Radiological Emergency Awareness & Response

Off-Site Emergency Preparedness Training

Modified for PART of Westford Aug 2020

Learning Goals

- Types of radiation
- Measuring radiation
- Difference between exposure and contamination
- Sources of radiation exposure
- Effects of exposure
- Components of the program
- Emergency Planning Zones
- Reception center facilities
- Organization interrelationships
- Emergency classification levels and community response

Learning Goals (cont'd)

- Precautionary actions
- Protective actions
- Security driven events
- Governor's declaration of state of emergency
- Post emergency terms
  - Reentry
  - Return
  - Restricted Area
  - Relocation
- Nuclear power plant
  - Pressurized water reactor
  - Containment
- Chernobyl vs. Three Mile Island

Radiation in Perspective

- Radiation is a form of energy. Everything around us is made up of small particles called atoms. The atoms in some matter are unstable and can split to form new matter. When this happens, it gives off energy called radiation. This energy can be used to make electricity, to treat cancer, and in other helpful ways.

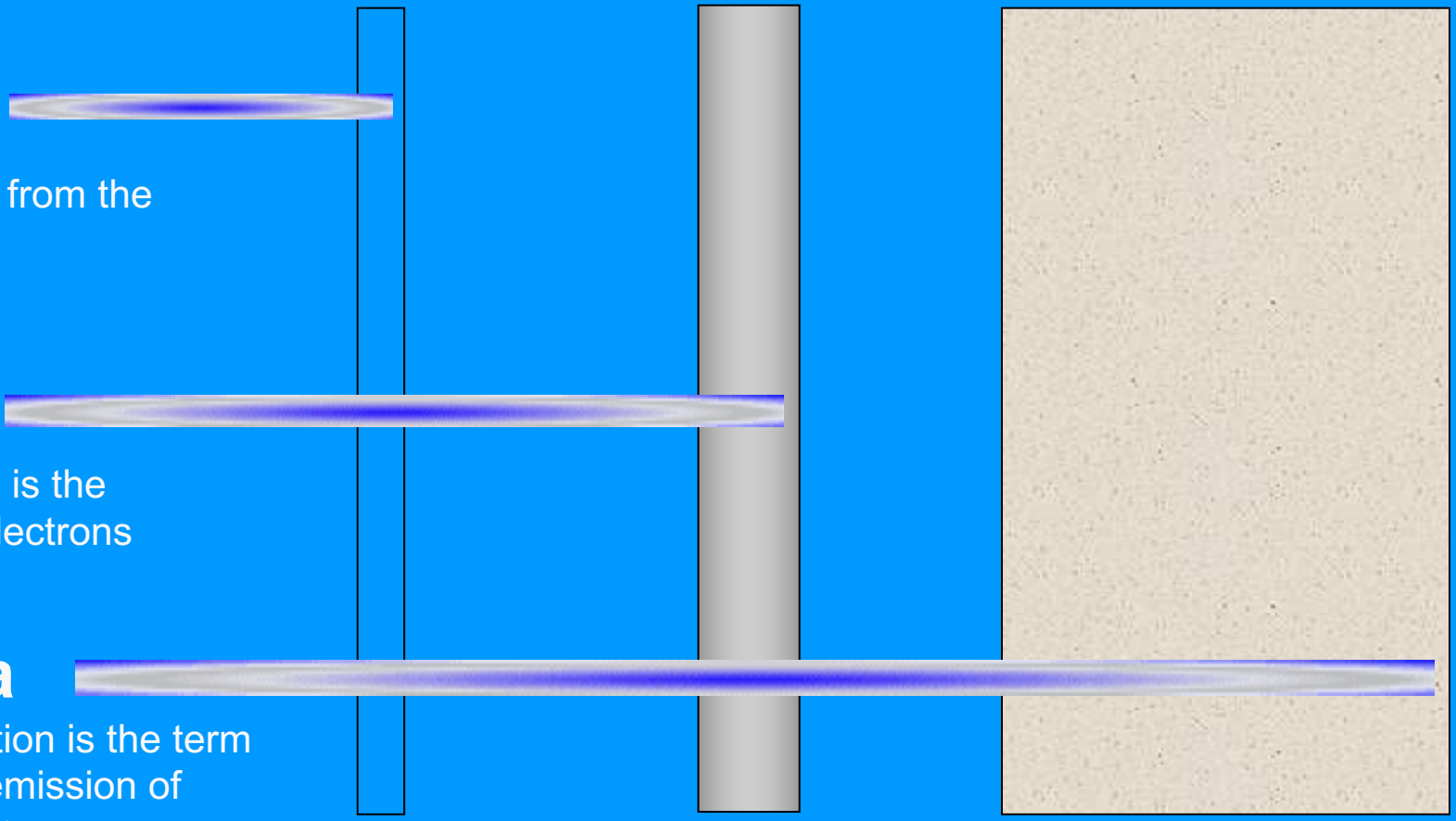
- Radiation is all around us. It is in the air we breathe, the food we eat, and the water we drink. It is in our homes and even in our bodies. This is called natural or background radiation.

- In addition to background radiation, there is also man-made radiation. It comes from such things as medical and dental x-rays, color televisions, smoke detectors and some watches with dials that glow in the dark. Very small amounts of radiation come from nuclear power plants.

Radiation in Perspective

- Radiation is measured in units called millirems.
- For radiation to cause any measurable biological effect in human beings, most scientists agree that the exposure must reach about 25,000 millirems in a single, short time exposure.
- Federal standards drawn up and enforced by the Nuclear Regulatory Commission (NRC) require that workers at nuclear power plants receive no more than 5,000 millirems of radiation a year. The NRC further required that no member of the public be exposed to more than five millirems a year from the operation of a nuclear power plant.

