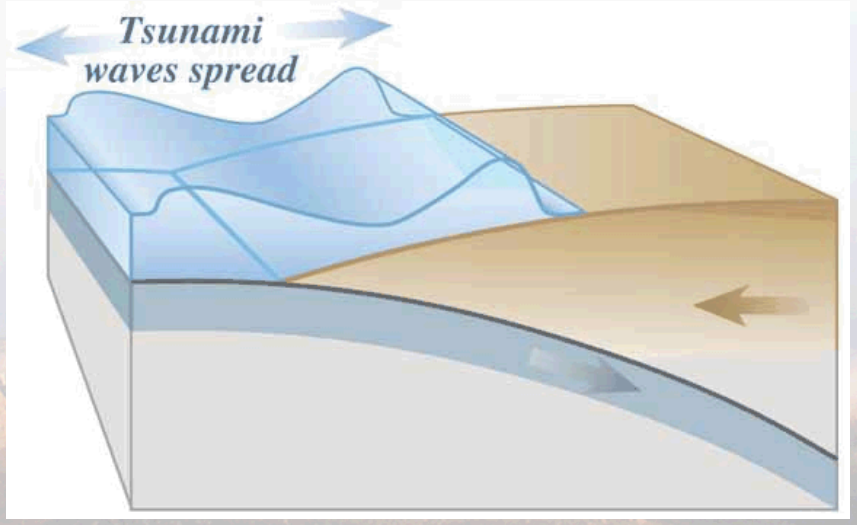
Tsunami Generation

Note: These are **WEST** coast U.S. schematics. Reverse for Japan Tohoku quake.



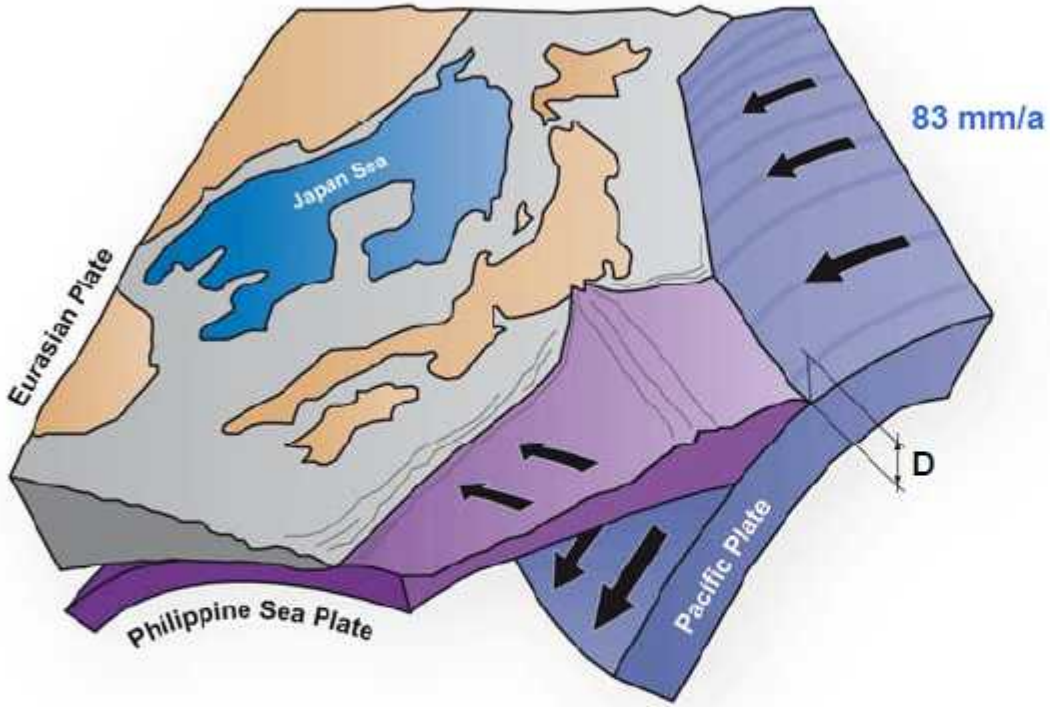






Tohoku-Taiheiyou-Oki Earthquake

VGB PowerTech

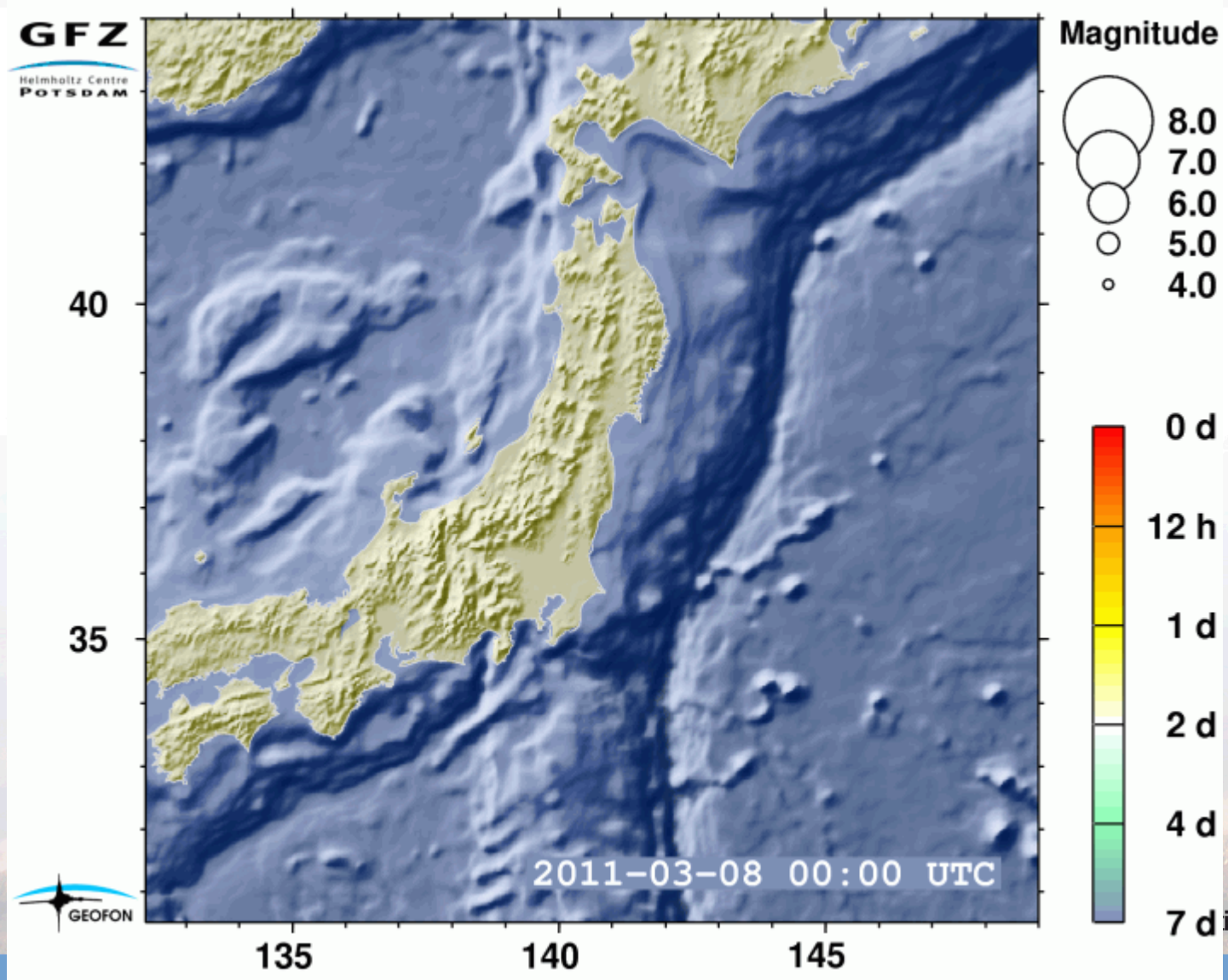


- **Vertical Displacement**
  D ≈ 7 to 10 m
- **Peak Displacement**
  D_{max} ≈ 17 to 25 m [1])
- **Rupture Zone**
  A ≈ 500 km x 100 km
- **Hypo Center Depth**
  Z_H ≈ 20 to 25 km
- **Crack Velocity**
  v ≈ 2 km/s
- **Water Depth**
  Z ≈ 8 km

- **Rough Estimate of Water Volume Involved**
  $V \approx A \cdot \frac{1}{4} D \approx 500\ km \cdot 100\ km \cdot 2{,}5\ m = 125\ km^3$
- **Consequence:** Sudden displacement of a huge water volume ► **Tsunami.**

Source: Dr. Hein Meidow, Cologne, 2011 JST: Japan Standard Time UTC: Coordinated Universal Time [1]) in deep underground

Seismicity Animation



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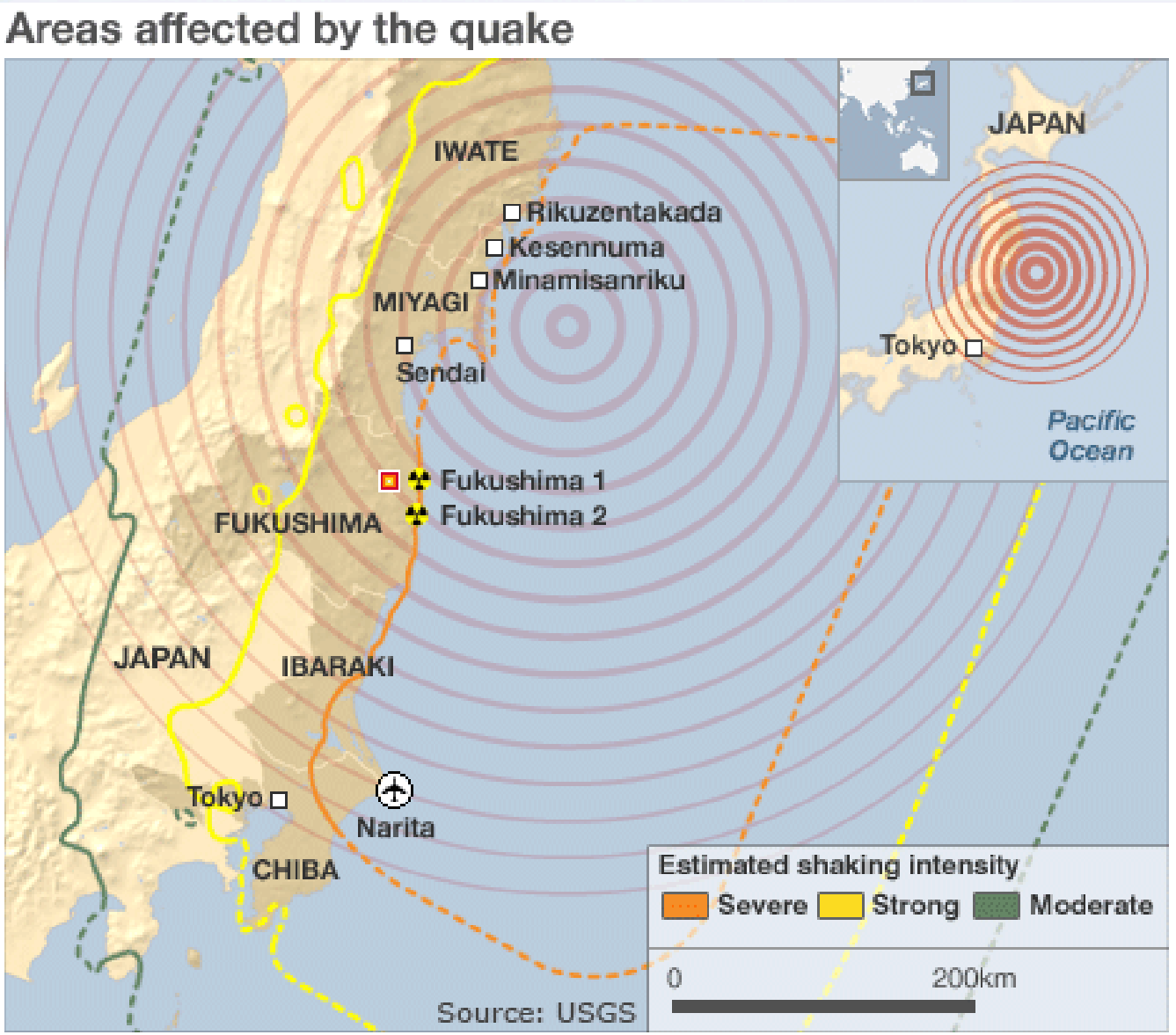
Map View of Area



Tsunami Statistics

- Original Design Basis was ~3 meters based on 1900 Chile earthquake/tsunami
- Upgrade in 2000 to 6 meters based on more modern data
- Actual 3/11/11 tsunami was 14 meters!
- Ground level at Fukushima Dai-ichi in 10 meters.
- You can't out guess Mother Nature?

Fukushima Event Evolution

“Before Earthquake” Photo

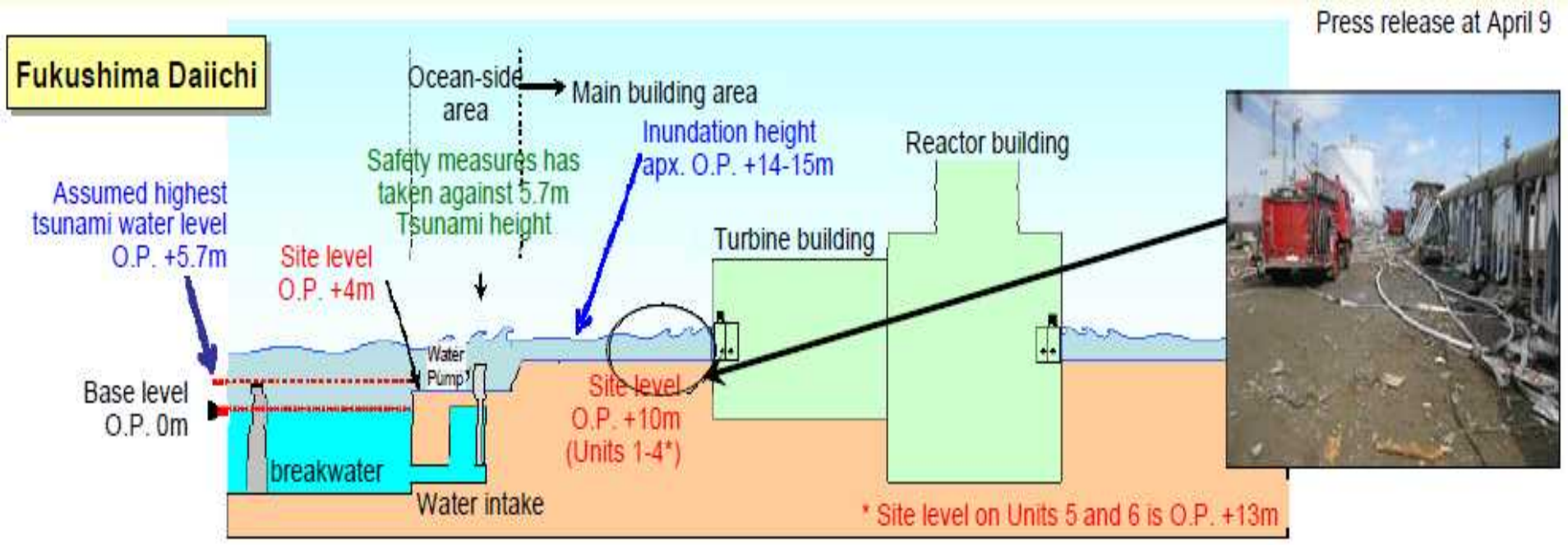
All Emergency Shutdown Systems WORKED (Initially)

- Reactors Automatically Shut Down
- Emergency Core Cooling Initiated
- All Systems Under Control

Post-quake Tsunami Hits Coast

- Massive Damage
- Destroys Electric Power Grid (which supplied power for "routine" plant operations)
- Emergency Diesel Generators Started, as Designed
  - HOWEVER, tsunami washed diesel fuel storage tanks away! Pumps ran ~ 8 hrs on battery backup.

Height of Tsunami



O.P. : Onahama bay construction base level


Incoming Tsunami


Tsunami Floodwater

The Nightmare Unfolds

Had the (electric) ventilation fans been working, most/all of hydrogen gas generation would have gone out the tall stack shown in the following picture(s).

View of explosion / Steam venting

Monday, March 14

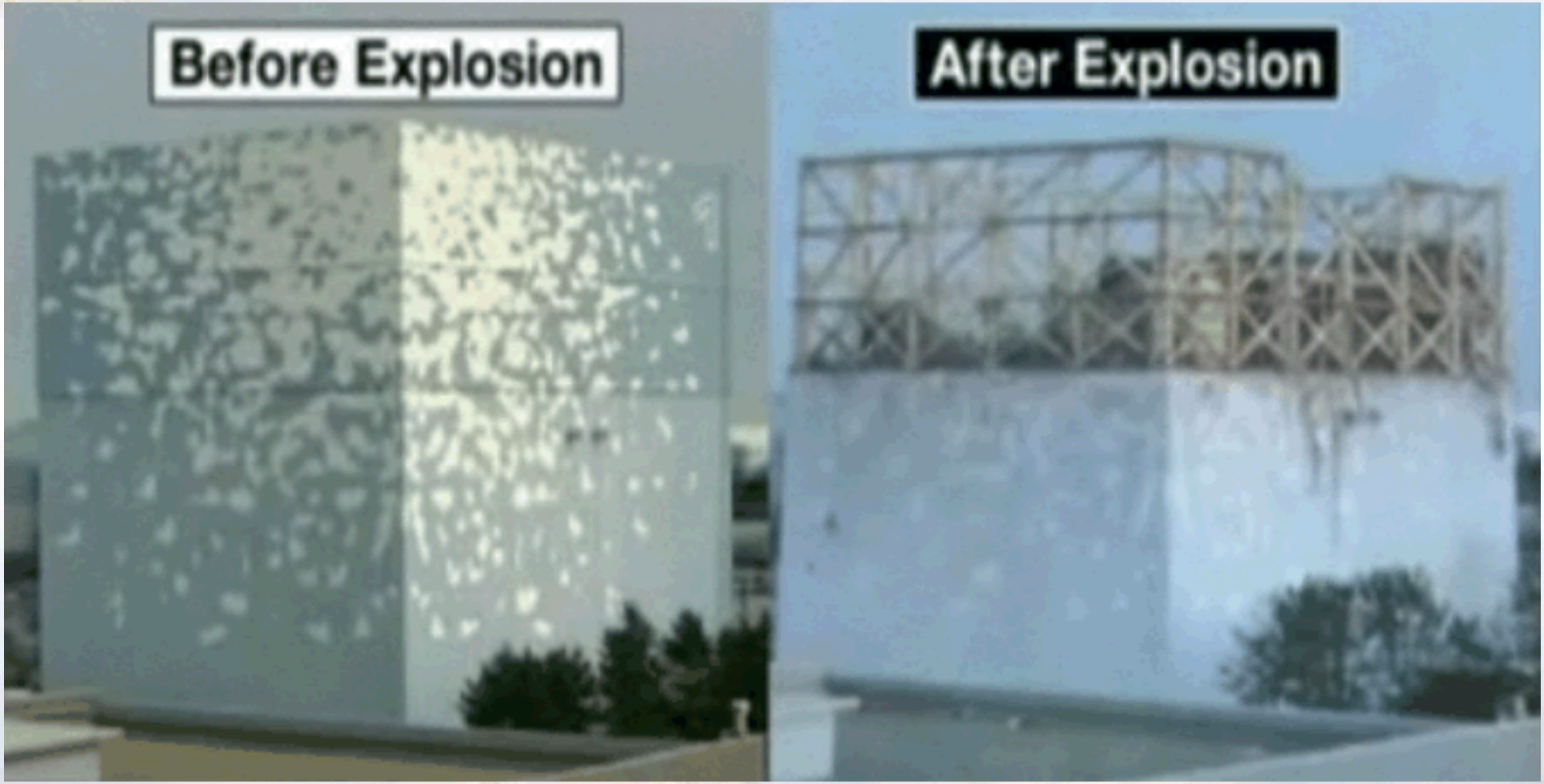
Monday's blast destroyed the containment building but the reactor is still intact. Japanese officials also said cooling systems have failed at a third reactor.

