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TITLE: AUDITING NUCLEAR WEAPONS QUALITY PROGRAMS AT LOS ALAMOS

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FIFTEENTH ANNUAL ENERGY DIVISION CONFERENCE

SESSION B: QUALITY ADVANCES IN RESEARCH

AUDITING NUCLEAR WEAPONS QUALITY PROGRAMS AT LOS ALAMOS

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ABSTRACT

Some of the problems involved in introducing quality assurance on a broad scale in a national laboratory are discussed. A philosophy of how QA can be utilized beneficially in research and development activities is described briefly, and our experiences at Los Alamos in applying QA to nuclear weapons activities are outlined. The important role of audits is emphasized; audits are used not merely to determine the effectiveness of QA programs but also to explain and demonstrate the usefulness of QA to a generally sceptical body of engineers and scientists. Finally, some ways of easing the application of QA in the future are proposed.

Introduction

This talk is a report on the experiences of our first year of developing and auditing the nuclear weapons quality assurance programs at Los Alamos. One might wonder what is different about this audit program. Primarily, the difference lies in the fact that formal quality assurance programs have not been part of the "culture" at our Laboratory. Prior to 1987, only a small fraction of the Laboratory's activities were covered by QA programs, and these programs had been developed chiefly because of the requirements imposed by outside sponsors. The Laboratory as a whole had no policy on QA, and the major programs, such as nuclear weapons, for example, preferred not to initiate formal QA on their own. In fact, the general attitude on the subject ranged from total ignorance of what QA is, to a firm belief that QA is inappropriate for our work and should be avoided at all

costs. What made this situation somewhat anomalous was the fact that the DOE had for several years required formal QA programs for all its contractors, including Los Alamos, for both non-weapons and weapons activities.

In mid-1985, the Laboratory developed an overall quality plan for its work related to the design and testing of nuclear weapons. This plan provided for a coordinator with authority to oversee the development of quality plans by those Laboratory divisions having major responsibilities in the nuclear weapons program. The coordinator was also given the task of auditing the quality programs described by those plans. Nuclear weapons work comprises a major fraction of the Laboratory's budget and is carried out by many Laboratory groups. Nine of the more than thirty Laboratory divisions were selected as the major contributors to be included in the first phase of the new QA effort.

The first audit of a nuclear weapons quality program was conducted in mid-1987. Since then, a regular program of audits of the divisional quality assurance plans has been under way. This may sound straightforward, but it has meant in practice that a part of our "culture" at Los Alamos had to change, and the process of change has not always been easy. The coordinator for nuclear weapons quality assurance, Don Rose, has had the responsibility for bringing about this cultural shift, and I have been assisting him in this task almost from the beginning.

Developing a QA Philosophy

No quality plans existed in the nuclear weapons area when we began our efforts. We were convinced, however, that the Laboratory's outstanding record of accomplishmen over four decades was ample evidence that *de facto* quality programs existed in some form. Initially, therefore, the divisions having major responsibilities in nuclear weapons design and testing were asked to submit quality plans that described their existing methods for maintaining high standards in their work.

The first submissions were not generally satisfactory. The basic problem was that there was no common agreement on what quality assurance really is, especially when the term is applied to the research and development activities that form the bulk of our nuclear weapons efforts. A few persons were acquainted with QA in other contexts, chiefly production environments; the Laboratory has excellent QA programs, developed by the quality assurance section in Group MEE-9, for some of its production activities. Others knew vaguely about QA, but they associated it only with industry. In most cases, there were strong

negative feelings about the prospect of applying QA to research and development. These negative feelings were reflected either by an outright refusal to prepare quality plans or by submission of plans that were brief and not very informative.

In fairness, the bewilderment of the weapons divisions was matched by an uncertainty on our part as to what role a formal QA system should play in an R&D laboratory. Through research, reflection, and much discussion with our colleagues both in QA and in R&D, we have developed over the past two years a philosophy on how to apply QA beneficially in the area of R&D. This philosophy has been expounded in a couple of Laboratory reports[1] as well as in formal and informal presentations to audiences both within and outside our Laboratory.

