United States
Department of Energy
Office of Science

Accident Investigation Report

Ironworker Injured from Fall at the
Fermi National Accelerator Laboratory
Proton Improvement Plan – II Construction Project

Disclaimer

On May 26, 2023, Juston K. Fontaine, Deputy Director for Operations, Office of Science, appointed an Accident Investigation Board ("AIB" or "Board") to investigate an incident that occurred during construction at the Proton Improvement Plan – II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL) on May 25, 2023. Due to the seriousness of the event and the injuries sustained by the individual, the memorandum appointed a Board Chairperson for an accident investigation to be conducted in accordance with DOE Order 225.1B, *Accident Investigations*.

The discussion of the facts as determined by the Board and the views expressed in the report do not assume and are not intended to establish the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

Release Authorization

On May 26, 2023, as the Deputy Director for Operations, Office of Science, U.S. Department of Energy, I appointed an Accident Investigation Board ("AIB" or "Board") Chairperson to investigate the accident that occurred during construction at the Proton Improvement Plan–II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL) on May 25, 2023. This direction was amended on June 1, 2023, to appoint the remainder of the Board.

The Board's responsibilities have been completed with respect to this investigation. The analysis and the identification of the contributing causes, the root cause and the Judgments of Need resulting from this investigation were performed in accordance with DOE Order 225.1B, *Accident Investigations,* dated March 4, 2011.

I accept the findings of the Board and authorize the release of this report for general distribution.

9/6/23

Juston K. Fontaine
Deputy Director for Operations
Office of Science
U.S. Department of Energy

Date

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Acronyms and Abbreviations

AIB	Accident Investigation Board
B	Billion
BES	Basic Energy Sciences
Board	Accident Investigation Board
CAS	Contractor Assurance System
CD-0	Critical Decision-0
CESH	Construction Environmental, Safety & Health
CESHC	Construction Environmental, Safety & Health Certification
CON	Conclusion
DDO	Deputy Director for Operations
DOE	U.S. Department of Energy
DUNE	Deep Underground Neutrino Experiment
EMR	Experience Modification Rate
EMS	Environmental Management System
EOC	Emergency Operations Center
ERMB	Enterprise Risk Management Board
ERMP	Enterprise Risk Management Program
ES&H	Environment, Safety and Health
ESH&Q	Environment, Safety, Health and Quality
FESHM	Fermilab Environment, Safety and Health Manual
FNAL	Fermi National Accelerator Laboratory
FPD	Federal Project Director
FRA	Fermi Research Alliance, LLC
FRAPM	Functions, Responsibilities, and Authorities Program Manual
FSO	Fermi Site Office
FTE	Full Time Equivalent Employee
FY	Fiscal Year
GERT	General Employee Radiation Training
HA	Hazard Analysis
Harris	Harris Rebar Placing, LLC
HEP	Office of High Energy Physics (DOE Office of Science)
HEPAP	High Energy Physics Advisory Panel
HPI	Human Performance Improvement

IIPP	Injury and Illness Prevention Program
ISEM	Integrated Safety Environmental Management
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
IW1	Injured Ironworker
JHRA	Job Hazard Risk Analysis
JON	Judgement of Need
JTA	Job Task Analysis
LBNF	Long-Baseline Neutrino Facility
LINAC	Linear Accelerator
M	Million
M&O	Management and Operating
MNS	Mission Need Statement
MSO	Management System Owner
NTP	Notice to Proceed
Nucor	Nucor Harris Rebar Midwest LLC
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
O	Order
P5	Particle Physics Project Prioritization Panel
PARS	Performance Assessment Reporting System
PEMP	Performance Evaluation and Management Plan
PEP	Project Execution Plan
PIP-II	Proton Improvement Plan – II
PPE	Personal Protective Equipment
QIS	Quantum Information Science
QR	Quick Response
S-3	Subcontractor Safety Subcommittee
SC	DOE Office of Science
SME	Subject Matter Expert
SOG	Services Oversight Group
SQMS	Superconducting Quantum Materials and Systems
SRL	Self-Retracting Lanyard
SSSP	Site Specific Safety Plan