Radioactive nuclei emit three types of radiations



Alpha

alpha particle from the helium nuclei

Beta

beta radiation is the emission of electrons

Gamma

gamma radiation is the term used for the emission of energetic photons

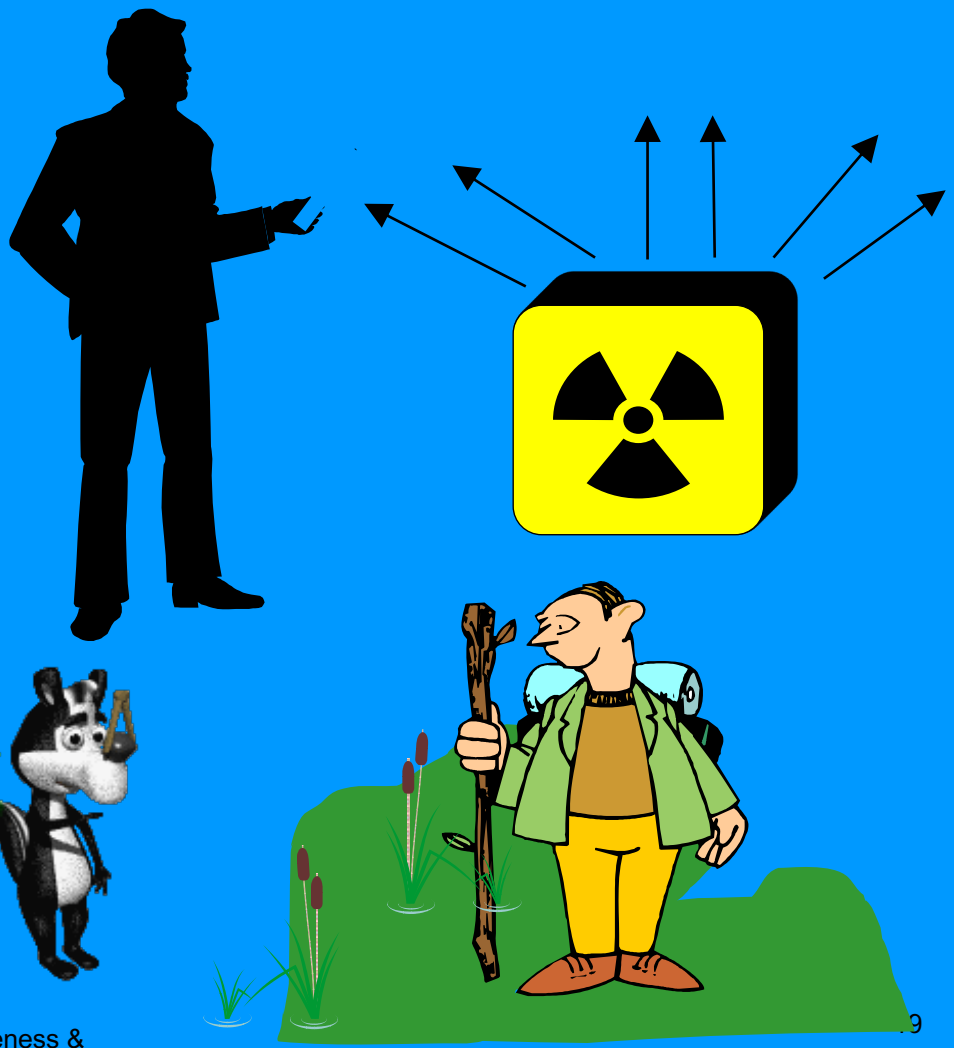
Sheet of paper

1/10 inch aluminum

40 inches concrete

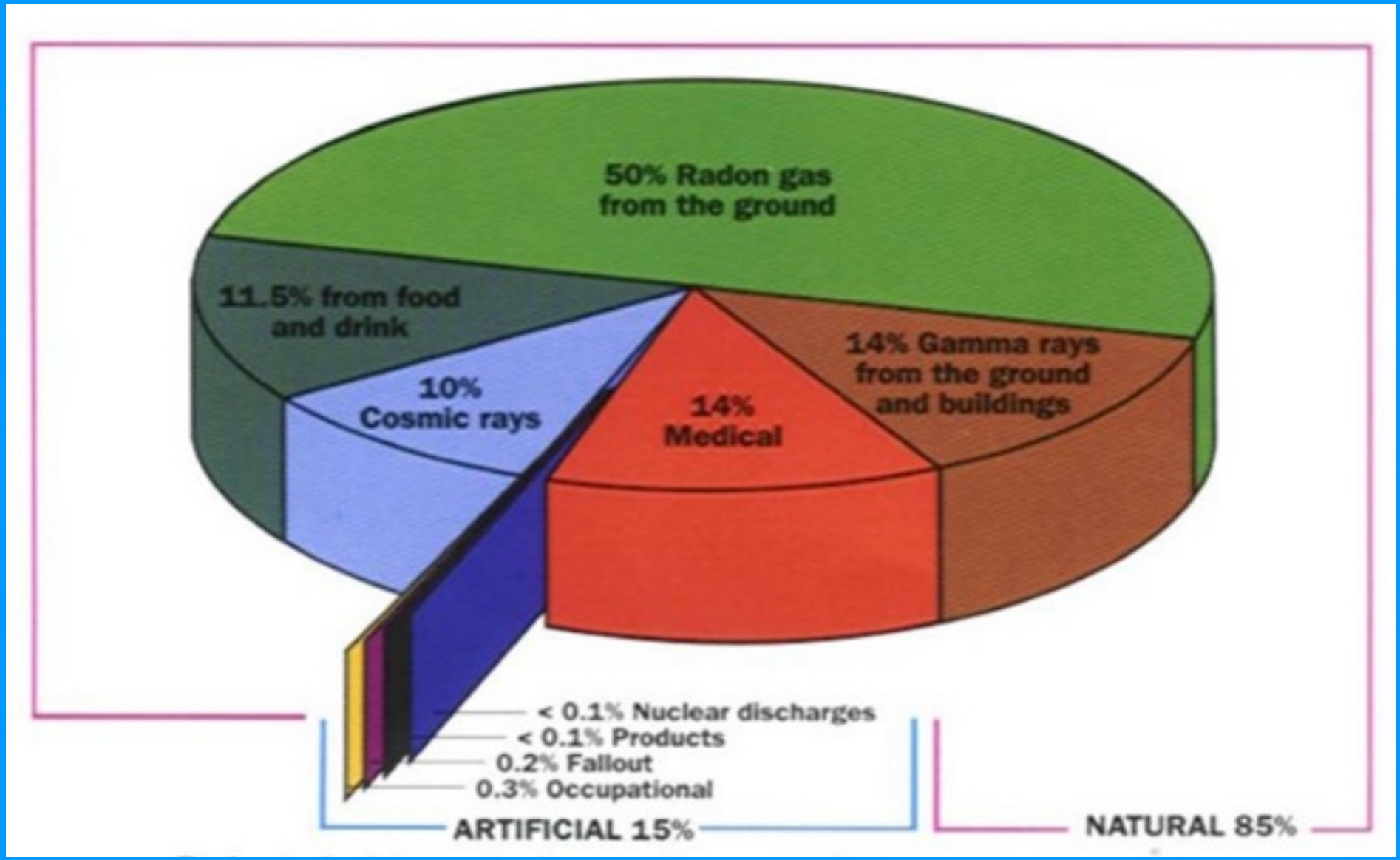
Exposure vs. Contamination

Radiation Exposure



Radioactive Material Contamination

Sources of Radiation Exposure in the United States



Source	Dose (mR/yr)	% of Total
Natural		
Radon	200	54%
Cosmic	27	8%
Terrestrial	28	8%
Internal	39	11%
Total Natural	**294**	**81%**
Artificial		
Medical x-ray	39	11%
Nuclear medicine	14	4%
Consumer products	10	3%
Total Artificial	**63**	**18%**
Other		
Occupational	0.9	<0.3
Nuclear fuel cycle	<1	<0.03
Fallout	<1	<0.03
Miscellaneous	<1	<0.03

Effects of Exposure
1000mR = 1R

0 to 50 REM (0 to 50,000mR)

A doctor would not be able to detect any changes to the body without chromosome analysis.

50 to 100 REM (50,000 to 100,000mR)

Blood tests would indicate a drop in red and white blood cells. The body would replace these cells over a short period of time (up to two weeks).

Effects of Exposure
1000mR = 1R

200 to 400 REM (200,000 to 400,000mR)

Possible death

400 to 600 REM (400,000 to 600,000mR)

50% death rate without medical attention

Over 600 REM (600,000mR +)

100% death rate without medical treatment

Radiological Emergency Response Plan

The Massachusetts Radiological Emergency Response Plan (MARERP) was developed to provide guidance and assistance to State and local officials with responsibilities for responding to radiological emergencies at nuclear power stations and to Federal or private agencies requested to assist in such response.

Components of the Program

Emergency Response Plan

- Designates who will do what

Implementing Procedures

- Further defines the *who* and *what*
- Provides the *when* and *how* to accomplish specific tasks

Training

- Provides the skills and knowledge necessary to perform the tasks

Components of the Program

Facilities and Equipment

- Ensures provision of facilities and equipment necessary to accomplish tasks

Drills and Exercises

- Testing of plans and practice for responders

Emergency Planning Zones (EPZs)

Plume Exposure Emergency Planning Zone

- 0 – 10 miles
- Possibility of an instantaneous release of radioactive material

Ingestion Exposure Pathway Zone

- 0 – 50 miles
- Primary concern: Long-term ingestion of radioactive material deposited onto crops within food chain

Emergency Planning Zones (EPZs)

Determination of zones is based upon:

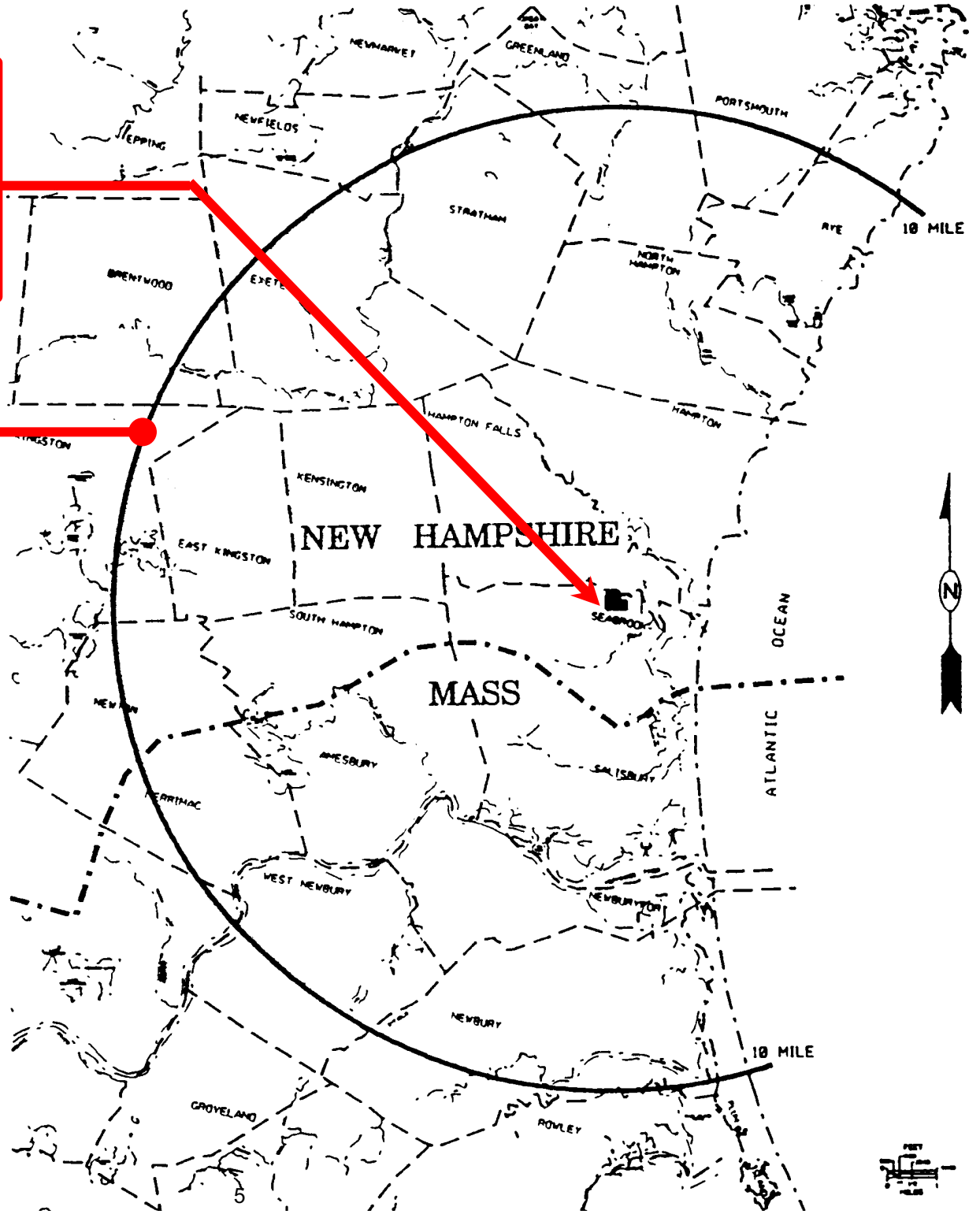
- NRC / FEMA recommendations
- Readily recognized landmarks (i.e., geographical & political boundaries)

