Comparison of Radiation Population Screening Recommendations from ROSS ToolKit on the RadResponder.net web site (Accessed July 30, 2020)

Source	Initial Screening Decision Level	Detailed Screening Decision Level	Notes	Discussion
Contamination Monitoring Guidance for Portable Instruments Used for Radiological Emergency Response to Nuclear Power Plant Accidents, Federal Emergency Management Agency, FEMA-REP-22, October 2002	**Acute**: Spot contamination of 1**.0 µCi (37,000 Bq)** **Stochastic**: 0.04 µCi/cm^2, (1,500 Bq/cm^2 or 90,000 dpm/cm^2) Operationally, this resulted in: 10 mR/h (CDV-718 GM); 10,000 cpm (CDV-700 Pancake); or 100,000 CPM (modern GM Pancake)	**Acute**: Spot contamination of **0.1 µCi** (3,700 Bq) **Stochastic**: 0.004 µCi/cm^2 (150 Bq/cm^2 or 9,000 dpm/cm^2) Operationally, this resulted in: 1 mR/h (CDV-718 GM); 1,000 cpm (CDV-700 Pancake); or 10,000 CPM (modern GM Pancake)	"The recommended decision criterion for individuals **(300 cpm above background)** for all the tested instrument/detector combinations that read out in cpm. When this criterion is used with the more sensitive instrument/detector combinations, additional protection from skin cancer and from contamination spread will be provided. To use the guidance, one should first locate the peak concentration of contamination using the methods described in the previous Section. Then a reading should be taken with the beta-sensitive area of the detector located at approximately one inch from the peak concentration. The decontamination decision criteria in terms of instrument response are the same for spot and widespread contamination."	Although designed for nuclear power, its broad use and implementation make it well suited for the broad application to any large-scale incident involving a beta/gamma radionuclide. It was presumed that the **screening level** referred to the limit on "loose contamination" which is presumed to stay on the person 36 hours (if there is no decontamination). The (lower) **monitoring level** was for the limit on fixed contamination and presumed to stay on the person 2 weeks. Note: both acute (spot) and stochastic (uniform distribution) activity levels result in similar detectability noted as the operational measurements for different types of instruments.

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				FEMA REP 22 presumes that many responders are still using relatively insensitive Civil Defense meters (CDV) and the guidance provided for count rate recommendations would be conservative for modern equipment. **Pro:** FEMA REP is the "Standard" for power plant responses. The FEMA REP-22 background document did a detailed analysis of the acute and stochastic impacts of contamination and optimal instrument technique to find the decision values of concern (see Table on previous page) **Cons:** there is some confusion about the appropriate use of the "fixed" and "fixed + loose" concepts. Also, based on all the instruments they reviewed, they defined a general decision criterion of 300 cpm using the "lowest common denominator" instrument rather than common, modern equipment. For this reason, the ***technical basis*** of spot and widespread contamination should be used, but not the default instrument reading.

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NCRP Commentary No. 19: Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism	Spot contamination on the skin exceeding 1 µCi (37 kBq) have priority for decontamination.	Decontamination procedures should "strive to reduce" surface contamination to below the following limits: • 0.1 µCi (3,700 kBq) on any one spot. • 10,000 dpm/cm^2 (167 Bq/cm^2) surface body contamination	"Initial personal monitoring and decontamination efforts at the scene should primarily focus on preventing acute radiation effects to affected individuals. Cross contamination issues are a secondary concern, especially when the contaminated incident site and number of evacuees is large. Individuals with *spot* contamination greater than 2.2 ·□10^6 dpm (37,000 Bq) should be a priority for decontamination."	Note that NCRP contamination guides are numerically similar or equal to FEMA's limits, however they are stated in different ways: The **screening level** is defined as the level when a person becomes a priority for decontamination (i.e., action is **warranted**). The (lower) **monitoring level** is defined as the level that "decontamination procedures should strive to achieve" The general area contamination 10,000 dpm/cm^2 is very similar to 9,000 dpm/cm^2 found in FEMA REP-22. Initial personal monitoring and decontamination efforts at the scene should primarily focus on preventing acute radiation effects to affected individuals.
Manual for First Responders to a Radiological Emergency, International Atomic Energy Agency (IAEA), October 2006	0.1 mrem/h (1 µSv/h) measured at 10 cm (4 inches) from the body >600,000 dpm/cm^2 (10,000 Bq/cm^2) beta/gamma contamination.		"These criteria indicate the level of skin contamination which could represent a hazard from direct irradiation of the skin, from intake by inadvertent ingestion, or that could indicate that the person has already inhaled or ingested significant amounts of radioactive material."	IAEA and ICRP have the highest relative body surface contamination levels. Even so, it was designed to avoid health impacts: "The criteria were established at levels which are below those at which contaminated people would experience deterministic health effects warranting medical treatment or follow-

