

**COMPENDIUM OF RAC MARSAME
REVIEW PANEL PRE-MEETING
WRITTEN COMMENTS**

for

**PUBLIC REVIEW MEETING
OCT 29, 30 & 31, 2007**

Compiled Oct. 26, 2007

Tom Borak Cover Note to Pre-Meeting Comments of 10/25/2007

10/25/07

Hi Jack,

Attached are some questions that I would like to pursue. I have made some computations that demonstrate my concerns. Most likely this should be covered in break-out sessions, but it may be a good idea for me to explain the issues for the whole committee.

Hey, if I'm late on Monday it is because I dropped the hard copy of MARLAP on my right foot and I have to walk with a severe limp.

Tom

Thomas B. Borak



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To: EPA/RAC
From: T. Borak (Group 2, Implementation)
Subject: First glance at MARSAME

General:

The document is filled with detailed information often coded into acronyms and equations. What is the specific target audience? In other words, who in an organization will have the responsibility of translating recommended procedures into a survey design and then provide guidance for implementation of this design in the field? What is the necessary technical background for these individuals and how will they be trained?

Chapter 5, Section 5.7, Table s 5.1 & 5.2

I would like someone from the MARSAME team to clarify the assumptions that were used to establish the equations in each of the tables. What are the necessary conditions for them to be valid? Given these assumptions, how will this be implemented in the field?

Chapter 5 Section 5.7.5

How is the “net” count obtained in order to apply the equations in Tables 5.1 and 5.2 for determining if a sample exceeds L_c or establishing the Minimum Detectable Count?

MARSAME Manual

Bruce W. Church comments 24 October 2007

MARSAME: An approach for planning, conducting, evaluating, and documenting radiological surveys! Discuss how well the document accomplishes this objective!

General Comments

- It would be very helpful to know the target audience. The Manual seems specific to the professional health physicist, but given that why would it require all the technical specifics contained in the manual. The professional HP would have access to the sampling & counting statistics, tables, various error tables and distributions etc.
If the target audience is management, (which from a planning standpoint is difficult to exclude) then it is too technical and gives them little help in decision making. Managers need to see the relationship of cost/benefit to the data and what the regulatory requirements (drivers) are that need to be met.
- Managers/owners have to consider budget, public relations & political considerations along with meeting the regulatory requirements. Frequently it is prudent to clean &/or dispose of M&E below regulatory requirements, i.e., background to satisfy all concerned. The tenor of the manual suggests that the owners are separate from the science that is going to assist them with decision making. Nothing could be further from the truth.
- The roadmap should have these considerations as gates (boxes) at the appropriate places.
- The Manual contains allot of useful information to someone, not sure who, (to much for the HP professional, not enough for the novice), however, it would be more useful to have the regulatory requirements for all the agencies involved as exemplified by the Appendix D of DOE’s Part 835, in appendix E-5 of the Manual.
- References were made several places in the manual about paying attention to risk to workers, (the typical noise about doing JSAs, having a HASP, requiring a RWP etc..) however, nothing specific was mentioned. For example most cleanups’ of M&E is working at a risk level of 1 in a million or less of cancer caused from exposure to radiation. Construction work, which is the general trade, employed for remedial action carries a 1 in ten thousand risk of accidental death, with JSAs, HASPs and RWPs. Some discussion on the risk tradeoffs in the decision making process is very prudent it seems to me! It is interesting that most often the removal of contaminated material actually transfers risk to the occupational worker for the sake of reducing a small risk even smaller.