SURF	Sanford Underground Research Facility
T&M	Time and Material
TQP	Technical Qualifications Program
U.S.	United States
WBS	Work Breakdown Structure
WCEI	Whittaker Construction & Excavating, Inc.
WPC	Work Planning and Control
WSHP	Worker Safety and Health Program

EXECUTIVE SUMMARY

On May 25, 2023, during construction at the Proton Improvement Plan–II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL), ironworkers were preparing to attach a rebar template to the side of a form wall. During this task, an ironworker positioned near the top of the form wall fell approximately 23 feet, striking a diagonal brace before landing on the concrete slab below, sustaining serious injuries, including head trauma.

On May 26, 2023, the U.S. Department of Energy (DOE), Office of Science (SC), Deputy Director for Operations (DDO) appointed a DOE Accident Investigation Board ("AIB" or "Board") to investigate the event to determine the facts and circumstances related to the event and identify possible status and adequacy of corrective actions from prior construction incidents and evaluate if systemic weaknesses are present in the Laboratory's construction safety program. The objective was to analyze the event and determine direct, root, and contributing causes, and from these provide Conclusions (CONs) and Judgments of Need (JONs).

The Board was faced with some unique situations and challenges as they prepared to conduct the investigation. Prior to its on-site investigation at FNAL, the Board was provided access to video footage that had been recorded on the construction site progress, which coincidently captured some work activities including the injured worker at the time of the accident. The availability of this video was instrumental to the Board's investigation. The video allowed some general conclusions to be drawn on the site conditions, placement of workers, and the mechanics of actions taken by workers. Unfortunately, the video does not help the Board understand the motivation behind why certain conditions existed, and why certain decisions were made to account for the actions observed.

Critical information to fill in the 'unknowns' related to worker motivations and details about the site conditions and working environment were not available, as ironworkers declined requests to be interviewed by the Board. This significantly limited the Board's understanding of the event context necessary to evaluate human performance aspects and thereby limited the foundation upon which our causal analysis was based.

The Board was able to conduct interviews with many construction workers on site the day of the accident, as well as support personnel in project oversight and emergency response roles. Workers interviewed by the Board were familiar with focus topics on safety being discussed at the Whittaker Construction and Excavation, Inc. (WCEI) daily jobsite planning meetings and expressed that they would not have any reluctance to raise a safety concern or ask a question if they had one. Despite these attributes, the numerous deficiencies noted during the accident investigation indicated management systems were not sufficiently comprehensive to identify and correct programmatic gaps.

The work instruction used to brief workers on the day of the accident did not identify the task being performed by the injured ironworker (IW1). Additionally, the document being used in the field, and signed by IW1, had not been accepted by the Fermi Research

Alliance, LLC (FRA) as required prior to the start of work. The Board's analyses identified that the injured worker did not use the fall protection PPE they were wearing in accordance with requirements. The Board identified many other safety program requirements were not being implemented at the PIP-II construction site. The definition of work activities was not clear or specific, and lacked the necessary identification of hazards and controls. The multiple subcontracts and subcontractor relationships did not include a methodology to establish a clear flow down of requirements. Oversight at multiple levels failed to recognize errors, omissions and incomplete safety documents had resulted in unapproved/unaccepted versions of documents being used for daily work activities. Collectively, these conditions indicate a systemic weakness and lack of attention to detail in managing project documentation.

The direct cause of the accident is the immediate event or condition that caused the accident. The Board identified that the direct cause of this accident was that IW1 fell approximately 23 feet to the concrete pad resulting in serious injuries, including head trauma.

Contributing causes are events or conditions that collectively with other causes increased the likelihood or severity of an accident, but that individually did not cause the accident. The Board identified the four (4) contributing causes of the accident and its consequences. The contributing causes were:

- Worker conducted the task without the use of required fall protection;
- Requirements not being implemented as expected;
- Direction of work not clear; and
- Work is not adequately defined with identified hazards, and applicable development and implementation of hazard controls.

