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**STATEMENTS OF CONSIDERATION FOR
FEMA-REP-22:
CONTAMINATION MONITORING GUIDANCE FOR
PORTABLE INSTRUMENTS
USED FOR RADIOLOGICAL EMERGENCY RESPONSE
TO NUCLEAR POWER PLANT ACCIDENTS**

FEDERAL EMERGENCY MANAGEMENT AGENCY

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INTRODUCTION

In November 1998, the Federal Emergency Management Agency issued a contract to KL. Travis and Associates of Springfield, Virginia to develop numerical guidance for decontamination decisions when using portable radiation instruments such that the guidance would be compatible with emergency response guidance already issued for using portal monitors to evaluate contamination on evacuees. This involved the completion of technical experiments to evaluate the response of different combinations of portable instruments and detectors that are commonly used for emergency monitoring of potentially contaminated individuals, vehicles, equipment and other possessions. The results of these experiments and associated evaluations were incorporated into a document entitled "*Background Information On FEMA-REP-22: Contamination Monitoring Guidance For Portable Instruments Used For Radiological Emergency Response To Nuclear Power Plant Accidents.*" The information in the background document was used as a basis for a FEMA guidance document entitled "*Contamination Monitoring Guidance For Portable Instruments Used For Radiological Emergency Response To Nuclear Power Plant Accidents (FEMA-REP-22).*" The issues discussed herein relate to both the guidance and background documents.

The guidance development process included three meetings of the FEMA Federal Radiological Preparedness Coordinating Committee (FRPCC), Subcommittee on Instrumentation. Substantive verbal and written issues were identified at those meetings and comments were received from members of the State Conference of Radiation Control Program Directors (CRCPD) Committee E-6. Additional comments were received later as a result of the announcement of draft document availability in the December 13, 2001 issue of the Federal Register. The comments are compiled as issues, and the rationales for their resolution are provided. Editorial comments and those requiring only clarification are not included.

RESOLUTION OF ISSUES

ISSUE 1 – Contrary to current practice, the proposed guidance identifies contamination control criteria for individuals and equipment below which intervention is not warranted on the basis of risk of health effects. As the documents make clear, the potential adverse health effects from the released contamination are likely to be negligible; however, the practice of releasing contaminated people and equipment makes it impossible to effectively control contamination in the field. The guidance should be numerically reduced to permit better contamination control as provided by the Portal Monitor Standard.

FEMA RESPONSE – To assure that the guidance would conform to limitations in the Portal Monitor Standard, the decontamination decision criteria were designed to provide reasonable assurance that the controlling health effect (acute exudative radiodermatitis) would not occur on spots of skin greater than 0.2 cm² from undetected contamination. However, widespread contamination, (not spot contamination) is the major concern for controlling the spread of contamination. Since widespread contamination is not associated with the controlling health effect, the decontamination decision criteria can be significantly reduced for the more sensitive portable instruments without affecting the monitoring speed. FEMA agreed to set the guidance on the need for decontamination at 300 cpm above background for all instruments when monitoring individuals for loose or fixed contamination. This value is in agreement with current FEMA REP-14 guidance for loose contamination on individuals when measured with a CD V-700 type of instrument. The same guidance would apply when monitoring for loose contamination on vehicles, equipment, and other possessions.

DISPOSITION - Comment accepted.

ISSUE 2 – Separate decision criteria for loose and fixed contamination on individuals are not justified. The guidance document should include only the most restrictive decision criteria for decontamination, not the less restrictive criteria for loose contamination. The criteria for loose contamination may belong only in the background document. This is because it will be nearly impossible to determine before-hand whether the contamination is fixed or loose. Providing a double set of criteria will be too confusing for the monitors who do not routinely use survey instruments.

