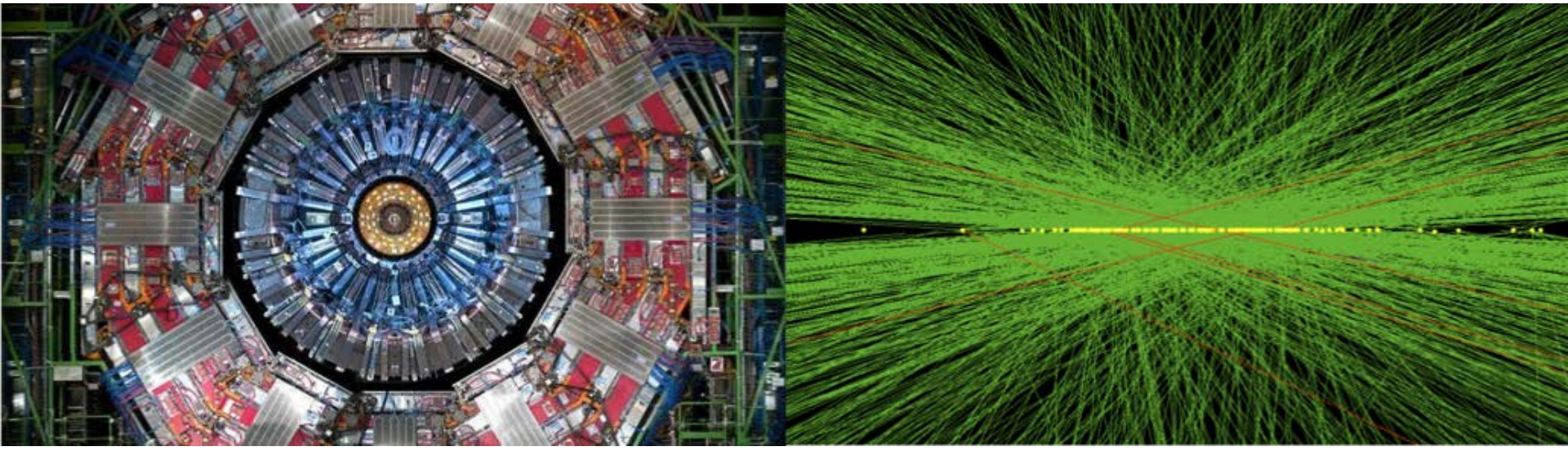
B02: ESH Overview and Response to Previous Reviews

T.J. Sarlina, HL-LHC CMS ESH&Q Coordinator

DOE CD-1 Review

October 22-24, 2019



Outline

- Presentation will include:
  - Biographical Sketch
  - Response to Previous Recommendations
  - DOE 413.3B Requirements
  - ISM
    - ES&H at Fermilab
    - ES&H at participating Institutions
    - Site Visits
  - Codes and Standards
  - Preliminary Hazard Analysis
    - Summary by institution
    - Hazard Analysis Worksheets
  - Summary

Biographical Sketch – T.J. Sarlina

- CMS Upgrade ESH&Q Coordinator
  - Assistant Radiation Safety Officer for Meson Department (1979-1982)
  - Senior Safety Officer for Research Division and Particle Physics Division (1982-2002)
  - Project Scheduler (2002-2008)
    - CDF Upgrade Project, DO Upgrade Project, Minerva, Dark Energy Camera.
  - Project Manager at Fuel Tech, Inc. (2008-2010)
    - Air Pollution Control Projects (power plants and refineries) in Hong Kong, Guangzhou, Liaoning Province
    - Austin, TX and
    - Seattle, WA
  - Associate Project Manager for ESH and QA on NO*v*A (2010-2014)
    - Constructed and commissioned Near Detector at Fermilab and Far Detector in Ash River, MN
  - Fermilab Quality Assurance Manager (2014-2017)
    - Transitioned the Fermilab QA Program from consultant led to internally owned
  - Fermilab Quality Assurance Specialist (2017-present)
    - Supporting the Fermilab QA Program under Jemila Adetunji, IERC QA Coordinator, US HL-LHC CMS ESHQ Coordinator

Response to June 2018 IPR

Charge #6 and #8

- #22 - Revise the ISM and QAP to accurately document the process for receipt, review, concurrence, coordination, and oversight of project specific plans and activities prior to the issuance of any contract instrument.
  - The ISM and pHAR documents have captured the oversight process for institutions.
- #23 - Develop a clear plan for identification and documentation of codes, standards, requirements, and timing for inclusion.
  - CMS-doc-13717 has been developed to document the applicable codes and standards.

