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Research Reactor QA Standard Selection, Survey and Benchmarking

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Research Reactor QA Standard Selection, Survey and Benchmarking

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Abstract

In June of 2012, the Nuclear Quality and Requirements Department at SNL TA-V conducted a survey of research facilities in the U.S. and internationally to determine 1) how they chose to implement QA and SQA and 2) to serve as a starting point for further questions. The results, collected in July 2012, were a broad spectrum of locations, standard selection, and regulating bodies in the U.S. and internationally. The results showed that standard selection, regulating agency, and resources allocated to implement QA (beyond a certain minimum) did not appear to have an impact on self-reported QA program effectiveness. The single greatest indicator of self-reported QA program quality effectiveness appeared to be the number of different techniques used to verify QA program effectiveness. The responses to the survey are detailed in the following report, along with a list of suggested follow-on questions for specific facilities.

ACKNOWLEDGMENTS

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OPAL research reactor, Australia
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NIST Center for Neutron Research, Maryland
And the anonymous respondents

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ACRONYMS

ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CMMI	Capability Maturity Model Integrated
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers, Inc.
ISO	International Standards Organization
kW	Kilowatt
MW	Megawatt
NQA	Nuclear quality assurance
NRC	Nuclear Regulatory Commission
OHSAS	Occupational Health and Safety Advisory Services
QA	Quality assurance
SNL	Sandia National Laboratories
SQA	Software quality assurance
TA-V	Technical Area Five at Sandia National Laboratories
TRTR	The National Organization of Test, Research and Training Reactors

1. INTRODUCTION

The purpose of this report is to detail the results of a benchmark survey that analyzed how nuclear research reactors in both the U.S. and internationally have implemented their quality assurance (QA) and software quality assurance (SQA) programs. The survey was disseminated in June of 2012, and the responses were collected by the end of July 2012. As this was an external survey, Sandia National Laboratories (SNL) specific information was not included in the results. The questions in this survey obtained subjective responses about the QA programs at individual nuclear research reactors. This report provides the results of the survey and has a list of follow-on questions that will be directed to specific survey respondents.

The U.S. government requires that all NRC and DOE regulated nuclear facilities implement a QA program. These requirements are stated in 10 CFR 50 and 10 CFR 830, respectively. In addition, 10 CFR 830 specifically states that DOE facilities must select and document a specific consensus standard of their choice to implement their QA program. It does not recommend or require a specific standard.

In 2008 when SNL, Technical Area Five (TA-V), implemented a new QA system, it selected ANS 15.8-1985 (Reaffirmed 2005) as the QA standard of record after reviewing a number of standards for their applicability toward research reactors. As part of our continuous improvement program, SNL (TA-V) wanted to understand how other research reactors conduct and implement their QA programs.

1.1. Respondent Characteristics

SNL (TA-V) sent the survey to fourteen facilities that served as a representative sample of research reactors. In addition, the survey was sent out to The National Organization of Test, Research and Training Reactors (TRTR) with an additional demographic question that served to identify the facility and differentiate between pre-selected facilities.

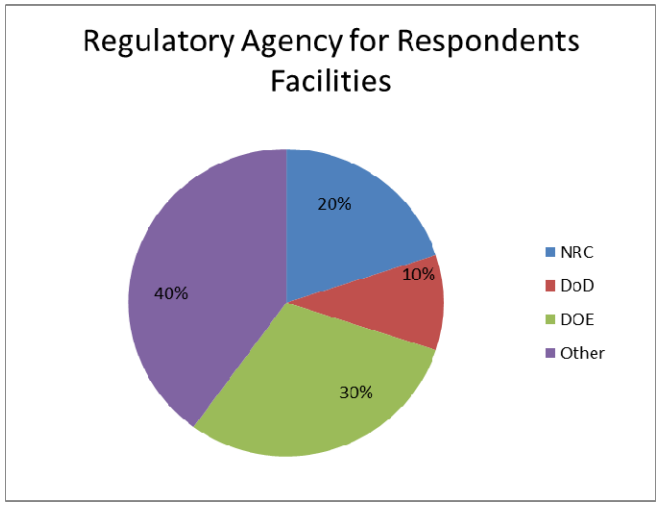

Figure 1. Regulatory Agencies

Eight of the fourteen facilities responded, and two additional responses were obtained from the TRTR. Of the total ten responses to the survey, six were from the U.S. and four were from international facilities. Half of the U.S. facilities were governed by DOE and the remaining U.S. facilities were regulated by either DoD or NRC. The international facilities were all regulated by their respective national regulating bodies (figure 1). SNL (TA-V) felt that these survey respondents represented a good cross-section of nuclear research reactors, both nationally and internationally.

The power ratings of the surveyed research reactors fall between 8 kW and 250 MW. The mean respondent reactor power is 39 MW, the median and the mode both are 20 MW. The total number of employees at the facilities is between six and 400. Figure 2 shows the total employees divided the power rating in megawatts for the 2-250MW rated reactors. Outside of the MW range the numbers become skewed (e.g. the 8 kW reactor has an employee/MW rating of 875). The plot shows that while the total employee count generally increases with the power rating of the reactor, the employees per megawatt generally decreases. It also shows that there is a significant variability in total employees for a given power rating (the kW rated reactors had a similar variability). Whether this is due to the missions each reactor fulfilled, its method of counting employees or other unknown factors is a question for further study.

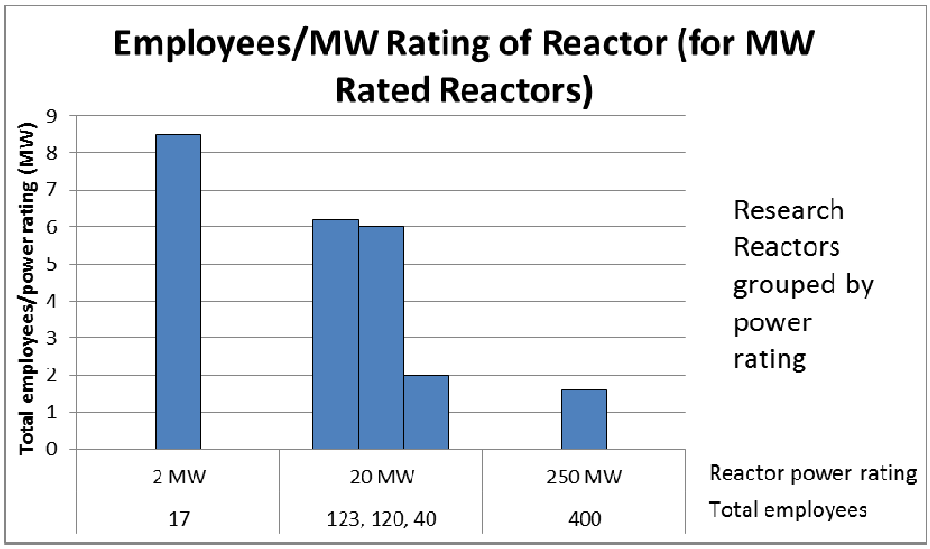

Figure 2. Employees per Power Rating of Reactor (for MW reactors)

Most of the reactors in the survey are pool/TRIGA type reactors, but pile type and bare core type reactors are also represented.