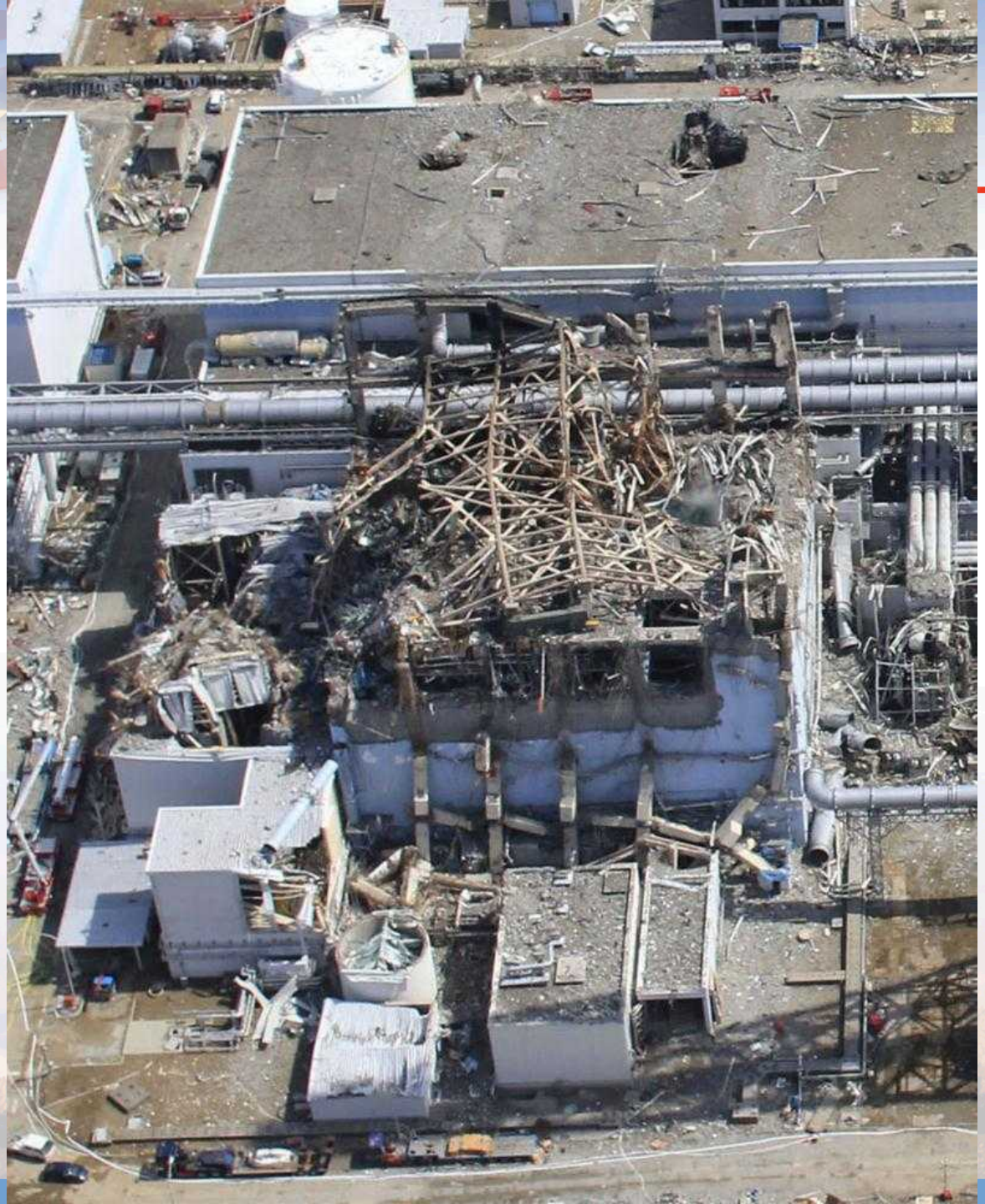
In this image made off NTV/NNN Japan television footage, smoke ascends from the Fukushima Dai-ichi nuclear plant's Unit 3 in Okumamachi, Fukushima Prefecture, northern Japan, March 14. The second hydrogen explosion in three days rocked Japan's stricken nuclear plant Monday, sending a massive column of smoke into the air and wounding 11 workers.

NTV/NNN Japan/AP

View of explosion / Steam venting


Emergency Generator
Diesel Tanks GONE!


Before Explosion
After Explosion



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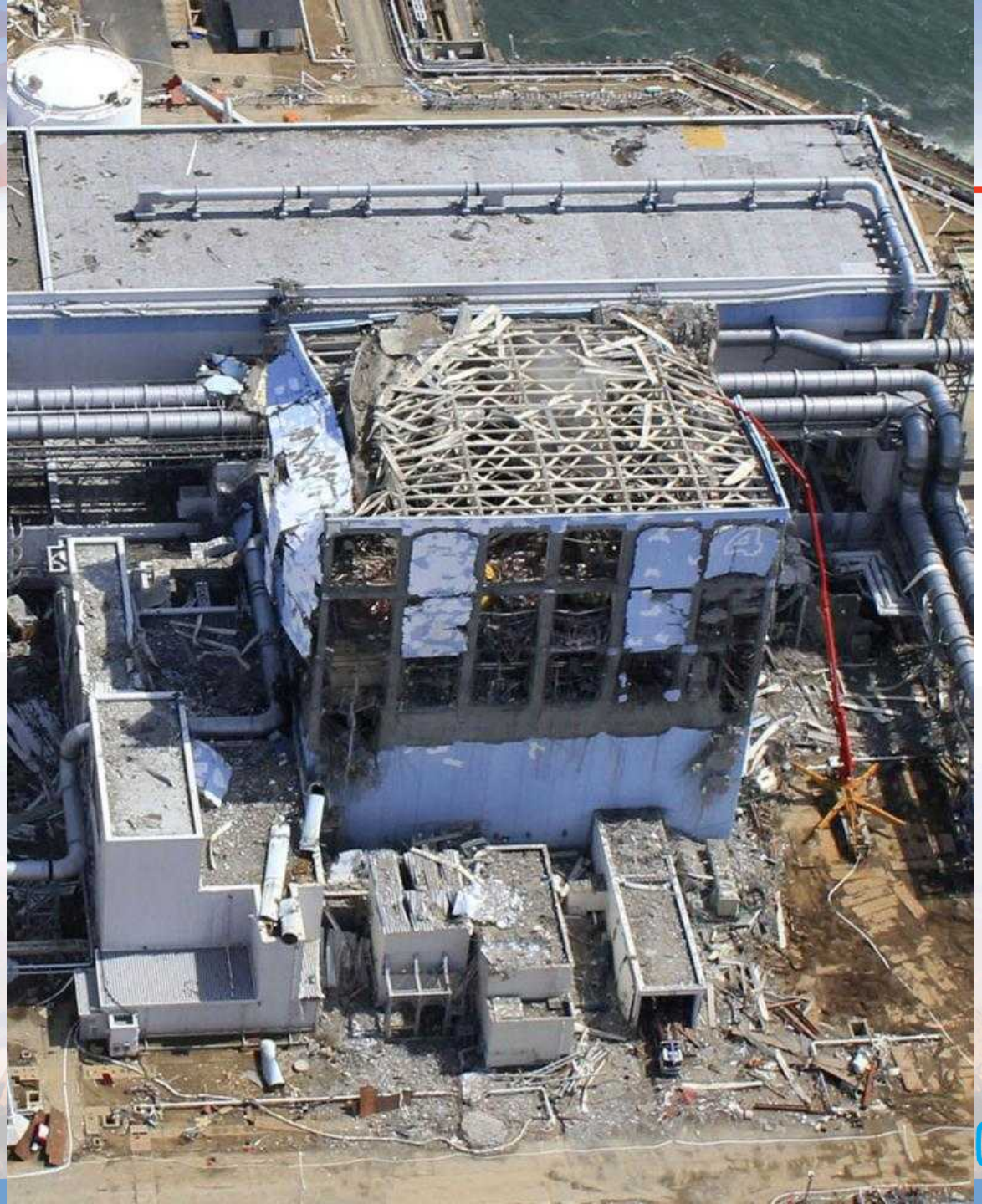

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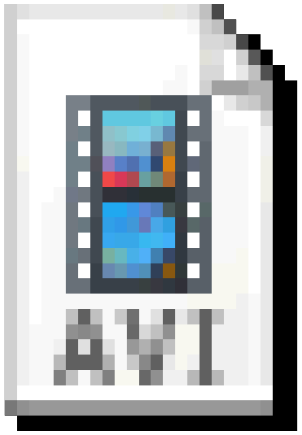
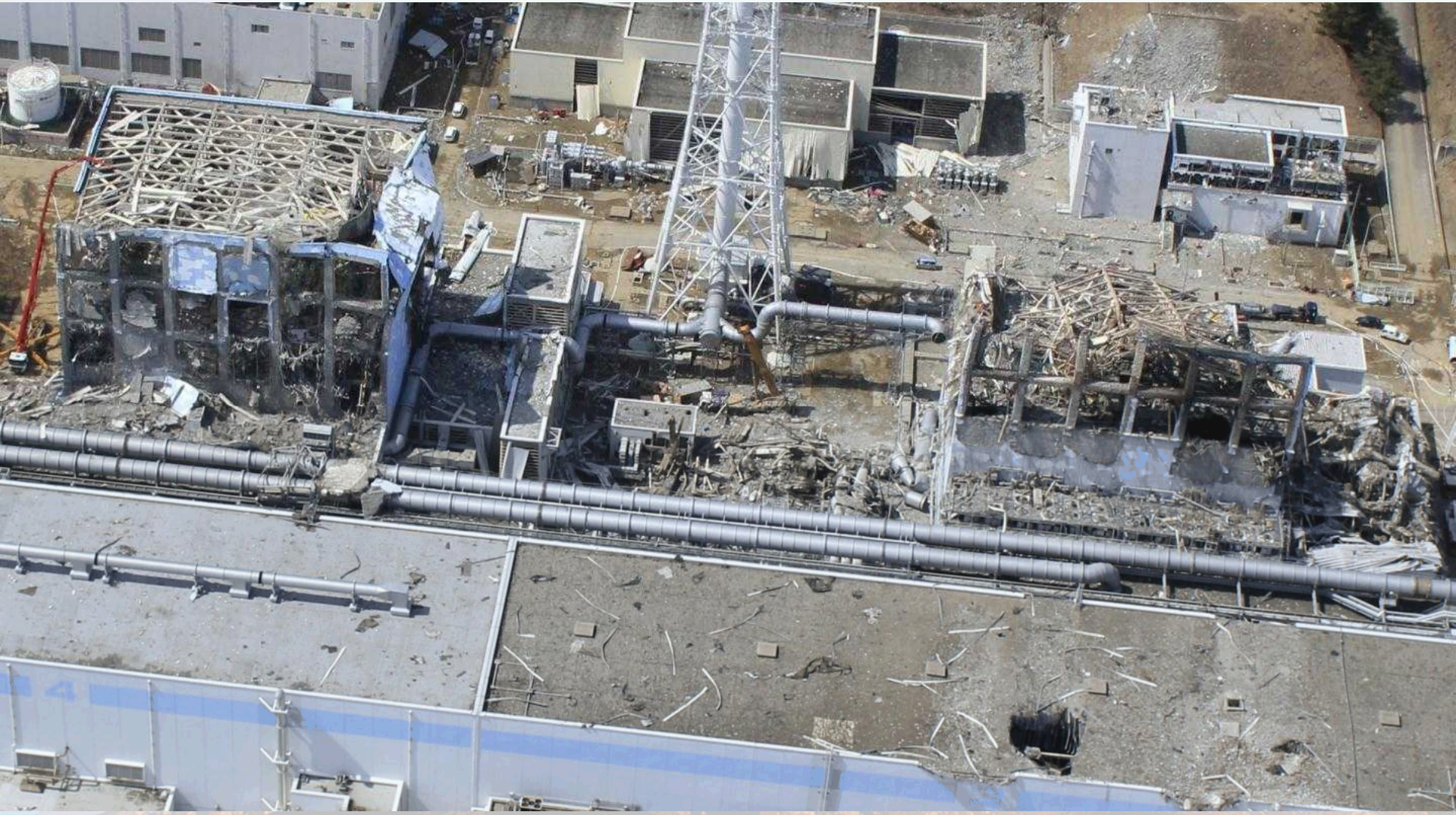
Explosion
Damage



110411_1f_14.avi

(Open Video OUT of Slide Show mode)


Explosion Damage



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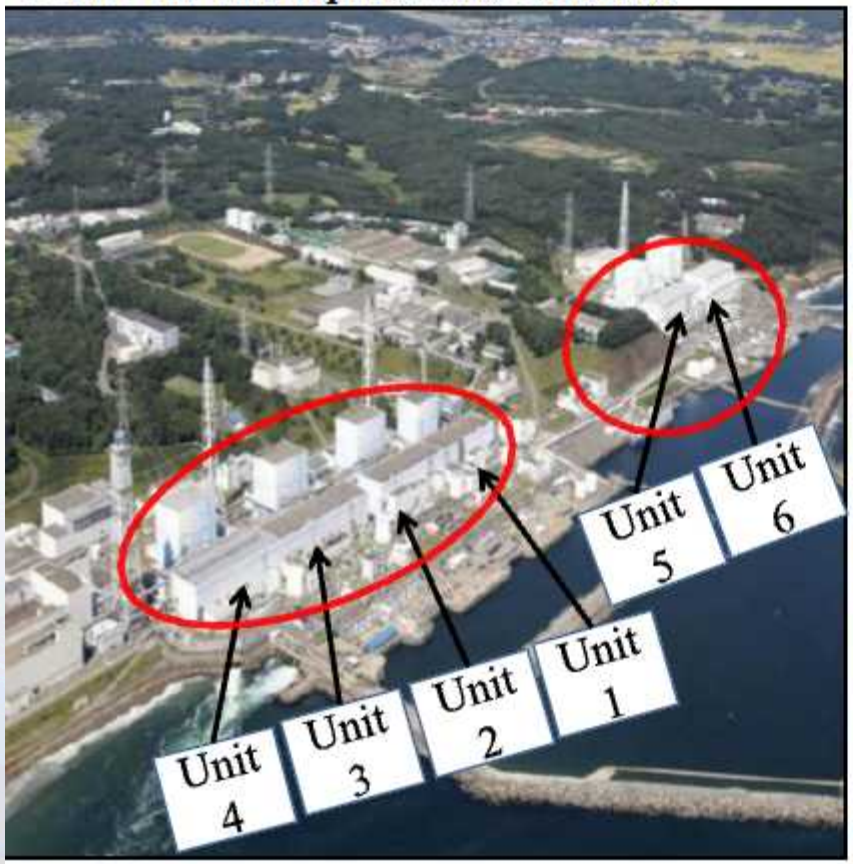
3. Nuclear Power Stations
Fukushima Dai-ichi Nuclear Power Station

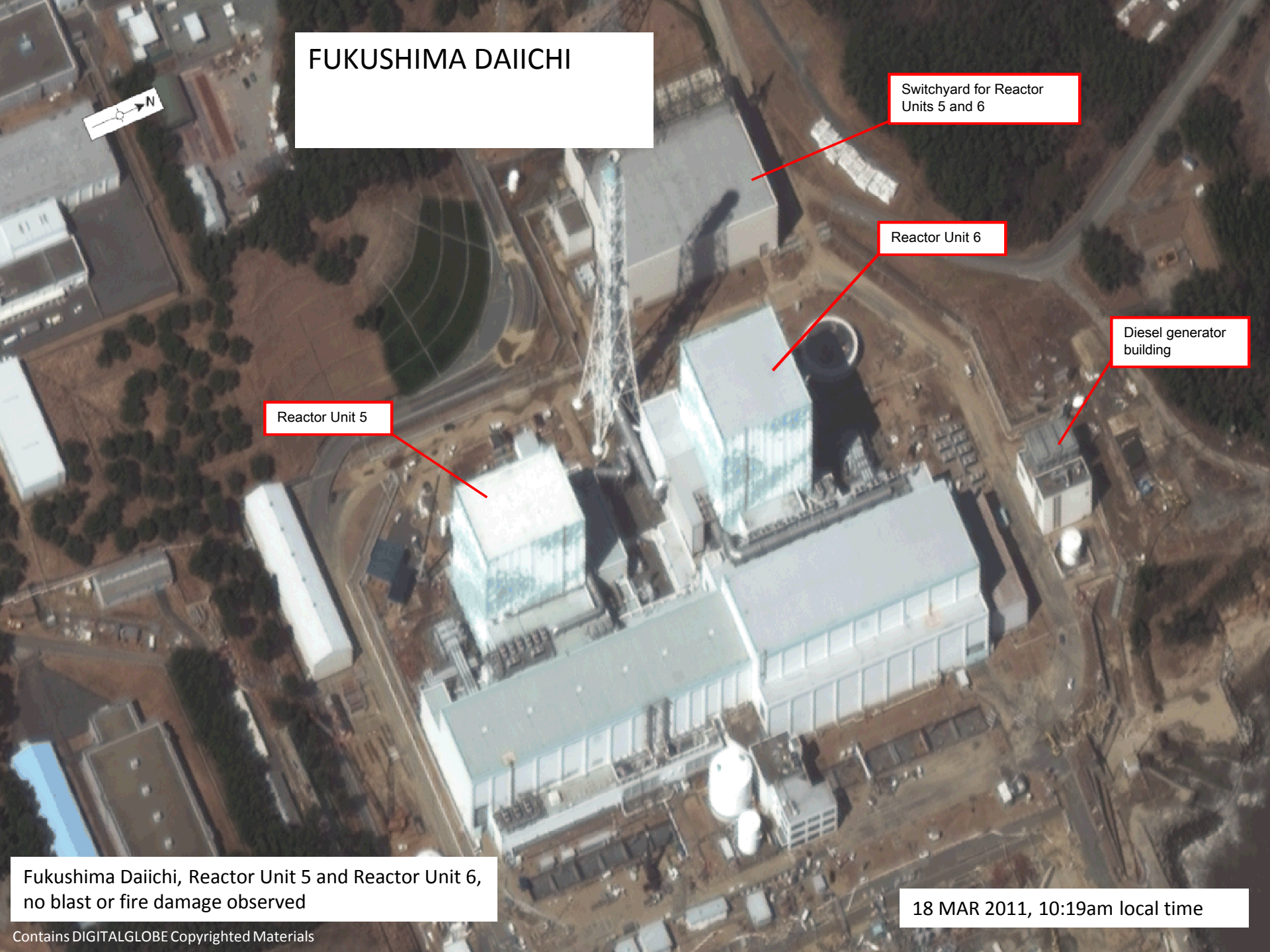
Before the Earthquake and Tsunamis



TEPCO

After the Earthquake and Tsunamis

Air Photo Service Inc (Myoko, Niigata Japan)



- The Government took measures such as taking shelters or evacuation as follows based on the reports from Fukushima Daiichi & Daini

Fri, 11 March

14:46 The earthquake occured
19:03 Emergency Declaration by the Gov't (Daiichi)
21:23 3 km radius evacuation (Daiichi)
10 km radius taking shelter (Daiichi)

Sat, 12 March

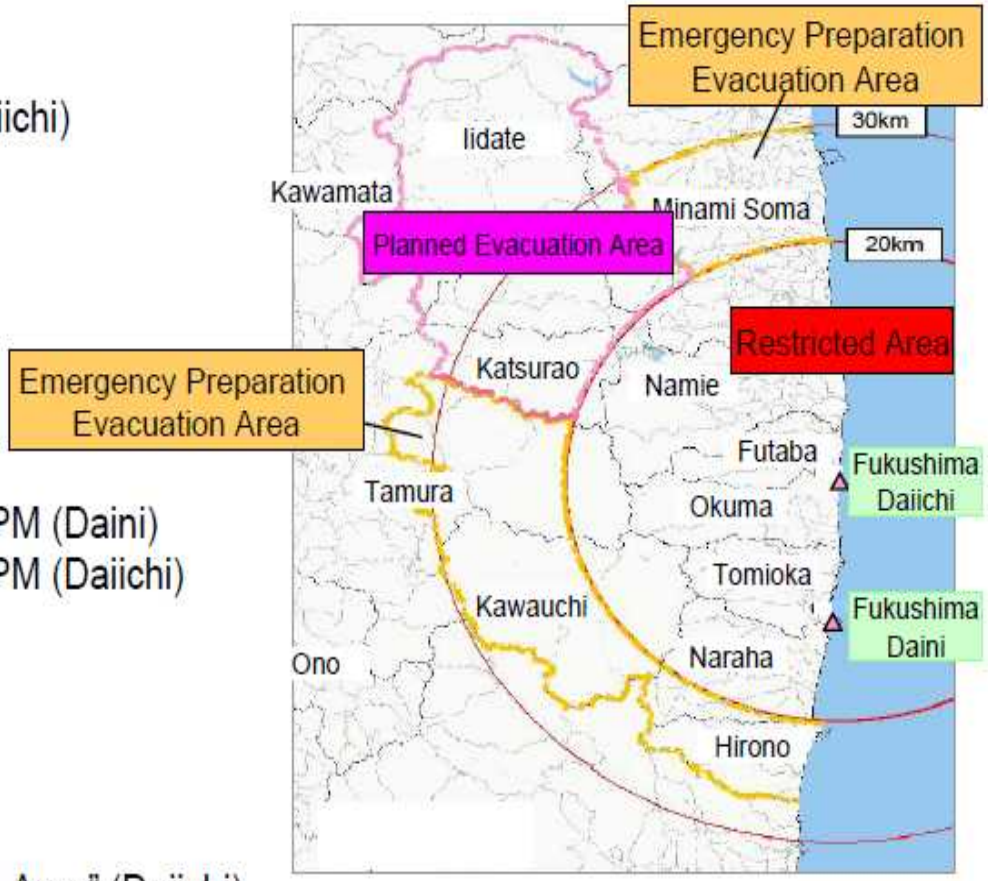
5:44 10 km radius evacuation (Daiichi)
7:45 3 km radius evacuation (Daini)
10 km radius taking shelter (Daini)
17:39 10 km radius evacuation directed by the PM (Daini)
18:25 20 km radius evacuation directed by the PM (Daiichi)

Tue, 15 March

11:00 20-30 km radius taking shelter (Daiichi)

Thu, 21 April

11:00 20 km radius is designated as "Restricted Area" (Daiichi)



Source: NISA website

Fri, 22 April

9:44 20-30 km radius taking shelter has been lifted (Daiichi)
Establishment of "Planned Evacuation Area" and "Emergency Preparation Area"

Fire Trucks

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EOC Field Staff Preparation

EOC Staff Activities

EOC Staff Activities

Radiation Worker Dose Limits

- 50 mSv/yr (routine operations)
- 250 mSv (once-in-lifetime Voluntary Emergency Exposure)

- Most-exposed emergency workers (3) received ~170 mSv

Health Effects of Radiation from Japanese Reactor Leaks

By Blaine N. Howard, Radiological Physicist

There are two types of health effects of radiation -- short term and long term.