Response to Nov 2018 ESH&Q Review

Charge #6 and #8

- #1 - Develop a clear list of design codes and standards that are applicable to both the U.S. and CERN operations.
  - CMS-doc-13717 has been developed to document the applicable codes and standards.
- #3 -The hazard analysis worksheets within the pHAR need to be reviewed by the ESH&Q Coordinator.
  - Hazard Analysis sheets have been updated to match Fermilab Quality Assurance Manual chapter 12030. Reviewed & approved by L2 Managers.
- #4 - The ISM Plan needs to be restructured to clarify collaborating institutions ESH requirements.
  - ISM Plan has been revised to better define ES&H requirements and expectations at participating U.S. institutions.
- #5 - Develop a set of ESH review criteria for institutional site visits.
  - An inspection form has been developed that will be used for ES&H site visits at all U.S. participating institutions.

Response to Mar 2019 Director's Review

Charge #6 and #8

- #10 – Document a more concise timeline of reporting minor injuries to the ESH&Q Coordinator.
  - Added requirements and timelines for reporting incidents and events to Section 2.3 of the Integrated Safety Management Plan, CMS-doc-13395.
- #11 – Address comments on pHAR.
  - Comments on the pHAR were addressed and included in the updated document, CMS-doc-13394.
- #12 – ESH&Q Coordinator needs to work with Particle Physics Division to locate approval documentation for the CO2 cooling system. If documentation cannot be found, a new ORC and Cryogenic Safety panel Review must take place and be approved prior to the CD-1 Review.
  - Particle Physics Division provided the documentation for authorized operation of the CO2 system at the SiDet location. Documents have been uploaded to CMS-doc-13804.

DOE O 413.3B Requirements

- National Environmental Policy Act (NEPA)
  - Minimal impact
  - Categorical Exclusion issued in January 2018
  - CMS-doc-13483
- Integrated Safety Management Plan
  - CMS-doc-13395
- Preliminary Hazard Analysis Report
  - CMS-doc-13394
- Security Vulnerabilities Assessment
  - CMS-doc-13755

Integrated Safety Management Plan

CMS-doc-13395

HL-LHC CMS Detector Upgrade Project

Integrated Safety Management Plan

Fermi National Accelerator Laboratory

CMS-doc-13395

September 4, 2019

Key Elements

- Conduct work to ensure protection of workers, the public, the environment, and equipment.
- Roles & Responsibilities for ISM Implementation.
- Includes support from the Fermilab ES&H Section.
- Requires each institution to provide an independent ES&H contact.
- Defines Stop Work authority.

CMS-doc-13395

Roles and Responsibilities

- U.S. CMS Project Manager has overall responsibility.
- ESH&Q Coordinator works with L2 Managers to evaluate institution ES&H programs and will conduct site visits as required. Site visits include representatives from the university ES&H organization.
- Level 2 Managers oversee work within their WBS.
- Level 3 and 4 Managers are responsible for direct implementation of all ES&H standards for the tasks being performed on a daily basis.
- Fermilab ES&H Section will provide oversight for activities at Fermilab as well as at participating U.S. institutions at the request of the CMS Project.

Roles and Responsibilities

- Each university or laboratory group will demonstrate compliance with the Project ES&H requirements.
- Universities and institutions provide ES&H professionals from their organization to ensure local ES&H programs, policies, and procedures are being followed appropriately.
- Each participating U.S. institution has provided:
  - Name and contact information for institutional safety contact responsible for conducting safety reviews.
  - Institutional list of ES&H Contacts. CMS-doc-13605