1.2. Selection of a Quality Assurance Standard

Internationally, there are two generally accepted reactor-specific QA standards: ISO 9000 and IAEA NS-R-4. In the U.S., there are two additional ANSI standards, ANS 15.8 and NQA-1. There are also many other standards relating to environment and health and safety that can be used in creating a QA program, but these standards are not specific to the operation of nuclear reactors.

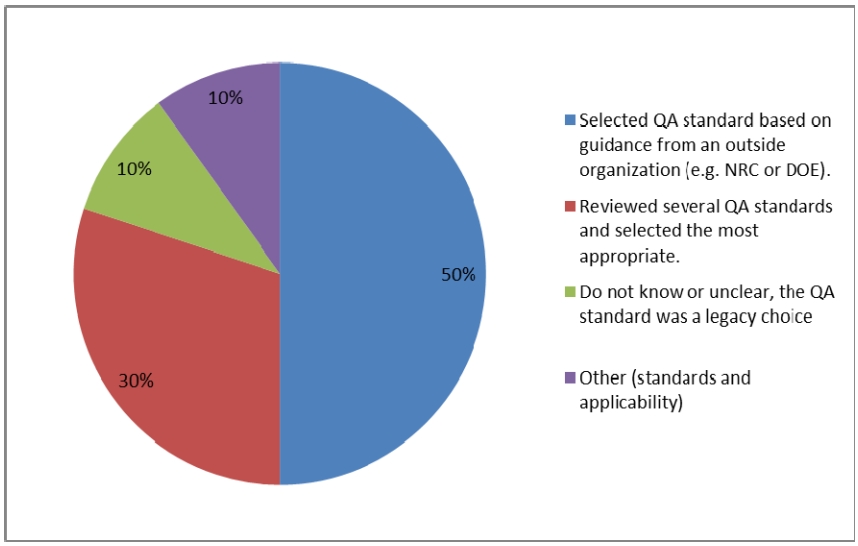

Figure 3. Facility Quality Standard(s) Selection

The initial survey asked questions to determine which standard(s) were used to implement QA, and why they were chosen (figure 3, figure 4). One question asked if a facility chose their QA standard internally or upon the guidance of their regulating body.

In the U.S., most respondents based their standard(s) selection on regulator guidance. Specifically, all DoD and DOE regulated respondents reported that they chose a single standard based on regulator guidance. The DOE regulated facilities chose NQA-1 and the DoD regulated facility chose ANS 15.8. The NRC regulated respondents used the NRC endorsed standard, ANS 15.8, but did not site regulator guidance as the reason they chose this standard. In addition to ANS 15.8, two of the three NRC regulated facilities also used ISO 9000 to create their QA program.

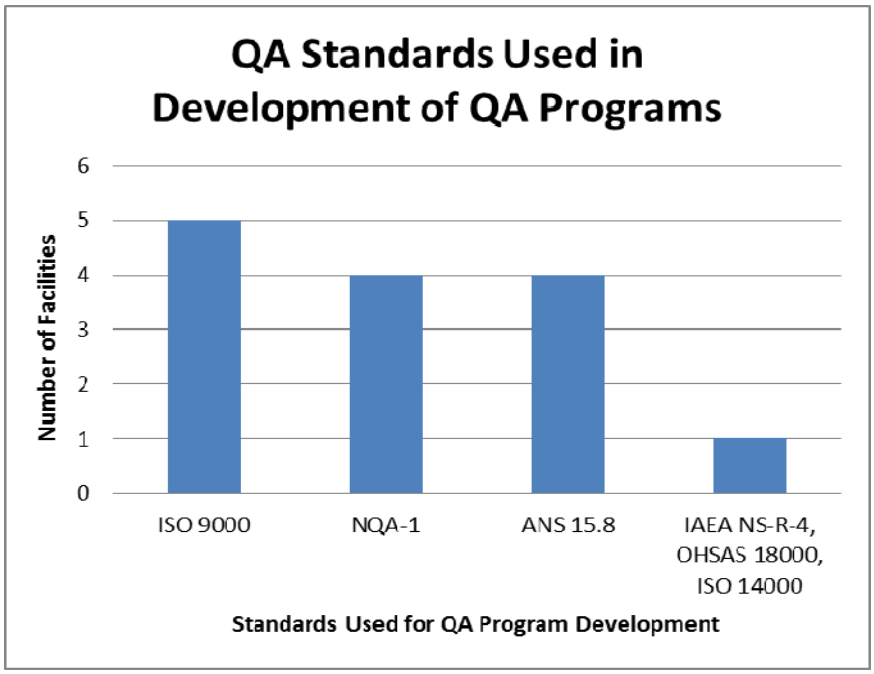

Figure 4. Standard(s) Selected for QA Programs

Most international respondents chose to use ISO 9000 as a basis for developing their QA program. However, one facility chose to use ANS 15.8 instead, and one facility used NQA-1, OHSAS 18000, ISO 14000, IAEA-R-4, and ISO 9000 in order to develop their QA program.

In the U.S., there was no single, preferred standard selected, and the regulators endorsed different QA standards. Internationally, ISO 9000 is the preferred standard.

2. QA IMPLEMENTATION, EFFECTIVENESS, AND VERIFICATION

The survey asked several questions to determine how each facility chose to implement their QA standard, how many resources they chose to dedicate to QA, how effective their QA program was, and how the program verified its effectiveness.