The root cause, if corrected, would prevent recurrence of the same or similar accidents, and address the charge elements assigned to the Board. In consideration of the above and other causes detailed in this Accident Investigation report, the Board determined that the root cause of the accident was that FRA has not assured that Integrated Safety Management was effectively implemented within the PIP-II project.

The Board identified 23 CONs and 12 JONs representing improvements, that if fully considered beyond the short term, will provide the necessary foundation for FRA to build upon, in order to reduce the potential for recurrence of similar events. The CONs and JONs are documented in Table ES-1below, and in Section 5.0 of this report.

Table ES-1. Conclusions and Judgments of Need

Conclusions	Judgments of Need
CON-1: Work tasks were not defined in sufficient detail, which did not allow for adequate identification of hazards and hazard controls to be developed.	JON-1: FRA PIP-II Project Management needs to ensure all subcontractors are defining work tasks prior to work.
CON-2: FRA, WCEI, Nucor, and Harris Management did not ensure that the principles of hierarchy of controls were implemented to evaluate opportunities to reduce worker exposure to hazards during work execution. CON-3: FRA, WCEI, Nucor, and Harris Management has not ensured that hazard controls are developed, implemented, and that work is performed within those controls.	JON-2: FRA PIP-II Project Management needs to ensure all subcontractors develop processes to ensure that all work is thoroughly analyzed, hazard controls are developed and implemented, and work is performed within those controls.
CON-4: FRA Management failed to mitigate previous work control deficiencies and implement effective corrective actions which would be expected in a robust feedback and improvement system.	JON-3: FRA Management needs to ensure work control deficiencies found during assessments are mitigated, and effective corrective actions are implemented in a timely manner as a part of their feedback and improvement system.
CON-5: Subcontractor management was not fulfilling safety program requirements resulting in safety practices not being implemented.	JON-4: FRA PIP-II Project Management needs to ensure FRA and its subcontractors conduct ongoing field verification of project compliance with accepted safety plans and performance of work.
CON-6: FRA failed to ensure that the accepted safety requirements and work practices were being implemented by all sub-tier subcontractors to execute work. CON-7: FRA processes allowed multiple and widespread issues within the project to go unrecognized. CON-8: The FRA CAS Program has been in transition and operating for many months without FSO review and approval.	JON-5: FRA needs to evaluate the proper frequency and independence in assessing worker safety program performance at the PIP-II Construction Project. JON-6: FRA needs to complete the CAS Program revision, obtain FSO approval and ensure effective implementation at the PIP-II project and across the entire Lab.

Conclusions	Judgments of Need
CON-9: Determining the overall health and effectiveness of the FRA CAS program is secondary to ensuring that the program is compliant with requirements.	
CON-10: FRA allowed WCEI to flow down requirements, including DOE safety requirements, to lower-tier subcontractors through indirect reference; thereby limiting awareness of applicable requirements for the execution of the work.	JON-7: FRA needs to establish procurement processes that clearly require the flow down of requirements to all levels of subcontractors to ensure that all requirements are available to all subcontractors.
CON-11: FRA PIP-II personnel are not fully aware of FESHM and contract requirements resulting in ineffective project oversight. CON-12: FRA failed to provide sufficient oversight of WCEI's, and Harris's critical work planning processes. CON-13: FRA responsibilities are not clearly assigned, as FESHM requirements were not written in a methodical manner to ensure full implementation and with defined responsibilities for all requirements. CON-14: The number of errors, omissions, and incomplete documents indicates a systemic weakness and lack of attention to detail in managing project documentation. CON-15: The lack of inclusion of medical services and first aid requirements from 29 CFR 1926.50(c) in the WCEI and Harris SSSPs is a gap that could lead to a delay in treatment for injured workers. CON-16: FRA failed to ensure that the safety documentation acceptance process was completed for all sub-tier subcontractors and allowed documents that had not been accepted for use to execute work.	JON-8: FRA PIP-II Project Management needs to clearly define, communicate, and execute project roles and responsibilities.