FEMA RESPONSE – Separate criteria for loose contamination may be useful in situations where available portable instruments are not sufficiently sensitive to detect small spots of contamination at levels specified for fixed contamination within a reasonable period of time (e.g., see data for the CD V-700 in Table 1 of the guidance document). The decision criteria and the detection parameters for spot contamination provided in the guidance document have been limited to those for fixed contamination as suggested. However, discussion has been included in the guidance document referring the reader to the background document for detection parameters associated with loose-plus-fixed contamination in circumstances where greater monitoring speed is needed to provide optimum protection of the evacuees.

DISPOSITION – Comment accepted with compromise.

ISSUE 3 – The background document currently references the previously issued “*Background Information On FEMA-REP-21: Contamination Monitoring Standard for a Portal Monitor Used for Radiological Emergency Response (March 1995)*” for basic technical information and derivations regarding health effects, threshold levels of contamination, and maximum acceptable spot size of deterministic health effects. Referring back and forth between documents compromises the ability to understand the rationale for the guidance. Although some redundancy would result, the needed information from the portal monitor standard and its background document should be incorporated into the background document for portable instruments.

FEMA RESPONSE – FEMA agrees and the background document has been revised accordingly.

DISPOSITION – Comment accepted.

ISSUE 4 – Guidance is provided to health physicists or medical personnel on how to evaluate individuals who cannot be decontaminated to levels lower than the decision criteria. While this type of information may be useful, it would be impractical to implement at reception centers and should be deleted from these documents.

FEMA RESPONSE – FEMA agrees. This topic goes beyond the scope of this guidance and the information has been deleted.

DISPOSITION – Comment accepted.

ISSUE 5 – The guidance allows the use of instruments that read only in mR/h. The proper unit for measuring surface contamination is counts per minute (cpm). Instruments that read only in mR/h should not be used for decontamination decisions.

FEMA RESPONSE – The guidance was revised to discourage the use of such instruments, but recognizes that these instruments can be used effectively if they have a beta window and have been checked to determine their response when exposed to contamination at the level of the decontamination decision criteria.

DISPOSITION – Comment not accepted.

ISSUE 6 – Except for situations where field teams are monitoring themselves for contamination, there should never be 0.1 mR/h background level. This should be made clear in the documents.

FEMA RESPONSE – For a real contaminating event where evacuees are showing up at the monitoring center with shoes, clothing, and other possessions contaminated to levels possibly much higher than the decontamination decision criteria, it would be possible for background levels resulting from contaminated surfaces and stored contaminated items of clothing and other belongings to build background levels of gamma radiation to 0.1 mR/h or more. Unless offsite response plans provide for moving monitoring centers if gamma exposure rates exceed some level that is significantly lower than 0.1 mR/h, the cautionary notes about instrument response may be useful. No change to the guidance is planned.

DISPOSITION – Comment not accepted.

ISSUE 7 – Proposed guidance on fixed contamination for vehicles and equipment is based on limiting the dose to individual members of the public to 100 mR/year and 2 mR in any one hour. These limits are for the general public from licensed operations. Since the exposure would not be from a licensed operation, lower limits like 15 or 25 mrem/year would be more appropriate, since they reflect limits for uncontrolled release of property. All of the detector types tested would appear capable of detecting levels set based on these criteria, so the main effect of this change would be that fewer contaminated equipment items or vehicles would be released.

FEMA RESPONSE – It is common practice to recommend limitations on first year dose to the general public resulting from accidents to be higher than would be allowed from occupational exposure. For example, the PAG for relocation is based on 2000 mrem in the first year.

Analysis of additional exposure pathways has shown that the projected beta dose to the skin from contaminated seat covers justifies lowering the decision criteria. This numerically lower decision criteria, accompanied by an increase in the assumed exposure time from 4 hours per day to 40 hours per week, lowers the projected dose from gamma radiation from 100 mrem to less than 40 mrem from the first year's exposure. Mechanical removal of the contamination from using the seats over a period of one year will reduce the actual dose even further.

DISPOSITION – Comment not accepted.

ISSUE 8 – The proposed criteria for fixed contamination of 95,000 cpm on vehicles and equipment intuitively seems high.

