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New Directions for QA in Basic Research: The Fermilab/DOE-CH Experience *

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New Directions for QA in Basic Research: The Fermilab/DOE-CH Experience

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Abstract

This paper addresses the underlying problems involved in developing institution-wide QA programs at DOE funded basic research facilities, and suggests concrete ways in which QA professionals and basic researchers can find common ground in describing and analyzing those activities to the satisfaction of both communities. The paper is designed to be a springboard into workshop discussions which can define a path for developing institution-wide QA programs based on the experience gained with DOE-CH and Fermilab.

Introduction

The purpose of a workshop is not to re-hash warmed-over topics. Workshops are meant to be informal "brainstorming" sessions that address problems that may or may not have a clear formulation. The first goal should be to clearly define the nature and scope of the problems, while the second goal is to propose possible solutions to those problems. That is if solutions are indeed possible. Because of its informal nature, workshop participants should feel free to speak their minds without fear of criticism. This notion is the basis of the often quoted but little practiced Point Eight of Deming's management method: drive out fear. Deming claims that it is necessary for better quality and productivity, that people feel secure. He notes that *se* comes from the Latin, meaning "without", while *cure* means "fear" or "care". *Secure* means "without fear"- not afraid to express ideas, not afraid to ask questions. Deming goes on to say, "Fear takes a horrible toll. Fear is all around, robbing people of their pride, hurting them, robbing them of a chance to contribute to the company. It is unbelievable what happens when you un-loose fear." I believe that Deming is right.

The purpose of this paper is to raise provocative questions and use them as a springboard into the subsequent workshop session. My comments will purposefully be provocative, but they are honest concerns of someone involved in basic research QA who also happens to have Staff responsibilities in the Directorate at a major high-energy physics research laboratory; Fermilab.

I want to narrow the scope of my remarks by stating up-front that I am referring *only* to activities done in pursuit of *basic research*, not to activities at nuclear facilities. This is probably the most important distinction that I will make in the course of the paper, so let me clarify what I believe this means. What are "nuclear facilities"? The applicability statement in the introduction of ANSI/ASME NQA-1 states, "Nuclear facilities include facilities for power generation, spent fuel storage, waste storage, fuel reprocessing, and plutonium processing and fuel fabrication." I assume that this includes R&D activities done in support of nuclear

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[1] Fermilab is operated by Universities Research Association, Inc. under contract with the United States Department of Energy.

activities. Basic research at particle accelerators is noticeably absent from the NQA-1 list, nor could one interpret them to be implied here without a serious violation of the intended meaning of the text. The basic research done at Fermilab is an extension of an international network of academic institutions. Fermilab is actually a large off-campus physics laboratory which is operated by a consortium of 72 universities. None of the research is used for nuclear facilities or weapons programs. Fermilab's "product" is journal articles and PhD dissertations. The real issue that remains to be discussed after this disclaimer is that DOE Order 5700.6B (Quality Assurance) requires all DOE contractors (including non-nuclear academic activities) to develop an institution-wide QA program in compliance with the 18 basic requirements of NQA-1.

* Defining the Logical Geography of the Problem

When Bill Anawalt invited me to give a presentation, I immediately responded with a barrage of questions about who would be attending and exactly what I should talk about. Many things ran through my mind. I could have talked about the philosophical framework that Fermilab used to develop its institution-wide QA program at a laboratory that had a 20 year successful operating record and no formalized (Orthodox) QA program until the advent of DOE Order 5700.6B.[2] This would have been a "how to" type of talk aimed at other basic researchers.

I could have talked about the problems of *properly interpreting* ANSI/ASME NQA-1 in a basic research environment. This might have included a discussion of *context sensitivity*, i.e., not imposing a *traditional interpretation* of NQA-1 (whose self-proclaimed purpose is to guide the design, construction, operation, and decommissioning of nuclear facilities), upon *non-traditional*, non-nuclear facilities which are beyond the scope and applicability of the standard.[3] This talk would have been aimed at DOE personnel, private contractors, and laboratory QA professionals who are responsible for quality.