The **short term** effects include **radiation sickness** and **death**.

The **long term** effects include **cancer**.

The Japanese emergency workers are the only people who receive significant amounts of radiation. For this emergency, the exposure limit has been raised from 100 mSv 250 mSv which still prevents them from the danger of short term radiation effects. See Figure 1.

Thus, there should be no <u>short term</u> radiation health effects in Japan.

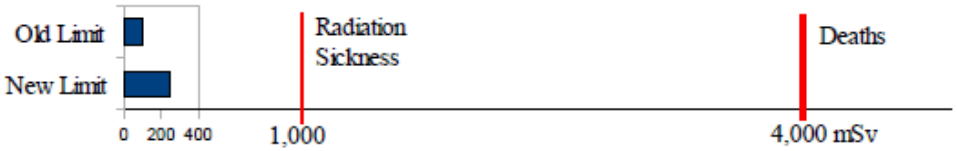

Figure 1. Emergency Worker Limits and Short Term Effects

Some claim that all radiation increases the risk of getting cancer. This is not in agreement with good radiological science. The General Accounting Office states it this way.

"According to a consensus of scientists, there is a <u>lack of conclusive evidence</u> of low level radiation effects below total exposures of about 5,000 to 10,000 millirem." [50 to 100 mSv]

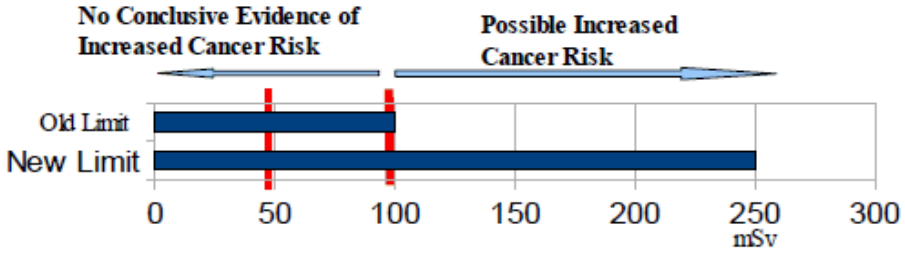

Figure 2. Emergency Worker Limits and Long Term Radiation Effects.

The emergency workers are likely to be at an increased risk of dying from cancer. See Figure 2. The Linear No Threshold (LNT) model may be used to calculate an upper limit of the expected risk. This calculation for a worker exposed to 250 mSv gives a 0.5% increase risk of dying from cancer. Since cancer deaths normally account for about 25% of all deaths and vary each year, an additional 0.5% would probably not be observable.

At the current levels of radiation, it is unlikely for persons outside the exclusion area to receive 50 mSv even if the levels persist for a year. This includes external radiation and internal radiation from ingestion or inhalation of radioisotopes. Japanese officials are monitoring these levels. About April 12, they expanded the evacuation zone to include areas where there is a risk of more than **20 mSv** annual dosage.

Thus, <u>no significant increase in cancer risk</u> among the public is expected.

The danger of low dose radiation is very much exaggerated.

If the Japanese should not worry, why should we?

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Cancer Thoughts

- 25% of people alive will GET cancer in lifetime
- 20% of people alive will DIE from cancer (all causes)
- Additional risk of dying from cancer for most-exposed workers went from 20% to 20.1%

Civilian Radiation Dose Limits

- 5 mSv/yr (routine operations)
- 20 mSv (Emergency)

3. Nuclear Power Stations
Fukushima Dai-ichi Nuclear Power Station

20 km radius of the plant and other designated areas → to evacuate

20 to 30 km radius of the plant → to shelter indoors

Aerial Measuring System (AMS) [NNSA]

In the event of an accident or incident involving radiological materials, NNSA, in consultation with state and other federal agencies, will deploy AMS immediately to the incident site and operations are as follows:

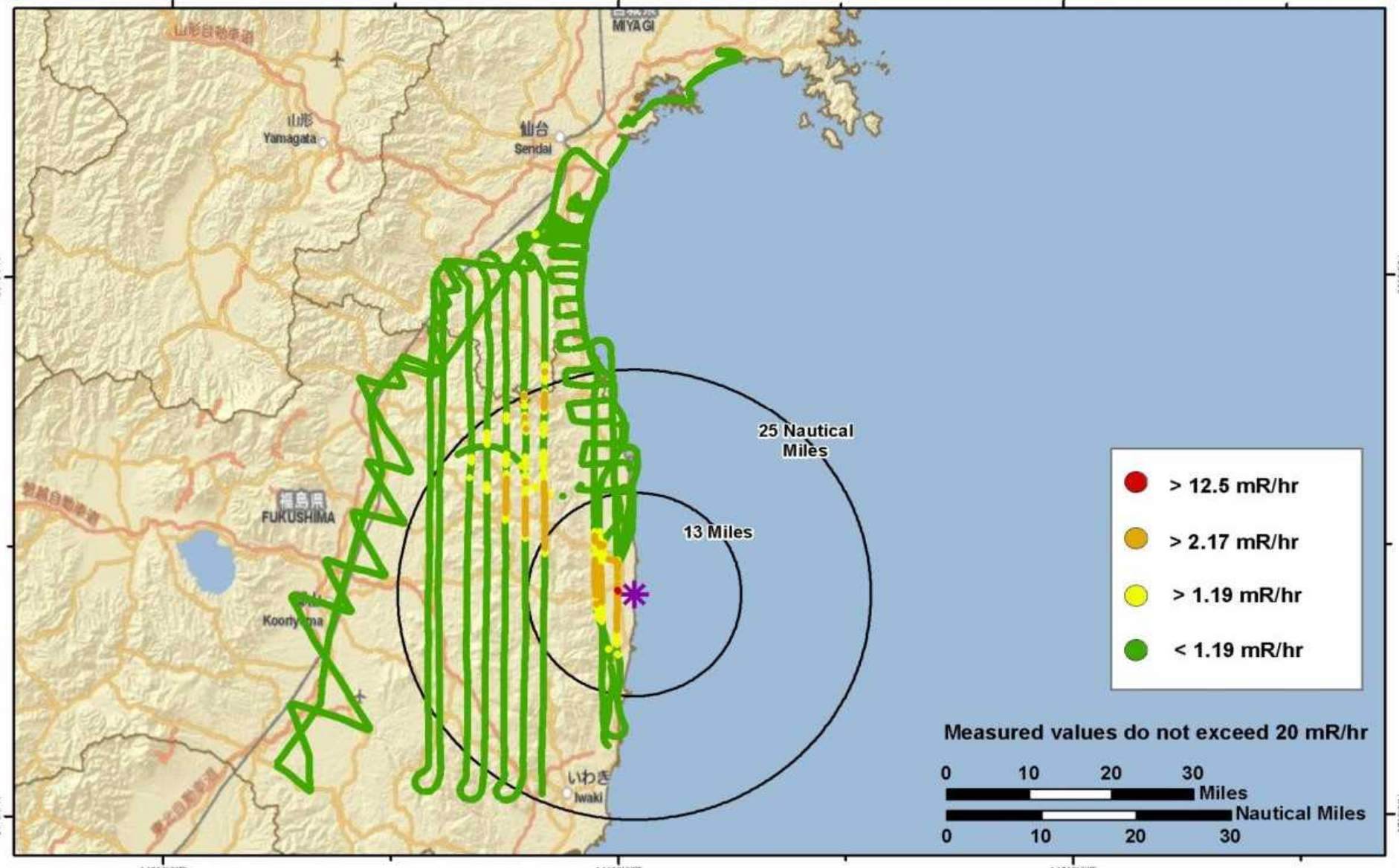
- Fixed-wing aircraft is deployed with the radiation detection system to collect information and determine the location of ground contamination.
- Helicopters to perform detailed surveys of ground contamination.
- NNSA scientists are then able to rapidly develop maps of the radiological materials deposited on the ground and the potential radiation exposure to personnel in the affected areas. This information gives emergency response officials information necessary to effectively respond to the emergency.

National Nuclear Security Administration

Aerial Monitoring Results

Combined UH-1 and C-12 Flights (March 24 & 26, 2011)

FUKUSHIMA DAIICHI
JAPAN

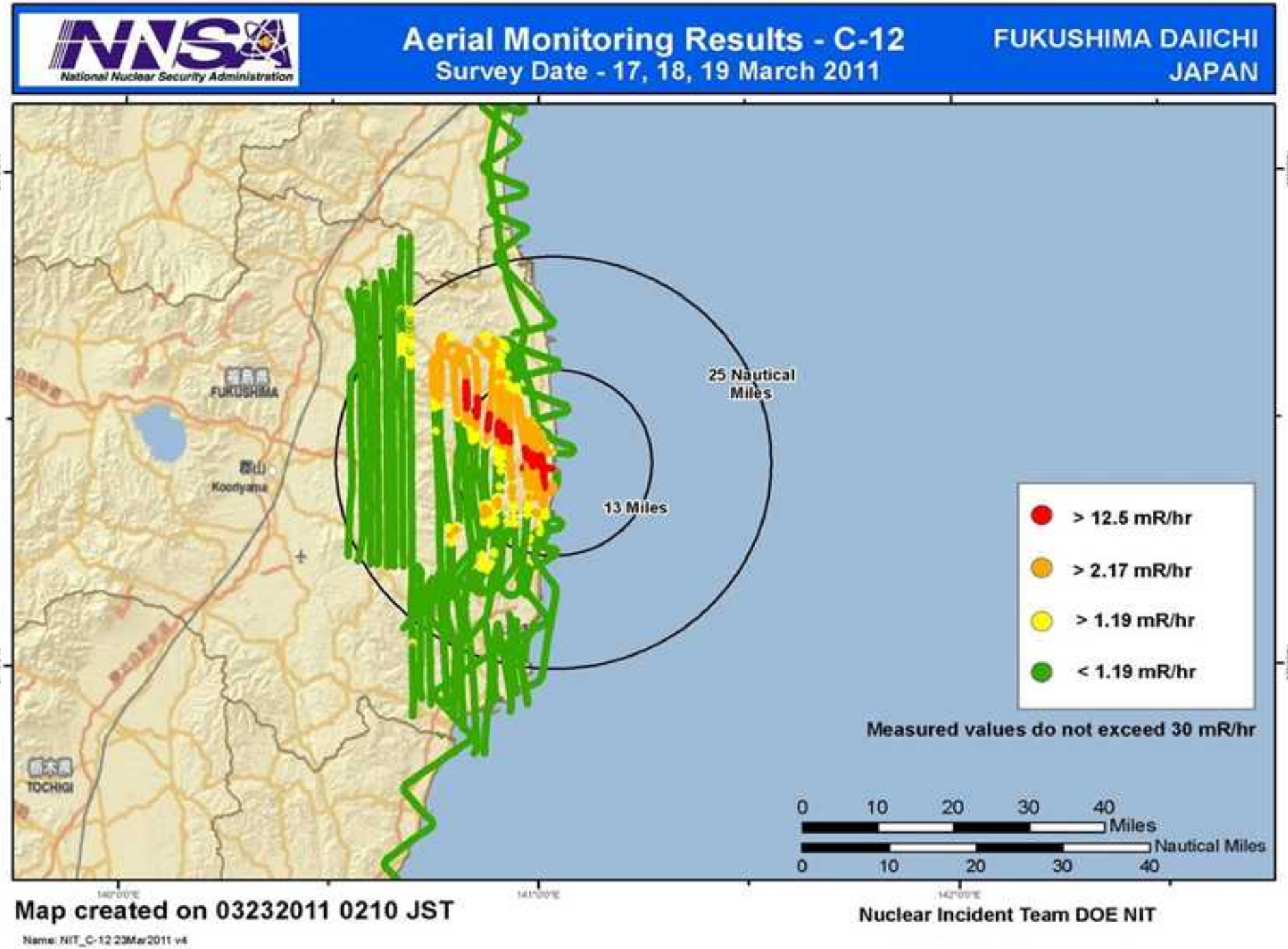


Map created on 03272011 0220 JST

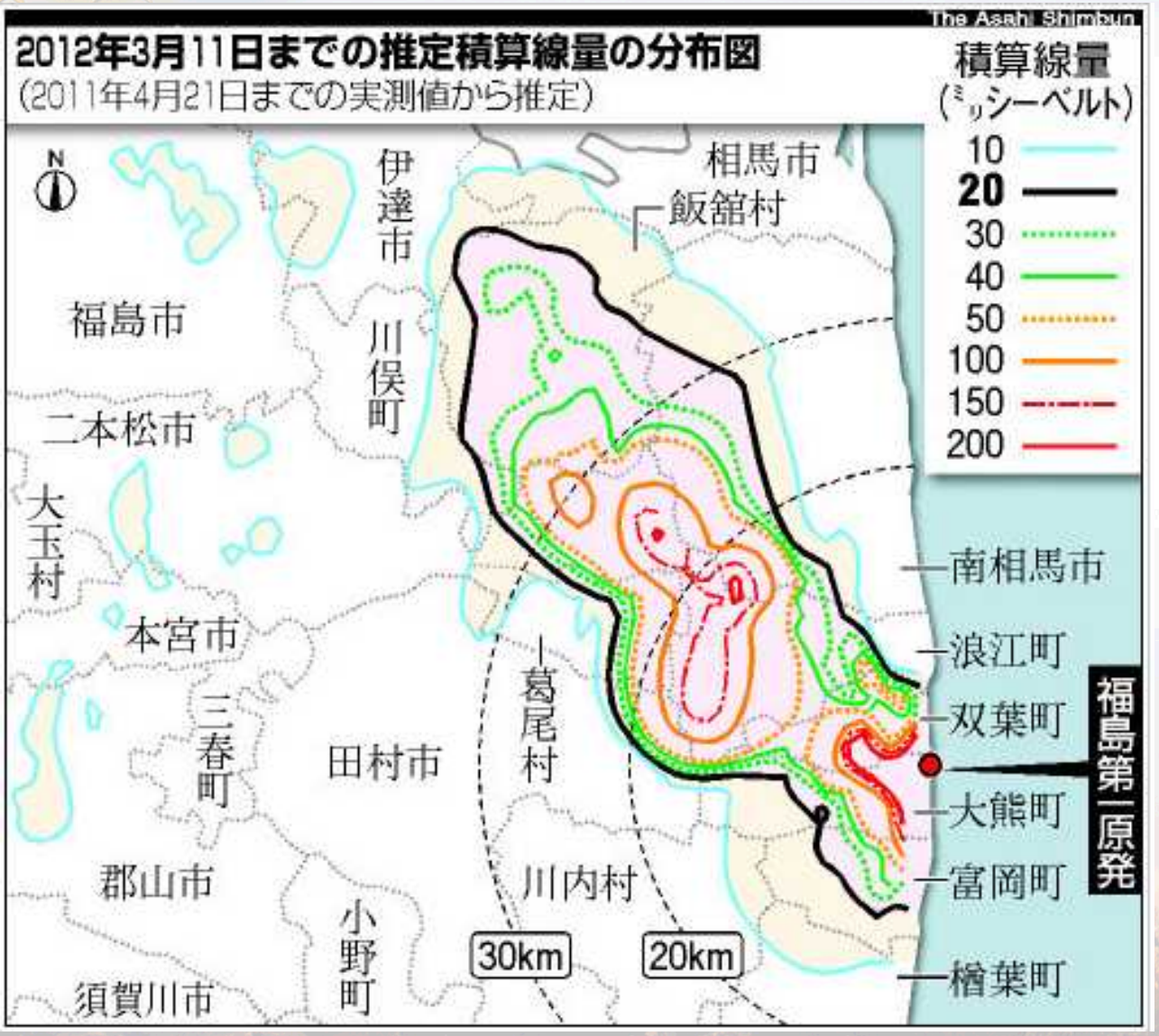
Name: NIT Combined C12 and UH1 26Mar2011 Results

UNCLASSIFIED

Nuclear Incident Team DOE NIT
Contact (202) 586 - 8100


National Nuclear Security Administration
Aerial Monitoring Results - C-12
Survey Date - 17, 18, 19 March 2011
FUKUSHIMA DAIICHI
JAPAN
FUKUSHIMA
Koriyama
TOCHIGI
25 Nautical Miles
13 Miles
> 12.5 mR/hr
> 2.17 mR/hr
> 1.19 mR/hr
< 1.19 mR/hr
Measured values do not exceed 30 mR/hr
0 10 20 30 40
Miles
Nautical Miles
0 10 20 30 40
Map created on 03232011 0210 JST
Nuclear Incident Team DOE NIT
Name: NIT_C-12 23Mar2011 v4

