Fermilab Independent QA Assessment Report

Assessment Number & Title: 13-QA-001-ORC-PPD **Version:** 01

Date(s) of Assessment: 10/24/2012 – 11/23/2012

Performing Organization: Office of Quality & Best Practices

Assessed Organization(s): Particle Physics Division (PPD)):

- PPD ES&H Group
- NOvA Experiment
- PPD Mechanical Engineering Department

Assessment Activities & Scope:

Assess the processes used for the Operational Readiness Clearance (ORC) as described in *Operational Readiness Clearance - ES&H Review of Experiments (*PPD_ESH_006*)*

Scope Limitations:

- ORC requirements or activities for tests, small experiments and small projects are excluded

Activities Reviewed Within this Assessment:

- ORC team review of processes for the NOvA Block Pivoter

Description of the Implementation & Effectiveness of Observed Activities:

While the requirements of PPD_ESH_006 are met, the purpose of this assessment was to evaluate the effectiveness of the ORC safety review process as applied to the NOvA Block Pivoter. The following provides comments from interviews addressing safety concerns, efficiency/effectiveness issues, and suggestions for improvement.

Individuals participating in the ORC review of the Block Pivoter and interviewed in this assessment:

- The Senior Safety Officer for PPD and the Chairperson of the NOvA ORC ES&H Review Committee
- The Level 2 Manager for NOvA Far Detector Assembly and Installation (WBS 2.9)
- NOvA's Project Mechanical Engineer

The Block Pivoter (Pivoter) was chosen for this assessment since the ORC process was conducted recently and because operation of this device has the potential for significant injury and impact to NOvA's mission completion. The Pivoter is a 375 ton moving platform capable of lifting and positioning NOvA's PVC detector blocks that weigh about 200 tons each. The Pivoter uses a high-voltage electrical system (480 VAC) and a high-pressure hydraulic system (up to 5500 psi).

According to persons interviewed and the review team the following potential safety related items should be addressed by management:

DETERMINE IF "AS BUILT" MATCHES "AS DESIGNED"

Clarification may be needed if the ORC is responsible to check if "as built" matches "as designed."
It was stated that engineering calculations are checked during design reviews and by the ORC subject matter expert (SME). While there is no specific requirement for the ORC to do this, discussion seemed to indicate this may be implied. This leaves room for interpretation based on what PPD_ESH_006 specifies and what interviewees mentioned.

- Interviewees mentioned that Fermilab outsources engineering work to universities or outside firms and there are examples where work delivered did not meet Fermilab requirements. This could be due to insufficiently developed requirements, misunderstanding due to insufficient vendor experience, and/or insufficient checking as the work developed.
- The ORC reviewers have differences in interpretation of checking engineering work, specifically calculations, e.g. checking to see calculations are done could be interpreted as …
    - There is evidence calculations were performed … or …
    - It is necessary to check the accuracy of the critical calculations by having the ORC SME perform a step by step check of the calculations.

REVIEW TRAINING PROCEDURE FOR SAFETY

Clarification may be necessary as to whether the ORC review is responsible to evaluate if the training procedures incorporate prudent safety considerations.

- Persons interviewed recalled and ORC records indicate that the ORC reviewed the operating procedures for safety considerations and checked for training records.
- ORC interviewees were unsure if the training was reviewed for safety. (e.g. the ORC review team assumed the training incorporated/followed the operating procedures).

USE A SYSTEMS APPROACH TO ORC

Clarification may be needed to determine what gets an ORC review. A systems approach may be more appropriate to ensuring safety. The following concern, while not a perfect example, was mentioned when the assessment team asked if maintenance procedures were reviewed for safety (there were no applicable Pivoter maintenance procedures and the following was offered as the basis for this observation).

- The Pivoter was the scope of this assessment, but one interviewee thought it better to look at safety of the Pivoter and lifting fixture in the assembly process. While the lifting fixture and Pivoter operate independently, there could be a situation where devices are interdependent and reviewing the operation of the system /process would be preferred.
- There was an issue with the lifting fixture where a 1000 pound module was dropped once (due to an electrical failure). This resulted in adding retaining hooks that resulted in safer operation and preventing damage when a potential drop occurred five more times.
- The lifting fixture was a complicated item and designed according to FESHM 5022 as a below the hook lifting fixture. There is no evidence that the ORC team checked the safety of operation. However, the lifting device was constructed at Argonne and reviewed by their ORC rules and by the time the Fermilab ORC committee saw the fixture, the retaining hooks were already installed.
    - Argonne staff designed the lifting fixture per the ASME B30.20 code for Below-the-Hook Lifting fixtures, the same code that the FESHM 5022 specifies. Fermilab staff filled out the FESHM 5022 required documentation on the fixtures. However, some aspects of this lifting fixture are not covered by the national codes (specifically how the cups fit to the ribbed PVC extrusions) and the ORC committee chose not to review this lifting fixture.

FORMAL KNOWLEDGE TRANSFER BY ORC SME

A more formal process may be prudent to ensure a mechanism for knowledge transfer by SMEs.