Conclusions	Judgments of Need
CON-17: FRA and subcontractor Management failed to ensure construction subcontractors had the required training to execute assigned work activities per FRA requirements, including high hazard work activities.	JON-9: FRA Management needs to ensure construction subcontractors are properly trained and qualified to execute work activities.
CON-18: FRA did not follow accident response and field preservation requirements.	JON-10: FRA needs to establish roles and responsibilities and protocols for accident response, and scene preservation.
CON-19: The FSO oversight approach on the PIP-II project has allowed gaps in the FRA CAS program that permitted weakness in subcontractor work processes. CON-20: FSO's oversight did not apply the degree of independence needed to assess PIP-II project work plans and execution or assess the effectiveness of FRA's CAS performance.	JON-11: FSO needs an oversight strategy that incorporates sufficient independence and is based on integration of project information.
CON-21: Despite minor deficiencies, the FRA emergency response addressed the accident and ensured IW1 was attended to with appropriate medical care and transported to an appropriate Level One Trauma Center for further treatment. CON-22: Taking the helicopter resulted in a longer transportation time compared to using an ambulance. This option was not optimal for transportation time to a hospital. CON-23: FRA should advocate with regional emergency response agencies for improved FNAL patient transport protocols to ensure the best patient outcome.	JON-12: FRA needs to complete an analysis and meet with regional emergency response agencies.

1.0 Introduction

1.1 Background

On May 25, 2023, a construction accident occurred on the Proton Improvement Plan – II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL) in Batavia, IL. During an activity involving concrete formwork, a subcontract worker fell approximately 23 feet. The individual sustained serious injuries, including head trauma.

The United States (U.S.) Department of Energy (DOE), Office of Science (SC), Deputy Director for Operations (DDO) directed an accident investigation to determine the facts and circumstances related to the construction accident, as well as any contributing factors at FNAL, and appointed the Accident Investigation Board ("AIB" or "Board") Chairperson on May 26, 2023. The May 26, 2023, appointment memorandum is included in Appendix A to this report. At this point, the criteria in DOE Order (O) 225.1B, *Accident Investigations,* to establish a Federal AIB had not yet been met. However, as identified in the appointment memorandum, "given the seriousness of the event and the injuries sustained to the individual, as well as the likelihood that the incident may result in the criteria of DOE O 225.1B, Appendix A, item 2.a.(2)", the DDO formally appointed the Chairperson of the Board and the Board.

The DDO directed that an investigation be conducted to identify causal factors, including a review of any relevant policies, procedures, work practices, or actions related to the accident (Appendix A). The investigation would also explore, as appropriate, an extent of condition. The May 26, 2023, appointment memorandum charged the Board to address the following items:

1. Determine the facts leading up to the accident.

2. Review the adequacy of the Laboratory's immediate response, interim actions, and extent of condition evaluation in response to this accident.

3. Assess the application of the construction program to include processes of training, planning of hazards, oversight, safety measures, and the work controls in place.

4. Assess the procedures for and actions taken to conduct, document, and perform the construction activities underway and provide for safe execution.

5. Conduct a causal analysis, using recognized methodologies, as needed, to determine the root and contributing causes of the accident that led to the injury.

6. Review and assess the status and adequacy of corrective actions from prior construction accidents at FNAL in the last three years for relevance and adequacy to prevent reoccurrences.

7. Evaluate whether broader systemic weaknesses are present in the Laboratory's construction safety program.

The accident was later found to meet the criteria provided in DOE O 225.1B, Appendix A, Item 2.a.(2): any single accident that results in the hospitalization for more than five calendar days commencing within seven calendar days of the accident, of one or more DOE, contractor, or subcontractor employees or members of the public due to a serious personal injury or acute chemical or biological exposure", and the DDO formally appointed a DOE AIB.

