Final Report for the Scientific Research As-Is Assessment

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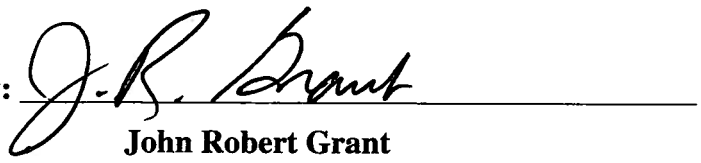
Approved By: 

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Executive Summary

The Scientific Research As-Is assessment, or "SR As-Is," was conducted in scientific research areas at Fermilab to determine the existence/levels of Quality Assurance (QA) and Contractor Assurance controls used to implement requirements that are found in the Integrated Quality Assurance (IQA) and the Fermilab Integrated Contractor Assurance Program (FICAP) documents. The Quality Assurance Sub-Team for Science[1] was charged with planning and conducting the assessment that had three objectives.

1. Compare the Quality Assurance Guidelines for Scientific Research at Fermilab (QAGfSR) with the Quality Guidelines for Research (ANSI/ASQ Z1.13 - 1999)
2. Evaluate the existence/level of controls for quality assurance requirements in scientific research
3. Evaluate the existence/level of controls for contractor assurance requirements in scientific research

The emphasis of the assessment was limited to determining the current existence of controls complying with criteria from the respective governing documents, the As-Is state, rather than on the evaluation of the effectiveness and efficiency of the controls. For each of the objectives, the detailed discussion and evidence from observations and recommendations are presented within this report. Note that this report uses color for some of the data analysis presentation. The following is a summary of results and recommendations for each objective.

COMPARISON OF THE QUALITY ASSURANCE GUIDELINES

Within ANSI/ASQ Z1.13 - 1999 (Z1), 5 sections and 95 sub-sections have suggested elements to be considered for a QA program in scientific research. Sufficient evidence of content agreement was found for 84 percent of those elements in QAGfSR. 3 percent of the elements were insufficient to conclude that elements existed in the QAGfSR that were within the Z1. For 13 percent of the elements, some evidence was discovered but requires additional clarification or corroboration to conclude the QAGfSR congruence to the Z1.

The QAGfSR guideline should be constructed to emphasize that some elements are requirements and "must" be considered in scientific research activities. The decision as to the level of congruence between the two documents should be made by the Scientific Review Committee[2] and reviewed and approved by OQBP.

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[1] *QA Sub-Team for Science* - Quality Assurance Representatives (QARs) & Quality Assurance Engineers (QAEs) assigned to engage management in the scientific community in the Scientific Research QA As-Is assessment & subsequent IQA implementation

[2] The Charge to the QA Sub-Team for Science designates a Scientific Review Committee to represent the interests of the scientific community and review recommendations made by the QA Sub-team for Science. If the SRC concurs with the recommendations, appropriate corrective action(s) are created. Appointments to the SRC are by the Associate Director for Research.

QUALITY ASSURANCE CONTROLS EVIDENCE IN SCIENTIFIC RESEARCH

The status of QA in scientific research was assessed by sampling five scientific research processes. The Associate Director for Research made the selection of processes based on risk as well as other concerns discussed in the body of this report. The scientific research processes were evaluated using Lines-of-Inquiry based on the criteria from the QAGfSR.

The results from the evaluation of the scientific research processes during the SR As-Is demonstrated that the requirements of the QAGfSR are being met. Of twenty-three questions about existence of controls from criteria within the Lines-of-Inquiry, 100 percent of the scientific research processes assessed had sufficient evidence to conclude controls existed.

While results conclude controls exist, recommendations for improvement were made for five areas: Qualification and Training, Documents and Records, Calibration, Management Systems, and Program Management.

CONTRACTOR ASSURANCE CONTROLS EVIDENCE IN SCIENTIFIC RESEARCH

The requirements of the FICAP are being met. Of 8 basic questions about existence of controls for criteria within the FICAP Lines-of-Inquiry, 100 percent of the management processes (evaluated only at the highest-levels) that address the FICAP criteria had sufficient evidence that controls existed.

Three areas were identified that may require additional consideration and corrective actions: Programs, Reporting, and Dissenting Opinions.

Purpose

The Scientific Research As-Is assessment, or "SR As-Is," was performed to determine the existence of scientific research controls for requirements from Fermilab's IQA and FICAP. The purpose of this report is to describe the Scientific Research As-Is assessment, to summarize the conclusions that may be drawn from the observations, and to recommend actions that should be taken.

Scope

The scope of this assessment was limited to identifying the existence of controls for the requirements from the IQA and FICAP in scientific research at Fermilab. The following items constituted additional constraints: review Fermilab's governing QA documentation for scientific research, assess a sample set of scientific research processes, and limiting the depth of the assessment. This constrained the scope as follows:

1. The Scientific Research As-Is Assessment is the first activity that used the QAGfSR for guidance. In order to adequately perform the review, one of the As-Is objectives was to compare the content between the QAGfSR (internal guidelines) and the source document for requirements, *Quality Guidelines for Research* (ANSI/ASQ Z1.13 - 1999).

2. A sample of five scientific research programs/processes was based on risk as determined by the Director for Research from the scientific research programs that were candidates for the As-Is assessment. The evidence of compliance to contractor assurance in scientific research was limited to the highest-levels of management in scientific research.

3. The scope was limited by the depth of assessment. The quality assurance Sub-Team for Science was limited to identifying controls used to satisfy the requirements of QAGfSR and FICAP. There was no effort to judge the effectiveness or efficiency of the controls, rather whether controls exist for the requirements.

Background

The QA As-Is Baseline Assessment was conducted in early 2009 to understand Fermilab's level of QA implementation compared to requirements found in the IQA and FICAP documents. Corrective action plans (CAPs) were formulated for any gaps found during the assessment.

The QA As-Is Baseline Assessment did not include Fermilab's science/research programs as the Science QA documents were still in draft at the time of the assessment. The SR As-Is, therefore, was planned after the QAGfSR was issued on September 9, 2009. Corrective action plans will be generated for any gaps once the SR As-Is Assessment results are accepted.

SR As-Is Assessment Process Description

The quality assurance Sub-Team for Science (QA Sub-Team) was charged to plan and conduct a current assessment, the "As-Is," of the existence of controls for quality and contractor assurance requirements in scientific research. The SR As-Is was conducted as follows:

THE SR AS-IS VERSUS THE AS-IS BASELINE ASSESSMENT

As mentioned in the background section, the assessment of scientific research was postponed during the As-Is Baseline, so this is the first QA assessment of scientific research and use of the QAGfSR program document. The same approach and processes were used in conducting both As-Is assessments. The evidence/level of QA and CA controls used to implement requirements found in the IQA and FICAP were identified and recommendations provided for any gaps discovered. In the SR As-Is, however, the recommendations must be accepted by the Scientific Review Committee (SRC) prior to the creation of corrective actions.

SR AS-IS FOR COMPARISON OF THE QUALITY ASSURANCE GUIDELINES

The quality assurance program for scientific research was assessed to the specifications within the QAGfSR. The QAGfSR was developed to address the consensus standard ANSI/ASQ Z1.13, *Quality Guidelines for Research*, as suggested by DOE Order 414.1C. Since the SR As-Is was the first activity using the Quality Assurance Guidelines for Scientific Research, an objective is the comparison of the content of QAGfSR and Z1. To evaluate the content agreement, a table comparing excerpts from each document with applicable comments was developed and is presented in Appendix B1, "Comparison of Z1 with QAGfSR".

QUALITY ASSURANCE REQUIREMENTS EXISTENCE IN SCIENTIFIC RESEARCH

The QAGfSR provided the requirements for the SR As-Is assessment to identify the existence of quality assurance controls for five scientific research processes. QA Lines-of-Inquiry were used to provide guidance in identifying controls satisfying criteria specified in the QAGfSR.

The Associate Director for Research, the Associate Director for Accelerators, and the Assistant Laboratory Director for Program Planning identified significant scientific research processes (programs) that are in place to carry out the scientific mission of the laboratory. A sample of five processes was selected for evaluation based on a number of criteria including; risk, importance of the scientific research to the laboratory, the maturity of the program, whether the process is subject to external review by DOE, FRA or other parties, and their importance to QA compliance.

These are the scientific research processes selected for assessment during the QA for SR As-Is Assessment:

- Experiments at D0
- Lattice QCD
- MINERvA
- MINOS
- Muon Accelerator Program

SR As-Is for Contractor Assurance

In the planning of the SR As-Is, the Office of Quality and Best Practices (OQBP) determined the FICAP assessment could be adequately addressed by limiting the assessment to the highest-levels of the scientific research management system. This decision is primarily based on the breadth and depth of Fermilab Divisions and Sections' processes that were sampled for FICAP compliance during the QA As-Is Baseline Assessment. Because much of the science program is assembled from D/S/Cs (matrixed personnel and processes), the processes observed during the QA As-Is are, in great part, the same processes used in the science program; and therefore, the expectation that similar levels of compliance would be observed in scientific research. Another reason to assess only the highest-level of the FICAP scientific research management system is because it is management that creates and communicates alignment and priorities for activities, which is a fundamental perquisite for the successful implementation of any program.

Since FICAP and QA in scientific research were assessed separately, the assessment of the FICAP, which consists of the following, was limited to evaluating the first four of the five components:

1. Cyber Security
2. Safeguards & Security
3. Environmental, Safety & Health
4. Emergency Management
5. Quality Assurance

FICAP was assessed in the four frontiers of scientific research:

1. Laboratory Experimentation
2. Computer Modeling
3. Theory Formulation
4. Field-Testing

The format of the FICAP is structured in the following way:

1. Program
2. Personnel Training and Qualifications
3. Documents and Records
4. Assessment
5. Performance [indicators/measures]
6. Reporting [incident and event]
7. Lessons Learned
8. Worker Feedback
9. Issues Management
10. Dissenting Opinions

While all items were assessed during the SR As-Is, the first four items of the FICAP were covered in the QA scientific research assessment. From the remaining FICAP items, Lines-of-Inquiry were used to guide the assessment and to determine if appropriate controls existed for the requirements in the FICAP.

Phases of the Quality Assurance for Scientific Research As-Is Process

A QA Sub-Team was chosen and a plan was developed for the SR As-Is to determine the existence of controls for the requirements in the FICAP and QA. Within the SR As-Is plan there are five phases applied to each process assessed:

INITIATION PHASE

- Review QAGfSR program document with the ANSI/ASQ Z1.13 standard
- Identify scientific research processes for assessment
- Schedule initial informational / planning meeting(s) with Process Owners, subject matter experts and/or appropriate departmental management

DEVELOPMENT PHASE

- Develop assessment tools
- Use preliminary meeting information to understand process and plan the Collection Phase

COLLECTION PHASE

- Define process and conduct preliminary meetings
- Update checklist with process/activity specific control elements
- Conduct review of gathered documents on processes and their quality controls
- Record observation data into the Excel spreadsheet
- Identify observations which are potential gaps in quality controls

VERIFICATION PHASE

- Verify the accuracy of SR As-Is data entered into the As-Is Excel spreadsheet with Process Owner
- Review the evaluation of controls (comparison with expected controls), gaps identified with Process Owner and submit observations to the Scientific Review Committee
- Agreement on gaps, what is required and issue appropriate CAPs
- Record any suggested gaps that were not issued CAPs

CORRECTIVE ACTION PHASE

- Develop and document CAPs to bridge agreed upon gaps
- Associate Director for Research approves CAPs and forward to the Head of OQBP for concurrence
- Track & report status of CAPs locally by QA Representative (QAR)
- Review the approved CAPs, reconcile differences, and OQBP concurrence
- Verify closure of CAPs as they are completed
- Track and report status of CAPs globally
- Periodically validate CAP implementation effectiveness

Results, Observations and Recommendations

This section contains the identification of items reviewed during the assessment, the discussion of the observations, and the proposed recommendations for each of the three objectives.

Comparison of QAGfSR with Z1

This section describes the comparison of the sections in Z1 and similar sections found in QAGfSR.

The table in Appendix B1 titled, "Comparison of Z1 with QAGfSR" organizes the elements from the sections in Z1 and the elements from similar sections found in QAGfSR. More specifically, the comparison was performed by listing each of the elements (sub-sections or bullets) in Z1 and identifying the analogous section and location within the QAGfSR. The analogous QAGfSR section was copied to an adjacent cell corresponding to an element in Z1. A comment from the QA Sub-Team provides an assessment to the degree of congruence; there may or may not be comments provided for all of the elements being compared.

The following is an excerpt of the table in Appendix B1 to serve as an example:

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
1.1	1.1 Scope					
1.1	This document can be used in the development of a quality system for basic and applied research. That is where the output is knowledge, information, data, or proof-of-concept, but not product or service design or development. This includes fields like the biological, ... [more...]	4	4	The output of research is knowledge, information, data, or proof-of-concept. The research effort itself involves the use of such methods as laboratory experimentation, computer modeling, theory formulation, and field-testing.	yes	the intent and exact words are used to describe science and lists the areas at Fermilab where science is expected to be found

Since the assessment was limited to determining the current state existence of controls of compliance, the results comparing the content agreement between QAGfSR and ANSI/ASQ Z1.13 are as follows.

Within the five sections in the Z1 and the 95 sub-sections and bullets that suggest elements for consideration in a quality assurance program in scientific research:

- 84 percent of the elements had sufficient evidence to support observations that content agreement existed.
- 3 percent of the elements had insufficient data to be able to conclude elements existed in the QAGfSR that were within the Z1.
- 13 percent of the elements had some evidence, but that evidence needs additional clarification or corroboration to conclude congruence between the QAGfSR and ANSI/ASQ Z1.13.

Observations and Recommendations

This section of the report provides feedback on the content agreement between the QAGfSR at Fermilab and ANSI/ASQ Z1.13, Quality Guidelines for Research. The QA Sub-Team not only identified the existence of comparable elements, but offered a subjective evaluation of how well the elements of the QAGfSR aligned with the Z1 guideline. These are the observations from the comparison of the documents:

- The QAGfSR is organized and requirements are phrased different than Z1. While the QAGfSR organization may make the content more suitable for the user community, this organization also makes identifying congruence more difficult to an assessor evaluating compliance. Additionally, different phrasing structure may make the intent and fulfillment of Z1 less obvious. This assessment focused on, at a minimum, identifying the existence of controls complying with criteria from the respective governing documents. Any subsequent effort by the DOE to assess the effectiveness of the QAGfSR will be even more difficult if elements are not as aligned/explicit as in Z1.
- There are Z1 elements (or sub-components of elements) not contained in QAGfSR. The absence of these elements may be the result of oversight or, because of the specific nature of the science conducted at Fermilab; these elements may not need to be emphasized or may not be relevant.

RECOMMENDATIONS

- A map should be created between the two documents to identify analogous portions to ensure clarity of congruence for any future inquiries. For instance, without a map a DOE assessor may not make as much of an effort as the QA Sub-Team to find the congruency and the result might be a less than satisfactory report.
- Elements mentioned in Z1, but not mentioned in the QAGfSR, should be specifically pointed out in the QAGfSR if these elements exist within other supporting documents so readers are clearly directed to these elements. Elements not appropriate to Fermilab, but suggested by Z1, should be identified in a map or addendum with an explanation as to why these do not apply. Addressing all elements in this manner will ensure none were unintentionally overlooked.
- While the ANSI/ASQ Z1.13 guideline is based on prescribed action prefaced by "should," the QAGfSR guideline should be constructed to emphasize that some elements are requirements and "must" be considered in scientific research activities. For example, the required use of standardized practices may ensure important elements are addressed and aid in avoiding honest mistakes. There are many benefits to using proven methods, standardization of the system, and using a graded approach when applying the standardized system.
- The Scientific Review Committee should make the decision as to the current and appropriate level of congruence between the QAGfSR and Z1. The committee should provide a report with an explanation as to what changes are needed or not needed. Their assessment should be reviewed and approved by OQBP.

- The Scientific Review Committee should determine if comparable QAGfSR elements exist, the suitability/applicability of these elements, and the effectiveness and efficiency with which the QAGfSR elements meet the intent of Z1.
    - Some criteria to assess the elements suggested by Z1 for the QAGfSR:
        - Suitability: The degree to which the element's requirements for a product or service has the right properties for a specific purpose. (Does the scope of the system or process being examined encompass the scope of the relevant certifications and other requirements?)
        - Adequacy: The ability with which the element's requirements meet a need satisfactorily or sufficiently for a particular purpose. (Does the system have the resources and organization needed to accomplish its objectives?)
        - Efficiency: A process characteristic specified by the element indicating the degree to which the process produces the required output with minimum resource consumption (e.g. time or cost). (Are we doing things right? Do we have to correct things after the fact or are we avoiding the issue by being proactive?)
        - Effectiveness: The degree to which the element' requirements for a product or service meet customer requirements and expectations. (Do all of our activities productively contribute to achieving the deliverables? Do our performance metrics indicate that the system is, in fact, accomplishing its objectives?)

Controls Evidence of Quality Assurance in Scientific Research

This section summarizes the requirements evidence of QA in scientific research; the objective data used for the observations and the resources reviewed are recorded in Appendix B

There are three sections that apply to all of the scientific processes.

1. The QAGfSR Lines-of-Inquiry - The Lines-of-Inquiry contain the criteria used to guide the SR As-Is to determine the existence of controls for the requirements of QA in the five processes.
2. Observations for All Scientific Research Processes - This is a table (Table I at the end of section) that provides an overview of the existence of controls found for the criteria from the QA Lines-of-Inquiry for all five of the scientific processes.
3. Best Practices and Other Comments for Scientific Research - This section presents best practices and discusses other comments based on observations made for each scientific research process.

Lines-of-Inquiry - Quality Assurance Guidelines for Scientific Research

The following LOI, derived from Z1, guided the focus of this QA assessment in scientific research. The emphasis of the inquiry was limited to determining if controls *exist* rather than on the *effectiveness and efficiency* of the controls.

MANAGEMENT OF BASIC AND APPLIED RESEARCH PROJECTS:

Does the research organization require scientists to develop a research plan or proposal that describes the conduct of the research? Things to look for in the scientific research plan/proposal:

1. Is knowledge, information, data, or proof of concept the output of the research project, i.e. is it about Science?
2. Is a research plan or proposal developed that describes the management systems used to plan, perform, document, assess and transfer research results?
3. Is the research plan or proposal reviewed by the funding agency or primary external customer?
4. Does the research plan or proposal identify the following:
    a. Principle investigator and/or project manager and funding agency or primary customer of the research?
    b. The technical approach to be used, including a description of the research effort and expected results, the purpose of the work and evaluation criteria, a brief historical overview of the research, any potential problematical techniques and experimental methodology to be used, and any relationships with other known projects or areas of research?
    c. The schedule and deliverables of the research including the proposed duration, resources needed, scheduled milestones and deliverables?

d. Facilities to be used and requirements to be followed for the research?

e. Methods for performing and documenting research that follow accepted research practices ethical, germane to the discipline and to a level of detail adequate to ensure the research goals are capable of being achieved?

f. Methods for assessing the performance of the research that will ensure that accepted research practices are employed and that research goals are met including independent reviews by peers or other qualified parties not involved in the research?

g. Transferring the results of the research as described in the plan through publication, presentation, collaboration with others, sponsoring workshops or providing scientific advice to outside agencies and organizations?

RESEARCH QUALITY MANAGEMENT PROGRAM:

Has the research organization defined its mission and established a quality management program with the goals to help achieve its mission and to ensure that it meets the needs of its customers and stakeholders? Things to look for:

5. Science QA Program. Has organization implemented a plan that identifies its customers and stakeholders and their needs and expectations; translated these into institutional language; defined internal and external organizational interfaces; defined critical success factors; established quantitative units of measurement, and developed methods to assure results of measurements? Are these used as a basis for management systems and improvement?

6. Science QA Program. Has the organization established leaders who are committed to create and sustain the vision, mission, customer focus, and quality values and assure they are translated into policies and practices, and widely communicated?

7. IQA Program. Does the organization provide support for performance of research in the form of appropriately qualified and trained personnel; properly engineered, designed and constructed facilities and apparatus, and supporting software; items and services that are of the required quality; safely stored and retrievable records; and methods to verify characteristics of items and services important to quality?

8. Science Environment. Has the institution established a research environment that minimizes unnecessary burdens, provides an environment which fosters creativity and intellectual stimulation, and provides an atmosphere where good ethical work practices are accepted as the only acceptable way of performing and supporting research?

9. Independent/Peer Reviews. Are reviews of research quality supported by the organization through internal rules or external independent reviews?

10. Management Assessment. Are assessments of facility and support service adequacy performed by the organization's managers and internal customers to determine if the infrastructure is adequately supporting its customers?

11. Performance Measurement. Are personnel capabilities and performance being evaluated by managers at all levels to identify and improve performance?

12. Quality Improvement. Are the lessons learned from results of the assessments and evaluations being used as a basis for management decisions and improvements?
13. Quality Improvement. Is a process in place to continuously seek opportunities (through a "no-fault" policy) to minimize risk and make improvements rather than waiting for a problem to resolve itself?
14. Quality Improvement. Are improvement goals established, clearly integrated and communicated throughout the research organization?
15. Quality Improvement. Are all members of the organization trained in the principles of quality assurance and improvement?
16. Project Management. Does the research organization manage with accepted principles of project management to ensure research projects meet the requirements defined in research plans with respect to the quality of scientific results, cost and schedule, and ES&H concerns.
17. IQA Program. Is all test, measurement, and diagnostic equipment calibrated and operated to a level of detail to ensure the validity of research measurements and tests and are all aspects of research recorded to and adequate level of detail.

Observations and Recommendations

The results from this SR As-Is demonstrated that the requirements of the Fermilab Quality Assurance Guidelines for Scientific Research are being met. Of twenty-three questions about existence of controls from criteria within the QA Lines-of-Inquiry, 100% of the scientific research processes assessed had sufficient evidence to support observations that controls exist which satisfy the requirements within the QAGfSR.

Even though the SR As-Is observations found adequate compliance in all scientific research processes, there are important considerations:

- the results in Table I should not be used to compare one scientific research process area against another scientific research process area (although, all of the controls had satisfactory compliance for all five of the scientific processes)
- while controls exist, opportunities for improvement exist within the scientific research processes, and gaps need to be determined and concurred with by the Scientific Review Committee
- the requirements for scientific research as specified in Z1 and QAGfSR are based on "should" and thus even the requirement for existence or need of a control is subjective.
- each scientific research process area assessed has different operating environments and diverse missions, maturity in programs/processes, process owners and management, and procedures

Assessing QA in scientific research captures information at one point in time and not all items or perspectives could be included in this assessment. Thus, variation is expected. However, the data still allow these observations to be examined for trends and other issues.

While the QA Sub-Team observed adequate compliance (i.e. existence of a control(s)) with the guidelines for all five scientific research processes selected for assessment, five areas were identified that may require additional consideration and corrective actions. None of these identified areas are specific to a particular scientific research process, but these areas have a theme that all of the processes share at some level. These areas are:

- Qualification and Training
- Documents and Records
- Calibration
- Management Systems
- Program Management

QUALIFICATION AND TRAINING

When evaluating the five scientific processes, the QA Sub-Team did not find any issues that could be construed as non-compliant (i.e. a non-existent control) within qualification and training. However, some process-owners/interviewees expressed concern about the following subjects.

Because of any of the following concerns, some forms of training might need more formal approaches:

- Mentor-Protégé programs are of concern since the ability to bring new knowledge to the lab (i.e. through post-docs) and the ability to transfer scientific research knowledge and tribal knowledge have more risk now than before. Work-study and internship programs are not as prevalent as in the past.
- The aging Fermilab workforce and the associated situations of retirement, disability, death or employee transition/change in their employment environment put the lab at risk of skill loss. The skills and knowledge the employees possess may not be adequately recorded and transferred to allow seamless transition and operation when they leave positions within Fermilab.
- Losing people to other labs (e.g. CERN etc.) because of the necessary change in the physics mission at Fermilab, loss of preeminence as the largest fundamental particle physics experiment, and uncertainty in funding and new programs may result in significant change in skill and knowledge. Succession plans for scientific positions may prove to be beneficial. As with the other bullets, there is the concern about the seamless transition and operation.
- The temporary nature of the scientific workforce in the lab adds emphasis as to why important skills need to be formally documented and transferred.

The QA Sub-Team and interviewees understand that any training program should be implemented using a graded approach and acknowledge the value of more cross training.