Fukushima Environmental Radiation Contours



Dose Contours = mSv/year

Assumes 8-hr/day outdoor exposure

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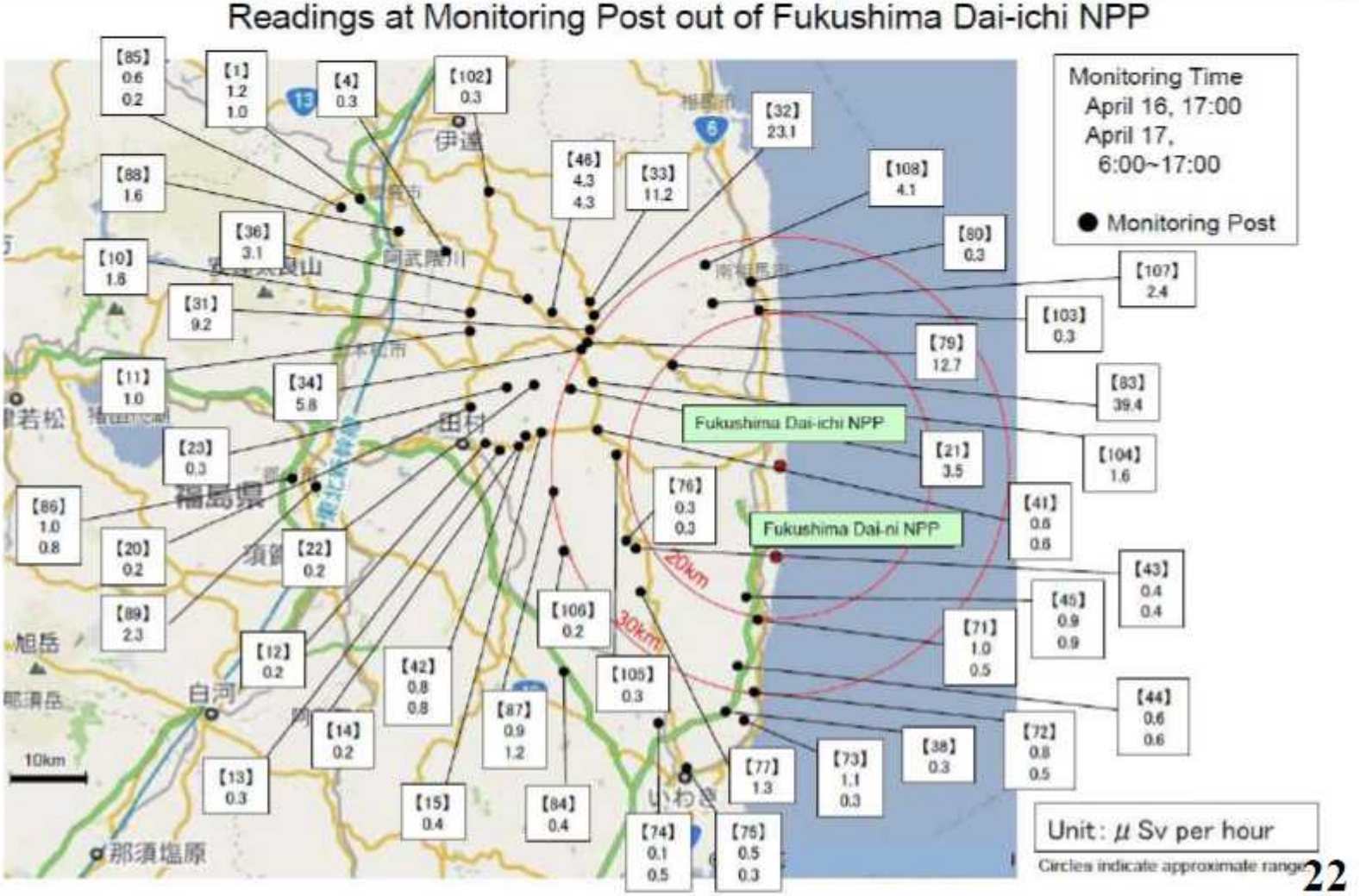
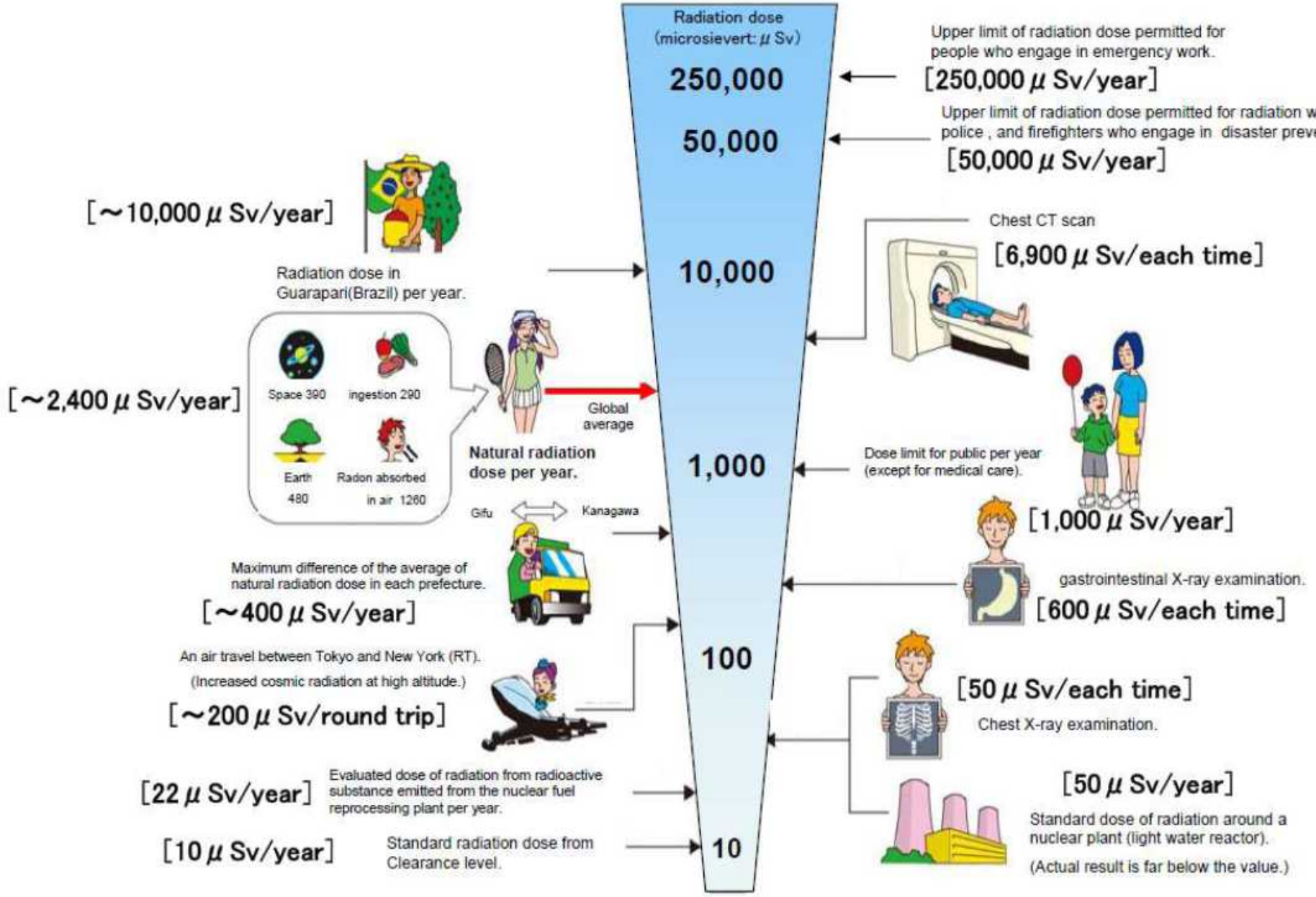
Readings at Monitoring Posts out of Fukushima Dai-ichi NPS



Radiation in Daily-life



※ Sv【Sievert】=Constant of organism effect by kind of radiation(※) × Gy【gray】

※ It is 1 in case of X ray and γ ray.

2. Contain the Spread of Radioactive Substances
(sea, soil and atmosphere)

Experts are making the utmost efforts to prevent dispersing radioactive substances contained in dust, debris and vapor.

Spraying synthetic materials on the surface of the ground and debris to prevent radioactive substances dispersion

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Utility Service Repair

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Utility Service Repair

Cooperation with the IAEA

1. Information Sharing

(1) Japan has been providing facility-related and other relevant information to the IAEA.

(2) Nuclear Industry Safety Agency (NISA) provided updates on situations of the Fukushima Dai-ichi Nuclear Power Station at the IAEA Technical Briefing (21st March) and at the side event of the Fifth Review Meeting of the Contract Parties to the Convention on Nuclear Safety (4th April).

2. IAEA Expert Missions

(1) The IAEA has extended to Japan upon the request of the Government of Japan, in connection with the incidents involving the nuclear power plants in Japan by dispatching a series of the IAEA experts to Japan mainly in the field of radiation monitoring. Such dispatch of experts includes :

(a) Radiation Monitoring Teams, totaling up to 16 members who have been taking measurements mainly in Fukushima since 19 March;

(b) one marine expert from the IAEA's laboratory in Monaco, who boarded Research Vessel "MIRAI" during 2 -4 April to observe and provide advice for Japanese experts on their method of collection and analysis of seawater samples; and

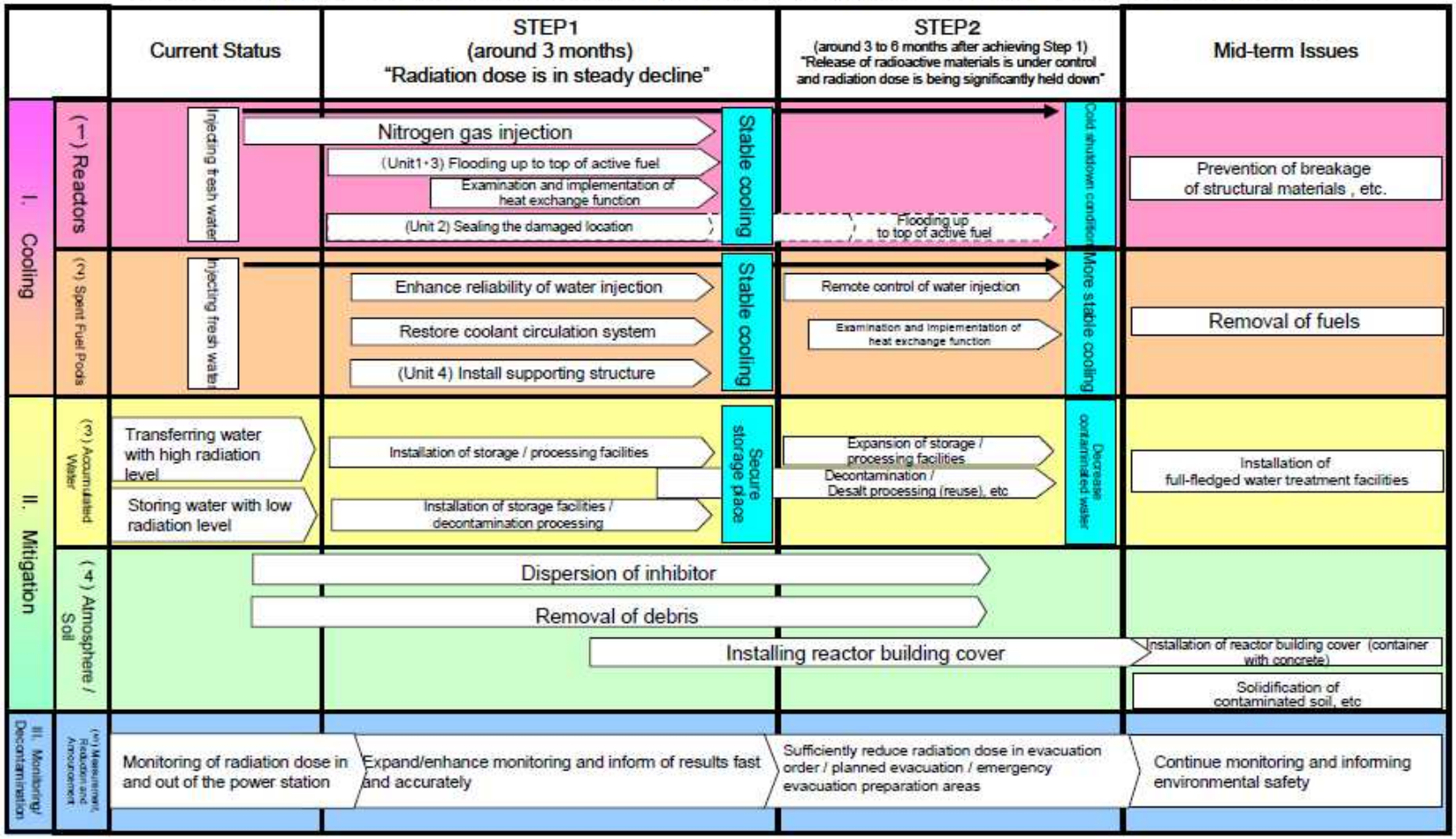
(c) A Joint FAO/IAEA Food Safety Assessment Team, who met with local government officials, farmers etc. in Fukushima, Ibaraki, Tochigi and Gunma prefecture.

(2) In addition, IAEA experts in BWR technology met with Japanese officials and operators including NISA and the Tokyo Electric Power Company (TEPCO) and visited the Fukushima Dai-ichi Nuclear Power Plant on 6 April.

Roadmap Towards Restoration

- By bringing the reactors and spent fuel pools to a stable cooling condition and mitigating the release of radioactive materials, we will make every effort to enable evacuees to return to their homes and for all citizens to be able to secure a sound life.

< Roadmap for Immediate Actions (Issues / Targets / Major Countermeasures) >



Survey Inside Reactor Buildings by Robot

- Measured a dose of radiation, etc by remote control robots “inside the double doors” in reactor buildings of Units 1-3 where were inhibited to enter due to high radiation dose assumed.
- Examining how to utilized the robots for field survey such as measuring radiation dose indoors or not.

Opening a double door (April 18)

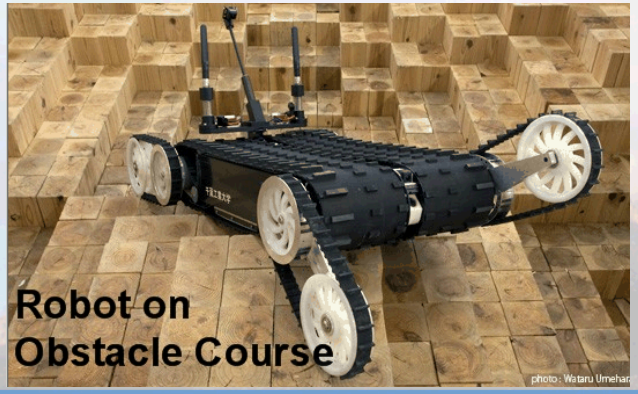
<measurement results>

	Unit 1	Unit 3
Measurement area	Reactor building 1st floor From northern double doors to elevator	Reactor building 1st floor Around southern double doors
Radiation dose	49mSv/h(Maximum) 10mSv/h(Minimam)	57mSv/h(Maximam) 28mSv/h(Minimam)
Temperature	About 28～29℃	About 19～22℃
Humidity	About 49～56%	About 32～35%
oxygen density	About 21%	About 21%

(provisional figure)

<The list of provided robots>

maker	Robots by iRobot		Robots by QinetiQ	
				
name	Packbot	Warrior	Talon	Dragon Runner
Monitoring function	image	Image only	image	Image only
	Radiation etc.	—	Radiation etc.	—
Arm keeping function	○	◎	○	○



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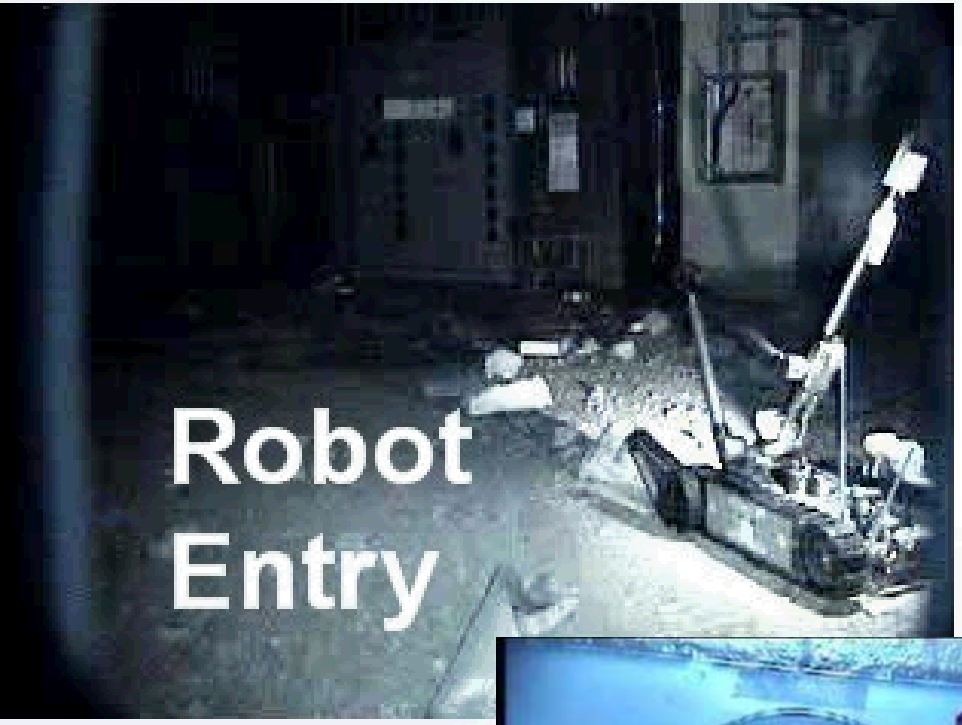
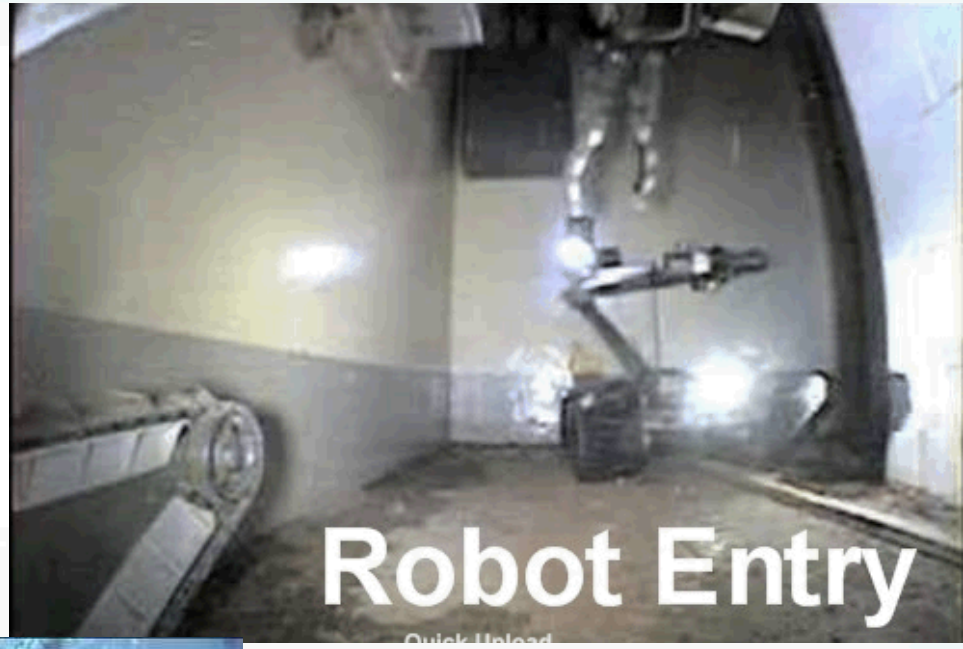
Robotically Conrolled Track Vehicle

Robot-Controlled Backhoe

Robot Controller Command Center





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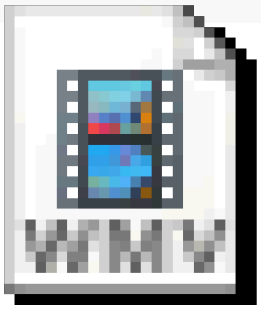

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(Open Video OUT of Slide Show mode)

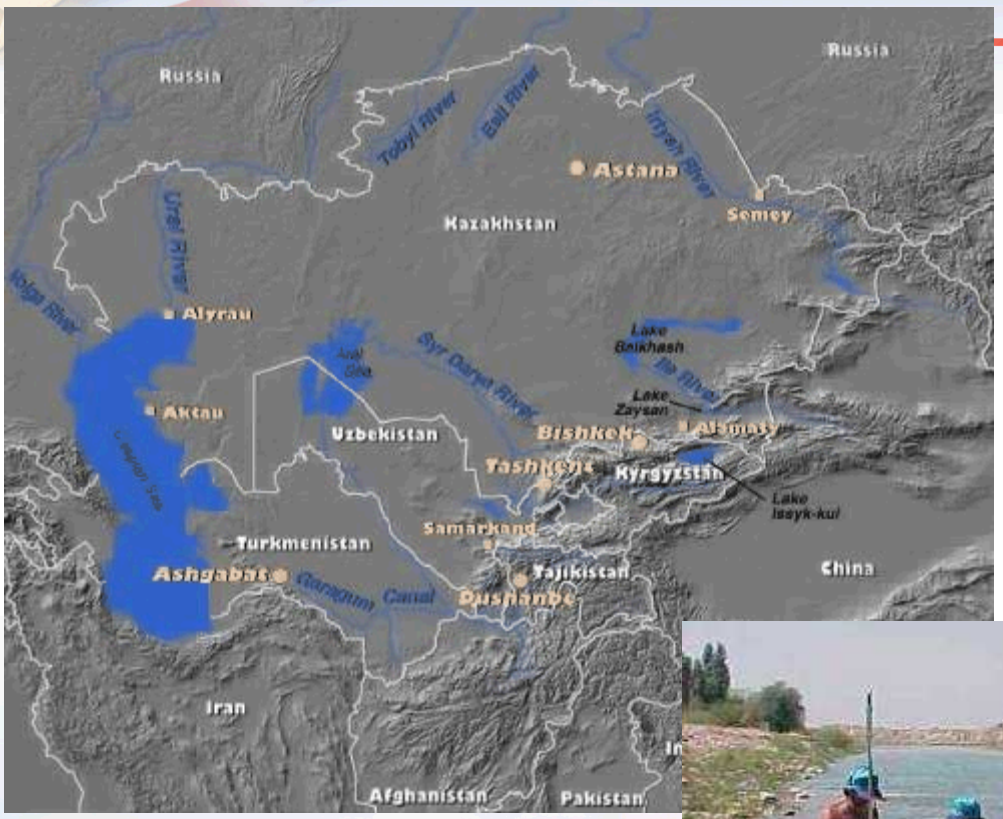
Final Thoughts

- **Strengthen Interagency Coordination and Cooperation**
- **Develop a Strategy for International Engagement**
  - Why? Who? How?
- **Phases of Engagement**
  - Introductory
  - Intermediate
  - Advanced

Regional Training Workshops

- Bahrain 2007 and 2008
- Qatar 2008
- Jordan 2007 and 2008

The NAVRUZ Experiment: Cooperative Monitoring for Radionuclides Central Asia Transboundary Rivers



Negotiations during project workshop in Tashkent

Training on sample collection, Chirchik River, Uzbekistan

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Radiation Measurements Standards in the Middle East

- Radiation Measurements Cross Calibration (RMCC) Project
  - Develop a network of scientists and labs that can devise indigenous solutions to issues such as proliferation monitoring, environmental assessments, emergency response, and radioactive materials smuggling
  - Partnered with the IAEA, DOE/MAPEP

First RMCC Workshop, Kuwait, October 2004

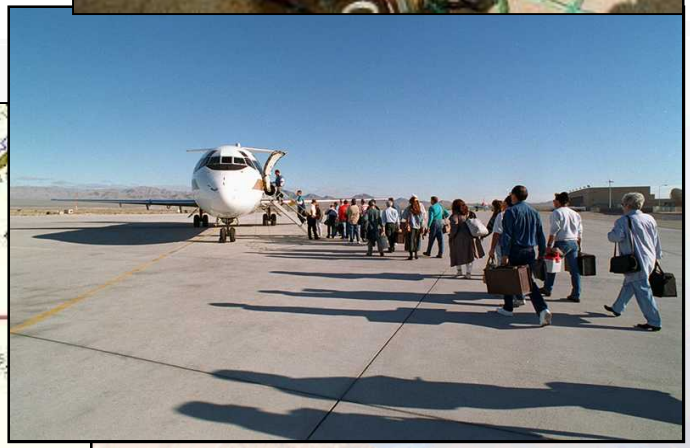
Fifth RMCC Workshop, Doha, Qatar, May, 2010

U.S. Response Timeline
T = 0 to 1 Hour

- Local Authority and/or Nuclear Facility will implement its Emergency Response Plans
- State and Local Officials will be notified.
  - Local First Responders will be first to arrive on the scene.
  - First Responders will begin responding to the emergency and evacuation of local area based upon Emergency Response Plans.