- While ORC teams are assigned to larger projects and team members do share information, participation on the ORC team is not indefinite. There is an effort to maintain knowledge transfer within the project, but not necessarily between projects.
- There is no formal "living" growing checklist / lessons-learned created by ORC members that gets passed on from ORC team to ORC team (or project to project).

COORDINATE ORC AND CSRP

Coordination of activities between the ORC and Cryogenic Safety Review Panel (CSRP) may improve the quality of safety coverage.

- CSRP is a separate team from ORC team.
- The groups do not meet to plan or discuss results.
- Collaborative reviews could be conducted and be improved through coordinated activities.

PRIORITIZATION OF ORC WORK

Management should prioritize ORC team members' work to ensure timely completion of ORCs.

- The ORC took almost a year for the Pivoter from request to completion.
    - The ORC approvals took much longer than the project expected so project's SMEs used the Pivoter in production to position two complete detector blocks prior to completion of the ORC (experts were present and management was aware of usage)
    - There was a test plan that was used and improved from the testing of the full height engineering prototype (FHEP) of the Pivoter; this knowledge was applied to using the Pivoter in Ash River.
        - The FHEP Pivoter in CDF was tested at full load, the Ash River Pivoter was not
    - There appears to be inconsistency in PPD_ESH_006 or a lack of a process to allow an exception that permitted the use of the Pivoter in production. Not having a process for exception may have a negative impact on the culture's perception of the need to adhere to the ORC process and an impact on safety.
        - *Apparent inconsistency in PPD_ESH_006* - Footnote 2 in section 5.0 gives a fair amount of leeway to people in charge of project (e.g. experts were present during the positioning of the detector blocks: the project mechanical engineer and PPD director). On the other hand, item #3 in list at end of this paragraph seems to take this away. PPD_ESH_006 should be updated to clarify and/or specify an appropriate process to follow.
- Prioritization of responsibility and activities is becoming an issue.
    - ORC committee members do not have the ORC work prioritized with respect to their regular duties. Management needs to clearly prioritize ORC work, especially when a reviewer is over committed with regular duties.
    - The impression is that ORC is deemphasized as "other" work since it is "Laboratory Committee and Service Work" on the bottom of the performance evaluation sheets and thus appears under-valued as "job serving on committees." Prioritization gets worse if individual serving on ORC crosses Division boundary.

PROVIDE REVIEWERS WITH DESIGN PHILOSOPHY

Consider developing an engineering design philosophy that is shared with the ORC review team earlier in the design process, when differences in approaches are easier to resolve, rather than during a review on the completed item.

- The features that the deliverable needs frequently get deconvolved into details of specifications since there is an urgency "to get project underway." There are benefits to developing a complete

set of requirements and elaboration of the design philosophy, which includes the level of expert or non-expert systems that need to be incorporated to address safety requirements.

- There have been conflicts with the design philosophy impacting the engineering requirements and the way the ORC review team interprets the requirements.
- Reviewers should include their opinions early in the design process to harmonize the design engineer's decisions and the reviewer's expectations. The difference in expectation between what the design team engineered and built and what the review team expects can cause delays, increase cost and create contentious misunderstandings if these issues are not resolved early in the process.

HARMONIZE ORC AND FEM ACTIVITIES

Consider harmonizing the ORC & Fermilab Engineering Manual (FEM) activities.

- The ORC members should participate in the design reviews to follow the progress, understand the decisions made, and be more proficient and prepared when conducting the ORC review
    - When the ORC team or any review team (e.g. CSRP) has not been involved with ongoing design reviews, this creates delays and results in differences in the interpretation of requirements.
- The reviewer needs to be educated.
    - The design engineer should be responsible to inform reviewers about use and interpretation of regulations and codes for potential knowledge gaps
        - Example, the mechanical engineer designing the Pivoter had to learn a great deal about hydraulics and there was no one on site with equivalent knowledge that could appropriately check that work without being brought up to "speed."
    - Problems could be minimized by explicitly expressing some of the issues that the reviewers might encounter in understanding the codes, application of the codes, and the philosophy that the design supports.

Conclusions:

This assessment identified potential gaps and provided suggestions to improve the thoroughness of reviewing safety in the ORC process. Any of the suggested items could potentially impact safety, overtly or more subtly as a cultural perception. Management should determine the level of formality and structured approach to be incorporated to appropriately address these issues.

Findings:

None

Observations and Recommendations:

See above

Commendable Practices:

None

Persons Interviewed:

- Eric McHugh
- Pat Lukens
- David Pushka

Documents Reviewed:

- *ES&H Review of Experiments (*PPD_ESH_006*)*
- Procedure for Researchers (PFX, May 17, 2011)

Attachments:
None

Standards, Regulations, and Other Program Requirements Applied:
While standards, codes etc were applied during the design and the ORC review, they were not consulted during the conduct of this QA assessment.

Corrective Action Plans Issued:
None

Assessors' Names (asterisk indicates team leader):

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- John Dawson - ESH QAR

Submitted by: Thomas King **Date:** 11/20/2012

Distribution (Distribute to assessed organizations' management, OQBP head, and other interested parties):

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