DOCUMENTS AND RECORDS

Based on the guidelines currently available, the practices of document control appear to be adequate in scientific research, particularly with scientific papers and pre-publications. But it appears there is a need for standardization in the documentation structure to ensure

that unintended mistakes are avoided and to aid users and reviewers with what information the documents require. The QA Sub-Team suggests a more formal or standardized approach to the preparation of documents (e.g. MOUs, QA Plans, check lists, and other scientific infrastructure documents for contents). For example, DZero uses a standardized MOU within the collaboration. Suggestions were offered on using a standardized format for QA plans in scientific research (e.g. check list to ensure the appropriate content coverage and/or a formalized table of contents structure). The benefits of standardization are well-known when used with a graded approach and make allowances for flexibility.

CALIBRATION

While the observations determined that calibration was adequate for the SR As-Is, it needs to be a more formal program. For example, the QA Sub-Team found evidence of D0 Online and Offline calibration procedures for particle detectors. However, the QA Sub-Team could not find any clear and coordinated plan or guidance for a calibration program. Within scientific research programs, there are scientific measurements and apparatus that are more conventional that should be governed by a standardized calibration program. But each group/team seems to have unique ways of handling calibration. The QA Sub-Team realizes that there are unique scientific processes and measurements are on the cutting-edge and calibration methods for cutting-edge activities are not and may not appropriately be part of any formalized or standardized calibration program (e.g. based on an IEEE or NIST process). The scientific community should review the calibration issue and create a reasonable approach that will provide the correct tone and direction so scientific researchers, particularly new post-docs, can follow a standard methodology.

MANAGEMENT SYSTEMS

The QA Sub-Team did not observe any non-compliance in scientific research regarding management systems. However, there is an opportunity for improvement in this area. To put this discussion in context, the applicable QA Lines-of-Inquiry is, "Does the research plan describe the management systems used within the research?" The team found it difficult to identify where the management systems were mentioned in the scientific research programs. The Lines-of-Inquiry also require the controls associated with each management system should be described using a graded approach (i.e. #2 QA LOI, "...describes the management systems used to plan, perform, document, assess and transfer research results"). Some of the confusions arise because the QA Sub-Team could not find a clear definition of the management system that is communicated throughout the scientific programs. Part of the reason the team determined that the current situation in scientific research is compliant is because of the DOE requirements for many management systems, for instance, ES&H, security and safeguards, EVMS, travel, grants and proposal system among others are addressed by the Laboratory in some form or other.

PROGRAM MANAGEMENT

Based on the observations, the program management of scientific research is adequate (e.g. budget, schedules, scope were observed). It appears there may be additional value by using other project management tools/approaches. For instance, utilizing a risk register where all risks are collected, risk thresholds defined, and responsibilities are assigned for

monitoring and acting if/when risk is detected. All of the five scientific processes certainly covered many of the risks in the conceptual/program/project description documents, but the presentation of these risks was dispersed throughout the documents and, as such, it was difficult to assess the thoroughness and appropriateness of activities associated with the risk assessment. Fermilab appears to follow what is required by DOE with respect to the usage of project management practices, but other standardized program management practices should be evaluated.

RECOMMENDATIONS

The following are the recommendations for scientific research processes that may require additional consideration and corrective actions:

- Qualification and Training - A review of the scientific research processes should be conducted and appropriate documentation and training be provided where the risk is highest for skill and knowledge loss.
- Documents and Records - Many scientific research documents could benefit by using a more standardized approach.
- Calibration - Calibration needs to be a more formal program in scientific research.
- Management Systems - Define scientific research management systems in a document and explain how these management systems are generally used in a scientific research program (for the planning, performing, documenting, assessing, and transferring of research results). Identifying the most important scientific research management systems in each specific scientific research program provides direction and cohesion for the participants in the program, and specifies who is responsible for the controls used to manage the processes within that management system.
- Program Management - Review the generally accepted project management tools and evaluate if these may have additional benefit for program management in scientific research.

Best Practices and Other Comments for Scientific Research

Best practices from a scientific research process were not assessed by the QA Sub-Team for effectiveness and efficiency.

The following are contributions from the MINOS Collaboration that they feel qualify as best practices.

- Matching of management responsibilities for data analysis to individuals qualified to perform the analyses personally. In many cases management continues to perform actual analysis. In other cases, they have contributed to earlier versions of the analysis, and/or done very similar physics analyses on related experiments.
- The creation of a Young MINOS organization, which elects its own leadership, to guarantee that the needs of students and postdoctoral researchers are being met.

This organization has representation on the MINOS Institutional Board and the MINOS Executive Committee. An example of its impact on Quality Assurance has been its continuing insistence that upper management ensure that adequate computing resources be made available - a demand that has been reflected in upper management's work with the laboratory.

There are additional specific comments on observations which are in the objective evidence in Appendix B2. Since these are the assessors' notes, most of these comments were for additional explanation.

TABLE I - OBSERVATIONS FOR SCIENTIFIC RESEARCH PROCESSES

Lines-of-Inquiry for Quality Assurance Guidelines for Scientific Research	D0 Experiments	LQCD	MINERvA	MINOS	Muon Accelerator
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Is there a research plan?					
1. Is the ***project/program*** about Science?	YES	YES	YES	YES	YES
2. Does the research plan describe the management systems used within the research?	YES	YES	YES	YES	YES
3. Is the research plan reviewed by the customer?	YES	YES	YES	YES	YES
4. Does the research plan or proposal identify the following:					
a. Principle investigator and primary customer of the research?	YES	YES	YES	YES	YES
b. The technical approach to be used including a description of the research effort, expected results and any potential problems?	YES	YES	YES	YES	YES
c. The schedule, resources and deliverables	YES	YES	YES	YES	YES
d. Facilities requirements for the research?	YES	YES	YES	YES	YES
e. Methods for performing and documenting research to ensure the research goals are achieved?	YES	YES	YES	YES	YES
f. Methods for assessing the research performance to ensure that goals are met?	YES	YES	YES	YES	YES
g. Methods of transferring the results of the research to outside agencies and organizations?	YES	YES	YES	YES	YES
Has the research organization defined its mission and established a quality management program with the goals to help achieve its mission?					
5. Has the organization implemented a plan with stakeholder's needs and expectations; defined critical success factors; and developed methods to assure results of measurements to use as a basis for improvement?	YES	YES	YES	YES	YES
6. Has the organization established leaders who are committed to create, sustain the vision, mission, customer focus, and quality values and assure they are translated into policies and practices, and widely communicated?	YES	YES	YES	YES	YES

TABLE I - OBSERVATIONS FOR SCIENTIFIC RESEARCH PROCESSES (CONT'D)

Lines-of-Inquiry for Quality Assurance Guidelines for Scientific Research	D0 Experiments	LQCD	MINERvA	MINOS	Muon Accelerator
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
7. Does the organization provide for qualified and trained personnel; resources of the required quality; safely stored and retrievable records; and methods to verify items and services important to quality?	YES	YES	YES	YES	YES
8. Has the institution established a research environment that fosters creativity and an atmosphere with ethical work practices in performing research?	YES	YES	YES	YES	YES
9. Are independent reviews reviews of research quality supported by the organization?	YES	YES	YES	YES	YES
10. Are assessments of facility and support services adequacy performed by the organization's managers?	YES	YES	YES	YES	YES
11. Are personnel capabilities and performance being evaluated to identify and improve performance?	YES	YES	YES	YES	YES
12. Are the lessons learned from results used as a basis for management decisions and improvements?	YES	YES	YES	YES	YES
13. Is a process in place to continuously seek opportunities to minimize risk and make no-fault improvements rather than waiting for a problem to resolve itself?	YES	YES	YES	YES	YES
14. Are improvement goals communicated throughout the research organization?	YES	YES	YES	YES	YES
15. Are all members of the organization trained in the principles of quality assurance and improvement?	YES	YES	YES	YES	YES
16. Does the research organization manage with principles of project management to ensure research projects meet the requirements.	YES	YES	YES	YES	YES
17. Is all diagnostic equipment calibrated to ensure the validity of research measurements and research recorded to an adequate level of detail.	YES	YES*	YES	YES	YES

YES* - this criteria is really not applicable for this scientific research process

Controls Evidence of FICAP in Scientific Research

This section summarizes the effort to determine the existence of controls for the requirements from the FICAP for the management systems in scientific research. The Lines-of-Inquiry, derived from the FICAP during the As-Is Baseline assessment, were used to provide guidance in identifying controls satisfying criteria specified in the Fermilab Integrated Contractor Assurance Program. The objective evidence supporting the observations and recommendations is presented in Appendix B3, "FICAP Controls Evidence in Scientific Research."

Discussion of the applicability of FICAP to scientific research is at the end of Appendix B3 titled, "Applicability of FICAP to Scientific Research."

Lines-of-Inquiry - FICAP Guidelines for Scientific Research

The following Lines-of-Inquiry guided the focus of this contractor assurance assessment in scientific research.

1. Program - Has Fermilab management established a comprehensive and integrated contractor assurance system for ensuring the protection of the public, workers, environment and national security assets through continuous improvement for environment, safety, and health; safeguards and security; cyber security; and emergency management? Things to look for:
    a. Are the processes of the Contractor Assurance System formal and documented?
    b. Are personnel implementing Contractor Assurance System processes trained and qualified to perform assigned oversight activities?
    c. Are Contractor Assurance System responsibilities implemented?
    d. Are the results of Contractor Assurance System activities validated, documented, communicated, classified, evaluated, tracked and resolved?
2. Assessment - Has Fermilab management established a rigorous and credible assessment program that evaluates the programs, processes, and performance on a recurring basis?
3. Performance - Have formal mechanisms and processes been established for collecting both qualitative and quantitative information on performance, and is this information used as the basis for informed management decisions to improve performance? Things to look for:
    a. Are the processes for assessment and performance measurement formal and documented?
    b. Are personnel implementing the assessment and performance measurement program processes trained and qualified to perform assigned oversight activities?
    c. Are assessment and performance measurement program responsibilities implemented?

4. Reporting - Has Fermilab management implemented formal programs to identify issues and report, analyze, and address operational events, accidents and injuries? Things to look for:
    a. Are the processes for event identification, reporting and investigation formal and documented?
    b. Are personnel implementing event identification, reporting, and investigation processes trained and qualified to perform assigned oversight?
    c. Are event identification, reporting and investigation responsibilities validated, documented, communicated, classified, evaluated, tracked and resolved?

5. Lessons Learned - Has Fermilab management established formal programs to communicate operating experience/lessons learned during work activities, process reviews, and incident/event analyses to potential users and applied to future work activities? Things to look for:
    a. Are the processes of the operating experience/lessons learned program formal and documented?
    b. Are personnel implementing operating experience/lessons learned processes trained and qualified to perform assigned oversight activities?
    c. Are operating experience/lessons learned program responsibilities implemented?

6. Issues Management - Has Fermilab management established a comprehensive, structured issues management system that provides for the timely and effective resolution of deficiencies? Things to look for:
    a. Are the processes of the Contractor issues management program formal and documented?
    b. Are personnel implementing contractor issues management processes trained and qualified to perform assigned oversight activities?
    c. Are contractor issues management program responsibilities implemented?
    d. Are the contractor issues management processes ensuring that site operations are performed safely, securely, and in compliance with applicable requirements'?

7. Worker Feedback - Has Fermilab management established a comprehensive, structured issues management system that provides for the timely resolution of employee concerns and feedback on safety performance from workers? Things to look for:
    a. Are the processes of the contractor worker feedback programs formal and documented and, when taken together, do they meet the above stated objective?
    b. Are personnel implementing Contractor Worker Feedback program processes trained and qualified to perform assigned oversight activities?
    c. Are contractor employee concerns and worker feedback responsibilities implemented?

8. Dissenting Opinions - When an assessment or investigation team member holds a dissenting opinion, is a minority report created and submitted up the line management chain, along with the final report? Things to look for:
    a. Is a copy of both reports submitted to Assurance Council (AC) as well?
    b. Does the division/section/center head and the appropriate Management System Owner review and attempt to resolve any dispute with the team members?
    c. If the author of the minority report believes the issues are still in dispute, is he/she permitted to refer the issue to the AC? Is the AC's decision is binding.

Observations and Recommendations

The results from the SR As-Is demonstrated that the requirements of the FICAP are being met. Of eight basic questions within the FICAP Lines-of-Inquiry about existence of controls for requirements, 100% of the highest-levels of the management systems addressing FICAP components in scientific research had sufficient evidence that controls existed (see TABLE II - Observations of Compliance to FICAP).

The following observations were made based on the objective evidence obtained during SR As-Is. While the QA Sub-Team observed adequate compliance, three areas were identified that may require additional consideration and corrective actions. These areas are:

- Programs
- Reporting
- Dissenting Opinions

PROGRAMS

It is not clear if the vertical integration process has been fully implemented as specified within the FICAP (section 1.2, pg 16). It is not clear if the names of the Management System Coordinators (MSC) are widely communicated. According to the FICAP, the "D/S/Cs participate in the development of institutional programs through the Advisory Council for Integrated Assurance (AC)" (pg. 16). It is not clear how AC communicates with the scientific staff.

REPORTING

This observation is related to the FICAP specifications found in Section 6.1 (Introduction to Reporting), which states:

> "Fermilab policy requires that laboratory management and the DOE are notified of all events which may:
>
> - affect the safety and health of the public or workers;
> - seriously impact the intended purpose of the laboratory;
> - have an adverse effect on the environment; or
> - create publicity detrimental to the mission of the laboratory."

While senior management for scientific research is responsible for reporting on the above four items, it is not clear if accurate and concise information is readily available to them to provide such oversight. The typical senior manager has acquired significant on-the-job training as well as advanced certifications. However, because of this extensive experience, it is not clear if a formal oversight training plan is applicable. Laboratory management may wish to consider preparing comprehensive guidance documentation for the scientific research management on how to handle significant events and the associated flow-down process. A guidance document is even more applicable when considering the ramifications of potential change in management based on the current environment and demographics of the senior scientific research management and staff.

DISSENTING OPINIONS

Although evidence about the encouragement of dissenting opinions in scientific research was mentioned by the interviewees, no evidence of a formal process for documenting a minority report or encouraging dissenting opinions was found. It is not clear if such a dissenting opinion or minority report is formally recorded and submitted to the next level of scientific managers or to the AC to resolve issues.

There are methods to discuss or express dissenting opinions in the scientific environment. Scientists express their dissenting opinions in group discussions and by not participating in the authorship of publications of scientific results that they do not agree with. An example cited by an interviewee was with collaboration members that did not agree to a study's results and withdrew their names from the paper; additionally, the interviewee explained that dissenting opinions are not only tolerated, but also encouraged in the scientific process. This observation is related to the FICAP specifications found in section 10.1, on page 65, which states:

> "If an assessment or investigation team member holds a dissenting opinion, a minority report is to be created and submitted up the line management chain, along with the final report. A copy of both reports shall be submitted to AC as well. The division/section/center head and the appropriate MSO will review and attempt to resolve any dispute with the team members. If the author of the minority report believes the issues are still in dispute, he/she may refer the issue to the AC. The AC's decision is binding."

RECOMMENDATIONS

Given there has been a limited roll-out and training of the FICAP and that changes are anticipated based on the H-13[3] clause in the FRA-DOE contract, the following recommendations (which may require subsequent modification based on H-13 interpretation) are offered from the previously mentioned observations.

- Programs - An organizational and responsibility chart should be published for the management systems mentioned in FICAP and, at a minimum, the senior management in scientific research should be knowledgeable about this

[3] H-13 is a clause within the FRA and DOE contract (DE-AC02-07CH11359). H-13 will replace DOE o 226.1A on which the FICAP is based, but the underlying information is still relevant as the applicability is unchanged

responsibility chart. Also, a process should be defined and the personnel assigned from the AC need to participate in flowing the communication between the AC and the D/S/Cs and the scientific staff. Training in these areas as well as other aspects of the FICAP should be developed and implemented for the various levels of Fermilab scientific research management as appropriate.

- Reporting - Using a graded approach, current and comprehensive documented guidance and/or training materials should be prepared for the scientific research management providing oversight for Fermilab staff members as well as scientific users on the process for notifying the DOE of all significant events as specified in the FICAP.
- Dissenting Opinions – A process for dissenting opinion in scientific research should be developed that resolves issues and is acted upon. It should also include a process of recording a minority report.

TABLE II - OBSERVATIONS OF COMPLIANCE TO FICAP

Lines-of-Inquiry for Fermilab Integrated Contractor Assurance Program	Observed?
	Yes/No
1. Program - Has Fermilab management established a comprehensive and integrated contractor assurance system for ensuring the protection of the public, workers, environment and national security assets through continuous improvement for environment, safety, and health; safeguards and security; cyber security; and emergency management?	Yes
2. Assessment - Has Fermilab management established a rigorous and credible assessment program that evaluates the programs, processes, and performance on a recurring basis.	Yes
3. Performance - Have formal mechanisms and processes been established for collecting both qualitative and quantitative information on performance, and is this information used as the basis for informed management decisions to improve performance?	Yes
4. Reporting - Has Fermilab management implemented formal programs to identify issues and report, analyze, and address operational events, accidents and injuries?	Yes
5. Lessons Learned - Has Fermilab management established formal programs to communicate operating experience/lessons learned during work activities, process reviews, and incident/event analyses to potential users and applied to future work activities?	Yes
6. Issues Management - Has Fermilab management established a comprehensive, structured issues management system that provides for the timely and effective resolution of deficiencies?	Yes
7. Worker Feedback - Fermilab management established a comprehensive, structured issues management system that provides for the timely resolution of employee concerns and feedback on safety performance from workers?	Yes
8. Dissenting Opinions - When an assessment or investigation team member holds a dissenting opinion, is a minority report created and submitted up the line management chain, along with the final report?	Yes

APPENDIX

Appendix A - Charge to the QA Sub-Team for Science

From: Jeffrey Appel
To: Keith Schuh, Bakul Banerjee, Tom King,
cc: Greg Bock, Vicky White, Steve Holmes, Bob Grant, Marilyn Smith, Jackie Coleman
---
Date: Monday, February 01, 2010 10:49AM
Subject: From Greg Bock - Charge to QA Assessment Sub-Team

January 30, 2010

To: Quality Assurance (QA) Sub-Team for Science

From: Greg Bock, Associate Director for Research

Subject: Charge to the QA Sub-Team for Science to Conduct an "As-is" Assessment of QA in Scientific Research

The QA Sub-Team is charged to plan and conduct an "As-Is" baseline assessment of QA implementation in scientific research. The team consists of two Quality Assurance Representatives (QARs), one each from the PPD and CD Divisions and a QA Engineer (QAE) from OQBP. During the assessment, the team will determine the status of implementation of requirements found in the Quality Assurance Guidelines for Scientific Research at Fermilab, *Quality Guidelines for Research* ANSI/ASQ Z1.13, Integrated Quality Assurance (IQA), and Fermilab Integrated Contractor Assurance Program (FICAP). The team will work with process owners of a set of selected research efforts and apply a graded approach when determining the level of rigor the application of requirements must meet prior to assessing implementation in each area.

The team presented to me a plan for the As-Is activity on January 21, 2010. The assessment is being conducted late January 2010 to late February 2010. The QA Sub-Team for Science is specifically charged to:

- Identify scientific processes including R&D activities and experiments associated with the three frontiers of the scientific mission of Fermilab, namely Energy, Intensity and Cosmic Frontiers.
- Prepare a hierarchical list of Fermilab scientific processes, including those owned by single organizations (Division/Section/Center), as well as those cross-cutting processes for which activity occurs in multiple organizations.
- Identify significant sample scientific processes within the Laboratory, based on a definition that is consistent with the IQA and Quality Assurance Guidelines for Scientific Research at Fermilab. Significant scientific processes will be those that have significant risk potential for the Laboratory as discussed with me.
- Submit a suggested prioritized order in which significant scientific processes will be selected for assessment. I will approve the finalized prioritized list before the assessment begins.

- Based on the degree of risk, assist each owner for each selected processes in identifying needed controls from the Quality Assurance Guidelines for Scientific Research at Fermilab document for each process. The results of this activity will constitute the "To-Be" state of these processes.
- The team will perform an assessment of the selected scientific processes against the referenced documents above. The results of this assessment will constitute the "As-Is" state of these scientific processes. Identify current, existing best practices as part of the "As-Is" assessment.
- Identify gaps between the "As-Is" and "To-Be" states for each scientific process and communicate them to each significant scientific process owner. As needed, Corrective Action Plans (CAPs) will be assigned by the Associate Director for Research based on the observations and with the concurrence of a Scientific Review Committee (appointments to this committee will be by the Associate Director for Research). Within two weeks of notification of observations by the Associate Director for Research, scientific process owners will be expected to prepare the corrective action plans to address gaps.
- Assist scientific process owners in the preparation and implementation of the corrective action plans.

Appendix B - Objective Evidence from SR As-Is

All of the information found within Appendix B is objective evidence and should be viewed as the working notes from the SR As-Is from the QA Sub-Team. These notes are excerpts from documents or notes from interviews and may or may not have explanatory comments. These have not been edited to the level of clarity and provided with explanations or comments as the information in the main body of this report.

Appendix B1 - Comparison of QAGfSR with Z1

The following table, "Comparison of ANSI/ASQ Z1.13 with QAGfSR" compares the sections in Z1 and similar sections found in QAGfSR. More specifically, the comparison was performed by listing each of the elements (sub-sections or bullets) in Z1 and identifying the analogous section and location within the QAGfSR. The analogous QAGfSR section was copied to an adjacent cell corresponding to an element in Z1. A comment from the QA Sub-Team provides an assessment to the degree of congruence; there may or may not be comments provided for all of the elements being compared.

The following is the legend for the colors used in the table. The colors within the cells are used to aid the reader in the evaluation of the level of congruence between Z1 and QAGfSR. The green or "yes" would be an evaluation that the level of congruence between the element in Z1 and QAGfSR is good.

- green = "yes"
- green with yellow = "yes to maybe"
- yellow = "maybe"
- yellow with red = "maybe to no"
- red = "no"

Color Legend for Compliance of QAGfSR to IQA Consensus Standard ANSI/ASQ Z1.13				
Yes	Yes to Maybe	Maybe	Maybe to No	No

Appendix B1 - Comparison of QAGfSR with Z1

TABLE: COMPARISON OF ANSI/ASQ Z1.13 WITH QAGFSR

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
1.1	1.1 Scope					
1.1	This document can be used in the development of a quality system for basic and applied research. That is where the output is knowledge, information, data, or proof-of-concept, but not product or service design or development. This includes fields like the biological, physical, and applied sciences, which use methods such as field investigation, laboratory experimentation, computer modeling, and theory formulation.	4	4	The output of research is knowledge, information, data, or proof-of-concept. The research effort itself involves the use of such methods as laboratory experimentation, computer modeling, theory formulation, and field-testing.	yes	the intent and exact words are used to describe science and lists the areas at Fermilab where science is expected to be found
		4	16	This guideline does not apply to efforts that have specific quality assurance (QA) plans/programs approved separately by the Department of Energy (DOE), such as Fermilab projects with specific project QA plans as required by DOE Order 413.3A.		
		4	23	All research at Fermilab complies with the policies and guidelines established by the Director		
		6	4	Specific procedures for much of the experimental program are documented in the Fermilab "Procedures for Experimenters (PFX)," available on the web at http://www.fnal.gov/directorate/documents/		The PFX and what it covers may be where many items are covered when the team did not find an appropriate reference in the QAGfSR
3	3.0 Definition					
3.1	3.1 External customer	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
3.1	An organization or person outside the research institution organizational structure who funds the research activities and for whom the outcome and associated peripherals of that research are provided. As defined below, stakeholders are not external customers.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.2	3.2 Internal customer	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.2	An organization or person inside the research institution organizational structure that is provided a product or service from some other organization or person in the laboratory.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.3	3.3 Principal investigator	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.3	An individual who has primary responsibility for performing or overseeing the research. In some instances, the principal investigator is also referred to as the project manager for the research project.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.4	3.4 Peer review	1	2	Science, by its very nature, is an enterprise with built in mechanisms of self-checking, which in turn assure quality in scientific research. Peer review is an essential element at many stages in our research, and is central to quality assurance.	yes	This is about defining a term, so there should be no problems since all definitions are accepted - nice addition statement too

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
3.4	One of the primary mechanisms for assuring quality in science. Within a scientific community, peers are defined as those persons who constitute the competent professional group whose role it is to define what quality research results are within that particular discipline. Technical peers are individuals who typically meet all of the following criteria	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.4	-They have an equal or greater level of academic education in the same technical discipline in which the work is performed or in a closely related field, or have equivalent work experience and technical activity in a related discipline.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.4	-They have demonstrated evidence of proposing and solving engineering, experimental, or theoretical problems that are recognized as valid by that community of technical peers.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted
3.4	-They have contributed to the body of knowledge within a technical discipline such as publishing research results in the proceedings of scientific meetings or in professional journals.	5	3	ANSI/ASQ Z1.13-1999. The document adopts the definitions in the ANSI standard, and follows the topics and ordering in that standard.	yes	This is about defining a term, so there should be no problems since all definitions are accepted

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
4	4 THE MANAGEMENT OF BASIC AND APPLIED RESEARCH PROJECTS					
4	The research organization should require scientists to develop a research plan or research proposal that describes the conduct of the research. Research plans may define an entire program of research in which multiple scientists perform studies in a particular scientific field. For very large and complex experiments, a research plan may be generated for each experiment. Any changes to the established management systems (or any other requirements) should be specified in the research plan. This guidelines document should be used by the research organization to develop research plans, and by the funding agency or primary external customer to review those plans.	9	25	Once an idea has generated sufficient interest and adequate starting collaborators, a proposal is prepared. Sometimes, collaborations send an Expression of Interest (EOI) and/or Letter of Intent (LOI) to the Laboratory to apprise the Laboratory of things that might impact its planning. Typically, an LOI has a more developed plan for the research and a more complete list of proponents. Once there is a proposal, the Fermilab Quality Assurance program plays a role for research in which Fermilab is involved. The decision to proceed with the research gets input from further discussions and reviews, and the approval authority level varies with the research category and the scale of the effort. Proceeding through the research includes various steps or milestones. See Figures 1 through 4 for a representation of the process flows in the four types of scientific research at Fermilab	yes	A THOUGHT - This says that a plan, MOU, LOI, ... "is used" (isn't this really a Fermilab requirement/necessity ... more than just a "should"; Z1 in section 4 discusses this extensively); nowhere was it found or does it appear to discuss what some of the items of the plan should include or what it "must address" - at least a high level. Perhaps that next level of describing the plan content is in the PFX (and just may have been overlooked). As a suggestion, if there are "must address" items and some do not apply to a specific plan, then the authors might simple be able to respond that "the items were considered and are not applicable or not addressed at this time."

