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Decision Making for Late-Phase Recovery from Nuclear or Radiological Incidents: New Guidance from NCRP

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Background

DHS (2008)

- Protective Action Guides for RDD and IND
  - Protection of public health in the early, intermediate, and late phases of response
- Optimization process required for late-phase recovery

DHS (2010)

- NCRP committee to prepare report on optimization for late-phase recovery from RDD and IND event

Scope of NCRP report subsequently expanded to nuclear reactor accidents

SC 5-1: Decision Making for Late-Phase Recovery from Nuclear or Radiological Incidents

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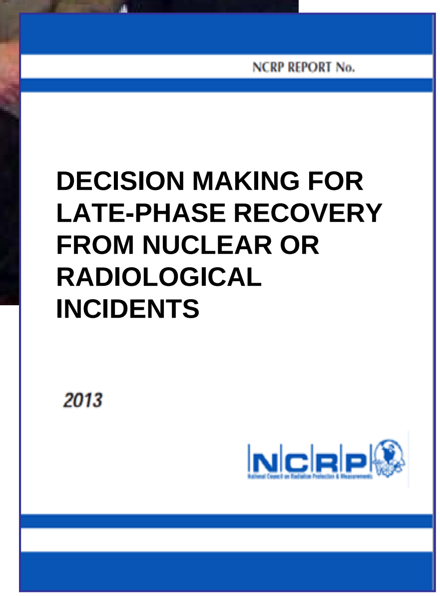
Scientific Authority Since 1929

Standing: B Buddemeier (LLNL), J MacKinney (DHS, Consultant), M Noska (FDA, Consultant), D Allard (PA, Advisor), A Wallo (DOE), K Kiel (Holy Cross), J Edwards (EPA, Advisor), A Nisbet (PHE, Advisor), J Cardarelli (EPA, Consultant), D Barnett (JHU), & S Frey (Staff Consultant) **Seated:** V Covello (CRC), SY Chen (IIT, Chairman), H Grogan (Cascade, Advisor), J Lipoti (NJ), & D McBaugh (Dade Moeller)


NCRP REPORT No.

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

2013

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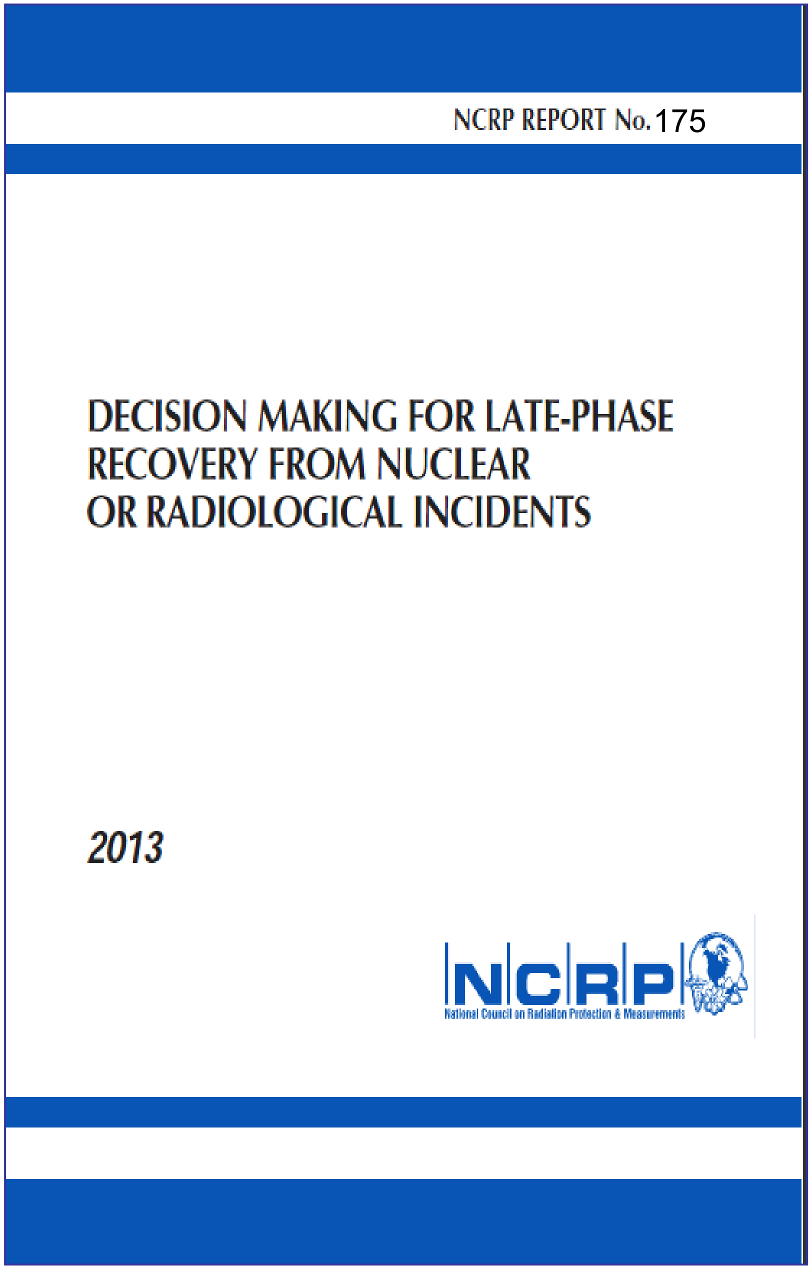
NCRP REPORT No. 175