2.1. QA Implementation

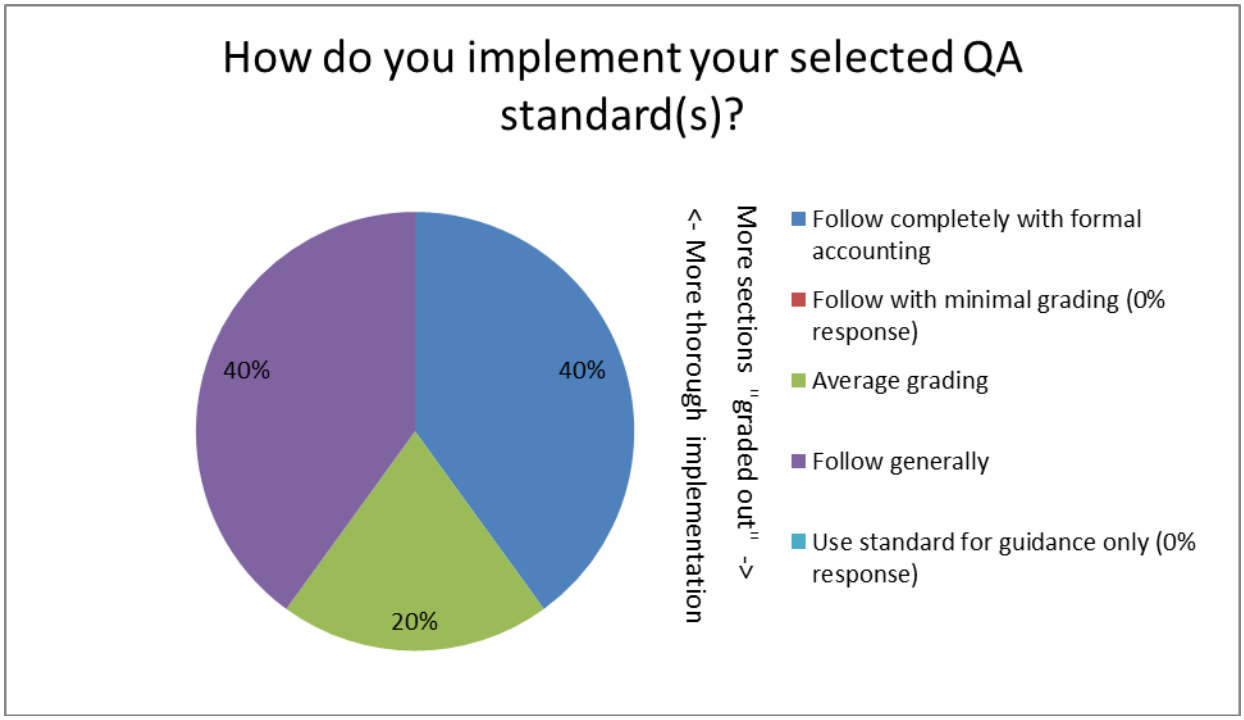

Figure 5. QA Standard Grading

Each facility was asked how it chose to implement its QA; with either a written and specific program, an informal program, or no distinct program. All of the facilities surveyed chose to implement a written and specific QA program based either on a single standard or a compilation of several standards. Even the facilities with minimal staffing (i.e., low power facilities) had a written and specific QA program. Each facility was also asked how formally they implemented their chosen consensus standard(s) (figure 5). Facilities chose to either implement fully, or to only generally follow their chosen standard(s). Two facilities chose to use an average amount of grading (vice minimal). No facilities used their standard(s) with minimal grading or 'for guidance only' when creating their QA program. There was no correlation between the regulating agency and the formality of implementation.

Several of the survey answers were compared to determine if there was any correlation between the regulatory agency and the "grading out" of sections of their selected standard when creating their QA program; the results showed that there was no correlation. The respondents were then grouped according to international, DOE, or NRC regulated facilities. Each group had one facility that chose to formally follow their standard, and at least one facility that performed

'average' grading or only generally followed the standard. Of the facilities that chose to follow their standard(s) formally, two selected NQA-1, one used ANS 15.8, and one used both ISO 9000 and ANS 15-8.

The amount of grading each facility used was compared to the number of standards used (figure 6) Facilities that chose to use only one standard were much more likely to implement it formally; the only facility that chose to use a single standard and only follow it generally also rated its QA program effectiveness as 'immature.' This implies that the amount of grading used to implement the chosen standard(s) is primarily a function of the number of standards chosen.

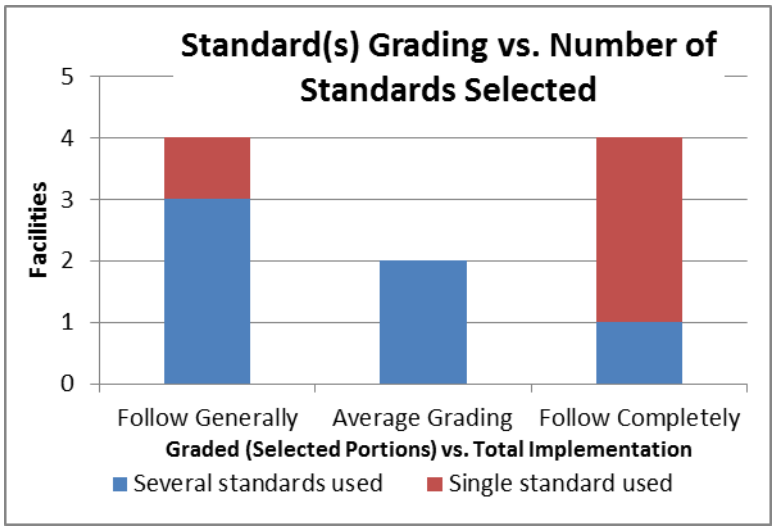

Figure 6. Grading Standard(s) vs. Number of Standards Used for Program Development

2.2. QA Effectiveness

One of the survey questions asked respondents to rate the effectiveness of their QA program. The responses were analyzed with several other responses to determine correlation between the effectiveness and several other factors.

Comparing formality and standard(s) chosen to effectiveness (figure 7) showed that neither the formality of implementation nor the standard chosen had any impact on the effectiveness of the QA program. There was also little or no impact on the effectiveness of the QA program if one standard or several standards were used.

