Radiological Survey Report of Radiological Emergency Preparedness (REP) States

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HS/ER-5 Committee on Emergency Response Planning

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PREFACE

The Conference of Radiation Control Program Directors (CRCPD) "Radiological Survey of REP States" was sent to 35 states that engage in Radiological Emergency Planning (REP) for nuclear power plants. Responses were received from 24 states and approximately 38% of them shared their procedures for Radiological Monitoring and Assessment. The survey was designed to ascertain how the various states would detect, measure, and analyze the effects of a radiological release. As this was primarily a survey of the REP States, the purpose was to determine what techniques are used for a radiological response to a nuclear power plant accident. Therefore, many of the questions were designed to determine how the different states meet the guidance contained in the U.S. Nuclear Regulatory Commission's (NRC) *NUREG-0654 FEMA-REP-1*, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants* as it applies to the criteria for Accident Assessment, Protective Response, and Radiological Exposure Control. In fact, some of the questions reference specific criterion from *NUREG-0654*.

As might be expected, the responses and procedures varied greatly, reflecting the differing capabilities, organizational structure, and funding of the state agencies that are responsible for this task. A potential topic for future analysis, not performed in this survey, would be the correlation that exists between funding and equipment resources. Some states have expensive assets such as well-equipped laboratories or aerial monitoring capabilities while other states rely exclusively on the federal government and its assets to provide these functions.

This report is not designed to analyze the adequacy of the Standard Operating Procedures (SOP) that were received nor is it designed to rank the SOP in order of preference. That would go far beyond the original scope of this project. The procedures were reviewed to help understand some of the survey responses when those procedures were provided for review. The most notable result of the survey is that there is a wide variation in the level of detail provided in procedures. It might be surmised that some of the more detailed procedures were written for individuals who are not normally performing functions that they have been assigned in an emergency. Likewise, shorter procedures, with very little guidance, may have been developed for the more experienced user. As the proficiency level of the staff using these procedures was not available, no definitive statements can be made regarding this assumption other than to say there is an extreme variation in procedures among the states.

In the area of equipment used for radiological response, there does appear to be some standardization in that most hand-held instruments are now made by a few manufacturers. As mentioned above, there is a wide variation in what tasks are performed in the field. One example is counting and analyzing field

samples. Some states only collect samples in the field and all counting and analysis is performed in a laboratory. Of course, there are other states that have the capability to collect and analyze samples in the field. Regarding personnel monitoring, there is a very large variation in the equipment and techniques used to monitor individual dose. Generally, this is performed using hand held instruments or portal monitors and many states list a variety of equipment used for this task. While the main report goes into detail on this topic, there are still many questions that could be used for future surveys.

Dose assessment is one area where there is standardization among the state programs. The majority of states elect to use the NRC's dose assessment program Radiological Assessment System for Consequence Analysis (RASCAL) to perform dose assessment. Again, there are differences here also. More complex dose assessment requires a high level of proficiency. Some states are afforded the luxury of employing highly experienced staffs that are able to perform these complex assessments. Other states with less staff expertise, have chosen to rely on the federal government for the more detailed and complex assessments.

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INTRODUCTION

The need for a survey of how the different states approach radiological measurement and assessment of an incident at a nuclear power plant was identified by the Federal Emergency Management Agency (FEMA). Several key issues are responsible for the identification of that need. Most notably, there have been many changes in the techniques used for radiological monitoring and assessment since the development of the current criteria for radiological measuring and assessment in *NUREG-0654 FEMA-REP-1, Rev 1*. As an example, the idea of using a personal computer for dose assessment when *NUREG-0654* was published in 1980 would have been science fiction. In addition, most radiation detection equipment readily available for use at the time the guidance was written was fairly simple. Portal monitors for personnel monitoring were the exception rather than the rule as they are today.

Based on the previous discussion, FEMA approached the CRCPD with a proposal and Scope of Work to investigate the capabilities of REP states to detect, measure, and analyze the effects of a radiological release. The work under the FEMA contract was assigned to the CRCPD's HS/ER-5 Committee on Emergency Response Planning in 2015. The committee believed the best way to approach the project was to develop a survey for REP states. The survey included a total of 18 questions related to radiological monitoring techniques and procedures. A copy of the survey is provided in Appendix A. The survey answers were tabulated in an electronic spreadsheet, which is available upon request. Appendix B provides figures illustrating the findings.

Discussions in this report summarize the responses by functional areas:

- dose assessment;
- environmental monitoring;
- personnel monitoring;
- field monitoring;
- procedures; and
- other topics of interest.

As in any survey, the answers sometimes lead to more questions or thoughts for future surveys. Therefore, by no means should this survey be thought of as the final step in the investigation. Future follow-up surveys or additional surveys on topics that were not included here may be needed to fill in any gaps identified through this first set in the process. The primary purpose of this survey was to gather a large amount of information in a short period of time. This report includes graphical representations in Appendix B that demonstrate that the goal essentially was achieved.

DOSE ASSESSMENT

The first four questions of the survey focused on dose assessment. Dose Assessment Capabilities is a key component of one of the 16 planning standards of *44 CFR Part 350 - Review and Approval of State and Local Radiological Emergency Plans and Preparedness.*

MODEL SELECTION

By far the NRC's dose assessment model, Radiological Assessment System for Consequence Analysis (RASCAL), is used by most states. In fact, 88% of the responders stated that they either used RASCAL exclusively for dose assessment or that it was one of the models used for dose assessment. The next most popular model was Unified RASCAL Interface (URI) at 50 %. This was followed by Meteorological Information Dose Assessment System (MIDAS) at 38 %. The reason that percentage totals exceed 100% is that a number of states use more than one model for dose assessment. The survey also revealed that most states do not use dose assessment codes developed in-house. Over the years, most states have lost the expertise or staff to maintain their own dose assessment codes. This is reflected in the low percentage (13%) that still maintains in-house dose assessment capability.

SHORTFALLS OR ISSUES WITH MODELS

The survey requested information on any problems, shortfalls, or issues that have been identified with the current model. About one-third of the respondents noted problems. The main problem was that some models do not have the sophistication to incorporate all of the variables that may influence the chi/q determination with 57% of those stating this as the problem. At a distant second, 14% of the respondents noted compatibility problems with mapping software. Besides these two issues, there were not any discernable trends noted.