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

2013

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Publication later in 2013 (final editorial review)

NCRP Report 175

- Nuclear/radiological incidents leading to long-term contamination
- A decision framework for late phase recovery
- Implementing optimization for decision making
- Long-term management of contamination
- Recommendations for late phase recovery

➢ **Appendices**

  - Past events; managing radioactive waste; decontamination technologies; economic analysis, risk communication; practical aspects of optimization

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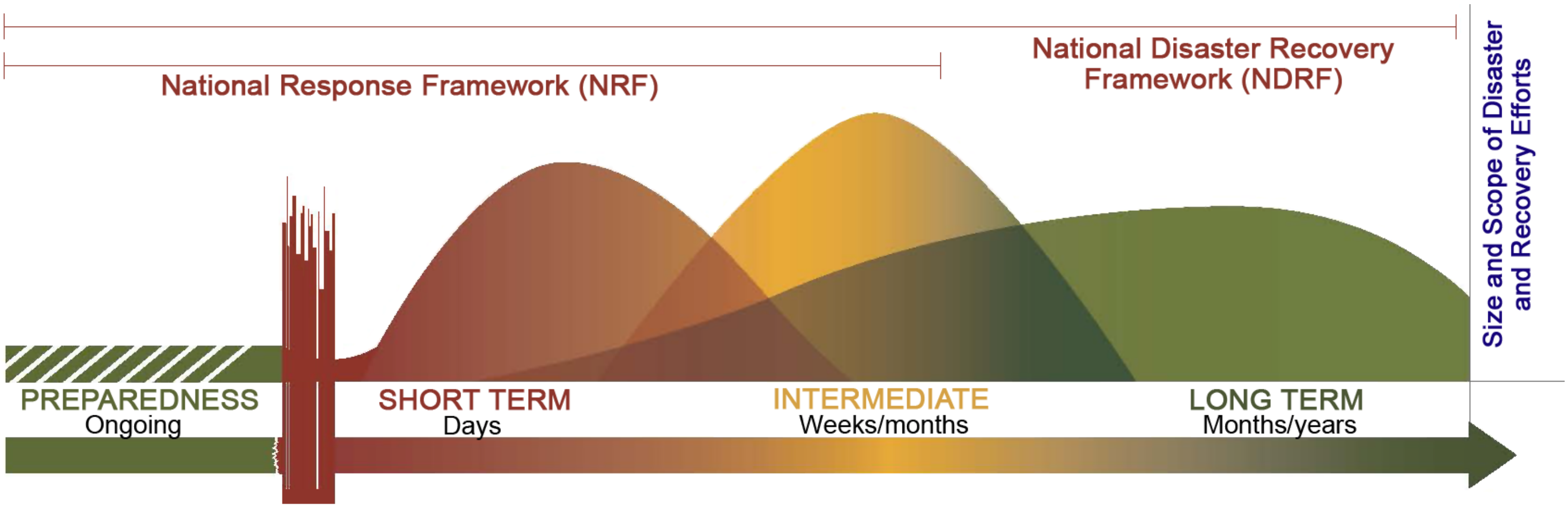
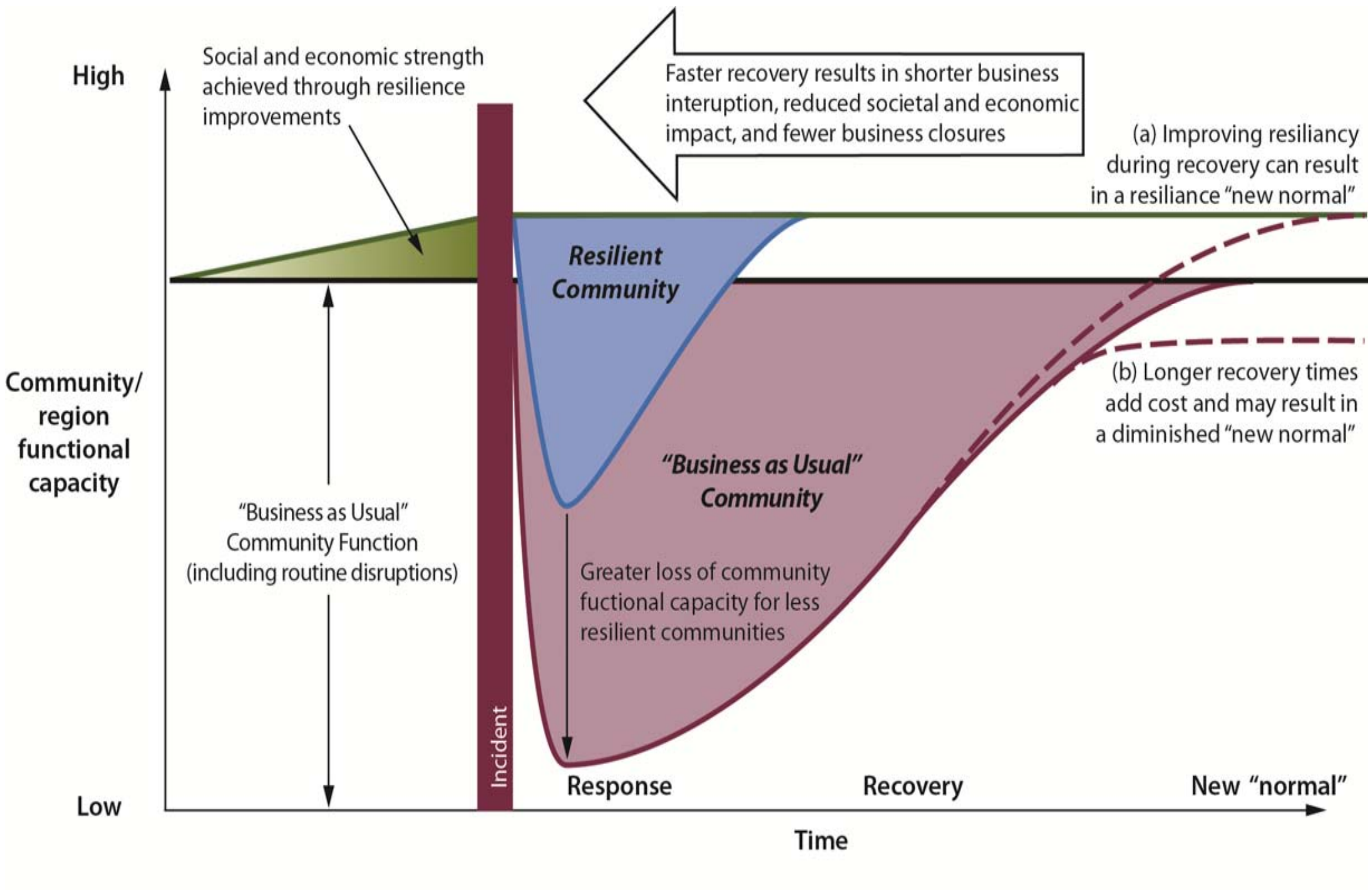
Time-frame for late-phase recovery*