FEMA RESPONSE – As discussed in response to the previous issue, further analyses of exposure pathways has resulted in lower decision criteria for vehicles, equipment, and other possessions. As a result, the decision criteria for modern instruments with pancake detectors has been reduced from 95,000 cpm to 36,000 cpm. This may also intuitively seem high. However, the comparative reading for the same level of contamination when using the less sensitive CD V-700 is 1000 cpm. This compares to present guidance in REP-14 of 5000 to 10,000 cpm. Although the previously proposed guidance was too high only for fixed contamination on auto seats and other similar surfaces that might result in exposure at close range for extended periods, all of the guidance for fixed contamination on vehicles, equipment and other possessions has been reduced. The guidance has also been revised to permit emergency response plans to include numerically lower decision criteria where justified and suggests that 1000 cpm for all tested instrument/detector combinations might be approved.

DISPOSITION – Comment accepted.

ISSUE 9 – The justification for lowering the criteria includes a condition that “20 percent of the portion of the EPZ assigned to each reception center can be monitored within 12 hours using these criteria.” To avoid misinterpretation during exercise evaluations when only a portion of the reception centers are demonstrating, this condition should refer to the monitoring of 20 percent of the plume EPZ population, including transient population, within 12 hours.

FEMA RESPONSE – FEMA agrees with the comment and the guidance has been revised accordingly.

DISPOSITION – Comment Accepted.

ISSUE 10 – Experience supports the use of portal monitors for scanning large numbers of people with maximum accuracy and minimum scanning times. The conclusions should include a statement which emphasizes the benefits of portal monitors over portable instruments and which urges programs to use them.

FEMA RESPONSE – The guidance document includes information on the relative benefits of using portal monitors compared to portable instruments. It also includes the relative benefits of using modern portable instruments compared to the use of the standard CD V-700. These benefits will also be included as a conclusion for the guidance document. However, due to the high costs of purchasing a new set of instruments and other associated costs, FEMA will avoid urging the States to convert.

DISPOSITION – Comment partially accepted.

ISSUE 11 – A decision criteria of 300 cpm should not be used for the more sensitive instruments. A main objective of the experiments that were conducted to support this guidance was to evaluate the response of commonly used portable instruments when the contamination level is equal to the decontamination decision criteria developed for the portal monitor. From this information, decontamination decision criteria could be derived for portable instruments that would correspond to the criteria for portal monitors. Then the decision on the need for decontamination would be the same when using a portal monitor or a portable instrument. This objective has not been achieved. The derived guidance for portable instruments does not consider the sensitivity of the various instrument/detector combinations. As presented, persons monitored with the least sensitive instruments (e.g., CD V-700 with a standard detector) would be sent for decontamination for removal of contamination at the same level of spot contamination derived as the threshold for portal monitors. However, persons monitored using a modern portable instrument with a pancake detector would be sent for decontamination at contamination levels of about three percent of the decision criteria for spot contamination when using a portal monitor or a standard CD V-700. This could cause confusion at the monitoring center if a portal monitor indicates that decontamination is not necessary, but a check with a modern portable instrument indicates that decontamination is clearly needed. Similar problems may ensue if adjacent political jurisdictions use portable instruments with different sensitivities.

FEMA RESPONSE – This anomaly is the result of differences in detection capabilities of portal monitors and portable instruments. Because of their multiple detector capability, their ability to sum the counts from multiple detectors, and their ability to integrate the counts over time, portal monitors are more efficient than portable instruments at detecting widespread contamination. Portable instruments, on the other hand, can move in closer to the contaminated surface and are better than portal monitors at detecting spot contamination. A compromise was reached to abandon the objective of keeping the risk of deterministic health effects from undetected spot contamination constant no matter what type of instrument is used. This was done in order to take advantage of the opportunity to control the spread of contamination when using more modern portable instruments if they are available. When using a CD V-700, this compromise will

provide the same level of protection from deterministic health effects as would be achieved by using a portal monitor. If portable instruments that are more modern than the CD V-700 are used or if CD V-700s that have been modified to use pancake detectors are used, the potential for contamination spread will be reduced and greater protection from skin cancer will be achieved. These benefits were judged to more than offset the difficulties in explaining the different levels of protection from contamination spread, depending on the type of instrument used. This compromise will not affect the speed at which individuals can be monitored using portable instruments.