SUMMARY

Dose assessment has become fairly standardized across the REP states since most states use either RASCAL or URI, which both use the same code for dose assessment calculations. While RASCAL is designed to model every reactor in the United States, it cannot completely model all of the unique features of the different reactor designs. Therefore, as might be expected of those reporting problems, it is not surprising that 57% of the problems were related to incomplete modeling.

ENVIRONMENTAL MONITORING

Under the heading of environmental monitoring, there are six questions that deal with how field teams take measurements, about the equipment used in the field to perform radiological monitoring, and about surveys and how results are analyzed. Once again, some responses are very similar and others varied.

PORTABLE INSTRUMENTATION

For portable instrumentation, there is some standardization because the guidance for that is well established. Unfortunately, most responders did not list the type or manufacturer of the instruments used. In certain instances, this information could be gathered by referring to the procedures if they were provided. Of the limited data available, there were no unexpected responses found related to instrument types.

FIELD SPECTROMETRY

The survey indicated that most states do not perform field spectrometry. In fact, only 21% of the states have this capability. Of the states that do have this capability, 100% use their own mobile lab. These results are not that surprising considering the costs associated with the maintenance and operation of a mobile laboratory and the need for experienced and trained staff to operate the lab.

FIXED MONITORING STATIONS

Most of the states (67%) have fixed monitoring stations. Of those that reported having fixed monitoring stations, 31% have the ability to continuously download the data. Another 31% can manually download the data and the remaining 38% must first analyze the data by taking it to a lab. The implication here is that it is critical for most states to deploy field monitoring teams quickly as that is the only source of real time data for assessment of radiological impacts to the public.

DATA COLLECTION AND SHARING

One topic not covered in the survey but relevant to the collecting and sharing radiological data is the use of RadResponder[1] for data management. Many states are now able to share their data externally with the use of

[1] The RadResponder Network is the collaborative product of FEMA, DOE, and EPA, created as a national standard for the management of radiological data in order to leverage information from across the nation to uniformly establish a flexible, efficient and networked approach to radiological data management.

RadResponder. This, too, varies among states. Some states only share actual field team measurements while others have the capability to share data automatically from their fixed monitoring stations. The survey indicated that roughly 75% of the states do not have the capability to share their data outside of their organization. This implies that if they are using RadResponder they are not yet using its data sharing capabilities.

CAPABILITIES OF FIXED MONITORS

Another topic not addressed in the survey was the capabilities of the fixed monitors that are deployed. There was no question included to determine whether they are capable of sampling the air for iodines and particulates in addition to ambient radiation levels.

PERSONNEL MONITORING

The final area of the survey dealt with the equipment and techniques used for personnel monitoring. Four of the survey questions dealt with this topic. The survey developers expected that a large percentage of the states would be using portal monitors. However, the survey revealed that only 22% of the states reported using both portal monitors and hand-held instruments. Another 43% report that they use only hand-held instruments. One reason these numbers are so low is that 52% of the responders answered this question by listing personal dosimetry as the equipment used for personal monitoring. A future survey question may provide more consistent response if a distinction is made between monitoring for contamination versus monitoring personnel exposure. Therefore, what can be said with some certainty is that of the 48% of the responders that correctly interpreted the question as how do you monitor for contamination, a little less than half use portal monitors. Again, this answer is misleading since 83 % of the respondents state that they have developed contamination standards for the use of portal monitors.

Careful analysis of the responses received indicates that at least 83% of the states use portal monitors. Of those states that use portal monitors, 71% have developed their own in-house procedures. The most significant finding here is that most states not only use portal monitors, but they have developed their own standards and procedures for use. A future survey may inquire as to how they developed these standards and procedures and how they may differ.

PROCEDURES

One of the questions asked if the state would be willing to share its procedures and others specifically asked if it would share procedures related to the question. The percentage responding "yes" to the question regarding the willingness to share was 86%. The actual percentage that provided procedures was 38%, which was somewhat disappointing. It is unknown why there is such a discrepancy in the responses. Perhaps, the questions were not clear enough or perhaps a legal or senior level approval process prevented them from being provided. The small percentage of procedures received limits the conclusions that can be made from inspection of the procedures. As stated earlier, the time and resources spent examining the procedures submitted was limited. The primary reason is that it was beyond the scope of the survey itself. The other was the realization from a statistical sampling standpoint that any conclusions to be drawn from a more extensive review of the available procedures would probably not necessarily be representative of the average REP state since most of the states did not submit their procedures.

There are some conclusions that can be drawn from the survey and cursory review of procedures. The most evident conclusion is that the procedures vary greatly in the level of detail that is provided for some activities. This was evident when simply comparing the length of the actual procedures. The actual electronic size of the files themselves varies by a factor of 40 from the smallest to the largest. While this does not mean that one state has 40 times the detail of another state in their instructions, it does point out that there are large variations not only in detail but in the actual number of procedures. As stated previously, this may be a direct result of the level of experience and knowledge of the response staff. Some states may have highly trained staffs that can operate with minimal instruction and others that use staff that infrequently performed response related tasks. Another possible reason is the reliance on procedures provided by federal agencies, such as the Department of Energy Federal Radiological Monitoring and Assessment Center (FRMAC). It is noted that 13% of the responders use federal procedures exclusively for radiological monitoring and another 29% use federal procedures to supplement their own procedures.

CONCLUSIONS

NUREG-0654, FEMA-REP1, Rev 1 has been in use now for over 35 years and numerous other FEMA Guidance Memorandum, documents and the *FEMA REP Manual* have been issued to further clarify the guidance in *NUREG-0654.* Therefore, the most surprising conclusion from the survey is that there continues to be a wide variance in the methods, procedures, equipment, and staffing for response to a radiological emergency at a nuclear power plant in the United States.

While not included in this survey, it is a well-known fact that there is a wide variation in funding and staffing among the states when it comes to the REP program. In recent years, there has been an increasing trend in the number of nuclear power plants that have announced that they intend to suspend their operations prematurely. Early decommissioning ultimately has the potential to affect funding and staffing for the various REP programs. While no direct correlations with funding and equipment were established by this survey, a future survey might include this topic.