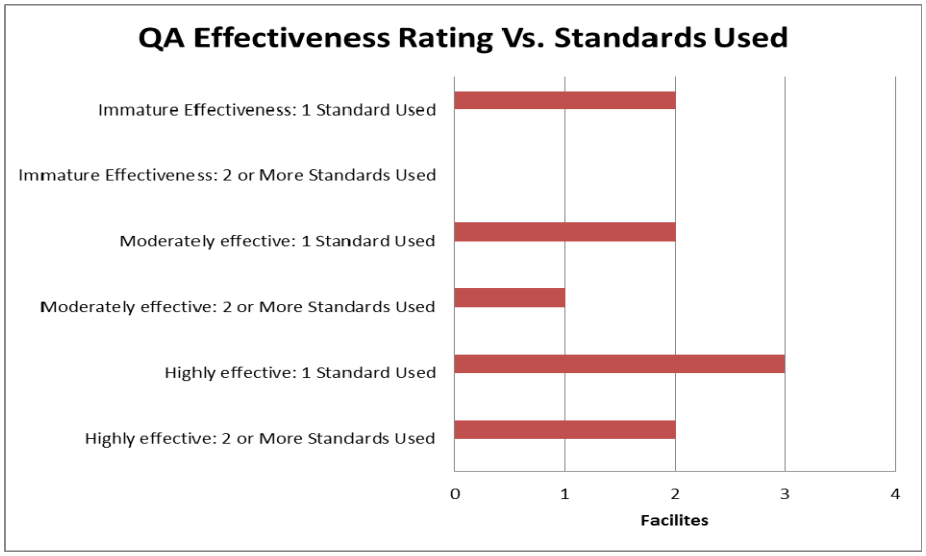

Figure 7. QA Effectiveness vs. Standards Used

Two facilities reported immature effectiveness and their answers were analyzed to determine if there was a common factor(s). One facility implemented ANS 15-8 and the other NQA-1. Both facilities reported that they only generally followed their standard, but the majority of facilities

also chose to use that level of formality (or less) when designing their QA program. The immature programs used an average amount of grading when they implemented their QA program, but several mature facilities also used an average amount of grading when implementing their QA program. The data does not indicate that the amount of grading used when creating a QA program related to the maturity level of that QA program. Other than average grading, the only thing the facilities with immature effectiveness had in common was a desire to put more resources into the QA program. One of the facilities noted that it allocated only one staff member who only allocated 10% of their time to QA program at the facility.

The total percentage of employees dedicated to QA implementation (figure 8) appeared to have little effect on the overall effectiveness of the QA program. Although immature programs dedicated less than 10% of their staff to QA, an equal number of highly effective programs also dedicated less than 10% of their staff to QA. There was no correlation between percentage of employees dedicated to implementing their QA program and the effectiveness of their QA program.

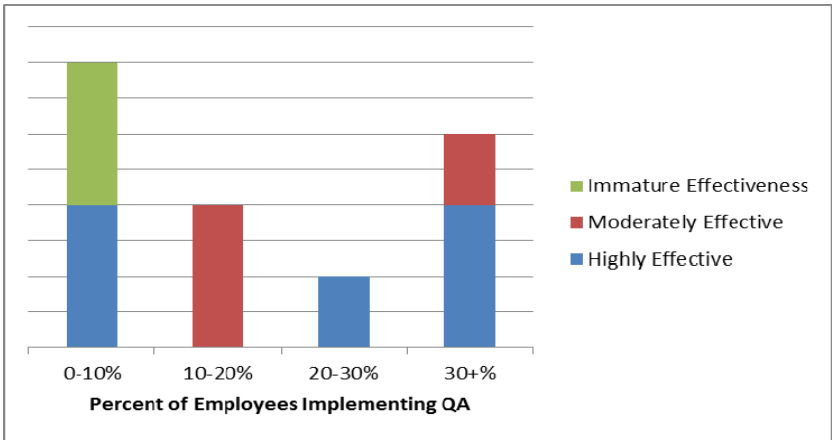

Figure 8. QA Effectiveness vs. QA Resource Dedication

SNL (TA-V) compared the percentage of employees dedicated to implementing QA to the total number of employees at each facility (figure 9). Facilities with 10 or less employees dedicated between 10-30% of their full time staff to implementing quality. The data indicates that these small facilities have one, or perhaps two employees dedicated to QA. Conversely, with the exception of the facility that used five QA standards to create their QA program, no facility with more than fifty people dedicated more than 10% of their staff to QA.

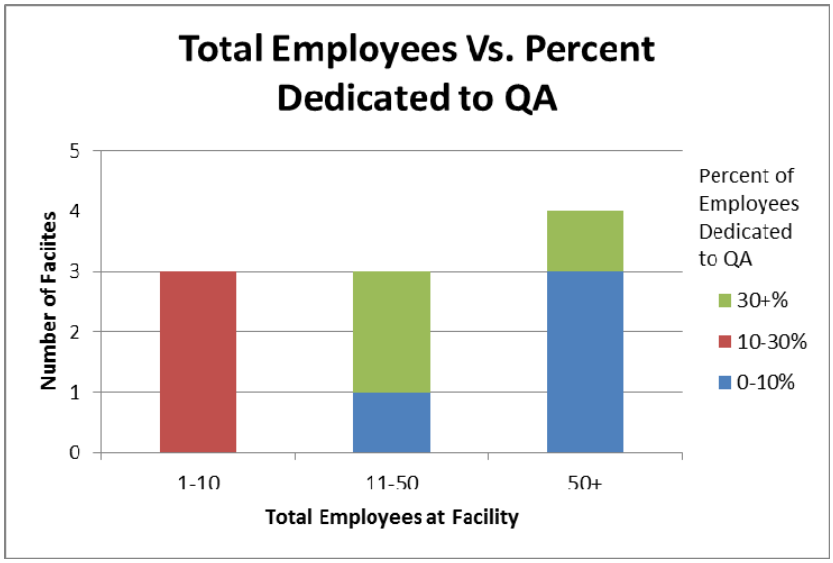

Figure 9. Total Employees vs. QA Dedication

No facility reported that they would prefer to put QA resources elsewhere (figure 10). Of the respondents, 60% felt they had adequate (vice insufficient) resources dedicated to implementing QA. QA effectiveness increased as more (relative) resources were allocated. However, even a highly effective facility reported that it would prefer more resources, while some moderately effective facilities felt they had the correct amount of resources.

