Long-Term Recovery from Nuclear Accidents

THE SCIENCE AND RESPONSE TO A NUCLEAR REACTOR ACCIDENT

Post Emergency Transition to Recovery

The National Academy of Sciences

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S.Y. Chen, Ph.D., CHP
Illinois Institute of Technology
Chicago, IL

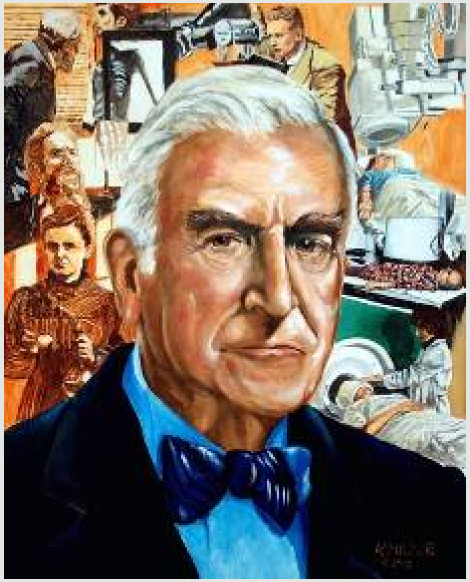
ILLINOIS INSTITUTE OF TECHNOLOGY

National Council on Radiation Protection & Measurements

1929: U.S. Advisory Committee on X-ray and Radium Protection

1946: U.S. National Committee on Radiation Protection

1964: National Council on Radiation Protection and Measurements chartered by Congress (Public Law 88-376)



NCRP REPORT No. 175

DECISION MAKING FOR LATE-PHASE RECOVERY FROM NUCLEAR OR RADIOLOGICAL INCIDENTS

2014

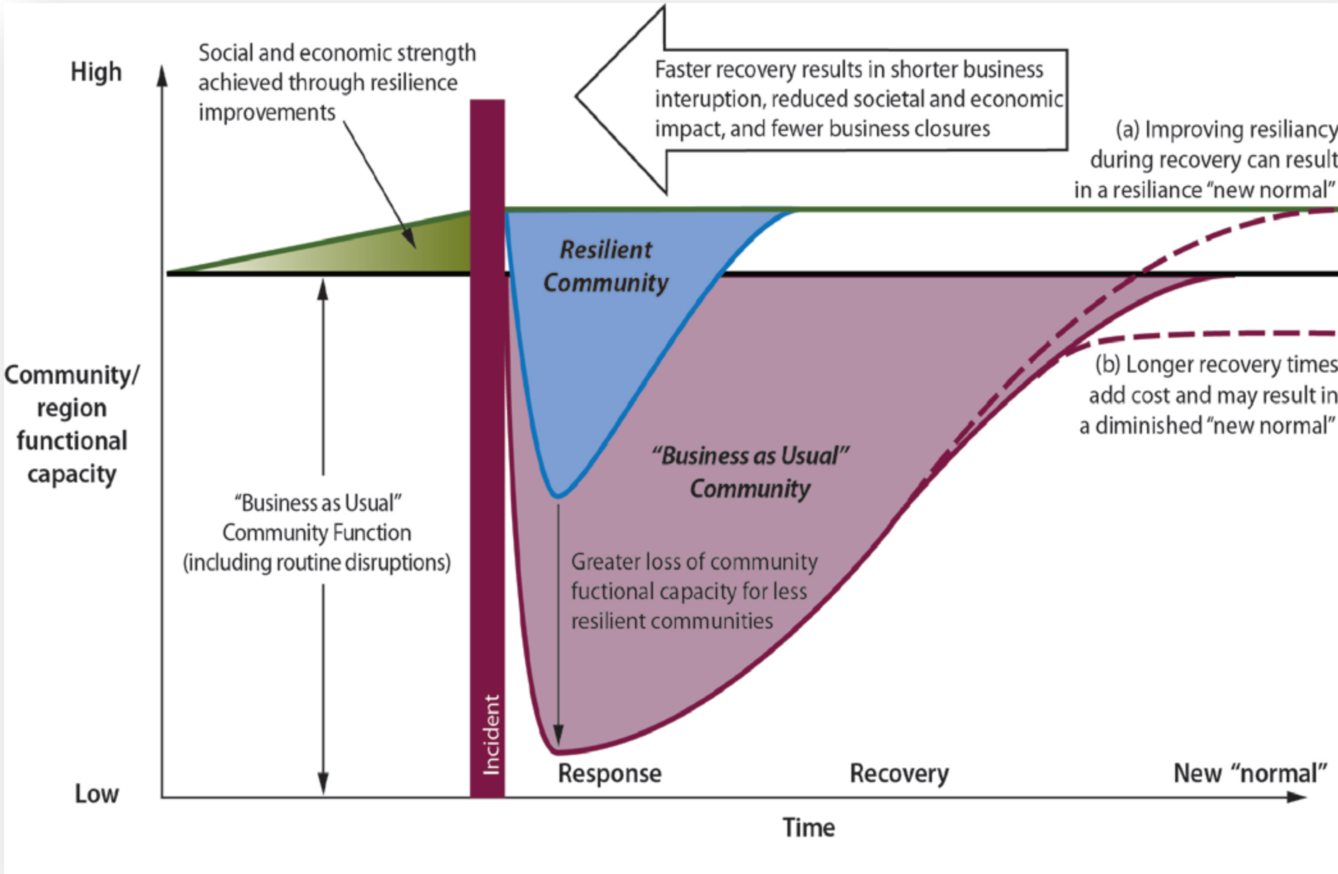
NCRP
National Council on Radiation Protection & Measurements