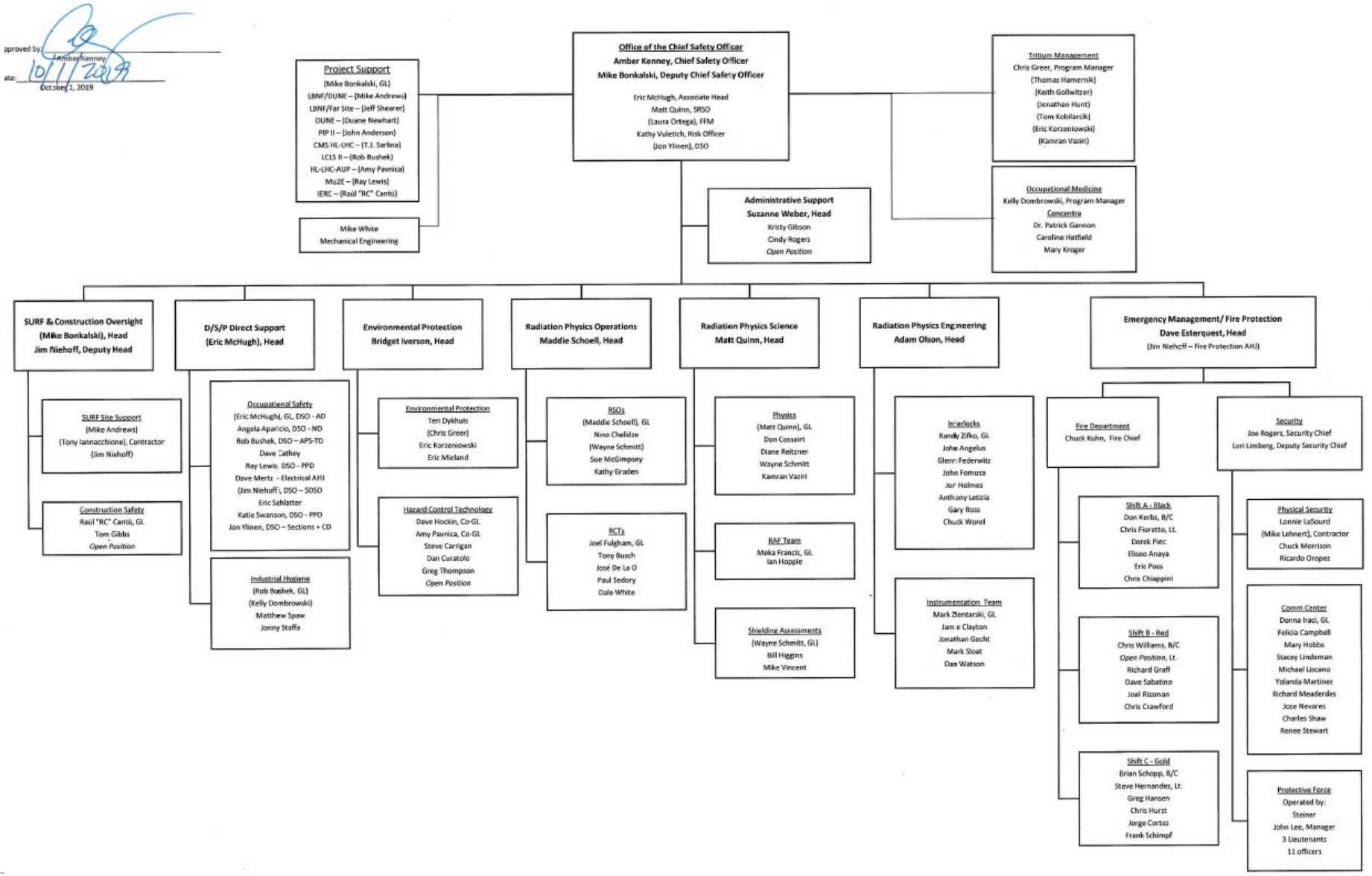
Institutional ES&H Contacts (partial list)