Seabrook Station

10-Mile EPZ

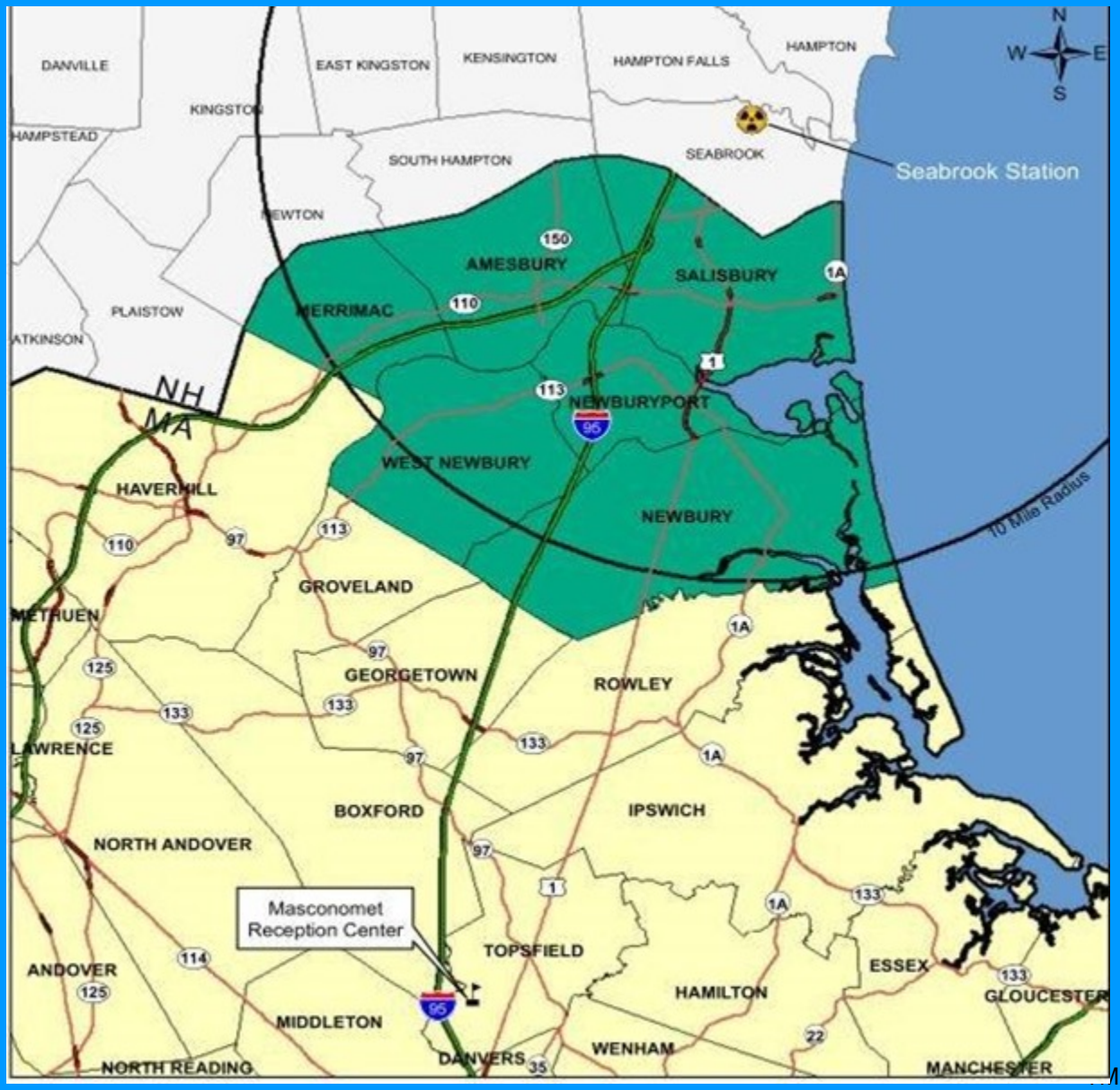
Peak population of EPZ
92,791*
*Summer mid-week

Resident population of EPZ
58,470



10-Mile Plume Exposure Emergency Planning Zone

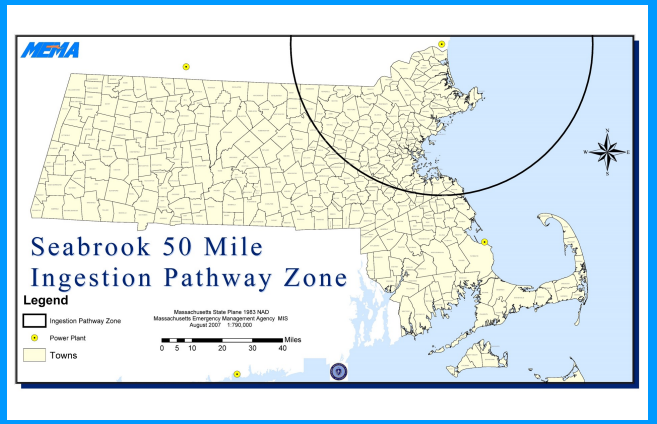
- Amesbury
- Merrimac
- Newbury
- Newburyport
- Salisbury
- West Newbury



50-Mile Ingestion Pathway Emergency Planning Zone

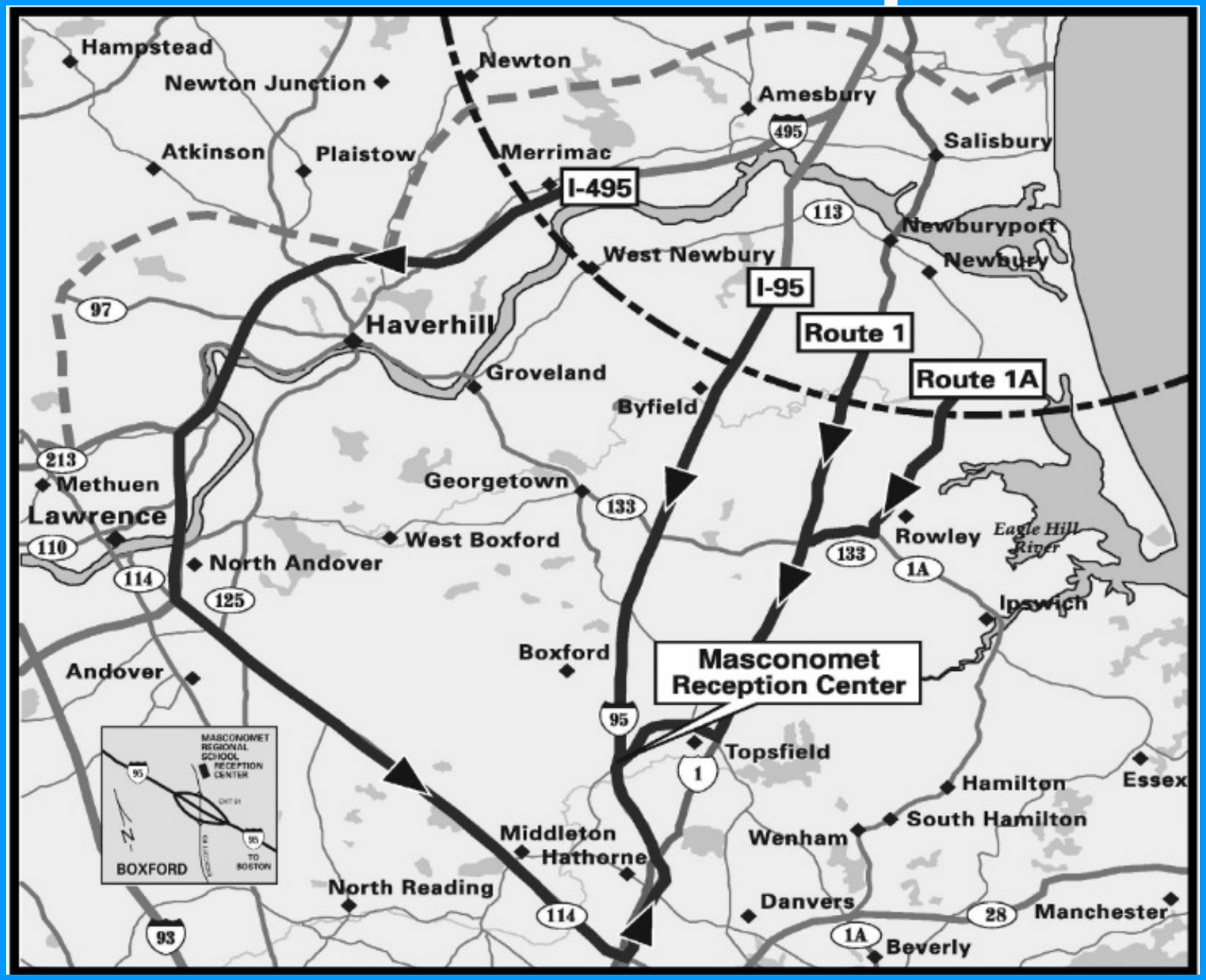
50-Mile Ingestion Pathway Emergency Planning Zone

- Massachusetts
- New Hampshire
- Maine



Primary concern is the long-term ingestion of radioactive material deposited onto crops within the food chain