I also could have talked about the faulty presuppositions which cause many QA auditors to construct misguided pictures of the institutions they audit. Some of the issues here might have included 1) the presupposition of organizational reductionism, i.e., that organizations are reducible to individual procedures (like the universe is reducible to quarks and leptons) and can be reconstructed bottoms-up, or 2) the presupposition of organizational emergence, i.e., that new organizational properties (management levels) emerge as a function of the combinatorial complexity of the organization and are not directly reducible to individual people or procedures, or 3) the value of the functional approach to organizational auditing, i.e., measuring an organization's performance against its stated goals and ability to function in compliance with those goals.[4]

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[2] I have covered this topic in detail in Mark Bodnarczuk, *Towards an "Orthodox" Quality Assurance Program: Canonizing the Traditions at Fermilab*, Presented at the Fourteenth Annual ASQC National Energy Division Conference, Session T, September, 1987.

[3] I have covered this topic in detail in Mark Bodnarczuk, *QA at Fermilab; The Hermeneutics of NQA-1*, presented at the 29th Annual Meeting of the Institute of Nuclear Materials Management, June 26-29, 1988.

[4] I have covered this topic in detail in Mark Bodnarczuk, *Reductionism, Emergence, and Functionalism; Presuppositions in Designing Internal QA Audits*, Presented at the Fifteenth Annual ASQC National Energy Division Conference, October 23-26, 1988.

I might also have talked about the nature and adequacy of peer review as the primary QA mechanism in basic research and the role QA professionals should play in these activities. I would have gone on to described the interface between basic research and standard engineering practices and concluded that scientists are not a *rebellious crowd* which doesn't want its work reviewed by other people, it's just that scientists want their work reviewed by competent people who can criticize it intelligently and with knowledge. The implication of this position is that if QA is to remain a *line function*, then the QA professional's role must necessarily be voyeuristic, i.e., he is (and must remain) on the "outside looking in".[5] This topic would have been addressed to all QA professionals, even those who manage QA activities at basic research facilities.

Instead, I chose to discuss the deeper underlying problems associated with developing a workable *doctrine* for QA in DOE funded non-nuclear basic research. In a sense, this approach addresses a more basic problem that is the foundation of all of the above topics. I believe that the problem of finding a workable doctrine for basic research QA is *the* central problem that will face non-nuclear basic researchers and QA professionals for some years to come.

*** Why Talk About a "Doctrine"?**

Why use the word "doctrine" in reference to QA in DOE funded non-nuclear basic research? Doctrine is normally divided up into two sub-categories. The first is commonly called *orthodoxy* and means holding to *right beliefs*. The second sub-category involves "cashing-out" those beliefs into *right practice*. This component of doctrine is often called *orthopraxy*. Orthopraxy is just defining how things ought to be done.

Since the formation of the Manhattan Project, basic researchers and Government agencies have been forced to live together within the same budget, but have yet to develop a *doctrine* that is acceptable to both communities. While Government funding agencies have not interfered much in the "orthodoxy" of basic research (in the scientific knowledge it produces), they have increasingly tried to determine the course of the "orthopraxy" of basic research (how it ought to be done). The problem is not getting better for basic researchers. This is because they find themselves inhabiting the same organizational structure as the troubled nuclear facilities listed in the applicability statement of NQA-1 (power generation plants, spent fuel storage, waste storage, fuel reprocessing, plutonium processing and fuel fabrication facilities). Because DOE management is responsible for overseeing all aspects of the Department's activities, the temptation is to use the same measuring rod to evaluate both nuclear and non-nuclear basic research facilities without distinguishing between them. It's just easier to use the "one size fits all" approach in regard to QA matters. I want to suggest that one of the driving motivations behind this problem is the cognitive style of the individuals involved. More particularly, it's a question of how people "carve up" the world. It's a question of taxonomy.

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[5] This topic was covered in detail in Mark Bodnarczuk, *Peer Review, Basic Research, and Engineering; Defining a Role for QA Professionals in Basic Research Environments*, Presented at the Sixteenth Annual ASQC National Energy Division Conference, September 17-20, 1989.

* Taxonomies and the Challenge of Revising Them

Taxonomy is the study of the general principles of *classifications* and the categories into which things are placed. A particular taxonomy is a way of "carving up" the world in such a way that the things that are described *make sense* to a particular observer. One taxonomy of the chair you're siting on is to place it into the category "chair". One could further taxonomize it into the categories "wooden" chair, or "metal" chair. These two taxonomies are not all that different because they are both macroscopic. But one could also taxonomize the chair by describing the motions of the atoms of which it is made. When using the *atomic* taxonomy, the chair as we describe it macroscopically disappears. Which is the "right" taxonomy? The atomic physicist and the wood craftsman could argue this point indefinitely unless they agree on some basic assumptions.