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	> 60,000 dpm/cm^2 (1,000 Bq/cm^2) for alpha contamination. The guidance recommends that responders use the dose rate method and the radiological assessors (i.e., ROSS) may use the surface contamination criteria.		"The criteria were established at levels which are below those at which contaminated people would experience deterministic health effects warranting medical treatment or follow-up. The criteria were established at levels which are below those at which contaminated people would experience deterministic health effects warranting medical treatment or follow-up."	up. The following were considered in the developing the criteria: • All the important isotopes, • All members of the public, including children and pregnant women, • Inadvertent ingestion of contamination from the skin, • External dose from skin contamination, and • Skin contamination as an indicator of inhalation dose. Generally conservative assumptions were used in the calculations (e.g. it is assumed that the skin contamination is undiminished for 4 days). For inhalation it was assumed that the skin contamination may have resulted from an airborne cloud and thus is an indicator of inhalation dose. Although dose rate reading is lower than FEMA-REP-22, The widespread contamination levels are almost 10X higher. **Pros**: The contamination values were picked up and used by NCRP Report #165. **Cons**: The document only lists 1 decision criteria, and that criteria are meant to avoid

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				deterministic effects, so it was listed as a screening level.
Manual for First Responders to a Radiological Emergency, International Atomic Energy Agency (IAEA), October 2006	10 mR/hr (100 µSv/h) at 1m	Criteria for screening of groups and locations, to ensure that any sources that could give ambient dose rates above 100 µSv/h are isolated.	This criterion is used to screen areas or groups of people to locate an object, exposure from which could result in severe deterministic health effects if carried or handled. The criteria were established at the level of ambient dose rate at 1 metre from a source that has about 1/10 the activity that has been shown (based on experience) to cause radiation injures if carried	For a severely resource constrained environment, this could help quickly identify contamination levels that may lead to early health impacts. **Pros**: When you really need a high-level screening value (for high throughput), this reference can help. **Cons**: 10 mR/h at 1 meter from a person is fairly significant contamination that could result in acute effects if not managed.
NCRP Report No. 161: **Management of Persons Contaminated with Radionuclides:** **Handbook (table 3.8 and 7.2 for initial screening levels and Table 3.9 for post-decontamination [detailed screening] levels)**	**No Intervention:** Alpha: <10 Bq/cm^2 (<600 dpm/cm^2) Beta/gamma: <100 Bq/cm^2 (<6,000 dpm/cm^2) **Intervention Optional** Alpha: >10 Bq/cm^2 (>600 dpm/cm^2) Beta/gamma: >100 Bq/cm^2 (6,000 dpm/cm^2)	Decontamination objective is to reduce the level to less than two times background. If that is impractical, then use: **Spot (0.2 cm^2):** Beta/gamma <3,700 Bq (0.1µCi) 220,000 dpm Alpha < 370 Bq (0.01 µCi) 22,000 dpm **General Body Surface:**	The skin decontamination objective is to reduce the level to less than two times background by washing the skin. The number of washings should be limited to avoid skin injury; two cycles or as long as each washing reduces the level by 50 % (Section 8). Recommended actions based on intervention levels include: **No Intervention:** Allow release **Intervention Optional** Decontaminate or advise to shower and wash clothing No significant health risk	**NCRP 161's** Chapter 3 is a "Compendium of Radiation Facts and Guidance" in which internally inconsistent recommendations are provided. Unfortunately, this results in the appearance of endorsement and this report can be essentially quoted to provide support for just about any value. Dose rate readings are from Table 7.2 and should be measured at 10cm from skin surface in a low background area.