DISPOSITION – Comment not accepted.

ISSUE 12 – Why do we need to measure contamination? FEMA is changing a policy that has been used for years without any problem. These changes will result in costs for the State and counties.

FEMA RESPONSE – There has always been a need to measure contamination. Even checking to see if it exceeded twice background as recommended in the old EPA guidance was a measurement. The measurement is made to see if decontamination or additional decontamination is needed. This avoids tying up the decontamination facilities unnecessarily. The guidance has been revised to allow sending individuals to decontamination without measurements if contamination is detected or, if practical, to send groups suspected of being contaminated directly to the decontamination facility without prior monitoring. However, individuals who have been through decontamination will have to be monitored afterward to determine whether they need further decontamination. If contamination is found at this stage, it should be measured to form a basis for further action.

DISPOSITION – Comment not accepted.

ISSUE 13 – The guidance does not balance risk, available technology, and cost. An offsite response organization that performs rapid screening of potentially contaminated persons using CD V-700 instruments with side window probes is not using the best available technology, but may still adequately protect the public. Guidance that implies the minimum acceptable time for such a screening when using a standard CD V-700 is 19 minutes would, in effect, force such organizations to purchase all new equipment, retrain all volunteers, and rewrite all plans that are currently approved. Such massive changes may not be in the best interest of the public we are trying to protect. Also, the new guidance introduces instrument and personnel shortages with no supporting funding.

The calculated time needed to completely monitor an individual using portable instruments is extremely long for an emergency situation. The derived scanning time and scanning parameters for using a CD V-700 are prohibitive. With the new guidance, even monitoring just the critical areas takes too much time. The optimum solution for protection of public health would be to convert to the use of portal monitors for identifying contaminated individuals and to use modern instruments with pancake detectors for follow-up monitoring after decontamination. However, planners must find ways to balance risk, available technology, and cost to determine what monitoring thresholds and equipment are appropriate for their communities. Relaxation of conservatisms built into the guidance for detecting spot contamination could be used to reduce the monitoring time. For example, relaxation of conservatisms incorporated into the assumptions

on acceptable spot size, and recognizing that radioactive and physical decay of contamination will occur over the assumed 14 day exposure time would justify increasing the allowed activity of spot contamination on skin. This would decrease the time needed for scanning an individual. In addition, the time needed to monitor an individual could be significantly reduced with very little increase in risk of health effects if trained operators monitoring for widespread contamination only in the areas most likely to be contaminated such as the head, shoulders, hands, and shoe soles. Another factor to consider is that the potential health consequences of not detecting contamination are usually mitigated by giving directions to monitored individuals to change clothes and shower at the earliest opportunity.

FEMA RESPONSE – The principle basis for monitoring guidance is protection of public health and safety. Cost of protection should be considered, but should not be the overriding factor. The guidance provided by the Portal Monitor Standard and provided in these documents for a variety of types of portable instruments is based on empirical studies related to acceptable levels of risk of health effects under emergency conditions. The guidance recognizes that, under some circumstances, it is appropriate to adjust emergency response plans and procedures for monitoring evacuees to assure the best protection of the public. This may require adjustments that take into account equipment shortcomings and time constraints for completing the monitoring. In order to speed up the monitoring process under these circumstances, it would be acceptable to perform an initial scan of areas on the body of evacuees where contamination would most likely be found and then followed by decontamination, a change of clothing, and complete re-monitoring for those initially found to be contaminated. It may also be appropriate in some cases for evacuees who have not been decontaminated and have not washed and changed clothes to be monitored using the detection and measurement parameters associated with loose-plus-fixed contamination as provided in Tables 4 and 6 of the background document. The guidance document has been revised to accommodate these changes. Proposed changes to increase the spot size and the activity to be detected would be contrary to standards already established by the Portal Monitor Standard. Also, it is appropriate to keep some conservatism in the assumptions to counter factors that could increase the risk of not finding important levels of contamination.