- The manual discusses scanning and in-situ applications of instruments also the need to collect samples. Little is mentioned about the vagrancies of sampling, i.e., the importance of a representative sample and/or measurement, etc. A discussion of factors that need to be considered in selecting how representative samples/measurements are made would be helpful. Let me illustrated with a real world example drawn from soil measurements. The objective is to measure the amount of fallout that has occurred over time. Many people think that all you have to do is collect a adequate volume of soil and that will be sufficient for measuring and understanding the true soil concentration. Nothing could be further from the truth. Mother Nature moves soil around with wind, erosion etc. Man intervenes with disturbance, such as plowing, irrigation etc. The only true sample location is one that has not been disturbed, and has the attributes to keep all that has fallen at the same location. The medium that comes close to this criterion is an aged lawn, most often found at cemeteries or old parks, where the caretakers have kept the lawn up for decades without disturbing the soil profile. Other evidence can confirm the validity of the sample, specifically investigating the natural radionuclides and their ratios, and the profile of Cs-137. The point of this is that one has to work smart using all facets of knowledge about the medium to be sampled or measured to make the statistics applied meaningful.
- In my experience most M&E is investigated using techniques that evaluate removable contamination such as smears/wipes. I didn't find any mention of this as sampling procedure or any attendant discussion using applied statistics. Why include the DOE's appendix D to part 835 and have no discussion on removable contamination?

Specific Comments:

- Page xv – Suggest adding an index. There are so many terms, steps, etc., etc., that an index would be really useful.
- R-2 – The roadmap is valuable, but needs to show decisions boxes looping through cost/benefit and budget boxes, as decisions there can drive disposition etc.
- R-12 – This is first time that DQA/DQO is mentioned, and the manual continues and refers to DQA a large number of times. However, I never could find where the detailed process is outlined. The exception is step 7, which is complete with its explanation. Because of its extensive use, suggest all steps be included in the manual.
- 1-3 - I think it is a weakness of MARSAME to not include some discussion about translating a regulatory risk limit to a corresponding concentration level. It would be difficult to reference the pertinent documents from the agencies, with perhaps a brief synopsis and/or table which do this. It leaves the processes outlined in the manual hanging with no endpoint to go to. This must be the reason why nothing is mentioned about management decisions. Perhaps this also suggests this manual is strictly for the novice professional. I believe it marginalizes the utility/usefulness potential for the manual.

- 3-22 - In the discussion of separate decision rule be developed for each action level. Question, wouldn't the most sensitive radionuclide, i.e., lowest concentration needing remedial action drive the decision rule?
- 3-25 – The discussion of measurement method uncertainty begs the questions as to why isn't sampling uncertainty and discrete sampling in general discussed?
- 3-28 – As a follow on to the above question on sampling the example here in paragraph 2 points out where for alpha spectroscopy following radiochemical separation would be acceptable. This obviously requires a meaningful sampling scheme. So why the reluctance to add a full discussion on how meaningful sampling is carried out?
- 4-10 – The discussion regarding decision rules mentions step 5 of the DQO process & the reader is referred to chapter 3. I could not find any mention to step 5 of the DQO process in chapter 3, or any other step in the DQO process in the manual with the exception of Step 7.
- 4-20, 23 – The discussions for scan only and In situ survey designs should be followed with a similar discussion on how to assess removable contamination!
- 4-26 – Pointing out differences between agencies is very good, do more!
- 5-5 – The special health and safety issues discussed should include the need to obtain and review “As Built Drawings.” Changes occur of the operating life of a facility, and hopefully “As BUILTs” are maintained. I have observed a near electrocution and a crane toppling because workers didn't know that underground electric cables and dead men (buried supports to a tank) were present at the time.
- 6-23 – The copper pipe example is not a good example unless more information can be stated about how the internal part of the pipe is sampled for Pu-239. For example is wipes used or acids or what to get the Pu available for assessment.
- 7-3 – The case study 7.2 appears to have little value to the manual. I fail to see what showing all the various SOPs is supposed to accomplish.



10/25/07

Initial Comments for Discussion at
EPA/SAB/RAC Meeting on MARSAME
Ken Duvall

The Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME) is well-organized, clearly written, and an important contribution to guidance on the disposition of Materials and Equipment from Deactivated and Decommissioned (D&D) sites.

After review, the following initial thoughts are open for discussion and are provided with the hope of strengthening the presentation and emphasizing certain aspects of the process.