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	Intervention Advisable Alpha: >100 Bq/cm^2 (>6,000 dpm/cm^2) Beta/gamma: >1,000 Bq/cm^2 (>60,000 dpm/cm^2) 0.2-0.3 µSv/h (20-30 µrem/h) measured at 10cm **Intervention Required:** Alpha: >1000 Bq/cm^2 (>60,000 dpm/cm^2) Beta/gamma: >10,000 Bq/cm^2 (>600,000 dpm/cm^2) 2-3 µSv/h (200-300 µrem/h) measured at 10cm	Beta/gamma <170 Bq/cm^2 (4.5 nCi/cm^2) 10,000 dpm/cm^2 Alpha <17 Bq/cm^2 (0.45 nCi/cm^2) 1,000 dpm/cm^2	Slow release **Intervention Advisable** Prevent inadvertent ingestion and inhalation, limit spread of contamination and decontaminate. **Intervention Required:** Prevent inadvertent ingestion and inhalation, limit spread of contamination and decontaminate.	NCRP 161 provides an initial goal of whole-body decontamination to decrease the level of contamination **to no more than two times background** (Citing the REMM website). However, in the event of large numbers of contaminated people, the goal of two times background becomes impractical and NCRP recommends the IAEA, FEMA REP-22, and NCRP C19 guidance Monitoring values listed appear in Table 3.9 labeled "Decontamination Guidance" which implies a Detailed Screening decision level. **Pros**: The guidance provides 4 different levels, providing the ROSS greater flexibility to justify a decision criterion and implement a graded approach. **Cons:** Screening and monitoring levels are not internally consistent since they were taken from different sources.
NCRP Report No. 165: Responding to a Radiological or Nuclear Terrorism Incident: A Guide	>0.1 mR/h exposure rate (~1 µGy/h air-kerma rate) at 10 cm, >600,000 dpm/cm^2 (10,000		**Recommendation (Nuclear Terrorism Incident):** Decontamination plans should focus on self-decontamination performed as people exit the severe-damage	Essentially the same screening levels as IAEA (2006): "Decontamination (skin and clothing) should always be performed [at the Screening levels]."

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for Decision Makers (2010)	Bq/cm^2) beta and gamma surface contamination, or >60,000 dpm/cm^2 (1,000 Bq/cm^2) for alpha surface contamination		and dangerous-radiation zones or enter shelters. The large number of potentially-contaminated citizens and the resources necessary for full decontamination will likely exceed the available response capabilities.	"Target levels for adequate decontamination should be in the local and regional emergency plans, but may be modified at the time of the response. These levels may be different than "any detectable level of contamination" and depending on the number of people to be monitored may make surveys with this level of detail impractical (CRCPD, 2006; NCRP, 2005)." **Pros**: Consistent with international guidance. The intent was that non-technical staff can use the dose rate screening method, however most US responders also have pancake probes. **Cons**: Dose rate and contamination levels may not be internally consistent. There is a lack of a "spot" contamination value. Instrument readings will depend on geometry and equipment efficiency.
NCRP Report No. 166: Population Monitoring and Radionuclide Decorporation		1,000 cpm using a GM Pancake probe. This document estimated	Although the 1,000 cpm value was listed as "screening," the text indicated it was a non-urgent value in alignment with	The text indicated "This level of exposure will produce a radiation dose of <0.5 mSv (50 mrem) to the skin even if left

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Following a Radiological or Nuclear Incident (2010)		this contamination to be ~670 dpm/cm^2	the monitoring definition above: "Persons with more than this level of contamination on their skin should be decontaminated when it is possible and appropriate to do so, and persons with less than this level of contamination may be sent home."	unwashed for 24 h and poses no physical risk to the contaminated person." **Pros**: Consistent with CRCPD RDD guidance. Simplified approach for US responders with pancake probes. Although pancake probe efficiencies vary, the inclusion of an assumed contamination level allows for instrument/geometry specific adjustment. **Cons**: Detecting 1,000 CPM of spot contamination requires several minutes per person to screen.
CRCPD RDD Handbook (2006)	• Send people with contamination levels greater than 10,000 cpm (0.05 mR/h using a gamma detector) to a designated decontamination area. • People contaminated to levels greater than 100,000 cpm are likely to have internal contamination and should be identified as a priority for follow-up for internal contamination.	• With contamination up to 1,000 cpm, allow individuals to leave; instruct them to go home and shower. • If the event is large and if adequate decontamination resources are not available, the release level can be increased to 10,000 cpm. Instruct people to go home and shower.	Additional Info: If there is a large population to be evacuated in the low radiation zone (< 10 - 100 mR/hr), self-decontamination at home to the extent possible may be advised.	This guidance takes a different approach of suggested **release** levels assuming using a pancake GM probe at 1 inch from the radiation Source instead of monitoring levels. The screening decision level is listed as "decontamination priorities" and the detailed screening decision level was the values for "send home." **Pros**: this straight forward guidance is easy to implement and well accepted by the US radiation control community.