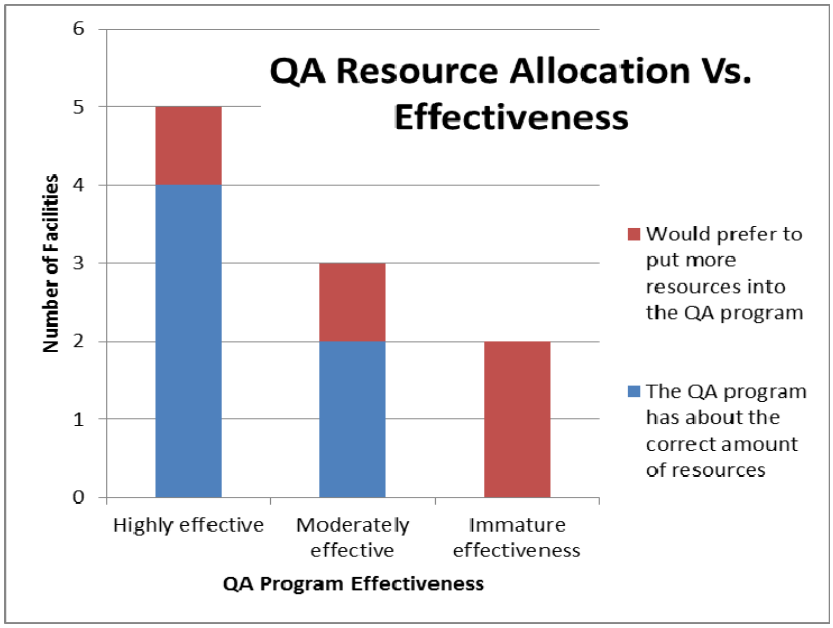

Figure 10. QA Resources vs. Effectiveness

These results indicate that the standard(s) used, regulating agency, and formality of standard(s) implementation had no apparent influence on the QA program effectiveness from the perspective of the respondents. Although ineffective QA programs felt they had insufficient resources, the amount of resources allocated appeared to have limited impact on the effectiveness of the QA program, once that program was at least moderately effective. The goal of future questions is to determine which additional factors impact effectiveness.

2.3. Verification of QA

The survey listed the following methods of verification of their QA program:

- self-assessments
- voluntary external independent assessments
- mandatory external regulatory assessments
- management review and action
- data analysis and trending
- performance metrics
- risk management
- issues management
- other

The facilities indicated which method(s) they used to verify the effectiveness of their QA program (figure 11). No single method of verifying QA effectiveness was used by all facilities (e.g., not every facility used self-assessments), and only one facility indicated it implemented every verification method listed.

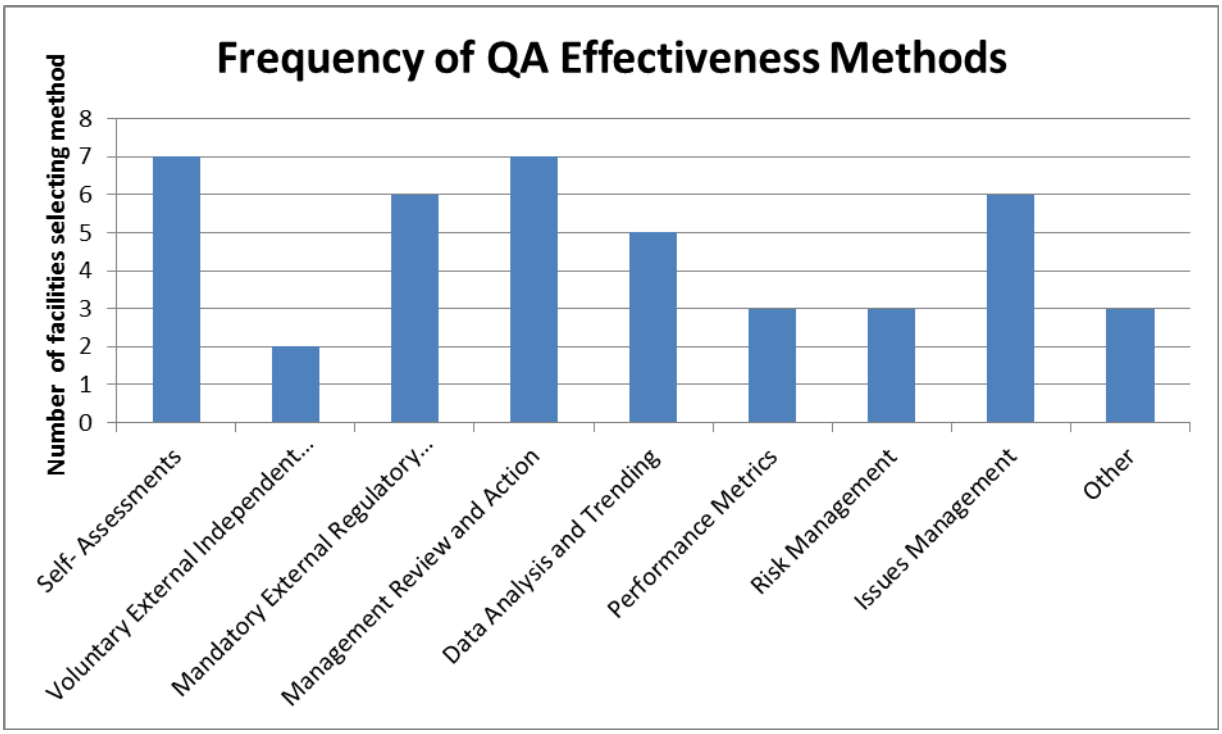

Figure 11. Frequency of QA Effectiveness Methods

Based on the survey results, the following were the most commonly used methods of QA program verification: self-assessments, management review and action, mandatory external regulatory assessments, and issues management. Self-assessments, the most common method used, are performed by all facilities except one international and the two NRC governed facilities. Mandatory external regulator assessments of QA were performed by all international facilities and one NRC facility, but no DoD or DOE facilities; the latter two generally used management review and issues management for assuring QA effectiveness.

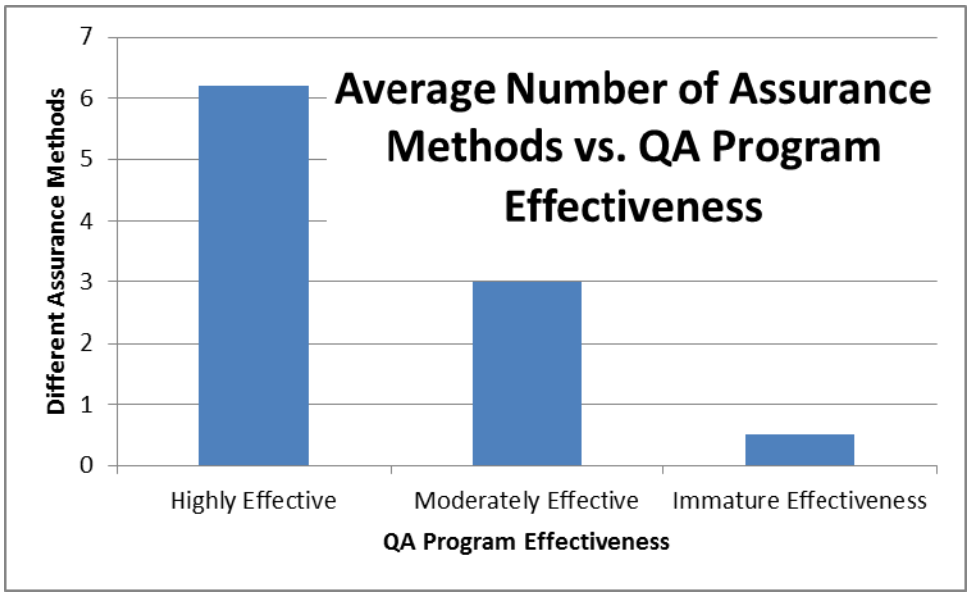

Figure 12. Number of QA Program Assurance Methods vs. QA Program Effectiveness

The only practice common to facilities with, self-assessed, highly effective QA programs was management review and action, although most also utilized self-assessments, issues management, and data analysis and trending. Any

method that was used less than 50% of the time was only used at highly effective facilities.