Evacuation Map

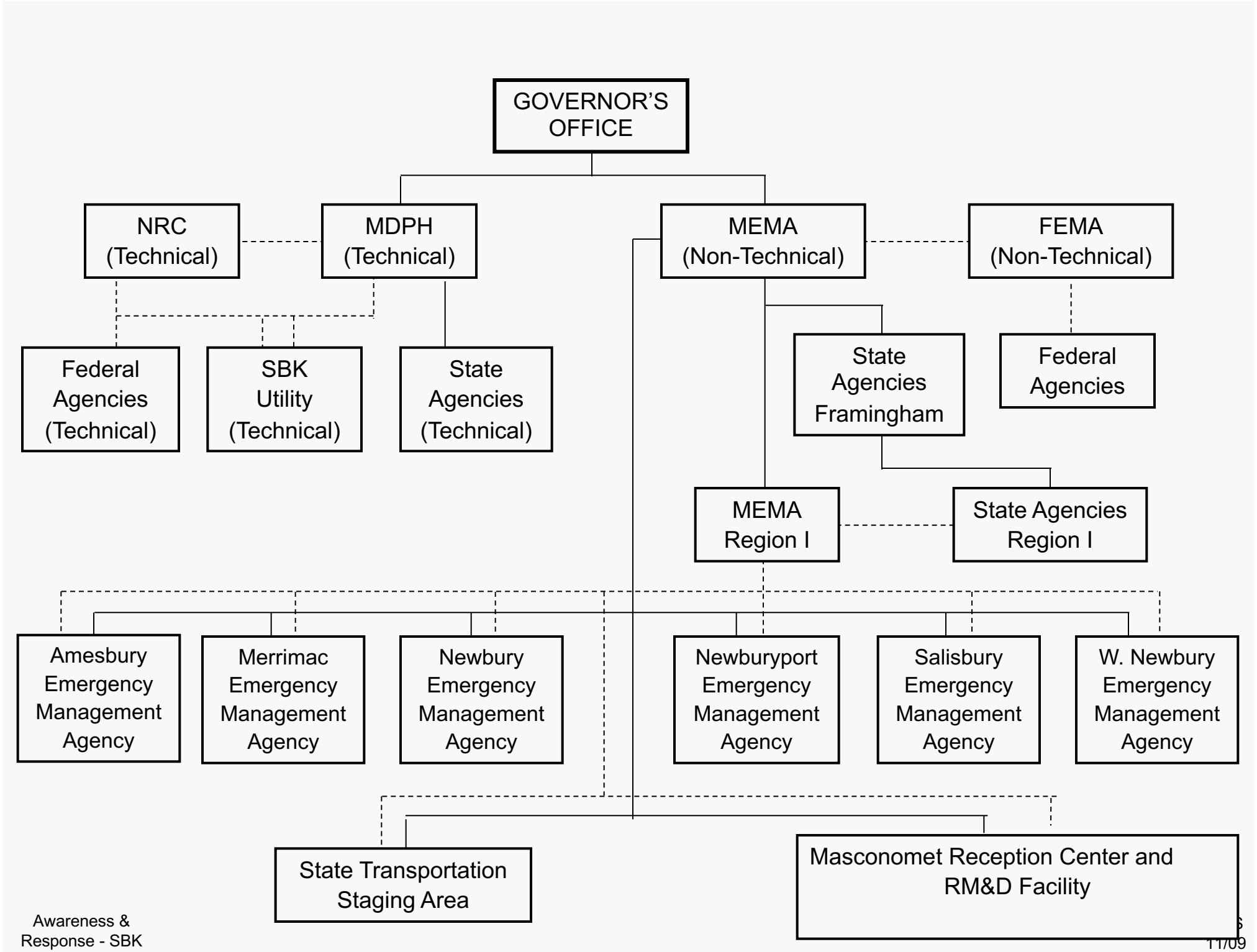


EPZ and Related Reception Center

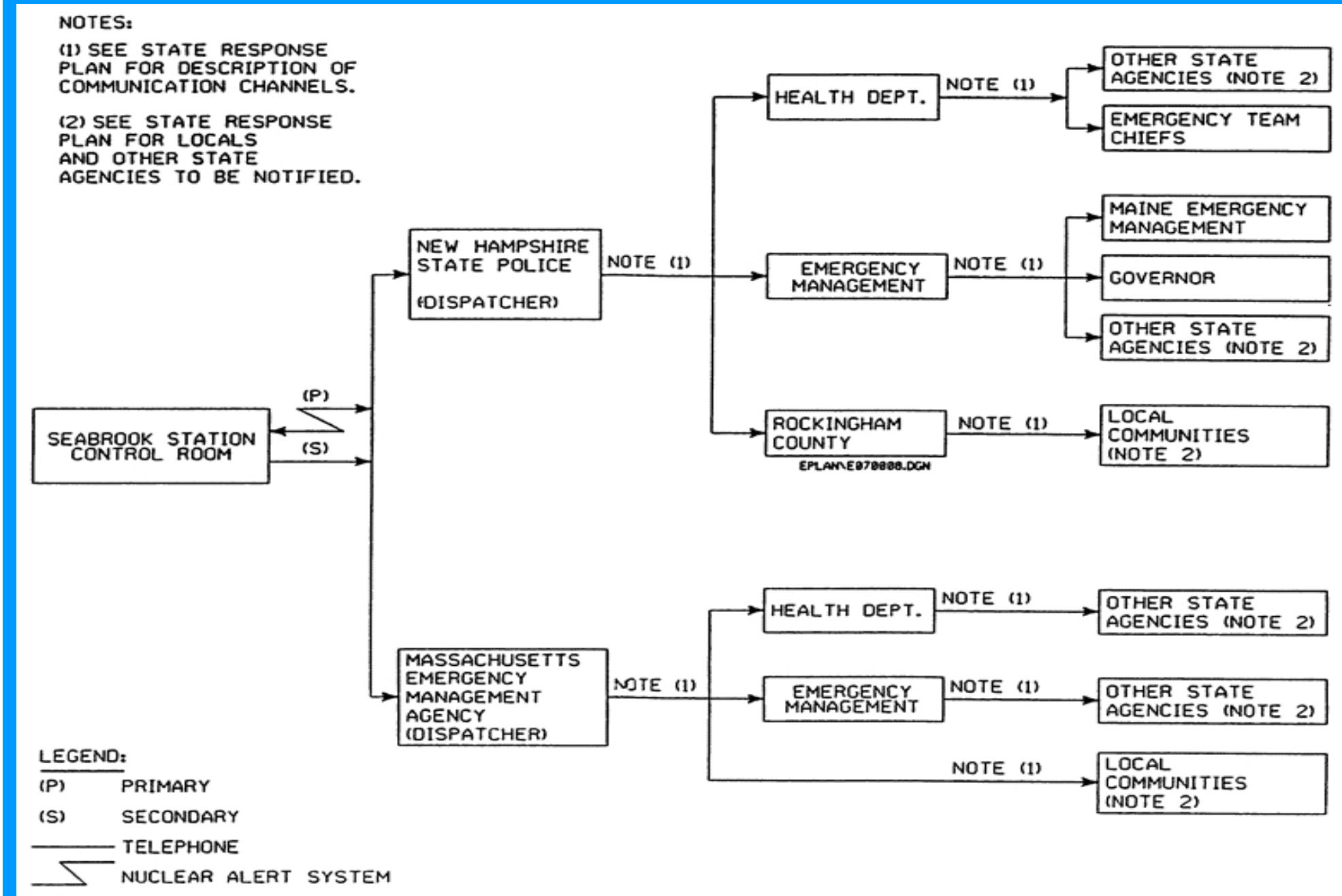
Amesbury Merrimac Newbury

Salisbury West Newbury Newburyport

Masconomet Regional School


GOVERNOR'S OFFICE
NRC (Technical)
MDPH (Technical)
MEMA (Non-Technical)
FEMA (Non-Technical)
Federal Agencies (Technical)
SBK Utility (Technical)
State Agencies (Technical)
State Agencies Framingham
Federal Agencies
MEMA Region I
State Agencies Region I
Amesbury Emergency Management Agency
Merrimac Emergency Management Agency
Newbury Emergency Management Agency
Newburyport Emergency Management Agency
Salisbury Emergency Management Agency
W. Newbury Emergency Management Agency
State Transportation Staging Area
Masconomet Reception Center and RM&D Facility

Initial Notification



Four Emergency Classification Levels

An **Unusual Event** means a minor problem has occurred at the plant. Public officials would be notified, but people in the area would not need to take any special actions.

An **Alert** means plant safety could be affected. As a precaution, public officials may transfer school children to host facilities outside the area and clear state parks and waterways. Radio or news broadcasts would inform the public of these actions.

A **Site Area Emergency** means a more serious problem has occurred. State and local officials will use the emergency alert system to keep people in the area fully informed. Sirens and CodeRed would notify persons in the area if the public needs to take any action.

A **General Emergency** is the most serious type of emergency. It could involve serious damage at the plant and the release of radioactive materials. Sirens and CodeRed would notify persons in the area. State and local officials will use the emergency alert system to issue public safety instructions to those in the area.

Four Emergency Classification Levels

- ***Unusual Event***
- ***Alert***
- ***Site Area Emergency***
- ***General Emergency***

Emergency Classification Levels

Unusual Event

Unusual events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.

Emergency Classification Levels

Unusual Event

Examples – what may cause this alert level

- Hurricane, earthquake, tornado
- Fire within plant lasting more than 10 minutes
- Loss of offsite power
- Loss of onsite AC power

Community Response

Unusual Event

- Key Personnel at State & Local Levels
  - State EOC Key Personnel
  - Region 1 EOC Key Personnel
  - EPZ Community 24 Hour Point
  - Essex County Regional Emergency communications Center
  - Key EPZ Community Personnel
    - Municipal Official
    - Emergency Management Director
    - Police & Fire Representatives

Emergency Classification Levels

Alert

Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant. Any releases expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Emergency Classification Levels

Alert

Examples – what may cause this alert level

- Fire potentially affecting plant safety systems
- Loss of offsite power and onsite AC power

Community Response

Alert

EPZ Communities

- Emergency Operations Center activated
- Dosimetry may be distributed
- Buses staged
- Health care facilities notified
- Recreation areas may be closed
- Local Transportation Staging Area staffed

Reception Communities

- Key Personnel notified
- Reception Center & host schools notified
  - May be activated
- Precautionary transfer of schools & day cares may be implemented
- State Transportation Staging Area staffed

Emergency Classification Levels

Site Area Emergency

Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases not expected to exceed EPA Protective Action Guideline exposure levels except near site boundary.

Emergency Classification Levels

Site Area Emergency

Examples – what may cause this alert level

- Fire which is affecting plant safety systems
- Loss of offsite power and onsite AC power for more than 15 minutes

Community Response

Site Area Emergency

EPZ Communities

- Sirens & EAS activated
- Schools & day cares transferred
- Special Needs verified
- Traffic Control Points/ Access Control Points staffed
- Dosimetry distributed

Reception Communities

- Radiological Monitoring & Decontamination facility staffed
- Dosimetry distributed
- Host schools activated
- Reception Center activated
- Traffic Control Points/Access Control Points staffed

Sirens

- What do they mean?
  - After 3 minutes
  - Tune to one of the Emergency Alert System stations:
    - 1030 AM Boston 1450 AM Newburyport
      92.5 FM Haverhill 93.7 FM Boston
      98.5 FM Boston

Do you know what to do if sirens sound?

“I would go to my house, get my family and head north”

“I’d go in and sit down. It’s too late to get out.”

“I’d love it, the last time it went off, it was a false alarm”

“I'd go out on the deck to see what was going on.”

“If ever I saw a flash, I’d run towards it”

“Just put your head between your knees and pray”

“Get a beer and lounge chair and wait for the flash”

“I would wonder what happened, I would probably call the police or neighbors.”

“I don’t know, I would freak out. I would probably get in my car and drive until I couldn’t hear the sirens anymore.”

…and finally

“First thing, put the radio on to (the) station you’re supposed to put it on to, “said Judy Vaughn of Seabrook. How did she know? “Because I get a calendar from them and read it every year. I'm not going to take off if I don't have to.”

http://www.seacoastonline.com/articles/20081012-NEWS-810120364

Emergency Classification Levels

Site Area Emergency

Events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels offsite for more than the immediate site area.

Emergency Classification Levels

General Emergency

Examples

- Loss of containment integrity
- Releases can be reasonably expected to exceed EPA guidelines

Protective Actions

Sheltering

Evacuation

KI Recommendation

Community Response

General Emergency

EPZ Communities

- Sirens & EAS activated
- Traffic Control Points/ Access Control Points activated

Sheltering

- Public advised to remain inside

Evacuation

- Transportation provided where needed
- Security for evacuated areas

Reception Communities

- Traffic Control Points/ Access Control Points activated
- Radiological, Monitoring & Decontamination facility activated

Evacuation

- Reception Center activated
- Mass Care shelters activated

Security Driven Events

Hostile Action - Definition

- An act toward a Nuclear Power Plant (NPP) or its personnel that includes the violent force to destroy equipment, takes hostages, and/or intimidates the licensee in order to achieve an end or objective.
- This includes attack by air, land, or water. Other acts that satisfy the overall intent may be included.