On June 1, 2023, the DDO amended the initial charge that established the Board to investigate the accident in accordance with DOE O 225.lB and appointed the remaining members of the Board. The June 1, 2023, amendment is also provided in Appendix A of this report. The action and charge, as communicated in the memorandum of May 26, 2023, remained the same for the appointed Board, but added additional expertise to the appointed Board's composition.

The Board first met as a group virtually on June 2, 2023, and met in person at FNAL on June 7, 2023, and began document reviews and walkdowns of the accident location. Interviews were conducted by the Board with personnel from the Fermi Site Office (FSO), Fermi Research Alliance, LLC (FRA), Burns and McDonnell (support contractors providing technical support to FRA for PIP-II project), Whittaker Construction and Excavation, Inc. (WCEI), and other subcontractor employees on site the day of the accident from Connelly Electric, and O'Donnell Crane services. Interviews were also conducted with one member of Nucor Harris Rebar (Nucor) and one member of Harris Rebar Placing, LLC (Harris); however, neither were on site the day of the May 25, 2023, accident.

Early in the investigation and as part of the finalization of the collection of facts and factual accuracy review, the Board made several requests to interview the Harris ironworkers on site the day of the accident, both directly and through their representatives. None of these offers were accepted by the ironworkers or their representatives; therefore, none of the ironworkers, including the injured ironworker (IW1), were interviewed directly as a part of this accident investigation. The Board relied on other interviews, document reviews, information from previous reviews and assessments, as well as information from Harris ironworker interviews conducted by FRA personnel on June 2, 2023, and witness statements taken before workers were released from the site the day of the accident.

In addition, the PIP-II construction site was monitored by a video camera to capture project progress for the PIP-II project team and the international community making contributions to the project, and to continue to build awareness and excitement in the physics and local community about the project. These videos, along with the security camera footage, were utilized by the Board during the investigation to observe work activities, including the accident and the emergency response. These videos provided insights into the work routines and practices during the PIP-II construction activities contributing to the formulation of this report. Figure 1-1 provides the accident investigation terminology used by the Board contributing to the formulation of this report.

A **causal factor** is an event or condition in the accident sequence that contributes to the unwanted result. There are three types of causal factors: cause(s), which is the immediate event(s) or condition(s) that caused the accident; root causes(s), which is the causal factor that, if corrected, would prevent recurrence of the accident; and the contributing causal factors, which are the causal factors that collectively with the other causes increase the likelihood of an accident, but which did not cause the accident.

The **direct cause** of an accident is the immediate event(s) or condition(s) that caused the accident.

Root causes are the causal factors that, if corrected, would prevent recurrence of the same or similar accidents. Root causes may be derived from or encompass several contributing causes. They are higher-order, fundamental causal factors that address classes of deficiencies, rather than single problems or faults.

Contributing causes are events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident. Contributing causes may be longstanding conditions or a series of prior events that, alone, were not sufficient to cause the accident, but were necessary for it to occur. Contributing causes are the events and conditions that "set the stage" for the event and, if allowed to persist or re-occur, increase the probability of future events or accidents.

Event and causal factors analysis includes charting, which depicts the logical sequence of events and conditions (causal factors that allowed the accident to occur), and the use of deductive reasoning to determine the events or conditions that contributed to the accident.

Barrier analysis reviews the hazards, the targets (people or objects) of the hazards, and the controls or barriers that management systems put in place to separate the hazards from the targets. Barriers may be physical or administrative.

Change analysis is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.

Error precursor analysis identifies the specific error precursors that were in existence at the time of or prior to the accident. Error precursors are unfavorable factors or conditions embedded in the job environment that increase the chances of error during the performance of a specific task by a particular individual, or group of individuals. Error precursors create an error-likely situation that typically exists when the demands of the task exceed the capabilities of the individual or when work conditions aggravate the limitations of human nature.