The number of different verification methods a facility used strongly correlated to the effectiveness of the program (figure 12). On average, highly effective programs used twice the number of methods to assure effectiveness as moderately effective programs. No immature QA program implemented more than one method of assuring QA program effectiveness. Although correlation is not causation, this indicates that tracking the number of ways a facility assures its QA program is a strong indicator of effectiveness.

The survey also asked if the facility had objective evidence to verify the effectiveness of their QA program. Having objective evidence of QA program effectiveness was also a strong indicator of program effectiveness. All of the highly effective programs had evidence. Less than half of the moderately effective programs had evidence, and none of the immature effectiveness programs reported that they had evidence that demonstrated their QA program's effectiveness.

3. SQA AND SAFETY SOFTWARE IMPLEMENTATION AND EFFECTIVENESS

The second half of the survey asked a series of questions about implementation of software and safety SQA (figure 13). Only one facility reported that they implemented SQA as a separate program (via NQA-1). In addition, one facility indicated that software was not included in its QA control, but intended to implement SQA (also via NQA-1) in its next upgrade. This reduced the amount of data collected from the survey questions that were specific to SQA. Two of the facilities said that SQA was beyond the scope of their operations. Lastly, only one facility specifically indicated that they did not use a consensus standard for SQA. The remaining four facilities also did not have a separate SQA program, but did not specify what, if any, consensus standard they reviewed for the SQA portion of their QA programs.

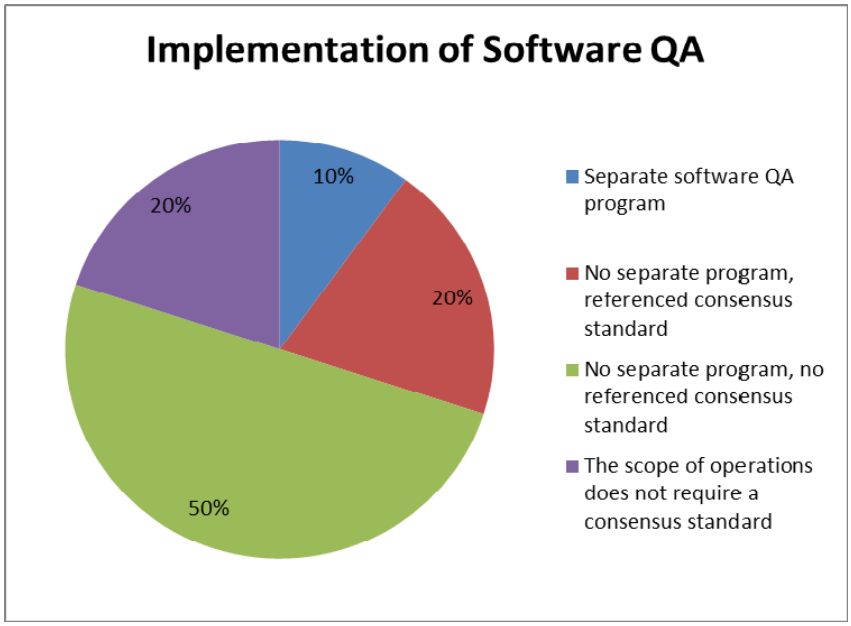

Figure 13. Implementation of SQA

All of the facilities that listed a SQA consensus framework/standard selected NQA-1. One of the facilities also referenced Capability Maturity Model Integrated (CMMI) and IEEE 7-4.3.2 in addition to NQA-1. One site noted that they used the CMMI as a reference standard. CMMI is a framework for process improvement which stems out of the software world. This shows that a additional tools were also utilized to increase QA effectiveness at a research reactor.

Most facilities did not specify a method for identifying safety software. Those that did specify a method used either DOE G 414.1, a site-specific form, or incorporated SQA in their change control process. Likewise, most facilities did not give an approach for grading safety SQA. Those that did grade their safety software used DOE G 414.1 or an ISO-based grading. If a facility chose to have a process for safety software (only 30% did) then that facility created an individual process for each piece of software depending on its application. This indicates that there is still a maturing process and application basis across the research reactor community for the identification of safety software.

Of the three facilites that documented an SQA consensus standard and approach for grading software, one categorized itself as highly effective with evidence of effectiveness, and the remaining two graded themselves as moderately effective. The other facilities did not reply to specifically give an effectiveness of their SQA program.

4. QUALITY ASSURANCE FOR EXPERIMENT, TEST, AND RESEARCH ACTIVITES

Although not part of the scope of questions for implementation of QA and SQA programs, SNL (TA-V) included a few questions specifically referring to QA for experiment, test, and research activities to determine what, if any, additional QA was incorporated with these processes (figure 14). Only one facility used a specific QA standard for experiments; it chose NQA-1, which has an optional section for experimental QA.

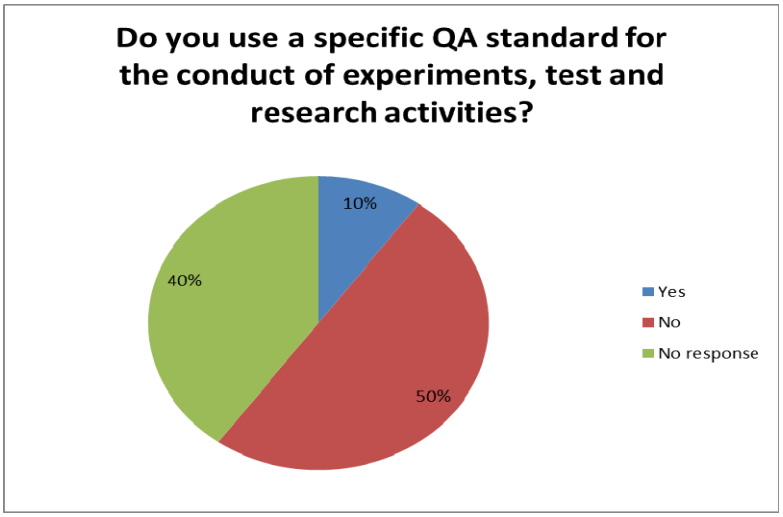

Figure 14. QA Standard for Conduct of Experiments

5. CONCLUSIONS AND FOLLOW-ON QUESTIONS

5.1. Conclusions

This quality assurance benchmarking survey was initially intended to answer the question "what standard(s) do you use to implement QA at your research reactor facility, and why." It was intended to be a simple survey in order to obtain the maximum amount of data and act as a starting point for more detailed inquiry. Although the subjective responses were based on the perspective of the respondents, SNL (TA-V) feels that the survey achieved both primary objectives.

