Department of Energy
Washington, DC 20585

MAR 13 1991

Mr. B. Joe Youngblood
Director, Division of High-Level
  Waste Management
Office of Nuclear Material Safety
  and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Youngblood:

For your information, enclosed is a copy of the report on Phase

Three of the U.S. Department of Energy Software Quality Assurance

Workshop. Should you have any questions, please contact me at

(202) 586-6046.

Sincerely,

Dwight E. Shelor
Acting Associate Director for
  Systems and Compliance
Office of Civilian Radioactive
  Waste Management

Enclosure:
Report on Phase Three of the U.S. Department of Energy
Software Quality Assurance Workshop

cc w/enclosure:
C. Gertz, YMPO
R. Loux, State of Nevada
M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV
S. Bradhurst, Nye County, NV
P. Niedzielski-Eichner, Nye County, NV

DOE
SOFTWARE QUALITY ASSURANCE
WORKSHOP REPORT

LAS VEGAS
JANUARY 22,23, 1991
FEBRUARY 4,5,6,7, 1991

PURPOSE:

* Build Cohesive Team
    * Identify Issues
        * Develop Recommendations For Improving Software QA

PARTICIPANTS

USERS   DOE
        QA MANAGERS   LANL
            TPOs   LLNL
                                 MACTEC
                                 REECo
                                 RSN
                                 SAIC
                                 SNL
                                 USGS

OBSERVERS

                                 EG&G
                                 EEI
                                 NRC

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1.0   **INTRODUCTION**

DOE Management and Quality Assurance have been listening to the scientific
community and have embarked upon a series of workshops designed to bring
forth the scientist concerns and provide acceptable solutions.

This report describes the participants, the process and the results of the
workshops to date.

2.0   **ISSUE IDENTIFICATION - DENVER - AUGUST 1990**

An initial workshop was held in Lakewood, Colorado (Denver) on August 7, 1990
This workshop was an open forum for raising concerns associated with the
implementation of a Quality Assurance Program (10 CFR 50 Appendix B & NQA-1)
in the scientific community.

There were four main areas of concern that resulted from the workshop:

A.   Lack of flexibility in the application of the QA Program during scientific
       research, acceptability of peer review, application of dual research, required
       restrictive predictions without consideration for unknowns, further definition
       of requirements, and procedures commensurate with acceptable (good)
       scientific practices.

B   Computer Software QA program (too complex, does not allow freedom to
       develop conceptual/prototype design/analysis) is based upon obsolete
       model concepts, not updated to present state-of-the-art, excessive
       documentation during development, lack of flexibility/lengthy change
       process, and needs in-depth review.

C.   Data - its definition, what form, when it is complete and most importantly,
       time limitation for transfer to the appropriate participants data archive within
       45 days of completion of data acquisition or development.

               Note: This is not considered a QA problem per se, rather a
               management (project) problem.

D.   Communications - It was apparent that inter-participant/project communications are limited and need improvement.

3.0   QUALITY ASSURANCE ISSUES WORKSHOPS - October 1990

A workshop was held October 10-12 and 25 in Las Vegas, Nevada. The subject was the concern: "Application of the Quality Assurance Program to scientific research." Participants included a Geologist and a QA Consultant from DOE; seven scientists, five QA Managers, and four TPOs from LANL, LLNL, SNL, and USGS; one Quality Consultant from EEI; and two Facilitator from MACTEC. There were two observers from the USNRC. The workshop generated a number of actions which are currently underway.

4.0   SOFTWARE QUALITY ASSURANCE WORKSHOP - INTRODUCTION

The workshop which is the subject of this document was designed to address the Denver issue:

> Computer Software QA program (too complex, does not allow freedom to develop conceptual/prototype design/analysis) is based upon obsolete model concepts, not updated to present state-of-the-art, excessive documentation during development, lack of flexibility/lengthy change process, and needs in-depth review.

Workshop participants included seven people from DOE, one from LANL, five from LLNL, three from SNL, five from USGS, six from MACTEC, two from REEco, four from RSN, and six from SAIC. Workshop observers included four people from the NRC, two from EG&G, and one from EEI. The workshop was organized and facilitated by three MACTEC personnel. A list of attendees may be found in Appendix A.

Nine workshop participants (representing a cross section of Management, QA, and technical people) were interviewed prior to the workshop. The purpose of the interview was to assess the scope of the problem in order to tailor the workshop to specific participant needs. Interview results were presented to workshop participants. Interview questions are included in Appendix B.

The purpose of the workshop was:

- Build Cohesive Team

- Identify Issues

- Develop Recommendations For Improving Software QA

The agenda for the workshop was:

January 22-23	February 4-7
Introduction	Introduction
Interview Results	Review Data Collected
Workshop Process	Identify Root Cause
Agreements	Generate Solutions
Work Styles	Evaluate Solutions - Formulate
Develop Problem Statement	Recommendations
Develop Goal Statement	Develop Action Plan
Identify Issues	Present to Management
Prioritize Issues	
Plan Data Collection	

Participants' expectation for the workshop are listed in Appendix C.

Workshop guidelines were developed and participants took an inventory to determine their Individual Work Styles. These were used throughout the workshop to improve communication.

5.0   PROBLEM STATEMENT

Participants developed the following Problem Statement:

> **Poor identification and definition of valid requirements has led to a pervasive lack of common understanding of SQA requirements and their need and application among NRC, DOE and participants. (What are the requirements? Why are they needed? To whom do they apply? When are they required?)**

6.0   GOAL STATEMENT

Participants developed the following Goal Statement:

The goal is:

> DOE and participants will identify a common set of precisely defined SQA requirements that will:
>
> 1.   Produce deliverables that will withstand the rigors of the licensing process.
>
> 2.   Be acceptable to the users by allowing flexibility and avoiding unnecessary controls.

