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MASTER

QUALITY ASSURANCE IN THE NUCLEAR TEST PROGRAM

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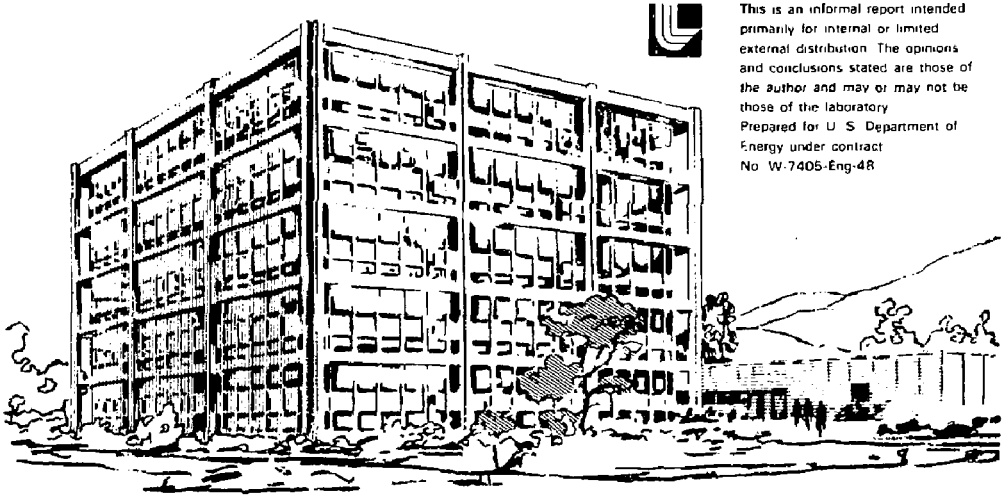

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QUALITY ASSURANCE IN THE NUCLEAR TEST PROGRAM

ABSTRACT

In February 1979 Test Program laid the ground work for a new quality assurance structure. The new approach was based on the findings and recommendations of the Ad Hoc QA Program Review panel, which are summarized in this report. The new structure places the responsibility for quality assurance in the hands of the line organizations, both in the "programmatic" and "functional" elements of the LLL matrix.

INTRODUCTION

For many years Test Program has used various procedures that, individually, are legitimate quality assurance activities. Things like bunker check lists, 0560 studies, the two-person access rule, full-power full-frequency dry runs, hot dry runs, and design reviews readily come to mind. However, the Peninsula industrial accident of October 23, 1975, proved that not all critical operations were adequately covered by such procedures.

Hence, in November 1975, Test Program's first comprehensive quality assurance program was started. Early in 1976 the position of Test Program Quality Assurance Manager was created and Quality Assurance Integrators (QAIs) were assigned to each event. The QA Manager was on the staff of the Associate Director for Nuclear Test. The QAIs were assigned by and supervised by the QA Manager.

This system continued until February 1, 1979. On this date James S. Kahn, Associate Director for Nuclear Test, issued a memo that laid the groundwork for an entirely different kind of QA structure. This structure is one recommended by the Ad Hoc QA Program Review Panel, which Kahn established in October 1978.

The first section of this report summarizes the findings and recommendations of the Ad Hoc QA Program Review Panel. The second section contains suggestions on how to go about setting up an effective and efficient QA Program. While the specifics are oriented toward Test Program, the approach and general philosophy may be useful in other areas.

FINDINGS AND RECOMMENDATIONS OF THE AD HOC QA PROGRAM REVIEW PANEL

There are two reasons why the Panel recommended that the existing QA Program be changed. First, new Laboratory policy -- new since Test Program's QA Program was started -- establishes a different system of responsibility and accountability. Previously, the QA Manager and the QAIs felt they had a major responsibility for defining and implementing the QA Program. Laboratory policy, described in Volume I of the Quality Assurance Manual (March 1, 1978), puts this responsibility elsewhere: "The existing Laboratory line organization is responsible to determine the need and to apply the level of QA appropriate to its activities." Hence the QA Program, as it then existed, was at variance with Laboratory policy. The second reason is that the QA system has never worked very well. A perceptive memo, written by Roger Lake on March 12, 1976, describes the difficulties he encountered as a QAI on the Fontina Event. More recently Allen Levy, of the Laboratory QA Office, observed Test Program's QA activities for the Panir Event. His comments, given in a memo dated October 23, 1978, indicate that many of the points made by Lake were still valid two years later.