CM Resource Response
Timeline T = 1 to 6 Hours

- NNSA's Radiological Assistance Program Teams (RAP Teams) begin to arrive.
- Department Of Energy activates National Consequence Management Assets upon request of state.
  - CM Home Team Activated and providing assessment within 2 hours of activation.
  - CM Response Team assets in route within 4-hours of activation.
- NNSA's Plume Dispersion Modeling underway.



100 and 500 uSv Dose Contours

Radiological Assistance Program Teams Arrive

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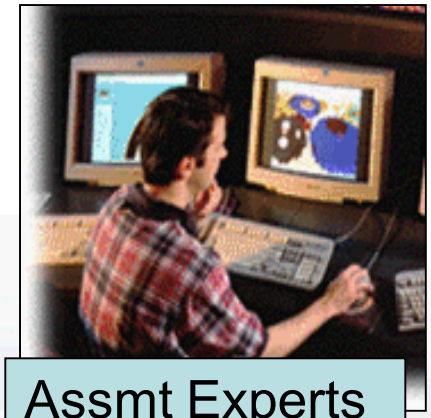
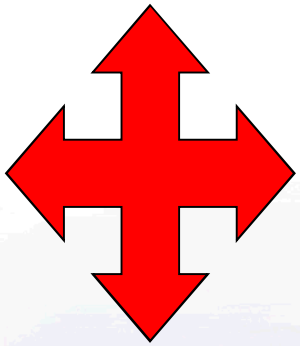
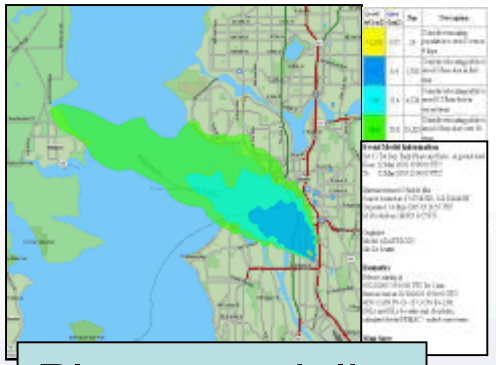
CM Home Team Is Activated

- Objectives:
  - Provide Technical Assessment and Plume Map support before CM response team assets arrive at the event site
  - Provide a resource for local authorities early in an event

- Resources
  - National Lab personnel
  - Assessment tools
  - Plume modeling







CM Response
Timeline T = 24 to 36 Hours

- CM Response Teams arrive (approximately 150 - 400 additional personnel in 3 teams).

- Provides experts to support the operations:
  - Sampling Experts
  - Lab Analysis Experts
  - Health and Safety Experts
  - Assessment Experts
  - Radiological Technicians

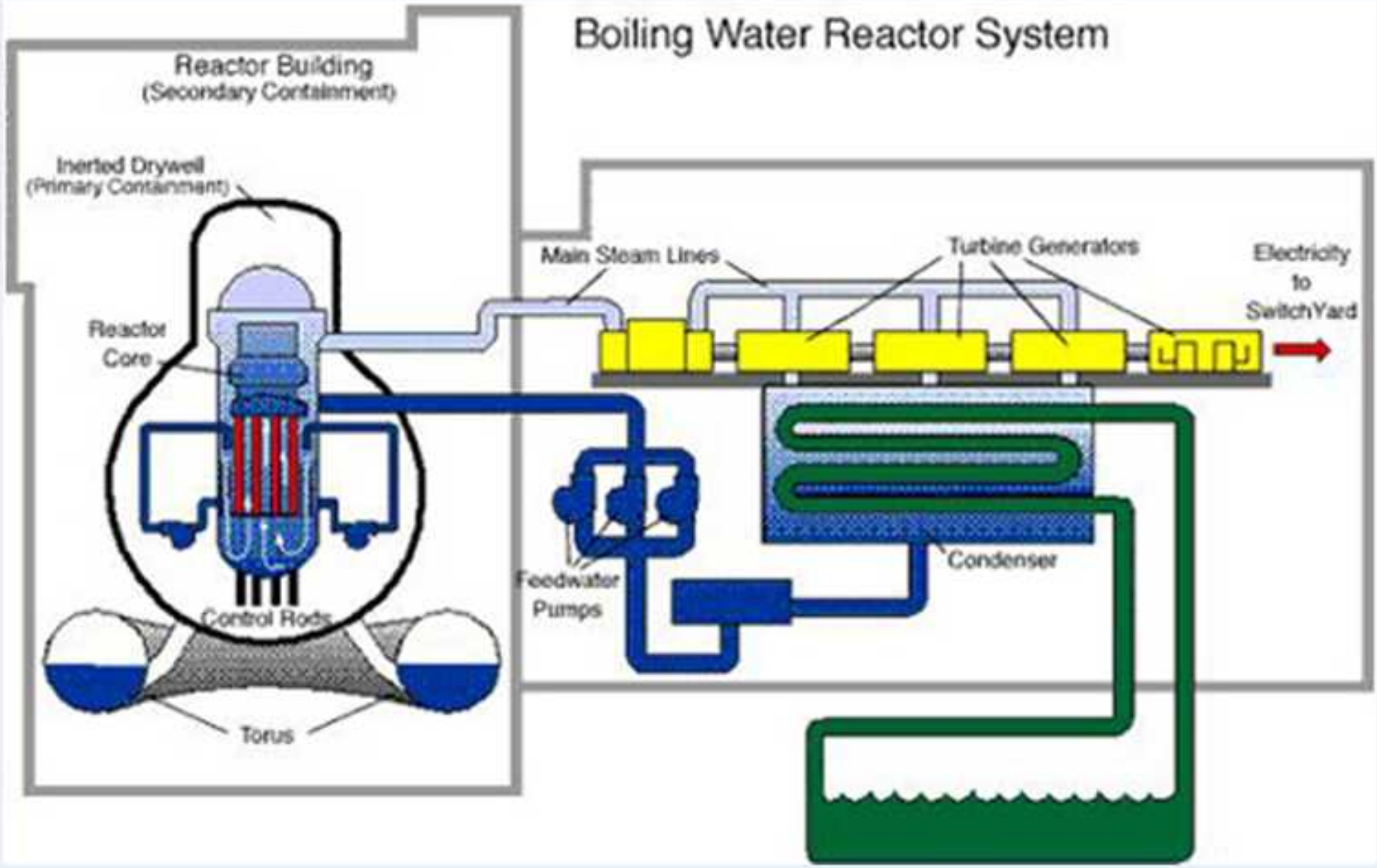
- All of these individuals take on specific roles as defined in pre-event planning/training.

Consequence Reports

- **Standardized report integrating effects predictions with Geographical Information System (GIS) provides consequence information in a format more directly useful to decision makers**
- **Reports are customized for different Weapons of Mass Destruction (WMD) scenarios or accident situations**
- **Different levels of detail can be selected**
  - summary, full report, full report including background and reference information

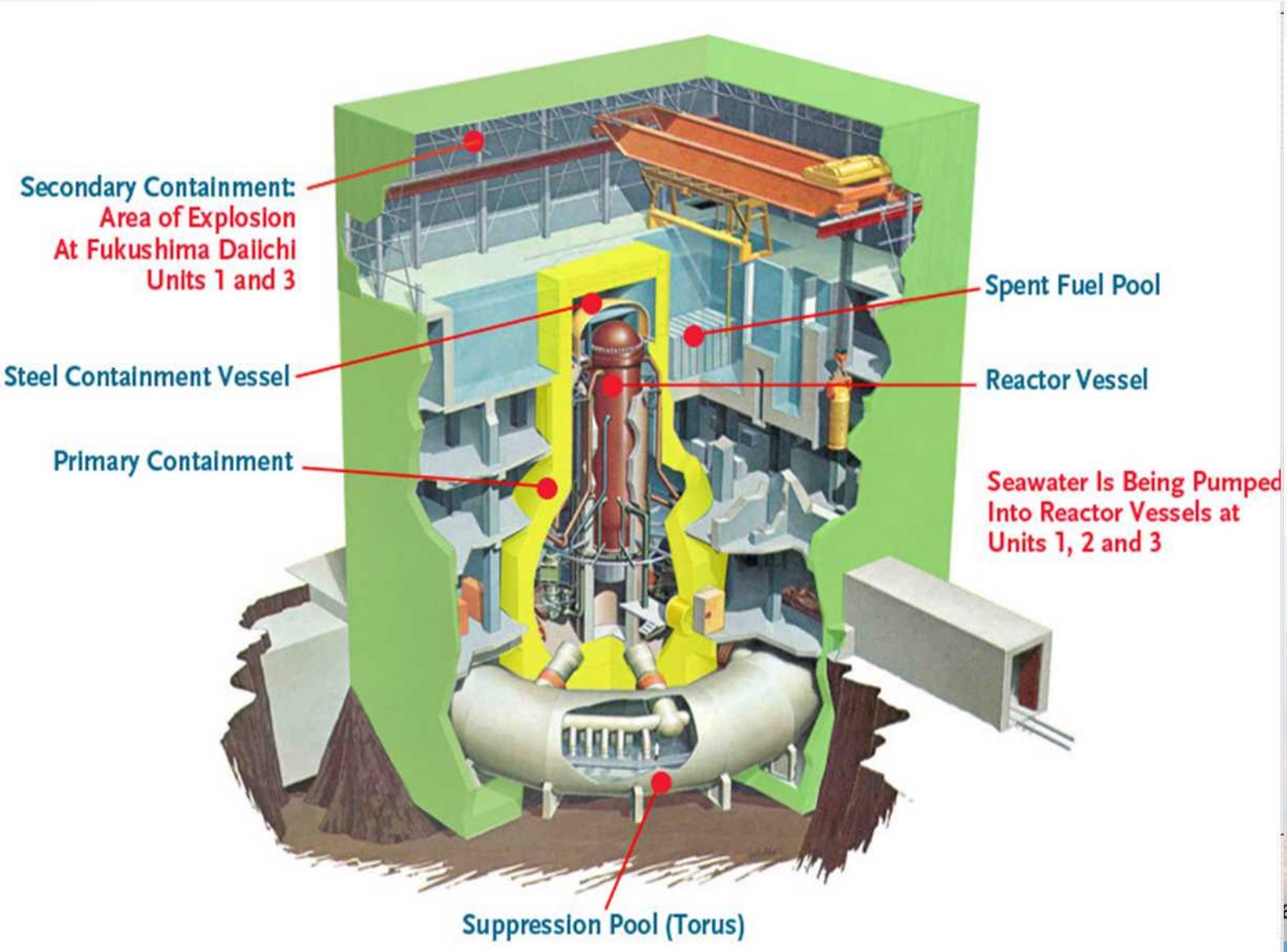
Thank You!

EXTRA SLIDES



A BWR reactor: The schematic above shows the torus at left, which is doughnut-shaped.

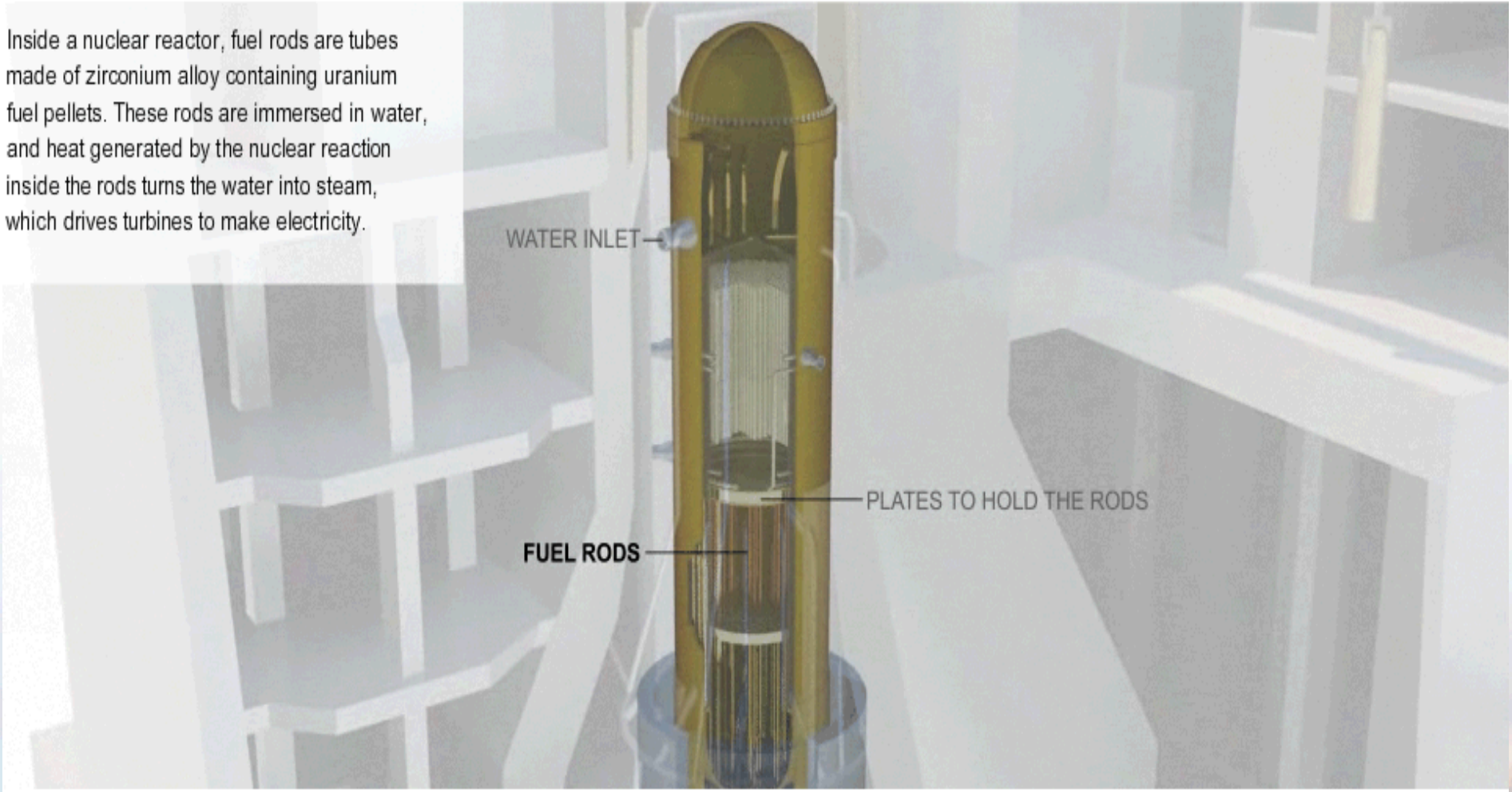
Fukushima BWR



How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

Inside a nuclear reactor, fuel rods are tubes made of zirconium alloy containing uranium fuel pellets. These rods are immersed in water, and heat generated by the nuclear reaction inside the rods turns the water into steam, which drives turbines to make electricity.



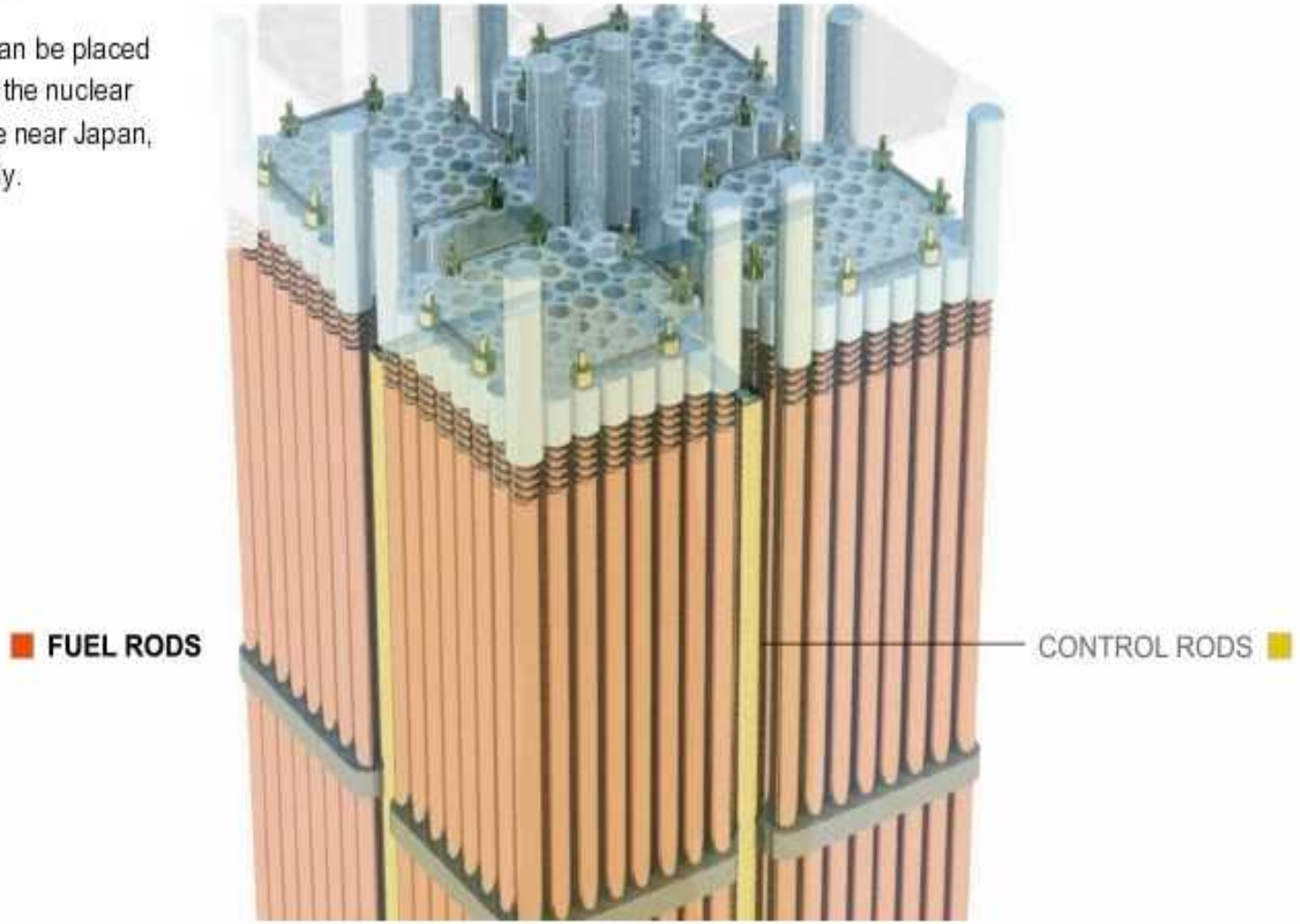
By MATTHEW ERICSON, XAQUÍN G.V., DYLAN McCLAIN, TOMOEH MURAKAMI-TSE, GRAHAM ROBERTS, ARCHIE TSE and JOE WARD | Send Feedback

Sources: Nuclear Energy Institute; Nuclear Regulatory Commission; Tokyo Electric Power; satellite image by Digital Globe via Google Earth

How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

In a shutdown, control rods can be placed between the fuel rods to stop the nuclear reaction. After the earthquake near Japan, control rods deployed correctly.



