



# DOE Response to Radiological Releases from the Fukushima Dai-ichi Nuclear Power Plant

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# Statement of Problem



- Occurred 14:46 March 11, 2011
- Magnitude: 9.0 Mw
- Epicenter location: 38° 6''N and 142° 51''E, and 24km in depth
- It is said that the height of tsunami attacked Fukushima NPP was more than 14m

Source: Nuclear and Industrial Safety Agency (NISA)

# Stakeholders

## United States

- Department of State
- Department of Defense
- Department of Energy (DOE)
- National Nuclear Security Administration (NNSA)
- Nuclear Regulatory Commission
- Advisory Team for Environment , Food and Health

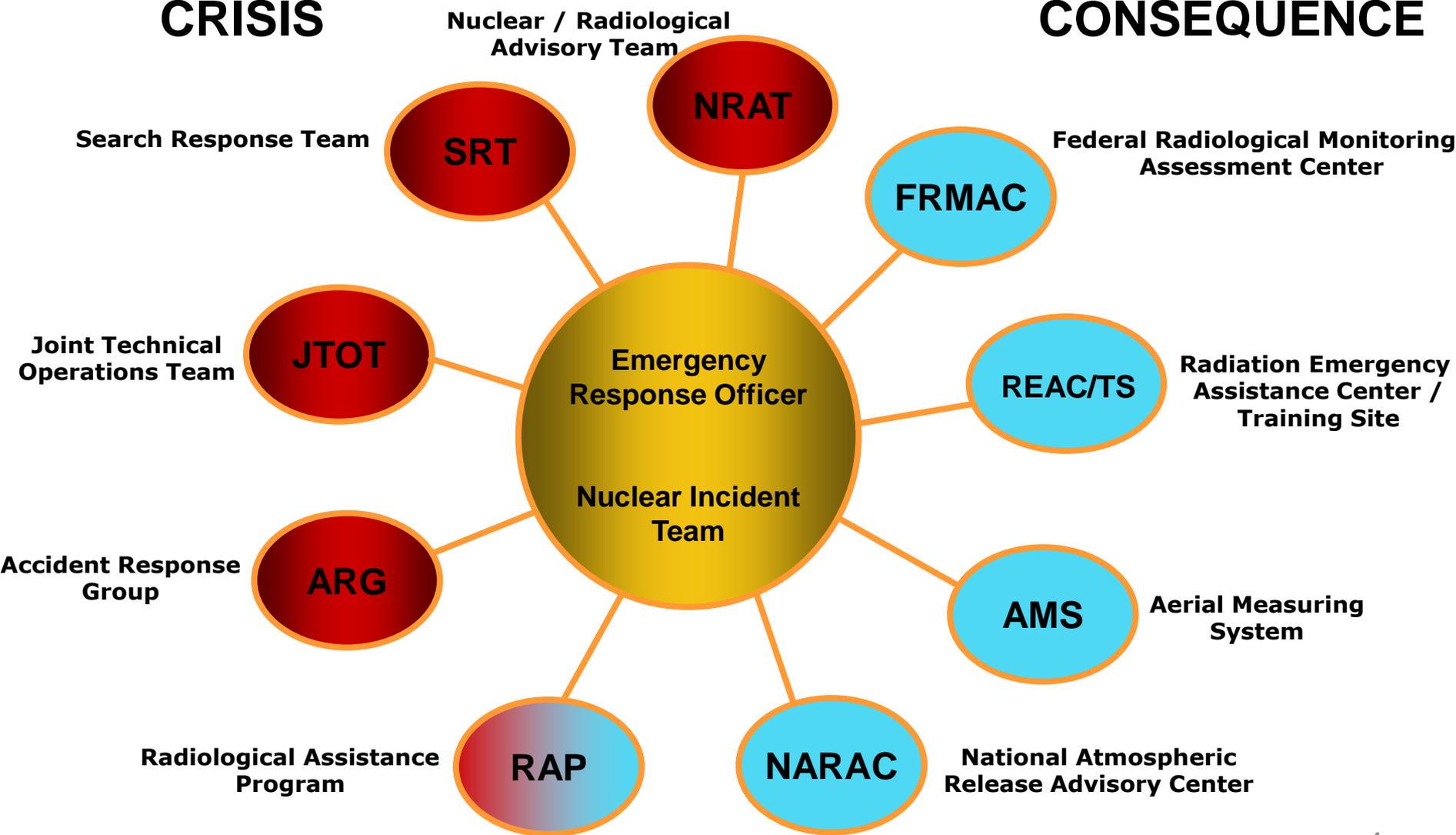
## Japan

- Japan Atomic Energy Agency (JAEA)
- Nuclear Safety Commission
- Ministry of Defense (MOD)
- Ministry of Economy, Trade and Industry (METI)
  - Nuclear and Industrial Safety Agency (NISA)
- Ministry of Education, Culture, Sports, Science & Technology (MEXT)
  - Nuclear Safety Technology Center (NUSTEC)
- Ministry of Agriculture, Forestry and Fisheries (MAFF)
- Ministry of Health, Labor & Welfare (MHLW)

# Office of Emergency Operations

## CRISIS

## CONSEQUENCE



# Operation Tomodachi

## DOE Objectives

- Assist the State Department mission to advise American citizens on protective action and evacuation guidelines
- Assist DoD mission to safely conduct humanitarian assistance/disaster relief operations and provide advice on departure/return of military dependents
- Partner with the Government of Japan (GOJ) through the State Department to aid in developing guidelines for protection of the public potentially affected by the releases

# Radiological Incident Response

## Resources

- Fixed
  - Nuclear Incident Team (NIT)
  - National Atmospheric Release Advisory Center (NARAC)
  - Consequence Management Home Team (CMHT)
  - Radiation Emergency Assistance Center/Training Site (REAC/TS)
  - Radiological Triage
- Deployed
  - Aerial Measuring System (AMS)
  - Consequence Management Response Team (CMRT)
  - Radiological Assistance Program (RAP)