ANSI/ASME NQA-1 and the "orthopraxy" of basic research (peer review and standard scientific practice) are both taxonomies that can be used to describe the activities of a laboratory like Fermilab. Both are ways of "carving up" basic research activities into categories that can be understood by a particular observer. Which is the "right" taxonomy? The basic researcher and the QA professional could argue this point indefinitely unless they agree on some basic assumptions. What are those basic assumptions and why have they to large degree eluded both groups, preventing meaningful communication? How could it be that QA professionals and basic researchers could look at the very same activities, in the very same laboratory, and come up with such divergent conclusions about what is going on? Let me repeat, the problem stems from a cognitive preference for how one "carves up" the world. It's a preference for what one "wants" or "needs" to see in order to understand how an organization functions.

When an NQA-1-based QA professional analyzes the activities of a basic research environment, she wants to see the organization "carved up" into the 18 basic requirements of NQA-1. If it's not, the organization is viewed as non-compliant. When a physicist analyzes the activities of a project or laboratory, he wants to see the organization "carved up" into the basic research "orthopraxy" of peer and technical reviews, graduate students, lead technicians, and a principle investigator or spokesperson who is responsible for guiding all aspects of a project from conceptual design and procurement, through data taking, data analysis, and the publication of results.

When the director of a basic research facility is given the responsibility for the activities of a laboratory, the first thing he does is taxonomize the tasks that need to be done to carry out the laboratory's stated goals successfully. In other words, he "carves up" the various tasks into a "people design" that he believes will help the laboratory meet its stated goals. Rarely, if ever, does he carve the tasks up into the taxonomy of the 18 basic requirements of NQA-1. He simply does not think in those sorts of categories. This is the first thing the QA professional notes on his "findings" pad during an audit.

People are recalcitrant about giving up their taxonomies. This is understandable because after all, this <u>is</u> how they categorize and understand their world. QA professionals continue to demand that basic researchers *uncritically* force their activities into the taxonomy of the 18 basic requirements of NQA-1. Basic researchers retort that their "orthopraxy" has succeeded for 300 years in organizing scientific activities into humanity's most successful enterprise. Then the emotions and the ego defenses get going! The funding agency assumes the "*Well*, I'm the customer" stance. The basic researcher responds by asserting that

he is being paid *because* of his expertise in taxonomizing and carrying out the projects under his control. When the discussion degenerates to this point, it has become a test of wills, a battle for control and dominance, a battle over which group should define what orthopraxy *is* in university-based basic research.

Part of the problem is failing to distinguish between basic research that is *specifically* done in support of nuclear applications, and basic research that is done to produce PhD students and journal articles. I have mentioned this earlier. But in addition to this, the thing that QA professionals and university-based physicists disagree over most is the way each group "carves up" and categorizes laboratory activities. It is not anything *intrinsic* to how the activities are actually carried out. But who is "right" and which is the "right" taxonomy? I believe this question must be rephrased if it is to get a serious answer which avoids the infinite regress of our imaginary physicist and woodcarver over which is the "right" description of the chair. The question ought to be phrased, "Which is the 'right' taxonomy *for basic research*?" In other words, is the "orthopraxy" of basic research adequate to address the problems of today's "Big Science" environment? For reasons that I have discussed at some length elsewhere, I believe that it is more than adequate.[6] But the adequacy of the taxonomy of basic research *for basic research* still fails to address the problem of being required to "carve up" the activities of organizations like Fermilab into the taxonomy of NQA-1.

While I believe that the contents of the 18 basic requirements of NQA-1 can be used to capture the essential components of organizing *any* project, carving up Fermilab's activities into an institution-wide QA program that follows these categories has been a long and arduous project. The difficulty was partly due to the resistance of some scientists to accept the program and partly because at points, NQA-1 just doesn't fit basic research activities. But we have made it fit anyway, producing a QA program that covers all laboratory activities from the Directorate to the cafeteria staff. Many Fermilab management will openly admit, that carving up the Laboratory's activities using the taxonomy of NQA-1 has helped them to isolate quality problems that they might have otherwise not detected as readily. In effect, while maintaining that the "orthopraxy" of basic research is the "right" taxonomy *for basic research*, we have used the categories of NQA-1 as a calibration check on our management practices. In other words, we have used it as a *standard* against which we can measure the adequacy of scientific practice, *not* a substitute for scientific practice.