Overlap between response and recovery: Long-term recovery starts shortly after the incident

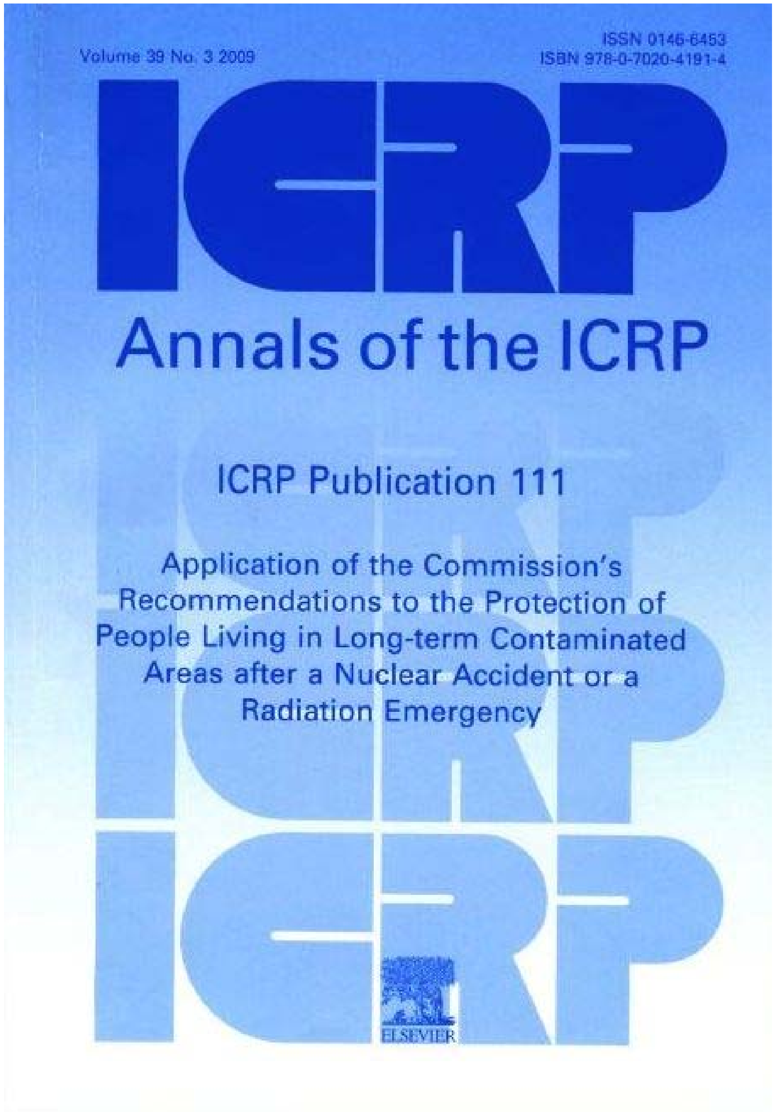
***Source: FEMA, National Disaster Recovery Framework, 2011**