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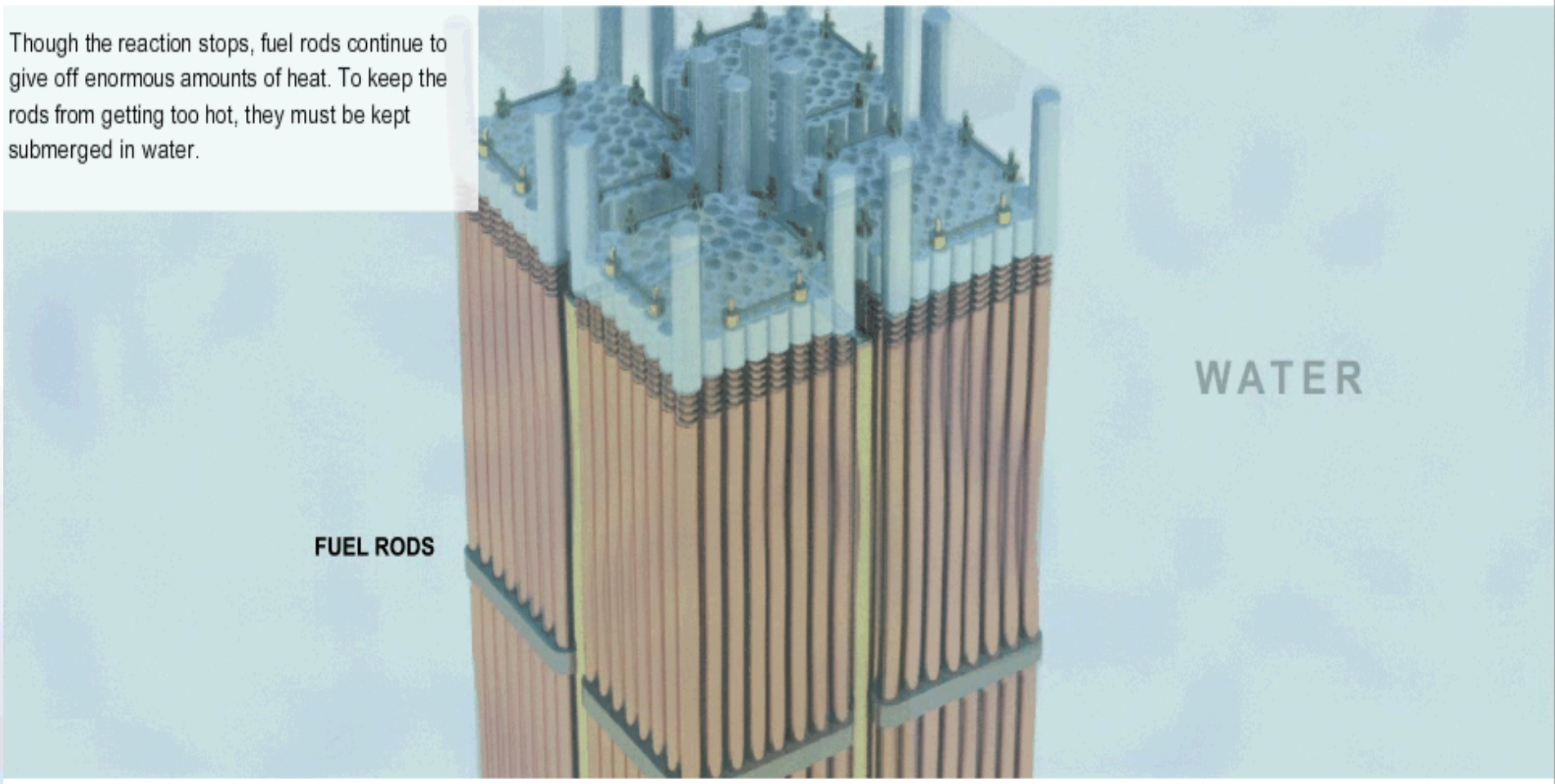
How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

Though the reaction stops, fuel rods continue to give off enormous amounts of heat. To keep the rods from getting too hot, they must be kept submerged in water.



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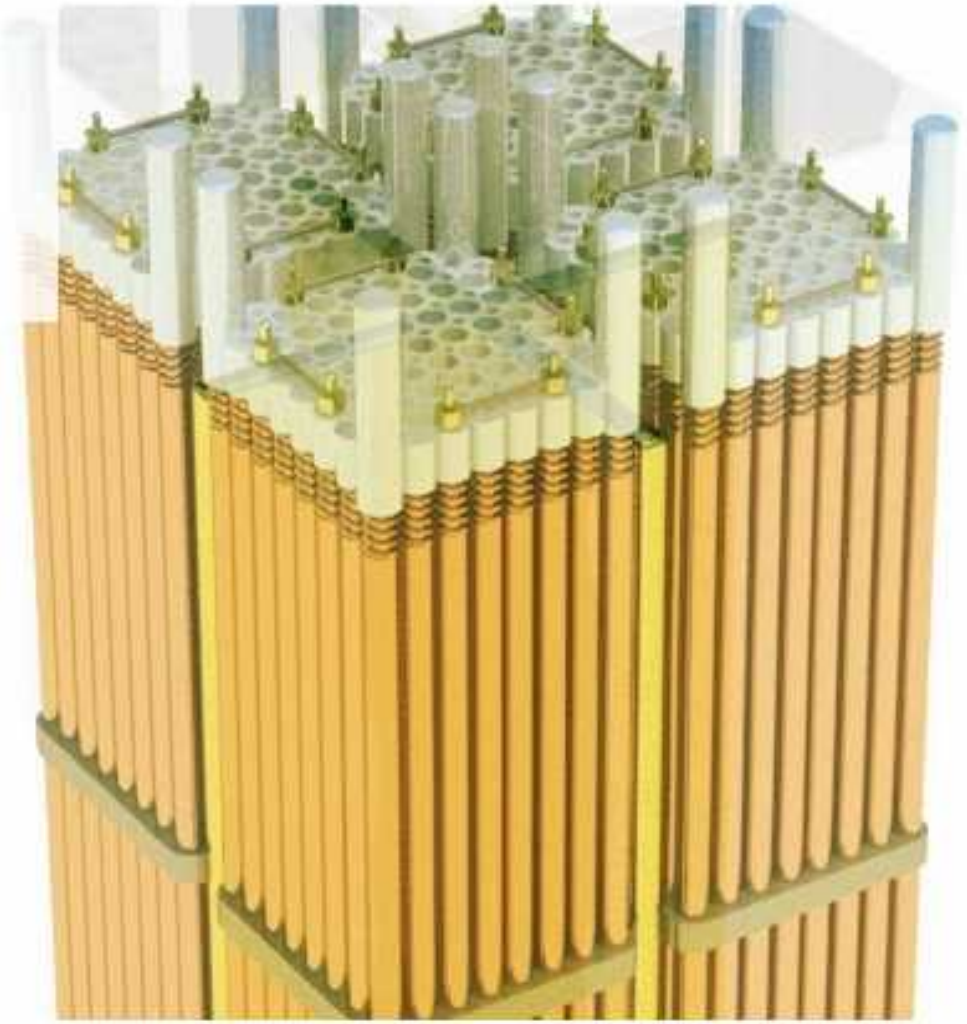
How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

In Japan, there was no electricity to run the cooling system. Operators added water, intending to vent the steam and replace the water as it evaporated. But the water began boiling away faster than they could replace it.



FUEL RODS

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Sources: Nuclear Energy Institute; Nuclear Regulatory Commission; Tokyo Electric Power; satellite image by Digital Globe via Google Earth

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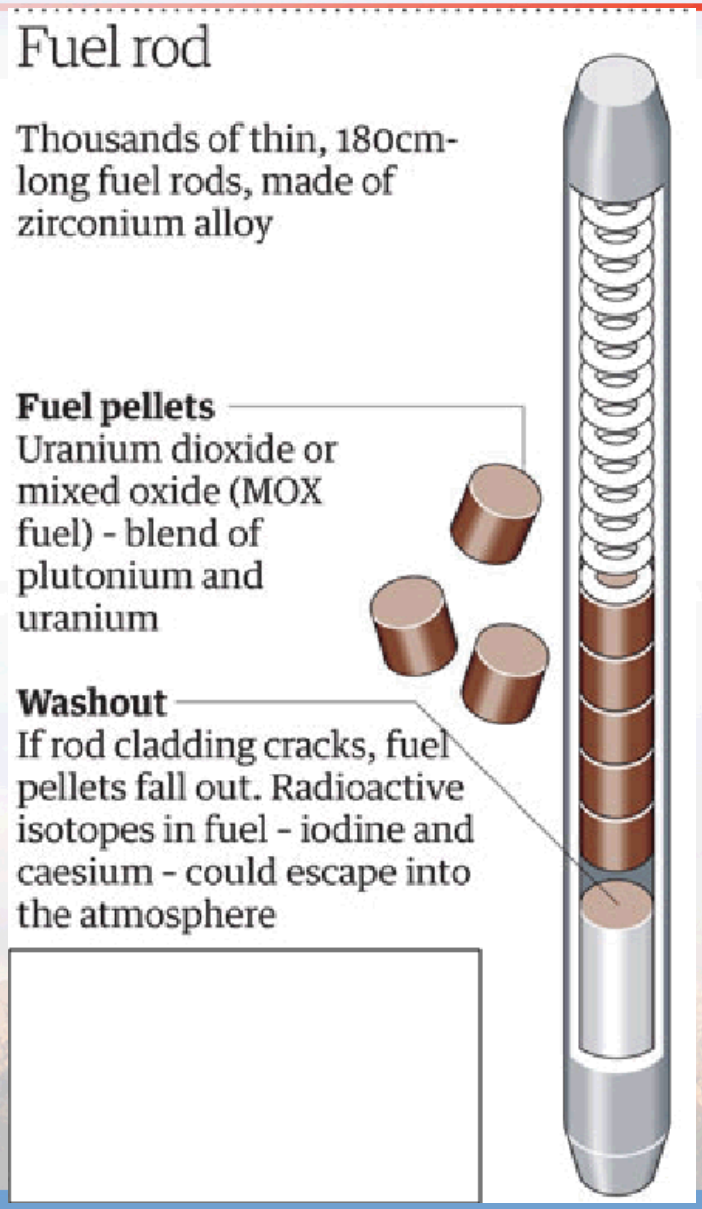
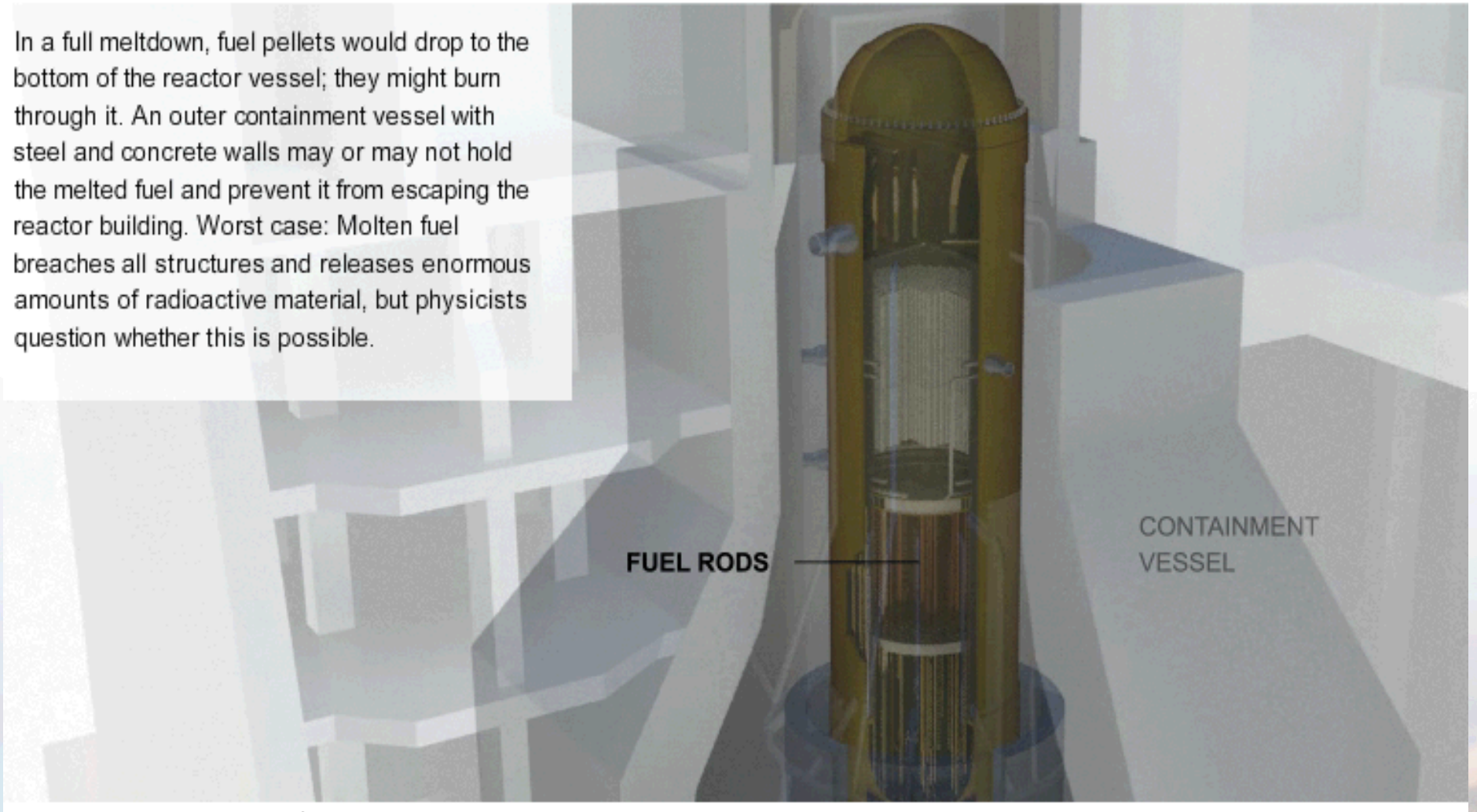
Fuel Rod Schematic



How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

In a full meltdown, fuel pellets would drop to the bottom of the reactor vessel; they might burn through it. An outer containment vessel with steel and concrete walls may or may not hold the melted fuel and prevent it from escaping the reactor building. Worst case: Molten fuel breaches all structures and releases enormous amounts of radioactive material, but physicists question whether this is possible.



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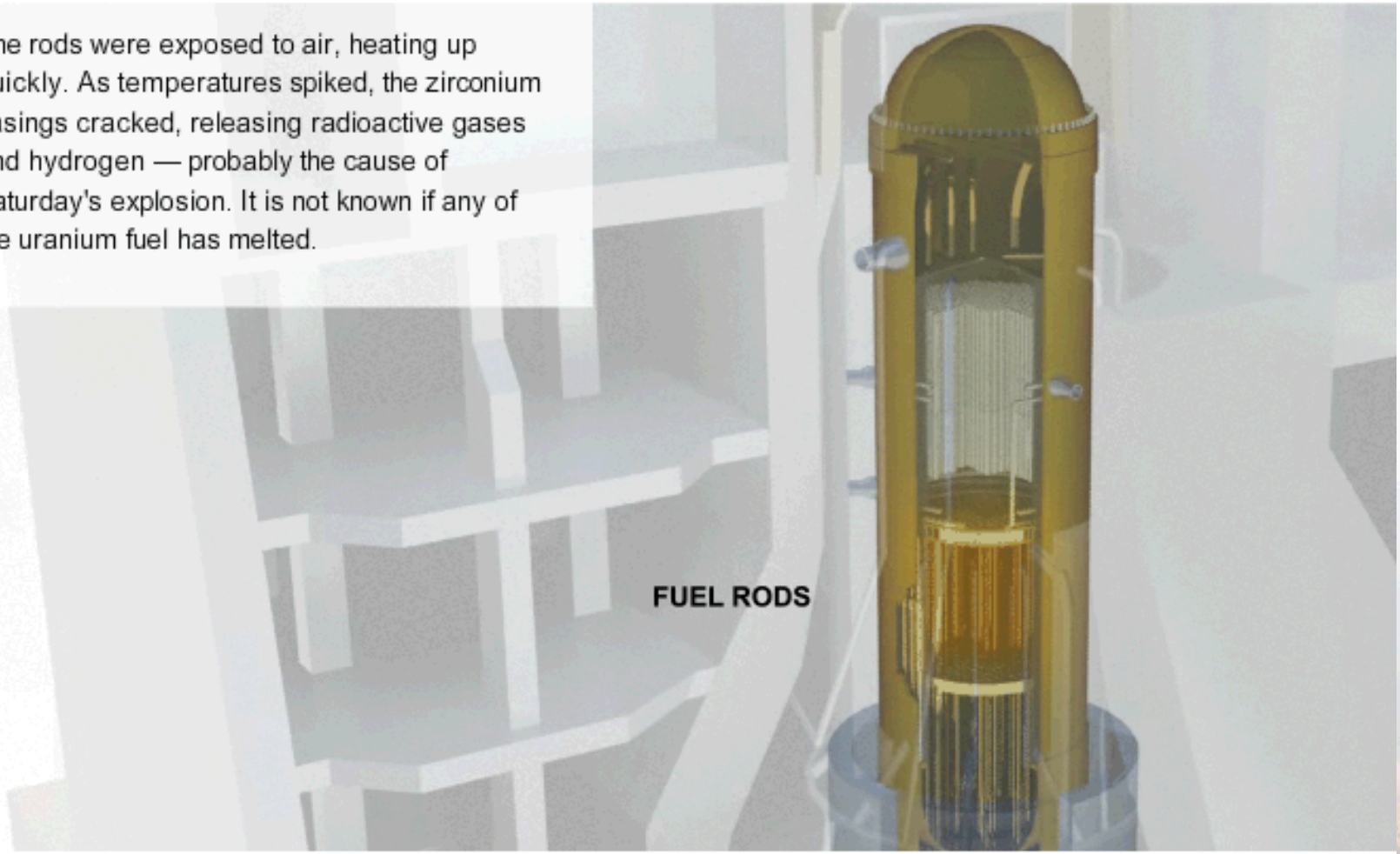
How a Reactor Shuts Down and What Happens in a Meltdown

The operating reactors at Fukushima Daiichi power station automatically shut down during the earthquake. But after subsequent cooling failures, two of them went into partial meltdown.

The rods were exposed to air, heating up quickly. As temperatures spiked, the zirconium casings cracked, releasing radioactive gases and hydrogen — probably the cause of Saturday's explosion. It is not known if any of the uranium fuel has melted.



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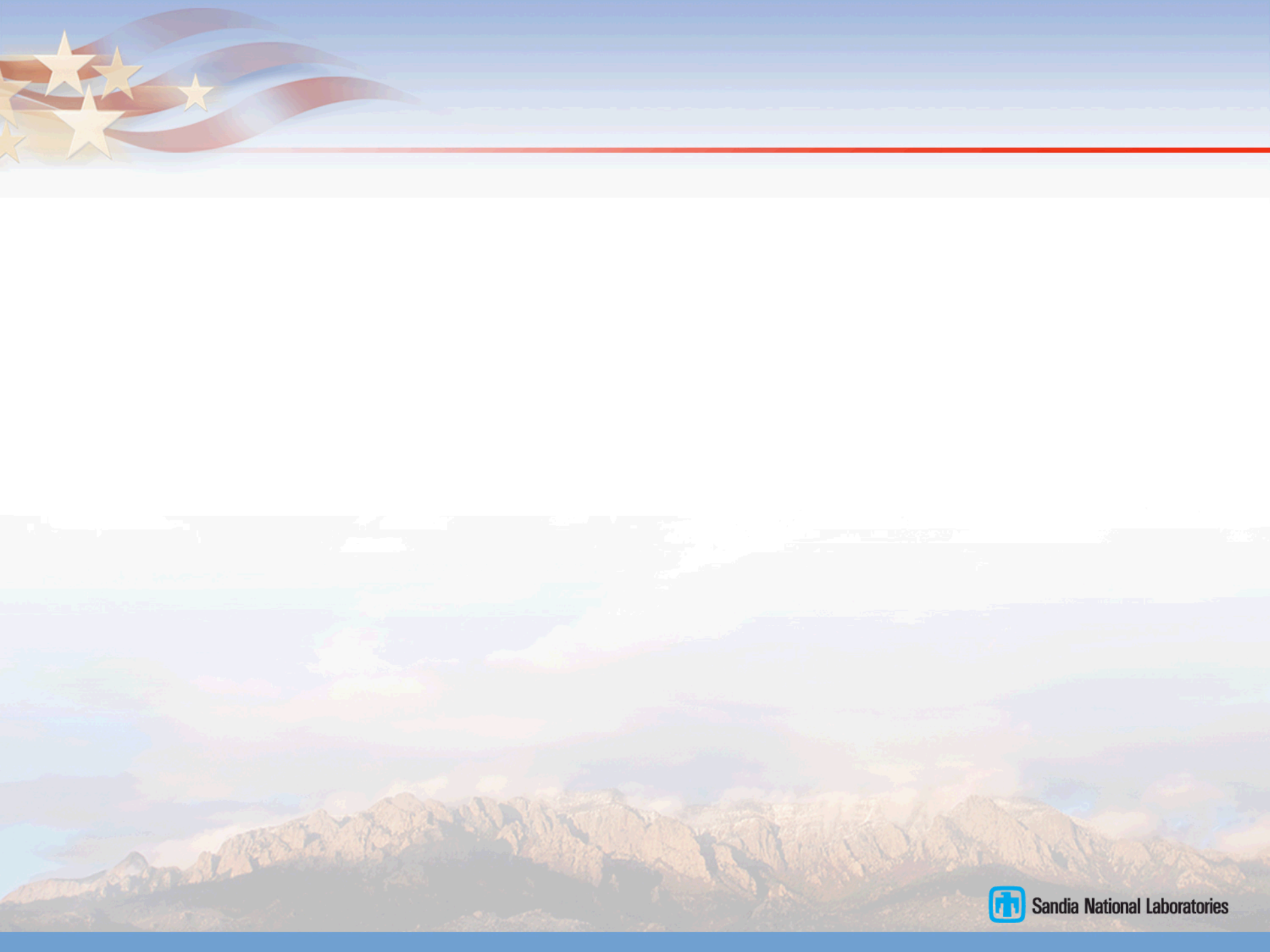
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DOE/NNSA Consequence Management (CM) Program Overview

Prepared by:

Thomas Laiche, CHP

Nuclear Incident Response Programs
Sandia National Laboratories
Albuquerque, NM

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

National Nuclear Security Administration

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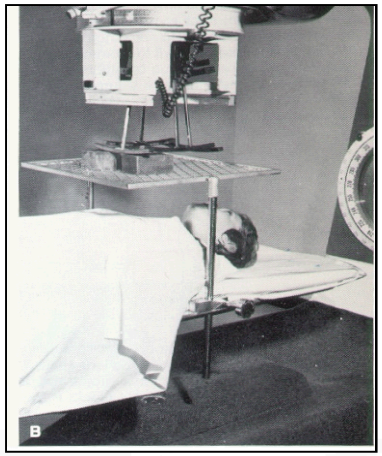
Large Quantities of Radioactive Material can be Found Throughout the World

- **Nuclear Reactors**
- **Nuclear Weapons**
- **Medical/Industrial Applications**
  - **Therapy Equipment**
  - **Sterilization Equipment**
  - **Density Gauges**
  - **Well Logging**
  - **Radiography**
  - **Thickness and Level Gauges**
  - **Power Generation**
  - **Radioisotopic Thermal Generators (RTG)**

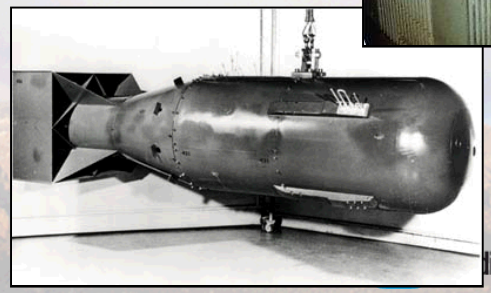


Radiotherapy Unit

Nuclear Power Plants

RTG

Nuclear Weapons



History

- March 28, 1979: Three Mile Island
- Event highlighted inadequacies in planning for a large-scale Nuclear Emergency
  - Evacuation Plans for the nearby cities inadequate
  - Significant confusion about protective actions
- An Executive Order was issued mandating federal preparations for radiological emergencies
- Preparations focused on nuclear power and weapon accidents

Three Mile Island
Nuclear Power Plant

New CM Program Focus

- **The events of September 11, 2001 resulted in a philosophical change:**
  - **Terrorists may strike with no warning**
  - **First knowledge of nuclear terrorism attack may be the explosion/dispersion**

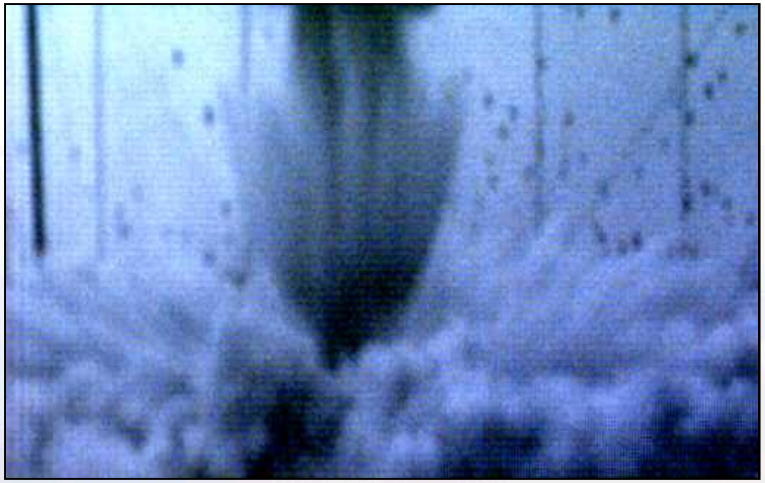
- **DOE/NNSA CM Program transitioned focus to preparations for intentional terrorist attack(s)**

Mission

Develop and maintain rapidly-deployable equipment and technical expertise for world-wide response to nuclear and radiological terrorism events as well as nuclear/radiological accidents or emergencies

DOE/NNSA CM Expertise

Research – Explosive Dispersion of Radioactive Materials



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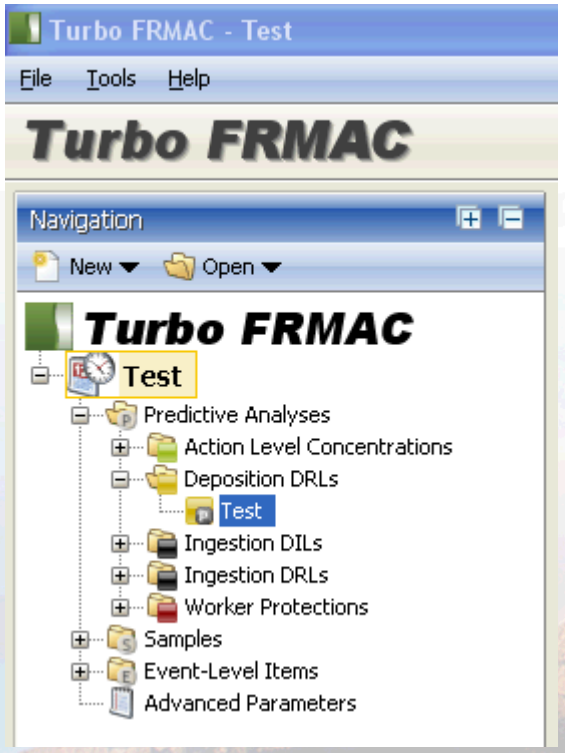
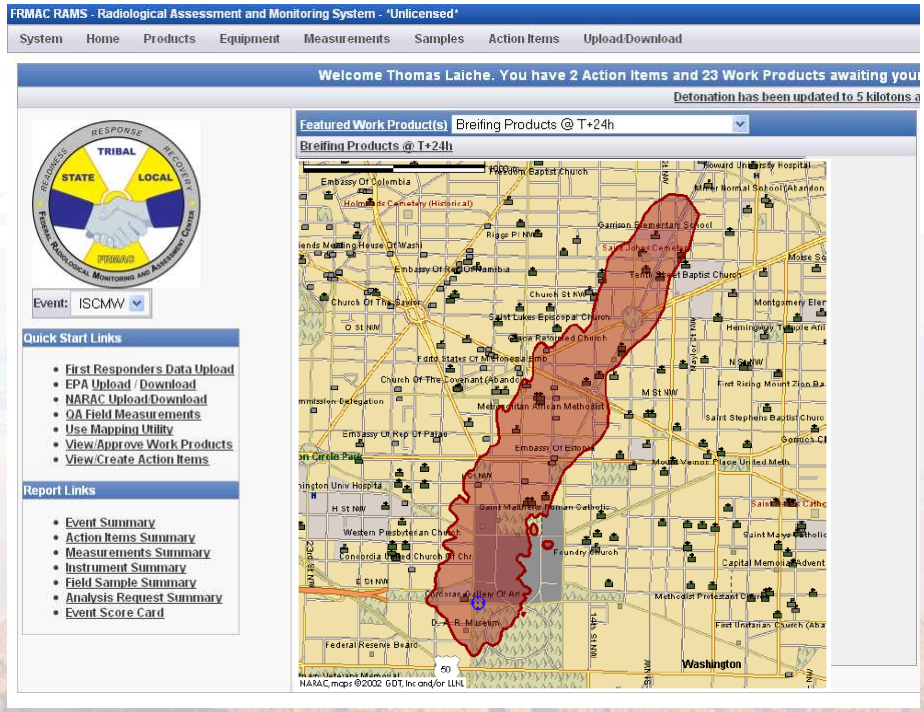
DOE/NNSA CM Expertise

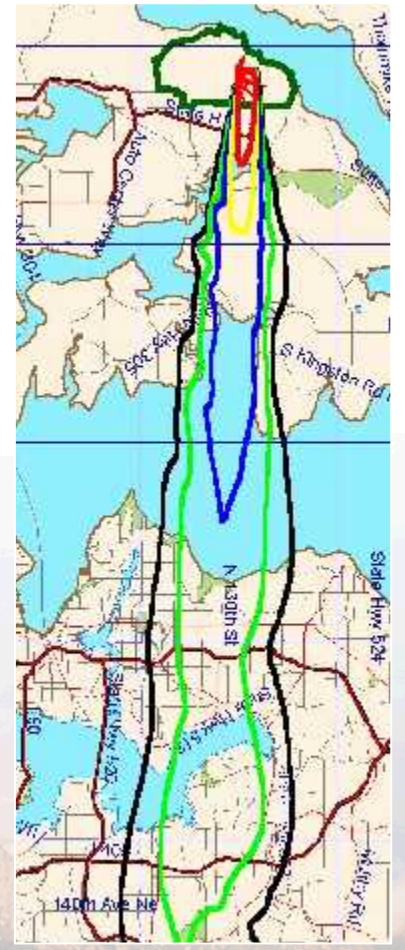
Equipment – Fixed Wing and Rotary Aircraft, Radiological Monitoring Equipment, Communications, Mobile Laboratories

DOE/NNSA CM Expertise

Models and Software – Develop and Use the most up-to-date Software, Databases, and Effect Models







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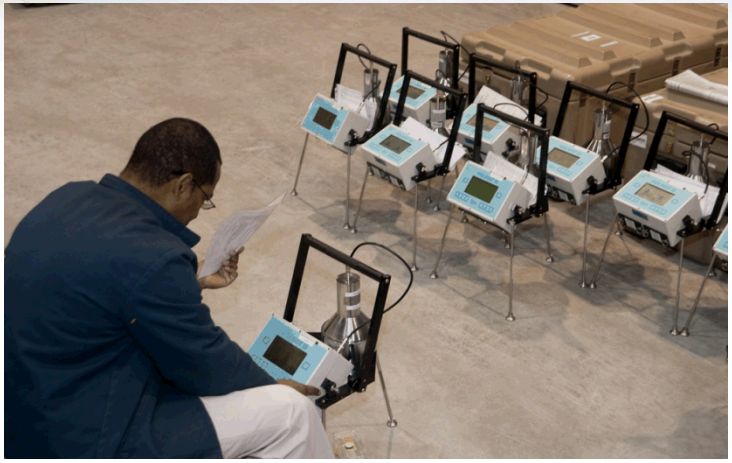
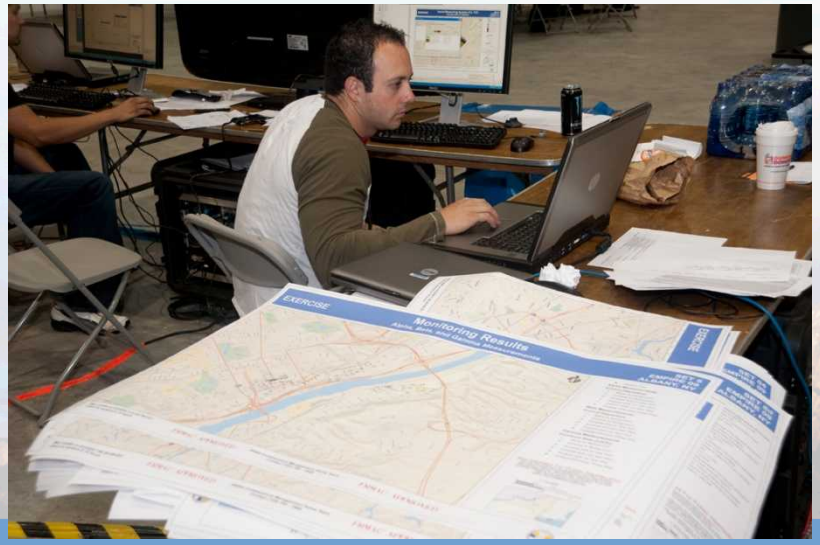
DOE/NNSA CM Expertise

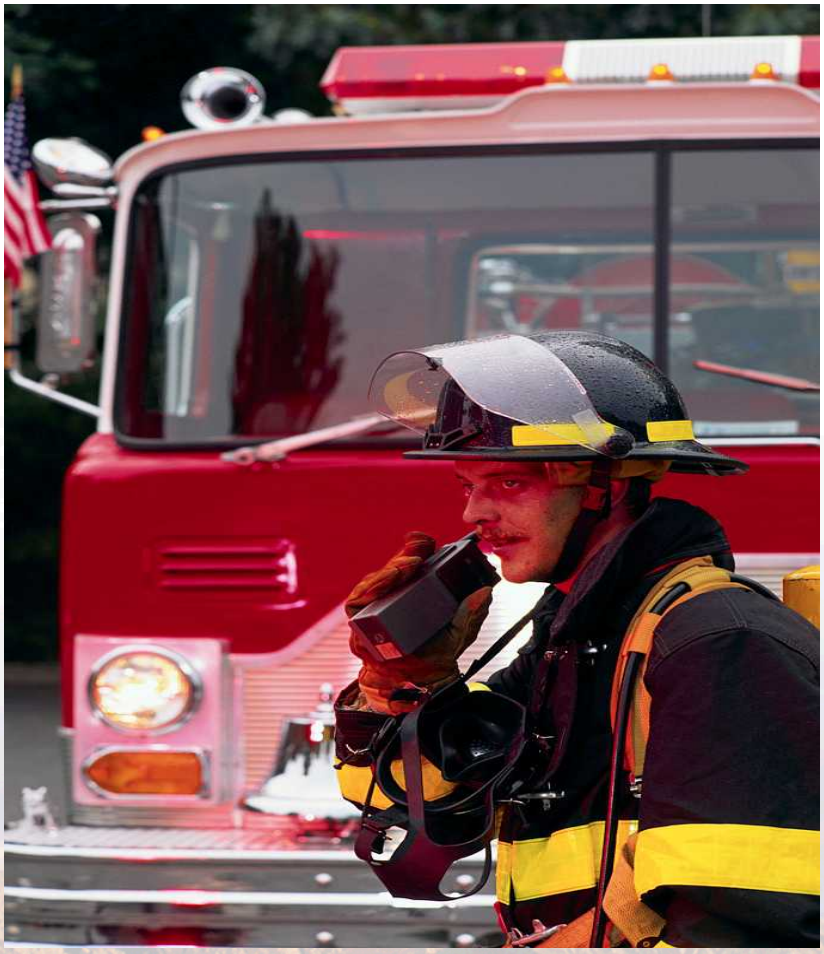


Personnel – Staffed with Personnel with Various Technical Expertise



What is FRMAC?

Federal Radiological Monitoring and Assessment Center (FRMAC) is a federal asset available upon request to respond to nuclear/radiological incidents as described in the National Response Framework (NRF) and the Nuclear/Radiological Incident Annex



What is the Purpose of FRMAC?

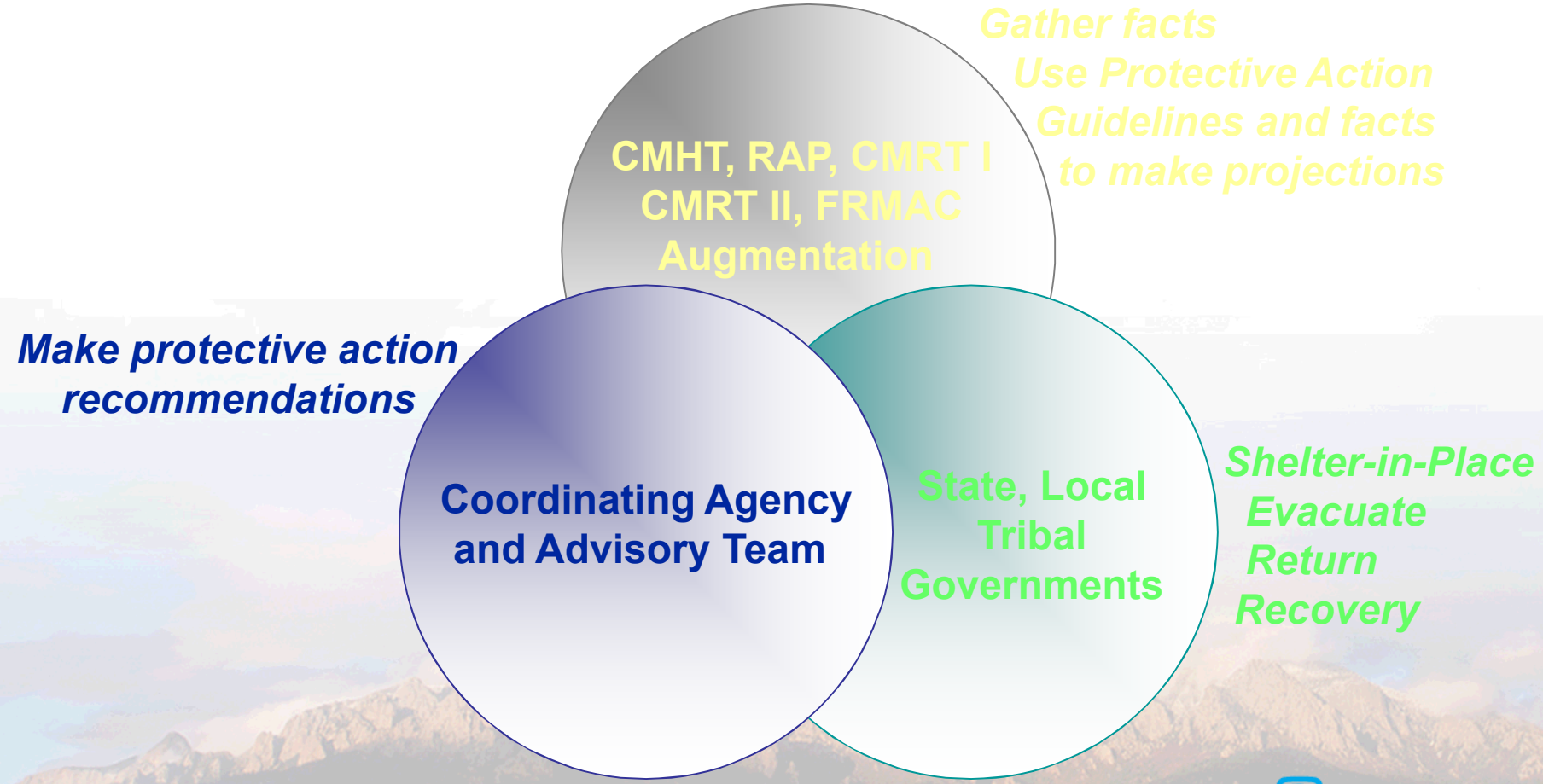
- Assist the state, local and tribal governments in their mission to PROTECT THE HEALTH AND WELL BEING OF THEIR CITIZENS
- Integrate multiple Federal agencies into one center where the Federal government can act and speak with one voice

FRMAC/CM Assets

Federal Radiological Monitoring and Assessment Center (FRMAC) includes:

- Data Analysis/CM Home Team
- Field Monitoring Teams
- Mobile Laboratory
- Radiological Assessment
- Aerial Measurement System
- Effects Models

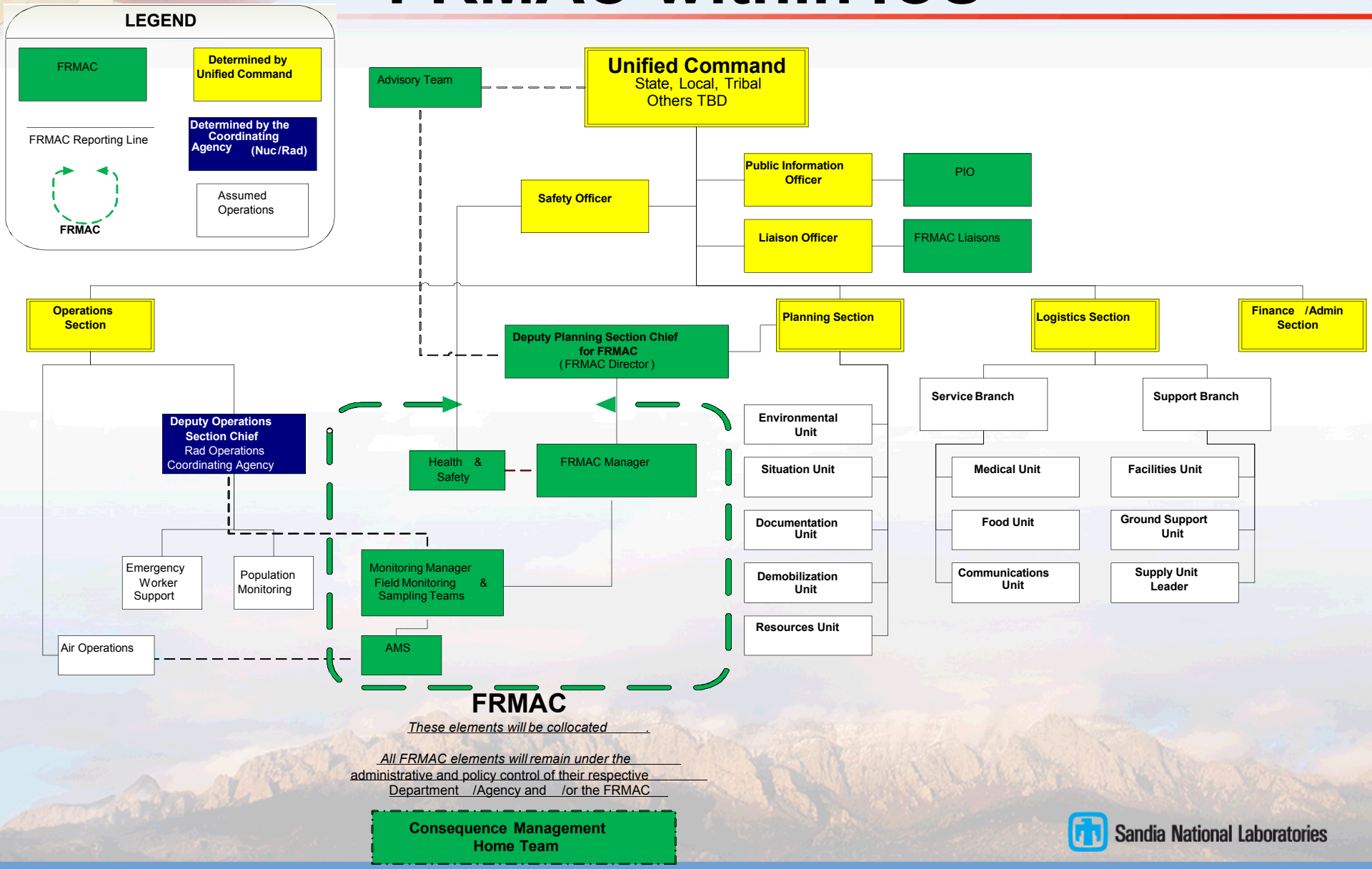
CM Program/FRMAC Help Provide Coordinated Radiological Emergency Response



Who Makes Up FRMAC?