It was evident from the survey responses that most states rely on federal resources such as the NRC's RASCAL Dose Assessment program and on FRMAC assets for analysis and monitoring of the Ingestion Pathway. With projected funding and staffing on the decline, it may be expected that states will continue to rely more on federal support going forward.

ACRONYMS

DOE	Department of Energy
EPA	Environmental Protection Agency
FRMAC	Federal Radiological Monitoring and Assessment Center
FEMA	Federal Emergency Management Agency
MIDAS	Meteorological Information Dose Assessment
RSCAL	Radiological Assessment System for Consequence Analysis
REP	Radiological Emergency Planning
SOP	Standard Operating Procedures
URI	Unified RASCAL Interface

REFERENCES

NUREG-0654 FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants

44 CFR Part 350 - Review and Approval of State and Local Radiological Emergency Plans and Preparedness.

APPENDIX A
RADIOLOGICAL SURVEY OF REP STATES

1. Does your state perform independent dose assessments during nuclear power plant emergencies, i.e., plume modeling? If no then what Offsite Response Organization performs this function.

   Yes or No

2. What methods or models do you use for dose assessment? (Reference NUREG-0654 Criterion I.8 and I.10)

   RASCAL

   URI (Universal RASCAL Interface)

   MIDAS

   Other (List)

3. If you use an in-house developed dose assessment/modeling program, would you provide a summary of its features and capabilities as an attachment to this survey?

   Yes (attached)

   No (Please provide a reason, e.g., proprietary)

4. Have you identified any shortfalls or issues with your modeling program that need to be addressed? For example, at multiple reactor sites, does your model allow for multiple releases from multiple reactors or multiple spent fuel pools? Explain.

5. What equipment do you use to determine radiological conditions in the environment? (Reference NUREG-0654 Criterion I.7, I.9, and I.11)

   Ambient Radiation Levels

   Air Sampling

   Air Cartridge and Particulate Filter Counting

   Other sampling (List)

6. Do you use field spectrometry to analyze air samples?
   Yes___ No____ N/A_____

7. Does your state have a mobile laboratory?
   Yes_____ No_____

8. Does your state have fixed monitoring stations in place at nuclear power plants?

   Yes

   No

9. If you do have fixed monitoring locations, how is the data collected?

   Continuous Automated Data Flow

   Manual Download

   Other (specify)

10. Do you currently have the ability to share your fixed monitoring data?

    Internally Only

    Other state and local organizations

    State/Federal/Contiguous State/Local/Licensee

    No sharing capability

11. Have you developed in-house procedures for radiological monitoring during nuclear power plant accidents or do you use standardized procedures from another source (i.e. FRMAC, EPA)?

    In-house

    DOE FRMAC

    EPA

    Other (List)

12. Would you be willing to share your procedures with CRCPD for a comparative study?

    Yes (Attached)

No (Please provide reason)

13. What equipment is used for personnel monitoring and exposure? Please list specific manufacturer and model. (Reference NUREG-0654 Criterion J.12, K.3.a, K.3.b, K.4, K.5.a, K.5.b)

14. Do you use standard procedures for personnel monitoring provided by the manufacturer or have you developed your own procedures for personnel monitoring?

    Standard Manufacturer Procedures

    In-house Developed Procedures

15. Would you be willing to share your procedures with CRCPD for a comparative study?

    Yes (Attached)

    No (Please provide reason)

16. Have you developed contamination monitoring standards for the use of portal monitors for radiological response?

    Yes_____ No_____

17. Do you have contamination monitoring guidance developed for the use of hand-held survey instruments used for personnel monitoring during a radiological response?

    Yes_____ No_____

18. Would you be willing to provide a contact that has experience and expertise with radiological monitoring, development of procedures and dose assessment for follow up information?

    Yes (Provide name, email address and phone number of contact)

    No (State reason)

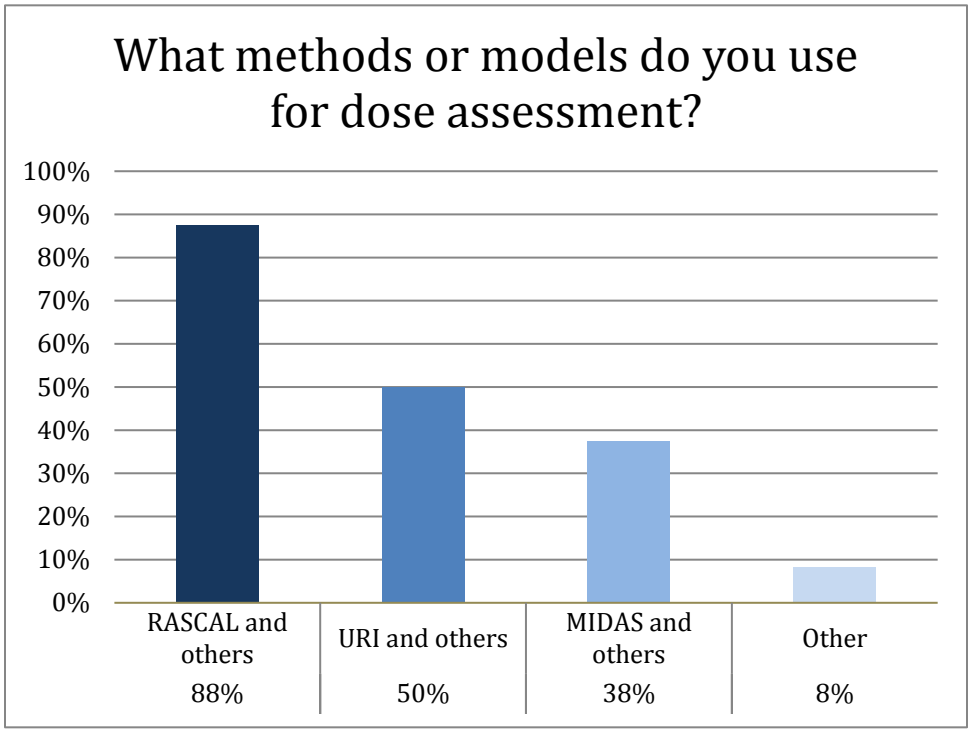
APPENDIX B

FIGURES ILLUSTRATING REPONSES

TO RADIOLOGICAL SURVEY OF REP STATES

Note regarding number of respondents:

The Conference of Radiation Control Program Directors (CRCPD) "Radiological Survey of REP States" was sent to 35 states that engage in Radiological Emergency Planning (REP) for nuclear power plants. Responses were received from 24 states. Graphics in Appendix B are represented in percentages. Assume the number of respondents to be 24 unless otherwise specified.