Figure 1-1. Accident Investigation Terminology

1.2 Site Description

FNAL Figure 1-2 is a single program DOE, SC, National Laboratory, operated by the FRA, an alliance of the University of Chicago and the Universities Research Association, Inc. FRA manages and operates FNAL for DOE and provides guidance, advocacy, and oversight. The FNAL campus is in Batavia, Illinois, 40 miles west of Chicago, and consists of 6,800-acres of DOE-owned land and a real-property lease with the South Dakota Science and Technology Authority at the Sanford Underground Research Facility (SURF) in Lead, South Dakota.

Figure 1-2. Aerial View of the Fermi National Accelerator Laboratory

FNAL's mission is to be the frontier laboratory for particle physics discovery. Thousands of scientists, engineers, technicians, users, and students from around the globe contribute their expertise to push the boundaries of particle physics knowledge. FNAL hosts a range of cutting-edge experiments and develops and builds technologies that support research at locations around the world, including the Large Hadron Collider in Europe and the South Pole Telescope. FNAL aims to be the worldwide leader in accelerator-based discovery neutrino science, a goal endorsed by the 2014 Particle Physics Project Prioritization Panel (P5). The new Long-Baseline Neutrino Facility (LBNF) will send the world's most intense neutrino beam to massive Deep Underground Neutrino Experiment (DUNE) detectors at FNAL in Illinois and at SURF in South Dakota. This will be made possible by completion of the PIP-II, the first particle accelerator on U.S. soil built with significant contributions from international partners. Through DUNE and a suite of short-baseline neutrino experiments, FNAL has brought the world together to unlock the mysteries of neutrinos.

The FNAL Accelerator Complex produces both low and high-energy neutrino beams. FNAL facilities and research also support world leading particle accelerator and detector

technologies and hosts several world-leading cosmic science efforts exploring the mysteries of dark matter and dark energy; and one of five national quantum information science (QIS) research centers, the Superconducting Quantum Materials and Systems Center (SQMS). Much of what shapes FNAL activities is completion of approximately $5.5 Billion (B) portfolio of projects, which involves on-site construction of facilities and supporting infrastructure.

As cited in the FNAL Fiscal Year (FY) 2022 Annual Laboratory Plan, Human Capital breakdown includes:

- 1,917 Full Time Equivalent Employees (FTEs);
- 30 Joint Faculty;
- 114 Postdoctoral Researchers;
- 52 Undergraduate Students;
- 273 Graduate Students;
- 1,681 Facility Users; and
- 975 Visiting Scientists.

FNAL's total real property inventory consists of 370 buildings, (10 of which are considered excess facilities) with 3.501 million (M) gross square feet of space, consisting of 28,913 in excess facilities and an additional 25,005 gross square feet in leased space, with an estimated Replacement Plant Value of $2.66B. The tallest building at FNAL is the 16 story, 420,000 square foot, Wilson Hall which provides a good reference point for relative position on the site. Fiscal Year (FY) 2021 total costs were $587.87M, with over 90% coming from the SC High Energy Physics Program at $530.23M. Other sources of funding included SC Basic Energy Sciences, SC Advanced Scientific Computing Research, and other SC and DOE or Government Programs outside SC.

Proton Improvement Plan-II (PIP-II) Project

The PIP-II project was initiated in response to the SC Office of High Energy Physics Mission Need Statement (MNS) approved in 2015. That MNS was created to address recommendations made by the 2014 Particle Physics Project Prioritization Panel (P5) Report, a subpanel of the High Energy Physics Advisory Panel (HEPAP). HEPAP recognized the need to deliver higher power proton beams to the neutrino-generating target at FNAL, which serves the DUNE that will be located within the LBNF. PIP-II's objective is to provide high power proton beams to the neutrino-generating target that serves the DUNE program.

Figure 1-3. Rendering of the PIP-II Facilities

The total project cost approved for the project at Critical Decision 3 in April of 2022 was $978M, which allowed for initiation of construction with a project completion, Critical Decision 4, in the first quarter of fiscal year 2033. There was an early conventional facility subproject started in 2020 that included site work and the cryogenic plant construction, which preceded the current work. The remaining conventional facilities work includes additional site preparation, construction of the utility plant, the booster connection subproject, and the Linear Accelerator (LINAC) complex, which was where the current active construction is concentrated. The PIP-II construction site is located just east of Wilson Hall on the FNAL central campus, with the LINAC footprint extending to the south. The accident described in this investigation occurred on the construction site of the future Proton Improvement Plan-II facilities (Figure 1-3).