S.Y. Chen,
Chairman **SC 5-1**
Illinois Institute of Technology,

In 2008, DHS issued Protective Action Guides (PAGs) for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) incidents, providing recommendations for protection of public health in response to an RDD or IND incident.

The current Report, expanded to include nuclear reactor accidents, provides ***a basic framework and approaches to implementing and optimizing decision making during late stage recovery for large-scale nuclear incidents.***

Late-phase recovery: a challenging journey back to new normality



Model: Dr. Mary Ellen Hynes, DHS (2001); Blair Ross, ORNL; CARRI 2008 ©

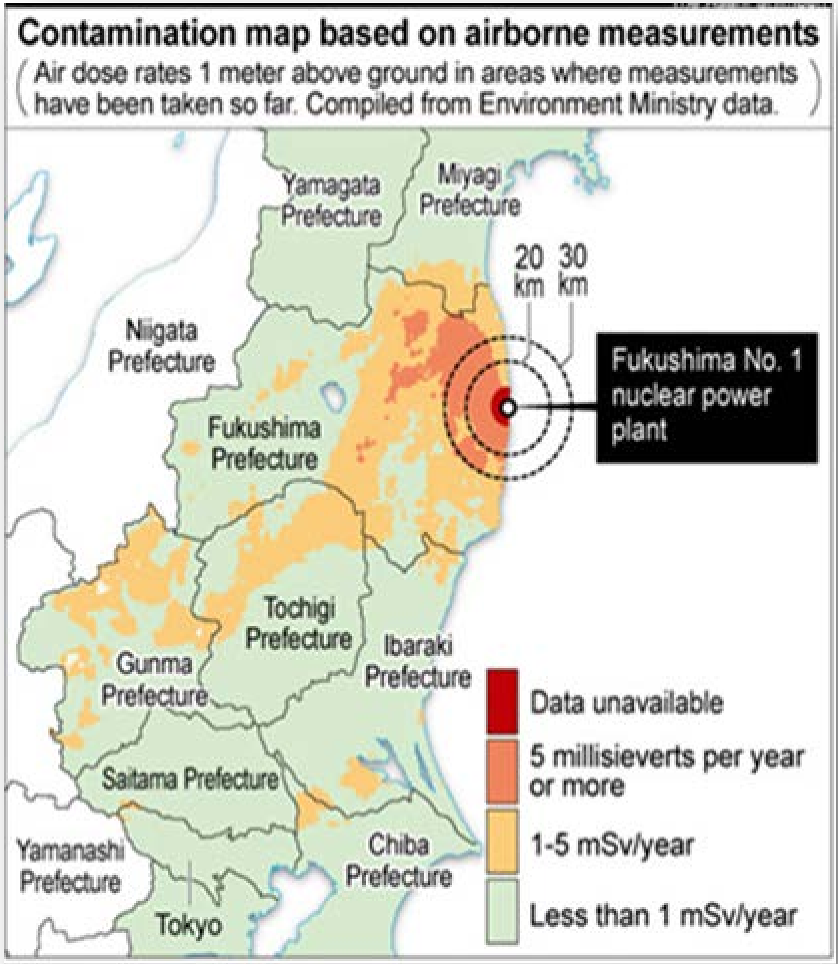
New Normality

Community Resiliency

- **Resourcefulness**
- **Adaptive capability**
- **Expediency**

Recovery from a nuclear or radiological incident is contingent on proper remediation of contamination (Source: NCRP).