Note: Totals reported exceed 100% because some reporting used more than one type of method or model.

Figure B – 1. Predominant use of dose assessment methods and models.

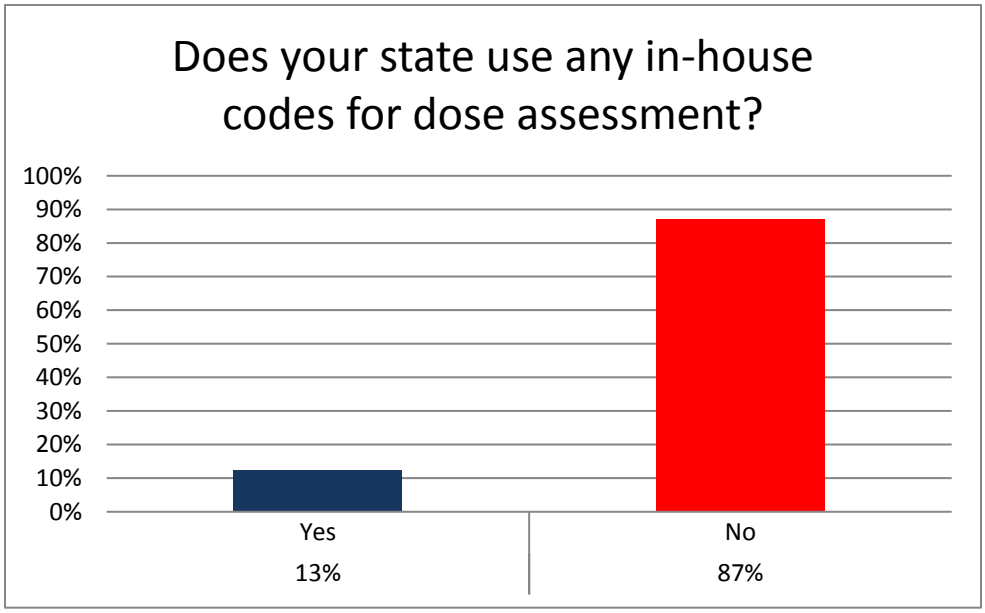


Figure B – 2. Frequency of use of in-house codes for dose assessment.

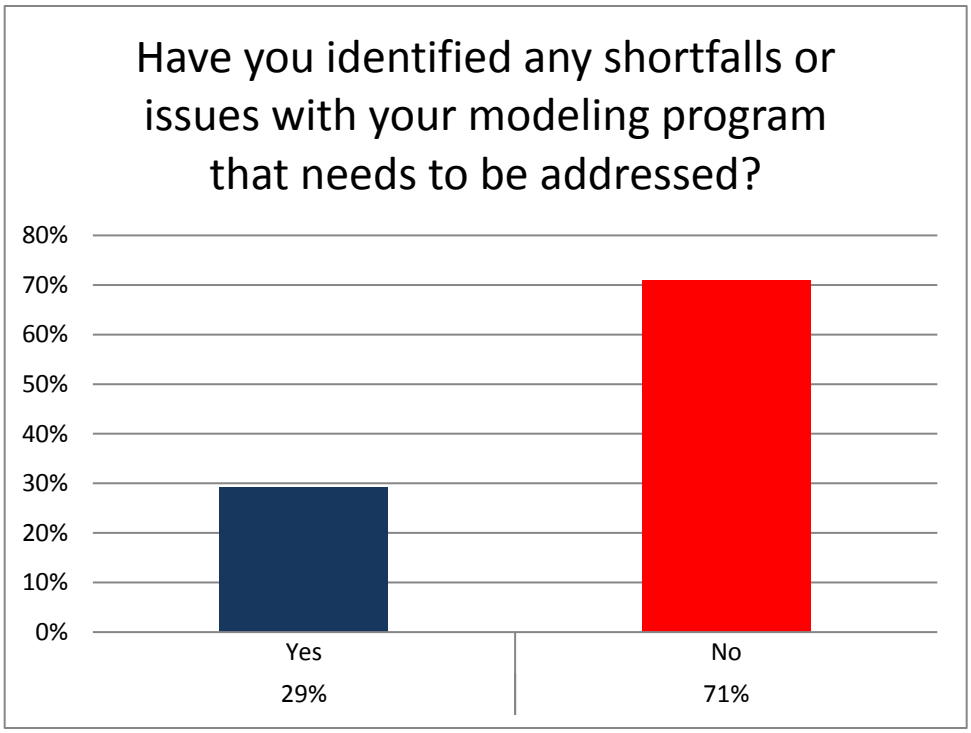


Figure B – 3. Shortfalls or issues with modeling programs.