Late-phase recovery, resilience and new normality



New Normal

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



ICRP (2009) recommends an optimization approach to Late-Phase Recovery Issues

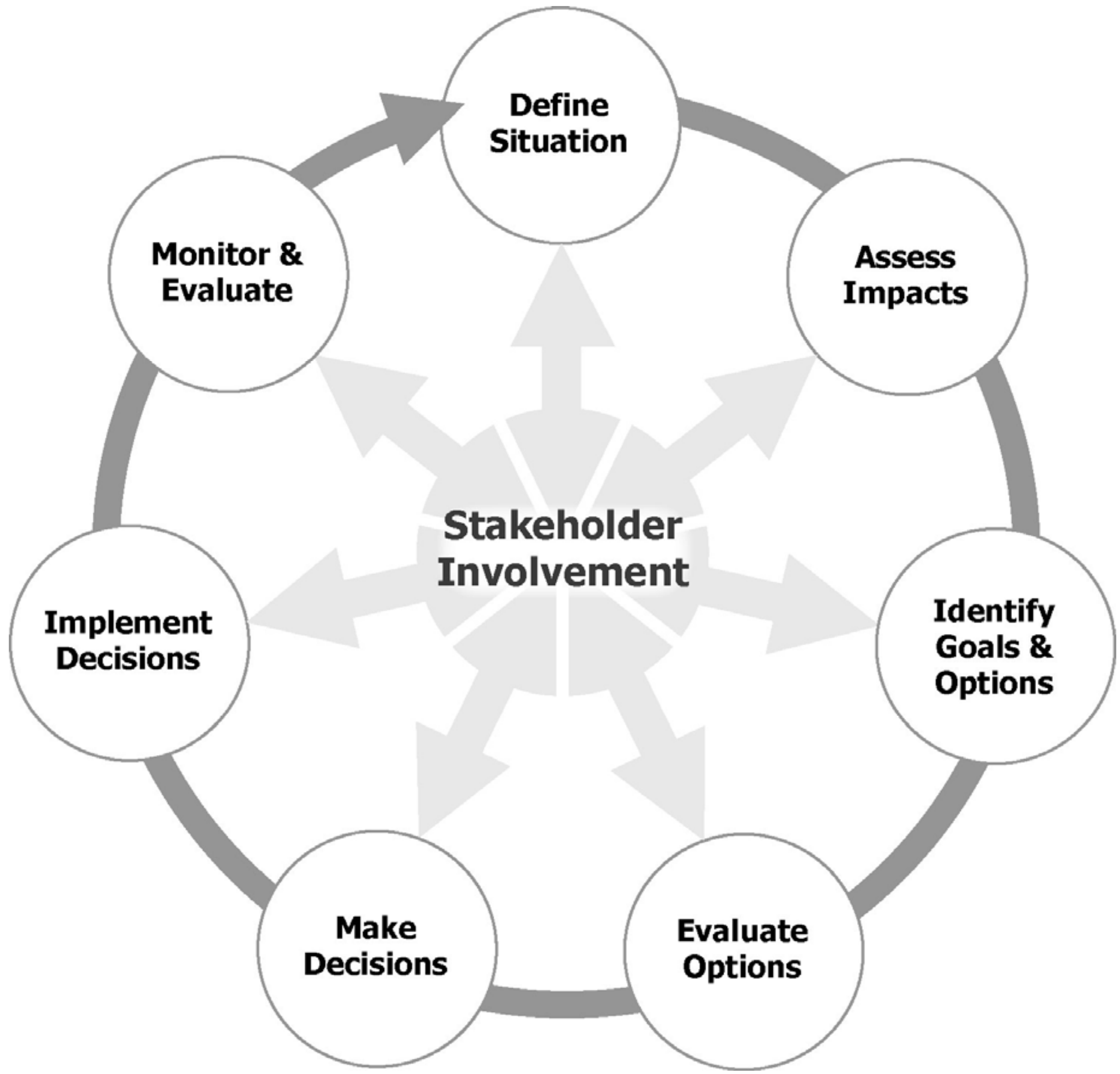
Principles of protection

- **Justification**
- **Optimization**
- Establishing reference levels of residual dose for individuals: 1 – 20 mSv/y, typical value1 mSv/y
- **ALARA** considerations