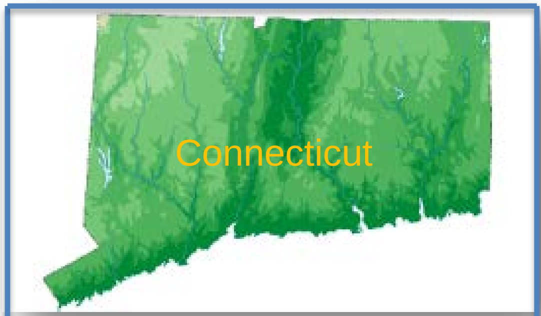
Addressing wide-area contamination: the unprecedented impacts



(Contamination area near Fukushima.
Source: The Asahi Shimbun 2011)

Fukushima cleanup level at 1 mSv/y:

- **13,000 km², or**
- **3% of Japan's land mass,**
- **Costs at $15.6 B**

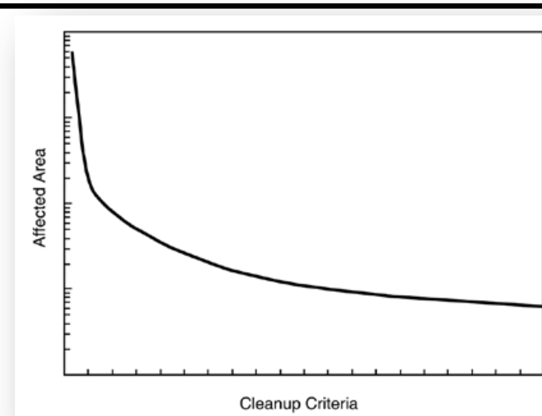


Contaminated area is about the *size of State of Connecticut*

Weighing difficulty options during remediation

Estimated radioactive waste volume from cleanup of nearby prefectures surrounding Fukushima NPP is $29x10^6$ m^3, or about 1 billion ft^3. This *has exceeded* the US commercial LLW disposal capacities combined. Some *adaptive management strategy* is needed.

Temporary storage of contaminated material – examples from clean-up demonstration tests



Waste volume is *directly proportional* to the rigor in cleanup.

(Source: ICRP 2012)

Late-phase recovery: major issues in wide-area radiological contamination

- Recovery considerations
  - Local ***economic viability***
  - Major ***infrastructures***
  - ***Repatriating*** displaced populations
  - Returning to "***new normality***" in the ***most expedient*** manner
- Remediation strategy
  - Future ***land uses***
  - ***Priority*** of remediation
  - ***Resources and technology***

- Decision-making process: site-specific optimization
  - ***Wide-area*** contamination
  - ***Multi-faceted*** issues
  - ***Radiological vs non-radiological*** concerns
- Involving stakeholders
  - ***Empowerment***
  - ***"Whole community"*** **approach**
- Risk communication
  - ***IRPA principles***
  - Use of modern ***communication technology***

Approach to address long-term recovery issues

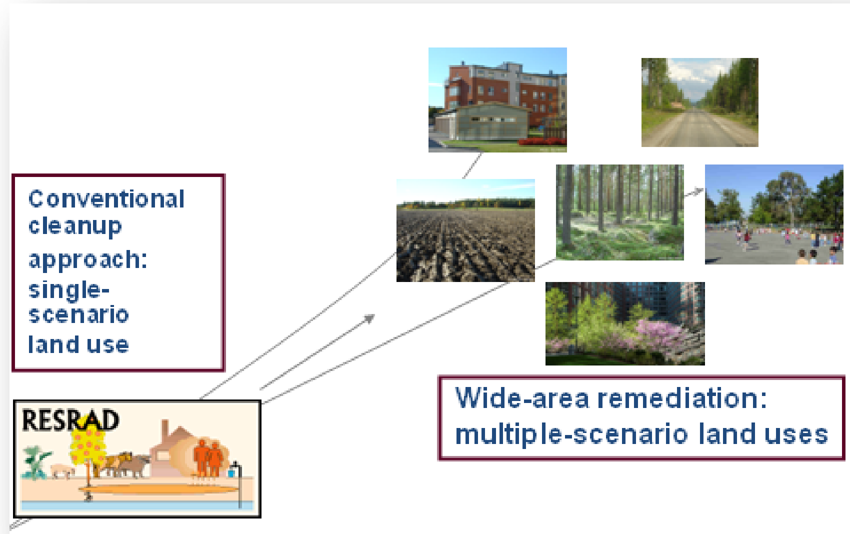
- **ICRP 103 on optimization:**
  The likelihood of exposure, the number of people exposed, and the magnitude of individual doses “***should all be kept as low as reasonably achievable, taking into account economic and societal factors***.”
- **ICRP 111 on long-term exposure:**
  “…while initially the exposures may be rather high and priority may be given to reducing the highest exposures, continuous efforts need to be made to reduce all exposures with time.”
- **DHS (2008):**
- A long-term recovery effort will likely involve a “***full-scope risk management approach over a broad range of issues that include: impacted areas, types of contamination, human health, public welfare, technical feasibility, resource availability, costs, short-term and long-term effectiveness, economic effects, and public acceptance***.”
- Use “***site-specific optimization***” to address the multifaceted issues involving long-term recovery.