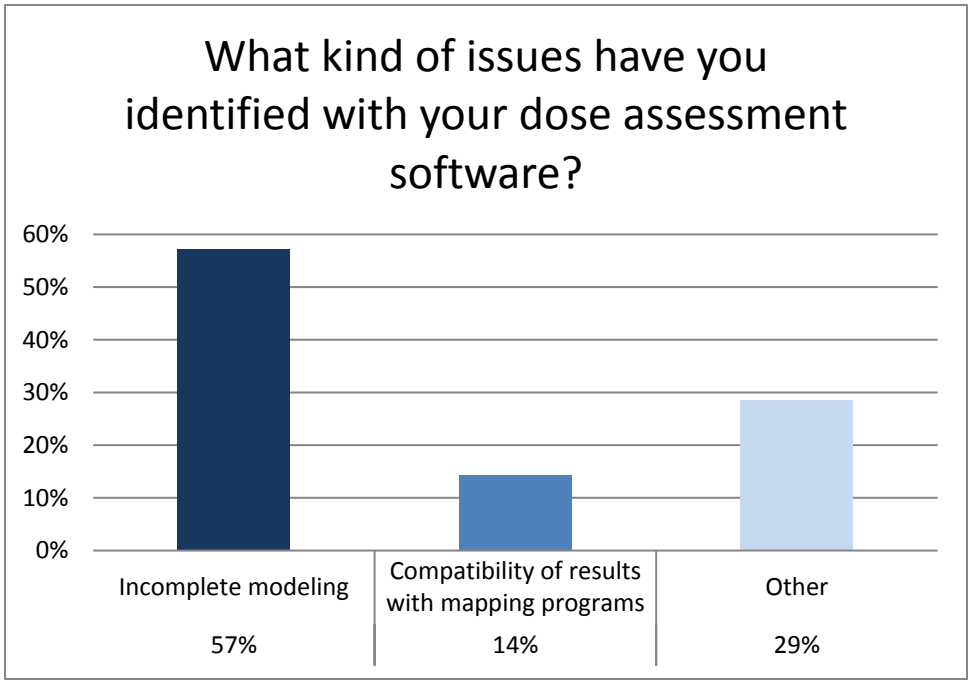


Figure B – 4. Kinds of issues identified with dose assessment software.

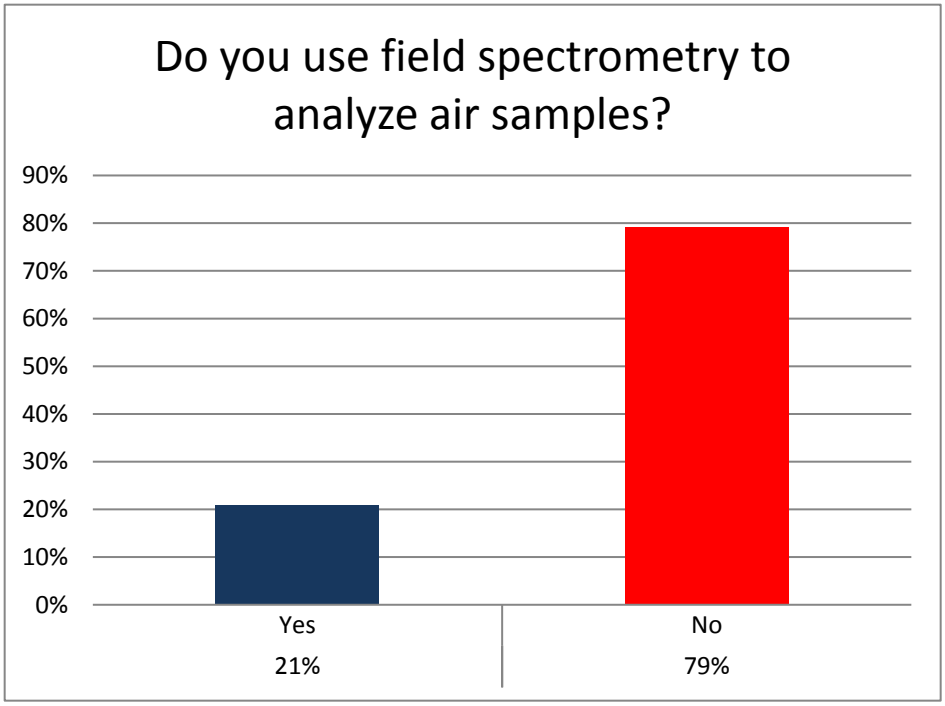


Figure B – 5. Frequency of use of field spectrometry to analyze air samples.

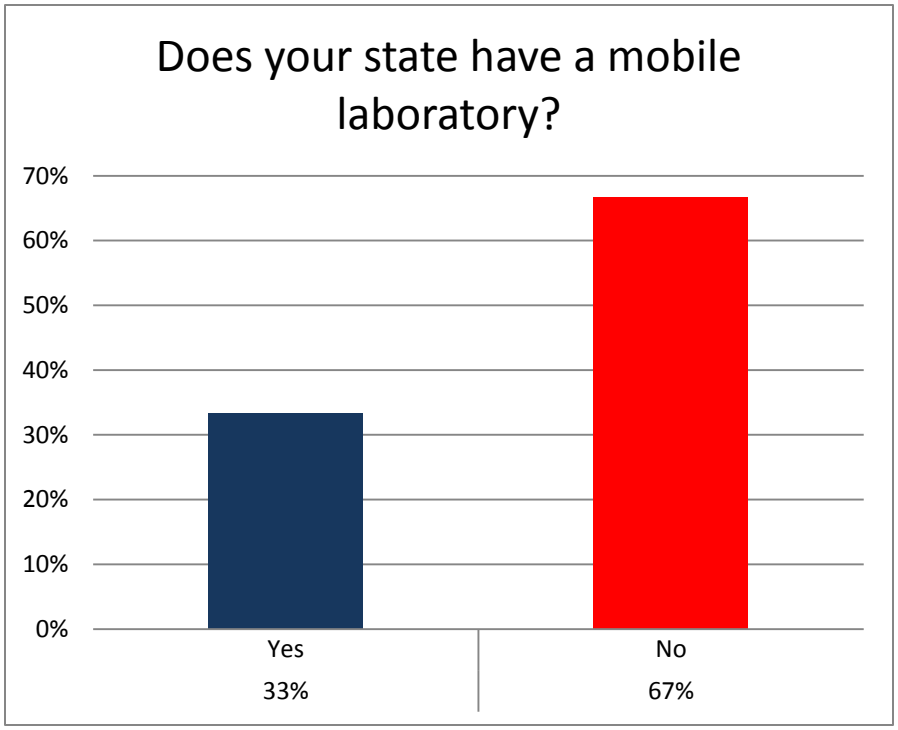


Figure B – 6. Frequency of states having mobile laboratory.