Institution	NSF/DOE	PI (email) phone	ES&H Responsible	University ESH Staff Member
Boston	DOE	TFPX:Zeynep Demiragli (zeynep.demiragli@cern.ch)	Samantha Beglinger (sbegling@bu.edu)	Rhoda Bianchi, Program Manager OHS (rhodab@bu.edu) 617-353-6368
Brown	DOE	OT:Meenakshi Narain (narain@hep.brown.edu)	Linda Olmsted (linda_olmsted@brown.edu) 401-863-7697	Stephen Morin, Director EHS (stephen_morin@brown.edu) 401-863-3353
Caltech	DOE	MTD:Maria Spiropulu (smaria@caltech.edu)	Jason Trevor (trevor@hep.caltech.edu) 626-395-6560	Caz Scislowicz, ARM, Director EHS (caz@caltech.edu) 626-395-6727
Carnegie Mellon	DOE	EC:Manfred Paulini (paulini@heps.phys.cmu.edu)	Barry Luokkala (luokkala@cmu.edu) 412-268 2756	Shailendra Singh, Director EHS (shailen2@andrew.cmu.edu) 412-268-5609
Fairfield	DOE	EC:David Winn (winn@fairfield.edu)	Victor Podrasky (vgpodrasky@fairfield.edu) 203-751-5882	Joseph Bouchard (jmbouchard@fairfield.edu) 203-254-4000 ext. 2546
Princeton	DOE	OT:Daniel Marlow (marlow@princeton.edu) MTD:Christopher Tully (cgtully@princeton.edu) TD:Isobel Ojalvo (iojalvo@princeton.edu)	Geoff Gettelfinger (gettelf@princeton.edu) 609-245-4404	Robin Izzo, Director EHS (rmizzo@princeton.edu) 609-258-6259
U. of Rochester	DOE	OT:Demina Regina (regina.demina@rochester.edu)	Myron(Mike) Culve (mculver@pas.rochester.edu)	Mark Cavanaugh, CFPS, CHSP, Director EHS (mcavanaugh@safety.rochester.edu) 585-275-8412
NIU	DOE	EC:Vishnu Zutshi (vzutshi@niu.edu)	Michele Crase (mcrase@niu.edu) 815-753-9251	Scott Mooberry, Director EHS (smooberry@niu.edu) 815-753-6250

ES&H Expertise

- Fermilab ES&H Section will provide subject matter experts.
  - Raymond Lewis: Particle Physics Division – Division Safety Officer.
  - PPD DSO is responsible to complete Occurrence Reporting and Processing System (ORPS) or Computerized Accident Incident Reporting System (CAIRS) reports.
  - Additional personnel available on an as-needed basis if other expertise required (FESHCom Subcommittees).
- Independent University ES&H personnel will be involved at all production and testing sites.
- CMS ESH&Q Coordinator will work with CERN LEXGLIMOS (Large Experiment Group Leader in Matters of Safety) – Niels DuPont.
- Integration, installation and commissioning stages at CERN will be covered by CERN ES&H personnel.

Fermilab ES&H Section Organization



FESHComm Subcommittees

Fermilab ES&H Committee (FESHCom)

- + Cryogenic Safety Subcommittee (CSS)
- + Electrical Safety Subcommittee (ESS)
- + Fire Hazard Subcommittee (FHS)
- + Incident Prevention Subcommittee (IPS)
- + Mechanical Safety Subcommittee (MSS)
- + Radiation Safety Subcommittee (RSS)
- + Safety Assessment Document Review (SAD)
- + Subcontractor Safety Subcommittee (S-3)
- + Tritium Task Force

Major Work or Assembly Sites per WBS

WBS #	WBS Description	Facilities
402.02.03	Outer Tracker: Sensors	Brown, Rochester, Fermilab
402.02.04	Outer Tracker: Electronics	Fermilab, Princeton, Rutgers
402.02.05	Outer Tracker: Modules	Brown, Fermilab, Princeton, , Rutgers
402.02.06	Outer Tracker: Flat Barrel Mechanics	Fermilab
402.02.07	Outer Tracker: Integration	Fermilab
402.04.03	Calorimeter Endcap: Sensors	Brown, Fermilab, Texas Tech, FSU
402.04.04	Calorimeter Endcap: Modules	Carnegie Mellon, Texas Tech, UC Santa Barbara
402.04.05	Calorimeter Endcap: Cassettes	Fermilab, Minnesota
402.04.06	Calorimeter Endcap: Scintillator Caorimetry	Fermilab, FSU, Maryland, NIU, Rochester
402.04.07	Calorimeter Endcap: Electronics and Services	Fermilab, Minnesota
402.06.03	Trigger / DAQ: Cal Trigger	Wisconsin
402.06.05	Trigger / DAQ: Correlator Trigger	Wisconsin
402.06.06	Trigger / DAQ: DAQ	Fermilab
402.08.03	Timing Layer: Barrel Timing Layer	Virginia, Caltech, KSU
402.08.04	Timing Layer: Endcap Timing Layer	Fermilab, Nebraska, Kansas

Table 2: Major work or assembly sites for the U.S. CMS HL-LHC detector upgrade project.