7.0   ISSUE IDENTIFICATION

Work groups reviewed the eight software QA issues identified in the Denver workshop. An additional 74 items were added for a total of 82 issues. The complete list of workshop issues is given in Appendix D). A prioritizing process was used to determine the most important issues to be resolved.

Workshop participants chose these three as the top priority issues to be resolved

A.   Ambiguous requirements which appear to lack a basis for need and are poorly understood.

B.   Requirements focus of documenting all phases/cycles of software development, not on testing/validation

Emphasis needed on the quality of software required for licensing and not paper trail.

C.   Software QA requirements must include a software classification scheme based on the nature, importance and intended application, and be commensurate with impact on quality.

The problem solving process used for addressing the above three issues was.

1. Define Problem
2. Collect Data
3. Identify Cause
4. Generate Solutions
5. Evaluate Solutions/Formulate Recommendations
6. Develop Action Plan

8.0   PROBLEM DEFINITION

Participants used a brainstorming process to answer the following questions in order to expand their understanding of the problem.

What	is involved? is wrong?
Who	is generating? is affected?
Where	is it happening?
When	is it happening?
How	serious? costly? painful?

Group responses are given in Appendix E.

9.0   DATA COLLECTION.

Each work group identified additional information needed for problem solving Members were assigned to collect the data before the workshop reconvened on February 4, 1991. Data Collection Summaries are given in Appendix F

10.0   ROOT CAUSE ANALYSIS.

Participants used a "fishbone" brainstorming process to identify possible causes for each of the three issues being addressed. Possible causes were prioritized to determine root causes. Results are given below.

Group A Problem Statement

Ambiguous requirements lack a basis for need and are poorly understood.

Root Cause

- Lack of precedence/experience

- Mixture of management vs. regulatory controls

- Inconsistent definitions

- Lack of standard requirements

- Determination of when to and when not to apply QA controls

Group B Problem Statement

Too much emphasis on documentation vs testing.

Root Cause

- Fear of not meeting licensing requirements

- Difference between software quality and model quality is not understood

- Misapplication of engineering requirements to scientific work

Group C Problem Statement

SQA overkill

Root Cause

Lack of centralized consistent guidance

- People are too conservative and are afraid to say requirements are not applicable

- Minimum requirements for licensing are unknown

- Lack of knowledge on the part of those that define SQA requirements appropriate to the project

- Interpretation of SQA requirement is overly conservative and multilevel

11.0   SOLUTION DEVELOPMENT

While focusing on root cause, participants brainstormed possible solutions to each of the three identified issues, concentrating on quantity, not quality. Solutions were prioritized to determine the best alternatives.

Top priority solutions were evaluated to determine:

- To what extent the solution would resolve the problem

- The amount of positive impact

- The amount of negative impact

- The cost in time, money, or resources

- The time it would take to put solution into effect

Those solutions which best met the above criteria are given below, for each group.

Group A Issue

Ambiguous requirements which appear to lack a basis for need and are poorly understood.

Solutions

1.   Requirements/Development - Identify the hierarchy of NRC/YMP SQA requirements recognize NRC needs and revise requirements as necessary to allow a practical/flexible acceptable QA approach to:

- Experimental QAS development end use

- Modeling-physical and numerical

- Scientific Software use

- Engineering software use

- Administrative software use

2. Training: Establish a definitive consistent training program which emphasized requirements driven, top down training using implement/developer workshops.

3. *Drive the implementing procedures to address both Q and non Q activities in one process*

4. Emphasis on cooperative over sight "WIN-WIN"

5. Communications Support -

    •   Establish an inter active and dynamic process among users, QA regulators and managers to develop requirements and then implementing procedures with emphasis on understanding, need and end use THEN let the program have a chance to work.

6. Establish a "mock" licensing panel to evaluate qualified software.

7. Establish common definitions

    •   Software types

    •   Document types

    •   Distinguish between scientific/engineering software

8. Adopt industry standards and practices for software development, use and document and adopt to one needs.

9. Establish QA/scientific software group "GURU'S"

Group B Issue

Requirements focus of documenting all phases/cycles of software development, not on testing/validation.

Emphasis needed on the quality of software required for licensing and not paper trail.

Solutions

1. Clear guidance from DOE as to what is required to justify software results in license application program.

2. Rewrite QARD - Section 19

   - Simplify

   - Tech people part of process

   - Delete life cycle

   - Clarify definitions

   - Separate management requirements from license requirements

3. Workshop on documentation of software (scientific)

4. Include SW in mock license process

5. Clear distinction between site characterize design and administrative SW

6. Develop scientific approach to SQA documentation vs. engineering

7. Scientists determine QA affecting points and document needs

8. Redirect emphasis toward model quality

9. Change grading process to match concept

Group C Issue

Software QA requirements must include a software classification scheme based on the nature, importance and intended application, and be commensurate with impact on quality.

Solutions

1. SQA GRADING - Use grading to achieve flexibility in application of SQA controls.

2. SQA CLASSIFICATIONS - Develop definitions and software classification system.

3. SQA ADVISORY GROUP - Establish a standard SQA AG comprised of SQA experts users and selected others.

4. IDENTIFY OPTIMUM SQA REQUIREMENTS FOR LICENSING

5. SQA MANAGER - Appoint qualified project level SQA manager.

6. AGGRESSIVE INTERPRETATION of existing requirements to build appropriate programs at the participant level.

7. SQA TRAINING - Develop project level SQA training for staff and auditors.

8. EVALUATE IMPACT of rejecting standard, widely accepted approaches to SQA.

12.0   INTEGRATED RECOMMENDATIONS

Preliminary Action Plans were prepared by each of the three groups and are included as Appendix G.

After review and discussion of the Action Plans, the twenty-six proposed solutions were integrated into a list of five proposed recommendations, which are given below.