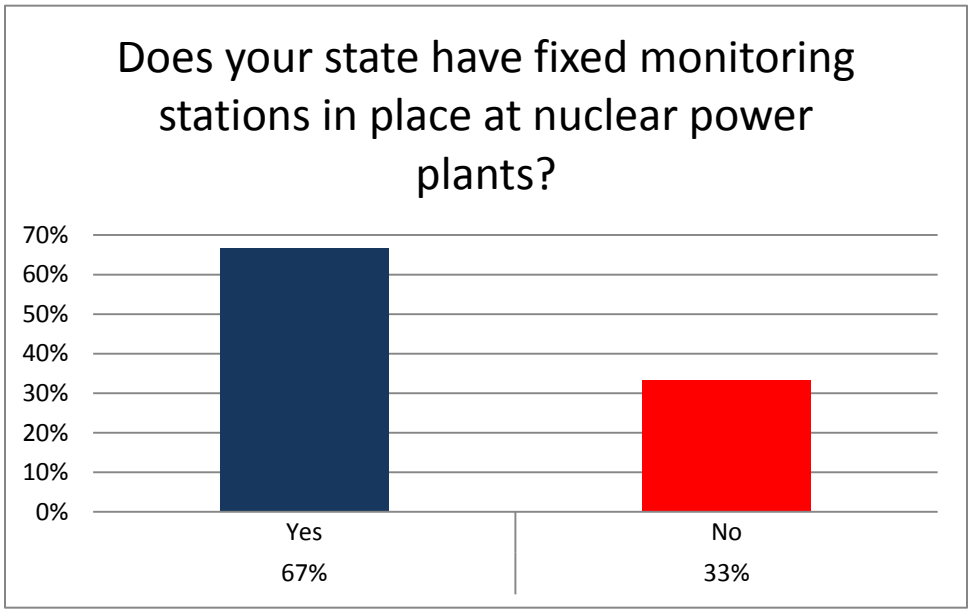


Figure B – 7. Frequency of states having fixed monitoring stations at nuclear power plants.

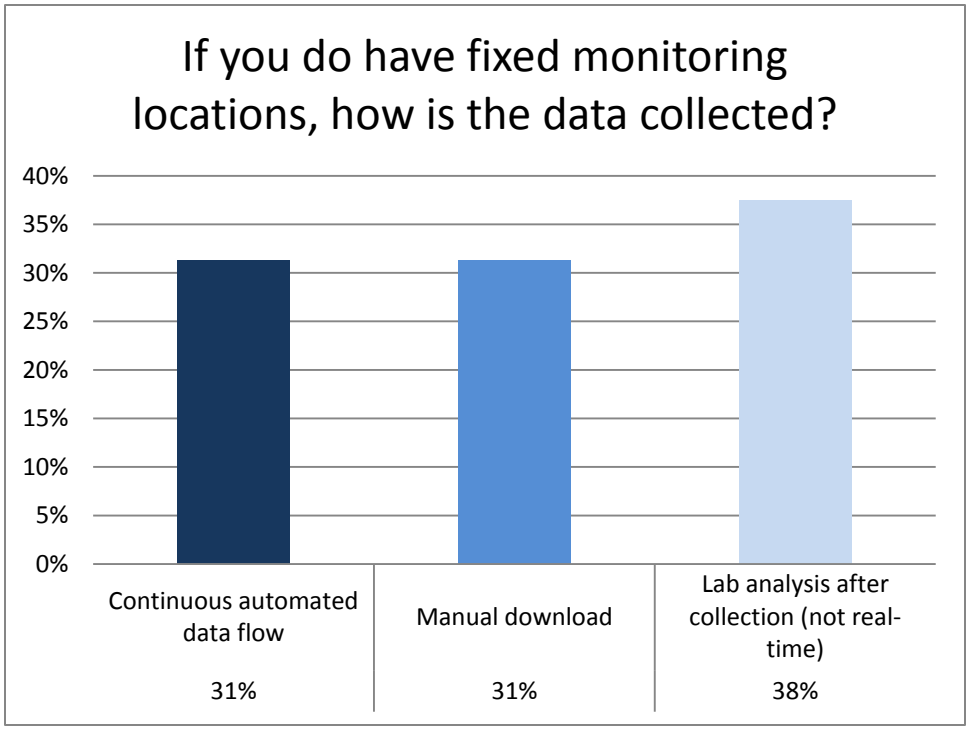


Figure B – 8. How data is collected at fixed monitoring locations.