1.3 Accident Investigation Scope, Conduct, and Methodology

The Board began its activities on June 2, 2023, and completed the report on August 29, 2023. The Board reviewed and analyzed the circumstances surrounding the accident to determine its cause, as charged by the DDO, and to understand lessons learned to reduce the potential for recurrence of similar accidents. These analyses also included an assessment of potential deficiencies in safety management systems.

In addition, the Board was requested to specifically identify all relevant facts, determine direct, contributing, and root causes of the event, develop Conclusions (CONs), and identify Judgments of Need (JONs) to support the prevention of recurrence. The scope of the investigation also included DOE programs and oversight activities.

The Board conducted its investigation using the following methodology:

- Identifying facts relevant to the accident through interviews, document and evidence reviews, walkdown of the site, and examination of physical evidence.

- Developing event and causal factor charting, barrier analysis, change analysis to analyze the facts and identify the cause(s) of the accident.
- Developing CONs and JONs based on the analyses of information gathered, that lead to corrective actions to prevent recurrence.

1.4 Organizational Relationships

The following section provides information for the organizational entities with involvement and responsibilities related to the work performed at FNAL and the PIP-II project.

1.4.1 U.S. Department of Energy, Washington, D.C.

The U.S. Department of Energy (DOE) is both the owner and regulator of the DOE sites, including FNAL, and maintains responsibility for ensuring that all DOE mission activities, regardless of whether they are performed by DOE Federal employees or by DOE contractors, are performed safely (i.e., protective of the worker, the public, and the environment) and efficiently. DOE is led by the Secretary of Energy who is appointed by the President of the United States.

DOE's mission is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions and providing Federal stewardship for the 17 National Laboratories, including FNAL.

1.4.2 DOE, Office of Science, Washington D.C.

The DOE Director for the Office of Science (SC) reports to the Undersecretary for Science and Innovation within DOE. SC administers a variety of scientific program areas through multiple program offices, such as the Office of High Energy Physics (HEP), Basic Energy Sciences (BES), among others. SC's mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States. SC is the Nation's largest Federal sponsor of basic research in the physical sciences.

1.4.3 DOE, Office of Science, Office of High Energy Physics, Washington, D.C.

The High Energy Physics (HEP) program reports to DOE SC and supports experiments found deep underground and in outer space, around the U.S. and across the globe, including FNAL, that make this science possible. PIP-II is one of the HEP funded projects.

1.4.4 DOE, Office of Science Deputy Director for Operations, Washington, D.C.

The DOE SC Deputy Director for Operations (DDO) is responsible for the effective stewardship and management of the 10 SC National Laboratories and their contracts, including FNAL. Responsibilities include field office oversight, laboratory policy,

safeguards and security, facility and infrastructure management and modernization, and operations oversight, including such critical areas as nuclear safety, worker safety and health, the environment, and the isotope program. Through these efforts, the DOE SC Operations serves the Nation by facilitating the core research and development mission of the National Laboratories.

The DDO is the Head of Contracting Activity for the Management and Operating (M&O) contracts at the National Laboratories and manages the DOE Site Offices at the laboratory locations.

1.4.5 DOE, Fermi Site Office, Batavia, IL

The Fermi Site Office (FSO) is the local DOE office reporting to the DDO. The FSO, comprised of Federal staff, administers the contract, maintains situational awareness of operations, and provides oversight of Fermi Research Alliance, LLC (FRA). FRA is contracted with DOE to manage and operate FNAL. FSO's internal programs include oversight processes such as assessments, audits, reviews, inspections, tests, surveillances, and investigations, as well as less formal processes such as facility tours, walk-throughs, work observations, document and record reviews, attendance of contractor meetings, and other routine interactions with contractor management and staff.