Recommendation 1

Establish a standing software working group.

A.   Develop a Charter

- Review and recommend revisions to the software program

- Membership must represent the broad scope of the project and include specialties such as SQA, software developers and technical personnel

- Membership limited to 10

- Evaluate need for SQA Manager

- Provide long-term focus for resolution of software issues, and interpretation of requirements

B.   The Working Group will identify the optimum SQA requirements for licensing.

- Presentation of SQA Workshop group results

- Examine current regulations, DOE Orders, Industry Standards, NRC guidance

- Emphasize accepted scientific practices

- Consult with outside experts including the NRC

- Develop definitions and software classifications

- Use software classifications to provide flexibility in the application of SQA controls

- Document rationale for modifications to existing SQA program

C.   Participant Review

- Participant review of proposed SQA program

D.   Present Program to DOE/NRC

- DOE first

- NRC

E.   SQA Training

- Auditors and participants point of contact must receive same SQA requirements training.

Recommendation 2

Identify and clarify existing flexibility in Section 19 of QARD (e.g., nature, complexity, and importance).

Action

1.   Participants* communicate implementation concerns to project office QA.

2.   QA* Sponsor meeting(s) with Participants* to devise solutions to implementation issues.

- * Representatives from this workshop

Recommendation 3

Identify and gather previously performed analyses of standards/requirements for software QA and make available to software working group.

Action

Al Williams of the Project Office will be the Point-of-Contact for dissemination of information.

Recommendations 4

Include software in the Mock Licensing process recommended in the Phase 2 QA workshop.

Action

Software workshop participants* will contact Phase 2 QA workshop participants** to request that project related software activities are represented in the Mock Licensing Process.

* J. Blink & T. Chaney
** L. Jardine

Recommendation 5

Use grading process to achieve flexibility in application of software QA controls. Grading should be at a level of detail to distinguish among different software uses.

Action

Once the project grading process is revised the defined software categories can be used to guide the selection of controls to be applied to software.

Participants reviewed the list of eighty-two issues identified the first day of the workshop. The group determined that the five proposed recommendations would effectively resolve sixty-nine of the eight-two issues. They also requested that the remaining thirteen concerns be tracked as a part of the followup process. A list of the thirteen remaining issues is given in Appendix H.

13.0 MANAGEMENT PRESENTATION

Workshop recommendations were presented to management on February 7, 1991. The meeting agenda is given below. Management presentation handouts are included in Appendix I.

AGENDA

Introduction (L. Hayes, D. Helton)
    Introductions
    Agenda
    Workshop Credo
    Workshop Process

Recommendations (J. Stuckless, K. Schwartztrauber)
    The problem
    Integrated Solution
    Additional Short-term Solutions

Closing (All)
        Summary
        Questions
        Decisions

The workshop recommendations were well received by management. Participants were encouraged to develop an action plan and take preliminary steps to begin carrying out the recommendations.

Participants developed an action plan which includes preliminary tasks for implementing each of the five recommendations, along with persons responsible and target dates. A copy of the action plan is given in Appendix J.

Participants have agreed to schedule another meeting by March 18, 1991 to review progress and assign additional tasks.

APPENDIX A

WORKSHOP ATTENDEES

WORKSHOP ATTENDEES

DOE

1. Carl Gertz (Visitor)
2. Joe Caldwell (MACTEC) Workshop Organizer
3. Steve Harris (SAIC)
4. Don Helton
5. Bruce Hutchinson
6. Al Williams
7. John Matras (SAIC)
8. Claudia Newbury
9. Bill Price (MACTEC
10. Linda Roy (MACTEC
11. Dan Royer
12. Keith Schwartztrauber (SAIC)
13. Nancy Voltura

EEI

1. Tom Colandrea

EG&G

1. Elaine Ezra
2. Jeff Logan

LANL

1. Gary Cort

LLNL

1. Jim Blink
2. Robert Dann
3. Les Jardine
4. James Johnson
5. Teresa Quinn

MACTEC

1. Cathie Martin (Facilitator)
2. Herb Worsham (Facilitator)

NRC

1. John Buckley
2. John Gilray
3. Paul Prestholt
4. Teek Verma

REEco

1. Mono Fox
2. Christine Thompson

RSN

1. Saeed Bonabian
2. Russ Hilsinger
3. Mahmood Mirza
4. Randy Schriener

SAIC

1. John Ashton
2. Jim Harper
3. Keith Kersch

SNL

1. Stephen Bauer
2. Larry Costin
3. Taber Hersum (MACTEC)
4. Les Shephard

USGS

1. Tom Chaney
2. Larry Hayes
3. Dwight Hoxie
4. Mark Kurzmack
5. John Stuckless

APPENDIX B

INTERVIEW QUESTIONS

INTERVIEW QUESTIONS
SOFTWARE QA WORKSHOP
JANUARY 22-23, 1991
FEBRUARY 4-7, 1991

1. What is the QA software problem?

2. How serious is the problem? 1-5 _____

3. How confident are you that it can be solved 1-5 _____

4. How confident are you that workshop recommendations will be carried out? 1-5

    _____

5. What has been done so far to solve the problem?

6. Who wants the problem so... .?

7. What will it take to solve the problem?

8   What could inhibit the resolution of the problem?

9   What support is needed in order to solve the problem?

10 What is the quality of communication between participants and DOE? 1-5 _____

11. What is the quality of communication between participants? 1-5 _____

12. What should be the role of QA in software?

13 What do you expect will happen during the workshop?

14 What would you like to see happen during the workshop?

15. If you had three wishes about software, what would they be?

16. If Software QA were a person, how would you describe it today?

17 What would you like it to look like?

APPENDIX C

PARTICIPANT EXPECTATIONS

PARTICIPANT EXPECTATIONS

The workshop participants were asked to give their expectations for the workshop. These expectations are reported below to aid the reader in understanding the issues and the need for resolution.