Security Driven Events

Unusual Event

- Notification of any credible site-specific security threat
- A validated notification from the Nuclear Regulatory Commission (NRC) providing information of an aircraft threat greater than 30 minutes away

Security Driven Events

Alert

- A notification from the Seabrook Security Force that an armed attack, explosion, airliner impact, or other hostile action is occurring or has occurred within the protected area.

Security Driven Events

Site Area Emergency

- Determination that loss of physical control of the plant is **imminent**.

- A notification from the Seabrook Security Force that an armed attack, explosion, airliner impact, or other hostile action is occurring or has occurred within the protected area.

Security Driven Events

General Emergency

- A hostile force has taken control of plant equipment such that plant personnel are unable to operate equipment required to maintain safety functions.

Post-Emergency Terms

Reentry

- Temporary entry into a restricted zone under controlled conditions.

Return

- Reoccupation of areas cleared for unrestricted residence or use by previously evacuated or relocated populations.

Post-Emergency Terms

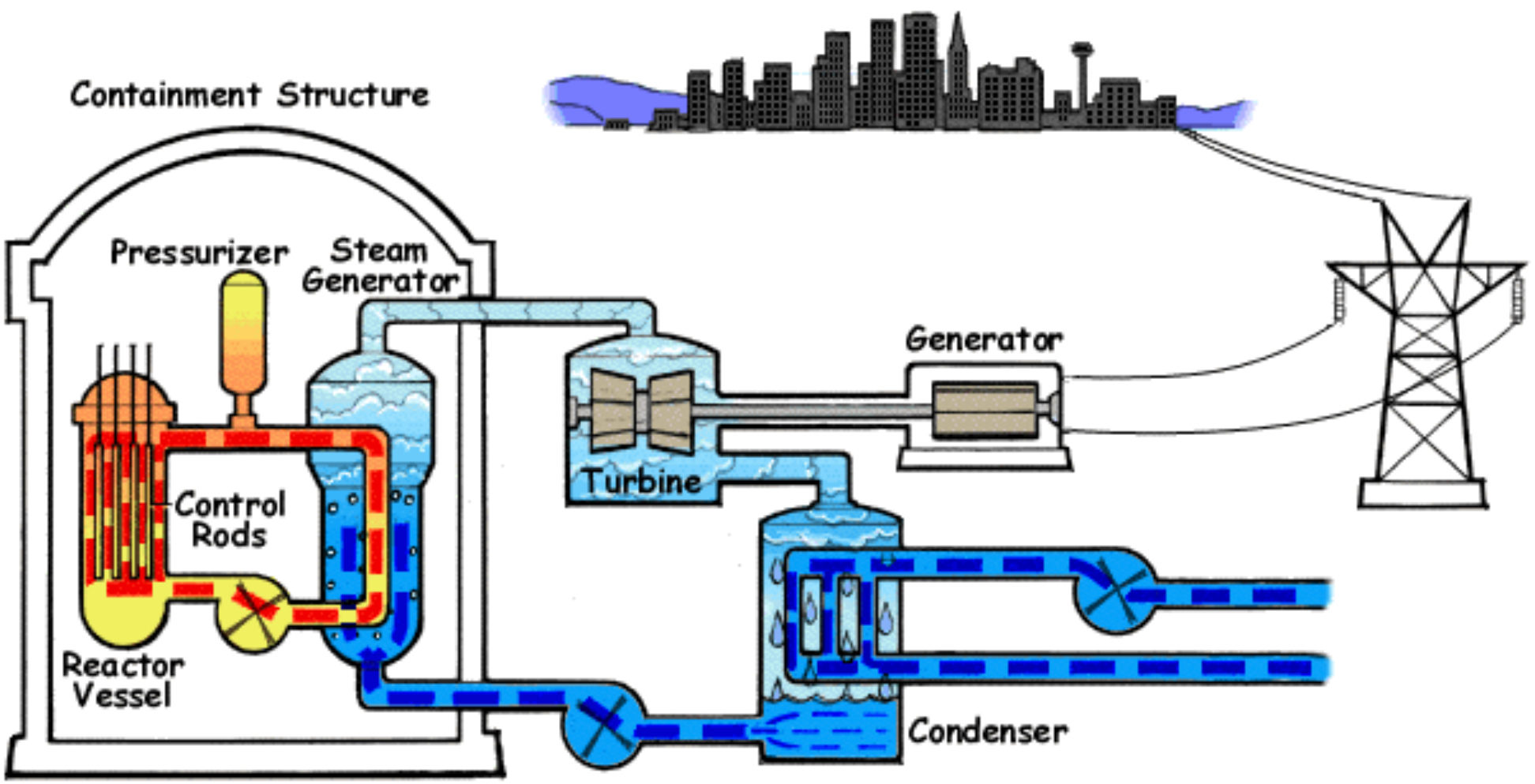
Restricted Area

- An area of controlled access from which the population has been evacuated or relocated.

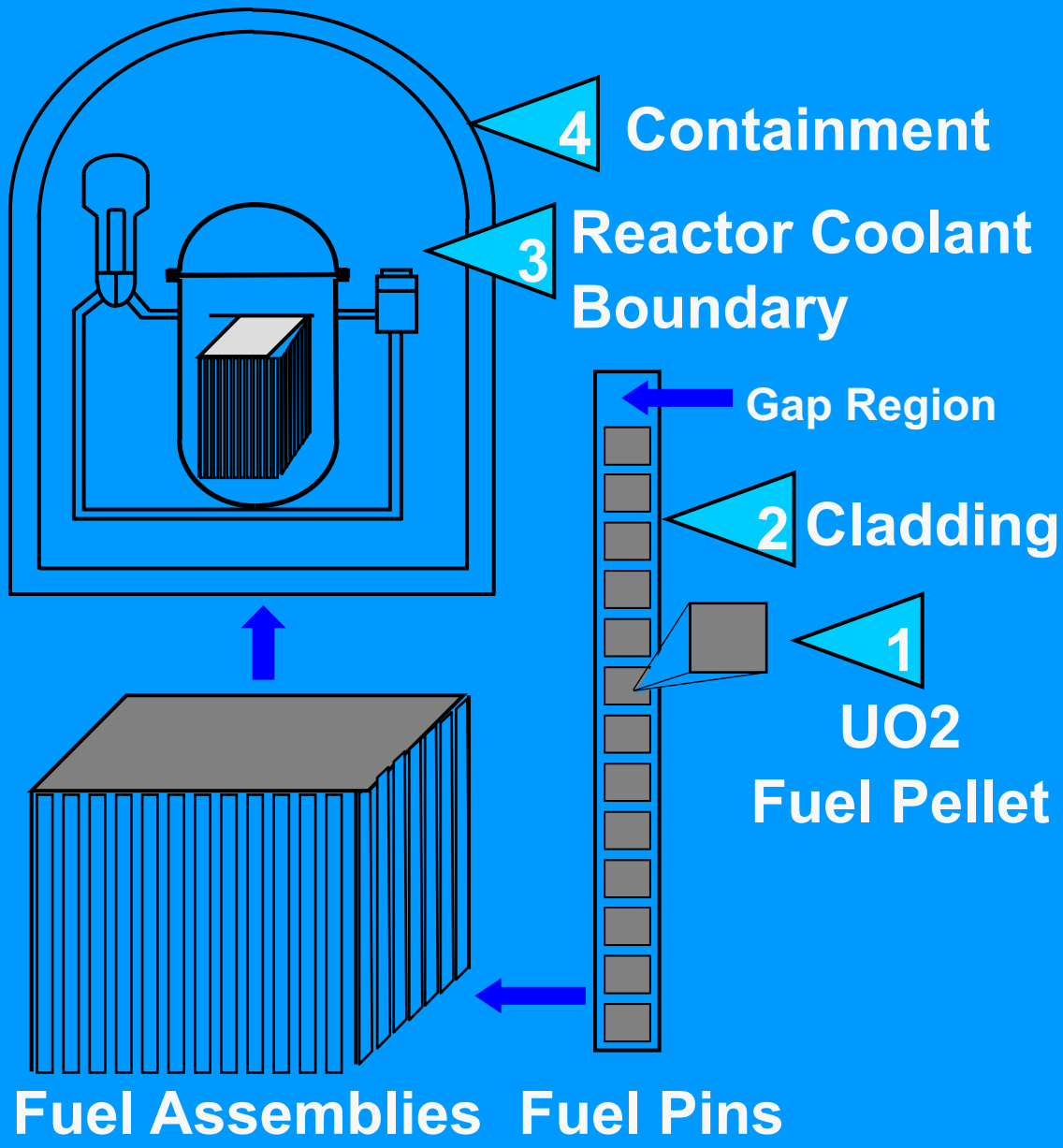
Relocation

- A protective action, taken in the post-emergency phase, through which individuals not evacuated during the emergency phase are asked to vacate a contaminated area to avoid chronic radiation exposure from deposited radioactive material.

Seabrook Station


Containment Structure
Pressurizer
Steam Generator
Generator
Turbine
Control Rods
Reactor Vessel
Condenser