* The Present Status of the Problem

I believe that the major problem that must now be faced in regard to QA and DOE funded basic research does not primarily concern basic researchers. In addition to Fermilab, laboratories like Argonne, Brookhaven, Princeton Plasma Physics, Solar Energy Research Institute, Aimes, Berkeley, Los Alamos, SLAC, Lawrence Livermore and others have developed, or are in the process of developing, QA programs that are unique to those portions of their activities that are involved in non-nuclear basic research. All have found, or are finding, ways to respond to the *spirit* and *intent* of DOE Order 5700.6B and NQA-1 without abdicating the traditions of basic research "orthopraxy". As I view it, the ball is in DOE's court, or should I say the ball is in DOE's "courts."

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6 Mark Bodnarczuk, *Peer Review, Basic Research, and Engineering; Defining a Role for QA Professionals in Basic Research Environments.*

From the perspective of QA managers and researchers at basic research facilities, it is hard to know who the players are on the DOE "team." In addition to the organizational problems of figuring out who speaks with the authoritative voice of QA (Project Management Engineering Division, Laboratory Management, Environmental Safety and Health, the Operations Office, Headquarters), some of the DOE players have volleyed the ball back to basic researchers in support of their response to DOE Order 5700.6B, while still others have purposely turned their heads as the ball rushed by them.

One of the DOE players that has consciously chosen to be in the QA basic research game is DOE-CH. This should come as no surprise because DOE-CH's area of management oversight is *primarily* basic research activities, some of which live side-by-side with nuclear facilities at multipurpose laboratories like Argonne and Brookhaven. The first thing DOE-CH did in trying to implement DOE Order 5700.6B was to re-think the relationship between the DOE Operations Office and its contractors. This new relationship has been canonized in a document called "Institutional Quality Assurance at DOE-CH Laboratories; A Partnership" issued under the signature of the Operations Manager, Hilary Rauch. In this document, the relationship between the DOE Operations Office and the basic research contractor has been described as a "Partnership". The exact nature of the "Partnership" was captured in a paper presented by Ed Cumesty, Deputy Manager of DOE-CH.

> "DOE, as the general partner, has the authority to establish requirements and the responsibility to communicate them in a way that does not artificially restrict opportunities for effective compliance. As the operating partner, the laboratory director must satisfy the requirements but develop a complementary system which supports the overall operation of the laboratory....Our agenda is to assist the laboratories in their efforts to implement an institutional QA program. The most important agenda item is to accept "variations on a theme". Variations are expected and will be supported as long as they are linked to the environment in your laboratory and support an overall goal of excellence in scientific operation."[7]

This approach to "variations on a theme" provides the flexibility necessary to not seriously constrain the basic researcher and at the same time to assure DOE-CH that the highest quality in basic research is obtained (in more "orthodox" QA environments, this is known as the "graded" approach to QA). Most importantly for our discussion, it recognizes as valid the taxonomy and "orthopraxy" of basic research *for basic research.* It is a combination of scientific freedom *within the boundaries* of compliance with DOE Order 5700.6B because the QA programs are "linked to the environment of the laboratory" and at the same time are traceable to the taxonomy of NQA-1. The overall spirit of DOE-CH's approach to QA is eloquently captured in Hilary Rauch's introduction to the document.

> "History suggests that human inspiration is rooted in goals more than methods. It is our longings that fire imagination but our processes that often quench the flames. This paper gives an account of the effort to build upon

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[7] Edward G. Cumesty, *An Agenda for Quality Assurance in Advanced Energy Laboratories,* Presented at the 14th Annual ASQC National Energy Division Conference, Session T, September, 1987.

> the quality traditions of the CH laboratories without sacrificing the creative spark that is the source of their human energy. Our objective is to ensure continued excellence in scientific and technical accomplishments in a world that rightfully demands meaningful assurance that the public support and trust afforded these national institutions is justified."[8]

This document constitutes a new relationship within which basic researchers and DOE-CH can continue to expand their horizons and grow as mutual partners. Most importantly to the discussion above, DOE-CH has acknowledged the taxonomy of basic research as appropriate *for basic research*, and at the same time complied with the intent of DOE Order 5700.6B by requiring that NQA-1 be used as a standard against which the scientific taxonomy can be judged and calibrated.