Management of late phase recovery

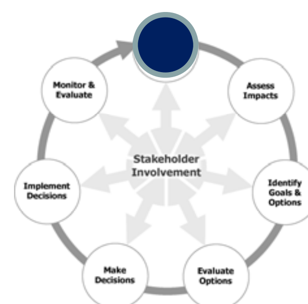
- Radiological protection is not the only concern
- Recovery involves restoration of whole communities
    - Infrastructure
    - Public services
    - Business and employment
    - Remediation of the contamination
- Key considerations
    - Public health and welfare
    - Socioeconomics
    - Waste generation and environmental impact
    - Communication

Optimization process for decision making



Optimization **Step 1**:Define situation

- Establish accurate and detailed characterisation of:
  - ➢ Contamination
    - Radionuclide composition (α,β,γ radiation) and concentration
    - Location of hot spots
    - External dose rate, ground deposition, surface contamination
    - Activity concentrations in food, water and consumer products
  - ➢ Land use
  - ➢ Essential services
  - ➢ Demography and habits



Optimization **Step 2**: Assess impacts

Radiological impact

- Use environmental monitoring data and assessment models to:
  - Identify important pathways of exposure and the timeline
  - Calculate doses to representative persons

Non-radiological impacts

- Psychological
- Health and welfare
- Ecological

Optimization **Step 3:** Identify goals and options

Goals

- Radiological criteria:
  - Reference levels of dose to constrain optimization
- Economic and business targets
- Minimising waste generation

Options

- Control access and modify individual behaviour
- Intervention for food and drinking water
- Intervention for inhabited areas
- Self help actions

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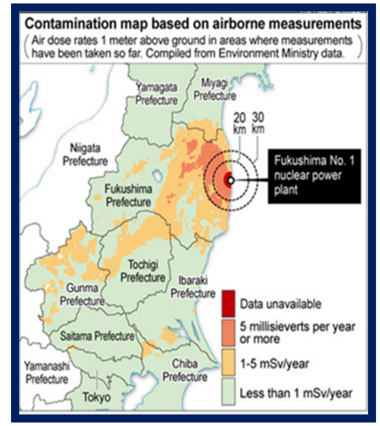
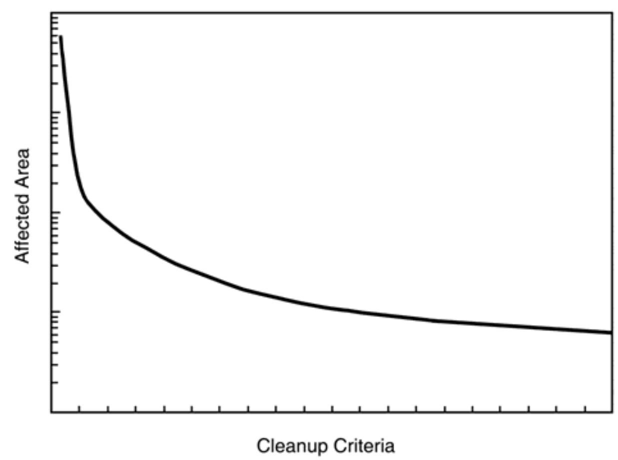
Radiological goals

- No pre-set clean-up criteria
- Criteria for wide area contamination are likely to be different to those applied for conventional clean-up
- Multiple land use scenarios, multiple pathways, multiple radionuclides
- Focus should be on doses not activity concentrations in/on media
- Consider applying Reference Levels recommended by ICRP (2009) to constrain radiological aspects of optimization in consultation with stakeholders