## Capabilities

- Predictive modeling
- Data collection
  - Measurements
    - Air
    - Ground
  - Samples
- Data assessment
- Data interpretation/communication

**All NNSA consequence management assets...and then some**

# DOE Timeline

- March 11:
  - DOE/NNSA activated the following assets
    - Nuclear Incident Team (NIT) in Washington, DC
    - DOE/NNSA Consequence Management expertise on the US Agency for International Development (USAID) Disaster Assistance Response Team (DART) in Tokyo
    - National Atmospheric Release Advisory Center (NARAC) at Lawrence Livermore National Laboratory (LLNL)
    - Consequence Management Home Team (CMHT) at Remote Sensing Laboratory (RSL) with outreach to Sandia National Laboratory (SNL), LLNL, and Los Alamos National Laboratory (LANL)
    - The Radiation Emergency Assistance Center/Training Site (REAC/TS) in Oak Ridge, TN

# DOE Timeline (cont'd)

- March 14, 2011
  - At White House direction, DOE deployed a tailored CMRT and AMS capability via military airlift to Yokota Air Base



## DOE Timeline (cont'd)

- March 16: CM Assets arrive at Yokota AB and fly first AMS Test flight
- March 17: First aerial measurement activities over plant conducted; first field monitoring mission completed
- March 20: LNO deployed to PACOM in Honolulu
- March 22: Initial data published on DOE website



# Coordination & Advice

- Partnership with United States Forces Japan (USFJ) for AMS
- Radiological consequence management advice for US Ambassador and USFJ
- Planning, operations, and assessment with several ministries of the government of Japan
- Field expedient early warning system to be used while reactors were considered unstable

**These activities aided key leaders in decision-making and informed DOE monitoring and assessment efforts**

# Aerial Monitoring

## What was done

- Fixed wing and helicopter
- Up to 3 aircraft per day
- DOE & GOJ data



## Why it was done

- Map ground deposition out to 80 km from FDNPP
- Support evacuation, relocation, agricultural decisions