* The Elusive Problem of "Independence"

But despite the DOE-CH approach there is another problem lurking on the horizon for basic research QA and scientific "orthopraxy". I call it the elusive problem of independence. How does one define exactly what "independent verification" means? How "independent" does verification need to be for it to be *truly* independent? These questions are at the very heart of the issue of defining basic research "orthopraxy." To start with, there are ever-widening circles of independence that one can choose from in order to gain independent verification. The problem is that the taxonomies of QA professionals and basic researchers are at odds as to where to begin the process.

With the basic researcher, the level of independence *varies* with the cost and programmatic nature of the project. The lowest level of verification might be an analysis of program activities by a person (or persons) at least 1 level of management above the work being done. Additional layers of independence can be had by insisting that work be reviewed by 2, 3, or 4 levels of management above the individuals doing the work in a Division composed of say 700 people. A yet wider circle of independence can be obtained by having multiple layers of management in organizationally distinct Divisions review work or by using standing review committees (safety, mechanical, electrical, etc.) composed of laboratory-wide personnel. If one desires a still wider circle of independence the work can be reviewed by various levels of management within the Directorate. Up to this point, work is reviewed by individuals who are *organizationally* independent by are not independent of the *laboratory structure*. A final component of independence can be obtained by using committees like the Physics Advisory Committee (PAC) composed of individuals from Fermilab and competing laboratories or by using private contractors who are totally outside the discipline of high-energy physics. Choosing *which* level of independent verification is appropriate for the cost and programmatic nature of the project is the decision of Fermilab management and is based upon the taxonomy of basic research "orthopraxy".

The QA professional's approach is very different. There seems to be a prejudice which affirms that those *totally* outside the organization are more *truly* independent. The assumption here is that because they are organizationally

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8 Hilary Rauch, *Institutional Quality Assurance at DOE-CH Laboratories; "A Partnership"*, Published by the U.S. Department of Energy Chicago Operations Office, June, 1988.

disinterested parties this assures high-quality independent verification. This assumption is true, but it's only half the truth.

In some sense the QA professional's approach is an *inversion* of the basic researcher's "orthopraxy". In other words, the DOE's established "orthopraxy" normally *begins* at the outermost circle of independence and moves tops-down through the lower levels of verification. What is the reason for this inversion? My observation is that while DOE QA professionals are charged with the responsibility of providing management oversight and high-quality independent verification for DOE activities, the organization has not been designed to embody the level of technical expertise necessary to carry out these responsibilities. It's no one's "fault" *per se*, that is just how the organization has evolved since the AEC days, i.e., much of the technical work is done through private contractors. This approach is the antithesis of the basic research environment where technical competence is embodied almost exclusively *within* the scientific community. There is no one else to which one can appeal on technical matters involving science, i.e., even an independent group from the National Academy of the Sciences must be selected from within the community of scientists. This problem has not gone un-noticed by the new DOE administration. In issuing his 10-Point Plan for Environmental Protection on June 27, 1989, Secretary of Energy James D. Watkins remarked,

> "Strengthening the technical capability of line management in the environment, safety and health areas, such as we did by establishing a brand new support group at Rocky Flats, is my sixth initiative. It is a well-known fact that the very large majority of our work in the field is actually carried out by private contractors. This fact in no way relieves DOE field managers of their own responsibility and accountability to ensure that contract execution meets expected performance standards of excellence."[9]

The Admiral goes on to identify this lack of the embodiment of technical skills *within* the Department as a "flaw" in the DOE structure caused by the management decisions of his predecessors. My point is this; because DOE must acquire the majority of its technical support from private contractors they are often forced *ipso facto* to begin at the outermost circle of independent verification whether the activities require this level of verification or not. Given the problems of the troubled nuclear industry, we can legitimately ask ourselves where this approach to the elusive problem of "independence" has gotten the Department? As I understand it, the Admiral's call for increasing the embodiment of technical skills *within* the Department is a step closer to the basic researcher's model of "orthopraxy." Even if the majority of the Department's work continues to be carried out by private contractors, the emphasis should be placed primarily on high-quality *technical expertise*, not simply on *organizational independence*.