LABORATORY POLICY

The Panel, in reviewing the situation, concluded the fundamental problem was that responsibility and authority were split; some people felt they had responsibility but lacked the authority to be effective, while others who had the authority believed QA was some other person's job. As noted, Laboratory policy resolves this difficulty by assigning responsibility to the "line organization," which already has the necessary authority. However, it leaves open the definition of what a "line organization" is in a matrix structure such as ours. Getting this sorted out took more of the Panel's time than any other single topic. For purposes of untangling this question the Panel found it convenient to summarize one aspect of Laboratory QA policy.

The Panel understands Laboratory policy to be that the line organizations will:

(1) Review their activities to identify potential problem areas.

(2) Determine which potential problem areas pose unacceptable risks.

(3) Define a QA plan that specifies the actions necessary to reduce these risks to acceptable levels.

(4) Develop implementing procedures to insure that these actions are carried out.

WHO IS RESPONSIBLE FOR QA?

But what organization should actually do these things? Should it be the various Divisions and Departments? The Program Leaders? Going back to basics, the two dimensions of a matrix structure usually are called the "Program" dimension and the "Function" dimension. Broadly speaking, the Program is responsible for determining what should be done, for defining the job. The Function responsiblity, then, is to figure out how to do the job defined by the Program and see that the work is done to acceptable standards. Thus, in effect, there are two general line organizations, each with its own area of QA responsibility according to the basic definitions of Program and Function. Applying this to the four items of Laboratory policy noted above, the Panel came to the following conclusion. It is a Program responsibility to:

(1) Review activities to identify potential problem areas;

(2) Determine which potential problem areas pose unacceptable risks.

It is a Function responsibility to:

(3) Define a QA plan that specifies the actions necessary to reduce these risks to an acceptable level;

(4) Develop implementing procedures to insure that these actions are carried out.

Obviously, there must be interaction between Program and Function in all four steps. For example, (3) is really a cooperative effort. The Functional organization may prepare various options for risk reduction and calculate the amount of reduction for each with its associated costs. The Program must then decide which option to select, or in other words, how much QA is enough.

As part of this discussion the Panel addressed the problem of interfaces between LLL people and external suppliers or contractors. It concluded that interfaces are primarily a Functional responsibility. If the QA job defined by the Program requires monitoring the work or material provided by others, then the Functional organization using this work or material must make adequate provision for monitoring in its own QA plan. Adequate provision could include things such as examination and approval of the supplier's QA program, in-plant inspection, acceptance inspection, acceptance testing, etc.

All this, however, does not complete the necessary assignment of responsibilities for QA. At least for Test Program, which does work in Livermore, Las Vegas, and at the NTS, one must specify the kinds of activities for which the various Program elements should do (1) and (2) above. Also, for the Functional elements, one must give more detail about the place where they are responsible for doing (3) and (4). The following two pages summarize the Panel's conclusions. Figure 1 lists the four sub-Programs making up Test Program, each headed by a Program Leader. These Program Leaders are responsible for the "job definition" kinds of activities indicated. Figure 2 lists Functional organizations, including people and groups who act like Functional organizations in this context, and specifies the location where each is responsible.