Briefly, our view is that QA is fundamentally equivalent to what scientists and engineers have called "good laboratory practice" or "good engineering practice." But these traditional practices, although usually effective, have sometimes failed because of human error or the pressures of schedule or budget. A QA system tries to minimize these failures by requiring that the measures used to ensure the excellence of R&D work be written out explicitly in a QA plan and supporting procedures and that sufficient documentation exist to demonstrate objectively how effectively the system is being implemented. A good QA plan, therefore, primarily describes the practices that most conscientious engineers and scientists follow as a matter of course, with some additional emphasis on the importance of adequate records.

We have proposed that QA, understood in this way, is a benefit rather than a burden to an R&D laboratory. The very act of writing down a QA plan for an R&D group forces one to think carefully about what systematic methods are needed to help assure that the group's work is valid. If group members participate actively in preparing the quality plan, everyone involved understands the rationale for the system and becomes aware of just what is expected from each individual in the team. Uniform standards exist throughout the group, and it becomes much less likely that mistakes will occur through carelessness, haste, or outside pressure. There are clear

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[1] "A New Approach to Quality Programs for the National Laboratories," A. H. Davis, P. L. Bussolini, and R. R. Geoffrion, LA-UR 86-4351 (see also, Quality Progress, January, 1988, pp. 24-27).
"How Can Quality Assurance Contribute to Research and Development Laboratories," A. H. Davis and D. G. Rose, LA-UR 88-917.

guidelines for new members of the group to follow. The agencies that fund the work are reassured about the quality of the results. And perhaps most important, the group members have demonstrated to their profession and to the world that they are committed to the highest standards of excellence.

We believe these benefits are real, but it has not been an easy task to convince others that this kind of QA is worthwhile. On the one hand, our primary funding agency, the DOE, was pressing for the adoption of quality assurance in the more traditional forms embodied in national consensus standards, such as NQA-1. On the other hand, many of our scientists and engineers resisted fiercely what they felt was useless bureaucratic dictation by outsiders on how they should conduct their work. Ultimately, we have had moderate success in convincing many of our colleagues that it is better to work constructively on QA systems that are suited to our needs and can possibly even help us, rather than to resist blindly until an inappropriate QA system is forced upon us. We feel that our approach will meet the intent of national consensus standards without compromising the traditional values of an R&D laboratory.

Having begun to develop a new philosophy, we asked our weapons divisions to try again to write QA plans. This time we could explain more clearly what was needed, and we provided a guideline -- a set of about nine elements that we thought ought to be addressed to some degree in all of the plans. Here is a list of these elements by title; in our complete guideline we explained each of them in more detail:

Guidance for Weapons Quality Plans

0) Introduction -- Mission and Scope
1) Organization
2) Training
3) Planning
4) Design
5) Control of Materials and Equipment
6) Control of Processes
7) Records
8) Audits

We emphasized that quality plans did not have to adhere blindly to this format; these elements would just serve us as a checklist to make sure that important quality aspects had been covered. The divisions took us at our word on this point; very few of them adopted the guideline as a format for their quality plans. However, the plans did turn out to be much more satisfactory on this second round, although most of them still

went through a number of revisions before everyone felt reasonably comfortable about them. Don Rose and I, in the Quality Coordinator's office, did not always agree with everything we saw. But we felt that it was important that the plans really reflect the actual practice in the divisions, since division managements had complete responsibility for implementing the quality programs. If modifications in these programs seemed desirable to us, they would have to be introduced slowly as the people involved became convinced of the utility of the change.

The Audit Program

As the divisional plans were completed -- over a period of about a year -- it was possible to begin the audit program. Here again there were psychological roadblocks to be surmounted. Very few of our R&D people knew what was involved in a QA audit. The very word "audit" had evil connotations. It brought to mind steely-eyed investigators, searching for every minor shortcoming and hoping to find evidence of incompetence or dishonesty. Before each audit, we had to explain our purposes and reassure people who were sometimes quite nervous or defensive.