The DOE auditor who evaluates basic research QA programs like the ones fostered under DOE-CH guidance must not fall into the trap of insisting that researchers *begin* at the outer-most circle of verification. They must evaluate whether or not there is *sufficient* technically competent independence in the "people design" of the researcher, and not automatically assume that the failure to use *private contractors* is identical with the failure to *assure technically competent independent verification*. One size does not fit all. I see this issue as

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[9] Secretary of Energy James D. Watkins, Remarks on *DOE News; Watkins Announces Ten-Point Plan for Environmental Protection, Waste Management*, page 8, June 27, 1989.

the one of paramount importance for finding doctrinal agreement between basic researchers and their respective funding agencies.

*** Where Do We Go From Here?**

Where do we go from here? One must begin to define some common ground between the basic researchers and QA professionals. What is a satisfactory level of independent verification and how does one begin to find a common measure between such seemingly divergent ways of "carving up" the activities of basic research? In regard to the first part of this question, (as I have just stated) the answer lies in placing primary emphasis on *technical expertise*, not simply on *organizational independence*. In regard to the second part of the question, divergent taxonomies like NQA-1 and basic research "orthopraxy" can only find a common measure on a deeper *conceptual* level. In other words, it's a matter of conceptually translating between the two taxonomies. The key here is to develop "conceptual equivalents" that satisfy the criteria specified by the *unique language* typified by each taxonomy. For instance, what the basic researcher calls a Magnet Development and Test Facility, the QA professional may call an "independent audit function." What the basic researcher calls peer review (the intense technical review of proposed experimental projects by a Physics Advisory Committee composed of individuals from other competing laboratories) the QA professional might call Control of Special Processes (because it is the certification of the participants and procedures of the process that are at stake). The goal of this translation process should be to find the conceptual equivalents and translate them into the language spoken in the respective taxonomy. The QA Manager at a basic research facility like Fermilab must be able to speak both languages fluently. In fact, this is one of his major tasks.

I contend that when the two seemingly divergent ways of "carving up" basic research are analyzed at the lower level of "conceptual equivalents", one finds an amazing correspondence between what once seemed like an impossible paradox. Unless this process is undertaken, the basic researcher fails to take full credit for QA functions that are in place at his laboratory but are improperly labeled within the taxonomy of basic research "orthopraxy". On the other hand, QA professionals can fail to properly assess the full scope of QA activities in basic research, and subsequently develop skewed and misguided conclusions when auditing such facilities. Either way, the result is simply *wrong* and the controversy which surrounds QA and DOE funded basic research is perpetuated. Sometimes I wonder if a solution to the problem is not forthcoming because controversy is exactly what is desired? We must seek agreement, not disagreement and antagonism.

But much more conceptual translation work needs to be done. The major task facing both basic researchers and QA professionals is to develop an attitude of mutual respect for the way the other "carves up" the world. I have stated this clearly and repeatedly to my basic research colleagues and they have accepted my challenge by developing an institution-wide QA program that is based on the 18 requirements of NQA-1. The task that now faces QA professionals, is to continue (and in some cases begin) work on the conceptual translation *from the NQA-1 side* of the paradox.

One way to approach this is for QA professionals to go back and carefully analyze the 18 basic requirements of NQA-1. The key here is to move beyond the technical (and often impenetrable) language of the standard, and attempt to capture the essence and intent of each requirement, without using "QA jargon." What exactly does each requirement mean? What actually is the difference

between Design Control, Document Control, and Control of Instructions Procedures and Drawings when all may involve pieces of paper or computer databases? What exactly is the difference between Control of Purchased Items and Services and Identification and Control of Items? These requirements are often quoted by QA professionals, but when they are asked to define what the requirement actually entails *in a basic research environment* or asked to formulated a definition in their own words without using "QA Jargon", myriad divergent interpretations of the requirements are put forth as true.

The point is that QA professionals must begin to put the goal of *quality* above *taxonomic convenience*. This is a painful exercise because we are comfortable with the way we "carve up" the world. QA professionals must sincerely want to communicate with basic researchers about quality issues and not allow the way they "carve up" laboratory activities to be a stumbling block to finding common ground. They must be willing to suspend their judgment for a time, and seek an honest, open analysis of their time-honored way of doing business. They must be willing to hold the taxonomy of NQA-1 in one hand and basic research "orthopraxy" in the other and objectively adjudicate between the two, producing a conceptual translation. Much like the management of Fermilab has benefitted and grown from the exercise of using NQA-1, quality professionals that have been open to the QA traditions of basic researchers have learned and grown. This is the function of a "partnership" to benefit from the strengths of the other partners.