- Workable software QA program
- Simplified approach to commercially acquired software
- Identify software issues
- Find solutions acceptable to scientists
- Go back to look at NRC requirements
- Listen to issues
- Better understanding of how to meet requirements
- Software systems people want to use
- Workable system to develop software
- Software supports licensing
- System that is easier to follow than to avoid
- Issues keeping us from using current program
- Level of documentation required
- Reduction in software QA overkill
- Identify a few issues -- identify an action plan to resolve them
- Layers of documentation
- Minimize documentation
- Uniformity as applied to implementation
- When do we start controlling software
- Less emphasis on "assurance" and more on quality
- Flexible, workable program
- Software programs not needing QA -- identify
- See more flexible, speedier implementation
- Common understanding of what requirements permit
- Define requirements, identify actions needed for flexible program
- Want to see something agreed upon that meets licensing requirements and participants can implement
- Want to see simplified project-wide system
- Hear viewpoints from various perspective and create plan of action for management to implement
- Simplified program with appropriate controls
- We understand requirements, so we can support them
- Work together to create a solution
- People will be able to implement their programs

APPENDIX D

SOFTWARE QA ISSUES

SOFTWARE QA ISSUES

The following is a list of all the issues identified. Voting results and reference numbers for those issues that were duplicates. Bold print indicates the top issues chosen for problem solving.

SOFTWARE QA ISSUES

Issues	Vote No 1	2	Reference
1. Software QA control applied too early.	26	16	
2. Software QA control specified in inappropriately excessive detail.	15	0	14
3. Work acceptable to one participant may not be acceptable to another.	8	0	12
4. QA 88-9 (QARD Section 19) requirements focus on documenting all phases/cycles of development, not (as it should) on testing/validating software that will be used. (Combined with 24, Group B)	23	18	4,5,8, 74,78
5 Labor intensive documentation greatly impedes scientists from keeping abreast of state-of-the-art techniques of products.	1	0	49
6 Documentation centers on development cycle without regard to determination of acceptability prior to use or change/configuration controls once software is operational.	12	0	
7 Present trail (myriad) from QAP 88-9 QARD to USGS QAPP Software QA Plan to QMP is too complex to allow reasonable implementation.	0	0	8
8. The present process contains too many unnecessary layers of requirements documents.	26	16	7,13,26,27, 47,57,62, 64
9. There are multiple types of software; therefore, there should be multiple types of controls.	0	0	79
10. Current controls are applied without consideration of cost.	0	0	76

APPENDIX E

PROBLEM DEFINITION NOTES

PROBLEM DEFINITION NOTES

GROUP "A" RESULTS

Problem: Ambiguous requirements which appear to lack a basis for need and are
            poorly understood.

GROUP "A" MEMBERS

Saeed Bonabian	Raytheon
Christine Thompson	Reeco
Terri Quinn	LLNL
Mahmood Mirza	Raytheon
Dennis (Dan) Royer	DOE
Larry Hayes	USGS
John Gilray	NRC
Linda Roy	MACTEC
Elaine Ezra	EG&G
Steve Harris	SAIC
Russ Hilsinger	Raytheon
Al Williams	DOE
Les Shephard	SNL
Mono Fox	Reeco
James Harper	SAIC
John Matras	SAIC
Don Helton	DOE

PROBLEM DEFINITION

What?

1   Lack of understanding of basis of requirements
2   Failure by DOE to implement clear requirements
3.   Failure to justify need for requirements
4.   No explanation of requirements
5.   Ambiguous requirements
6.   Conflicting upper-tier documents
7   Inappropriate requirements for high level waste repository
8.   Misapplication of code of Federal Regulations (CFR)
9.   Lack of training
10. Lack of historical precedence
11. Blind compliance
12. Clear description of software categories and controls
13. Requirements do not reflect current, accepted and proven software engineering
     methods
14. Lack of the involvement of the parties concerned in the decision-making process
15. Confusion between QC and QA as applied to software
16. Scientists cannot or will not implement "perceived dumb requirements"
17. Lack of guidance when you do not need QA certain software programs

18. Lack of experience in developing and implementing similar programs
19. Lack of getting to specifics on which requirements are the problem
20. Perceived need by management to demonstrate a "functioning" SQA program
21. When does the SQA program interface with the applicable DOE orders?
22. Failure to categorize software programs and products
23. No policy board to interpret requirements

Who?

1. Don't know who is generating the requirements
2. All participants and field workers
3. Is DOE responsible for concerning SQA in the Yucca Mountain project
4. All software users are affected
5. Failure of the users to get the specific problems with the requirements
6   Regulatory and technical management and staff are generating and affected

Where?

1   Washington, D.C.
    - NRC
    - DOE
    - Consultants and contractors
2. Participants' locations
3   "Certain" participants' locations
4   YMP office
5   Subcontractors

When?

1   Present
2. Past
3   Future
4. Development, implementation and operational phases of SQA program
5. At time of p manent design activities for quality affecting items
6   During QA c.erview programs (audits, surv. etc.)

How?

    - Serious
    - Costly
    - Painful
1. Problem is very serious
2. Complete non-cooperation from scientist (deleted)
3. Boycott by scientists (deleted)
4. Insufficient results since inception of project
5. Success of project directly dependent on YMP resolving SW problem
6. High cost of developing, improving, implementing and surveilling program
7. Carrying on the documentation concerning unnecessary controls
8. Approximately 622 man-hours per software package verified and validated

9. Personnel turnover because of inability to complete program resulting in loss capabilities, experience, technical credibility and high costs
10. Estimate of one man-year to bring existing 10,000 line code to SQA program requirements
11. Design cannot be approved without resolution
12. Serious versus non-serious depends on one's viewpoint and resolution of problem
13. Degradation between project office and the participants and between the participants themselves
14. 223 QA requirements for software

GROUP "B" RESULTS

Problem: Requirements focus on documenting all phases/cycles of software development, not on testing/validation.