1) Supplement to MARSSIM

Comment: MARSAME emphasizes that the document is a supplement to MARSSIM (Abstract, Roadmap, Introduction and Overview Chap 1, Chap7, etc.). However, the document appears to stand on its own without any real connection to the MARSSIM process. Additionally, an explanation as to why MARSAME is considered to be a supplement to MARSSIM is not obvious nor evidence of the need to be connected to MARSSIM is evident.

Suggestion: I believe MARSAME does supplement MARSSIM by providing guidance on the handling of Materials and Equipment (M&E) that must be removed from MARSSIM subject areas (lands and buildings). It is my impression that the need for MARSAME came about upon recognizing that the scope of MARSSIM would be limited to real property (lands and structures) and the release of sites at fixed locations. Non-real property (materials & equipment), utilized as part of operations at these facilities and sites, would have to be dismantled, deconstructed, and removed from the site based on available disposition options such as release and reuse, restricted release, or handling as waste and debris. This dispositioning of M&E would be covered under different regulations and procedures and therefore the need for separate MARSAME guidance. So, the initial thought that these M&E have been connected to operations in the very same rooms, facilities and sites for which the MARSSIM process is applied appears to be a reasonable assumption. This would imply that, as a natural progression in the D&D process, the disposition of M&E should be considered right along with the disposition of rooms, buildings, lands, and sites covered by MARSSIM. (However, the implementation process may involve removing M&E and applying MARSAME prior to serious application of MARSSIM.)

Additionally, MARSAME applies to the dispositioning of M&E that is utilized in the D&D operation itself, and not associated with past facility operations. These M&E include trucks, backhoes, scrapers, etc. for which SOPs would readily apply. Application of MARSAME to these M&E would not be connected to MARSSIM considerations at the site. MARSAME should be appropriately balanced in its discussion pertaining to M&E connected to past facility operations and M&E connected to D&D.

With regard to the disposition of M&E related to MARSSIM applicable facilities, decisions in the MARSSIM process can be more directly imported and connected to decisions in MARSAME. Certain information in MARSSIM, regarding Categorization (impacted or non-impacted) of Areas, Classification of Areas (Class 1, 2, & 3), the graded approach, the historical site assessments, and the process knowledge, commonly apply to both MARSSIM and MARSAME decision-making and should be jointly utilized for more effective utilization of resources. For example, if M&E is removed from a MARSSIM Class 1 area, which under the MARSSIM classification process, the contamination is expected to exceed the Derived Concentration Guide Line (DCGL). In this case, there is evidence for the need to consider that the M&E from that area may exceed the Action Level (AL) under MARSAME. Noting that the DCGL is more likely adjusted to dose levels of 15-25 mrem/yr, and the AL, to a more stringent level of 1-

mrem/yr for clearance, there is comparable evidence that M&E from a MARSSIM Class 1 area should receive more effort, under the graded approach, in demonstrating compliance with disposition requirements. Also, the very same process knowledge and historical assessments may apply jointly to rooms and equipment that are subject to both MARSSIM and MARSAME and the use of this information should be approached with both project needs in mind.

I believe that a real connection between MARSSIM and MARSAME resides at the Classification step for the graded approach and that there exists information that should be commonly shared. In this regard, there exists a real connection between MARSSIM and MARSAME and that MARSAME does truly supplement the MARSSIM process. It is suggested that the MARSAME workgroup explore all potential possibilities for incorporating MARSAME into the MARSSIM information sharing and decision-making process. It is also recognized that for M&E, not connected with MARSSIM applicable facilities and that fully utilize SOPs in the dispositioning process, are already sufficiently addressed in MARSAME.