In explaining what a QA audit is and why we do them, we try to make the following major points. The audit is not adversarial; the only good reason for an internal audit is to help management see how well their quality plan is working and where improvements might be helpful. The audit is not a technical peer review; although we always have at least one technically knowledgeable person on the audit team, a quality audit is concerned with general systems for assuring good scientific or engineering practice and does not try to evaluate technical adequacy. Of course, evidence that appropriate technical peer reviews are conducted is often a requirement of the quality program. Basically the auditors want to ascertain that in the written quality plan the division does indeed say what they do, and that objective evidence exists to show that they do what they say.

In the course of examining the quality system, questions may arise about why some practices are used and others are not, and suggestions may be made about possible improvements. All these matters are discussed during the audit and at the post-audit meeting. The tangible result of an audit is a report that summarizes the audit team's conclusions on how well the quality system is working and what improvements could be made. Management is normally asked to prepare a written response to the audit report. Usually, the results are not controversial,

since possible misunderstandings are discussed and cleared up before the audit report is finally issued. Not only is the report an ai to management in evaluating and improving their quality system, but it also provides evidence to the DOE that effective quality systems exist at our Laboratory.

In practice, our audits have relied far more on interviews with the people working in our nuclear weapons programs than on the examination of objective evidence, as in traditional audits. The reason for this is that our focus is not on detailed compliance with a set of regulations but on the effectiveness of the QA program as a whole. Especially in this initial phase of our efforts to introduce QA to the weapons program, audits serve as an important tutorial device. They provide forums in which the reasons for the QA program and the difficulties in instituting it can be discussed frankly and in detail.

After most audits that we have performed, we have noticed that the attitude of the auditees has mellowed perceptibly. It is one thing to discuss the benefits of QA in an abstract way; it is quite another thing for the audited organization to see directly that the QA people really care about what the technical divisions are doing, want to understand their problems, and want to be helpful in searching for solutions. I do not mean to imply that auditors and auditees are always in perfect agreement, but there is a feeling of mutual respect and trust. In this way, audits can do far more to promote the development of effective QA programs than can lectures or papers or orders from higher management or the DOE. Our audits are not like the product audits performed in industry. Instead, they are designed to help our R&D staff re-examine periodically their own practices and see how they can better meet the standards of excellence that they are striving for.

Conclusion

We feel that we are making a good start at Los Alamos in introducing QA into an environment in which its benefits had not previously been appreciated. Our progress has been slow, for we had no clear guidance as to where we were heading or how we could get there. We had to develop both our goals and our methods as we progressed. If we had it to do over, what would make things easier?

First, I think, the existence of a clearly articulated philosophy of QA as applied to an R&D laboratory is essential. We hope that in our papers and in our work at Los Alamos we have contributed to this goal. Second is a sense of direction and

support from upper management. At Los Alamos we lacked that initially. Laboratory management was as wary of QA as the rest of the staff and reacted primarily to pressure from the DOE. Since no overall Laboratory policy on QA existed, we had to develop our programs from the bottom up. The situation is now changing; the Laboratory has appointed a Quality Assurance Officer and appears to be committed to developing QA programs on a Laboratory-wide basis. We believe our experiences in the nuclear weapons area can assist Laboratory management in instituting an enlightened QA policy.

Finally, we need the cooperation and encouragement of the DOE, our primary funding agency. The DOE's experience with QA has chiefly been in connection with its production contractors. In expanding and formalizing its QA requirements to include all its contractors, the DOE has not sufficiently recognized the different character of the QA needed for R&D laboratories. The result has been the adversarial attitudes that marked the initial attempts at introducing QA at Los Alamos and the other design laboratories. It is now time for all parties to reassess the situation. We can cooperate effectively toward the common goal of excellence if we all are willing to modify extreme positions and to concentrate on developing workable and beneficial QA systems. We hope that our efforts at Los Alamos over the past few years will contribute to stimulating these necessary changes in attitude.