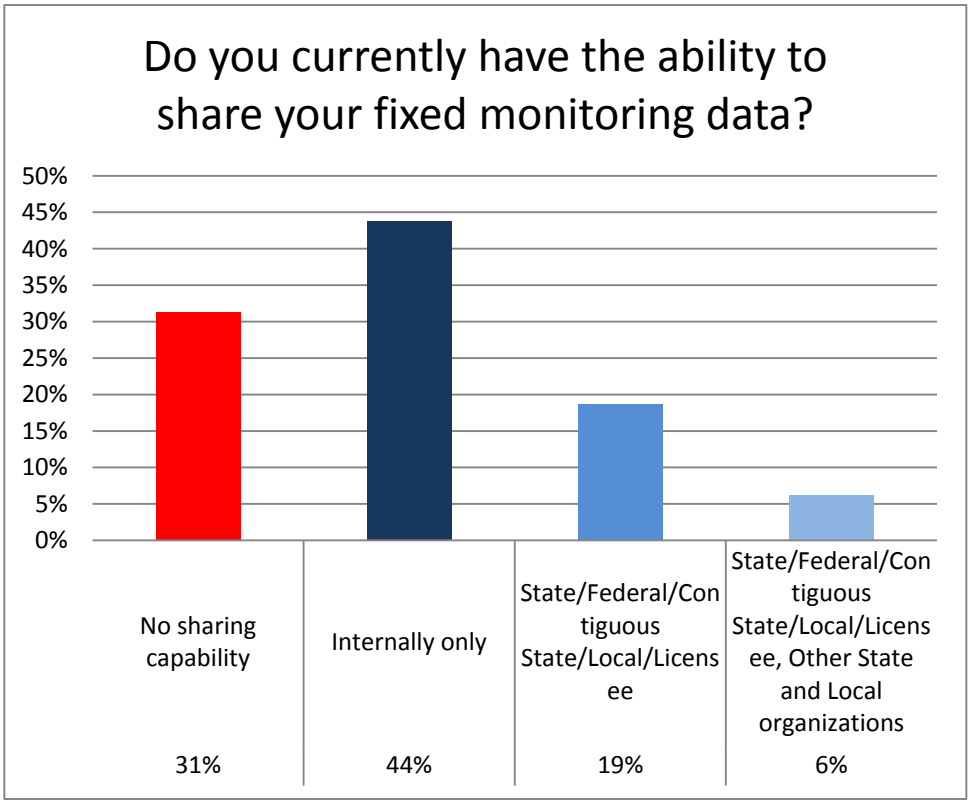
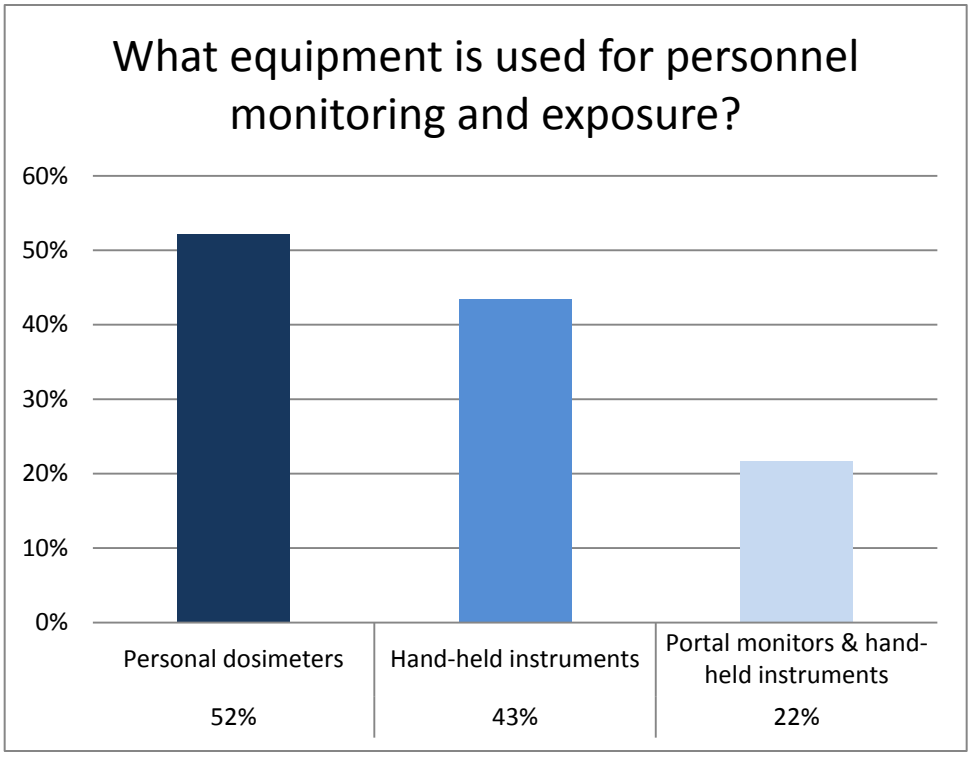


Figure B – 9. Frequency of states having ability to share fixed monitoring data.



Note: these percentages exceed 100% because the instruments have multiple functions.

Figure B – 10. Types of equipment used for personnel monitoring and exposure.

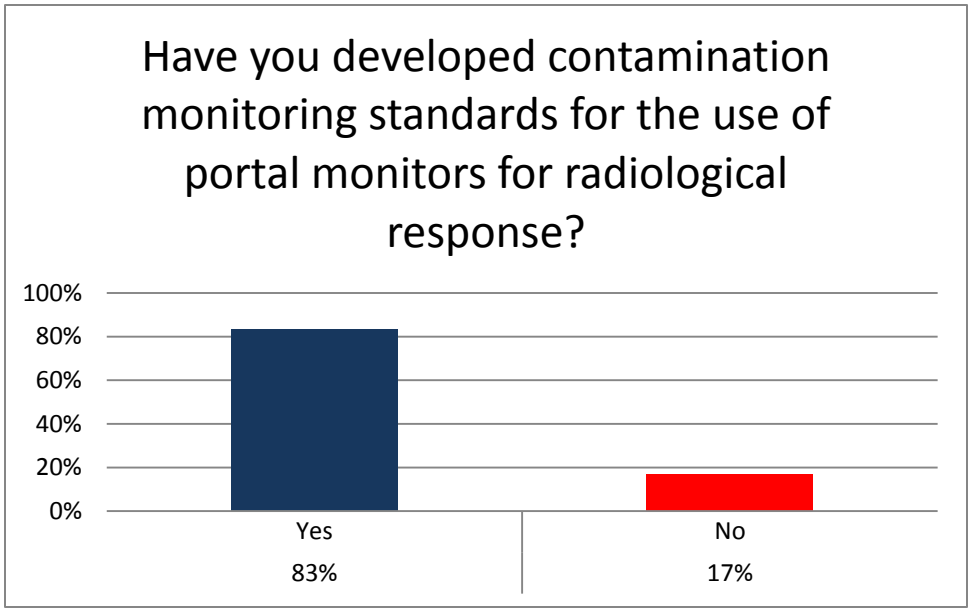


Figure B – 11. Contamination monitoring standards for the use of portal monitors.