Site Visits

- Site Visit Checklists - CMS-doc-13668

US HL LHC CMS ES&H Site Visit Checklist

WBS X.X.X *Date:*

Contacts: *Location:*

1.	Mechanical Hazards	Satisfactory	Unsatisfactory	N/A
	Pressure or vacuum vessels			
	Compressed gasses			
	Tech shop machinery and tools			
	Ladders and scaffolds			
	Crane, forklift, aerial lift, or hand truck use			
	Below the hook lifting fixtures			
	Slings			
	Lockout/Tagout			

2.	Fire Protection
	Fire detection, suppression, and reporting
	Fire doors, emergency exits, and emergency lights
	Fire extinguishers
	Flammable gasses

3.	Electrical Hazards
	Electrostatic discharge protection
	High voltage and low voltage power distribution system
	Exposed electrical hazards
	36" Clearance in front of electrical panels

4.	Radiation Hazards
	Lasers
	Radioactive sources
	Ultraviolet radiation
	Magnetic fields

5.	Industrial Hygiene Hazards	Satisfactory	Unsatisfactory	N/A
	Ergonomics			
	Personal Protective Equipment (PPE)			
	Respiratory protection			
	Eyewash and Showers			
	Temperature extremes			
	Lead or Beryllium			

6.	Cryogenics & ODH Hazards	Satisfactory	Unsatisfactory	N/A
	Gaseous cooling systems or refrigerants			
	Cryogens (i.e. Nitrogen, Argon, LOX, CO_2, Helium, etc.)			
	Confined spaces			

7.	Environmental Protection	Satisfactory	Unsatisfactory	N/A
	Chemical handling, storage, and disposal			
	Polychlorinated Biphenyls (PCBs)			
	Air emission sources			
	Chemical vent hoods			

Site Visits

- Site Visit Reports (ESH and QA) - CMS-doc-13856

Upgrade Project ESH and QA Site Visits for 2019

Abstract:

UCSB site visit reports for ESH and QA - July 2019.
Fermilab site visit reports for ESH and QA - August 2019.
Rutgers, Princeton, Brown site visit reports for ESH and QA - September 2019.

Files in Document:

- 2019-07 UCSB ESH Site Visit - pdf (2019-07-Site-Visitt-ESH-CMS-UCSB.pdf, 73.7 kB)
- 2019-07 UCSB QA Site Visit - pdf (2019-07-Site-Visit-QA-CMS-UCSB.pdf, 108.8 kB)
- 2019-08 Fermilab Site Visit QA - pdf (2019-08-Site-Visit-QA-CMS-Fermilab.pdf, 105.5 kB)
- 2019-09 Brown ESH Site Visit - pdf (Field_Checklist-ESH-HL-LHC-CMS-Brown.pdf, 59.5 kB)
- 2019-09 Brown QA Site Visit - pdf (Field_Checklist-QA-HL-LHC-CMS-Brown.pdf, 87.5 kB)
- 2019-09 Princeton ESH Site Visit - pdf (Field_Checklist-ESH-HL-LHC-CMS-Princeton.pdf, 57.7 kB)
- 2019-09 Princeton QA Site Visit - pdf (Field_Checklist-QA-HL-LHC-CMS - Princeton.pdf, 82.4 kB)
- 2019-09 Rutgers ESH Site Visit - pdf (Field_Checklist-ESH-HL-LHC-CMS-Rutgers.pdf, 57.4 kB)
- 2019-09 Rutgers QA Site Visit - pdf (Field_Checklist-QA-HL-LHC-CMS - Rutgers.pdf, 79.7 kB)

Viewable by:

- USCMS-MGMT
- USCMS-UP-REVIEWS
- USCMS-UP-TEAM
- USCMS-UP-PHASE2
- CMS Spokesperson

Modifiable by:

- USCMS-MGMT
- USCMS-UP-TEAM
- USCMS-UP-PHASE2

Quick Links:
Latest Version

Site Visits

- Site Visits (ESH and QA)
  - UCSB – July 2019
  - Fermilab – August 2019
  - Rutgers – Sept 2019
  - Princeton – Sept 2019
  - Brown – Sept 2019

Site Visits

- Site Visit ES&H Overview
  - Existing work areas are generally clean and well organized.
  - There are space limitations that result in tight quarters for some operations. Removal of unnecessary equipment and minor reorientation of the spaces will address the items.
  - Some general housekeeping improvements are needed.
  - Personal Protective Equipment (PPE) is available.
  - Chemicals are stored properly.

Codes and Standards

- Some code requirements vary between the United States and CERN.
- The Project Manager worked with the Level 2 Managers and their respective engineers to develop the USCS HL-LHC Codes and Standards document.
- Differences in code requirements between the U.S. and CERN as they relate to this Upgrade Project have been documented in CMS-doc-13717.
- CERN code and standard compliance is evaluated as part of the standard review cycle.

Codes and Standards

Purpose	Code or Standard	US	CERN	Notes/Comments
Quality/Reliability: Electronics	IPC 610 and IPC-2222/IPC-6012 class 2. For some high performance boards, use IPC 610 class 3. See http://www.ipc.org	**IPC**	**IPC**	Institute of Printed Circuits (IPC) is an international trade association that sets standards for board designs.
Mechanical Equipment	Mechanical codes for lifting equipment, pressure equipment, cryogenic equipment, and lifts are detailed here: https://hse.cern/content/m	**ASME B31.3**	**EN13480**	Only "pressure equipment" applies to HL-LHC CMS – the cooling pipework in the tracker and the endcap calorimeter are subject to high pressures. The designs for the piping must follow rules in GSI-M-2 found here: https://edms.cern.ch/ui/file/875610/LAST_RELEASED/GSI-M-2_EN.pdf
Mechanical: Pressure Release Devices		**ASME BPVC VIII**	**EN4126**	Pressure release devices are not US deliverables, however are needed for testing the piping both at FNAL and at CERN.
Materials	Use of Plastic and other Non-Metallic Materials at CERN with respect to Fire Safety and Radiation Resistance		**CERN Specific IS41 [Ref-5]**	The requirements for al non-metallic materials – Mechanica environmental resistanc for the desired applicati the appropriate standar – Satisfactory fire perf ignition, rate of flame s release, etc.) to specifie