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
4	The sections below describe what should be included or referenced in a typical research plan. When research is performed in an organization that has implemented an institution-wide QA program, redundancy and duplication in terms of developing the elements of a research plan should be avoided. The objective should be to ensure that the elements described in this guideline are covered either (1) by including a description of these elements in a research plan as described below, or (2) by including a reference in the research plan as to how the element is satisfied by a higher-level institutional QA program.			"include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach..." see next cell below too	yes to maybe	In the very next section is the evidence of elements which should be included in a plan per the QAGfSR. What seemed to be missing in most plans is the QA implementation within the research plan. For instance, the elements in the higher level QA program (which for science is the QAGfSR) may, or may not, be stated in the plan, but the implementation within the plan is unspecified or incomplete. No evidence was found that says, "these elements of the QAGfSR must be addressed..." Since the guideline is a "should" based document, "must be addressed" means that a response to the elements in the research plan may even be, "this QA element was considered as not pertinent." Thus it need not be expanded upon in the research plan, but at least it was considered.

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
4	The research organization should be committed to managing its technical work in accordance with accepted principles of project management and should ensure that all in-house and subcontracted research projects meet the requirements defined in research plans with respect to the quality of scientific results, cost and schedule, and environmental, safety, and health concerns.	9	10	leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. Research efforts are defined initially in a proposal or draft Memorandum of Understanding (MOU). These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.	yes to maybe	NO evidence was found in reference to "accepted principles of project management" - although per QAGfSR - "any relevant issues involving the research" covers a lot! Also much of that which follows sounds like good project management practices. This section gets referred to as QAGfSR 19:10 in other areas of this documents
4.1	4.1 Responsibility for the research					
4.1	The research plan should identify (1) a principal investigator (or project manager) who is responsible for the research and (2) the funding agency or the primary external customer of that research.	9	2	Scientific research efforts have a principal investigator (PI) or spokesperson (sometimes co-PI's or co-spokespersons) to share the work and to help ensure availability for operational issues. These leaders are identified when the research is proposed, and there are orderly processes for changes to these leaders when the research will continue for extended periods of time.	yes	It appears that the "funding agency or external customer" needs to be specifically stated
4.1	The principal investigator may delegate work to others who are qualified to do the research.	9	15	Aspects of these responsibilities may be delegated as appropriate to facilitate effectiveness and communication	yes	

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
4.2	4.2 Planning the research					
4.2	4.2.1 Technical Approach					
4.2	The principal investigator should provide a written description of the research project. To an extent commensurate with the type of research (exploratory research, fundamental studies, institutional projects, etc.), the principal investigator should describe the research to be performed and the possible research results, hypotheses, and calculated predictions that may or may not be corroborated by the actual data accumulated by experiments.	15	7	Research efforts are defined initially in a proposal or draft Memorandum of Understanding (MOU). These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.	yes	This section gets referred to as QAGfSR 15:7 in other areas of this documents
		9	9	These leaders are the primary contact between the Laboratory and the research, and these leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. This latter function is essential for determining, assuring, and improving the quality of the research		
4.2	The principal investigator should describe the purpose of the experimental work and identify the criteria that can be used for assessing the degree of success of the work, given input from stakeholders and customers.	6	4	Specific procedures for much of the experimental program are documented in the Fermilab "Procedures for Experimenters (PFX)," available on the web at http://www.fnal.gov/directorate/documents/	yes to maybe	What seems to be missing is knowing how to assess that the work conforms to the criteria and how to assess when the criteria has been satisfied is not addressed; it could be this is was overlooked and within the PFX

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
4.2	The principal investigator should provide a brief historical overview of the research, including publications that describe previous experiments or theories that have led to the research described in the research plan.	16	2	Proposals and draft MOU's are reviewed by the relevant management at the Laboratory for appropriateness for the Laboratory mission, feasibility, and how the research fits into the broader research program at the Laboratory and around the world.	yes	While the words are not exact, the intent seems right. Most scientific endeavors start out with a review of the efforts to date and how the new work is an extension from the past work
4.2	The principal investigator should describe any unusual or potentially problematic techniques and experimental methodology that will be employed in the performance of the research and how these will be handled.	18	21	These reviews try to identify and anticipate problems, and make recommendations for corrective action. In some cases, there are ad hoc internal and/or external reviews of potential and identified research problems organized within the research effort itself, and reporting directly to that research effort organization – again with the goal of defining methods of preventing or correcting problems.	yes	
4.2	The principal investigator should describe any relationships, interrelationships, or dependencies that the experimental work has to other known projects or areas of research. When it is known that similar work will be performed elsewhere, this should be stated with a brief explanation of how the work is coordinated or the reason it is necessary that it be competitive.	16	2	Proposals and draft MOU's are reviewed by the relevant management at the Laboratory for appropriateness for the Laboratory mission, feasibility, and how the research fits into the broader research program at the Laboratory and around the world.	yes	

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4.2	4.2.2 Schedule and Deliverables					
4.2	The principal investigator should identify the proposed duration (term) of the research as well as identify the resource planning for	16	10	For large efforts, a Stage I approval may be granted once the goals of the research and techniques intended for use are accepted, with full (Stage II) approval awaiting more definitive plans and understanding of the availability of resources. (perhaps 15:7 section appropriate - include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.)	yes	
4.2	(1) support and technical (or research) staff, graduate students, and postdoctoral researchers,	16	8	The level of such review depends on the nature of the research and the scale of resources needed (perhaps 15:7 section appropriate - include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.)	yes	

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4.2	(2) operating expenses,	22	3	As discussed above, human and material resources are identified as part of the proposal/MOU processes, and included directly in budget and staff planning processes. In the case of major programs, human and material resources are also included in additional program planning documents. (perhaps 15:7 section appropriate - include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule.)	yes	
4.2	(3) equipment including computer programs, and	15	7	Research efforts are defined initially in a proposal or draft Memorandum of Understanding (MOU). These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule	yes	

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4.2	(4) special training requirements.	22	8	Individual scientists receive informal training as a part of doing research at the Laboratory and collaborating with other scientists and engineers. Informal training also occurs as part of the research environment at the Laboratory. The typical degree of earlier training of the laboratory scientists who have responsibility for directing or participating in research is generally a Ph.D., 6 years of postdoctoral experience, and a graded sequence of assignments at the lab. A similar profile exists for university researchers as they advance through a series of experiments.	yes	Of course there are the courses required by ESH & HR… And there are training and courses that lesser skilled individuals (techs and interns) may need
		23	7	In addition to training, mentoring is necessary to assure the longer-term quality of the research effort at the Laboratory and beyond. For Laboratory employees, such mentoring is a part of the annual goal setting and performance review processes. For users, mentoring is performed by the home institution, assisted by efforts internal to individual research efforts where they exist (e.g., in large experiments).	yes	

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4.2	The principal investigator should describe any scheduled milestones and deliverables for the research, including construction and fabrication of items and development of software if appropriate, scheduled evaluations, and the presentation of nonproprietary research results at scientific meetings or publication of the results in preferred professional journals.	15	7	Research efforts are defined initially in a proposal or draft Memorandum of Understanding (MOU). These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule	yes	
		9	25	Once an idea has generated sufficient interest and adequate starting collaborators, a proposal is prepared. Sometimes, collaborations send an Expression of Interest (EOI) and/or Letter of Intent (LOI) to the Laboratory to apprise the Laboratory of things that might impact its planning. Typically, an LOI has a more developed plan for the research and a more complete list of proponents. Once there is a proposal, the Fermilab Quality Assurance program plays a role for research in which Fermilab is involved. The decision to proceed with the research gets input from further discussions and reviews, and the approval authority level varies with the research category and the scale of the effort. Proceeding through the research includes various steps or milestones. See Figures 1 through 4 for a representation of the process flows in the four types of scientific research at Fermilab		

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4.2	4.2.3 Facilities and Requirements					"Facility" is never mentioned but the word "resource" is
4.2	The principal investigator should describe any facility and schedule requirements needed to carry out the research. Consideration should be given to the following elements	15	7	Research efforts are defined initially in a proposal or draft Memorandum of Understanding (MOU). These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research; the technical approach proposed to achieve the goals of the research; resources (both funding and human resources) needed for implementation of the research and anticipated sources of those resources; any special environmental, safety, or health issues associated with the research; and the anticipated schedule	yes	One may consider facilities are part of resources and the environment
4.2	-If the performance of the research will require the use of permanent laboratory facilities, briefly describe the required use, location, gross square footage, and impact on the laboratory's utility services for each year the research will be performed.				maybe to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10) The QAGfSR guide may not say it in so many words but the MOU's may cover these items. Almost all scientific research planning requires space and utility estimation or reconfiguration.

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4.2	-Identify whether major modification will be needed to existing laboratory facilities in order to perform the research.				may be to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10) The QAGfSR guide may not say it in so many words but the MOU's may cover these items. Almost all scientific research planning requires space and utility estimation or reconfiguration.
4.2	-If the performance of the research will require the acquisition of leased space, briefly describe the required use, estimated square footage, and the impact on that space for each year the research will be performed.				may be to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10) The QAGfSR guide may not say it in so many words but the MOU's may cover these items. Almost all scientific research planning requires space and utility estimation or reconfiguration.

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4.2	-If the research requires that experiments be performed in the field (outdoors), briefly describe the required use, location, and environmental impact of the research.			other than "field-testing" - nothing	maybe to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10). This may be an example of an area in Z1 that has little relevance to Fermilab and may or may not be worth mentioning since one cannot predict what future experiment may require this activity.
4.2	-If the research requires that samples be taken, include or reference a description of the means for collecting, safeguarding, and processing of the samples, and the reasoning for the chosen sample size and distribution.			no mention of sampling or representative portion	maybe to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10)
4.2	-Identify whether equipment and materials are already in place to perform the research and, if not, what new equipment and materials will have to be procured.			no mention of new purchases or acquisitions	maybe to no	Resources & environment are specified in QAGfSR 15:7, but the specificity with respect to this section does not seem to be provided. This may be another example of some of the limitation with respect to specifying what the plan needs to address (again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10) The QAGfSR guide may not say it in so many words but the MOU's may cover these items. Almost all scientific research planning requires space and utility estimation or reconfiguration.

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4.3	4.3 Performing and documenting the research					
4.3	All research performed as a part of a research plan should follow accepted research practices, germane to the discipline. To a level of detail that is adequate to ensure that the research goals are capable of being achieved, the principal investigator should be responsible for	25	2	Annual assessments of the performance of Fermilab staff members are part of the standard procedure at the Laboratory. This process includes annual goal setting, self-assessment of achievements, and review by supervisors. These assessments directly affect the salary of staff members	yes to maybe	Much can be accomplished with reviews and one assumes that researchers will specify a mechanism to achieve goals and will self-evaluate accomplishments to determine if the research is on track to achieve goals.. There is some room for interpretation if the QAGfSR specifies sufficient detail be provided by the researcher within the plan that is adequate to ensure that the research goals are capable of being achieved,
4.3	-Ensuring that to personnel associated with the project and ensuring that communications with these individuals are ongoing throughout the project.	23	24	In addition, special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at the Laboratory. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.	yes	
4.3	-Managing the work to achieve cost and schedule requirements and notifying the customer or funding agency of any situations that might impact the ability to meet commitments.			QAGfSR 15:7 section refers to cost with respect to schedule and there is reference to reviews; also some reference to reviews to make CA to research, but not to the "project" - nothing seems to specifically refer to this requirement - Check section found at 10:21 -	yes to maybe	Actually one expects this happens but no evidence could be found to identify a correlated control - It does appear that the customer or funding agency is informed on the status of the project(s)
4.3	-Ensuring that materials and supplies associated with the research plan are properly stored and that reasonable shelf-life limitations are observed.	24	12	The Laboratory maintains document repository services through its Publications Office, Archives, and Documents Control Policy	yes to maybe	If documents and records are the issue then the evidence here is sufficient, but the QAGfSR is not addressing item control
4.3	-Determining the calibration, performance, and operating requirements of all test, measurement, and diagnostic equipment to a level of detail that is adequate to ensure the validity of research measurements and tests.	24	16	the collection of data occurs, the quality of that data is continuously monitored as it taken. This quality assurance is typically built into the data acquisition process itself, with follow-up monitoring in near-real time and later off-line analysis, separate from the research-goal analysis itself	yes to maybe	The intent appears to be addressed, not with as much direct wording, but there is no central and systematic calibration guidelines

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4.3	-Assuring that the appropriate aspects of the research are recorded in laboratory notebooks or other project records and that the entries are developed to an adequate level of detail, and are legible, complete, and correct.	19	4	While archival publication of research results remains the primary record of research, additional transfer of the results occurs in multiple forums.	yes	The intent appears to be addressed, not with as much direct wording, but the words found to support this specification don't actually have as much specificity in QAGfSR as in Z1
4.3	-Assuring that laboratory notebooks, other project records, and the data from the research are retrievable and protected from change, loss, or damage.	24	12	The Laboratory maintains document repository services through its Publications Office, Archives, and Documents Control Policy	yes	
4.3	-Defining (or referencing) performance criteria for the evaluation of software programs to a level of detail that is adequate to ensure that the research goals are capable of being achieved.				maybe to no	Perhaps more maybe than NO, ... No evidence was observed where specification on resources might address this and there is nothing specific to software. While one might assume much could be read into what reviews do, there appears to be no evidence about specifying criteria for evaluation of software, specifically, nor specifying what constitutes success or when goals are achieved. Again, per QAGfSR - "any relevant issues involving the research" covers a lot - see excerpt from QAGfSR 19:10
4.3	-Defining the appropriate human or machine-readable (computer) inspections and tests. The detail, extent, and methods of inspections and tests should be adequate to ensure that the experiment is capable of achieving its research goals.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems, and make recommendations for corrective action.	yes to maybe	It appears that no computer specific requirements exist, but resources get mentioned. Otherwise, this is more yes than maybe.

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4.3	-Assuring that measurement uncertainty analyses are appropriately documented and properly used.	24	16	In scientific research where the collection of data occurs, the quality of that data is continuously monitored as it taken. This quality assurance is typically built into the data acquisition process itself, with follow-up monitoring in near-real time and later off-line analysis, separate from the research-goal analysis itself.	yes to maybe	Depends on how one reads uncertainty vs. quality of data
4.4	4.4 Assessing the performance of the research					
4.4	The principal investigator should assess the performance of the research to a level of detail that will ensure that accepted research practices are employed and that the research goals can be met.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems, and make recommendations for corrective action.	yes	It appears the committee(s) is requested to do do the assessemnt and review. But it seems highly unlikely that the primary researcher would not be involved.
4.4	The goal should be to identify, correct, and prevent problems that might hinder the achievement of the purpose and goals specified in the research plan.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems, and make recommendations for corrective action.	yes	It appears the committee(s) is requested to do do the assessemnt and review. But it seems highly unlikely that the primary researcher would not be involved.

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4.4	Personnel performing the research or support work should strive to evaluate their own performance and look for ways to improve the quality of their work continuously.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems, and make recommendations for corrective action.	yes	It appears the committee(s) is requested to do do the assessemnt and review. But it seems highly unlikely that the primary researcher would not be involved.
4.4	The principal investigator should describe any independent assessments that are to be performed by peer review panels, institutional reviews of the research to be performed by personnel who are not directly involved in the research, or other reviews that are to be initiated by the primary customer of the research. The results from these assessments should be used to improve the research process.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved. These reviews try to identify and anticipate problems, and make recommendations for corrective action.	yes	It appears the committee(s) is requested to do do the assessemnt and review. But it seems highly unlikely that the primary researcher would not be involved.

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4.5	4.5 Transferring the results of the research	17	11	Given the strong impetus for publishing research results in recognized journals, and interest in them, research groups have established various forms of internal review, sometimes multi-stage arrangements. These reviews may include working early-on in analysis groups, assignment of "godparents" (individuals or groups to mentor and monitor the research) when the work reaches a certain level of maturity, formal review of first and second drafts of papers by assigned reviewers and open to the full research collaboration – all this before the work is submitted for publication. Less formal release of preliminary results for conference and other presentation may occur before formal submission of results for publication.	yes	
4.5	The principal investigator should prepare the research results for dissemination as described in the research plan. The principal investigator should consider transferring results of nonproprietary research by methods such as	17	19	In addition, submission to journals is accompanied by submission to the Fermilab Publications Office, which reviews for intellectual property rights and adds an additional level of quality assurance.	yes	
		27	7	Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	

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4.5	-Publication of results in a preferred professional journal.	27	7	Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	
4.5	-Presentation of results at a scientific meeting.	23	24	In addition, special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at the Laboratory. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.	yes	
4.5	-Collaborating with researchers from national labs, industry, or universities.	23	24	In addition, special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at the Laboratory. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.	yes	
4.5	-Sponsoring workshops or conferences around related research topics.	23	24	In addition, special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at the Laboratory. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.	yes	

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4.5	-Providing scientific and technical advice or assistance to state or local government agencies and industrial organizations.	23	24	In addition, special attention is paid to the quality and number of seminars, colloquia, workshops, and training sessions available at the Laboratory. Public calendars and daily e-mailed reminders of such events are available to all. An atmosphere that encourages exchanges between speakers and audience at such events is a recognized goal.	yes	
5	5. *INSTITUTIONAL QUALITY* MANAGEMENT PROGRAM					
5	The research institution has both customers and stakeholders. The institution should define its mission. It should establish a quality management program with goals to help achieve its mission and to ensure that it meets the needs of its customers and stakeholders. The institution should address the following elements in such a manner to help achieve these goals.			Perhaps more adequately covered in Dir Policies? Fermi National Accelerator Laboratory advances the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high energy physics and related disciplines. http://www.fnal.gov/pub/about/whatis/mission.html IQA is the QA Program PM Policy - http://www.fnal.gov/directorate/Directors_Policy/project_management.shtml Pg 4 line 25 of QAGfSR references Dir Policies	yes	There is reference to the Director Policies in the QAGfSR and the Fermilab "mission", but not the mission statement

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5.1	5.1 Planning					
5.1	Within the context of the institution's defined research mission, the institution should					
5.1	-Identify the institution's customers and stakeholders and identify their needs and expectations.			All research at Fermilab complies with the policies and guidelines established by the Director	yes to maybe	The Dir Policies specify adherence to DOE Orders... One might say that by following 226 and PEMP and the DOE-FRA contract we are following the customer needs and expectations. The QAGfSR does not specify any of these other documents While Fermilab follows the "Work Smart" as expected standards, perhaps the QAGfSR should directly reference laboratory's mission,/vision & all director's policies and also reference the applicable DOE Orders and standards (many DOE Orderes and standards, if not all, are listed in the References section)
5.1	-Translate the customers' and stakeholders' needs into the language of the institution.				no	OK, this is one interpretation - the PEMP provides what the customer is looking for
5.1	-Define internal and external organizational interfaces.	12		Figures 1 through 4 show organizational relationships	yes	
5.1	-Adopt a strategic planning process that defines critical success factors for the achievement of the organization's mission and incorporates the principles of continuous improvement.	27	1	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results	yes	

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5.1	-Establish quantitative units of measurement so that the institution's success in meeting customers' and stakeholders' needs can be monitored.	27	1	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff.	yes	
5.1	-Develop methods to ensure that the results of the measurements are used as the basis for management decisions and improvement.	27	1	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results	yes to maybe	There appears to be no evidence that metrics are to be used for management decisions

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5.2	5.2 Leadership					
5.2	Managers at all levels should exemplify personal commitment to (and involvement in) creating and sustaining an organizational vision, a mission, customer focus, and quality values. Managers should demonstrate their commitment by devoting significant time and resources to these activities.	21	17	The tradition of Fermilab's scientific managers is to remain active in the research endeavor as part of their employment. Promotion opportunities are enhanced at the Laboratory for those who do so with success. As such, managers are sensitive to the needs of younger staff members to participate actively in research, and mentor their doing so with success. The continuing participation in research also enhances the managerial focus on the research goals of the scientific programs.	yes to maybe	
5.2	Managers are responsible to ensure that the organization's vision, mission, customer focus, and quality values are	9	9	These leaders are the primary contact between the Laboratory and the research, and these leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. This latter function is essential for determining, assuring, and improving the quality of the research	yes to maybe	Perhaps more may be here, Did not see evidence of definitive statement for: vision, mission, and customer focus, but there is the quality values ...
5.2	-translated into policies and practices for line managers, supervisors, and other personnel.	9	9	These leaders are the primary contact between the Laboratory and the research, and these leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. This latter function is essential for determining, assuring, and improving the quality of the research Aspects of these responsibilities may be delegated as appropriate to facilitate effectiveness and communication.	yes	

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5.2	-widely communicated to (and easily understood by) all personnel.	9	9	These leaders are the primary contact between the Laboratory and the research, and these leaders have responsibility for the quality of the research, the safety of people and equipment in the research, as well as for reporting on the progress, status, and any relevant issues involving the research. This latter function is essential for determining, assuring, and improving the quality of the research Aspects of these responsibilities may be delegated as appropriate to facilitate effectiveness and communication.	yes	Presumably understood...
5.3	5.3 Support for the performance of research					Given - did not look for any additional evidence here
5.3	5.3.1 Human Resources					
5.3	The institution should					
5.3	-Provide resources so that appropriate management and technical training are available.	27	16	Training for quality assurance in research is a built-in part of the scientific process, with students learning from mentors and researchers regularly needing to present and defend their work internally to their collaborators and externally to the larger community. In addition, scientists are constantly participating in workshops, seminars, and physics studies and going to various schools and technology training to keep current.	yes	

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section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.3	-Ensure that personnel with appropriate education, experience, and skills are hired.	22	8	Individual scientists receive informal training as a part of doing research at the Laboratory and collaborating with other scientists and engineers. Informal training also occurs as part of the research environment at the Laboratory. The typical degree of earlier training of the laboratory scientists who have responsibility for directing or participating in research is generally a Ph.D., 6 years of postdoctoral experience, and a graded sequence of assignments at the lab. A similar profile exists for university researchers as they advance through a series of experiments. In addition, the Laboratory maintains formal training databases for staff and users. These take the form of interconnected Individual Training Needs Assessment (ITNA) and the Laboratory's ES&H Training Database known as TRAIN.	yes	
5.3	-Define roles, responsibility, and authority for support staff.	15	8	These documents (whether a simple e-mail for the smallest efforts, full-blown proposals to the Director, or anything in between) include the goals of the research; information on roles and responsibilities anticipated for the research;	yes to maybe	This is not specifically mentioned for staff
5.3	-Ensure that support and technical personnel with necessary education, experience, and skills are appropriately assigned.	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff.	yes	

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
		22	8	Individual scientists receive informal training as a part of doing research at the Laboratory and collaborating with other scientists and engineers. Informal training also occurs as part of the research environment at the Laboratory. The typical degree of earlier training of the laboratory scientists who have responsibility for directing or participating in research is generally a Ph.D., 6 years of postdoctoral experience, and a graded sequence of assignments at the lab. A similar profile exists for university researchers as they advance through a series of experiments.	yes	
5.3	5.3.2 Material Resources					
5.3	To the extent that the risk associated with its research warrants, the institution should					
5.3	-Ensure that sound engineering/scientific principles are applied to the design and construction of research facilities, and ensure that the design of fabricated research facilities and apparatus is appropriately documented.	23	13	The methods of ensuring that sound engineering/scientific principles are applied to the design and construction of research facilities and to the design of supporting computing and networking are covered in the main IQA document.	yes	
5.3	-Ensure that sound engineering/scientific principles are applied to the design of supporting computer software, and ensure that such software is appropriately documented.	23	13	The methods of ensuring that sound engineering/scientific principles are applied to the design and construction of research facilities and to the design of supporting computing and networking are covered in the main IQA document.	yes	
5.3	-Ensure that procured items and services of required quality are provided to the researcher and support staff.				no	No supportive evidence was found in the QAGfSR. But this is an area where everybody knows, or learns quickly learns, what purchasing procedures must be followed. So the question is, should the QAGfSR remind the SR community that the specification and acceptance criteria of a purchased item are the responsibility of the requestor.