Emphasis needed on the quality of software required for licensing and not paper trail.

MEMBERS

Jim Blink	LLNL
Mark Kurzmack	USGS
Bob Dann	LLNL
Tom Chaney	USGS
Steve Bauer	SNL
Jim Johnson	LLNL
Keith Schwarztrauber	DOE/SAIC
John Ashton	SAIC
Nancy Voltura	DOE
Claudia Newbury	DOE
Paul Prestholt	NRC

PROBLEM DEFINITION

What?

1. Too much documentation.
2. Not enough testing (no data).
3. Amount of documentation for lifecycle process is foreign to SW developers.
4. Lack of current emphasis on experimentation (no data).
5. Lifecycle documentation is management of process for DOE not for NRC licensing process. (20)
6. Emphasis on V&V configuration management versus development activities. (see No. 12)
7. Inadequate understanding of role of SW in scientific investigation by management. (1.A)

8.   0856 does not require reviews of SW requirements design or coding (why should YMP?).

9.   SW lifecycle does not match development. (5)

10.   No definition of end product documentation for different types of SW   (1)

11.   Details of testing and verification process must be determined by SW developers   (0)

12.   Ultimate proof of SW will be found in V&V not history of development   (0)

13.   SW development testing and independent V&V testing are not the same   (0)

14.   SQA program overkills administrative/management systems (non-sci. code) emphasis on use of systems. (1)

15.   No guidance on identifying importance of SW for licensing.

16.   No real need for requirements · documents below QARD.

17.   Difficulty of independent review of V&V that is meaningful.

18.   QARD is inconsistent and adds requirements to 0856. (2 and 4)

Who is Generating?

- Management
- DOE
- Participants

Who is Affected?

- SW developers
- SW users
- Project
- Public (S S)

Where Happening?

- All OCRWM participants that do Q-affecting analyses using SW

When Happening?

- NOW

How?

- Serious problem existed for two years
- Loss of personnel
- Impacts licensing
- Costly due to lack of guidance on SW QA requirement interpretations
- Overkill = Costly implementation
- Diminished credibility for design activities (current)
- Wasted resources with trial and error implementation attempts

GROUP "C" RESULTS

Problem: Software QA requirements must include a software classification scheme based on the nature, importance and intended application, and be commensurate with impact on quality.

MEMBERS

John Buckley	NRC
Tom Colandrea	EEI
John Stuckless	USGS
Taber Hersum	SNL
Randy Schreiner	RSN
Keith Kersch	SAIC
Dwight Hoxie	USGS
Gary Cort	LANL
Don Helton	DOE
Bill Price	DOE/MACTEC
Teek Verma	NRC
Jim Blink	LLNL
Bruce Hutchinson	DOE
Les Jardine	LLNL
Saeed Bonabian	RSN
Tom Chaney	USGS

PROBLEM DEFINITION

What?

1   Data acquisition/reduction SW should be controlled by analysis of NIST traceac standards only and not by SQA.
2   Acquired SW documentation requirements are too extensive and inappropriate
3   Need to define SW classes and apply SQA as appropriate.
4   There are no standards for grouping SW into categories for control
5   Change control requirements during SW development significantly affect schedule
6   Commercially acquired SW SQA control requirements are too extensive
7   Non-quality affecting SW should be subjected to less restrictive controls than quality affecting.
8   Define SQA products and deliverables.
9   There are no processes for tieing SW to the data it produces and tracking it across the project.
10   What is considered quality affecting SW and what is not.
11   Requirements def. and design specification requirements are too inflexible and do not conform to the natural way of SW development.
12.   Lack of what is required of the part for licensing.
13   The basis for requirements is not visible to part.
14   Lacking a simple approach to the control of straightforward SW.
15   Current SQA requirements do not make adequate use of standard scientific controls

16. Current program lacks flexibility necessary to evaluate SW on a case-by-case basis
17. Lifecycle model is applied too rigidly.

Who?

18. Lack of knowledgeable, central driving force to define and direct the SQA program
19. Technical aspects of the program within the part and the DOE are affected
20. Who is actually driving these requirements?

When?

21. Overkill for conceptual software not applicable to licensing.
22. Problem of appropriate controls is serious right now.
23. When does the development of SW become quality affecting.

How?

24 Serious -- wasted manpower and extensive time doing thing s that are not required
25 Provisions should be made for upgrading prototype SW to quality affecting status
26 Current program adds significant cost to the development and use of SW.
27 Current program inhibits scientific creativity.

Where?

28 All analytical facilities that use SW in data acquisition.

APPENDIX F

DATA COLLECTION SUMMARIES

GROUP A DATA COLLECTION

1.   Matrix of SW types in line (from SQAPs)

   • No consistency

2.   SW Engineering Standards

   • Need standard definitions

3   Different phases of SW life cycles

4.   No board based SQA programs for overseas

5   WIPP · Applications of SW

6.   SQA audits - Surveillances

7.   List of existing SW standards and programs

8.   Scientific SW

   • Engineering SW
   • Other SW

9   Physical model is numerical model

10.   SQA being required too early

11   SQA too inclusively

   e.g . Prototype model development

12   Trial from 0856 to QARD to USAS QMP tortuous and tenuous

13   Compliance based auditing costly, ineffective, misguided, and generates "ILL WILL"

14   Upper tier documents are so complex and convoluted that it is virtually impossible to trace requirements to source

15.   Validation should not be addressed under 19 but should be scientific issue under Criterion 3

16   QARD #19 is not a fundamentally flawed document, requires some corrections and clarifications

17.   Testing

18   Validate unique models

19   Excessive detailed manual tailor to application and use of code

20   Hard copy output

21   Excessive need of procedures

22   Hardware configuration management is critical

GROUP B DATA COLLECTION

1   Software documentation should be dictated by the end-use of product

2   Documentation of required design and implementation(?) process is not required by
        NRC for licensing

3   Agree 0856 documentation reasonable

GROUP C DATA COLLECTION

*1   Analytical equipment and controlling sw are not dedicated solely to YM? which
        creates control problems

