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HL-LHC CMS Detector Upgrade Project

Integrated Safety Management Plan

Fermi National Accelerator Laboratory


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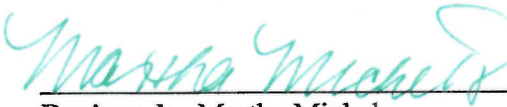
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Approved: Vivian O'Dell date
HL-LHC CMS Project Manager

 2018-11-14

Reviewed: Anders Ryd date
HL-LHC CMS Deputy Project Manager

 11-14-18

Reviewed: Martha Michels date
Fermilab Chief Safety Officer

 11/14/2018

Prepared: T.J. Sarlina date
HL-LHC CMS Project ES&H Manager

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1 ES&H Policy, Scope and Purpose

A strong Environment, Safety, and Health (ES&H) program is essential to the successful completion of the HL-LHC CMS Project at Fermi National Accelerator Laboratory (Fermilab) and collaborating universities. The Project is committed to ensuring a safe work environment for HL-LHC CMS Project workers at all institutions and to protecting the public from hazards associated with project activities. In addition, all work will be performed in a manner that preserves the quality of the environment and prevents property damage.

The safety of everyone that participates in any operation is of the highest value. Great science and great safety performance go hand in hand. Our goal is that every worker goes home every day free of on job injuries, and that both managers and workers can and should learn from any event that results in injury or near miss. Open, prompt, and honest reporting is crucial to help in continuous improvement.

Collaborating institutions will ensure that all work performed meets all applicable standards and certifications at their institution and is consistent with the philosophy set forth above. Staff or contractors from one institution working at another's site will meet the other institution's ES&H and training requirements. Equipment delivered to the FNAL site by collaborating institutions will comply with FNAL ES&H requirements, and equipment delivered to the CERN site by the Project will comply with CERN ES&H requirements.

2 Integrated Safety Management System

The Project utilizes the concept of an Integrated Safety Management System (ISMS) as its overarching philosophy and approach to integrating safety systematically into work activities. ISMS is an organized process whereby work is planned, performed, assessed, and systematically improved to promote the safe conduct of work. These concepts will be described as they apply to this Project in the balance of this section.

2.1 Principles of Integrated Safety Management (ISM)

The fundamental principles described in DOE P 450.4 are incorporated into the HL-LHC CMS Project processes to ensure that all work is planned and conducted safely, although this philosophy is not unique to DOE and can be applied to describe safe work practices at any international institution. The Project is committed to conducting our work efficiently and in a manner that ensures protection of workers, the public, and the environment.

2.1.1 Roles and Responsibilities for ISM implementation

It is important that roles and responsibilities be clearly understood. Roles and responsibilities for those organizations involved in the HL-LHC CMS Project are described in the HL-LHC CMS Project Management Plan [5], in the Fermilab ES&H Manual (FESHM) [2], and in the NSF Project Execution Plan [6]. The key roles and responsibilities are discussed here.

2.1.2 HL-LHC CMS Detector Upgrade Project Manager/Deputy Project Managers

The roles and responsibilities of these positions are described in the HL-LHC CMS Project Management Plan [5]. These individuals are responsible for administering, planning, organizing, and controlling the HL-LHC CMS Project technical, cost, schedule and ES&H objectives. The Project Manager and the Deputies, via their project work supervisors, have the responsibility to assure that the appropriate competence and training exists at all levels and that the appropriate processes, consistent with the ISM's five core functions, are in place to address the ES&H aspects of all work on the project.

Core Function #1 – Define Scope of Work

Core Function #2 – Analyse the Hazards

Core Function #3 – Develop and Implement Hazard Controls

Core Function #4 – Perform Work Within Controls

Core Function #5 – Provide Feedback and Continuous Improvement

2.1.3 HL-LHC CMS Project ES&H Manager

The HL-LHC CMS Project ES&H Manager has overall ES&H oversight responsibility for the HL-LHC CMS Project. This person coordinates ES&H activities and facilitates the resolution of any issues that cut across various Fermilab Divisions and Institutions (e.g. universities). The ES&H Manager has been assigned to assist the HL-LHC CMS Project Management Team by providing ES&H oversight of all relevant activities. The ES&H Manager keeps the HL-LHC CMS Project Manager informed of current or potential ES&H issues, and informs the Project Manager and the Fermilab PPD Division Safety Officer (PPD DSO) of any Project-related safety incidents. The PPD DSO is responsible for completing reports for the Occurrence Reporting and Processing System (ORPS) and the Computerized Accident Incident Reporting System (CAIRS).