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.3	-Provide an institutional system for the safe storage and retrieval of research records.	18 24	10 12	As part of preparations for these reviews, statistics are accumulated about the numbers of publications and the numbers of citations for each publication using the facilities of public archival services, some of which the Laboratory contributes directly to maintaining. The Laboratory maintains document repository services through its Publications Office, Archives, and Documents Control Policy.	yes	

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.3	-Provide institutional services to help the researcher and support staff identify and minimize uncertainties associated with measurements.			Specific procedures for much of the experimental program are documented in the Fermilab "Procedures for Experimenters (PFX)," available on the web at http://www.fnal.gov/directorate/documents/	maybe to no	Perhaps more "maybe." No supportive evidence was found in the QAGfSR during reading or using the search strings - "measur" or "minimiz", but there are institutional services to help the researcher more fully covered in the PFX. And, QAGfSR mentions there are specific procedures documented in the Fermilab PFX. Technical Division Support Machine Shops - Experimenters who need the services of a machine shop can call on two large shops, the Village Machine Shop and the Wilson Hall Shop, and 10 smaller satellite shops located throughout the site, all operated by the Technical Division. The satellite shops, each staffed by a machinist, contain some equipment that qualified nonmachinists can use. [more...] Product Testing and Measurement - Do you need to evaluate conformity of manufactured products to dimensional and material specifications? The Quality Control Group of the Technical Division has an array of test and measurement systems for this purpose, including computer-controlled 3-D coordinate measurement machines, capable of making almost any conceivable mechanical or optical measurement. [more...] Materials Testing - When it comes to special

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.3	-Provide systems such as analytical or inspection services to assist researchers in verifying characteristics of items that are important to research results.			Specific procedures for much of the experimental program are documented in the Fermilab "Procedures for Experimenters (PFX)," available on the web at http://www.fnal.gov/directorate/documents/	maybe to no	Perhaps more "maybe." No supportive evidence was found in the QAGfSR, but there are services to assist the researcher more fully covered in the PFX. And, QAGfSR mentions there are specific procedures documented in the Fermilab PFX. Technical Division Support Machine Shops - Experimenters who need the services of a machine shop can call on two large shops, the Village Machine Shop and the Wilson Hall Shop, and 10 smaller satellite shops located throughout the site, all operated by the Technical Division. The satellite shops, each staffed by a machinist, contain some equipment that qualified nonmachinists can use. [more...] Product Testing and Measurement - Do you need to evaluate conformity of manufactured products to dimensional and material specifications? The Quality Control Group of the Technical Division has an array of test and measurement systems for this purpose, including computer-controlled 3-D coordinate measurement machines, capable of making almost any conceivable mechanical or optical measurement. [more...] Materials Testing - When it comes to special materials--polymer composites and adhesives,
5.3	5.3.3 Research Environment					
5.3	The institution should evaluate the distribution of administrative tasks and aggressively minimize unnecessary burdens. In doing so, the institution should				maybe to no	Might be in PFX, and while it seems like Fermilab does this, no evidence was found in the QAGfSR
5.3	-Provide an environment for research that fosters creativity and intellectual stimulation and encourages innovation and collaboration.				maybe to no	Might be in PFX, and while it seems like Fermilab does this, no evidence was found in the QAGfSR, but this is what original research is all about

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.3	-Provide an atmosphere where good work practices are recognized as the only acceptable way of performing and supporting research.				maybe to no	Might be in PFX, and while it seems like Fermilab does this, no evidence was found in the QAGfSR, but this is what original research is all about
5.3	-Support worker empowerment and foster a "no-fault" attitude for identification and correction of quality problems.				no	No evidence could be found to support this statement
5.3	-Encourage ethical conduct of research.	23	13	The methods of ensuring that sound engineering/scientific principles are applied to the design and construction of research facilities and to the design of supporting computing and networking are covered in the main IQA document. 2.3.2. Research Environment The research environment is maintained as part of the Director's Policy. Specific policies on human rights, nondiscrimination, and anti-harassment (http://www.fnal.gov/pub/news03/humanrightspolicy.html) exists, in addition to policies on quality assurance, community outreach, training, assessments, code of conduct, and other matters that affect the research environment.	yes	
5.4	5.4 Assessment					
5.4	5.4.1 Research Reviews					
5.4	Reviews of research quality should be supported by the institution, either through internal reviews or by providing for independent external reviews.	24	21	Reviews of research quality are held regularly and ad hoc, both by internal reviews (e.g., via Director's Reviews and those organized within Divisions/Sections/Centers) and by external reviews (e.g., by the FRA, DOE, NSF, PAC, and AAC).	yes	

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.4	5.4.2 Support Activities					
5.4	Assessment of facility and support service adequacy should be performed by the institution's managers and internal customers. The goal of these assessments should be to determine if the institution's infrastructure is adequately supporting its customers.	24	8	Users Executive Committee is concerned with the research and more general environment at the Laboratory. The Laboratory management meets as requested with this group, and responds to suggestions and concerns expressed	yes	
		18	2	Indications of the quality of scientific research include: • Peer review of individual projects by committees, referees, peer reactions to seminars and conference talks • Assessment of impact by citation counts; e.g., using the SPIRES database, counts and prestige of awards and recognition, etc. • Overall assessment of group quality by agency reviews; e.g., Triennial DOE reviews • Performance in job market and recruitment.		

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
		24	15	In scientific research where the collection of data occurs, the quality of that data is continuously monitored as it taken. This quality assurance is typically built into the data acquisition process itself, with follow-up monitoring in near-real time and later off-line analysis, separate from the research-goal analysis itself. Reviews of research quality are held regularly and ad hoc, both by internal reviews (e.g., via Director's Reviews and those organized within Divisions/Sections/Centers) and by external reviews (e.g., by the FRA, DOE, NSF, PAC, and AAC). Assessments have also been accomplished via surveys by the Users Organization, American Physical Society, and individual Divisions and Sections.		

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.4	5.4.3 Management Activities					
5.4	Assessment of managers' support for research should be requested of the institution's customers and appropriate stakeholders.	24	15	In scientific research where the collection of data occurs, the quality of that data is continuously monitored as it taken. This quality assurance is typically built into the data acquisition process itself, with follow-up monitoring in near-real time and later off-line analysis, separate from the research-goal analysis itself. Reviews of research quality are held regularly and ad hoc, both by internal reviews (e.g., via Director's Reviews and those organized within Divisions/Sections/Centers) and by external reviews (e.g., by the FRA, DOE, NSF, PAC, and AAC). Assessments have also been accomplished via surveys by the Users Organization, American Physical Society, and individual Divisions and Sections.	yes	
5.4	5.4.4 Personnel Performance					
5.4	Managers at all levels should evaluate personnel capabilities and performance so that improvements can be made.	25	1	Annual assessments of the performance of Fermilab staff members are part of the standard procedure at the Laboratory. This process includes annual goal setting, self-assessment of achievements, and review by supervisors. These assessments directly affect the salary of staff members	yes	

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.4	5.4.5 Data Utilization					
5.4	The results of assessments should be used as the basis for management decisions and improvements.	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff.	yes	Evidence provided seems to be short of stating the assessment results are used to make management decisions and improvements
5.5	5.5 Quality improvement					
5.5	5.5.1 Principles					
5.5	Managers should create a research atmosphere that stimulates and fosters creativity. Improvement efforts should be directed toward continuously seeking opportunities for improvement rather than waiting for a problem to reveal opportunities.	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.5	5.5.2 Quality Improvement Goals	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.5	The strategic quality improvement goals established by the institution in Section 5 should be implemented throughout the organization. These goals	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.5	-Should be clearly integrated with the overall technical and business goals of the research organization.	27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.	yes	
5.5	-Should provide focus for increasing effectiveness.	24	2	As noted above, the Laboratory staff engages directly in the research effort at the Laboratory. In this way, awareness of the research environment is known directly by the Laboratory, and discussion and efforts are continuous on maintaining the strengths of the research environment and increasing its effectiveness.	yes to maybe	While effectiveness was discussed within 24:2 the evidence does not appear to be specifically addressing improvement goals

Appendix B1 - Comparison of QAGfSR with Z1

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
5.5	-Should be communicated to and understood by everyone.	19	4	While archival publication of research results remains the primary record of research, additional transfer of the results occurs in multiple forums. Relevant regular and one-time conferences and workshops are keen on hearing the results of Fermilab research. Some of these meetings are sponsored by Fermilab, but all such relevant meetings include major presentations of Fermilab-based research results in their programs, both as invited presentations and by accepting submitted papers, etc. Assurance of this broad dissemination of the results of research is aided by the participation of Fermilab staff members and users as conveners and on the organizing and/or international advisory committees of nearly all major conferences.	yes	

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
		27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff. Given the competitiveness of the research environment, no additional mechanisms are needed for the goal of making the most of the data in terms of scientific results and impact. Nevertheless, quality improvement is enhanced by the processes of providing local forums for presentations of results (e.g., seminars and weekly All Experimenters' Meetings), publicity for major achievements through the Office of Communication, and the active involvement in the nomination and selection processes for national and international awards, and presenters at conferences and workshops.		
5.5	-Should be defined and progress measured.	18	17	The external advisory committees (PAC and AAC) are regularly apprised of the progress of the research at the Laboratory and the results of research performed at Fermilab. For major research efforts, these committees may have recommended approval of the research in the first place, and they monitor the results in the context of the original goals for which the research was approved.	yes	

section	ANSI/ASQ Z1.13	Page	Line	QA_Guidelines_for Scientific_Research	Comply?	Team Comments
		27	2	Quality improvement goals for individual performance are established pro-actively as part of the goal setting and annual performance assessment processes. Where possible, these goals are meant to be measurable. The line supervision responsible for the Annual Performance Review is responsible for assuring that there is appropriate mentoring of researchers and support staff.		
5.5	-Should be regularly reviewed and should reflect changing customer expectations.	21	2	In planning the Laboratory program, in addition to the various Laboratory advisory committees that review the research, the Laboratory obtains input from the funding agencies and the user community. From the agencies, this input comes directly from frequent and regular communication, and as an output of agency reviews. From the users of the facilities, the Laboratory obtains input from individual contacts with colleagues, and more formally through the Users Organization and its Users Executive Committee (UEC). The UEC is supported by the Fermi Research Alliance, the contractor-operator of Fermilab. The UEC meets monthly, and meetings include direct discussions with Laboratory management. The UEC also organizes an annual users meeting, which further enhances the input from these stakeholders.	yes	
5.5	5.5.3 Training					
5.5	All members of the organization should receive, training in the principles of quality improvement.	22	15	Laboratory maintains formal training databases for staff and users. These take the form of interconnected Individual Training Needs Assessment (ITNA) and the Laboratory's ES&H Training Database known as TRAIN.	yes	

Appendix B2 - QA Controls Evidence in Scientific Research

This section substantiates the observations[4] obtained for each of the five scientific research processes during the SR As-Is assessment. The observations are correlated with the QA Lines-of-Inquiry questions and provide references to the documentation or comments from the process owners (interviewees).

Each of the numbered items, below, in this section represents the corresponding Lines-of-Inquiry questions, which are found in the section, "Lines-of-Inquiry - Quality Assurance Guidelines for Scientific Research." For example, "1" contains the observations and substantiating information for the question, "Is knowledge, information, data, or proof of concept the output of the research project, i.e. is it about Science?"

As mentioned previously, the emphasis of the SR As-Is assessment was limited to determining the current state of existence of controls complying with criteria from the respective governing documents, the As-Is state, rather than on the evaluation of the effectiveness and efficiency of the controls. Areas observed to have satisfactory controls for criteria show a response of "Yes - the criteria is satisfied", have the referenced supporting document(s)/ comment(s), and may or may not have supporting discussion in the "COMMENTS".

While the QA Sub-Team also attempted to identify controls that are considered as "best practices", it is most important to identify areas that need improvement. Thus if the control is non-existent or requires improvement, a gap exists and improvement is necessary. Those criteria identified having little supporting evidence are further elaborated upon in the COMMENTS section and are the focus of this report.

[4] The QA Sub-Team for Science appreciates efforts taken by individuals from the scientific research community to identify, acquire, deliver, review and provide documents and informative discussions in our efforts to conduct this assessment.

EXPERIMENTS AT D0

The following are the objective observations, corresponding to the respective QA Lines-of-Inquiry questions, obtained for the Experiments at D0 during the SR As-Is.

1. Yes - the criteria is satisfied
   - Documents used:
     - Proposal for a Forward detector for the D0 Area (Fermilab Proposal # 0709)
     - Run 1 DZero Proposal #740.
     - Run IIb Upgrade Technical design Report, Part 1 Physics Goals. (FNAL Pub# 02/327-E)
     - Physics with the D0 Upgrade; http://www-d0.fnal.gov/hardware/upgrade/pac0495/physics_toc.html
     - SUPPORTING INFORMATION:
       i. "There is broad agreement within the experimental and theoretical high-energy physics communities that the most pressing issue facing particle physics is the search for the origin of mass. More specifically, we seek to understand the mechanism by which the W and Z particles that mediate the weak force gain mass, while the photon, which has the same couplings to matter, remains massless. In the Standard Model of particle interactions, this electroweak symmetry breaking occurs through interactions with a so far unobserved particle, called the Higgs boson. Furthermore, within the Standard Model framework, the Higgs particle is responsible for the masses of all the known particles."
       ii. "Searching for the Higgs has become the highest priority in the High Energy Physics community, not only because it is the last undiscovered particle of the Standard Model, but also because its unique role within the Standard Model provides a window that may help us understand the new physics that must be present at higher mass scales."
2. Yes - the criteria is satisfied
   - Documents used:
     - D0 Management Plan (http://d0server1.fnal.gov/projects/spokes/documents/d0_manage_sept97.html
     - D0 Memorandum of Understanding (http://d0server1.fnal.gov/projects/run2b/Meetings/DOEReviews/EIR_Nov02/D0_Run2b_Multi-Year_MOU_v2.pdf)
     - SUPPORTING INFORMATION:
       i. "The scope of the Run IIb Upgrade is that set out in the Work Breakdown Structure (WBS) for the project and, upon having received approval, the baseline set of deliverables as determined by the Department of Energy. The project management infrastructure (D0 Run IIb Project Office) resides at Fermilab, and the responsibility for D0 Run IIb project management resides in the D0 Run IIb Project Manager (PM). The PM reports to the Fermilab Associate Director for Research, in part through regular

meetings of the Project Management Group (PMG). The D0 Run IIb PM has appointed WBS Level 2 (L2) subproject managers who are responsible to him for specific subsystems of the D0 Run IIb Upgrade Project."

ii. The prominent management structures currently in place are:
   1. Run II physics analysis
   2. Analysis groups emphasizing certain physics areas are defined and each group is lead by two conveners. The overall coordination of the physics analysis efforts is the responsibility of the Physics Coordinator. The term of the conveners and the Coordinator are two years. The Coordinator is appointed by the Spokespersons. The conveners are appointed by the Spokespersons in consultation with the Physics Coordinator.
   3. Run II detector = Upgrade Project
   4. Run II Software

3. Yes - the criteria is satisfied
   - Documents used
     - The web page link is a section has pointers to the overview documentation for the D0 Upgrade, including PAC reports, Reports from the DOE review panel (Lehman Committee), as well as pointers to internal reports and workshop proceedings.
       http://www-d0.fnal.gov/hardware/upgrade/upgrade.html#Documents
     - SUPPORTING INFORMATION:
       i. PAC Letters
       ii. PAC Report on Physics with the D0 Upgrade
       iii. Final Lehman Report

4a. Yes - the criteria is satisfied
   - Documents used
     - D0 Management Plan
     - D0 Memorandum of Understanding
     - SUPPORTING INFORMATION:
       i. The management structure proposed for the future is outlined in the following sections. The current structure which has been in existence for a long time and which is independent of the phase of D0 (taking data, building etc) is the institutional board and the spokesperson(s). In addition to this there are committees and groups whose importance and relevance depend more on current priorities in D0.
     - COMMENT:
       The TDR and PMP indicate that the D0 collaboration via the spokesperson will be the primary investigators and the Lehman review process indicates that DOE is the customer.

4b. Yes - the criteria is satisfied
   - Documents used
     - Proposal for a Forward detector for the D0 Area (Fermilab Proposal # 0709)
     - Run 1 DZero Proposal #740.

- Run IIb Upgrade Technical design Report, Part 1 Physics Goals. (FNAL Pub# 02/327-E)
- SUPPORTING INFORMATION:
  i. Follow link to TDR. "There is broad agreement within the experimental and theoretical high-energy physics communities that the most pressing issues facing particle physics is the search for the origin of mass. More specifically, we seek to understand the mechanism by which the W and Z particles that mediate the weak force gain mass, while the photon, which has the same couplings to matter, remains massless. In the Standard Model of particle interactions, this electroweak symmetry breaking occurs through interactions with a so far unobserved particle, called the Higgs boson. Furthermore, within the Standard Model framework, the Higgs particle is responsible for the masses of all the known particles. Searching for the Higgs has become the highest priority in the High Energy Physics community, not only because it is the last undiscovered particle of the Standard Model, but also because its unique role within the Standard Model provides a window that may help us understand the new physics that must be present at higher mass scales. The Tevatron Collider at Fermilab is currently the only facility in the world capable of making a Higgs discovery. Simulation studies have shown that the two Tevatron Collider experiments, CDF and DØ, are sensitive to the Higgs over almost all of its presently allowed mass range. Our goal is to accumulate sufficient data to make a sensitive search for the Higgs that will have a high probability of success if the Standard Model predictions are correct."
  ii. COMMENT : Also covered in TDR Chapters 3.5.2, 3.5.3, 3.6, 9.8 & 10

4c. Yes - the criteria is satisfied

- Documents used
  - Web link has detailed schedules with milestones. (http://d0server1.fnal.gov/Projects/UpgradeProject/Current_Web_Schedule/Index.htm)
  - Magnetic tracking sub-project (http://lss.fnal.gov/archive/test-proposal/0000/fermilab-proposal-0823.pdf)
  - SUPPORTING INFORMATION:
    i. Fermilab Proposal 0823 includes sections for cost and scheduling with conclusions showing how the upgrade affects the science.

4d. Yes - the criteria is satisfied

- Documents used
  - Proposal for a Forward detector for the D0 Area (Fermilab Proposal # 0709)
  - D0 MOU
  - Run IIb Upgrade Technical design Report, Part 1 Physics Goals (FNAL Pub# 02/327-E)
  - SUPPORTING INFORMATION:
    i. Chapter 5 of the MOU Identifies Fermilab Effort, services and Facilities (NOTE: The format of these documents do not allow for cutting and pasting of text into this document.)

4e. Yes - the criteria is satisfied

- Documents used
  - Physics with the D0 upgrade.
  - This web page shows that there are separate groups that are doing data quality analysis full time. It also lists contact information. (http://www-d0.fnal.gov/computing/data_quality)
  - SUPPORTING INFORMATION:
    i. "In this report we have described the upgrade to the D0 detector for Tevatron Run II, and outlined some of the physics which we intend to pursue. During this period, the Tevatron will be the highest energy accelerator available and will yield unsurpassed luminosity. We believe that the upgrade project satisfies the requirements of maintaining the excellent performance of the D0 detector while significantly improving its capabilities in the areas of b-tagging, and muon and electron identification and measurement. The result will be a versatile, general purpose detector, well-matched to the accelerator environment and to the physics requirements of Run II, with particular strengths complementary to those of CDF. We expect the upgraded D0 detector to play a leading role in carrying high energy physics into the twenty-first century."
    ii. From MOU - "The Tevatron Collider at Fermilab is currently the only facility in the world capable of making a Higgs discovery. Simulation studies have shown that the two Tevatron Collider experiments, CDF and DØ, are sensitive to the Higgs over almost all of its presently allowed mass range. Our goal is to accumulate sufficient data to make a sensitive search for the Higgs that will have a high probability of success if the Standard Model predictions are correct."

4f. Yes - the criteria is satisfied

- Documents used
  - Web page shows chart of how this is organized. (http://www-d0.fnal.gov/computing/data_quality/#detcontacts)
  - SUPPORTING INFORMATION:
    i. Most of the methods for doing searches of documented data are done using software tools. The links are to these tools. Data Certification, Monitoring, Data Quality Checker are some of the activities done.

4g Yes - the criteria is satisfied

- Documents used
  - D0 management Plan Appendix III: Guidelines for Publications
  - SUPPORTING INFORMATION:
    i. "The EB is charged with approving an analysis. Approval means that the results can be shown in talks at seminars and conferences, and can be shared with physicists outside the collaboration. The EB can define subsets of results related to an analysis for approval, with other aspects reserved for more work and later approval. For each such approval, there must be a Physics Note available which gives the details of the analysis in sufficient detail that a member of the collaboration can be expected to understand the results. The EB is also charged with approval of draft publications before circulation to the collaboration for review, after the collaboration review,

and after comments are received from the journal referees and have been incorporated by the author(s)." NOTE: There are seven steps spelled out in the guideline.

5. Yes - the criteria is satisfied
   - Documents used
     - D0 Management Plan
     - See Womersley document from Dennis Kovar that shows that a science review was done. (http://indico.fnal.gov/getFile.py/access?resId=0&materialId=12&confId=1810) Document presented to the PAC April 17, 1995
     - Magnetic tracking sub-project proposal (http://lss.fnal.gov/archive/test-proposal/0000/fermilab-proposal-0823.pdf)
     - Information presented at the PAC meeting. Physics with the D0 Upgrade. (http://www-d0.fnal.gov/hardware/upgrade/pac0495/physics_intro.html)
     - SUPPORTING INFORMATION:
       i. "At any time there are a number of aspects of D0 which require an explicit management structure. These are time dependent structures. When we were taking data, it was important to have a leadership of the operational aspects of the experiment. This is no longer needed and has been de facto retired. The Trigger Certification Board was an important part of our operation, this is now retired. For some time before and after the start of data taking it was important to emphasize the groups working on Object ID (jets, electrons, muons). Until 1990 there was no D0 Upgrade and there were neither Upgrade Project nor Upgrade Software Groups. These currently constitute very important aspects of the D0 Experiment."
       ii. The responsibility for the creation and modification of these management structures lies with the Spokespersons.
       iii. The responsibility for appointments to the leadership in such areas is the responsibility of the spokespersons.
       iv. The prominent management structures currently in place are:
           5. Run I physics analysis
           6. Analysis groups emphasizing certain physics areas are defined and each group is lead by two conveners. The overall coordination of the physics analysis efforts is the responsibility of the Physics Coordinator. The term of the conveners and the Coordinator are two years. The Coordinator is appointed by the Spokespersons. The conveners are appointed by the Spokespersons in consultation with the Physics Coordinator.
           7. Run II detector = Upgrade Project
           8. Run II Software
           9. D0 after run II: D033
              a. It is expected that advice on the existence and leadership of such structures will be solicited from a broad base including the D0 Advisory Council.
              b. It is expected that the Spokespersons will interact actively in the management of all aspects of the experiment and will

ensure adequate discussions at all levels concerning major directions and decisions.

c. The D0 Upgrade Project is defined within Fermilab as well as within D0. The relative roles resulting from the need to ensure a line of fiscal responsibility is delineated in the Do Upgrade Project Management Plan. At the time of creation, the Spokespersons solicited input from the Collaboration to be used in their discussions with Fermilab. In case of substantial modification further input from the Collaboration will be solicited.