2   Internationally acceptable alternative controls could be uses in place of SQA controls

*3   Shrink-wrap software is inappropriately controlled

4   Software change control requirements can increase cost by 20 to 40 percent (as
        much as 900 percent)

5   True cost of SQA at project level is not available

6   Cost should come down if requirements are applied more reasonably

7   All issues can be directly or indirectly tied to QARD 19.0

8   Auditors tend to be overly conservative in the application of SQA due to inadequate
        training

9   Application of QA controls to non-qual. affecting work adds unnecessary time and
        cost to YMP

10   Examples exist within the project to demonstrate that there is sufficient flexibility in
        the SQA requirements to apply them in a meaningful manner.

* Generating NRC/CAR

APPENDIX G

PRELIMINARY ACTION PLANS

GROUP A ACTION PLAN

Recommendations	Responsible Person	Due Date
1 Requirements (1-8)	TPO DESIGNATION	3/15
• Get letter recommending requirements committee · Charter · People and Dates · Justification/Benefits	Division Director Larry Hayes	
Then a meeting to review draft letter	Linda Roy	2.20
2 Identification/definitions process accomplished	Al Williams Gertz /Horton	6 30
3 Train to requirements	TPO Carol Rehkop	7 31
4 Implement Requirements	TPO Larry Hayes	TBD
5 GURU Panel	T. Quinn	
• Select and assemble group to develop charter		2 20
• Develop draft charter		4 20
• Members selected and first meeting		5.30

REQUIREMENTS

1 Identify persons to revisit QARD

2 Evaluate current DOE and NRC requirements

3 Evaluate industry standards

4 Separate management imposed requirements

5 Use good engineering and scientific practices and DOE and NRC imposed requirements to determine changes to be made to current definition and requirements

6 Determine where recommended requirements are to be stated (e.g. QARD. SOAP. etc)

7 Appropriate participants review of recommended requirements

8   Submit recommendations to DOE management

GROUP B ACTION PLAN

Recommendations	Responsible Person	Due Date
1 Identify optimal software requirements for licensing		
A Participants identify optimal requirements based on scientific practices, appropriate requirements, industry standards	USGS, TMSS, LLNL, NRC, SNL, DOE, LANL, Raytheon, QA	4 1
B Interview utilities with license experience	Keith S. John Ashton	
C Develop consensus requirements for action by Horton to revisit QARD	USGS, TMSS, LLNL, NRC, LANL, DOE, SNL, RSN	6 15
2 QA Grading		
A Use grading process to ensure flexibility in applicability of QA controls grading should be at a level of detail to distinguish between, among different SW uses (TRAINING)	Nancy Voltura	3 ·

GROUP C ACTION PLAN

Recommendations	Responsible Person	Due Date
· Establish SQA advisory group, develop charter	Blink, Hersum, Stuckless, Colandrea Price, Kersch	3 8
• Appoint members	TPOs/Gertz	3 22
• Evaluate need for SQA manager	SQA AG	4 19

Recommendations	Responsible Person	Due Date
2. Identify optimum SQA requirements for licensing		
• Obtain workshop input	Plus committee	4:17
• Examine DOE Orders current regulations, industry standards, NRC guidance accepted scientific practices	SQA AG	5.17
• Compare to QARD		
• Consult with outside experts including NRC		6 14
• Documentation for modification to QARD or deviation from standard approaches including traceability matrix		6 28
• Develop definitions and SW classification system		
• Define grading strategy to achieve flexibility in application of SQA controls		
3 Present new SQA approach to DOE NRC	SQA AG	7 1
4 SQA Training	TBD by SQA AG	8 1
• Auditors, participation point of contract		
• Participation level	TBD by TPE	12 1

SHORT-TERM ACTION

1 Clarify existing Section 19 0 QARD to identify existing flexibility

> D Hoxie, B. Price, T. Verma, and T Hersum

2 Preliminary data collection to support SQA AG examinations

APPENDIX H

REMAINING UNRESOLVED ISSUES

REMAINING UNRESOLVED ISSUES

The following issues were not specifically addressed by the recommendations given to management. Workshop participants expressed a desire that these remaining issues be tracked as a part of the workshop follow-up process:

10. Cost controls not addressed (see #76)

15 Level of approval for SQA program

21 Lack of clear mechanism to take exception to upper tier requirements (training?)

29 No projectwide data base for qualified software except records system

37 Inappropriate subordination of the role of software configuration management

39 Antiquated mechanisms for archiving project QA records (see #77)

40 Integrate data into the SQA process

41 Identifying hardware as well as software environment

45 More emphasis on testing and verification

46 Current program emphasizes compliance-based auditing, and it should promote performance-based auditing

51 Control applications of commercial grade software--not the software (see #68, 71, 72)

67 For model based software evolution, physical model needs to be separately controlled but linked to the numerical model controlled by SQA

73 Violation of copyright laws

82 Why do we have to apply formal QA to the development of a potential repository conceptual design?

APPENDIX I

QA SOFTWARE

WORKSHOP

PRESENTATION

TO

PROJECT MANAGEMENT

LAS VEGAS, NEVADA

FEBRUARY 7, 1991

AGENDA-DOE/PARTICIPANT
QA SOFTWARE WORKSHOP

INTRODUCTION (L. Hayes/D. Helton)
- o Introductions

- o Agenda Discussion

- o Workshop Credo

- o Process
  Problem statement

GROUP REPRESENTATIONS
(J. Stuckless/K. Schwartztrauber)