2) Role of Preliminary Measurements and Cleanups

Comment: In MARSSIM, Preliminary Measurements are Scoping, Characterization, and Remedial Action Surveys. These surveys are primarily conducted to scope and characterize conditions prior to cleanup, and to assess conditions during cleanup operations. They play an important role in developing decommissioning strategies and in planning the final status survey (FSS), which is conducted after cleanup is complete. It is suggested that the role of cleanup of M&E is not seriously considered in MARSAME and does not appear to be a viable option in the disposition process. Consequently, Preliminary Measurements appear to have a minor role in MARSAME, and appear to have not much more importance than sentinel measurements.

Cleanup, as a viable option in MARSAME, is not mentioned in the Abstract. It is not discussed in the Roadmap or Chap.1, Introduction and Overview. Cleanup is not an option in Figs 1-8, in the Roadmap, which describe the MARSAME process. Figs 1-8 describe a process that handles, transports, and segregates M&E, but does not engage in any cleanup process to reduce contamination levels in M&E. MARSAME applies to Class 1 M&E, which by definition, is expected to exceed the AL, but provides no provision for the cleanup necessary to meet the AL. Even for the waste disposition option, there may be need for some cleanup to meet waste acceptance criteria for certain disposal options. Furthermore, cleaning or wiping down is consistent with the application of ALARA. In MARSAME, ALARA is applied only to the AL as shown in Fig. 5. If the absence of cleanup in the disposition of M&E is intended, it should be noted and explained for why the application of MARSAME does not take that option into account. However, I believe that there is ample justification for considering cleanup a step in the dispositioning process.

With regards to Preliminary Measurements, MARSAME has appointed a reduced role, and an almost redundant role to sentinel measurements. Page 1-11, *Preliminary surveys*

(e.g. scoping, characterization, and remedial action support surveys) may be performed as part of the IA to collect additional information. Page 2-11, If there is insufficient information available to design a disposition survey following categorization, it may be necessary to perform preliminary surveys to obtain the required information. Sentinel measurements are described as, Page 2-9, Sentinel measurements are biased measurements performed at key locations to provide information specific to the objectives of the IA. In both cases, Preliminary measurements and Sentinel measurements are expected to provide information to the Initial Assessment (IA). In this role, it appears that Preliminary measurements are available when there is a void in information provided by process knowledge, historical assessments and sentinel measurements. This is not consistent with the traditional roles of scoping, characterization, and remedial action surveys. Without a role for Cleanup of M&E, I believe, there lacks a useful role for scoping, characterization, and remedial actions surveys.

It appears that much of MARSAME is focused on M&E that can be readily released without cleanup. This is not consistent with the disposition of M&E associated with past facility operations where radioactive material was processed and handled. This is not consistent with the expectations for a supplement to MARSSIM, where cleanups are an important aspect of the process. Overall, the focus of what M&E MARSAME addresses should be clear and balanced between M&E from facility operations subject to MARSSIM and M&E utilized in the D&D operation itself. Also, the focus on M&E that need remediation or on M&E that can be readily and routinely released under an existing SOP should be clearly distinguished. Furthermore, what is the role of preliminary measurements, which are many times utilized not only in the disposition decision-making but also in deciding cleanup options, if cleanups are not a viable option. In, MARSSIM, preliminary measurements can also be utilized in lieu of the FSS if no cleanup is required.

Suggestion: MARSAME should address M&E that is consistent with supplementing MARSSIM. That involves M&E that was involved in facility operations and are to be removed from areas that are D&D under MARSSIM. These M&E are expected to be cleaned, if for no other reason than ALARA, and for which preliminary measurements (scoping , characterization, and remedial action surveys) are applicable to plan the disposition survey. Sentinel measurements appear to be useful for Categorization (Impacted/ Non-Impacted), and for that purpose only. Preliminary measurements should be carried over from MARSSIM in a manner that is consistent with traditional use of these surveys. M&E connected to D&D operations, which are not expected to become severely contaminated or have covering while in use, may fully utilize SOPs in the dispositioning process and appear to be already sufficiently addressed in MARSAME.