Cleanup level at 1 mSv/y:
- 13,000 km^2, or
- 3% of Japan's land mass



Optimization **Step 4**: Evaluate options

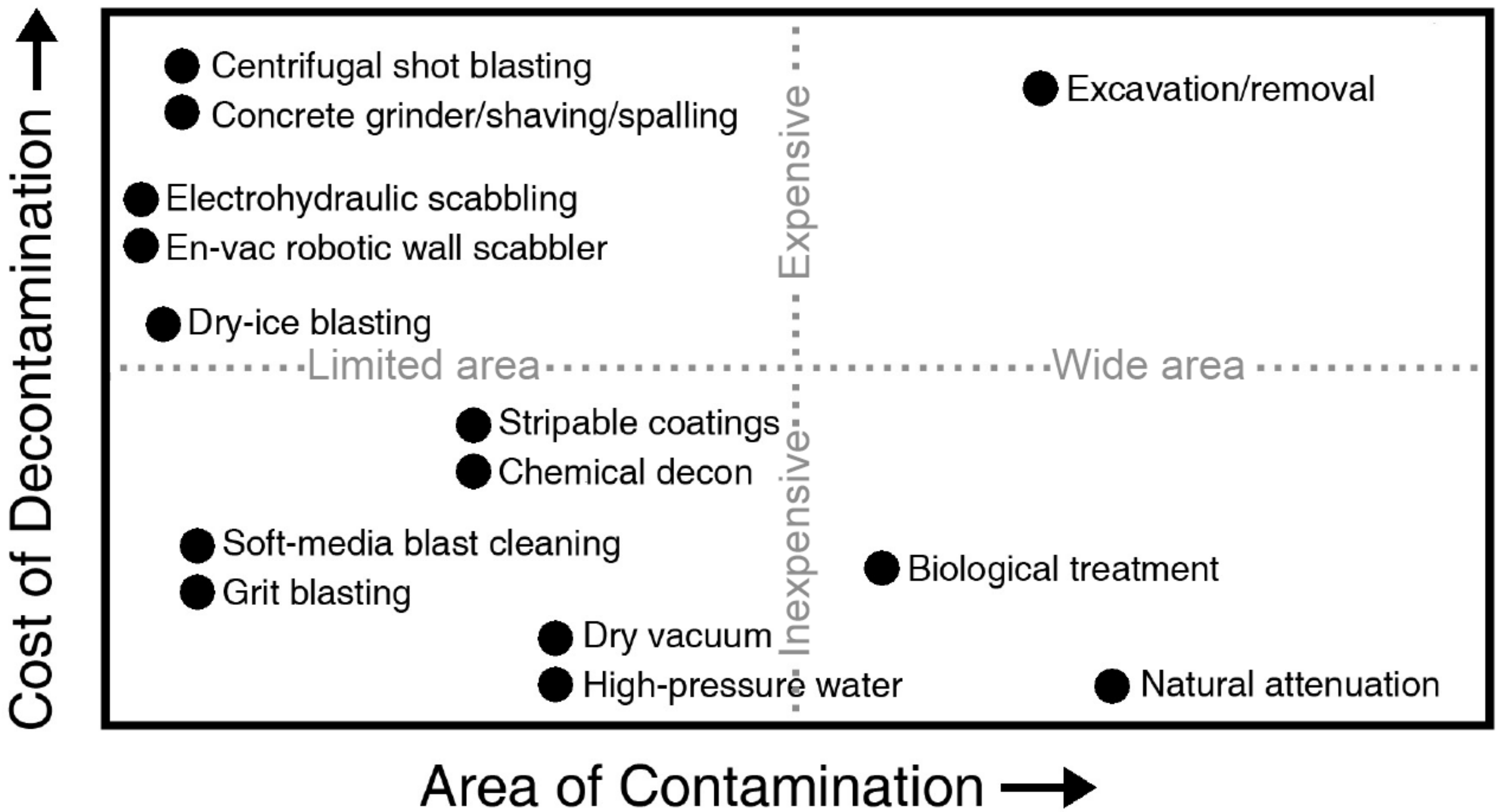
Criteria

- Timing
- Effectiveness
- Technical feasibility and capacity
- Economic cost
- Legislation
- Waste disposal
- Environmental issues
- Radiological impact
- Impact on people

Techniques

- Cost benefit
- Multi-attribute
- Other economic models
- Stakeholder consultation