- o The Problem (need)

- o Integrated Solution

- o Additional (short-term) Solutions

CLOSING (All)
- o Summary (All)
- o Questions
- o Decisions

DOE SOFTWARE QUALITY ASSURANCE WORKSHOPS

LAS VEGAS

JANUARY 22-23 AND FEBRUARY 4-7, 1991

TO IDENTIFY SPECIFIC ISSUES ASSOCIATED WITH THE SOFTWARE QA PROGRAM, AND TO DEVELOP RECOMMENDATIONS FOR IMPROVING THE SOFTWARE QA PROGRAM

(WORKSHOP CHARTER)

PARTICIPANTS

SCIENTISTS/ENGINEERS

	DOE	
QA STAFF	LANL	MACTEC
	LLNL	REECO
DATA AND	SNL	RSN
INFORMATION	USGS	SAIC
ADMINISTRATOR		

OBSERVERS

NRC
EEI
EG&G

SOFTWARE QA ISSUES IDENTIFIED AT THE DENVER WORKSHOP

August 7, 1990

1. Software QA control applied too early.

2. Software QA control specified in inappropriately excessive detail.

3. Work acceptable to one participant may not be acceptable to another.

4. QA 88-9 (QARD Section 19) requirements focus on documenting all phases/cycles of development, not (as it should) on testing/validating software that will be used.

5. Labor intensive documentation greatly impedes scientists from keeping abreast of state-of-the-art techniques of products.

6. Documentation centers on development cycle without regard to determination of acceptability prior to use or change/configuration controls once software is operational.

7. Present trail (myriad) from QAP-88-9/QARD to USGS QAPP, Software QA Plan, to QMP is too complex to allow reasonable implementation.

8. The present process contains too many unnecessary layers of requirements documents.

QA SOFTWARE WORKSHOP CREDO

"Establish an interactive and dynamic process among Scientists/Engineers regulators, QA staff, and managers to develop requirements and then implementing procedures, with emphasis on <u>understanding</u>, <u>need</u>, and <u>end use</u>; then let the Program have a chance to work"

WORKSHOP PROCESS:

Las Vegas Meeting

o Initial input & open discussion of problems relating to QA software implementation

o Address & clarify the problems

o Problems impact on ability to do needed technical/scientific work effectively

(Close interaction between Technical staff, management, and QA throughout entire process)

o Group Consensus Building

PROBLEM STATEMENT

Poor identification and definition of valid requirements has led to a pervasive lack of common understanding of SQA requirements and their need and application among NRC, DOE and participants. (What are the requirements? Why are they needed? To whom do they apply? When are they required?)

GOAL STATEMENT

DOE and participants identify a common set of precisely defined SQA requirements that will:

1. Produce deliverables that will withstand the rigors of the licensing process.

2. Be acceptable to the users by allowing flexibility and avoiding unnecessary controls.

SUMMARY

o Obtain Acceptance by DOE Management

o Focus on Short-Term Improvements

o Establish a Software Working Group

o Identify and Define Requirements

o Process will remain interactive with all Participants

o Implement a QA Software Program that meets requirements--Regulatory and Technical

ACTION-------ACTION-------ACTION

As an indication of the effectiveness of the problem-solving process we used, I'd like to give you a brief scorecard as follows:

- o There were 82 specific software quality-related concerns identified by the workshop team members

- o As a result of solving the 3 most important problems, 69 of the 82 problems were also addressed

- o A number of the 13 remaining concerns were implicitly covered during the process of addressing the 3 major problems

All of the 13 concerns will be tracked as part of the follow-on process.

I MAY NOT HAVE THE ANSWER TO ALL YOUR
PROBLEMS. IN FACT I MAY RAISE MORE QUESTIONS
THAN I ANSWER. BUT REST ASSURED, IF YOU ARE
STILL CONFUSED WHEN I AM FINISHED, IT WILL BE
ON A HIGHER PLANE AND ABOUT MORE IMPORTANT
ISSUES.

PROBLEM STATEMENTS

1. THE CURRENT REQUIREMENTS ARE AMBIGUOUS,
   LACK A BASIS FOR NEED, AND ARE POORLY
   UNDERSTOOD

2. SOFTWARE QA REQUIREMENTS MUST INCLUDE A
   SOFTWARE CLASSIFICATION SCHEME BASED ON THE
   NATURE, IMPORTANCE AND INTENDED APPLICATION
   AND MUST BE COMMENSURATE WITH IMPACT ON QUALITY

3. REQUIREMENTS FOCUS ON DOCUMENTATION OF ALL
   PHASES/CYCLES OF SOFTWARE DEVELOPMENT , NOT
   ON TESTING/VALIDATION. EMPHASIS NEEDED ON THE
   QUALITY OF SOFTWARE REQUIRED FOR LICENSING AND
   NOT PAPER TRAIL

ESTABLISH A STANDING SOFTWARE WORKING GROUP

DEVELOP A CHARTER

- ● REVIEW AND RECOMMEND REVISIONS TO THE SOFTWARE PROGRAM

- ● MEMBERSHIP MUST REPRESENT THE BROAD SCOPE OF THE PROJECT AND INCLUDE SPECIALTIES SUCH AS SQA, SOFTWARE DEVELOPERS AND TECHNICAL PERSONNEL

- ● MEMBERSHIP LIMITED TO 10

- ● EVALUATE NEED FOR SQA MANAGER

- ● PROVIDE LONG-TERM FOCUS FOR RESOLUTION OF SOFTWARE ISSUES, AND INTERPRETATION OF REQUIREMENTS

THE WORKING GROUP WILL IDENTIFY THE OPTIMUM SQA REQUIREMENTS FOR LICENSING

- PRESENTATION OF SQA WORKSHOP GROUP RESULTS

- EXAMINE CURRENT REGULATIONS, DOE ORDERS, INDUSTRY STANDARDS, NRC GUIDANCE.