Optimization vs statutory cleanup

Addressing wide-area remediation:

- **Optimization encompasses *full range of cleanup approaches***
- **Complex decision making with *iterative, graded approach***
- **Challenging environmental conditions for remediation**
  - ***varying levels* of contamination**
  - ***cross contamination* or *re-contamination***
  - ***elevated* background**
- ***Multiple exposures* to individuals (difficult to define *critical group*)**
- **Generation of *radioactive waste* is already problematic**
- **Competing *societal priority issues***
- ***Infeasible* to declare the entire area a "Superfund" site**

Wide-area issues: *individual dose vs multiple exposure scenarios*



The optimization approach aims at dose reduction through *long-term management* strategy.

Long-term recovery: managing the residual impacts

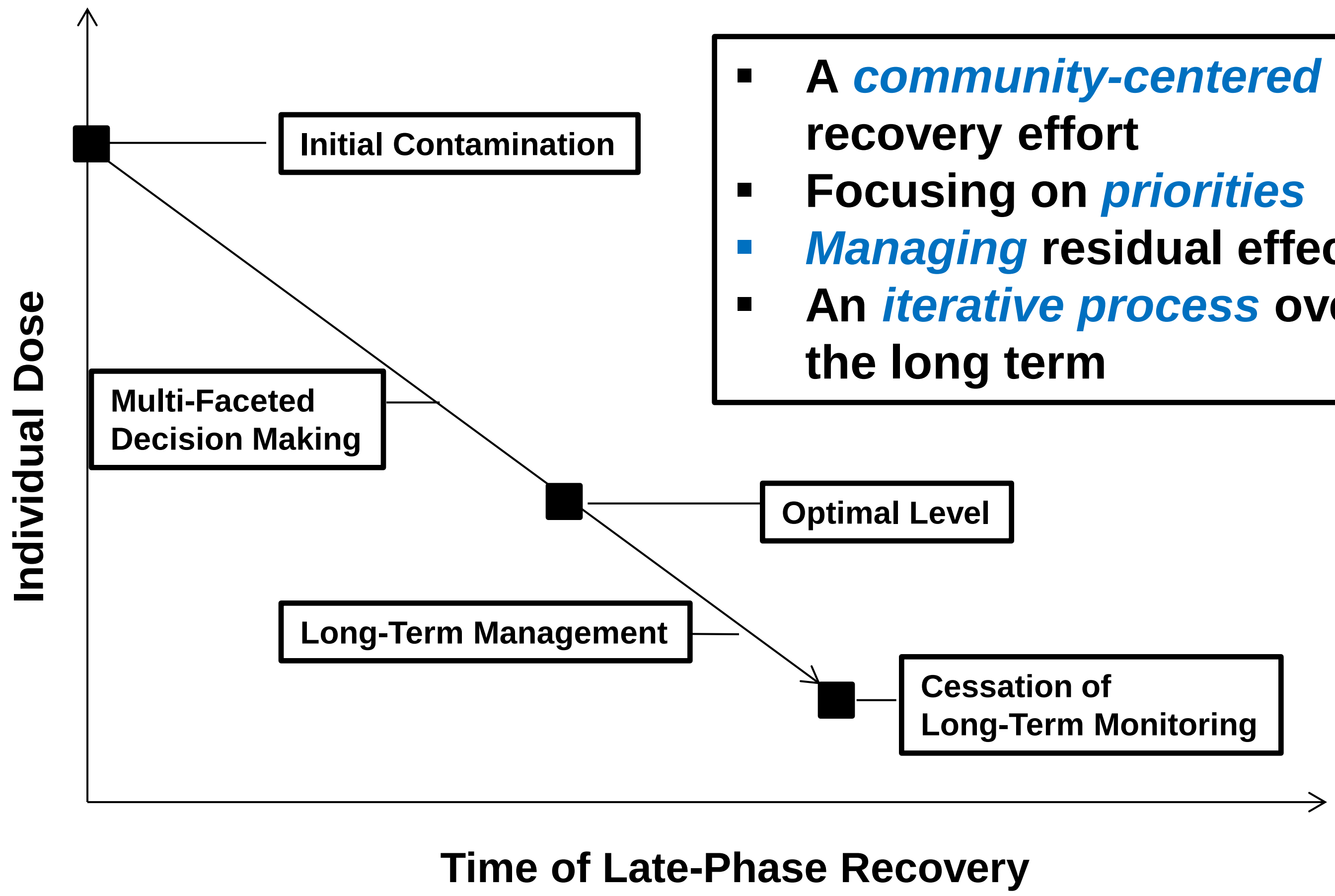
Population Monitoring

Controlling Residual Contamination

(Source: IAEA)

A long-term strategy by engaging stakeholders

- A ***community-centered*** recovery effort
- Focusing on ***priorities***
- ***Managing*** residual effects
- An ***iterative process*** over the long term



(Source: NCRP)