The Upgrade Project ES&H Manager shall work with the relevant project contact to identify safety hazards and risk mitigations. The Project ES&H Manager shall also review those university safety programs relevant for executing the Upgrade Project. These reviews will include site visits when warranted.

2.1.4 HL-LHC CMS Level 2 Managers

L2 Managers are responsible for implementing the Project plan in conjunction with all applicable ES&H standards and policies, including FESHM when the work is performed at Fermilab. L2 managers are also responsible for applying the Integrated Safety Management principles to their subsystems.

2.1.5 HL-LHC CMS L3/L4/L5 Managers

Level 3, Level 4, Level 5 Managers and project work supervisors are responsible for direct implementation of all ES&H policies and standards to the tasks being performed on a daily basis. Specific activities include: developing hazard analyses and providing them to the HL-

LHC CMS ES&H Manager for review and comment, completing inspections, and communicating with the Project ES&H Manager and Project Manager to address identified ES&H concerns.

2.2 ESH&Q Section Oversight

The FNAL ESH&Q Section will provide oversight for Project activities at Fermilab, and will support the Project ES&H Manager to assure that universities adhere to their ES&H programs. For work performed at Fermilab, this is done using the standard Division/Section/Project ES&H oversight channels and procedures to ensure that the HL-LHC CMS Project is in compliance with all ES&H standards and requirements. For work performed at universities, this work will be done under the oversight of local ES&H professionals, consistent with their established standards. The ESH&Q Section will provide subject matter experts to review university safety plans for relevant Project work.

Any concerns identified are brought to the attention of the HL-LHC CMS Project ES&H Manager. They are also documented to assure the appropriate level of tracking. Serious incidents, e.g. those that cause injury or significant damage to equipment will be referred to the Project Manager and the HL-LHC CMS ES&H Manager. Near misses will be referred by the relevant Manager to the HL-LHC CMS ES&H Manager, the Project Manager and the appropriate L2 Manager.

2.3 Organizations Participating in the HL-LHC CMS Detector Upgrade Project

All laboratories, universities, and institutions participating in the HL-LHC CMS Project are expected to follow their organizations' ES&H Programs, Policies, and Procedures.

The foundation of the ES&H program is understanding the hazards and regulatory drivers, and appropriate mitigations. Strong communication is key. Since the project is accomplished at a variety of locations, there will be a diversity of safety procedures. Procedures specific to the HL-LHC CMS Project will be developed via the following process:

Each L2 Manager will identify to the Upgrade Project ES&H Manager all universities involved in their system. The ES&H Manager will work with the L3 managers to identify a university-based ES&H professional who is independent of the project. The list of ES&H contacts at each university has been identified and is recorded in Reference [7].

The relevant managers and university PIs will work with the university ES&H professionals to develop a safety plan for construction and testing at the university. These plans will be documented and transmitted to the Upgrade Project ES&H Manager, who will then consult with Fermilab ES&H safety professionals to establish that the proposed procedures will provide appropriate safety protection. If deficiencies are found, this process will iterate until an acceptable safety plan is developed. Part of this process will include site visits by the CMS HL-LHC Project ES&H Manager and Fermilab ESH&Q Section safety professionals to validate the university safety procedures, as necessary.

Independent evaluation of the safety plan is part of the review suite, required by the international CMS collaboration [1], namely:

- An EDR (Engineering Design Review) or ESR (Electronic Systems Review) is held prior to the start of construction or upgrade of a large item or important procurement. Adherence to safety requirements is an inherent part of an EDR.
- A PRR (Procurement Readiness Review) may be held in anticipation of an EDR or an ESR, to authorize significant pre-production or pre-procurement, or where parts of the system are well understood and factorize from the overall design. Such parts can, for schedule reasons, be considered for approval to proceed, providing there is no risk to the satisfactory completion of the overall design needed for the EDR.

Safety incidents must be reported by the relevant manager to their L2 Manager, the Project Manager, and the Upgrade Project ES&H Manager. This includes incidental damage or schedule impact as well as near misses and events requiring first aid.

Incidents involving injuries that result in lost work or in detector damage of substantial cost or with schedule impact exceeding one week must be reported immediately. Affected work must be stopped until the safety issue is reviewed by the ES&H Manager, and mitigation approved by the Project Manager.

Safety lessons learned will be disseminated at the weekly Project management meetings.

3 Personnel Experience, Knowledge, and Skill

Each individual associated with the Project shall possess the experience, knowledge, skills, and abilities necessary to discharge their duties effectively and safely. Line managers must ensure that their workers are competent to safely accomplish the work through the hiring and training processes. An evaluation of training requirements will be conducted for all Project members and applicable training requirements will be established based on job duties. Line management is responsible to ensure that training and qualification requirements are established for their personnel, and workers are responsible to keep their training current, as defined by Fermilab, the HL-LHC CMS Project, and home institution requirements.