- EMPHASIZE ACCEPTED SCIENTIFIC PRACTICES

- CONSULT WITH OUTSIDE EXPERTS INCLUDING THE NRC

- DEVELOP DEFINITIONS AND SOFTWARE CLASSIFICATIONS

- USE SOFTWARE CLASSIFICATIONS TO PROVIDE FLEXIBILITY IN THE APPLICATION OF SQA CONTROLS

- DOCUMENT RATIONALE FOR MODIFICATIONS TO EXISTING SQA PROGRAM

PARTICIPANT REVIEW

- PARTICIPANT REVIEW OF PROPOSED SQA PROGRAM

PRESENT PROGRAM TO DOE/NRC

- DOE FIRST

- NRC

SQA TRAINING

- AUDITORS AND PARTICIPANTS POINT OF CONTACT MUST RECEIVE SAME SQA REQUIREMENTS TRAINING

SHORT TERM AND SPIN-OFF ISSUES

SHORT-TERM

- **EXISTING QARD FLEXIBILITY**

- **PRELIMINARY DATA COLLECTION FOR SOFTWARE WORKING GROUP**

SPIN-OFF ISSUES

- MOCK LICENSING PROCESS (PHASE 2 WORKSHOP COMMITTEE)

- QA GRADING
  - GRADING REVISION BY BLANCHARD, HORTON, ET. AL.

EXISTING QARD FLEXIBILITY

RECOMMENDATION:

IDENTIFY AND CLARIFY EXISTING FLEXIBILITY IN
SECTION 19 OF QARD. (EG: NATURE, COMPLEXITY,
AND IMPORTANCE)

ACTION:

1. PARTICIPANTS* COMMUNICATE IMPLEMENTATION
   CONCERNS TO PROJECT OFFICE QA

2. QA* SPONSOR MEETING(S) WITH PARTICIPANTS*
   TO DEVISE SOLUTIONS TO IMPLEMENTATION
   ISSUES

*REPRESENTATIVES FROM THIS WORKSHOP

PRELIMINARY DATA COLLECTION

RECOMMENDATION:

IDENTIFY AND GATHER PREVIOUSLY PERFORMED
ANALYSES OF STANDARDS/ REQUIREMENTS FOR
SOFTWARE QA AND MAKE AVAILABLE TO SOFTWARE
WORKING GROUP

ACTIONS:

AL WILLIAMS OF THE PROJECT OFFICE WILL BE THE
POINT-OF-CONTACT FOR DISSEMINATION OF INFORMATION

MOCK LICENSING PROCESS

RECOMMENDATION:

INCLUDE SOFTWARE IN THE MOCK LICENSING PROCESS
RECOMMENDED IN THE PHASE 2 QA WORKSHOP

ACTION:

SOFTWARE WORKSHOP PARTICIPANTS*   WILL CONTACT
PHASE 2 QA WORKSHOP PARTICIPANTS**   TO REQUEST
THAT PROJECT RELATED SOFTWARE ACTIVITIES ARE
REPRESENTED IN THE MOCK LICENSING PROCESS

* J. BLINK & T. CHANEY
** A. JARDINE

QA GRADING

RECOMMENDATION:

USE GRADING PROCESS TO ACHIEVE FLEXIBILITY IN
APPLICATION OF SOFTWARE QA CONTROLS. GRADING
SHOULD BE AT A LEVEL OF DETAIL TO DISTINGUISH
AMONG DIFFERENT SOFTWARE USES

ACTION:

ONCE THE PROJECT GRADING PROCESS IS REVISED THE
DEFINED SOFTWARE CATEGORIES CAN BE USED TO
GUIDE THE SELECTION OF CONTROLS TO BE APPLIED TO
SOFTWARE

APPENDIX J

WORKSHOP ACTION PLAN

	Tasks	Person Responsible	Target Date
1	Develop Charter Outline		
	• Identify people to write	SW Working Group T. Colandrea L. Hayes	2/7/91 Draft 2/15
	• Include the concept of small working groups of scientists and engineers		
2.	Gather data	A. Williams will hold. J. Stuckless	
	• Workshop results • DOE Orders • Analyses done • Current SQAPs • Industry Standards • NRC Guidance • Accepted industry practices • Industry experience		
2.	Give data to SW working	A. Williams	Week of 4/1
3.	Establish working group schedule		2/7
4.	Communicate implementation concerns and success stories to Project Office QA (Al Williams)	P. Covington K. Schwartztrauber J. Blink E. Ezra	2/22
5.	QA support meeting(s) to devise solutions	J. Caldwell	Two weeks later
6.	Letter to Gertz requesting support (or expressing it)		3/15
7.	Letter from Gertz authorizing committee		3/15

Tasks	Person Responsible	Target Date
8. Present workshop results to SW Working Group	J. Stuckless	4/1
9. Mock licensing process		
• Request that SW activities be included in Mock Licensing process	J. Blink	2/11
10. Track activities initiated by the first workshop re. licensing process workshops	P. Presholt	5/1
11. Obtain tapes NRC/DOE licensing tapes and send to each TPO	J. Harper	2/22
12. Report to SW workshop participants on progress of group revising:		
• Grading procedure	N. Voltura	TBD
13. Call follow-up meeting, if needed, to review action items--track action items and report to members	J. Caldwell (within six weeks)	3/18
14. Evaluate need to perform a team building exercise	J. Caldwell	4/1
15. Develop and present workshop results to TPO meeting	L. Hayes R. 450 Valley Bank Bldg.	2/22
16. Report of workshop results to the Bartlett Presentation	L. Shephard	2/8
17. Provide materials related to the software workshop to D. Horton for the TRB Dallas meeting.	J. Caldwell	3/1