FIGURE 1 SUMMARY OF PROGRAMMATIC QA RESPONSIBILITIES

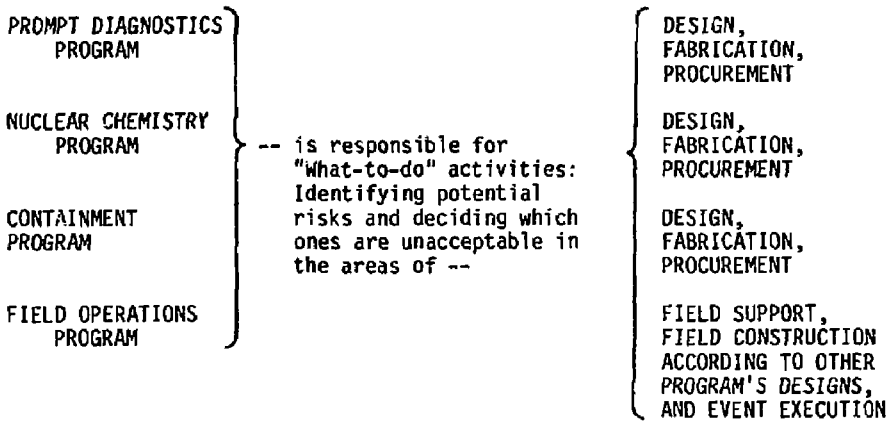
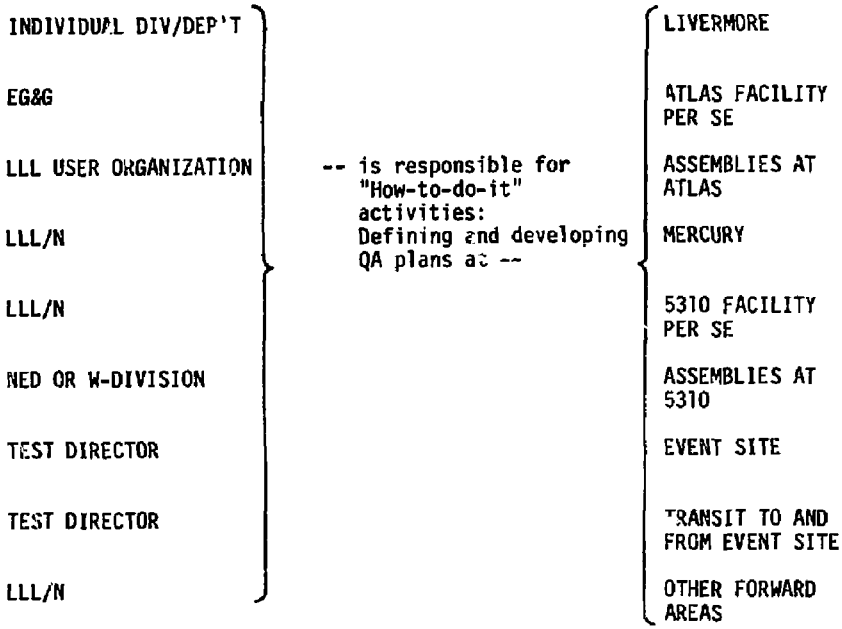


FIGURE 2 SUMMARY OF FUNCTIONAL QA RESPONSIBLITIES



THE ROLE OF THE QA PERSON

The final question addressed by the Panel was this: Since Laboratory policy assigns QA responsibility to the line organizations (both Programmatic and Functional), is there a useful job to be done by some QA person acting as staff to the Associate Director for Nuclear Test (ADNT)? The Panel's answer was "yes." In fact, there are two different jobs, but one person can do both of them since they are sequential in time.

The first job involves items (1) through (4) of Laboratory policy. As a major effort these are one-time-only types of activities, which must be done by the various line organizations before an intelligent and effective QA plan can be implemented. The Test Program QA person should represent the ADNT and make sure that the overall Test Program point of view is incorporated into the deliberations of the individual Programmatic and Functional elements.

More specifically, the following two items of the QA person's job description belong to this first temporary phase.

1. Assist the ADNT in making sure that the overall Test Program point of view is incorporated into:
   a) The identification of potential problem areas.
   b) The assessment of consequences of failure.
   c) The reduction of the failure likelihood factor to an acceptable level.

2. Representing the ADNT, review individual line organization's QA activities and provide independent assessment regarding:
   a) Completeness with respect to Test Program functions as a whole, including interfacing with non-LLL organizations.
   b) Compatibility of individual QA plans, including those of non-LLL organizations.

Before turning to the rest of the job listing it is worth emphasizing one point. The various line organizations are responsible for defining and implementing their own QA program. The Test Program QA person is staff to the ADNT and has no line authority.

The balance of the QA person's job listing principally concerns monitoring and auditing the QA plans developed as a result of carrying out Laboratory policy items (1) through (4). The amount of work involved depends strongly upon the outcome of the review of activities and assessment of failure consequences.

3. Representing the ADNT, participate in periodic QA audits and spot checks to make sure that the existing QA plans are being implemented effectively.
4. Review job items 1 through 3 to:
   a) Look for ways to make significant improvements in the existing plans.
   b) Make sure the QA plans are up to date and reflect the current Test Program structure and organization.

5. Provide a central point of contact for the ADNT for the following:

   a) QA records having applications and historical usefulness (i) beyond those records maintained by the individual functional line organization, and (ii) generated by the program line organizations.

   b) Analysis of records for the purpose of identification and resolution of long range quality problems.

6. Be available to all Test Program requestors as a QA expert to:

   a) Provide advice, guidance and arrange for training.

   b) Participate in those efforts requiring QA expertise, i.e., design review panel member, evaluation of supplier's QA capabilities, witnessing supplier inspection and test operations, and auditing supplier or LLL QA systems.

SUGGESTIONS ON HOW TO START AN EFFECTIVE AND EFFICIENT QA PROGRAM

GETTING A GOOD START

In Test Program's experience, so far, the most difficult part is getting off to a good start. Not just in starting, but in getting people to back off from quotidian concerns or problems and to view the whole forest. The final QA Program is more likely to be good if the initial study of potential problems (item (1) on page 4) is as broad and inclusive as possible. One way to do this is for the Program Leader to ask himself and others two questions:

What has happened that we would not like to have repeated?