10/25/2007



10/25/07

**US EPA
SCIENCE ADVISORY BOARD
RADIATION ADVISORY COMMITTEE
MARSAME REVIEW
October 29, 2007**

Summary of RAC Consultations on MARSAME
Jan Johnson

The RAC provided consultations to the Multi Agency Working Group on MARSAME: February 25, 2003 and October 21, 2003. Consultations do not require consensus of the RAC or a written report but only a letter to the Administrator stating that the consultation took place. As a result, the points brought out during consultations represent the ideas and concerns of individual members of the Panel. The DFO for the Panel records the points discussed in his meeting notes. The following summary points were gleaned from Dr. Kooyoomjian's very complete notes and my very incomplete memory:

February 25, 2003 Meeting

The MARSAME work group presented the work to date and asked the RAC to (1) comment on the technical approach; (2) suggest additional approaches to the problem; and (3) point out any pitfalls that the work group might encounter.

- The panel and the work group agree to apply MARSAME to various proposed scenarios
 - Cleaning heavy equipment used in and around a thorium contaminated site
 - The lack of a free-release scenario in MARSAME was identified as a problem
 - Inaccessible contamination was also considered with the suggestion that perhaps engine filters could be checked to assess contamination
 - Laboratory equipment contaminated with radioisotopes – it was noted that smear sampling would involve some uncertainty but it would be less than for scanning
 - Volumetrically contaminated materials (concrete structure)
- The RAC suggested that a roadmap similar to the one found in MARSSIM would be useful.
- The technical approach was considered
 - Modeling was discussed – the panel advised the work group to consider how modeling could fit into guidance
 - It was noted that MARSAME differs from NUREG 1761 *Radiological Surveys for Controlling Release of Solid Materials*
- The panel suggested adding more detail to the document including information on accurate monitoring, data quality, and likely advances in technology

- Other suggestions regarding the technical approach and potential pitfalls included:
 - Scenarios should be worked out to be more useful – better definition of the problems and issues
 - Need for a framework and guidance for specific situations
 - Need to check “sentinel” areas
- The RAC discussed the issue of moving from measured data to dose estimation
- Other specific scenarios were discussed
- The need for models to track decontamination activity was suggested
- The question of “How good is good enough?” was discussed.
 - The issue of how to handle background variability was discussed
 - The Panel reiterated the need for a roadmap and models that are not “black boxes”
- The RAC discussed the need to devise a framework for interfacing MARSSIM, MARSAME, and MARSAS
- A member of the public asked if MARSAME would deal with volumetric contamination; the working group confirmed that it would.

October 21, 2003 Meeting

- The Chair of the working group acknowledged that the purpose of MARSAME is to provide consistent measurement guidance for the release of materials and equipment based on the data quality objective (DQO) process.
- The Chair of the working group stated that survey unit coverage for Class 1 sites would be 100% and methods would include scanning, in toto measurements, and direct measurements. The role of statistical sampling is different in MARSAME from its role in MARSSIM
- The work group’s decisions were discussed
 - A definition of volumetric residual radioactivity will be included
 - The term “inaccessible area” was changed to “difficult-to-assess area”
 - Smear samples and sentinel measurements are diagnostic tools, not release tools
 - Example scenarios will appear both in the main text and in an appendix.
- A flow chart for Class 3 release was presented
- RAC members asked for clarification of terms
- The Chair of the working group asked the panel to address two issues:(1) technical approach, and (2) key teaching lessons for the example scenarios
- The panel asked the question: “How far should the bulldozer be disassembled to achieve compliance?” Balance between the cost of decontamination and the risk to the user from fixed contamination on the inside of the equipment (essentially zero).
 - The working group reiterated its position that smear samples were qualitative because of the variability in method (amount of pressure, area smeared, etc.)