Barriers to Release of Radioactive Material



Rock-Sled Test

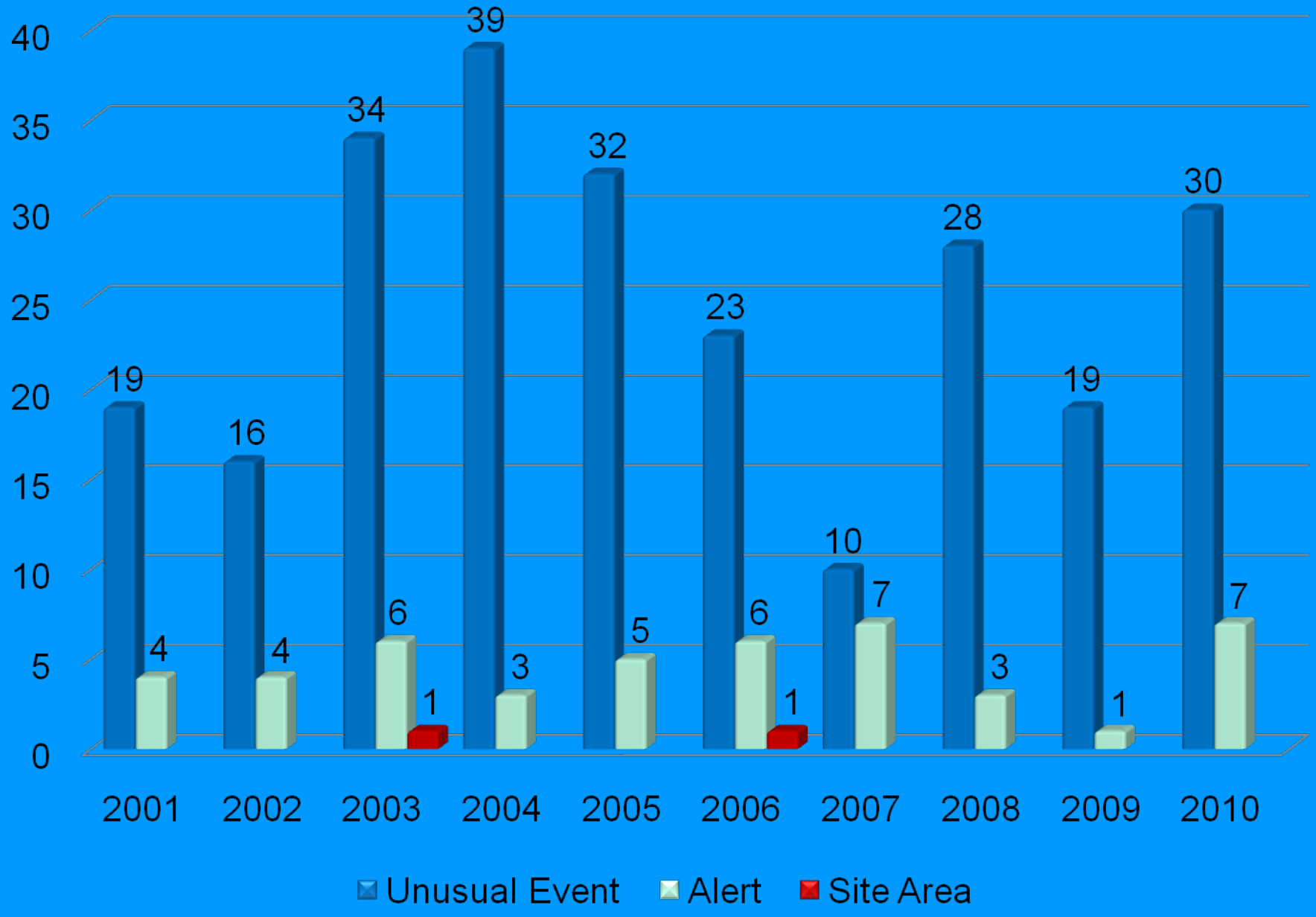
Chernobyl - 1984

Three Mile Island - 1979

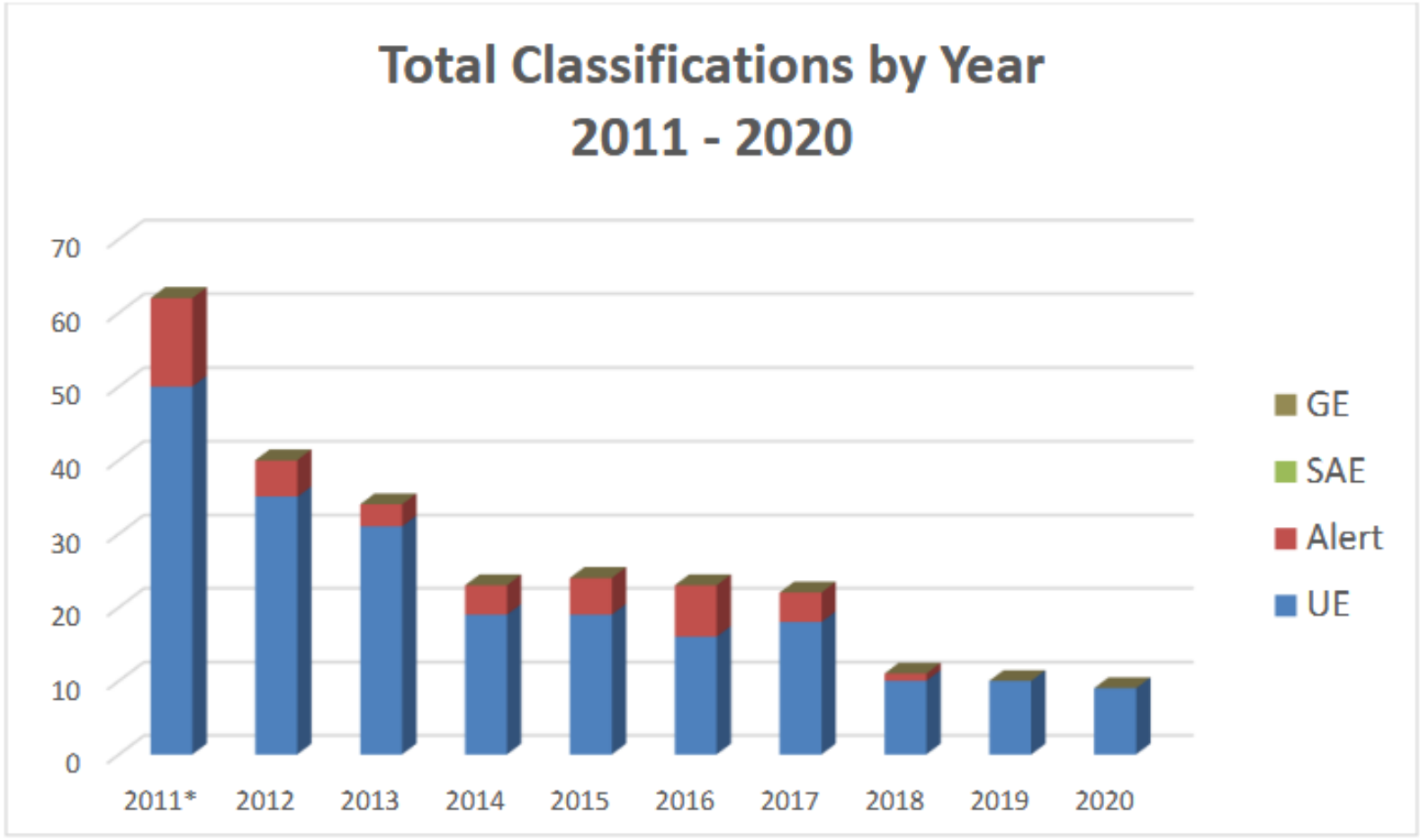
Chernobyl vs. Three Mile Island Accident Results

	Chernobyl - 1984	Three Mile Island (TMI) - 1979
Accident	100% Meltdown Explosion & Fire	80% Meltdown
Onsite Exposure/Injuries	80 - 1600 REM	1.5 REM (4 Workers)
Offsite Exposure/Injuries	0-2 Miles 16 REM 2-9 Miles 44.6 REM 9-19 Miles 5 REM	0-2 Miles 0.083 REM 2-9 Miles 0 REM 9-19 Miles 0 REM