Each contractor and subcontractor working at the project construction site will also be required, as a part of their ES&H Plan, to provide a competent workforce for the Project that has the ability to do work safely and efficiently.

4 Balanced Priorities

A strong ES&H program is essential to the successful completion of the HL-LHC CMS Project. The Project will allocate sufficient time and resources to ensure that work is performed safely. All staff and contractors must take the time to complete training, plan work properly, and conduct their work in a manner that adequately controls hazards. It is essential that ES&H

be fully integrated into the Project and be treated with the same priority as cost and schedule. Safety cannot be compromised because of cost or schedule pressures.

Every employee and subcontractor has the responsibility and authority to stop work when he or she believes the activity in which they are involved, or which they observe, is unsafe.

5 Safety Standards and Requirements

Before work is performed, hazards associated with the activity are evaluated and an agreed-upon set of controls is established which, if properly implemented, provides adequate assurance that the workers, the public, the environment, and property are protected from adverse consequences. For work to be conducted at Fermilab, these controls will be established based on the requirements outlined in the Fermilab ES&H Manual and supplemented by requirements specific to the HL-LHC CMS Project that will be developed as needed. For work performed at collaborating institutions, HL-LHC CMS personnel will follow the ES&H Manual and procedures of the collaborative institutions.

6 Hazard Controls Tailored for Work Performed at Fermilab

6.1 Hazard Analysis

Fermilab has a defined hazard analysis (HA) process [2], and workers have been trained in its use. Work procedures are periodically reviewed, and changes or new HAs may be developed at that time as well. When HAs are changed, or a new HA is developed, the workers review and sign to indicate acceptance of the requirements within the HA.

6.2 Personal Protective Equipment (PPE)

The level of PPE required will be determined appropriately for each task.

7 Operations Authorization for Work Performed at Fermilab

Fermilab has processes in place to ensure safe operations of equipment, experiments and accelerators. The process relevant for this Project is called Operational Readiness Clearance (ORC). The ORC panel reviews safety and general documentation. Upon successful completion of the ORC process, the panel will recommend unattended operation. HL-LHC CMS Detector Upgrade test stands, calibration stands and/or test beam setups will follow all applicable rules for operations authorization.

Should an incident occur, all employees, users, and subcontractors are instructed to dial 3131 to activate the Fermilab Emergency Response Plan.

The relevant HL-LHC CMS Manager and the Project ES&H Manager are responsible for investigating the incident. If the incident involves a recordable injury, the PPD DSO is expected to generate a CAIRS within 48 hours. The HL-LHC CMS Project ES&H Manager

will review the CAIRS report for completeness and that direct, root, and contributory causes are properly identified. Corrective actions will be determined and quickly implemented.

8 Installation

The HL-LHC CMS Project builds detector parts that are sent to CERN for integration, installation, and commissioning. Any integration, installation, or other work at CERN will follow CERN safety rules and policies. The international CMS Technical Coordinator is responsible for insuring the proper CERN training and safety guidelines are followed for all work done at CERN on CMS.

9 NEPA Compliance

The project complies with all requirements of NEPA and its implementing regulations (10 CFR 1021 and 40 CFR 1500–1508). This action has been reviewed and determined to meet the requirements for a Categorical Exclusion (CX) determination; the CX was issued in January 2018 and a copy is available in [3]. All environmental issues identified will be responsibly and economically addressed. The environmental risk is low.

10 Sustainable Design

Leadership in Energy and Environmental Design (LEED) for new construction or remodeling stipulates quantifiable measures which confer credits towards certification of a project as a “LEED-certified” to build as per DOE Order 430.2B. LEED certification does not apply to the HL-LHC CMS Project because no conventional facilities will be constructed. Projects that are not appropriate for LEED certification must apply the principles of sustainability wherever appropriate and cost-effective.

11 Bibliography

- [1] CMS Collaboration, "The CMS Constitution," [Online]. Available: <https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=3035>.
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- [3] V. O'Dell, "NEPA Category Exclusion," 12 January 2018. [Online]. Available: <https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=13483>.
- [4] Fermilab, "Fermilab Environment, Safety and Health Manual (FESHM)," [Online]. Available: <http://eshq.fnal.gov/manuals/feshm/>.
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[6] "Project Execution Plan for the MREFC HL-LHC Upgrade Scope of the Compact Muon Solenoid", CMS-DocDB-13279. Available: <https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=13279>

[7] Institutional contact lists of PIs, support staff, OSP contacts, and ES&H contacts Available: <https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=13605>