- **Department of Energy**
- **Environmental Protection Agency**
- **Department of Homeland Security**
- **Department of Health and Human Services**
  - Center for Disease Control
- **Department of Agriculture**
  - Food and Drug Administration
- **Nuclear Regulatory Commission**
- **And at least 10+ other Federal Departments and Agencies**
- **State, Local and Tribal Representation**

FRMAC within ICS



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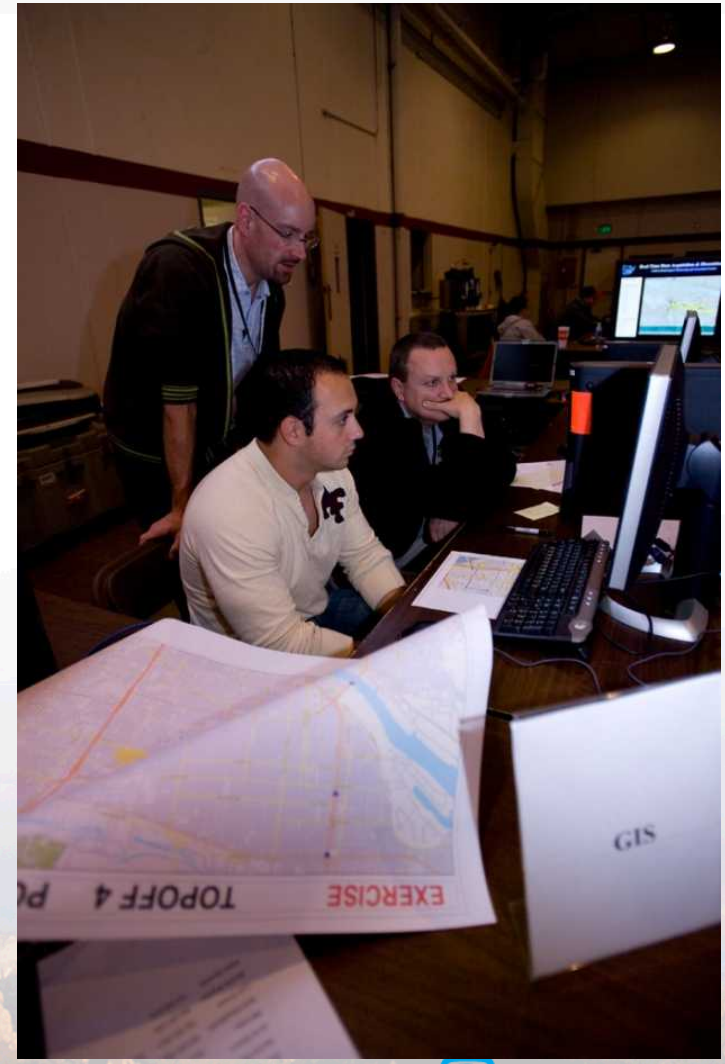
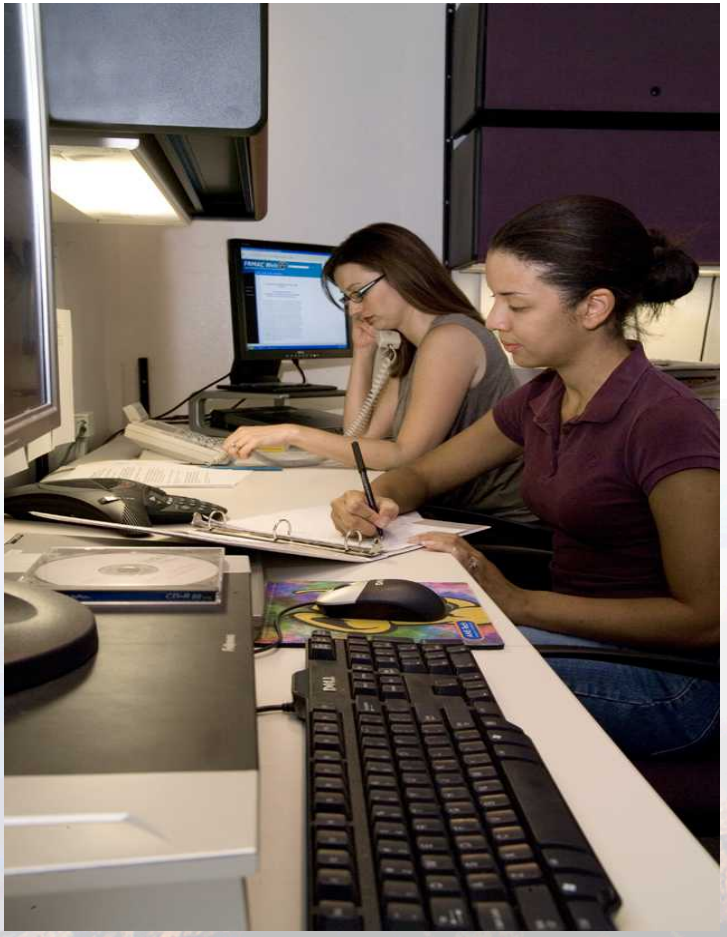
Elements of FRMAC

- CM Home Team
- Assessment
- Health and Safety
- Monitoring and Sampling
  - AMS
- Laboratory Analysis
- A Team
- GIS
- Document Control
- NARAC



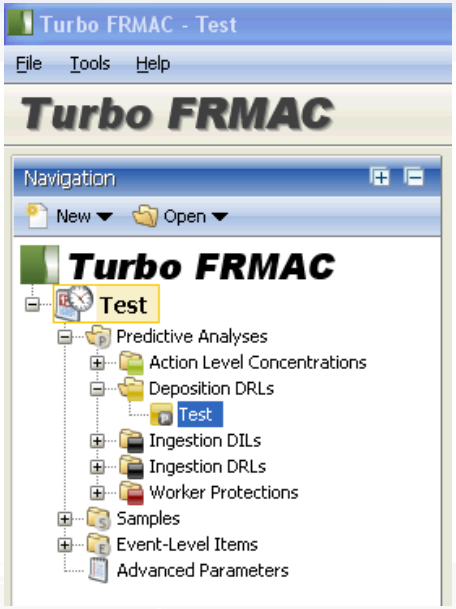
Elements of FRMAC



- **<u>CM Home Team</u> - Provides technical support to event response while CMRT is enroute**
  - Used as a reach-back resource
  - Used for expertise that may not be available in the field

Elements of FRMAC

- **Assessment** - **Provides decision makers with radiological information that can be used to issue Protective Actions**



- Interprets radiological information in terms of EPA, FDA, or State/Local/Tribal Protective Action Guides (PAGs)
- Uses FRMAC-approved methodology to calculate potential dose consequence

Elements of FRMAC

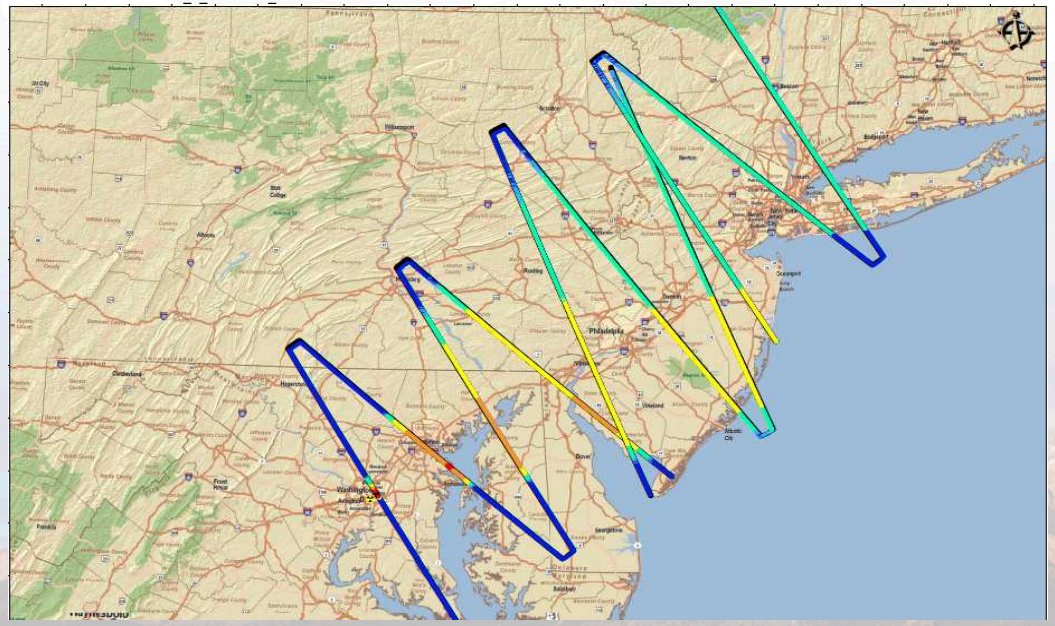
- **<u>Health & Safety</u> -**
  Responsible for the H & S of all FRMAC personnel involved in operations
  - Determines appropriate Emergency Worker Protective Action Guides
  - Determines Stay Times
  - Determines if Respiratory Protection is needed

Elements of FRMAC

- **Monitoring & Sampling - Coordinates efforts to provide scientifically defensible data of acceptable quality**
  - Develops sampling plans that include:
    - Monitoring point locations
    - Sample volume and types

Elements of FRMAC

- **Aerial Monitoring System (AMS)** - DOE's aerial-based radiation detection platform used to verify initial plume



Elements of FRMAC

- **Laboratory Analysis - Provides in-the-field radioanalysis of samples**
  - Maintains ability to ship samples off-site to contract laboratories

Elements of FRMAC

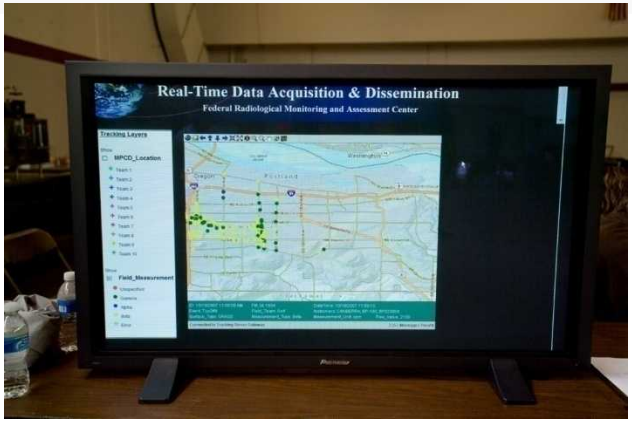
- **<u>Advisory Team (A Team)</u> - Federal Agency entity that makes recommendations to State, Local, or Tribal Decision Makers**
  - Provides approval to deviate from standard assessment calculations

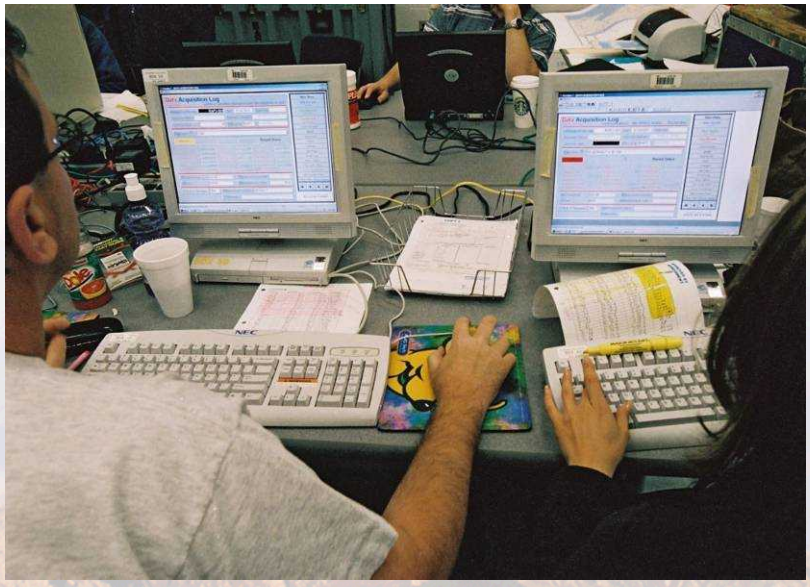
Elements of FRMAC

- **Geographic Information System (GIS) – A Computerized Database Management System that provides for the capture, storage, retrieval, analysis and display of spatial data**
  - Assists in the development of the Data Products
  - Most visible of FRMAC assets
  - Interacts closely with NARAC for Data Product development

Elements of FRMAC

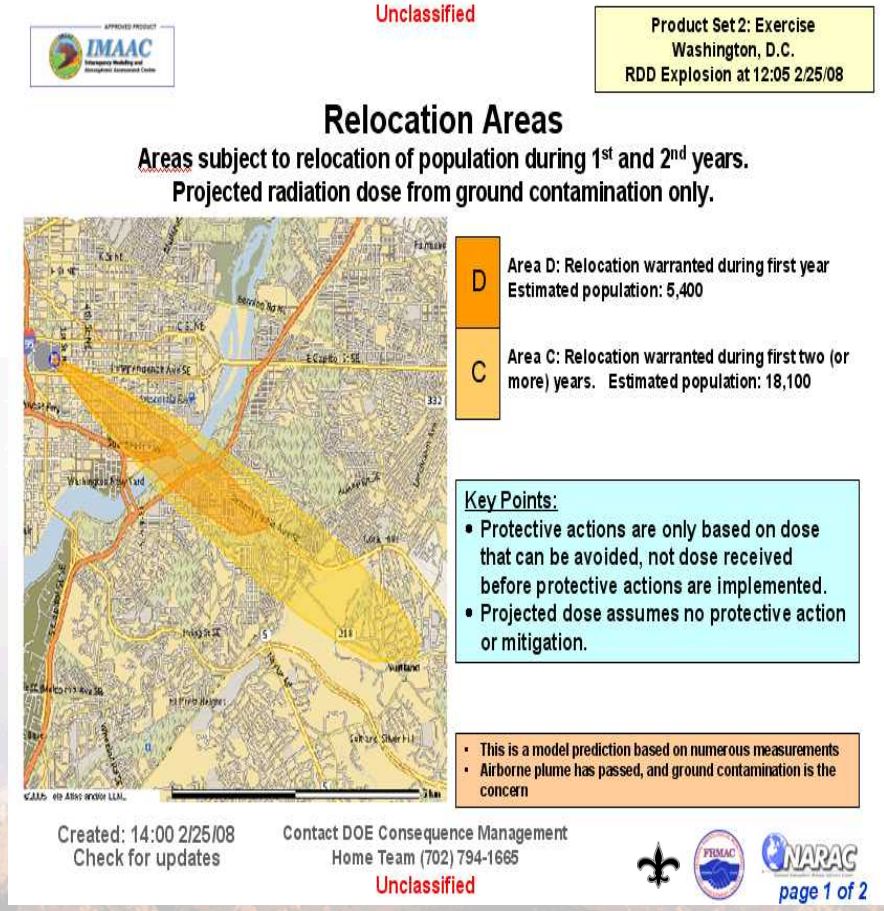
- **Document Control - Every off-site environmental radiological data point stored for long-term retention in FRMAC Data Center**
  - Uses RAMS Database to electronically collect and store Field Data, Laboratory Analyses, etc.





Elements of FRMAC

- **National Atmospheric Release Advisory Center (NARAC) - Provides models, tools and services that plot the probable spread of radioactive materials laid over a map of the affected area**
  - Uses the plots as part of both the Briefing Products and Data Products
  - These Products are used by Decision Makers to determine appropriate Protective Actions as well as disseminate information



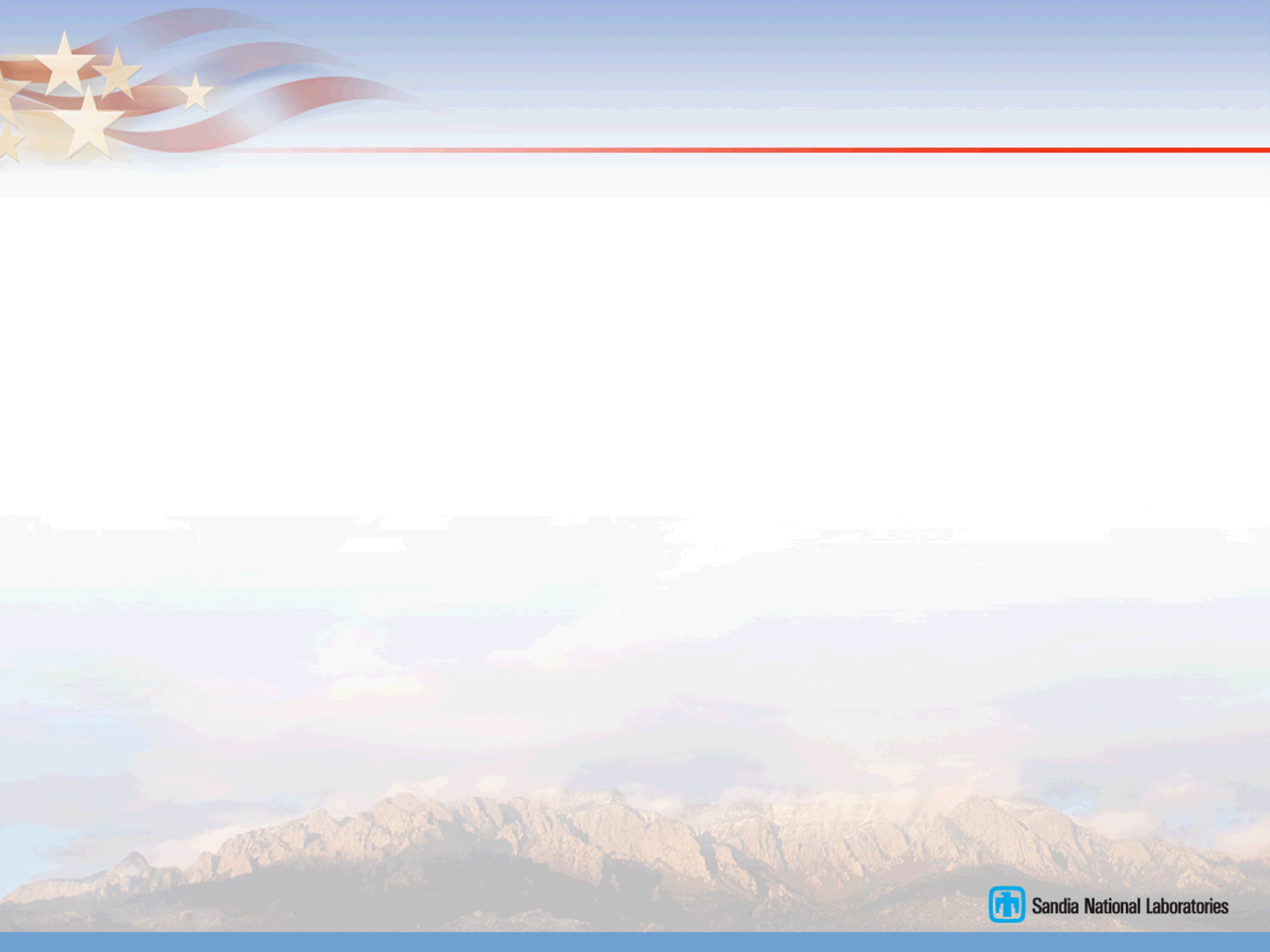
DOE/NNSA CM Program Overview Conclusion

- **Legislated Federal Program to prepare for and respond to nuclear and radiological terrorism events as well as nuclear/radiological accidents or emergencies**
- **Rapid, World-Wide Deployable Equipment and Personnel**
- **FRMAC established to provide the resources to State, Local and Tribal governments to assist with emergency response**

DOE/NNSA CM Program Overview Conclusion

- **FRMAC comprised of multiple Federal Agencies working together to speak with on voice**
- **Resources include personnel, communications, data analysis, models, monitoring, laboratories**

Questions


Sandia National Laboratories