Emergency Classification Levels 2001 to 2010

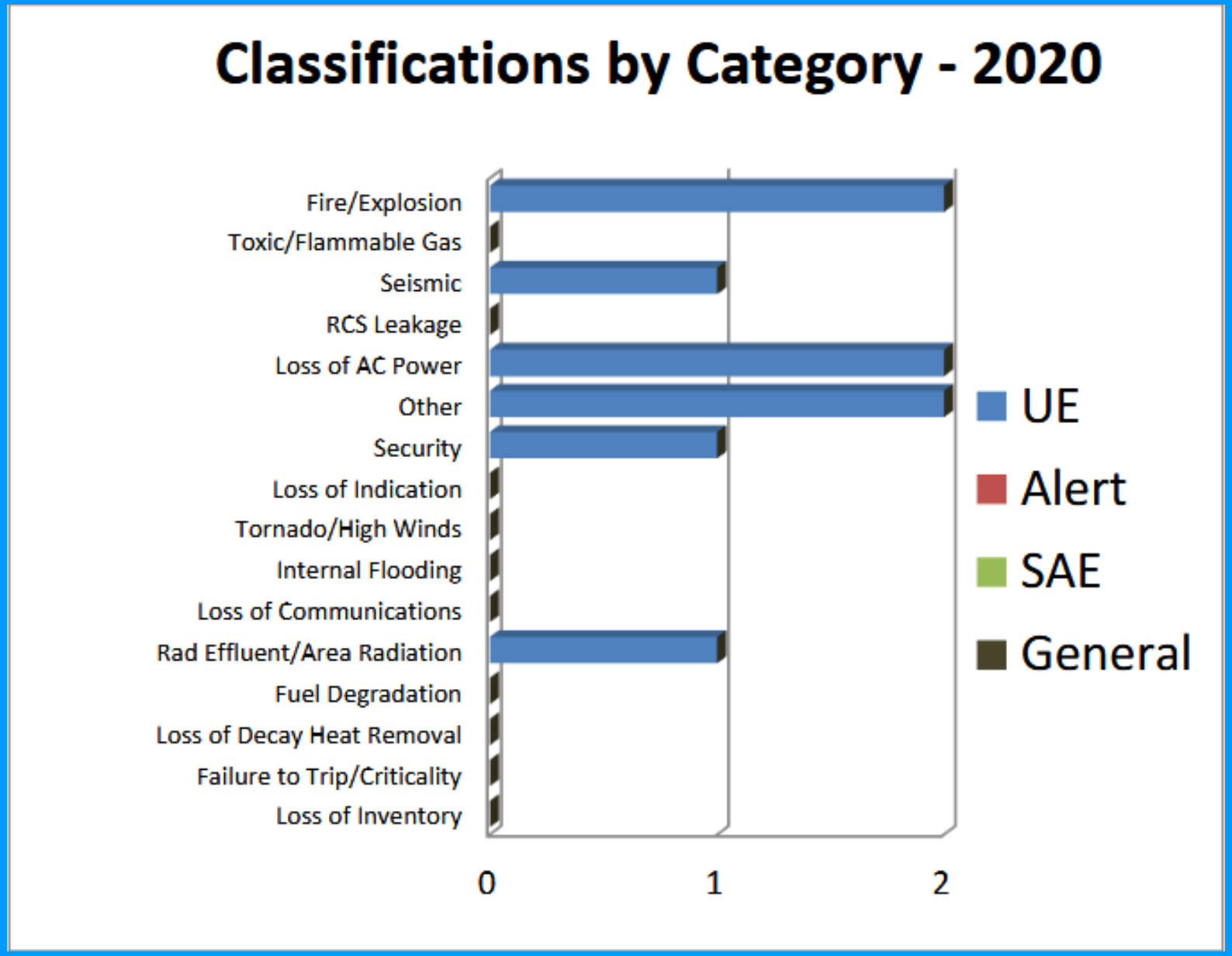


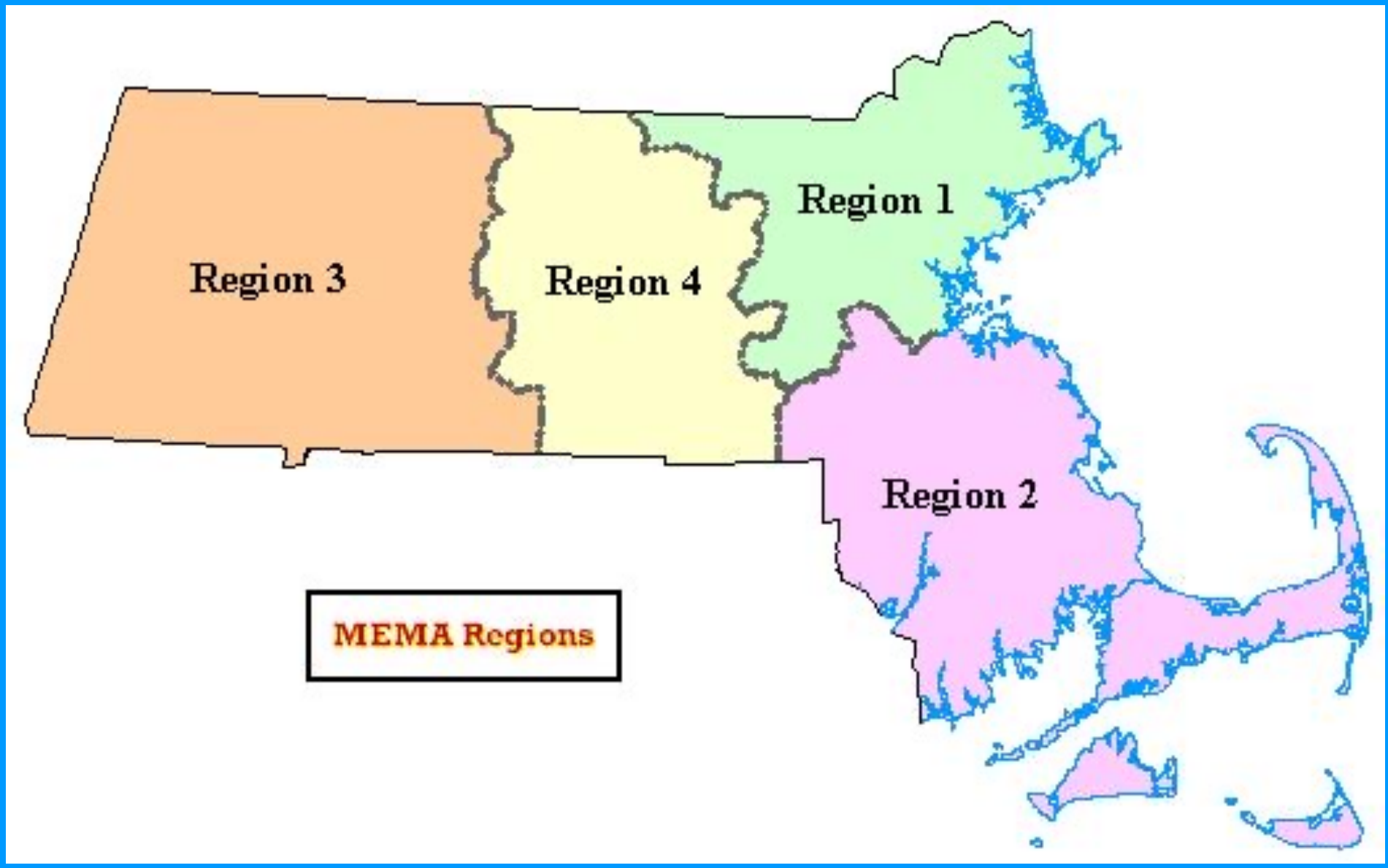
Emergency Classification Levels 2011 to 2020



* Sixteen (16) Unusual Events and one (1) Alert were declared on 8/23/11 due to an east coast seismic event.

2020 Emergency Classifications by Category




Region 3
Region 4
Region 1
Region 2
MEMA Regions

MEMA Region 1 Tewksbury

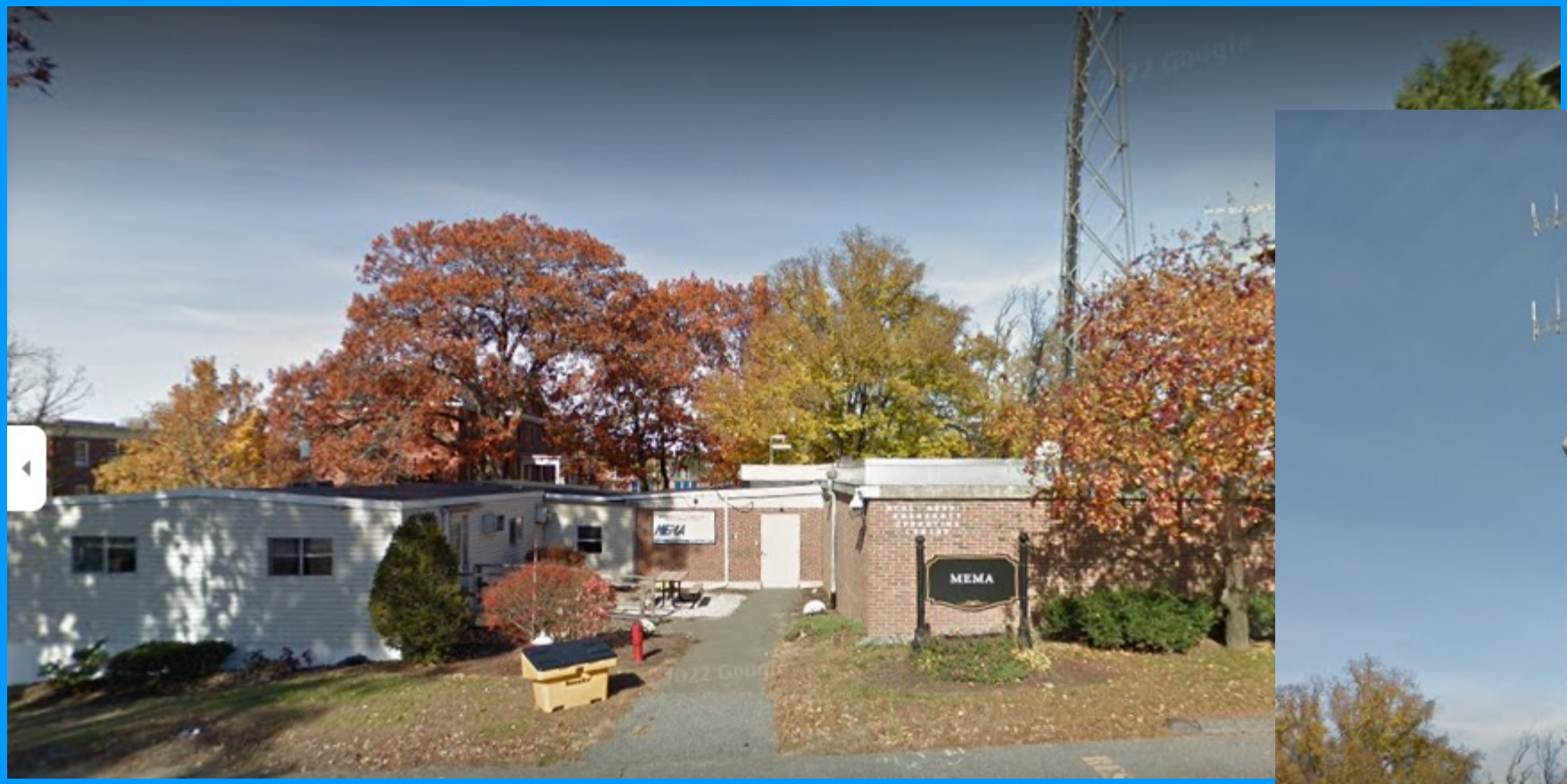


FIGURE 1

AREA I EOC LAYOUT

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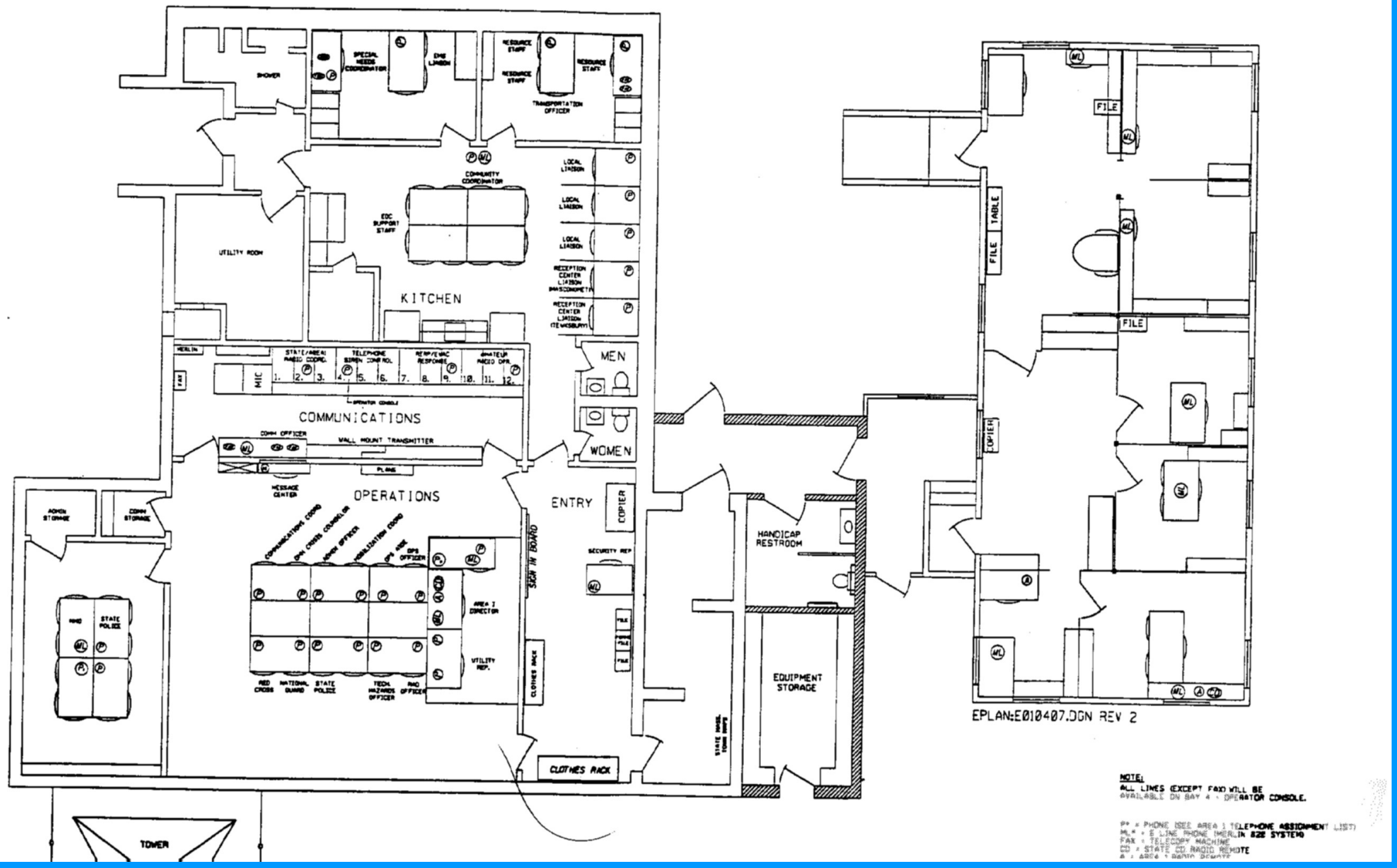