All research reactors that responded to the survey indicated that they had a formal, written QA program. In the U.S., the respondents that were regulated by either the DoD or DOE indicated that they chose their standard based on regulator guidance, either ANS 15.8 or NQA-1, respectively. The NRC regulated facilities used its recommended standard, ANS 15.8, but most used ISO 9000 as well. Internationally, most facilities used ISO 9000, and one facility used several other standards as well.

Three key data points came out of the survey response set. Firstly, the regulator, standard selection, and the amount of grading used when the standards were implemented seemed to have little or no impact on the effectiveness of the QA program. Secondly, once enough resources are allocated to create an adequate QA program, allocating further resources appeared to have limited impact on increasing effectiveness. Larger facilities apparently needed a smaller percentage of employees for implementing an effective QA program. Thirdly, there was a strong relationship between the number of verification methods to assure effectiveness of a QA

program, and the effectiveness of the program itself. The presence of evidence was also a strong indicator of QA program effectiveness.

The responses indicated via comments that there is a variety of attitudes toward QA at the research reactors. One respondent said that QA was the centerpiece of their operations, and had significantly more resources allocated to QA than the other respondents. Conversely, one respondent indicated that QA was an afterthought, and essentially put little to no resources into QA. Understanding the culture of QA at nuclear research reactors is one of the primary goals of the follow-on questions and research.

5.2. Follow-On Questions

Having established contacts with a willingness for further questions, SNL (TA-V) intends to follow-up with individual facilities to better understand the implementation of their QA programs. In addition to the questions discussed in the next section, which will be addressed to applicable facilities, SNL (TA-V) will also ask questions to get a sense of the facilities' QA culture, and how it functions during normal operations.

5.3. List of Questions for Further Consideration

*Questions will be asked to facilities as applicable.

1) How does your facility deal with contradictions between selected standards?

2) For the highly effective QA programs, what optimization(s) do you use to implement your QA program with <10% dedicated to QA?

3) In particular, two international facilities have identically rated reactors with about the same number of employees, similar assurance methods, and highly effective QA programs. However, one allocates greater than 30%, and the other allocates less than 10% percent of their staff to QA. What is the difference in development and implementation of the QA program that enables both to be highly effective?

4) Why do similarly rated reactors have substantially different numbers of employees? Was it due to counting methods, different missions, or something more significant?

5) How and why did you choose the consensus standards you reviewed?

6) How did you choose to implement that grading process?

7) What, if any, are the pressing issues with your QA program that are hindering your effectiveness?

8) For the larger facilities, do you have any particular economies of scale that help you streamline your QA program?

9) How did you choose the verification methods you used for assuring QA program effectiveness?

10) Did your verification methods help to defend your standard selection?

11) How do you incorporate SQA into your QA program if you don't have a separate SQA program?

12) Do you use a consensus standard for safety SQA, and, if so, what is that standard?

13) How do you consider safety software in your QA process? What is your process for determining/identifying safety software, if any?

14) What are your specific safety software determination/identification questions, if any?

15) Do you have a graded approach for software/safety software, and, if so, what is your process for grading safety software?

16) Do you re-evaluate your safety software for determinations and grading level, and if so, how often?

17) What issues do you face in your safety SQA program? What would help resolve those issues?

18) What standards and/or frameworks are reviewed to define SQA activities for safety software applications?

19) If there was no differentiation or no response about a specific QA standard for the conduct of experiment, test, and research activities, how do you incorporate these typically "one-off" activities with normal operations?

6. REFERENCES

*References are for information only—the exact revision date was not specified in the survey.

10 CFR 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR 830, "Quality Assurance Requirements," Subpart A.

ANSI/ANS 15.8, *Quality Assurance Program Requirements for Research Reactors.*

ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications.*

DOE G 414.1-2B, Chg. 1, *Quality Assurance Program Guide.*

DOE G 414.1-4, *Safety Software Guide for Use with 10 CFR 830, Subpart A, Quality Assurance Requirements and DOE O 414.1C, Quality Assurance.*

DOE O 414.1D, *Quality Assurance.*

IAEA NS-R-4, *Safety of Research Reactors.*

OHSAS 18000, *Occupational Health and Safety Management System.*

ISO 9000, *Quality Management: Definitions and Terminology.*

ISO 9001, *Quality Management: Requirements.*

ISO 14000, *Environmental Management.*

IEEE Std 730, *IEEE Standard for Software Quality Assurance Plans.*

IEEE Std 603, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Systems.*

IEEE Std 7-4.3.2, *IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations.*

ISO 9000 International Standards Organization, *Quality Management Systems.*

Memo to Record, July 18; David Wheeler (see appendix A).

U.S NRC Regulatory Guide 2.5, *Quality Assurance Program Requirements for Research and Test Reactors.*

APPENDIX A: SURVEY QUESTIONS

Sandia National Laboratories

Dear Colleagues,

I am the manager of nuclear quality and requirements for the nuclear and radiation effects research facilities at Sandia National Laboratories located in Albuquerque, NM. In the spirit of continuous improvement for our quality assurance program, Sandia is conducting a QA benchmarking survey covering basic elements of quality standards and selection, QA staffing, software QA, and the evidence and effectiveness for quality assurance in a research reactor or experimental reactor environment. Our target audience includes reactors used primarily for testing, research, experimentation and training.

We have obtained a list of research and test reactors from across the DOE and NNSA complex and through the National Organization of Test, Research, and Training Reactors, Inc. (TRTR). The survey is available at this link https://www.surveymonkey.com/s/Z3NSMBF and is being sent to the following nuclear reactor locations:

NRAD System Engineer/TREAT Reactor Systems Lead Engineer (INL)
TRIGA reactor at the university of Pavia in Italy
OPAL research reactor organization in Australia
HFR RR in the Netherlands
B&W Nuclear Operation Group – Lynchburg
FiR1 research reactor, Finland
MIT Nuclear Reactor
UCD/MNRC
University of Florida Training Reactor Facility
NIST Center for Neutron Research
White Sands missile range fast burst reactor
Advanced Test Reactor (INL)
High Flux Isotope Reactor (ORNL)
Armed Forces Radiobiology Research Institute
Hanford Facilities

After we complete the survey and analysis, it is our hope that some sites might be interested in sharing lessons and site specific QA information in a more in depth manner as a longer term effort for collaboration and continuous operational improvement. If this lesson sharing is of interest to you please indicate so on the survey comment field for contact information. Interested parties will have the option to receive benchmarking results by including contact information within the survey. You will also have the option to share your contact information with other sites within the survey. Site specific information will not be released.