DISPOSITION – Comment accepted with some modification.

ISSUE 14 – The importance of proper calibration needs to be emphasized. The evaluated instruments were calibrated using gamma radiation from a sealed Cs/Ba-137 as is common practice for calibrating portable instruments used for response to accidents at nuclear power facilities. This information needs to be emphasized as a conclusion with a reminder for programs to confirm the proper calibration source for their instruments. Those programs which are using a different source should be reminded to change their procedures so that a sealed Cs/Ba-137 source is identified.

FEMA RESPONSE – Calibration is important. The guidance has been clarified to indicate that the CD V-700 and CD V-718 instruments used in the experiments were calibrated using sealed Cs/Ba-137 gamma sources and that other more modern instruments were calibrated by the manufacturer to respond in the range of 3000 to 4000 cpm per mR/h. If instruments outside these categories are used, they should be tested to determine their response to a 0.1 μ Ci Cs/Ba-137 beta source at one inch from the detector.

DISPOSITION – Comment partially accepted.

ISSUE 15 – After an instrument has been calibrated and its response to a check source has been established, routine calibration is not necessary for its use in monitoring for contamination.

FEMA RESPONSE – Instruments used for evaluating contamination have an important role in radiation protection following a nuclear incident. Although the frequent use of a check source to verify proper response to a single exposure rate is a good quality control procedure, annual calibration of CD V-700 type instruments is required. Modern instruments should be calibrated in accordance with manufacturers' recommendations.

DISPOSITION – Comment not accepted.

ISSUE 16 – The decision criteria should not be expressed as “above background.” The process of subtracting background from the readings will slow the monitoring.

FEMA RESPONSE - Expressing the decision criteria as “above background” avoids having a variable criteria as guidance. The way to handle background is to take an initial background reading and just add this to the decision criteria to get a revised decision criteria suitable for the situation. Also, the guidance permits adjustments to the criteria where justified. So there should be no problem of getting FEMA to approve monitoring procedures if background is included in the decision criteria so long as this does not interfere with monitoring 20 percent of the evacuees in the plume EPZ as discussed in Issue 9 above.

DISPOSITION – Comment not accepted.

ISSUE 17 – Using the uniform decision criteria of 300 cpm and modern instruments, persons may be decontaminated to levels lower than the general contamination levels in the area to which they will return. This will be a waste of valuable time.

FEMA RESPONSE - Because of its high sensitivity to widespread contamination, this could also be true when using a portal monitor. Knowledge of the contamination levels in the area to where a person may return is not likely to be known at the monitoring center and trying to coordinate this information could be time consuming. Having an individual with residual contamination return to a non contaminated area could be of more concern.

DISPOSITION – Comment not accepted.

ISSUE 18 – How can we say the portal monitor guidance and the portable instrument guidance are coordinated when the portal monitor is okay if it can detect 1 μCi and a portable instrument must be able to detect 0.1 μCi ? By the logic used, the portal monitor standard should be reduced to 300 cpm on an instrument with a pancake detector.

FEMA RESPONSE – This is a common misconception. Since a portal monitor is most efficient for detecting widespread contamination, and a portable instrument is most efficient for detecting spot contamination, complete compatibility between the two types of instruments is not possible. But either instrument can be used to provide reasonable assurance of avoiding unacceptable health effects from the radiation associated with contamination. And, both a portal

monitor and a modern portable instrument with a pancake detector, can detect low levels of widespread contamination. The portal monitor is calibrated to be able to detect 1 μCi of contamination uniformly distributed over an adult. A modern portable instrument with a pancake detector would read this concentration at about 250 cpm over background. So, for detection of widespread contamination, the portal monitor and the most sensitive portable instruments are about equal. However, for a CD V-700 with a side window detector, the comparable value to be detected would be about 7 cpm over background; a level considered to be undetectable.