Cost and scale of application



Waste disposal

Issues

- Existing waste classification system – too rigid
  - Risk-based would be logical
- Need to design and implement robust waste disposal plan
  - Using existing infrastructure
  - Siting and usage of temporary storage and treatment
  - Packaging and transport

Remote car park with access control, concrete and hillside barriers for shielding, bentonite barrier to capture leachate

Estimated radioactive waste volume from cleanup of nearby prefectures surrounding Fukushima NPP is 29×10^6 m^3

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Optimization **Step 5**: Decision making

- Requires extensive community/stakeholder engagement
    - whole community concept to build resilience
    - local and regional knowledge
    - cultural dimension
- May require changes to regulatory infrastructure
- Complex and multifaceted
- Graded, proportionate and iterative
- Dose not the only factor
- Priority setting, trade offs and consensus building
- Transparency

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Optimization **Step 6**: Implementation

- Transparency and effective communication of rationale for recovery strategy, success criteria and timescales
- Pilot studies to test effectiveness – adjustments and improvements to strategy
- Background levels of radiation may be impossible to achieve

Children's Museum, Date. Japan. Decontamination options used: Pressure washing, shot blasting, sanding/grinding, soil removal

Optimization **Step 7:** Monitor and evaluate

Monitor

- Health and environmental monitoring
  - Psychological impact, cancers
  - Food, water and environment
  - Remobilisation and recontamination of environment

Evaluate

- Effectiveness of recovery strategy against goals
  - radiological and economic indicators
- End points

Recovery is an iterative optimization process!

Stakeholders

Engagement with stakeholders is fundamental to decision making during late phase recovery.

- IRPA (2009) Guiding Principles for Radiation Protection Professionals on Stakeholder Engagement. International Radiation Protection Association 08/08
- FEMA (2011) A Whole Community Approach to Emergency Management: Principles, Theme and Pathways for Action. Federal Emergency Management Agency. Washington

Risk communication

Minimum requirements

- prompt delivery of relevant information
- transparency
- consistency, clarity and completeness on:
    - the use and meaning of radiation measurements
    - relevant risk comparisons
    - how to reduce or avoid exposure
    - risks of radiation exposure to recovery workers
    - risks, costs and benefits of protection options
- anticipation, preparation, and practice.

Challenges to adoption of 'optimization'

"A new federally funded report is likely to recommend that contamination from a so-called "dirty bomb" should not have to be cleaned up as thoroughly as hundreds of existing radioactive sites throughout the United States, even though official estimates suggest this change would dramatically increase the risk of cancer in people living in the affected area"

Douglas P. Guarino
Global Security Newswire Nov. 26, 2012

Addressing wide-area remediation is a departure from the conventional cleanup approach and it is anticipated that there will be considerable opposition in the US to the new approach

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Conventional v Wide area ‘clean-up’

Conventional

- Controlled access
- Radiological risk is main focus
- Precautionary decision making
- Clean up goals close to background
- Expectation that pre-incident conditions will return

Wide area

- Unrestricted access
- Non radiological risks must be considered
- Practical decision making
- Iterative clean-up process – no preset goals
- Acceptance of a new normality

Recommendations from NCRP 175

1. Develop a national strategy promoting community resilience
2. Integrate late-phase recovery into planning and ensure it is exercised
3. Embrace the optimization paradigm for managing nonconventional wide-area contamination
4. Ensure stakeholder engagement and empowerment underpins the optimization process

Recommendations from NCRP 175

5. Develop a communication plan as an integral part of the preparedness strategy
6. Develop adaptive and responsive policies including those for waste management
7. Conduct R&D to specifically address the impact of wide-area contamination
8. Establish a mechanism to integrate lessons learned from past incidents.

Conclusions

- ICRP Publication 111 underpins new NCRP Report 175
- NCRP Report 175 further develops ideas and concepts and provides details on how to implement optimization through an iterative seven step process
- Challenge in US is to gain acceptance for a departure from the conventional clean-up approach for wide area contamination that is based on an optimization process