6. Yes - the criteria is satisfied
   - Documents used
     - D0 Management Plan
     - D0 organization Chart (http://www-ppd.fnal.gov/DivOffice/Org_Charts/dzero.pdf
     - SUPPORTING INFORMATION:
       i. Refer to organizational chart/
7. Yes - the criteria is satisfied
   - Documents used
     - D0 follows Fermilab requirements for hiring.
     - The management plan adds additional requirements for collaboration positions.
     - The Quality of Data is overseen by several working groups. The following link will allow a reviewer to connect to those groups. (http://www-d0.fnal.gov/computing)
     - Have sample ITNA
     - SUPPORTING INFORMATION:
       i. D0 uses various document databases and online software to manage documents and records. Example is the electronic log.
8. Yes - the criteria is satisfied
   - Documents used
     - FRA Code of Business Ethics and Conduct Program
     - D0 Management Plan
     - Directors Policy 37
     - SUPPORTING INFORMATION:
       i. Director's Policy No. 37.000 Rev. 0 - Code of Conduct
          2.0 - Effective Date 12/15/09
          3.0 - Scope - This policy covers all business relationships at Fermilab
          4.0 - Applicability - All Fermilab Employees
          5.0 - Policy - "Fermi Research Alliance, LLC, (FRA) requires that all employees conduct themselves with the highest standards of integrity, honesty and fair dealings to preclude either an actual conflict or the appearance of conflict between FRA's performance, including its contractual obligations to DOE, and the personal interest of individual employees."
       ii. Ethics Program - FRA CODE OF BUSINESS ETHICS AND CONDUCT PROGRAM - "All FRA employees, officers, directors, managers, and

agents, are required to comply with these standards, together with applicable local, state, and federal laws and any applicable grant and contractual requirements. As an FRA employee, any actions that you take in the course of your day-to-day activities and in relationships with customers, suppliers, contractors, and others is expected to be fully justifiable and not to be a cause for concern, or bring unfavorable publicity or embarrassment to FRA if disclosed. These standards apply to your conduct both on and off the job. You are expected to avoid unethical actions and/or Conflicts of Interest (both actual and the appearance of a Conflict), as well as report any Conflicts."

- COMMENT:
  i. We did not observed a specific research code of conduct - but did find the Dir Policy & FRA Ethics Program

9. Yes - the criteria is satisfied
   - Documents used
     - D0 Management plan- Chapter 7 - (http://d0server1.fnal.gov/projects/spokes/documents/d0_manage_sept97.html#top_docu)
     - Procedures for researchers - PFX - (http://www.fnal.gov/directorate/PFX/PFX.pdf)
     - SUPPORTING INFORMATION:
       i. "An important aspect of the management of a scientific collaboration, indeed of the scientific process in general, is the ability and need to subject ourselves to critical peer review. The use of review committees both ad hoc and standing is highly desirable. Such review committees or boards will be formed when needed and go out existence when their task is completed. Examples of these are editorial boards or subject/detector specific review committees. However there are some other committees which are permanent, but whose membership varies with time. At present these committees are:"
10. Yes - the criteria is satisfied
    - Documents used
      - Calibrations between shots to assure good data from working hardware. See entries from electronic log book the link is (http://www-d0online.fnal.gov/crlw/Index.jsp?inquiry=CRLWindex)
      - This is done annually and reported in technical memos. (http://lss.fnal.gov/archive/test-tm/2000/fermilab-tm-2453-di.pdf)
      - SUPPORTING INFORMATION:
        i. Charts on data taking efficiency, luminosity and downtime.
      - COMMENT:
        i. From experimental operations report; Given the smooth and efficient operation of the DZero detector, the collaboration is well positioned to take full advantage of increasing luminosity and to continue its multifaceted exploration of the high-energy physics frontier.
11. Yes - the criteria is satisfied
    - Documents used

- Fermilab requires personnel to have annual performance evaluations.
- Directors policy 22 for Scientific appointments
- D0 management Plan
- SUPPORTING INFORMATION:
  i. Copies of training plans are available
  ii. Peer review process of publications

12. Yes - the criteria is satisfied
- Documents used
  - Proposal - 0709 For detector at D0 uses previously developed detector technology. (http://lss.fnal.gov/archive/test-proposal/0000/fermilab-proposal-0709.pdf)
  - Weekly operations meetings
  - SUPPORTING INFORMATION:
    i. See page 10 of proposal 0709 for lessons learned at CDF and CERN

13. Yes - the criteria is satisfied
- Documents used
  - Online and offline monitoring of data by shifters. (http://www-d0.fnal.gov/computing/data_quality/) and (http://d0dbweb.fnal.gov/qualitygrabber/qualQueries.html)
  - SUPPORTING INFORMATION:
    i. The referenced web pages are daily reports and tools used to improve quality. Problems are openly discussed at collaboration meetings and solutions planned.
    ii. Example of Technical problem from monthly report.
      a. Areas of excess noise in the 90-degree ladders were related to faults in the detector lithography causing shorts between the n-implant and the p-stop. All detectors in hand are being inspected for this flaw. Micron Semiconductor has promised not to ship detectors with this problem in the future.
      b. There is a few-percent failure rate for n-side capacitors at final bias voltage. We are working to understand the final testing and burn-in specifications based on our experience with the first 30-40 ladders. Initial tests with the full readout system including the low-mass cable showed a narrow operating voltage range. This was cured by changes in termination and signal timing.

14. Yes - the criteria is satisfied
- Documents used
  - Bi-weekly data quality meetings and Offline Run Quality database.
  - Do home page with links to general information (http://www-d0.fnal.gov/atwork/index.html)
  - These web pages are a list of things that are being done to communicate QA and promote improvement.
    http://www-d0.fnal.gov/computing/data_quality/
    http://d0dbweb.fnal.gov/qualitygrabber/qualQueries.html
  - SUPPORTING INFORMATION:
    i. DØ Calendar

ii. DØ Agenda Server
iii. Agenda Server Overview
iv. Daily Meetings
v. Meeting Rooms
vi. DØ News
vii. DØ Notes
viii. DØ Wiki
ix. All DØ meeting
x. Speakers Bureau
xi. Institutional Board
xii. Advisory Council
xiii. All Experimenters' Meeting
xiv. DØ Requisitions
xv. Internal Docs
xvi. Video Conferencing
xvii. University of DØ

15. Yes - the criteria is satisfied
    - Documents used
        - ITNA
        - SUPPORTING INFORMATION:
            i. Copies of ITNAS are available on line for George Ginther
16. Yes - the criteria is satisfied
    - Documents used
        - D0 Management Plan (http://d0server1.fnal.gov/projects/spokes/documents/d0_manage_sept97.html
        - D0 Memorandum of Understanding (http://d0server1.fnal.gov/projects/run2b/Meetings/DOEReviews/EIR_Nov02/D0_Run2b_Multi-Year_MOU_v2.pdf)
        - The experiment had a Lehman Review for CD-0. That review requires a project management plan.
        - SUPPORTING INFORMATION:
            i. "This Memorandum of Understanding describes the long-term contributions of <Institution> to the design, construction, and commissioning of the D0 Run IIb Upgrade. It is understood that these contributions of <Institution> may later be modified or that additional responsibilities may be added."
            ii. "The scope of the Run IIb Upgrade Project is that set out in the Work Breakdown Structure (WBS) for the project and, upon having received approval, the baseline set of deliverables as determined by the Department of Energy. The project management infrastructure (D0 Run IIb Project Office) resides at Fermilab, and the responsibility for D0 Run IIb project management resides in the D0 Run IIb Project Manager (PM). The PM reports to the Fermilab Associate Director for Research, in part through regular meetings of the Project Management Group PMG). The D0 Run IIb PM has appointed WBS Level 2 (L2) subproject managers who are responsible to him for specific subsystems of the D0 Run IIb Upgrade Project."

17. Yes - the criteria is satisfied
    - Documents used
        - Calibrations between shots to ensure good data from working hardware. (http://www-d0online.fnal.gov/crlw/Log.jsp?viewTopic=CALMUO%2FLog)
        - SUPPORTING INFORMATION:
            i. Review of the online logbook verifies that calibrations were done.
            ii. Text file inserted:
            /mnt/www/htdocs/groups/calmuo/dq_calo_plots/CalCheckList

```
Are You In Store: YES
Store Number #: 7680
Run Number: 259655
Shifter Name: Rick Salcido
Number of Major Alarms: 0
Number Of Disabled Alarms: 12+8(muon)
White trigger 0
Matching Run Numbers:        YES
Updating: YES
METx (jets) Mean: 1.568
METx (jets) RMS: 16.25
METx (jets) Entries: 841
METx (jets) Underflow: 15
METx (jets) Overflow: 21
METy (jets) Mean: -0.8628
METy (jets) RMS: 15.28
METy (jets) Entries: 841
METy (jets) Underflow: 9
METy (jets) Overflow: 16
Noon Noise: 0
Purple Haze: 0
Coherent Noise:91
Shifter Comments:
Cal plots attached to checklist: No irregular plot
Muon plots attached to checklist: Yes
MuoExamine will be restarted: Yes
Date and Time: Tue Mar 16 13:04:32 2010
```

LATTICE QCD

The following are the objective observations, corresponding to the respective QA Lines-of-Inquiry questions, obtained for Lattice QCD during the SR As-Is.

1. Yes - the criteria is satisfied
   - Documents used
     - http://www.usqcd.org/physics.html
     - Fermilab Theoretical Particle Physics & Theoretical Astrophysics: DOE Laboratory Theory Group Review 2008 - A report of the work done by Fermilab Theory Group including that of Lattice QCD Group
     - SUPPORTING INFORMATION:
       i. Fermilab Lattice QCD group is a small group composed of not more than five individual, some of them working part-time and others being Postdocs. This group is a part of the larger Theory group. Based on the small size of the group and the nature of the research (see page 6 of QAGfSR), following documents are deemed adequate for the research program
       ii. Fermilab Lattice QCD group fulfills the objective stated in the webpage "...immediate objectives (for the Lattice QCD scientists] are to 1) calculate the effects of the strong interactions on weak interaction processes to the accuracy needed to make precise tests of the Standard Model. DOE Review document provides an overview of how the research plans is executed by the Fermilab group.
2. Yes - the criteria is satisfied
   - Documents used:
     - http://www.usqcd.org/physics.html
     - http://www.physics.arizona.edu/~doug/SCHEDULE
     - https://projects.fnal.gov/lqcd/reviews/April2010Review/
     - SUPPORTING INFORMATION:
       i. Fermilab Lattice QCD group works closely with various national and international collaborations. Each scientist is loosely associated with one or more such collaborations. There is a formal process of obtaining computing resources, mostly from USQCD collaboration with formally assigned Principal Investigators (PIs). The primary customer for this group is Office of Science (HEP & NP). Stakeholder expectations are defined in the most recent Lattice QCD Computing project proposal titled "LQCD-ext computing resources for Lattice Gauge" See LQCD project review web page:
       https://projects.fnal.gov/lqcd/reviews/April2010Review/ (restricted)
3. Yes - the criterion is satisfied
   - Documents used:
     - Fermilab Theoretical Particle Physics & Theoretical Astrophysics: DOE Laboratory Theory Group Review 2008 - A report of the work done by Fermilab Theory Group including that of Lattice QCD Group
     - http://www.usqcd.org/physics.html.

- 2008 DOE Report (Glen Crawford to Young-Kee Kim Dated 11/17/2008)
- SUPPORTING INFORMATION:
  i. In August 2008, DOE Office of High Energy Physics (OHEP) conducted a review of the entire Theory Group at Fermilab, including Lattice QCD group. As stated in the cover letter of the Review Report, "Panel members were unanimous in praising the quality, organization and focus of TP. Its efforts in collider phenomenology, perturbative and lattice QCD, and neutrino physics all have as a primary goal supporting the experimental program at Fermilab and the upcoming LHC program, and helping to shape the future DOE High Energy Physics program. The TP (Theoretical Physics) group also serves the US lattice gauge theory community by planning and housing some of the large computing facilities needed to do this research. Many panelists commented that it is important for laboratory theory groups to clearly identify unique missions and contributions to High Energy Physics that can serve to differentiate them from university groups. All panel members felt that TP had clearly distinguished itself in this regard and fully justified the research support provided for this group." DOE OHEP and Office of Nuclear Physics (ONP) also conduct annual progress reviews of the Lattice QCD computing facility project where both science performance as well as computing performance are assessed.

4a. Yes - the criteria is satisfied

- Documents used:
  - Discussion with interviewee See MILC Collaboration web site and Research Notes from Elvira Gamiz
  - SUPPORTING INFORMATION:
    i. Fermilab Lattice QCD group works closely with various national and international collaborations. Each scientist is loosely associated with one or more such collaborations. There is a formal process of obtaining computing resources, mostly from USQCD collaboration with formally assigned Principal Investigators (PIs). The primary customer for this group is Office of Science (HEP & NP). Stakeholder expectations are defined in the most recent Lattice QCD Computing project proposal titled "LQCD-ext computing resources for Lattice Gauge Senior members of the collaboration identify research work to be done and assign Principal Investigators to the project. For example, Elvira Gamiz indicated that she has been assigned to be the PI of the project "Lattice calculation of form factors for the processes K-> pi l nu: Extraction of the CKM matrix element |V_us|".

4b. Yes - the criteria is satisfied

- Documents used:
  - http://www.usqcd.org/physics.html
  - DOE Laboratory Theory Group Review 2008
  - http://physics.indiana.edu/~sg/milc.html
  - SUPPORTING INFORMATION:

i. Technical approaches to the research are often described in multiple documents associated with the research program. For example, the work done in conjunction with the Lattice QCD MILC collaboration is explained in the webpage: http://physics.indiana.edu/~sg/milc.html and page 56 to 58 of DOE Laboratory Theory Group Review 2008. Fermilab group uses the techniques for computer simulations detailed at http://www.usqcd.org/computing.html.

4c. Yes - the criteria is satisfied

- Documents used:
  - Discussion with interviewee
  - SUPPORTING INFORMATION:
    i. During the interview, Paul Mackenzie stated that schedules for Postdocs are motivation driven since they need to accomplish good work before their terms are over. Elvira Gamiz confirmed this statement.

4d. Yes - the criteria is satisfied

- Documents used:
  - Computing resources http://www.usqcd.org/computing.html
  - Discussion with interviewee
  - SUPPORTING INFORMATION:
    i. Facilities requirements for Theory group consist of adequate computing resources and office space. Lattice QCD staff members have adequate access to all Fermilab resources. Elvira is satisfied with both. Facilities requirements for Lattice QCD scientists are determined annually using a collaboration wide merit-based process managed by the USQCD scientific committees.

4e. Yes - the criteria is satisfied

- Documents used:
  - Publication outputs are available in various publication related databases, e.g. http://www-spires.fnal.gov/spires/hep/ and other scientific publication databases
  - SUPPORTING INFORMATION:
    i. Fermilab group depends on the traditional methods of performing theoretical research using accumulated tribal and collaborative knowledge of senior scientists, Postdocs and graduate students. This group also uses dedicated High Performance Computing facility at Fermilab to perform computer simulations. The method of documenting research results, although mostly automated, is informal.
    ii. One of the examples cited was the data validation procedure. The software used to create lattice QCD data is based on established software packages that are checked against the results created using earlier versions of software. These packages come with test suites to ensure that they perform correctly when installed on a new platform. New application codes are written twice, once for checking and once in a more optimized form. Version control is used to check for and recover from any bugs introduced in software upgrades. The data itself is check-summed to protect against corruption. Data is raided and backed up, and is replicated at least two separate institutions. Simple physics test are also used to

sanity check the data. For example, simple functions of the lattice gauge fields are recorded and checked on each lattice gauge configuration.

iii. Although not formally documented for the Lattice QCD program, individuals follow conventions established over many years as well as the processes described in QAGfSR (Page 17 para 3). According to both Paul and Elvira, there are various levels of internal reviews even before the work begins and a paper is written. Elvira thought that the "friendly competitor" review process is useful. Each published paper undergoes pre-publication review through Fermilab Publication office.

4f. Yes - the criteria is satisfied

- Documents used:
  - 2008 DOE Report (Glen Crawford to Young-Kee Kim Dated 11/17/2008
  - SUPPORTING INFORMATION:
    i. DOE often conducts formal assessment of the scientific work process. As stated in the 2008 DOE Report (Glen Crawford to Young-Kee Kim Dated 11/17/2008, the assessment outcome was highly satisfactory. In addition, work products of this group is often assessed by other larger collaborations, in this case MILC collaboration in an indirect manner. Citation count is very important to this group. One of Paul Mackenzie's papers is considered to be most cited papers in the field.
    ii. The method of assessment of research performance is the standard formal process of vetting within the collaboration and then submitting to peer reviewed journals. The informal process described by the senior scientist interviewed is as follows: " Publication process consists of internal and external review before calculations and after calculations. Before calculations begin, their relevance and feasibility are ascertained in discussions with experimentalists, phenomenologists, and other lattice gauge theorists. A study is made of previous work and the most important improvements are determined. When calculations begin, important algebra is performed twice by two members of the team. As analysis matures, it is presented to the whole collaboration by the leader of the analysis and the work is vetted by the entire group. The work is then written up in a draft publication which is gone over first by the collaboration. It is then circulated to colleagues at Fermilab and elsewhere for comments before submission to a journal. When it is submitted to a journal, it is also submitted to the on-line physics archive site arxiv.org to get comments from the broader community before publication. The journal then sends the article to one or more referees, who may suggest further improvements or revisions before publication."

4g Yes - the criteria is satisfied

- Documents used:
  - http://www.usqcd.org/index.html
  - Lattice 2009 Conference at Beijing : proceedings:
  - http://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=91

- SUPPORTING INFORMATION:
  i. Fermilab group shares its results at multiple annual meetings and workshops. See http://www.usqcd.org/index.html. Also see Meetings with other lattice theorists: http://rchep.pku.edu.cn/workshop/lattice09/index.xml. Information on meetings with experimentalists: http://usqcd.fnal.gov/lattice-experiment2007.html

5. Yes - the criteria is satisfied
   - Documents used:
     i. http://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=91
     ii. https://lqcd.fnal.gov/~ruthv/FNAL-MILC/FNAL-MILC_To_Do.htm
   - Discussion with interviewee
   - SUPPORTING INFORMATION:
     i. This type of research inherently depends on the continuous improvement on previous data and analysis techniques. Workshops and meetings are used to vet the data obtained analysis techniques proposed.
6. Yes - the criteria is satisfied
   - Documents used:
     - Org Chart: http://www-esh.fnal.gov/pls/default/org_chart.html?org=PD
     - QAGfSR and various Fermilab WDRS procedures are followed.
     - SUPPORTING INFORMATION:
       i. Senior scientists in this group are recognized leaders in their field. They are capable of attracting highly qualified Research Associates. The mission and vision of the funding agencies (in case of Fermilab, DOE OHEP) are also taken into account.
7. Yes - the criteria is satisfied
   - Documents used:
     - ITNA for Elvira Gamiz
     - Research Interest document for Wolfgang Altmannshofer
     - SUPPORTING INFORMATION:
       i. Researchers are responsible for their theoretical calculations. Most critical records for this group are data products. Individual researchers are responsible for their data storage in the allocated Fermi storage areas. See RA position descriptions.
8. Yes - the criteria is satisfied
   - Documents used:
     - Research Notes supplied by Elvira Gamiz
     - Notas_Ktopilnu.June.pdf (Initial presentation to the collaboration during weekly meeting)
     - Notas_Ktopilnu.Setember.pdf
     - Notas_Ktopilnu.December.pdf
     - SUPPORTING INFORMATION:
       i. According to Elvira, she feels that the research environment is one of continuous collaboration. She has access to mentors who are performing leading edge research in her field (e.g. Carlton de Tar, Steve Gottleib, Paul Mackenzie). See the discussion notes for September and December.

9. Yes - the criteria is satisfied
    - Documents used:
        - DOE Laboratory Theory Group Review 2008
        - Research Interest document
        - SUPPORTING INFORMATION:
            i. Lattice QCD group undergoes various independent reviews from DOE. When new Research associates join the group, their research interests are evaluated. See Research Interest document for Wolfgang Altmannshofer.
10. Yes - the criteria is satisfied
    - Documents used
        - http://www.usqcd.org/physics.html
        - USQCD All-Hands Meetings
        - SUPPORTING INFORMAITON:
            i. Fermilab group can access all facility and support service provided by Fermi lab. Elvira is happy with the computing resources provided to her. For her computing needs, she can ask help from the helpdesk. Helpdesk performance is continuously monitored by the LQCD project office.
11. Yes - the criteria is satisfied
    - Documents used:
        - Fermilab Performance review procedure
        - Weekly collaboration meetings
        - https://lqcd.fnal.gov/~ruthv/FNAL-MILC/FNAL-MILC_To_Do.htm
        - SUPPORTING INFORMATION:
            i. The primary assessment mechanism is the supervisor recommendations to Research Associates when they seek their next position. The annual performance evaluation mechanism is also in place. In addition, weekly meetings are another forum to get feedback.
12. Yes - the criteria is satisfied OR No Evidence OR The Response Needs Additional Clarification
    - Documents used:
        - Face-to-face MILC collaboration
        - http://www.physics.arizona.edu/~doug/SCHEDULE
        - SUPPORTING INFORMATION:
            i. There are examples of research papers detailing methods that did not work. Lessons learned from colleagues and "friendly" competition is a part of research work. Milc Collaboration (bi-annual) meetings are other methods of disseminating research lessons learned.
13. Yes - the criteria is satisfied
    - Documents used:
        - http://rchep.pku.edu.cn/workshop/lattice09/index.xml
        - http://usqcd.fnal.gov/lattice-experiment2007.html
        - SUPPORTING INFORMATION:
            i. The group seeks out new opportunities with other researchers and experimentalists in a continuous manner. See Meetings with other lattice theorists:
            http://rchep.pku.edu.cn/workshop/lattice09/index.xml

ii. Meetings with experimentalists: http://usqcd.fnal.gov/lattice-experiment2007.html

14. Yes - the criteria is satisfied
    - Documents used:
        - Publication List
        - SUPPORTING INFORMATION:
            i. Primary research goals are communicated through meeting and conferences, particularly through the annual all-hands meetings and the calls for proposals. Being a small group, most of the communications are informal.
15. Yes - the criteria is satisfied
    - Documents used:
        - ITNA for Elvira Gamiz
        - RA Job Description
        - SUPPORTING INFORMATION:
            i. All Fermilab employees are required to take the IQA course. Soon everybody will be trained. Elvira has an up-to-date ITNA which includes IQA training
16. Yes - the criteria is satisfied
    - Documents used:
        - http://www.usqcd.org/physics.html
        - SUPPORTING INFORMATION:
            i. Although the Lattice QCD Computing project supporting researchers follow the principle of project management, the Lattice QCD group does not use project management principles. Also, this group is under the umbrella of the overall Fermilab Theory Group that has charter and status update documents. Using graded approach, this is acceptable.
17. Yes - the criteria is satisfied
    - Documents used:
        - none
        - SUPPORTING INFORMATION:
            i. This group does not use any measurement and Test equipment.
        - COMMENT:
            i. Not applicable criteria

MINERvA

Documents obtained for review for the MINERvA SR As-Is assessment addressed the MINERvA project and the entire MINERvA program. The Quality Assurance Guidelines for Scientific Research specifies the focus of scientific research (the scope of this assessment) is "knowledge, information, data, or proof-of-concept." Projects focus on engineering and construction of buildings and/or prototypes components, which, while leading to the environment to conduct scientific research, are outside the focus of this assessment. As such, while all documents were reviewed for contribution by scientific processes, the influence of program documentation on the assessment of scientific research was greater than project documentation.

The following are the objective observations, corresponding to the respective QA Lines-of-Inquiry questions, obtained for the program MINERvA during the SR As-Is.

1. Yes - the criteria is satisfied
   - Documents used:
     - MINERvA_ProposalFineGrainDetector.pdf-
     - SUPPORTING INFORMATION:
       i. "MINERvA will be able to complete a physics program of high rate studies of exclusive final states in neutrino scattering, as described in Chapters 6-8, of elucidation of the connection between pQCD and QCD in non-perturbative regime, as described in Chapter 10, and of studies of the axial current in the elastic (Chapter 6), DIS (Chapter 10) and off-forward (Chapter 11) regimes, as well as inside the nucleus (Chapter 12). MINERvA then seeks the application of its data to aid present and future neutrino oscillation experiments (Chapter 13), where understanding the details of neutrino cross-sections and final states is essential for separating backgrounds to oscillation from signal. MINERvA can address all these topics, and can bring a new physics focus to the Fermilab program with a simple, low-risk detector of modest cost, as detailed in Chapters 14 and 16-17. The performance of this detector is expected to be excellent for resolving individual final states as well as measuring kinematics in inclusive reactions as documented in Chapter 15. As we submit this proposal to Fermilab, we are also preparing..."
2. Yes - the criteria is satisfied
   - Documents used:
     - While the following information might be found in other documents, the following was from discussion with David Boehnlein
     - SUPPORTING INFORMATION:
       i. Management system structure used in research in the Minerva Collaboration Program
          1. ASSESSMENTS - these are used for publications and quarterly collaboration meetings and reviews for conveners
          2. DESIGN - there are processes for experiments and analyses and software
          3. DOCUMENTS and RECORDS - the system used is DocDB

4. INSPECT and ACCEPTANCE TEST - this is conducted for online data analysis
5. TRAINING and QUALIFICATION - this is performed with ITNA, shift procedure, Mentor/Protégé, DAQ expert on call
6. PROCUREMENT - these procedures are used with University collaboration through use of MOU and Fermilab procurement system
7. PROGRAM - there are programs for the Analysis of events and types of experiments
8. QUALITY IMPROVEMENT - this is performed for software and analysis techniques and uptime improvement
9. WORK PROCESSES - these are described with shift and electronic logbook and wiki instructions

- COMMENT:
  i. David mentioned that the management system structure in more developed in the Minerva Collaboration Project.