References

[Ref-1]Code C1 Electrical safety code, https://edms.cern.ch/document/335725/1

[Ref-2]U.S. CMS HL-LHC Integrated Safety Management Plan, CMS-doc-13395

[Ref-3]U.S. CMS HL-LHC Quality Assurance Plan, CMS-doc-13093

[Ref-4]CMS Constitution, CMS-doc-3035

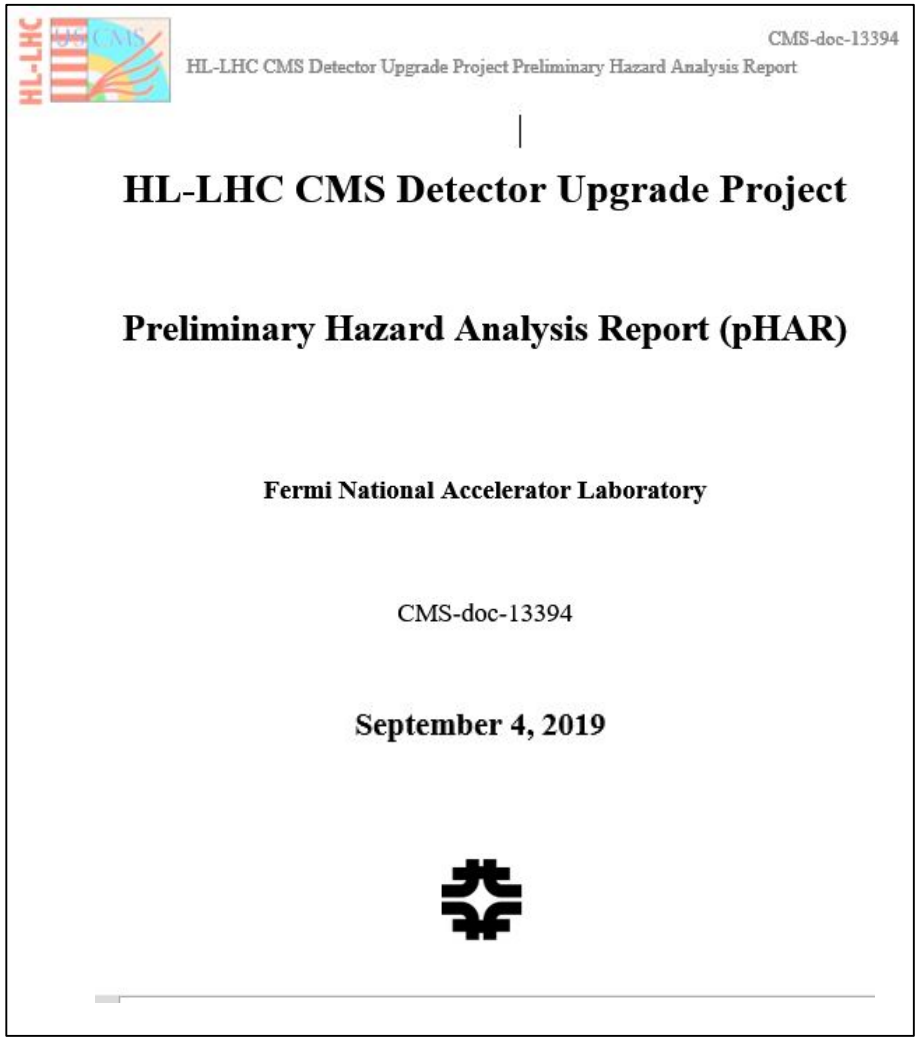
[Ref-5] IS41: *The Use of Plastic and Other Non-Metallic Materials at CERN with Respect to Fire Safety and Radiation Resistance*, https://edms.cern.ch/document/335806

[Ref-6]IS23 Rev. 3: *Criteria and Standard Test Methods for the Selection of Cables and Wires with Respect to Fire Safety and Radiation Resistance*, https://edms.cern.ch/document/335745

[Ref-7]IS48: *Fire Prevention for Cables, Cable Trays, and Conduits*, https://edms.cern.ch/document/335813

[Ref-8] *Fermilab Environment, Safety and Health Manual* (FESHM), [Online]. Available: http://eshq.fnal.gov/manuals/feshm/.

Preliminary Hazard Analysis Report



- Covers design, prototyping, pre-production, and testing at U.S. institutions and Fermilab.
- Proactive identification of project hazards and plans for mitigation.
- Hazards are typical of those expected during detector upgrades.

CMS-doc-13394

pHAR Hazard Summary

- Mechanical (Cranes, Rotating equipment)
- Leaks and Spills (Oils, solvents, chemicals)
- Electrical (Shock, Arc flash)
- Fire
- ODH/CO_2 (ODH Class 0 at SiDet)
- Lasers
- Radiation (Sources)
- Toxic Materials (Solvents, glues, epoxies)
- Environmental (Oils, solvents, chemicals)
- ESD (Electrostatic Discharge Damage)