For a brief description of our operations here at Sandia National Laboratories, please see the attached website and select the Nuclear Facilities Resource Center (NUFAC) hyperlink.
http://www.sandia.gov/research/facilities/technology_deployment_centers/index.html

Thank you in advance for taking the time in completing the nuclear quality assurance survey for research reactors sponsored by Sandia National Laboratories.

Best Regards,

Dave Wheeler
Manager, Department 1382
Nuclear Quality and Requirements
Sandia National Laboratories
Phone 505-284-4171

U.S. DEPARTMENT OF ENERGY

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Research Reactor Benchmarking

Thank you for agreeing to take this quality assurance (QA) bench-marking survey. The total time for this survey should be less than 20 minutes. Although it asks for demographic information, all of your responses are confidential, and any identifying information for a particular facility will be stripped from the final report. All questions are optional, so feel free to skip any questions that are not applicable to your facility.

Thank you for your time.

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1. What is the name of your facility?

2. Which of the published quality assurance standards did you use in developing your QA program? (select all that apply)

- [ ] ISO 9000
- [ ] NQA-1
- [ ] ANS 15.8
- [ ] IAEA NS-R-4
- [ ] Did not refer to any particular published standard
- [ ] The complexity of our operations does not require that level of formality
- [ ] Other (comments)

3. How was your quality standard(s) selected?

- ( ) Reviewed several QA standards and selected the most appropriate.
- ( ) Selected QA standard based on guidance from an outside organization (e.g. NRC or DOE).
- ( ) Do not know or unclear, the QA standard was a legacy choice
- ( ) Other (standards and applicability)

4. Please describe your type of facility (type, power, rating, etc.).

Type of reactor

Peak/Steady State Power

Total number of staff

5. Who is the regulatory agency for your facility?

- ◯ DoD
- ◯ DOE
- ◯ NRC
- ◯ Other (please specify)

6. What best describes implementation of your QA program?

- ◯ Developed a written and specific QA program based on a single selected standard
- ◯ Developed a written and specific QA program based on selected on best practices and/or a compilation of several published standards
- ◯ Informal QA program based on a single selected standard
- ◯ Informal QA program based on best practices and/or a compilation of several published standards
- ◯ Do not have a distinct QA program, quality requirements are incorporated into other processes
- ◯ Created a QA program based on a template or other method (please specify)

7. Approximately what percentage of your full time employees are responsible for implementing formal QA at your facility?

- ◯ 0-10%
- ◯ 10-20%
- ◯ 20-30%
- ◯ 30% or greater

Comments

8. Please describe how you choose to implement your selected standard in its entirety relative to the selected QA standards.

Follow completely with formal accounting	With minimal amounts of grading	Average grading	Follow generally	Use standard for guidance only
◯	◯	◯	◯	◯

9. How do you do assure the effectiveness of your QA program? (select all that apply)

- [ ] Self- Assessments
- [ ] Voluntary External Independent Assessments
- [ ] Mandatory External Regulatory Assessments
- [ ] Management Review and Action
- [ ] Data Analysis and Trending
- [ ] Performance Metrics
- [ ] Risk Management
- [ ] Issues Management

Other (please specify)

10. How effective do you consider your QA program?

Highly effective ○ Moderately effective ○ Immature effectiveness ○

11. Select which best describes the effectiveness of resources committed to your QA program.

- ○ Would prefer to put more resources into the QA program
- ○ The QA program has about the correct amount of resources
- ○ Would prefer to put some of the QA program's resources elsewhere

Feel free to add comments

12. Do you have evidence that demonstrates your QA program's effectiveness?

- ○ Yes
- ○ No

Comments (type, frequency, function)

13. If so, would you consider sharing your effectiveness model with other survey respondents?

- ◯ Yes
- ◯ No

Comments

The following questions are in regards to your software and safety software quality assurance programs.

14. Do you have a separate software QA program?

- ◯ There is no separate software or safety software QA program
- ◯ There is a separate program for safety software only
- ◯ Both safety and non-safety are in a separate QA program

Additional information

15. What consensus framework/standard(s) do you use for software/safety software QA?

- ☐ CMMI
- ☐ ISO 9000/9001
- ☐ IEEE Std 730
- ☐ NQA-1
- ☐ QC-1
- ☐ IEC 62138
- ☐ IEC 60880
- ☐ IEEE 7-4.3.2
- ☐ IEEE 603
- ☐ The scope of the operations does not require a consensus standard.

Other (please specify)

16. What is your process for determining safety software(s)?

- [ ] Follow DOE G 414.1 guidance
- [ ] Answer questions specified by your site in a form
- [ ] Submit to a review committee
- [ ] Random surveys across site
- [ ] Other

Would you please further explain the questions or identificatiion method?

17. What is your graded approach for safety software?

- ◯ DOE G 414.1
- ◯ IEEE grading standard
- ◯ ISO based grading
- ◯ IEC grading standard
- ◯ NITSL grading stand
- ◯ Other published grading standard (specify in comment section)
- ◯ Created your own graded approach

Please explain how you grade your safety software

18. How do you manage identified safety software applications?

- ◯ Individual process for each software depending on application
- ◯ Manage across similar types (I.e. Acquired, developed, analyses, and system)
- ◯ Single process and don't manage unique pieces of software practices.

Other (please specify)

19. How effective do you consider your software QA program?

Highly effective	Moderately effective	Moderately effective
◯	◯	◯

20. Do you have evidence of your software QA program's effectiveness?

- ◯ Yes
- ◯ No

Comments (types, frequency, function)

21. If so, would you consider sharing your SQA effectiveness model with other survey respondents?

- ◯ Yes
- ◯ No

Comments

22. Do you use a specific QA standard for the conduct of experiments, test and research activities?

- ◯ Yes
- ◯ No

If so, please state which standard

23. Would you be willing to be contacted for follow-up questions?

- ◯ Yes
- ◯ No

If so, please provide contact information

24. Would you like to share your contact info with other sites and have access to their contact info as well?

- ◯ Yes
- ◯ No

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