# Ground Monitoring

## What was done

- Mobile mapping
- In-situ & exposure rate
- Air & soil sampling
- Contamination swipes
- DOE, DoD, GOJ data

## Why it was done

- Mobile, in situ, exposure rate, soil, swipe
- Calibrate aerial measurements
- Define Isotopic mix
- Characterize the inhalation component of integrated dose
- Assess vertical and horizontal migration of deposited material



# Assessment

Assessments of measurements gathered showed:

- Radiation levels decreasing
- No measurable deposit of radiological material after March 19
- US bases and facilities all measured dose rates below 32 microrem/hr (32 millionths of a REM)\*\* – a level with no known health risks
- Agricultural monitoring and possible intervention will be required for several hundred square kilometers surrounding the site:
  - Soil and water samples are the only definitive method to determine agricultural countermeasures
  - Ground monitoring can give better fidelity to identify areas that require agricultural sampling

\*\* Note: 1 milliRem (mRem) = 10  $\mu$ (micro)Sieverts;  
1 milliRem (mRem) = 1000  $\mu$ (micro)rem

# Activity

- Daily AMS missions over US military installations and in the area around the FDNPS
  - > 85 flights
  - > 500 flight hours
- Daily monitoring activities at the U.S. Embassy, U.S. military installations, and in support of “ground truth” measurements for AMS.
  - > 590 air samples
  - > 140 in-situ spectra
  - > 100 soil sample
  - >269K total field measurements