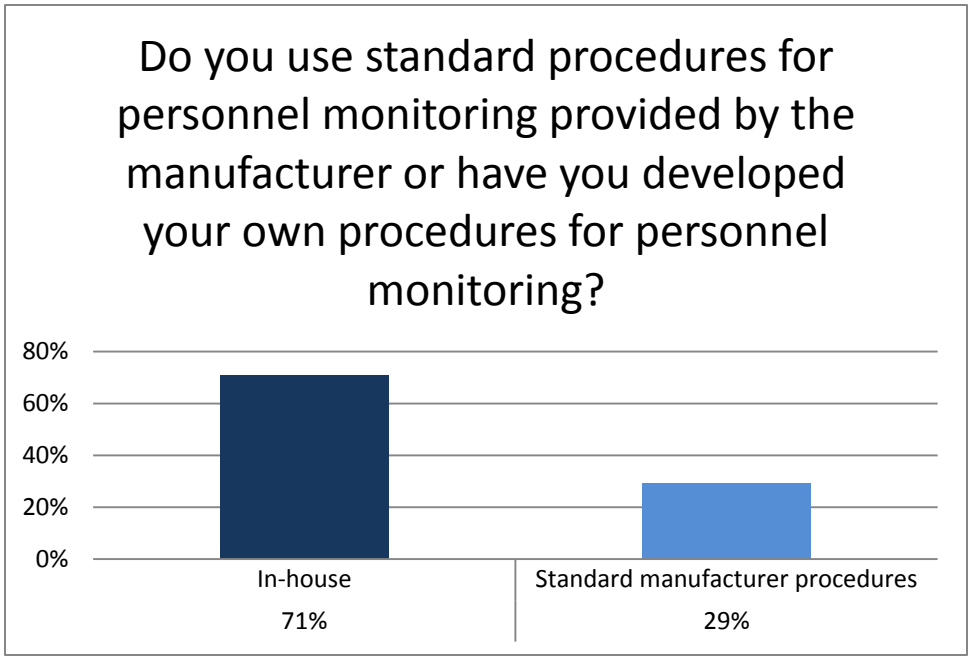


Figure B – 12. Use of manufacturer's or own procedures for personnel monitoring.

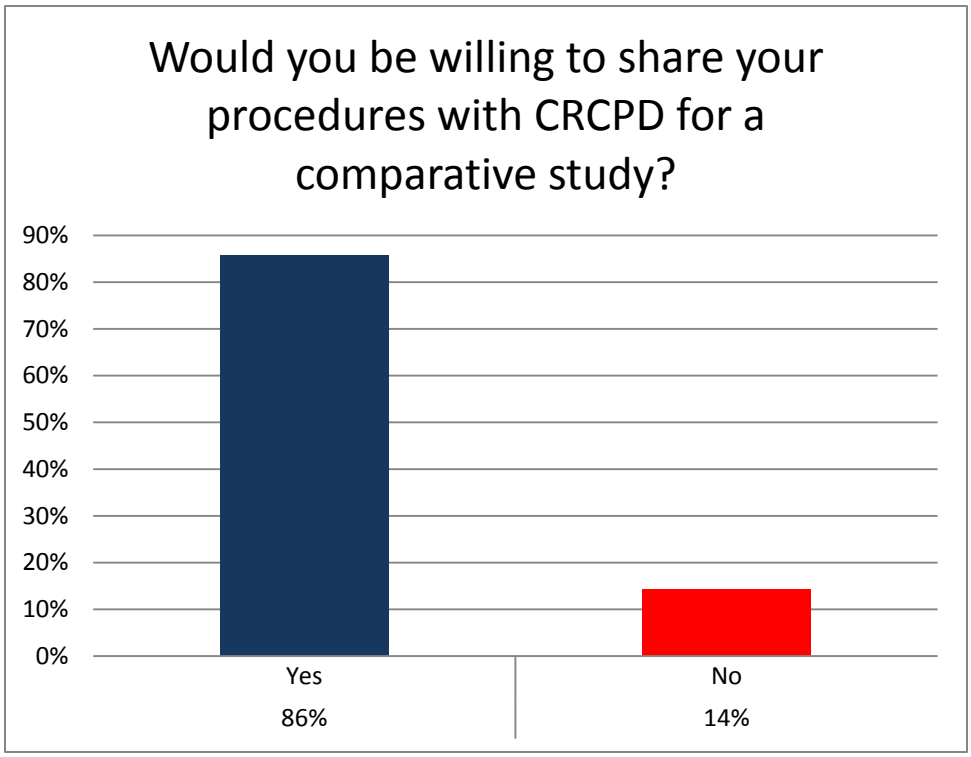
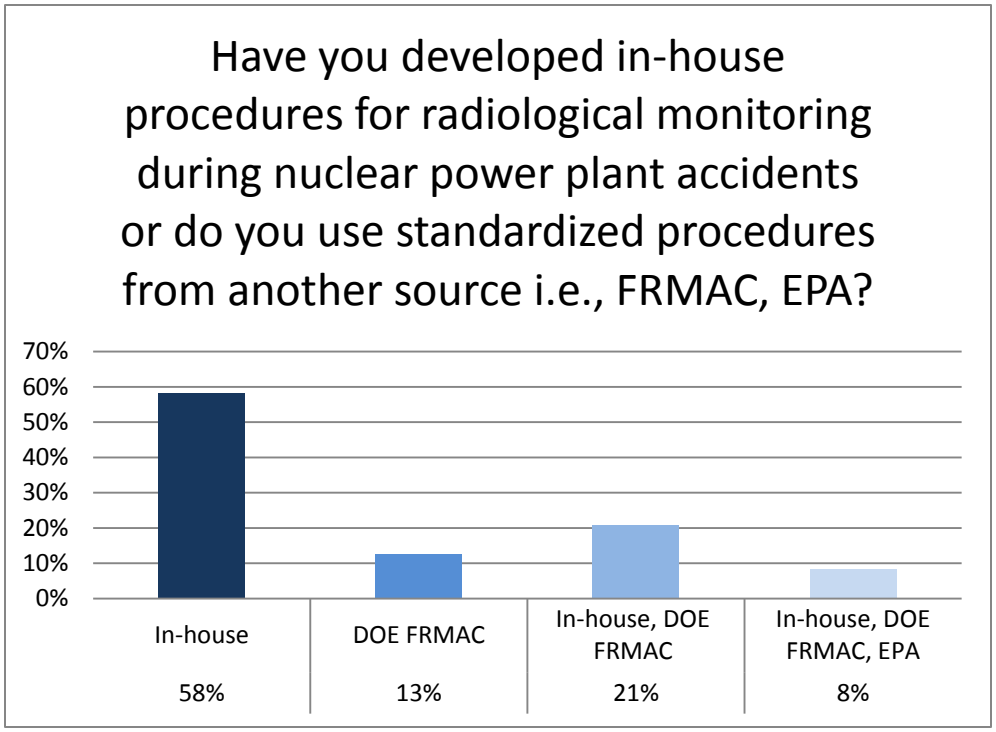


Figure B – 13. States willing to share procedures with CRCPD for a comparative study.



DOE	Department of Energy
FRMAC	Federal Radiological Monitoring and Assessment Center
EPA	Environmental Protection Agency

Figure B – 14. Use of standardized or in-house procedures for radiological monitoring.