- The DCGL criterion and 100% sampling was discussed. The cost of 100% sampling on a bulldozer was deemed to be prohibitive.
 - The panel considered whether an acceptable survey might be defined as a survey of the accessible exterior and engine exhaust
 - The panel noted that a technically and scientifically robust definition of a 100% survey could be developed.
- MARSAME does not allow an area to be reclassified downward, i.e., Class 1 to Class 2 or 3. – MARSAME should give guidance or recommend a practical approach to this concern.
- Limitations of field measurement technology were discussed with the work group asked to consider providing advice on this topic.
- It was noted that MARSAME does not recommend performing a survey of equipment before it enters the site.
- A RAC member recommended that some of the examples be worked through the ideal approach to identify “holes” in the approach and risks for not getting it right, i.e., dose risk and risk of letting uncontrolled radioactive contamination off the site.
- The RAC prepared a list of discussion items arising from the initial round of questions
 - Definition of 100% coverage for alpha emitters
 - Balance technical accuracy vs. practical use
 - Subjective judgments
 - Clarification of terminology
 - Modeling interfaces and practices
 - Decontamination place in the process
 - Practical suggestions for preventing contamination of equipment
 - Cost of surveys vs cost of disposal
 - Addressing difficult to measure radionuclides (H-3)
 - Small vs large operators – should the document address different approaches
 - How can the document be made workable
- Small vs large operators – graded and iterative approaches should be used in MARSAME
 - Use of soft data (e.g., old sampling data, expert judgment) vs hard data was discussed
 - Initial assumption for small operators might be Class 3.
- Cost of survey vs cost of disposal –
 - A list of considerations for the cost evaluation would be a useful effort
- Definition of 100% coverage
 - Is 100% a meaningful number
 - Should be discussed in advance with the regulators
 - Care is needed in the definition and interpretation of 100%

There is a significant (but not 100%) amount of redundancy in the advice given during the consultations. However, the following points appear to me to be the most critical:

- A roadmap is needed for the document
- Definitions need to be clarified
- A graded approach should be considered (i.e., small vs large operators)
- Typical scenarios and case studies should be included
- The cost of surveying versus the cost of disposal should be addressed
- A mechanism for “downgrading” a site from Class 1 to Class 2 or 3 should be developed
- Models to track decontamination should be addressed.
- There needs to be a framework for integrating MARSSIM, MARSAME, and MARSAS



10/24/07

Preliminary MARSAME Review, Bernd Kahn 10-24-07

1. The report appears to me to be logically presented with the various topics well considered. One aspect that seems insufficiently addressed is that, in practice, the M&E owner usually goes directly from defining and describing the M&E of concern to the regulatory framework to ask:

- What are the action levels or DCGL's?
- Does the regulator specify types of measurements?
- Does the regulator limit the dependence on historical knowledge relative to direct measurement?
- To what extent must the existence of volumetric contamination be explored?

Only when these questions are resolved would the owner plan the survey and assessment. Should this quite common approach be explored further in Section 3.3 or the Road Map? For example, the tables on pages E-8 and E-19 on surficial contaminant limits and associated discussion seem to be needed in Section 3.3 or earlier. The same applies to volumetric contaminant limits, for which the table on page E-19 is not very useful, but other tables by ANSI, the European Commission, and IAEA are available (and referenced in the ANSI case referenced) and should be inserted.

2. On page F-1, line 26, the Fluence Rate is erroneously labeled as FRER. This would be avoided if the authors wrote equations with conventional (ICRU) symbols instead of acronyms, e.g. Fluence Rate relative to Exposure Rate were written $\phi \cdot X$, not FRER.



10/26/07

Preliminary Comments on MARSAME by Paul J. Merges, Ph.D.