NOTE:
ALL LINES EXCEPT FAXD WILL BE AVAILABLE ON BAY 4 - OPERATOR CONSOLE.

P# = PHONE (SEE AREA I TELEPHONE ASSIGNMENT LIST)
ML# = 8 LINE PHONE (MERLIN 832E SYSTEM)
FAX = TELECOPY MACHINE
CD = STATE CD RADIO REMOTE
A = AREA I RADIO REMOTE

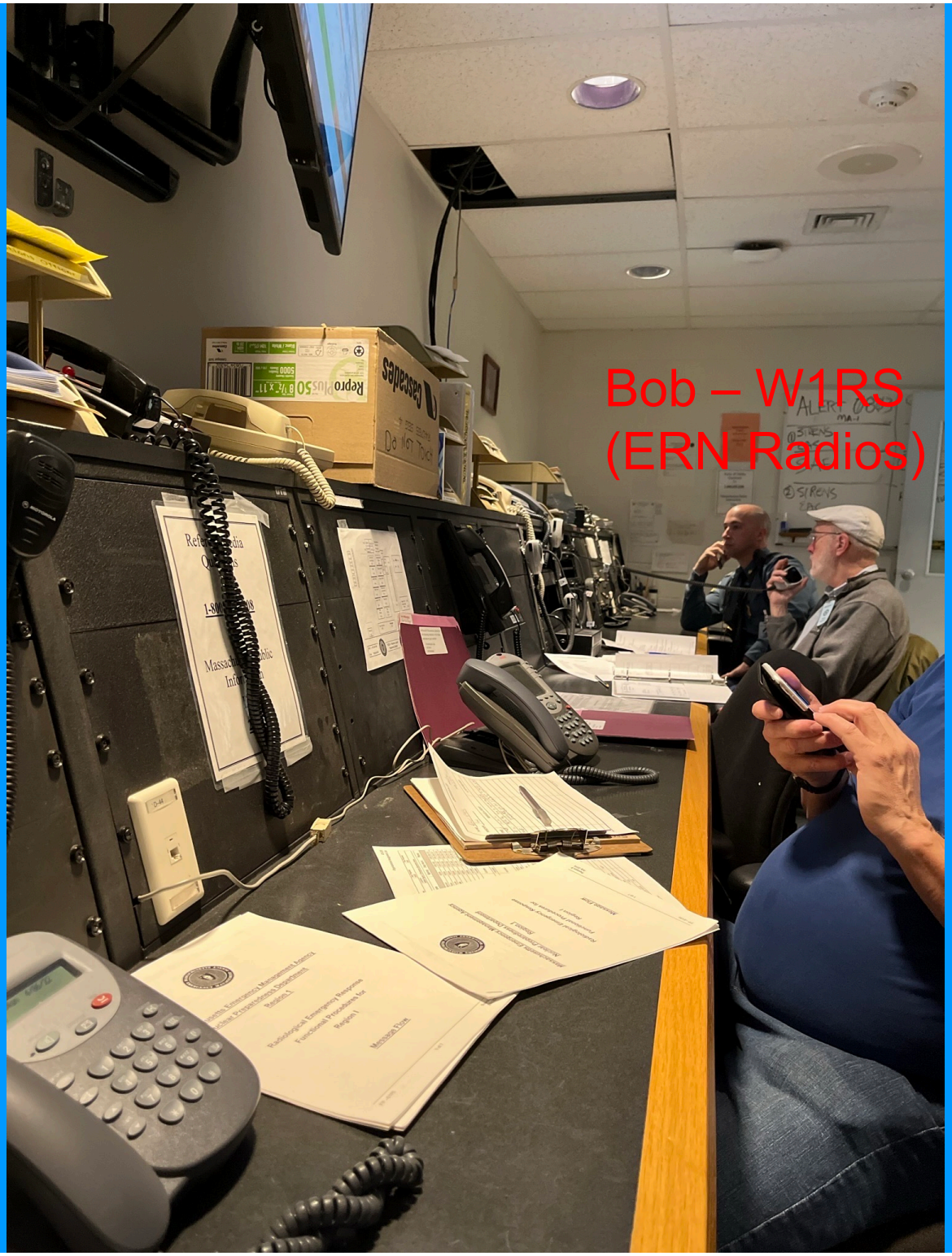

Communications Officer
HARRIS
PRIMARY CHANNELS
SECONDARY CHANNELS
ERM
DELL

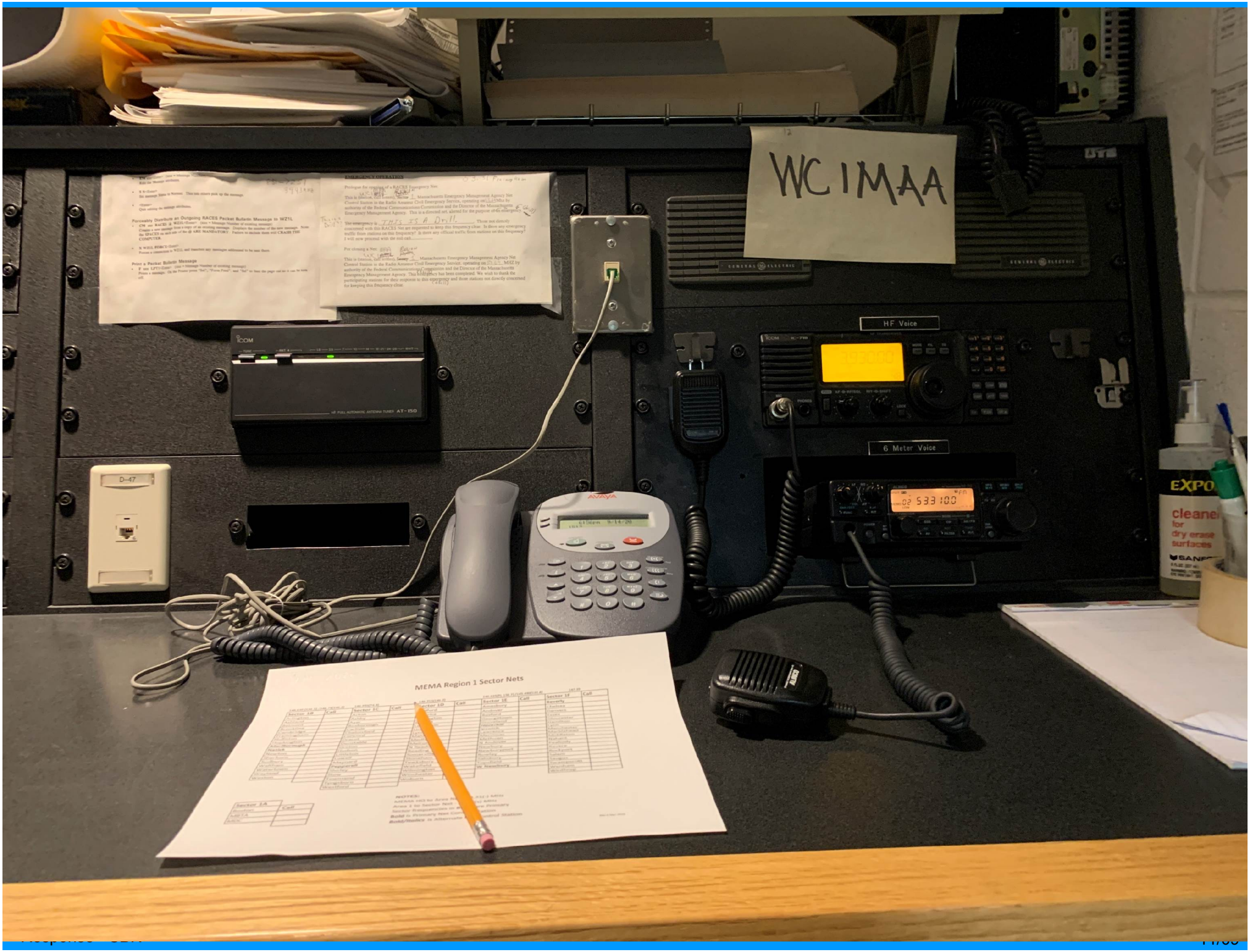

Operations
Officer
Ext.1517
Radiological
Officer
Ext.1525
State Police
18:59
town_cemp
guest_cemp
mema123$$
MEMA REGION I MANAGER


RADIOS
THIS IS A DRILL
MOTOROLA
1 MN-SA
MOTOROLA
3 AP/TP
MOTOROLA
7 NB-NPT
MOTOROLA
9 AM-NM
2021/12/08

At Work!


Richard – N1HY
(Just the FAX)
Charles – AA1VS
(CommO)
Dave – WI1R
(C & C Radio)


Bob – W1RS
(ERN Radios)


WC1MAA
HF Voice
6 Meter Voice
MEMA Region 1 Sector Nets

Questions???