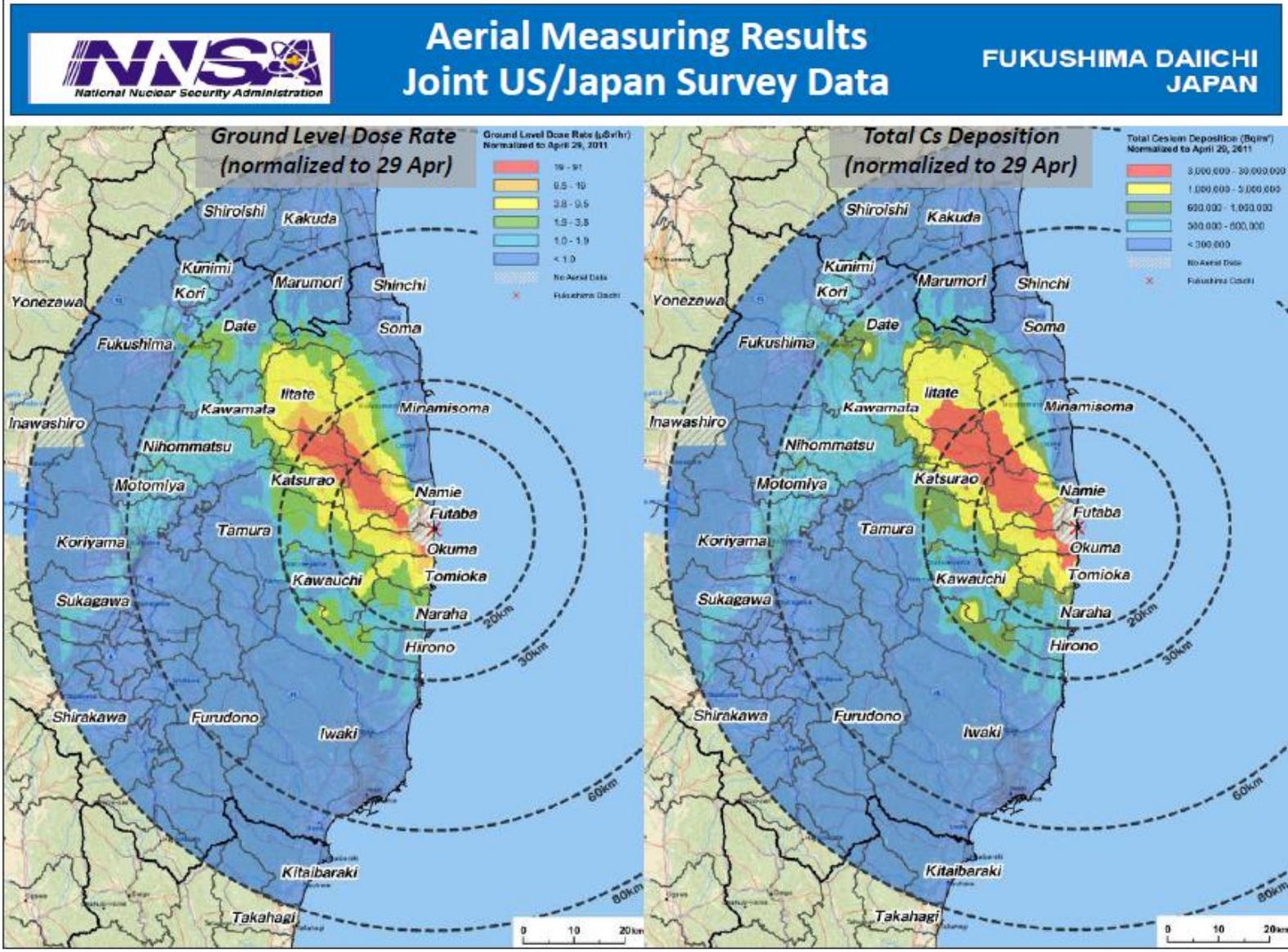


# Joint US-Japan AMS Data

- These results from a joint MEXT, DOE/NNSA and USFJ survey
- Data based on 42 fixed wing and helicopter survey flights at altitudes ranging from 150 to 700 meters between April 6 and April 29
- Exposure rates averaged over areas 300 m to 1500 m in diameter
- There is no data near the town of Inawashiro because it is mountainous and not easily accessible by low-flying aircraft
- The cesium deposition was determined from aerial and ground-based measurements
- The ratio of the amount of Cs-137 to Cs-134 was uniform across the survey region
- The survey boundary was chosen based on many preliminary measurements that showed the extent of the deposition



# Joint US-Japan AMS Data



# End State

- USFJ and GOJ to continue monitoring activities as needed
  - Japanese trained & equipped to fly DOE AMS
  - Japanese equipped with an enhanced laboratory analysis capability
  - USFJ trained & equipped to fly contingency AMS
  - DOE continues to support Japanese and USFJ from Home Team
- DOE footprint very minimal as of 6/1/11

**Resilience following a nuclear catastrophe**

# Successes

- First time full compliment of DOE/NNSA CM capabilities deployed to a large scale nuclear emergency
- DOE was able to perform on-the-fly analysis to deal with multiple ongoing releases, unknown source terms, challenging terrain as well as non-technical pressures.
- DOE Scientists developed customized products for U.S. military (data products, InField Monitoring System).
- DOE scientists embedded with Japanese scientists to create joint data products.

## Successes (cont'd)

- Liaison Officers proved important for information sharing and communication
- First time DOE/NNSA Nuclear Incident Team coordinated with White House and Senior DOE/NNSA Mgmt during a rad/nuc emergency.
- Using same vehicles each day allowed for some equipment to be stored overnight

# Challenges

- Unknown reactor status, source term along with chronic reactor releases
- Extended operations challenged several resource components
- Information tracking, data management and product prioritization proved challenging
- No mechanism to fund a Foreign Consequence Management mission

## Challenges (cont'd)

- No formal policy for coordination of interagency roles and responsibilities concerning monitoring, assessment and product development
- Poor expectation for quality and timeliness of data products development and delivery
- Reevaluate process for packaging, shipping and tracking samples
- Situational awareness within DOE/NNSA

# Challenges (cont'd)

- DOE/NNSA was considered DOE and the NIT was considered the one-stop shop without total knowledge
- Resource coordination by private sector with the Interagency