3. Yes - the criteria is satisfied
   - Documents used:
     - Minerva Proposal Fine Grain Detector
     - There are also Quarterly Collaboration Reviews
     - SUPPORTING INFORMATION:
       i. "Portions of the project that would be, by necessity, managed and funded by Fermilab would include site outfitting and utilities (e.g., magnet and quiet power, cooling), crucial safety items for the NUMI hall that must be designed at Fermilab (e.g., low voltage distribution to the electronics, the magnet coils), and installation costs associated with bringing modules to the NUMI near hall. At the time of the submission of this proposal, we do not have complete evaluations of these costs. As discussed in Section 14.1, these costs have not been estimated. We are encouraged, however, to note that the utilities requirements of MINERvA appear to be within the capacity of the NUMI near hall, and do not appear to require major infrastructure upgrades. We expect to update this document with a good estimate of these costs by the time of oral presentation to the PAC on December 12, 2003." The above turned out not to be true and additional cooling capacity for the cavern will need to be added to service other experiments.

4a. Yes - the criteria is satisfied
   - Documents used:
     - MINERvA Collaboration By Laws
     - SUPPORTING INFORMATION:
       i. The Bylaws specify the Spokesperson and the ability to appoint any individuals to any position within the collaboration
     - COMMENT:
       i. The Project Management Plan referred to the responsibility to FRA and DOE

4b. Yes - the criteria is satisfied OR No Evidence OR The Response Needs Additional Clarification

- Documents used:
  - MINERvA_ProposalFineGrainDetector
  - SUPPORTING INFORMATION:
    i. The entire proposal is about the technical aspects of why this approach was chosen, considered alternative, expected results and potential problems…

4c. Yes - the criteria is satisfied

- Documents used:
  - MINERvA_ProposalFineGrainDetector
  - SUPPORTING INFORMATION:
    i. "The cost of MINERvA is dominated by three major categories of expenses: external materials purchases, craft durable items and labor to assemble the active elements and absorber into modules. Each of these has its own appropriate costing methodology."
    ii. "A summary of the costs is shown in Table 18. The total project construction cost is estimated to be $3.96M, excluding the installation and hall utilities costs." This cost has been updated and new project deliverables are described in the current Project Execution Plan (DocDB 61)
    iii. "The MINERvA collaboration has not yet produced a resource-loaded schedule for the experiment capable of reliably predicting the schedule" New project deliverables are described in the current Project Execution Plan (DocDB 61)
    iv. The deliverables are from whatever is chosen from the proposal - The experiment described here will measure neutrino cross-sections and probe nuclear effects essential to present and future neutrino-oscillation experiments.

4d. Yes - the criteria is satisfied

- Documents used:
  - MINERvA_ProposalFineGrainDetector
  - SUPPORTING INFORMATION:
    i. "The spacious and fully outfitted MINOS near detector hall will be the ideal venue for a high-statistics, high-resolution ν and ν-nucleon/nucleus scattering experiment. The experiment described here will measure neutrino cross-sections and probe nuclear effects essential to present and future neutrino-oscillation experiments."

4e. Yes - the criteria is satisfied

- Documents used:
  - While the following information might be found in other documents, the following was from discussion with David Boehnlein
  - SUPPORTING INFORMATION:
    i. The publications and experimental method would be subjected to collaboration review to ensure goals of the program are achieved.
  - COMMENT:

i. Our group asked for any procedure for publication - similar to that available in CDF, but at the conclusion of this assessment we had not received any document. A list of MINERvA publications to date would also have been supporting evidence.

4f. Yes - the criteria is satisfied
- Documents used:
  - While the following information might be found in other documents, the following was from discussion with David Boehnlein
  - SUPPORTING INFORMATION:
    i. The prototype detector would be evaluated with a "vertical slice test" prior to going forward with the full design and build of a prototype

4g Yes - the criteria is satisfied
- Documents used:
  - Gran-NuInt07-v6.pdf
  - Fermilab Today
  - SUPPORTING INFORMATION:
    i. The Gran-NuInt07-v6.pdf is a presentation
    ii. Fermilab Today - Most of the 18 collaborating universities are involved in major projects, combined with other groups. Northern Illinois University performs quality control on extruded scintillator bars. Hampton University and the College of William and Mary are assembling scintillator bars into detector planes, with W&M leading the assembly of scintillation counters. "The goal of the task will be to take the 25,000 scintillator bars in the detector and assemble them into robust, light and tight assemblies," says W&M's Jeff Nelson. The University of Rochester is providing fiber optics for light collection and readout; assembly and response tests of detector modules; and reconstruction software. Two universities in Peru, Pontificia Universidad Catolica del Peru and Universidad Nacional de Ingenieria, are also working on reconstruction software. So is the University of California-Irvine, which will also provide the data acquisition system. The University of Pittsburgh is providing front-end electronics and calibration systems. The University of Minnesota-Duluth is running the test beam.

5. Yes - the criteria is satisfied
- Documents used:
  - While the following information was also found in the following document, this information came from discussion with David Boehnlein
  - MINERvA_ProposalFineGrainDetector
  - SUPPORTING INFORMATION:
    i. The program says what the goals are and specifies what needs to be taken for obtaining the desired answers form this scientific research
    ii. What is performed in the physics experiments and what we want to do comes from a cross section of the collaboration through meetings and reviews and results in suggestions, including means for improvement - there are weekly meetings

6. Yes - the criteria is satisfied
- Documents used:

- The following information came from discussion with David Boehnlein
- SUPPORTING INFORMATION:
  i. The leaders of the collaboration are chosen with focus on quality publication and contributing to the fundamental knowledge and realization that the knowledge of neutrinos is limited.
  ii. MINERvA Bylaws

7. Yes - the criteria is satisfied
   - Documents used:
     - The following information came from discussion with David Boehnlein
     - SUPPORTING INFORMATION:
       i. Qualified personnel prepare and review information that was used to create the MINERvA proposal, they hold significant positions within the laboratory and/or in academics, but it is not specifically written here.
       ii. Minerva has MOUs for accesses to and support for resources with AD & CD (i.e. MOU w CD for support on DocDB)
8. Yes - the criteria is satisfied
   - Documents used:
     - The following information came from discussion with David Boehnlein
     - SUPPORTING INFORMATION:
       i. The postulation of new experimental device(s) and experiments is certainly creative
       ii. There are the potential for a large number of dissertations from this work
9. Yes - the criteria is satisfied
   - Documents used:
     - The following information came from discussion with David Boehnlein
     - SUPPORTING INFORMATION:
       i. David mentioned publications are activities where independent review is highest.
       ii. DOE has annual review of Science &Technology. MINERvA would participate.
       iii. The program proposal refers to several reviews, but the SR As-Is assessors did not find evidence indicating the scope and naming the reviewing body.
       iv. The Bylaws also provide for the establishment of committees to evaluate analysis and review results submitted for publication. Minutes of the Project Management Group include summaries of independent reviews of MINERvA subsystems. An example of a recent external review is an external review of the MINERvA DAQ held Dec. 16, 2009
10. Yes - the criteria is satisfied
    - Documents used
      - MINERvA_ProposalFineGrainDetector
      - SUPPORTING INFORMAITON:
        i. While nothing specific is cited here, there is a significant discussion within the proposal of the MINOS hall as well as support service that would be able to "make or buy" components.

11. Yes - the criteria is satisfied
    - Documents used:
        - The following information came from discussion with David Boehnlein
        - SUPPORTING INFORMATION:
            i. Fermilab requires personnel to have evaluations
            ii. Potential presenters and authors are reviewed, to ensure accuracy and make improvements, by peers prior to approval of information content for a presentation or submission of work for publication
12. Yes - the criteria is satisfied
    - Documents used:
        - The following information came from discussion with David Boehnlein and from the interpretation of the proposal
        - MINERvA_ProposalFineGrainDetector
        - SUPPORTING INFORMATION:
            i. The science conducted and results obtained previously were used as a basis to understand shortcomings of the status quo and what needs to be done to improve the situation.
            ii. Data improvement is performed through analysis software (in real-time) and use of a tracking detector
13. Yes - the criteria is satisfied
    - Documents used:
        - The following information came from discussion with David Boehnlein
        - MINERvA_ProposalFineGrainDetector
        - SUPPORTING INFORMATION:
            i. Alternatives were considered with respect to component s to minimize risk of having insufficient capability, future capability, impact of cost and the impact on this build vs. the current experiment - MINOS.
            ii. Another example -see discussion of ASIC development
            iii. "We concluded that timing within the spill, both to flag overlapping events and measure time of flight and decay times at rest was important for our physics goals. Third, what level of technical risk, R&D time and cost is acceptable? We concluded that to allow MINERvA to operate as early as possible in the NUMI beamline and given the modest size of our collaboration and expected detector costs, we should choose low technical risk over lengthy R&D programs designed to reduce those costs or improve performance. In our design exercise, we considered four technologies for photosensors: multi-anode photomultiplier tubes (MAPMTs), IITs, avalanche photodiodes (APDs) and visible light photon counters (VLPCs). Ultimately, we chose to pursue a solution based on MAPMTs which results in a sensor+electronics cost (including EDIA and overhead but without contingency) of approximately $40 per channel, which breaks down approximately as $15 per channel for the sensor, $15 for the electronics and $10 for EDIA and testing. To defend this important decision, we discuss the alternative technologies mentioned above"

iv. Just looking at optimizing performance of the experiment using beam energies, might be wrong; there are many ways to optimize an experiment since we are looking for interesting results;
v. Bylaws - people present information to the executive board to make change in decisions to effect science - for instance, in MINOS there were 2 different methods to extrapolate the neutrino flux at the far detector

14. Yes - the criteria is satisfied
    - Documents used:
        - The following information came from discussion with David Boehnlein
        - SUPPORTING INFORMATION:
            i. David suggested that publication are the goals and mechanism for disseminating new knowledge and improvements and are available to those who want to "know". Initially the information might be only available to the collaboration but ultimately publications become public knowledge
15. Yes - the criteria is satisfied
    - Documents used:
        - TRAIN Neutrinos at the Main Injector for David Boehnlein
        - SUPPORTING INFORMATION:
            i. The document shows a number of courses and training of which QA training is one of these items.
16. Yes - the criteria is satisfied
    - Documents used:
        - MINERvA_ProposalFineGrainDetector
        - Project Management Plan (DocDB 59).
        - SUPPORTING INFORMATION:
            i. "The cost of MINERvA is dominated by three major categories of expenses: external materials purchases, craft durable items and labor to assemble the active elements and absorber into modules. Each of these has its own appropriate costing methodology."
            ii. "A summary of the costs is shown in Table 18. The total project construction cost is estimated to be $3.96M, excluding the installation and hall utilities costs."
            iii. "The MINERvA collaboration has not yet produced a resource-loaded schedule for the experiment capable of reliably predicting the schedule" (this is from the proposal and so I recorded this as implying it is yet to come - tk).
            iv. The deliverables are from whatever is chosen from the proposal - The experiment described here will measure neutrino cross-sections and probe nuclear effects essential to present and future neutrino-oscillation experiments.
            v. Certainly the project is managed using the principles of project management
17. Yes - the criteria is satisfied
    - Documents used:
        - The following information came from discussion with David Boehnlein and from the interpretation of the proposal

- MINERvA_ProposalFineGrainDetector
- SUPPORTING INFORMATION:
  i. Calibration is contemplated for the project, but there may be little that actually needs calibration while in the proposal stage
  ii. "For the absolute flux of neutrinos there is a second uncertainty which must be considered and that is the accuracy with which we know the number of protons on target. With the planned NuMI primary proton beamline instrumentation[12], the number of protons on target will be known to between (1 - 3)%, the range being determined by the calibration techniques used to control drift of the primary beam toroid devices."
  iii. There is a light injection system to measure the response of the phototubes so have to look at the level of light injected in by the Light Injection System.
  iv. MINERvA has weekly Calibration & Analysis meetings to coordinate work on these topics.

MINOS

Documents obtained for review for the MINOS SR As-Is assessment addressed the MINOS project and the entire MINOS program. The Quality Assurance Guidelines for Scientific Research specifies the focus of scientific research (the scope of this assessment) is "knowledge, information, data, or proof-of-concept." Projects focus on engineering and construction of buildings and/or prototype components, which, while leading to the environment to conduct scientific research, are outside the focus of this assessment. As such, while all documents were reviewed for contribution by scientific processes, the influence of program documentation on the assessment of scientific research was greater than project documentation.

Some of the supporting information in this report and documentation is limited to specifying the section/chapter in the referenced document rather than citing more detailed information (i.e. the actual text). The limited substantiation is due to the documents being stored as an electronic photocopy rather than as an electronic text format.

The following are the objective observations, corresponding to the respective QA Lines-of-Inquiry questions, obtained for the program MINOS during the SR As-Is.

1. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - SUPPORTING INFORMATION:
       i. 'A "near detector" located at Fermilab will monitor the beam and enable a comparison to be made between neutrino interactions in detectors at two quite different distances from the neutrino source. The approach of our experimental program is to perform a variety of different measurements, all of which would be sensitive to neutrino oscillations. A self-consistent interpretation of all these measurements would be required for a claim of observation of neutrino oscillations.'
2. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - SUPPORTING INFORMATION:
       i. The MINOS Collaboration has management systems for: Resources / Personnel / Structure / Spokesperson / PM
3. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - DOE-ST-2009-06-30_neutrino_results[1].pdf
     - SUPPORTING INFORMATION:
       i. 'In order to respond to the PAC's request for information on expected levels of commitment of the collaborators …'
       ii. Review of Scientific User Facilities - Latest DOE/FRA presentations

4a. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - MINOS_bylaws_v6.pdf

- SUPPORTING INFORMATION:
  i. The Bylaws specify the mechanism for the spokesperson and the Project Mgr.
  ii. The MINOS Spokesperson is selected by the Institutional Board [who chooses the PM]

4b. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Physics Motivations and Goals (Chapter 2)
    ii. Nonaccelerator Physics Opportunities (Chapter 9)

4c. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Funding, costs and schedules (4.6)
    ii. Cost Estimates and Schedules (Chapter 12)
      1. Itemized WBS Costing (12.1.7)
      2. Schedules (12.2)

4d. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Precision of beam pointing to the far detector (3.6)
    ii. Far Detector Site (Chapter 4)
    iii. Location, access, local facilities (4.1)
    iv. Construction and installation (5.1)
    v. Construction and Installation (6.7)
    vi. Online data taking (6.6)
    vii. Experimental hall requirements (6.7)
    viii. Installation costs (12.1.5)

4e. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Readout electronics (5.7)
    ii. Online computing [for data acquisition & storage (5.10)]
      1. "A central computer for communication with the distributed processors ...
      2. Five multi-gigabyte disk drives for storage of data prior to writing to t...
      3. Five workstation processors for local reconstruction of events ...
      4. Five high-quality color screens for event display and output from monitoring ...
      5. Four workstations for local program development and data analysis work.

6. Five 'hard-copy' data storage/reading systems.
7. Two 'carousel' or stacking systems for the data storage technology for ...
8. Local network hardware to tie everything together.
9. A fiber-optic data-link between the surface and underground."

iii. Online data taking (6.6)
iv. Experimental hall requirements (6.7)

4f. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Figure 5.12: Time-line for the far detector installation. (5.11)
    ii. Beam monitoring (6.3)
    iii. Simulation of Detector Response (Chapter 7)
    iv. "We are, of course, continuing simulation work both to refine our search methods and to investigate the possibilities of the different options for the detector discussed above. In particular we are studying finer granularity detectors to try to improve our experiment's performance" (8.10)
    v. "The long baseline neutrino oscillation experiment can be constructed using well-established particle detection technology with standard electronic readout as described in this proposal. Our development program is designed to hone this technology to its most cost effective form when incorporated into a large underground detector designed to detect a positive signature of tau neutrino interactions. For the purpose of this discussion, the detector can be considered as having three aspects, the active detector elements, the electronics, and the mechanical structure. The collaboration will continue to investigate, and hopefully improve, these aspects until the detector design is frozen in 1997'' (Chapter 11)

4g Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:
    i. Collaboration resources (A.1) - "However, we believe that the experiment could be done comfortably with an author list of 200, including Ph.D. physicists, graduate students and those engineers and other technical specialists expected to make major contributions. These 200 would then be backed up by the efforts of other technical specialists for specific tasks. As is usually the case, the level of commitment of the average author would grow with time. .... Then during the running and data analysis phase, some of the technical effort will no longer be required, while there will be an influx of students and postdocs to take part in running and data analysis."

5. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - SUPPORTING INFORMATION:

i. T Muon momentum measurement and resolution (7.4.2)
ii. describes physics simulations of the MINOS detector's response to potential oscillations (8.1)
iii. "The P-822 collaboration previously developed a formalism for the analysis of an experiment measuring the change in the fraction of apparent neutral current and charged current events between a near detector and a far detector using Soudan 2 as the target. The analysis of the MINOS experiment has the following differences (8.2.1):
    1. ... the differentiation of charged and neutral currents simpler ... with less systematic error.
    2. The extra available mass enables us to choose a restricted fiducial volume in the far detector.
    3. The neutral current trigger loss, ..., becomes an important potential source of systematic error "
iv. Use of Soudan 2 (8.9)
v. "... continuing simulation work both to refine our search methods and to investigate the possibilities of the different options for the detector discussed above. ... to try to improve our experiment's performance ..." (8.10)
vi. "We do not believe it [current plan] necessarily represents the optimum possible instrument for the physics goals of this experiment, for the total amount of money indicated. The focus of our work during the next 1-2 years will be to improve on this design through detector R&D, further engineering studies, better understanding of various tradeoffs, and more detailed and extensive simulations. Better understanding of the neutrino beams will also be an important input in the effort. ... the possible improvements in the reference detector. They range from rather radical modifications to more minor changes of the current detector parameters." (Chapter 10)
vii. "The long baseline neutrino oscillation experiment can be constructed using well-established particle detection technology with standard electronic readout as described in this proposal. Our development program is designed to hone this technology to its most cost effective form when incorporated into a large underground detector designed to detect a positive signature of tau neutrino interactions. For the purpose of this discussion, the detector can be considered as having three aspects, the active detector elements, the electronics, and the mechanical structure. The collaboration will continue to investigate, and hopefully improve, these aspects until the detector design is frozen in 1997" (Chapter 11)

6. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - SUPPORTING INFORMATION:
       i. The program proposal discusses a broad and deep Collaboration Structure and quality values are discussed and reviews and meetings are evident where information can be exchanged.

- COMMENT:
  i. The goals of the research plan are presented, but the vision and mission were not found or difficult to identify and to locate

7. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - SUPPORTING INFORMATION:
       i. Collaboration Resources (A.1) - "However, we believe that the experiment could be done comfortably with an author list of 200, including Ph.D. physicists, graduate students and those engineers and other technical specialists expected to make major contributions. These 200 would then be backed up by the efforts of other technical specialists for specific tasks. As is usually the case, the level of commitment of the average author would grow with time. .... Then during the running and data analysis phase, some of the technical effort will no longer be required, while there will be an influx of students and postdocs to take part in running and data analysis."
       ii. Detector Status and Operation (B.2) - "Data at the Soudan site are stored on disk in runs of ,..... 1 hour length, and is processed immediately after the end of a run on a local VAX Cluster with an analysis package ... SOAP performs noise rejection, pulse matching, track reconstruction, and sorting of events into various categories of physics interest, such as muons, multi-muons, monopole candidates, (contained) neutrino candidates, and semi-contained events. [...] An additional processor would be established to flag events that were in time with a Fermilab beam pulse. This event sample would be compared with the contained and semi-contained event samples to ensure that all Fermilab events were being found with high efficiency."
8. Yes - the criteria is satisfied
   - Documents used:
     - MINOS-fermilab-proposal-0875.pdf
     - SUPPORTING INFORMATION:
       i. Collaboration Resources (A.1) - "Collaborating institutions expect to provide over twelve R&D laboratories, eight production laboratories, and access to a large number of other laboratories on an as needed basis. We have cutting-edge equipment such as extensive computer farms, specialized software ..., specialized laboratories for the design and production of chips and boards, ... experience with the design and production of all relevant types of particle detectors including tracking detectors, calorimeters, and scintillators. This experience includes electronics, gas systems, and software for these detectors. Our extensive software experience includes Monte Carlo simulations, online control and data acquisition, and offline data analysis...members of our collaboration have built a number of magnets for accelerators and large high energy physics experiments."
9. Yes - the criteria is satisfied

- Documents used:
    - MINOS-fermilab-proposal-0875.pdf
    - DOE-ST-2009-06-30_neutrino_results[1].pdf
    - SUPPORTING INFORMATION:
        i. "In order to respond to the PAC's request for information on expected levels of commitment of the collaborators …"(3.1)
        ii. Review of Scientific User Facilities - Latest DOE/FRA presentations

10. Yes - the criteria is satisfied
    - Documents used
        - MINOS-fermilab-proposal-0875.pdf
        - SUPPORTING INFORMAITON:
            i. The entire plan is about assessment of a facility and services to create a muon facility that has (see other answers to other questions addressing) adequacy, higher performance and best ROI.
            ii. (B.2) "The detector is now in routine data taking operation more than 80% of the time. Most of the down time is associated with the upgrade of older modules which will be completed in 1995. The performance of the detector has been reliable and stable over the past four years of operation. We do not anticipate any problems with continuing operation through the time period when a neutrino beam might be available."
11. Yes - the criteria is satisfied
    - Documents used: None, this is from discussion with interviewee
        - COMMENT:
            i. Fermilab requires personnel to have evaluations
            ii. Presenters and authors are reviewed by peers prior to approval to present or submit
12. Yes - the criteria is satisfied
    - Documents used:
        - MINOS-fermilab-proposal-0875.pdf
        - FY09-ops.doc
        - SUPPORTING INFORMATION:
            i. (Summary) - "Finally, in collaboration with the Fermilab staff', we have made much progress in understanding how to optimize the neutrino beam and at the same time maintain maximum flexibility. The initial results of our simulation studies look very promising, although they are far from complete. … We want to reduce the costs of the detector and at the same time improve its performance. We need to obtain a better understanding, through simulation, of the performance of the detector and the impact of that performance on the physics output. Probably our most important challenge is to understand the physics trade-off's between good statistics and cleanliness of the signal. Good statistics require a large mass, hence coarse granularity, and maximum neutrino flux. The cleanliness of the signal can be improved by finer granularity (at the expense of the detector mass for total fixed cost) and a cleaner and better understood neutrino beam. We intend to focus our work this year on the optimization of such trade-off's."

ii. Lessons learned on incident and failure - NuMI / E-875 Main Injector Neutrino Oscillation Search (MINOS) (FY09-ops.doc)

13. Yes - the criteria is satisfied
    - Documents used:
        - MINOS-fermilab-proposal-0875.pdf
        - SUPPORTING INFORMATION:
            i. (Summary) - "Finally, in collaboration with the Fermilab staff', we have made much progress in understanding how to optimize the neutrino beam and at the same time maintain maximum flexibility. The initial results of our simulation studies look very promising, although they are far from complete. ... We want to reduce the costs of the detector and at the same time improve its performance. We need to obtain a better understanding, through simulation, of the performance of the detector and the impact of that performance on the physics output. Probably our most important challenge is to understand the physics trade-off's between good statistics and cleanliness of the signal. Good statistics require a large mass, hence coarse granularity, and maximum neutrino flux. The cleanliness of the signal can be improved by finer granularity (at the expense of the detector mass for total fixed cost) and a cleaner and better understood neutrino beam. We intend to focus our work this year on the optimization of such trade-off's."
14. Yes - the criteria is satisfied
    - Documents used:
        - MINOS-fermilab-proposal-0875.pdf
        - SUPPORTING INFORMATION:
            i. (Summary) - "Finally, in collaboration with the Fermilab staff', we have made much progress in understanding how to optimize the neutrino beam and at the same time maintain maximum flexibility. The initial results of our simulation studies look very promising, although they are far from complete. ... We want to reduce the costs of the detector and at the same time improve its performance. We need to obtain a better understanding, through simulation, of the performance of the detector and the impact of that performance on the physics output. Probably our most important challenge is to understand the physics trade-off's between good statistics and cleanliness of the signal. Good statistics require a large mass, hence coarse granularity, and maximum neutrino flux. The cleanliness of the signal can be improved by finer granularity (at the expense of the detector mass for total fixed cost) and a cleaner and better understood neutrino beam. We intend to focus our work this year on the optimization of such trade-off's."
15. Yes - the criteria is satisfied
    - Documents used:
        - Reviewed TRAIN ITP for Dr. Peter Shanahan
16. Yes - the criteria is satisfied OR No Evidence OR The Response Needs Additional Clarification
    - Documents used:

- MINOS-fermilab-proposal-0875.pdf
- SUPPORTING INFORMATION:
  i. Itemized WBS Costing (12.1.7)
  ii. Schedules (Figure 12.1)

17. Yes - the criteria is satisfied

- Documents used:
  - MINOS-fermilab-proposal-0875.pdf
  - Nucl.Instrum.Meth.A596:190-228,2008
  - SUPPORTING INFORMATION:
    i. (B.2) - "Data at the Soudan site are stored on disk in runs of ,..... 1 hour length, and is processed immediately after the end of a run on a local VAX Cluster with an analysis package ... SOAP performs noise rejection, pulse matching, track reconstruction, and sorting of events into various categories of physics interest, such as muons, multimuons, monopole candidates, (contained) neutrino candidates, and semi-contained events. ... An additional processor would be established to flag events that were in time with a Fermilab beam pulse. This event sample would be compared with the contained and semi-contained event samples to ensure that all Fermilab events were being found with high efficiency."
    ii. "Pulser calibration runs are performed daily to find amplifiers with incorrect gain, disconnected cables, etc. The response of the detector (as well as the electronics) is continuously monitored by analyzing the data from through-going cosmic ray muons."
    iii. "...the tube efficiency is determined. Such a definition not only considers if the tube is working, it also includes the anode-cathode matching efficiency and the track fitting efficiency. .... The maximum tube efficiency that is reached is 80% for very high pulse heights, but the modules were operated at the knee of the efficiency plateau to remain in the proportional gain region."
    iv. From Publication NucInstrMeth (Chapter 5) - "This section describes the calibration of the responses of the near, far and calibration detectors. This calibration corrects for scintillator light output variations as well as non-uniformities of light transmission and collection in the fibers, PMTS, and readout electronics."