pHAR Hazard Summary

WBS Number	WBS Description	Mechanical Hazards	Leak/Spill Hazards	Electrical Hazards	Fire Hazards	CO_2 ODH/Cryo Hazards	Laser Hazards	Radiation Hazards	Toxic Material Hazards	Environmental Hazards	ESD Hazards
402.01	Management: Schedule, budget, travel, workshops, integration planning										
402.02.03	Outer Tracker: Sensors			×	×			×			×
402.02.04	Outer Tracker: Electronics			×	×			×			×
402.02.05	Outer Tracker: Modules	×	×	×	×			×	×		×
402.02.06	Outer Tracker: Flat Barrel Mechanics	×		×	×	×			×	×	
402.02.07	Outer Tracker: Integration	×		×	×	×					×
402.04.03	Calorimeter Endcap: Sensors	×	×	×	×		×	×			×
402.04.04	Calorimeter Endcap: Modules	×	×	×	×			×	×		×
402.04.05	Calorimeter Endcap: Cassettes	×		×	×	×		×	×		×
402.04.06	Calorimeter Endcap: Scintillator Callorimetry	×		×	×		×	×		×	×
402.04.07	Calorimeter Endcap: Electronics and Services			×	×			×			×
402.06.03	Trigger / DAQ: Cal Trigger			×	×						×
402.06.05	Trigger / DAQ: Correlator Trigger			×	×						×
402.06.06	Trigger / DAQ: DAQ			×	×						
402.08.03	Timing Layer: Barrel Timing Layer	×		×	×	×	×	×	×		×
402.08.04	Timing Layer: Endcap Timing Layer	×		×	×	×		×	×		×

Hazard Codes (From QAM 12030)

HAZARD SEVERITY (CONSEQUENCE):

Critical	**High**	**Medium**	**Low**	**Minimal**

MISHAP PROBABLILITY (Could occur once in):

Annual	**2 years**	**10 years**	**30 years**	**100 years**

RISK ASSESSMENT CODE:

Critical	**High**	**Medium**	**Low**	**Minimal**

- The Project does not have any Critical ratings on any of the Hazard Analysis Worksheets

pHAR Hazard Analysis Worksheets

6.1.5 HAZARD: Environmental impact due to leak, spill or release

HAZARD INITIATOR: Unsafe practices, equipment failure, procedural violation.

HAZARD CONSEQUENCE: Release of oils, solvents, chemicals or radiation to the soil, groundwater, air, or sanitary system.

COMMENTS: Water/glycol mixture used in coldbox systems for sensor testing. Glues, epoxies, and solvents are also used in varying quantites during construction.

RISK ASSESSMENT PRIOR TO MITIGATION:

Severity	☐ 1-Critical	☐ 2-High	☐ 3-Medium	☒ 4-Low	☐ 5-Minimal
PROBABILITY	☐ A-Annually	☐ B-Once in two years	☒ C-Once in ten years	☐ D-Once in thirty years	☐ E-Less than once in one hundred years
Risk Assessment Code	☐ 1-Critical	☐ 2-High	☒ 3-Medium	☐ 4-Low	☐ 5-Minimal

MITIGATING FACTORS (DESIGN):

- Closed loop cooling systems designed following all applicable standards and regulations.

MITIGATING FACTORS (OPERATIONAL):

- Only trained personnel will operate systems, following established operational rules.
- CO_2 systems are subject to sensor test box operational readiness reviews.
- Chemical usage is minimized through review; less hazardous chemicals and processes are substituted where possible.

RISK ASSESSMENT FOLLOWING MITIGATION:

Severity	☐ 1-Critical	☐ 2-High	☐ 3-Medium	☒ 4-Low	☐ 5-Minimal
PROBABILITY	☐ A-Annually	☐ B-Once in two years	☐ C-Once in ten years	☐ D-Once in thirty years	☒ E-Less than once in one hundred years
Risk Assessment Code	☐ 1-Critical	☐ 2-High	☐ 3-Medium	☐ 4-Low	☒ 5-Minimal

Communication

- We have ES&H management and oversight systems in place. This includes Fermilab and participating institutions.
- All Project personnel have the responsibility/authority to stop work when they believe an activity poses an imminent danger to individuals, the environment, or the equipment.
- ES&H concerns will be brought to the attention of the appropriate L2 Manager, the ESH&Q Coordinator, and the Project Manager.
- Incidents resulting in personnel injuries or significant equipment damage may result in a formal work stop.
- Events will be discussed at regularly scheduled meetings where appropriate.

Summary

- The ES&H program is fully integrated into the Project.
- Roles and responsibilities have been defined for all levels of the Project.
- Hazards are evaluated and mitigation strategies put in place to protect employees, equipment, and the environment.
- We have addressed the recommendations from previous reviews.
- Documentation required by DOE O 413.3B is in place.
- Applicable codes and standards have been identified and documented.
- Ready to proceed to CD-1.