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				Cons: the lack of actual spot or widespread target contamination level makes it difficult to use alternate instruments.
CDC Population Monitoring in Radiation Emergencies, 2014			CDC does not recommend setting a pre-determined, fixed screening criterion to be applied to all people for all incidents under all circumstances. State planners and decision makers, along with state radiation control authorities, should consider a range of possible circumstances, keeping the following in mind: • Population monitoring objectives described in this guide • Specific radiation detection equipment instrumentation responders will be using (dose rate meters, beta/gamma portal monitors, and specific type of surface contamination monitors) • Staffing resources and the size of population expected to be processed • Facilities and resources available for on-the-scene contamination screening and decontamination • Availability of other resources	The CDC Population monitoring Guide should be a primary ROSS resource for how monitoring and decontamination is conducted. Appendix D lists national and internal decision criteria with a discussion on each similar to the ROSS toolkit. **Pros**: Excellent guidance on how to perform surveys and set up a monitoring program. **Cons**: does not supply specific decision levels.

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EPA (2017). U.S. Environmental Protection Agency. PAG Manual, Protective Action Guides and Planning Guidance for Radiological Incidents.	2x existing background in an area exceeding 0.1 mR/h or 1 µSv/h gamma exposure rate **(Area Not Qualifying as Low Background)** The term "2x existing background" does not allow the determination of a specific spot or widespread body contamination decision level because it is dependent on local background levels, the instrument being used and the monitoring technique.	2x existing background in an area <0.1 mR/h or 1 µSv/h gamma exposure rate **(low Background Area)** The term "2x existing background" does not allow the determination of a specific spot or widespread body contamination decision level because it is dependent on local background levels, the instrument being used and the monitoring technique.	For a known/identified spot of contamination, the threshold of 2 times background for a series of successive more aggressive actions: **Before Decontamination**: o If <2x existing background — *Recommended action:* Unconditional release. o If >2x existing background — *Recommended action:* Perform gross decontamination (carefully remove outer layer of clothing) and/or simple decontamination (examples include washing hands and face, wiping of exposed skin, washing feet or soles of shoes). **After Simple Decontamination Effort**: o If <2x existing background — *Recommended action:* Unconditional release. o If >2x existing background — *Recommended action:* Full decontamination. **After Full Decontamination Effort** (Changing clothes and/or showering are examples of a full decontamination effort. Washing or gentle scrubbing with soap or other mild detergent followed by	A contamination level of "twice background" is technically not possible to find using any moving monitoring technique. The EPA PAG document does not provide a monitoring method to help identify what the intended actual contamination level would be with an instrument reading of 2X background. The recommended "2x existing background" level for screening for surface contamination at monitoring stations is merely a simplified basis for responders to set their own instrument trigger levels based on practical circumstances at the time and location of each screening center. Local and state officials may choose to establish a screening level expressed in measurement units (e.g., counts per minute (cpm), µR/h) that are compatible with radiation detection instruments being used and appropriate for local conditions, taking into account the number of people in need of screening and available resources.

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			flushing is another example of a full decontamination effort.): o If <2x existing background — *Recommended action:* Unconditional release. o If >2x existing background — *Recommended action:* Continue to decontaminate people. **After Additional Full Decontamination Effort**: o If <2x existing background — *Recommended action:* Unconditional full release. o If >2x existing background — *Recommended action:* Send people for further evaluation.	**Pros**: The EPA PAG is considered a primary reference document for the response community, however this "decision level" should only be used for small events when resources are unconstrained. **Cons**: Without supplying a technical basis of actual spot or widespread contamination levels, the concept of "twice background" as decision level can result in resources being used for negligible levels of contamination. Since it is technically **not** possible to detect a spot activity of "twice background" with scanning contamination detection techniques, it is likely that the screening will "miss" some "2x background" contamination that could undermine public confidence in the screening process if found later.