What has not happened yet, but we would just as soon avoid?

In other words, start with a list of potential problem areas stated in general terms. For example, in Test Program such a list could include:

- Data loss
- Public embarassment
- Wrong measurement
- Failure to make a requested measurement
- Loss of equipment
- Delay in schedule
- Creation of hazardous situation

Having developed a complete list, the Program Leader next supervises the generation of specifics under each of these general categories. Are all data equally valuable? If not, which are the most valuable and which the least? What kinds of things could cause us public embarassment? For example, do we have any radioactive or other hazardous materials around? Can people who do not adequately understand the hazards (guards, janitors, secretaries, technicians, plant maintenance people, outside contractors, etc.) be exposed inadvertantly? For example, can people be exposed during lunch time or at night or during movement of the material from one place to another?

These are not the kinds of questions that come up in daily work. But somehow they must be thought of if the QA Program is to have any real value. It is the Program Leader's responsibility to see that the appropriate questions are asked and answered. As a stimulus, a partial list of questions for each of the above general categories is given in Appendix B. These are specifically oriented toward Test Program but may be useful in other Programs.

ESTABLISHING PRIORITIES

The next step is that of beginning to establish priorities. It is unlikely that the Program can afford total protection against all possible problems. Which problems are obviously serious enough to require some degree of coverage by QA? Which are so unlikely or so trivial in consequence that they do not need to be considered further? What is a criterion for deciding the problems which fall into the gray area between these two categories? As with the preceding step, these decisions are the responsibility of the Program Leader.

DEVELOPING CAUSAL CHAINS

The first two steps should yield a list of fairly detailed problems that merit further study. The next question to ask is how might they happen? What mistake, accident, unexpected occurrence, etc., might create these undesirable situations? In other words, one performs some sort of formal analysis to develop causal relationships and chains. A variety of techniques exist for doing this, for example, fault-tree analysis. At this point the responsibility shifts to the Functional leadership. Referring to the four-item summary of Laboratory policy on page 5, items (1) and (2) have been done, at least initially. Fault tree or other causal anaylsis is the first step in item (3), defining QA plans for the unacceptable risks.

EXAMINING CAUSAL CHAINS

Next, the causal chains are examined. Where are the simplest and least expensive places to break them? How much assurance must there be that the problem cannot happen? What procedures can be devised to give this assurance? How much will they cost? As stated before, this is an iterative process between Function and Program. Ideally, the Functional organizations will develop specific QA/QC plans and procedures that address the problems the Program Leader has decided are important, and at a price he is willing to pay.

This has been a very brief description of the procedure being used to establish a QA system in Test Program. It has not addressed any of the difficulties involved in continuing an effective QA program once one has been set up. That is a whole different set of problems.

APPENDIX A: MEMBERS OF THE AD HOC QA PROGRAM REVIEW PANEL

Joseph Behne

Richard Corallo

Thomas Holdsworth

Robert Horton

Otto Leipski

Allen Levy

John Morton

Jack Shearer, Chairman

APPENDIX B: PARTIAL LIST OF QUESTIONS TO STIMULATE THINKING

Some Questions To Ask Regarding Data Loss

Can the wrong instrumentation be used?

Who is responsible for accurate calibration?

Can the detectors or recording system be set for the wrong range?

How do you know the system is hooked up right?

Can the power fail just before or during measurement?

Can records be mislabeled, lost, or destroyed?

Can samples be improperly selected?

Can there be errors in data or sampling process?

Which data are most important?

Is equipment known to be working properly?

Are collimators, attenuators, lines-of-sight, etc. properly aligned?

Are data transmission links vulnerable to damage, interference, or disruption?

Can data be irretrievably lost during computer processing?

Are all necessary experimental conditions accurately recorded and identified?

Can something somebody else is doing interfere with your experiment?

Are calculations free of arithmetic and logic errors?

Can essential parts or components be left out during set-up?

How do you know that the things you bought or borrowed from somebody else are what you think they are?

Does the design make it easy to install critical components the wrong way?

Some Questions To Ask Regarding Public Embarassment

Are people like guards, plant maintenance workers, janitors, secretaries, technicians, crafts people, and outside contractors ever asked to work with or near some hazard they don't know about or don't properly understand?

What radioactive or other potentially hazardous materials are used or stored? Is access to them adequately restricted, especially during lunch time and at night? Is there an accurate inventory? How often is the inventory updated? If some of the hazardous materials were inadvertantly misplaced, how long would it take to discover that they're missing? Would you know for sure how much is missing?