MUON ACCELERATOR PROGRAM

The following are the objective observations, corresponding to the respective QA Lines-of-Inquiry questions, obtained for the Muon Accelerator Program during the SR As-Is.

1. Yes - the criteria is satisfied
   - Documents used:
     - Charter
     - Draft Proposal
     - Muon Collider papers - Accelerator Science Publications (2005-2008)
     - Research Goals; http://www.fnal.gov/pub/muon_collider/research-goals.html
     - SUPPORTING INFORMATION:
       i. The program plan exists and it is a proposal for a design so it is only about science. "... the goal of this organization ... is to execute a multi-year program aimed at completing a Muon Collider Design Feasibility Study, participating in the ongoing International Design Study for a Neutrino Factory, and providing a supporting muon accelerator technology R&D program . [This is a] multi-year national R&D program aimed at completing a Design Feasibility Study (DFS) for a Muon Collider. It also includes the supporting component development and experimental efforts that will inform the design studies and permit an initial down-selection of candidate technologies for the ionization cooling and acceleration systems"
2. Yes - the criteria is satisfied
   - Documents used:
     - Charter
     - Mutac Review Report: http://www.cap.bnl.gov/mumu/conf/MUTAC-090406/MutacReport2009Fin.pdf
     - SUPPORTING INFORMATION:
       i. The Charter mentions, "Level 1 Responsibilities: Design and Simulations, Technology Development, System Tests, Institutional Board, Technical Board, Program Management Office, Management Council."
     - COMMENT:
       i. Trying to identify some aspects of these management systems were difficult to find. For instance, while other criteria may be used, one source[5] states that all Management Systems include four fundamental principle activities: Planning, Performance, Measurement and Improvement
3. Yes - the criteria is satisfied
   - Documents used
     - Draft Proposal
     - Neutrino Factory and Muon Collider Collaboration Report 2010.

[5] Artur, Dennis, Quality Audits for Improved Performance, , American Society for Quality, 2003

- SUPPORTING INFORMATION:
  i. "We believe that this work is a critical part of any broad strategic program in accelerator R&D and, as the P5 panel has recently indicated, is essential for the long-term health of high-energy physics."
  ii. "… the Fermilab Director has received from DOE/OHEP asking that Fermilab serve as the host laboratory for an integrated national muon R&D program."

4a. Yes - the criteria is satisfied

- Documents used
  - Charter
  - SUPPORTING INFORMATION:
    i. "MAP Program Director (see Fig. 1) is responsible for all management, funding, and policy decisions"
    ii. "Support is envisioned to come from the DOE OHEP budget"

4b. Yes - the criteria is satisfied

- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "...Additional R&D is also needed on longer-term concepts including the muon collider and laser- and plasma-based linear colliders. Each has potential for greater energy reach and significant cost savings, but all still require feasibility demonstrations…"
    ii. "The challenge for a muon collider is to produce, collect, cool and accelerate enough muons to provide the luminosity required to study new phenomena in detail. Recent studies using a jet of mercury in a strong magnetic field have demonstrated that such a target is capable of surviving a four-megawatt proton beam. This first step toward providing muons is very encouraging."

4c. Yes - the criteria is satisfied

- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "This document describes a proposal for a unified, national Muon Accelerator Program for the coming 7 years (2010-2016)"
    ii. "The main R&D deliverables of the national Muon Accelerator Program will be:
      1. A Design Feasibility Study Report (DFSR) for a multi-TeV MCc ...
      2. Component development and system tests ...
      3. Contributions to the International Neutrino Factory Design Study (IDS-NF) to produce a Reference Design Report (RDR) ... "
    iii. "…funding profile—a "nominal" profile that reaches $15M per year and an "augmented" profile that reaches $18M per year in the outyears and would shorten the schedule by one year"

4d. Yes - the criteria is satisfied

- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "The absence of synchrotron radiation allows high-energy muon bunches to be stored in a compact collider ring, so a MC complex would fit conveniently on the site of an existing laboratory, e.g., Fermilab."

4e. Yes - the criteria is satisfied

- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "In addition, new ideas for "magnetically insulated" cavities and for using advanced surface treatments (i.e., atomic layer deposition, ALD) are promising. An important part of our proposed MAP technology development plan is to vigorously pursue the rf R&D program to establish the viable options for high-gradient NCRF operating within magnetic lattices, and to measure the associated operational parameters."
    ii. "Ideally, we would like to achieve an rf gradient at 201 MHz of 15 MV/m or more. It is important to note, however, that there is no "cliff edge" for this parameter—if a gradient of, say, only half this value were achievable a Neutrino Factory or Muon Collider could still be built. There would be a modest loss in transmission at a lower gradient but this could likely be compensated by somewhat increased beam power from the proton driver together with incremental improvements in capture, cooling, and acceleration."

4f. Yes - the criteria is satisfied

- Documents used
  - Draft Proposal
  - Mutac Review Report: http://www.cap.bnl.gov/mumu/conf/MUTAC-090406/MutacReport2009Fin.pdf
  - SUPPORTING INFORMATION:
    i. "As already noted, one of the major goals of the current R&D program is to choose among the accelerator alternatives and select a single initial collider configuration by 2013 .... To accomplish this, we anticipate the following steps:
       1. Develop an end-to-end design for a multi-TeV MC that is based on demonstrated technologies and/or technologies that can be demonstrated after a specified R&D program. Identify and document the key R&D tasks.
       2. (By means of end-to-end simulations (including beam-beam simulations to give luminosity estimates), demonstrate that the design will meet the required machine performance parameters. The subsystems simulated will be based on sufficient engineering input to ensure that the assumed design includes a reasonable level of realism (i.e., realistic gradients, magnetic fields, alignment tolerances, safety windows, spatial constraints, etc.). Simulations

will cover proton driver, target, and all downstream systems up to and including the collider ring; beam transfers between systems will be included as part of the simulation.

3. Document the initial machine configuration, including required technologies, description of subsystems, performance estimates (luminosity, cooling performance, backgrounds), and fabrication and installation approaches (sufficient for initial costing purposes)."

4g Yes - the criteria is satisfied
- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "The proposed R&D program for the coming 7 years provides an opportunity for many more thesis topics, and a continued and enhanced opportunity for university group involvement. Based on our experience to date, a university group consisting of one faculty member, one post-doctoral research associate, and one or more graduate students, can make a valuable and valued contribution to the overall R&D program. Although the majority of the resources we are requesting for muon accelerator R&D would be utilized by the national laboratories, the proposed program would also support significant university involvement."
    ii. "The organization will provide a mechanism for interacting with international organizations that have common interests, such as the IDS-NF and the MICE collaboration."

5. Yes - the criteria is satisfied
- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. "The goal of our proposed technology development R&D program is to:
      1. establish the viability of the concepts and components used for the MC-DFSR and NF-RDR designs,
      2. establish the engineering performance parameters that can be assumed in the design studies, and
      3. provide a good basis for cost estimates."

6. Yes - the criteria is satisfied
- Documents used
  - Draft Proposal
  - SUPPORTING INFORMATION:
    i. Refer to MAP org chart - long standing and well positioned managers

7. Yes - the criteria is satisfied
- Documents used
  - Draft Proposal
  - Have sample ITNA
  - SUPPORTING INFORMATION-
    i. "To fully develop the underground engineering R&D plan, we will convene an expert panel comprising two senior representatives, one a

design contractor and one a construction contractor, along with an independent technical consultant."

ii. See ITNA for Yagmur Torun - up-to-date.

- COMMENT:
  i. AD uses DocDB and this program is in development. The program is new and we minimally observed information specifying documentation management requirements, use of mechanisms for recording configurations, storage and retrieval of data (i.e. Shifter Checklists and logs), or mechanisms to ensure training and qualification of personnel (i.e. Shifter Training) - commonly used in other scientific research processes reviewed

8. Yes - the criteria is satisfied (note - creativity and ethical work practices are not specifically mentioned in the Quality Assurance Guidelines for Scientific Research)
   - Documents used
     - Draft Proposal
     - FRA Code of Business Ethics and Conduct Program
     - SUPPORTING INFORMATION
       i. Director's Policy No. 37.000 Rev. 0 - Code of Conduct
          1. 2.0 - Effective Date 12/15/09
          2. 3.0 - Scope - This policy covers all business relationships at Fermilab
          3. 4.0 - Applicability - All Fermilab Employees
          4. 5.0 - Policy - "Fermi Research Alliance, LLC, (FRA) requires that all employees conduct themselves with the highest standards of integrity, honesty and fair dealings to preclude either an actual conflict or the appearance of conflict between FRA's performance, including its contractual obligations to DOE, and the personal interest of individual employees."

       ii. Ethics Program - "FRA CODE OF BUSINESS ETHICS AND CONDUCT PROGRAM - All FRA employees, officers, directors, managers, and agents, are required to comply with these standards, together with applicable local, state, and federal laws and any applicable grant and contractual requirements. As an FRA employee, any actions that you take in the course of your day-to-day activities and in relationships with customers, suppliers, contractors, and others is expected to be fully justifiable and not to be a cause for concern, or bring unfavorable publicity or embarrassment to FRA if disclosed. These standards apply to your conduct both on and off the job. You are expected to avoid unethical actions and/or Conflicts of Interest (both actual and the appearance of a Conflict), as well as report any Conflicts."
     - COMMENT:
       i. This is certainly creative research - we did not observed a specific research code of conduct - but did find the Dir Policy & FRA Ethics Program

9. Yes - the criteria is satisfied
   - Documents used
     - Draft Proposal
     - FRA Code of Business Ethics and Conduct Program
     - SUPPORTING INFORMATION
       i. "Performance will be checked using our two independent simulation codes, ICOOL and G4beamline. If magnetic shielding is needed between "turns" in the lattice, its effect must be evaluated. Also, an evaluation of a configuration with magnetically insulated and/or gas-filled cavities will be made. To make sure collective effects are benign, we will model space-charge effects at the end of the channel. Finally, an exploration of error sensitivity will be carried out."
       ii. "To fully develop the underground engineering R&D plan, we will convene an expert panel comprising two senior representatives, one a design contractor and one a construction contractor, along with an independent technical consultant."
10. Yes - the criteria is satisfied
    - Documents used
      - Draft Proposal
      - SUPPORTING INFORMATION:
        i. "the entire plan is about assessment of a facility and services to create a muon facility that has (see other answers to other questions addressing) adequacy, higher performance and best ROI."
11. No Evidence -
    - Documents used
      - Draft Proposal
      - SUPPORTING INFORMATION:
        i. No supporting evidence found
      - COMMENT -
        i. While we did not discover any evidence and because at this point the program is just under proposal and personnel are not evaluated for performance, it is not unreasonable to envision conduct similar to other programs that have personnel, publication and presentation reviews; additionally, Fermilab requires all personnel to have annual evaluations as well as Individual Training Needs Assessments to identify training requirements.
12. Yes - the criteria is satisfied
    - Documents used
      - Draft Proposal
      - Interview with Process Owner
      - SUPPORTING INFORMATION:
        i. "There are a number of reasons why multiple designs are being considered. Muons have well-known features that complicate the accelerator design. Foremost among these are their short lifetime and their diffuse production in pion decay. As a result, muon beams are generated with emittances and energy spreads that are enormous by conventional

accelerator standards. Some of the differences in the collider scenarios reflect different assessments of the optimal choice of collider parameters, for example the number of muons per bunch or the pulse repetition rate. An important goal of the R&D program outlined here is to characterize both the performance and relative cost of the various alternatives in order to select the most promising one for further exploration and optimization."

ii. During the interview, the Lessons Learned process for the Magnetic Incident in MTA was cited. After the incident occurred, there were immediate work around action was taken. After the informal root cause analysis, associated procedure was revised and corrective actions were taken. The revised procedure was communicated to the group.

iii. "The Minos R&D plan, as articulated in the MAP proposal, is built around making measurements that inform the management decisions about the Muon Collider (and Neutrino Factory) configuration to be studied and developed. For example, "An important part of our proposed MAP technology development plan is to vigorously pursue the rf R&D program to establish the viable options for high-gradient NCRF operating within magnetic lattices, and to measure the associated operational parameters." What that means is that Minos representatives will use the results from the rf R&D to make management decisions about which technologies to pursue further ("viable options"), and what performance parameters to assume in the Minos studies ("associated operating parameters)."

13. Yes - the criteria is satisfied
    - Documents used
        - Draft Proposal
        - SUPPORTING INFORMATION:
            i. "The first step in the design effort for each subsystem will be to develop first-order design concepts: major parameters, layouts, beam optics designs and lattices, apertures and acceptances, rf requirements, and so forth. The next step will be to evaluate intensity-dependent effects such as space charge, electron cloud, and coherent instabilities via analytic calculations and computer simulations. Undoubtedly the third step will be to develop strategies to mitigate intensity-dependent effects, iterating if necessary on the designs. Finally, tracking studies including realistic errors will be carried out."

            ii. "Understanding breakdown may require detailed spacecharge simulations. To mitigate the possible effects, we are investigating:
                1. the application of SCRF processing techniques to copper cavities
                2. using atomic layer deposition or Be walls to prevent cavity breakdown
                3. designing bucked coil lattices that minimize magnetic fields on the cavities
                4. designing a magnetically insulated cavity "

            iii. "The twelve tasks identified in Table 10 will accomplish the following:
                1. define the in situ ground conditions to the full project depth (Tasks 1-6)

2. identify adverse ground behaviors, and provide a rationale for selecting design
3. and construction options (Tasks 7-8)
4. support the development of a basis-of-estimate and perform a first-order cost,
5. schedule, and risk analysis (Tasks 9-11)
6. Provide expert recommendations for further study and design work (Task 12)"

14. Yes - the criteria is satisfied
    - Documents used
        - Draft Proposal
        - SUPPORTING INFORMATION:
            i. "In addition, some of the fundamental materials issues (high-field superconductors, radiation hardness, thermal margins, structural materials, electrical insulation, etc.) are common to different types of magnets, such as dipoles for the collider and solenoids for muon cooling. Therefore, materials R&D can and should be effectively organized through an integrated effort supporting various magnet R&D areas for the MC as well as other accelerator projects."
            ii. "The proposed R&D program for the coming 7 years provides an opportunity for many more thesis topics, and a continued and enhanced opportunity for university group involvement. Based on our experience to date, a university group consisting of one faculty member, one post-doctoral research associate, and one or more graduate students, can make a valuable and valued contribution to the overall R&D program. Although the majority of the resources we are requesting for muon accelerator R&D would be utilized by the national laboratories, the proposed program would also support significant university involvement."

15. Yes - the criteria is satisfied
    - Documents used
        - ITNA
        - SUPPORTING INFORMATION:
            i. See ITNA for Yagmur Torun - up-to-date

16. Yes - the criteria is satisfied
    - Documents used
        - Draft Proposal
        - SUPPORTING INFORMATION:
            i. "The organizing principles of MAP (see Fig. A-1) are listed below:
                1. Fermilab will provide overall leadership of the national Muon Accelerator Program (MAP).
                2. The MAP will be a collaborative effort, integrating participants from the existing NFMCC and MCTF.
                3. The MAP will have a dedicated management team, led by a Program Director reporting to the Fermilab Director. The Program Director provides the primary point of management contact to

DOE/OHEP. The MAP Program Director will control the allocation of funds to the collaborating institutions.

4. DOE-OHEP will establish a Muon Program Manager who will oversee the MAP
5. program from within the agency.
6. The MAP will be organized and managed utilizing project management tools.
7. An oversight group will be formed with representation drawn from the participating institutions.
8. Activities undertaken by the MAP and the associated resource support will be agreed upon with DOE, with a mutually understood ~7-year time horizon for development of the DFS, IDS-NF, MICE, and carrying out a supporting technology development program.
9. An advisory committee will monitor progress of the program and report to the oversight group and/or the Fermilab Director.
10. The organization will provide a mechanism for interacting with international organizations that have common interests, such as the IDS-NF and the MICE collaboration."

17. Yes - the criteria is satisfied
    - Documents used
        - Draft Proposal
        - Interview with Process Owner
        - SUPPORTING INFORMATION:
            i. "In addition, making precision measurements of standard model processes will open windows on physics at energy scales beyond our direct reach." (doesn't really say how precision/accuracy is to be achieved)
        - COMMENT:
            i. There is some evidence calibration is considered to achieve precision measurements of standard model processes" in the proposal, but the calibration requirements appears to be up to users to ensure that instrumentation is calibrated and to determine when and where such instrumentation is used. The Cleanroom Monitor is considered to be one of the key equipment that may require calibration. No formal program for data validation procedure has been established yet.
            ii. "Calibration is, of course, crucial to MAP R&D measurements. Many of our presentations and technical notes are either directly or indirectly to do with calibration. Before we make measurements, there are discussions in weekly meetings and workshops about the measurement strategy, and calibration is an important part of the planning and discussion."

Documentation Used by SR As-Is for QA in SR Processes

Documentation Used for Observations for QA in DZero

File Name or URL	Document Title
http://d0server1.fnal.gov/projects/spokes/documents/d0_manage_sept97.html	D0 Management Plan
http://www-d0.fnal.gov/hardware/upgrade/pac0495/physics_toc.html	Physics with the D0 Upgrade
	Lehnan draft Report, January 13-15, 1998
http://lss.fnal.gov/archive/2002/pub/Pub-02-327-Epart1.pdf	Run IIb Upgrade Technical design Report
http://d0server1.fnal.gov/Projects/UpgradeProject/Current_Web_Schedule/Index.htm	D0 Upgrade Schedule
http://lss.fnal.gov/archive/test-proposal/0000/fermilab-proposal-0823.pdf	D0 upgrade proposal
http://d0server1.fnal.gov/projects/run2b/Meetin	D0 MOU
http://www-d0.fnal.gov/computing/data_quality	D0 Data Quality Coordination
http://www-ppd.fnal.gov/DivOffice/Org_Charts/dzero.pdf	D0 Organizational chart
http://lss.fnal.gov/archive/test-tm/2000/fermilab-tm-2453-di.pdf	Report on Accelerator/Experiment Operations - FY 2009
d0.fnal.gov/www_buffer/pub/Run2_publications.html	List of publications
http://lss.fnal.gov/archive/test-proposal/0000/fermilab-proposal-0709.pdf	Proposal for a forward Detector at D0

Appendix B2 – Documentation Used by SR As-Is for QA in SR Processes

Documentation Used for Observations for QA in LatticeQCD

File Name or URL	Document Title
http://www.usqcd.org/physics.html	DOE Laboratory Theory Group Review 2008
http://www.physics.arizona.edu/~doug/SCHEDULE	Meeting schedule
https://projects.fnal.gov/lqcd/reviews/April2010Review/	DOE Progress Review for the USQCD Computing Facility
2008 DOE Report (Glen Crawford to Young-Kee Kim Dated 11/17/2008)	2008 DOE Report (Glen Crawford to Young-Kee Kim Dated 11/17/2008)
https://lqcd.fnal.gov/~ruthv/FNAL-MILC/FNAL-MILC_To_Do.htm	Weekly collaboration meetings
http://physics.indiana.edu/~sg/milc.html	MILC Collaboration
http://www.usqcd.org/computing.html	USQCD Computing Facility
http://www-spires.fnal.gov/spires/hep/	Spires database for papers
https://academicjobsonline.org/ajo?joblist---80-139	Job Listing
http://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=91	Lattice Beijing Conference
ITNA for E. Gamiz	ITNA for E. Gamiz
Research Interest Document fro W.	Research Interest Document fro W.
http://www.slac.stanford.edu/spires/find/hep/www?rawcmd=find+a+p+b+mackenzie&FORMAT=WWW	Publication list
http://www.slac.stanford.edu/spires/topcites/2009/eprints/to_hep-lat_alltime.shtml	Citation for Mackenzie paper
http://indico.fnal.gov/conferenceDisplay.py?confId=1942	Latest review presentations
http://rchep.pku.edu.cn/workshop/lattice09/index.	Meeting with other Lattice Thorists
Notas_ktopilnu.[June, September, December].doc	Research notes from Elvira Gamiz
researchInterest.pdf	Research interest Document
http://www.usqcd.org/index.html	US Lattice Quantum Chromodynamics
http://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=91	Oops! This link appears to be broken, but have pdf
http://www-esh.fnal.gov/pls/default/org_chart.html?org=PD	PD — PARTICLE PHYSICS DIVISION OFFICE
https://lqcd.fnal.gov/~ruthv/FNAL-MILC/FNAL-MILC_To_Do.htm	Oops! This link appears to be broken, but have pdf
http://usqcd.fnal.gov/lattice-experiment2007.html	PD — PARTICLE PHYSICS DIVISION OFFICE

Appendix B2 – Documentation Used by SR As-Is for QA in SR Processes

Documentation Used for Observations for QA in MINERvA

File Name or URL	Document Title
Experiment at WIPP May Unlock Secrets of the Universe.doc	Experiment at WIPP May Unlock Secrets of the Universe
MINERvA_AllCollaborators.xlsx	contact list with info for all collaboration participants
MINERvA_Bylaws.rtf	MINERvA Collaboration By Laws
MINERvA_CD-0 MNS_ConceptualDesign-wLineNumbers.docx	Mission Need Statement for the MINERvA project
MINERvA_ExperimentalProposal20040201.pdf	Proposal to Perform a High-Statistics Neutrino Scattering Experiment Using a Fine-grained Detector in the NuMI Beam
MINERvA_PMP_version_33.doc	MINERvA Project Management Plan
MINERvA_ProposalFineGrainDetector.pdf	Proposal to Perform a High-Statistics Neutrino Scattering Experiment Using a Fine-grained Detector in the NuMI Beam
MINERvA_QAP_v9.doc	MINERvA Quality Assurance Program
MINERvA_Shift.rtf	7 March 2008 Proposed MINERvA Collaboration Shift Policies
MINERvA_UpdatePhysicsCaseAddendum20040402.pdf	Addendum to the MINERvA Proposal: Updates to the Physics Case for MINERvA