1. General Comment 1 – The December 2006 draft MARSAME (hereafter referred just as MARSAME) is an exceptionally well-prepared and very logically presented document. It is an excellent explanation of the science and theory in support of the cleanup of radioactively contaminated M&E. It will be the primary United States source of this information and process for such remedial actions in the future. MARSAME was prepared by the multi-year efforts of staff from four federal agencies who have different, and sometimes conflicting radiation responsibilities. The cooperative spirit of these agencies and their staff is to be commended. The combined radioactive remediation program as presented in the radiation trilogy of MARSSIM, MARLAP, and MARSAME, is a world leading effort that could not have been developed without this cooperative effort. Even if MARSAME were never finalized (which I truly hope would not occur), the subject MARSAME document would be a radioactive contamination reference document for years in the future. In essence, the RAC has been asked to polish an item that already shines! Keep this comment in mind as one reviews the rest of my comments.
2. General Comment 2 – The purpose of MARSAME is stated in Section 1.1 (p1-2, line 41). The goal should be stated and It should mimic that of MARSSIM and state that this overall goal is not to just produce better documents, but to assure clean radioactively decontaminated sites, the proper disposition of the M&E previously thereon, and the technical and legal defensible documentation on this M&E disposition.
3. General Comment 3 – The relationship between MARSAME and MARSSIM should be presented in MARSAME in greater detail, especially how decisions should be made in situations where M&E has co-mingled with surface materials under a MARSSIM review.
4. General Comment 4 – MARSAME should include the role of ARARs (as described in CERCLA) and state regulations in the development of action levels and other disposition issues.
5. General Comment 5 – MARSAME provides detailed information on the DOE and NRC processes, policies, regulations, and case studies information currently followed to assure the proper disposition of M&E. Similar discussions of the EPA and DOD M&E disposition process should be included in the MARSAME text, appendices, case studies, and references.
6. General Comment 6 – MARSAME should discuss the role subsurface contamination has on evaluations of surface contamination. Such discussion should address the extent such contamination may have when it migrates to the

- surface following surface decontamination (e.g., tritium “weeping” to the surface in concrete blocks at nuclear reactor decommissionings).
7. General Comment 7 – MARSAME should provide a discussion of the role of the independent verification contractor (IVC) throughout the whole MARSAME process of planning, performing, and assessing disposition surveys of materials and equipment.
 8. General Comment 8 – MARSAME should note the target audience(s) for which it was predominately prepared.
 9. P. xxv – The list of acronyms should include CERCLA, EC, IAEA, UMTRCA, and URL since these are noted in the document.
 10. Roadmap-4 and 6 – The first box in Roadmap Figure 3 should be an exact repeat of that box in Figure 2 from which it evolves in the roadmap. This should apply to all figures in the roadmap and text that evolve from a previous figure.
 11. P. 2-5, Section 2.2.2 – Collect and Review Additional Historic Data should include reviewing the files (inspection reports, incident analyses, and compliance history) of current and former regulatory agencies. Discussions with these agencies and their inspectors could also be fruitful.
 12. P. 2-16, Table 2.1 – Complexity considerations should include TOSCA materials, as well as, hazardous wastes.
 13. P. 3-6, Section 3.3.1 – It is noted that ALARA considerations are listed as an item to base action levels. ARARs and especially state regulations should be also added to the items upon which to base action levels.
 14. P. 3-6, line 125 – While waste acceptance criteria can be evaluated for potential “disposal” sites, care should be taken to avoid the appearance of prejudging RFP bids for waste disposal.
 15. P. 3-23, line 504 – Ra-226 may be considered for disposal as “NORM” waste.
 16. P. 4-37, line 868 - It is suggested that text add statement that large long-timeframe cleanups have a tendency toward changing contractors. Early documentation of the survey design process would assist in such transitions, as well as, provide support documentation for IVC reviews.
 17. P. 7-1, Case Studies – The case studies are those provided by DOE and NRC. Additional case studies, especially one from the EPA and another from DOD, would be very helpful.

18. P. B-12 line 132 – Change sentence to read – Manufacturers “or their radiation licensing agency” ...

19. P. C-2, Table C.1 - Add “Medical Waste Disposal Facilities” to Nuclear Medicine box.

20. P. C-5, Table C.1 – Add “Po-210 (static eliminators/various manufacturers)”.

P. E-1, Disposition Criteria – Additional sections should be added to address disposition criteria of EPA and DOD, as well as note that state radiation regulations would be considered as ARARs. Also, a short discussion of the role of LLRW compacts in radi