What can happen to cause a release of radioactive or other hazardous material?

Is it clear that safety or emergency equipment will work when needed? Do people know where this equipment is located and how to use it? Is periodic refresher or update training necessary?

What about people whose work involves potentially hazardous material or operations? Do they need special training, including refresher courses? How often? Who is responsible for seeing that this happens?

Is it ever desirable to exclude transients and visitors during particular operations or processes?

What about delegation of responsibility; what happens when the person normally in charge isn't there? Is there a clearly designated alternate? Does this alternate have adequate training and authority? Do the other workers know that this alternate is now in charge?

Do people from other parts of the Laboratory sometimes work in your area? Do they know about potential hazards they might encounter? Are they adequately trained to deal with them? Who is responsible for seeing

that they are adequately informed, trained, and that they follow your procedures? (In a matrix organization the answer to this last question is not always obvious.)

What kinds of incidents that neither cause injury nor release hazardous materials might result in adverse publicity?

Some Questions To Ask Regarding Making a Wrong Measurement or Failing To Make a Requested One

Is the person requesting the measurement qualified to make this request?

Are changes in criteria always transmitted to the people who will do the work?

Who is responsible for maintaining an accurate and up-to-date list of requested measurements?

If one of the existing workers has to be replaced, what provisions are necessary to make sure his replacement is well informed?

Is it ever a good idea to check back with the original requestor to make sure that what you're doing is what he wanted, and that he still wants it?

Some Questions To Ask Regarding Loss of Equipment

Do untrained people have access, especially during lunch time or at night?

Who is responsible for seeing that necessary preventive maintenance is done?

Are all equipment operators adequately trained? Is refresher or update training necessary? Who sees that they get it?

What pieces of equipment are especially critical in that their failure would create a domino-like effect on other gear?

What prevents the equipment from being used in a way for which it was not designed?

Are there environmental restrictions that must be observed? For example, not too hot, or too cold, too wet, too dry, or too dusty.

Can people make unauthorized modifications? Have the consequences of proposed and authorized modifications been thought through?

When it is necessary to move the equipment, what needs to be done to prepare it for movement? Will it be adequately secured or tied down during movement? Who is responsible for doing both of these?

Is any of the equipment especially sensitive to shock? Vibrations? Sudden power surge? Loss of power during operation? Other unusual sensitivities?

Some Questions To Ask Regarding Schedule Delay

What assurance is there that the criteria sent to the Nevada Test Site are accurate and up to date?

Is there an adequate inventory of crucial spare parts, especially those having long lead times?

Do inventory levels in general reflect projected use rates?

Are design reviews held early enough that any necessary changes can be accommodated?

If some supplier sends the wrong thing will this be discovered early enough to correct?

Should any orders be checked for accuracy and completeness before they're sent out?

Would it be useful to have some sort of early warning system to spot unusual problems or requirements well in advance of need?

Are the necessary people always informed of critical dates in time to meet them?

When criteria are changed are the necessary people always informed?

Some Questions To Ask Regarding The Inadvertant Creation of Hazardous Situations

Is it possible for a known hazard to be left unattended during work, or to be accessable during off-hours, including lunch?

Who is responsible for assuring that fail-safe devices, interlocks, shields, etc., are in place and in good working order?

How do you know the existing safeguards and procedures are being enforced?

Are there situations where the normal emergency reaction (e.g., putting water on a fire) is not correct? What will prevent this from happening?

What level of illumination is necessary for the type of work being done?

When or where would a static electrical discharge be dangerous? A mechanical shock?

How much overtime work in what period of time is too much?

Have any safety responsibilities been delegated to other people or groups?

Do you and these other people or groups have a written statement saying what has been delegated? Do you feel you have enough knowledge of and assurance about their performance?

If you supervise people, do these people ever go somewhere else, either inside the Laboratory or outside it, to do part of their work? Do potential hazards exist at these other places? Are your people adequately trained to recognize these hazards and deal with them? Whose job is it to see that they are adequately trained? Who should identify the hazards that might exist there and decide what level of training is necessary?

Are potentially hazardous materials ever moved from one place to another, especially off-site? Who is responsible for seeing that adequate precautions are taken during this movement? Is access to the material properly restricted during packaging, shipping, receiving, and unpacking? Can the material be left unattended at any time during the entire transportation process?

Are there processes or procedures in which use of the wrong material could cause a fire, explosion, or other significant problem? Are there sufficient checks to make sure that the correct material is always used?