Appendix B2 – Documentation Used by SR As-Is for QA in SR Processes

Documentation Used for Observations for QA in MINOS

File Name or URL	Document Title
AEM_01Mar_2010.pdf	NuMI-MINOS Status Report
Best Practices.txt	MINOS Best Practices
CRLWEntry.pdf	CRLW Entry - OmCheckListNear - Date 12/05/2009 - example of a completed MINOS checklist.
Data Stability Excerpt.pdf	RHC Data Stability Update
Data Validation Excerpt.pdf	Data Validation for the Near and Far Detector
DOE-ST-2009-06-30_neutrino_results[1].pdf	Results from Current Neutrino Experiments - DOE S&T Review of Scientific User Facilities - Latest DOE/FRA presentations
Excom meeting presentation description.docx	Minutes of the December 2009 executive committee meeting at Caltech - MINOS Collaboration: Minutes of Collaboration
FY09-ops.doc	NuMI / E-875 Main Injector Neutrino Oscillation Search (MINOS) - [RCA-LL-PI] - "FY09-ops.doc" is the most recent MINOS contribution to the Operations TM maintained each fiscal year by program planning. This is the requested item "Annual Director's Review report" Represents documentation of an incident/failure and lessons learned
IB meeting presentation description.docx	Abstract: Report from the Institutional Board - Minutes of Collaboration
MINOS meeting agenda.htm	Minutes of Collaboration w Titles of Presentations
MINOS shifter guide_Feb10.pdf	MINOS Shifter's Guide - TOC
MINOS_authorship_paper_rules_v7_approved-tk.pdf	MINOS Authorship and Publications Rules
MINOS_bylaws_v6.pdf	The MINOS Collaboration Bylaws
MINOS_data_approval_v2.2-3-tk.doc	MINOS Data Approval Procedure
Minos_fermilab-tm-2414-e.pdf	MINOS Experiment Plan FY 1996-1998
MINOS_Shift_Checklists.pdf	MINOS Logbook: Start of the Shift - Assume operational control of the detector...to ensure a smooth transition from one shift to the next
minos10org_nonames.txt	MINOS Collaboration Organization Document
MINOS-fermilab-proposal-0875.pdf	P-875: A Long-baseline Neutrino Oscillation Experiment at Fermilab
minospub_2-4-2010.docx	MINOS Experiment Publications
Nucl.Instrum.Meth.A596:190-228,2008	The Magnetized Steel & Scintillator Calorimeters of The MINOS Experiment

Appendix B2 – Documentation Used by SR As-Is for QA in SR Processes

Documentation Used for Observations for QA in Muon Accelerator

File Name or URL	Document Title
FNALAccelPhysPubs.doc	Selected Recent Fermilabs' Accelerator Science Publications (2005-2008)
http://apc.fnal.gov/MUONRD/	
http://www.cap.bnl.gov/mumu/collab/table_workshop.html	
http://www.cap.bnl.gov/mumu/MUTAC/	
http://www.fnal.gov/pub/muon_collider/	
ITNA_Torun.jpg	TRAIN ITP
MAP_Charter_draft-R2e.doc	The Muon Accelerator Program Charter
MAPproposal-R3c-1.pdf	R&D PROPOSAL FOR THE NATIONAL MUON ACCELERATOR PROGRAM
MTA HA Training V1_2 30Jan06.doc	MuCool Test Area Hazard Awareness Training Handout
MTA HA Training v1_3 9Oct06.doc	MuCool Test Area Hazard Awareness Training Handout
muon_collider_papers.pdf	Muon Collider References
MuonAcceleratorSupportingDocs.pdf	Emial containing report - Magnetic Incident in MTA
NFMCC-FY10plan-Final-abridged.pdf	FY2010 R&D Plan Neutrino Factory and Muon Collider Collaboration
Particle_count.jpg	Photo of particle counter with Calibration sticker
TalkLBL0109.ppt	Simple Rectangular Cubic Pill-Box cavity Concept - NFMCC- MCTF, Collaboration meeting

Appendix B3 - FICAP Controls Evidence in Scientific Research

The following are the objective observations obtained for the assessment of the FICAP in scientific research during the SR As-Is.

Each of the numbered items, below, represents the corresponding question from the Lines-of-Inquiry (see - *Lines-of-Inquiry for FICAP Guidelines for Scientific Research*). For example, "1" contains the observations and substantiating information for the question 1 in the Lines-of-Inquiry for FICAP Guidelines for Scientific Research section, *"Program - Has Fermilab management established a comprehensive and integrated contractor assurance system for ensuring the protection of the public, workers, environment and national security assets through continuous improvement for environment, safety, and health; safeguards and security; cyber security; and emergency management?"*

The emphasis of the SR As-Is was limited to determining the current state of existence of the controls, the As-Is state. Areas observed to have satisfactory compliance to criteria show a response of "Yes - the criteria is satisfied", have the referenced supporting document(s), and may or may not have supporting discussion in the "COMMENTS". While the QA Sub-Team also attempted to identify controls that were exemplary, it is most important to identify areas that need improvement. Thus if the control is non-existent or requires improvement, a gap exists and improvement is necessary. Those criteria identified having little supporting evidence are further elaborated upon in the COMMENTS section.

The following are the conclusions from the data and observations obtained during the assessment of the management systems for FICAP during the SR As-Is.

Appendix B3 - FICAP Controls Evidence in Scientific Research

1. Yes - the criteria is satisfied
   - Documents used:
     - Fermilab Integrated Contract Assurance (FICAP)
     - Fermilab Integrated Quality Management Program website
     - Integrated Quality Assurance (IQA)
     - Fermilab QAR and QAE contact list
     - Quality Assurance Guidelines for Scientific Research
     - Fermilab Environment, Safety and Health web site
     - 1000 series of ES&H documents addressing Laboratory's Policy and Administration
     - ES&H Lab contacts by D/S/C and by topic
     - Fermilab Emergency Response Plan (2007)
     - Fermilab Site Security Plan for Computing Division (dated August 2008) - A confidential document
     - Fermilab Cyber Security Program Plan for General Computing Enclave 6/25/2009 [ID 1066] (confidential/restricted distribution)
     - SUPPORTING INFORMATION:

       According to the interviewee (Dr. Jeff Apple), the FNAL staff associated with the scientific program follows the requirements and guidelines provided by the Laboratory. There is no science program specific guideline.

       a. All five components of the Contract Assurance Program, namely, Cyber security, Safeguards and Security, ES&H, Emergency Management, and Integrated Quality Assurance, of Contract Assurance program are formal. See program documents listed above. The QA Sub-Team could not identify a separate management system for Safeguards and Security. However, this component is implemented using a combination of ES&H management system and cyber security program. Each Fermilab building has an assigned Building Manager who is directly responsible for safety and security of the building.

       b. Personnel implementing each of the above components of the programs are appropriately trained. See the list of contacts, oversight officers and steering committee members. Each management system has assigned Management System Owners (MSOs) and Management System Coordinators (MSCs). The organizational structure for the cyber security management system was considered as an example during the assessment. Fermilab Cyber Security officers are Vicky White (Computer Security Executive) and Mark Leininger (Computer Security Manager) and Joe Klemencic (Computer Security Coordinator). Although, within the scope of this assessment, no clear evidence was found of any comprehensive (or specific, as the case may be) training program needed for the Management System Coordinators (MSCs), most MSCs are fully qualified by virtue of various certifications they possess, their seniorities and on-the-job training. QARs have undergone specific QAR training.

       c. Contract Assurance System responsibilities are implemented by the MSOs as defined in the program plan documents. The following were identified as the respective MSO for each program: ES&H (Nancy Grossman);

Quality Assurance (Bob Grant); Emergency Response (D/S/C building owners); Cyber Security (Vicky White); Safeguard and Security (Bruce Chrisman).

d. Other than the FICAP document, no clear evidence was found of a comprehensive FICAP implementation plan and procedures. However, considering each of the management systems individually, it appears that the responsibilities are implemented. It is evident that MSOs provide oversights for their corresponding management systems. In addition, various measurement data are collected to address any discrepancies. See the Issue Tracking section of this report. Each Contract Assurance component has its own methods of validation, documentation, and communication. Each management system uses different methodologies for classification, evaluation, tracking and resolution. The interviewee was aware of the Fermilab's internal audit group responsible for conducting selected internal audits.

- COMMENT: It is not clear if the vertical integration process mentioned in FICAP (Section 1.2, P. 16) has been fully implemented. It is not clear if the names of the Management System Coordinators (MSC) are widely communicated. According to FICAP "D/S/Cs participate in the development of institutional programs through the Advisory Council for Integrated Assurance (AC)" (P. 16). It is not clear how AC communicates with the scientific staff.

2. Yes - the criteria is satisfied
   - Documents used:
     - Fermilab Assessment Manual [under development]
     - SUPPORTING INFORMATION:
       a. Fermilab has established a formal assessment program based on IQA. In addition, scientific programs often undergo various stakeholder (including DOE) reviews. MSOs have their own scheduled assessment programs. Taken all together, Fermilab has an assessment program. Each applicable D/S/C has instituted various program specific assessments. There are various mechanisms and processes to collect, assess and disseminate Laboratory's scientific program performance, for example, Fermilab Accelerator Operations Report. The Laboratory Director uses Fermilab Today and All-hands Meetings to communicate upcoming assessments and lessons learned on important issues.
3. Yes - the criteria is satisfied
   - Documents used:
     - Accelerator/Experiment Operations - FY 2009
     - Report from Fermilab for the Newsletter of the APS Topical Group on Hadronic Physics
     - DOE Performance Evaluation and Measurement Plan (PEMP)[6]
     - SUPPORTING INFORMATION:

[6] The Performance Evaluation and Measurement Plan (PEMP), primarily serves as DOE's Quality Assurance/Surveillance Plan (QASP) for the evaluation of Fermi Research Alliance, LLC performance regarding the management and operations of the Fermi National Accelerator Laboratory

a. The primary performance measurement process for the Laboratory is the DOE PEMP process. Laboratory has instituted various performance measurement programs related to science. There are various mechanisms and processes to collect, analyze and disseminate Laboratory's scientific program performance. One such example is Fermilab Accelerator Operations Report. The Laboratory and its scientific programs are routinely evaluated for performance by various review and assessment committees.
b. To measure achievement of performance goals, various assessments and reviews are held for scientific programs. Most of the scientific performance measurements are done by senior staff members. Measurements related to scientific operations are mostly automated as a part of the lab-wide management systems. Some of the examples are ORPS/Dart reports.
c. Each scientific D/S/C management and program managers are responsible for scientific operations related measures. Many of them are reportable to DOE at a high level.

4. Yes - the criteria is satisfied
   - Documents used:
     - Injuries/Vehicle Accidents Reported
     - Fermilab Leading & Lagging Indicators
     - Running 365-Day DART Rate
     - ESHTRK database
     - ES&H Train and ITNA Completion
     - SUPPORTING INFORMATION:
       a. See FESHM 1040 (ES&H assurance program Rev10/2007) for event reporting. Similar systems exist for Cyber Security (POEMs). All reportable incidents are presented to DOE.
       b. Individuals in charge of FICAP components undergo various certifications. In addition, most oversight personnel have long experiences with the subject matter.
       c. Each MSO uses appropriate event management mechanisms, often customized for applicable DOE orders. The ESHTRK database is often used for event identification, classification, documentation, and investigation responsibility assignments. MSOs are responsible for evaluation, tracking, resolution and validation of events for their areas of responsibilities. Scheduling meetings are used for management reporting.
     - COMMENT: There is no evidence that a formal training plan for people conducting oversights follow specific training programs. However, these individuals have acquired significant on-the-job training as well as hold certifications as needed. It is not clear if a formal oversight-training plan is applicable.
5. Yes - the criteria is satisfied
   - Documents used:
     - Lessons Learned Procedure (2/22/10).
     - SUPPORTING INFORMATION:

a. Fermilab Lessons Learned Procedure is in place. However, the formal implementation is in progress. In the scientific environment, lessons learned are accounted for by using various methods. Individuals interviewed gave examples of informal Lessons Learned process. An example cited was a paper in Nuclear Instruments and methods - Conference Proceedings. Another example given was about the discussion in weekly meetings about lessons learned.
b. The Laboratory is in the process of implementing a formal lessons learned program. However, various formal/informal processes have been put in place by MSOs. These are mostly associated with the issues/incident management system for the respective FICAP components. Lessons Learned process in the scientific environment is guided by senior staff members with many years of experience.
c. The formal Lessons Learned program is not fully implemented yet. The Laboratory Director uses Fermilab Today and All-hands Meetings to communicate lessons learned on important issues. For example, he communicated the Fermilab LHC Magnet failure issue in this manner.

6. Yes - the criteria is satisfied
   - Documents used:
     - Stop Work Authority - FESHM 7020
     - Fermilab ESHTRK
     - SUPPORTING INFORMATION:
       a. The ES&H and Emergency Management related issues management program is formal. ESHTRK database is used for this purpose. Cyber security issues are tracked internally and reported to DOE using POEMs. Other internal management systems are used as needed. Issues with scientific programs are discussed in the All-Experimenters Meetings. Special reports like AAC/PAC/HEPAP reports and Fermilab Annual Reports/ DOE Reviews are also used for issues management.
       b. For FICAP related management systems, issues management is done by senior staff members, who have many years of experience on the job.
       c. Each MSO is responsible for identifying responsibilities in their management plans. They are also responsible for communicating them through assigned MSCs.
       d. Fermilab uses ESHTRK issues management system for safety and security requirements. Most of the compliance related issues are also tracked in this database, but it is not clear if all contract assurance requirements are tracked in this database.
7. Yes - the criteria is satisfied
   - Documents used:
     - Site visit report for American Physical Society
     - Focus Group initiative
     - Whistle Blower Protection (in FRA Contract with DOE)
     - FESHM 1060 - for Employee Concerns and training responsibilities
     - Fermilab Internal Complaint Procedures (Administrative Grievance) Procedure
     - SUPPORTING INFORMATION:

a. The Performance Review process is the primary vehicle for worker feedback. However, there are other feedback processes. At the request of the Laboratory Director, the American Physical Society team visited Fermilab in 2008. They collected and reported feedback from individual workers. As a follow up, Laboratory Director organized a Focus Group initiative. A Focus Group report was issued. Both of these reports are publicly available.
b. Performance reviews are conducted by supervisors. For safety related issues, each division has a trained Senior Safety Officer (SSO - ES&H coordinators) who is responsible for ES&H related worker feedback.
c. The process of Stop Work Authority addresses immediate concerns of workers.

8. Yes - the criteria is satisfied
   - Documents used:
   - FICAP Chapter 10 and interview with Jeff Apple.
   - SUPPORTING INFORMATION:
     a. According to FICAP, "If an assessment or investigation team member holds a dissenting opinion, a minority report is to be created and submitted up the line management chain, along with the final report. A copy of both reports shall be submitted to AC as well. The division/section/center head and the appropriate MSO will review and attempt to resolve any dispute with the team members. If the author of the minority report believes the issues are still in dispute, he/she may refer the issue to the AC. The AC's decision is binding." It is not clear if such a dissenting opinion or minority report is formally submitted to the AC or scientific managers. However, in the scientific environment, there are methods to record dissenting opinions and these are honored. For scientific programs, scientists express their dissenting opinions by not participating in the publications of scientific results that they do not agree with. An example cited by the interviewee included the CDF paper on the Study of Multi-Muon events. Ten Institutions did not agree to this study and withdrew their names from the paper. According to interviewee, in scientific process, dissenting opinions are not only tolerated, but also encouraged.
     b. No clear evidence of D/S/C Dissenting Opinion process with links to capturing and forwarding to next level was found.
     c. Could not find any evidence of minority report.
   - COMMENT: No evidence of a formal minority report was found. Regarding dissenting opinions, it is not clear if the scientific management is tied to AC in any manner. No evidence of a D/S/C Dissenting Opinion process with a link to capturing and forwarding to next level was found.

Documentation Used by SR As-Is for FICAP

File Name or URL	Document Title
http://www.fnal.gov/directorate/OQBP/Index_Files/Procedures_Forms/FCAP_B5_WO_line_%20numbers.pdf	Fermilab Integrated Contractor Assurance Program
http://www.fnal.gov/directorate/OQBP/Index_Files/Procedures_Forms/Integrated%20Quality%20Assurance%20Rev%20000-2%20B17.pdf	Integrated Quality Assurance
http://www.fnal.gov/directorate/OQBP/QAR.html	Quality Implementation Team - QAE Contacts
http://www-esh.fnal.gov/	ES&H Website
http://www-esh.fnal.gov/pls/default/esh_home_page.page?this_page=800	FESHM - Fermilab ES&H Manual [Index]
http://www-esh.fnal.gov/pls/default/esh_home_page.page?this_page=1000	FESHM - Fermilab ES&H Manual - 1000 series Policy & Administration
http://www-esh.fnal.gov/pls/default/esh_home_page.contacts	ES&H Contacts [Fermilab site-wide]
http://www-esh.fnal.gov/pls/default/esh_home_page.page?this_page=23259	FNAL Emergency Response Plan
http://www-esh.fnal.gov/pls/default/committees.html	Fermilab Committee Members - (for various ES&H related committees)
Fermilab Site Security Plan for Computing Division	Fermilab Site Security Plan - confidential document.
http://www-esh.fnal.gov/FIESHM_Plan/IESHM_112007.pdf	Fermilab Integrated ESH Management System
Fermilab Cyber Security Program Plan for General Computing Enclave 6/25/2009 [ID 1066]	Restricted distribution document
http://security.fnal.gov/contacts.html	Computer Security Contacts and Roles
http://www.fnal.gov/directorate/Directors_Policy/index.shtml	Confidential/Fermilab Director's Policy Manual, policy no. 39
http://lss.fnal.gov/archive/test-tm/2000/fermilab-tm-2453-di.pdf	Accelerator/Experiment Operations - FY 2009
http://www.fnal.gov/directorate/program_planning/APS_Topical_Group_FermilabReport2008.pdf	Report from Fermilab for the Newsletter of the APS Topical Group on Hadronic Physics - July 2008
http://www.fnal.gov/directorate/program_planning/directors_reviews/index.html	Directorate Program Planning - Directors Reviews - Index
http://esh-docdb.fnal.gov/cgi-bin//ShowDocument?docid=334	FESHM 1040 (ES&H assurance program Rev10/2007 for event reporting
http://www.fnal.gov/directorate/OQBP/Index_Files/Docs_in_Progress/Fermilab_Assessment_Manual_Rev000_A4.pdf	Fermilab Assessment Manual (Draft)

Applicability of FICAP to Scientific Research

The DOE Order 226.1A is specified in the Fermi Research Alliance, LLC and DOE contract. [7, 8] The Fermilab Contractor Assurance Program (FICAP) document is the DOE approved Fermilab interpretation of DOE O 226. The following is from the introduction within the Fermilab Integrated Contractor Assurance Program document.

> "Fermilab's Contractor Assurance Program is required at the highest level by contract DE-AC02-07CH11359 between the Department of Energy (DOE) and the Fermi Research Alliance (FRA). The contract identifies DOE Order 226.1A, Implementation of Department of Energy Oversight Policy, as the requirements document for Fermilab's Contractor Assurance Program. The order requires contractors to document, effectively implement, assess requirements, and ensure that systems are continually improved. DOE Order 226.1A also requires that Fermilab flow down its assurance requirements to subcontractors, to the extent necessary to ensure contractors' compliance with the requirements and the safe performance of work."

The following clauses are from the Fermilab contract and describe the implementation requirements, expected level of compliance, the goals, and applicable areas requiring compliance.

Clause C.3.3.3[9]
"The Contractor shall develop and implement a Laboratory assurance process, acceptable to the Contracting Officer, which provides reasonable assurance that the objectives of the Contractor's management systems are being accomplished and that the systems and controls will be effective and efficient. The Contractor's assurance process shall reflect an understanding of the risks, maintain mechanisms for eliminating or mitigating the risks, and maintain a process to ensure that the management systems and their attendant assurance process(es) meet contract requirements."

Clauses C.3.2.1.a and C.3.1.2
"Mission Accomplishment (Quality and Productivity of R&D): The Contractor shall produce high-quality, original, and creative scientific results that demonstrate sustained scientific and technological progress and impact, while receiving appropriate external recognition of accomplishments."

"Program Development and Mission Accomplishment - The Contractor shall strive to meet the highest standards of scientific quality and productivity, "on-time, on budget, as-promised delivery of program deliverables, and first-rate service to the research community through user facility operation."

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[7] H-13 is a clause within the FRA and DOE contract (DE-AC02-07CH11359). H-13 will replace DOE o 226.1A on which the FICAP is based, but the underlying information is still relevant as the applicability is unchanged

[8] DOE o 226 in FRA contract DE-AC02-07CH11359 (August 24, 2006). See APPENDIX I - DOE Orders and Notices Applicable for Implementation Under Contract No. DE-AC02-07CH11359, List B - List of Applicable Directives (Section J, Appendix I, page J-I-3) , 226.1 - 9/15/05 - Implementation of Department of Energy Oversight Policy

[9] this is found within Section C.3.3 - Performance Objectives and Measures and the third paragraph, this notation format "Clause C.3.3.3" is used in referring to clauses going forward

Clauses C.4.2.A.1 and C.4.2.A.c
"Laboratory Goals

a. Enable the most powerful attack on the fundamental science questions of the field of high-energy physics.
b. Provide world-class facilities for high-energy physics as part of the global network of particle physics.
c. Develop science and technology for particle physics and cosmology research.

Fermilab's mission is to advance the understanding of the fundamental nature of matter and energy, by providing leadership and resources for qualified researchers to conduct research at the frontiers of high-energy physics and related disciplines."

Nowhere does the DOE O 226.1A give exclusions for any part of Fermilab/FRA, including science.

Appendix C - Acronyms

Acronym	Full Name or Designation
AAC	Accelerator Advisory Committee
AC	Assurance Council
ALD	Atomic Layer Deposition
ANSI	American National Standards Institute
APDs	Avalanche Photodiodes
ASIC	Application Specific Integrated Circuit
ASQ	American Society for Quality
CAPs	Corrective Action Plan(s)
CD	Computing Division
CDF	Collider Detector at Fermilab
D0	DZero - designation, used interchangably, for a Tevatron detector
DAQ	Data Acquisition
DART	Days Away, Restricted, or Transferred
DFSR	Design Feasibility Study Report
DocDB	a document database
DOE	U.S. Department of Energy
EB	Executive Board
EDIA	Engineering, Design, Inspection, and Administration
EOI	Expression of Interest
ES&H	Environment Safety and Health
ESHTRK	ES&H Event Tracking System
FESHM	Fermilab ES&H Manual
FICAP	Fermilab Integrated Contractor Assurance Program
FNAL	Fermilab National Accelerator Laboratory
FRA	Fermilab Research Alliance
HEP	High Energy Physics
IDS-NF	International Design Study for the Neutrino Factory
IQA	Integrated Quality Assurance
ITNA	Individual Training Needs Assessment
ITP	Individual Training Plan
LOI	Letter of Intent
LQCD	Lattice Quantum Chromodynamics
MAP	Muon Accelerator Program
MAPMTs	Multi-Anode PhotoMultiplier Tubes
MC-DFSR	multi-TeV collider Design Feasibility Study Report

Acronym	Full Name or Designation
MCTF	Muon Collider Task Force
MICE	Muon Ionization Cooling Experiment
MINERvA	Main INjector ExpeRiment ν-A
MINOS	Main Injector Neutrino Oscillation Search
MOU	Memorandum of Understanding
NCRF	Normal Conducting RF
NFMCC	Neutrino Factory and Muon Collider Collaboration
NF-RDR	Neutrino Factory Reference Design Report
NSF	National Science Foundation
NuMI	Neutrinos at the Main Injector
OQBP	Office of Quality and Best Practices
PAC	Physics Advisory Committee
PEMP	Performance Evaluation and Management Plan
PFX	Procedures for Experimenters
PI	Principle Investigator
PM	Project Manager
PMG	Project Management Group
PMP	Project Management Plan
PMT	PhotoMultiplier Tube
PPD	Particle Physics Division
QA	Quality Assurance
QAE	Quality Assurance Engineers
QAGfSR	Quality Assurance Guideline for Scientific Research at Fermilab
QAR	Quality Assurance Representatives
QC	Quality Control
R&D	Research & Development
ROI	Return on Investment
SCRF	SuperConducting RF
SOAP	Simple Object Access Protocol
SPIRES	HEP Librabrary Database
SR	Scientific Research
SRC	Scientific Review Committee
TDR	Technical Design Review
TRAIN	Fermilab course recording database
UEC	Users Executive Committee
VAX	a computer made by DEC
VLPCs	Visible Light Photon Counters
WBS	Work Breakdown Stucture
WDRS	Workforce Development and Resources Section
Z1	*Quality Guidelines for Research* (ANSI/ASQ Z1.13 - 1999)