DISPOSITION – Comment not accepted.

ISSUE – 19 Does the guidance apply to jurisdictions that do not fall under the REP Program (e.g., the REP-5 guidance)?

FEMA RESPONSE - The guidance already addressed this issue as follows: “The guidance is limited in scope and does not apply to ... accidental releases to the environment that have an isotopic mix that would not be expected from a nuclear power plant accident....”

DISPOSITION – Already covered by the guidance.

ISSUE 20: FEMA’s proposed limits for spot contamination on individuals are approximately a factor of two more restrictive than those proposed as revised regulations by NRC in the Federal Register, Volume 66 #134 July 12, 2001 (pp. 36502 – 36509). The FEMA draft guidance is based on the ability to detect 0.1 μCi of contamination on a small spot of skin. The level of 0.1 μCi was calculated as the contamination level at which a dose of 1200 rem to the skin could occur (possibly resulting in “acute exudative radiodermatitis”) if the area of contaminated skin were 0.2 cm^2 . No reason is given as to why 0.2 cm^2 was judged to be the best size to use. Based on guidance in EPA 400-R-92-001 (which is based on a WHO reference from 1984) the FEMA guidance states that acute exudative radiodermatitis results from skin dose in the range of 1200 to 2000 rad. The lower end of the range (1200 rad) is calculated to be the dose that would be received by 0.2 cm^2 of skin if 0.1 μCi of skin contamination were confined to an area of that size.

Based on more recent research than the 1984 WHO reference, the National Council on Radiation Protection and Measurements (NCRP) in their 2001 Statement No. 9 recommended that the annual skin dose be limited to 50 rad averaged over the most highly exposed 10 cm^2 of skin. This would ensure that breakdown of the skin barrier function and consequent possibility of infection would be avoided. Averaging the FEMA limit of 0.1 μCi over 10 cm^2 of skin, gives a skin dose of 24 rad, regardless of spot size. This is less than half the value recommended by NCRP.

Following the NCRP (and proposed NRC) method of determining skin dose and health effects from an isolated spot of contamination, it has been shown above that 0.2 μCi of fixed contamination (regardless of spot size) would not be expected to result in breakdown of skin barrier function, let alone cause acute exudative radiodermatitis. In light of this, there can be no justification for keeping the minimum detectable level (MDL) for spot contamination at 0.1 μCi . Once an appropriate new MDL is determined, the applicable experiments described in the

background document must be performed again with a source of the proper activity and the tables in the guidance updated accordingly.

FEMA RESPONSE: The commenter is correct that NCRP has recommended and NRC has proposed corresponding changes to their regulation that would place the acceptable skin dose from spot contamination at about twice the level recommended in 1995 by FEMA in the “*Contamination Monitoring Standard for a Portal Monitor used for Radiological Emergency Response (FEMA-REP-21)*” and presently proposed for similar guidance for portable instruments. Although raising the MDL by a factor of 2 would reduce the monitoring time an estimated 10 to 30 percent, there are additional considerations that justify keeping the existing FEMA guidance. They are as follows:

1. The NCRP and NRC guidance and regulations apply to occupationally exposed adults, but the FEMA guidance applies to the general public, including children who may be more sensitive than adults for health effects to the skin.
2. The NCRP guidance included a lower action level that was not adopted by the NRC proposal. NCRP recommended 10 rad averaged over 10 cm² of skin as the dose level at which exposed persons would be monitored over a period of 4 to 6 weeks for possible development of health effects to the skin. The existing FEMA Standard is 2.4 times higher than this.
3. NRC can justify a higher dose because the regulations apply only to occupationally exposed adults which represents a captive audience with special training and which, presumably, would aid in detecting and treating any skin effects that might result from undetected contamination.

DISPOSITION: Comment not accepted.