1.4.6 Fermi Research Alliance, LLC, Batavia, IL

Fermi Research Alliance, LLC (FRA) is an alliance of the University of Chicago and the Universities Research Association, Inc. FRA manages and operates FNAL pursuant to a Performance Based Management and Operating Contract with DOE.

FRA is responsible for accomplishing the missions and programs assigned by DOE and managing and operating the Laboratory in accordance with the provisions of this contract. Included in the contract are provisions for ensuring the safety and health of workers and the public and the protection and restoration of the environment as fundamental responsibilities of the prime contractor, with appropriate flow down of those requirements to visiting scientists, users, and lower-tiered subcontractors.

1.4.7 Whittaker Construction and Excavation, Inc., Earlville, IL

Whittaker Construction and Excavation, Inc. (WCEI) is contracted to FRA for all labor, equipment, transportation, overhead, bonding costs, safety oversight, quality control oversight and supervision as required for the construction of the PIP-II LINAC Complex.

The subcontract is a Firm Fixed Price contract with a base period of performance described in the contract as December 1, 2022, to January 12, 2026. The contract was approved by DOE on December 16, 2022. The subcontract describes that WCEI will perform the work using its expertise and knowledge, and its performance will be accomplished in a workmanlike manner by qualified, careful, and efficient personnel. WCEI is responsible for the safety of all persons employed by WCEI and its

subcontractors on the FNAL site, or other Government premises, or any other person who enters the sites or premises for reasons relating to this subcontract.

1.4.8 Nucor Harris Rebar Midwest LLC, Bourbonnais, IL

Nucor Harris Rebar Midwest LLC (Nucor) was contracted to WCEI to furnish all materials, appropriate union labor, and supervision related to the supporting form and concrete preparation work for the PIP-II LINAC project.

Included in the contract are provisions that the Subcontractor shall take all reasonable safety precautions with respect to their work. The Subcontractor is to comply with (1) all safety measures initiated by (a) Contractor, or (b) Owner, or (c) both; and (2) with all applicable laws, ordinances, rules, regulations, and orders of any public authority for the safety of persons or property.

1.4.9 Harris Rebar Placing, LLC, Milford, MA

Harris Rebar Placing, LLC (Harris) was contracted to Nucor to furnish all labor, materials, equipment, and supervision necessary to complete the reinforcing steel and couplers installation on the PIP-II LINAC project. Included in this subcontract are statements that the specific terms and conditions will be the direct flow down of the agreement between Nucor and WCEI, together with the scope of work defined in this subcontract, and that Harris has a comprehensive and fully supervised safety program and agrees to assume sole responsibility for compliance with all safety requirements by Harris and Harris engaged parties.

2.0 The Accident

2.1 Description of Work Activity

The project involves the installation of form walls including pre-assembled sections of engineered systems from Doka USA, Ltd. (Figure 2-1). Doka concrete formwork wall sections were assembled at a staging area near the edge of the excavation and lowered into the site using a crane. Wall erection for the northwest corner of the structure commenced on May 24, 2023. Starting on May 24, 2023, and continuing to May 25, 2023, WCEI construction carpenters installed several sections of Doka form walls on the north and west sides of the project. Both WCEI carpenters and Harris ironworkers had also used an aerial lift in the days prior to the accident. Moreover, carpenters had utilized the aerial lift to perform work activities in the northwest corner of the formwork (Figure 2-2).

Figure 2-1. Northwest Corner of Doka Formwork

Figure 2-2. Aerial Lift in Use on Site

On the morning of May 25, 2023, the ironworkers used a crane to install a rebar column on the northwest corner of the forms. Subsequently, they installed a rebar template bar on the north side of the installed Doka form wall (Figure 2-3). IW1, a journeyman Harris ironworker, was assigned the task of passing wires attached to a piece of rebar through holes in the formwork at various points. Rebar ties are short sections of rebar with connecting wires which are used to secure the template bar to the formwork (Figure 2-4).

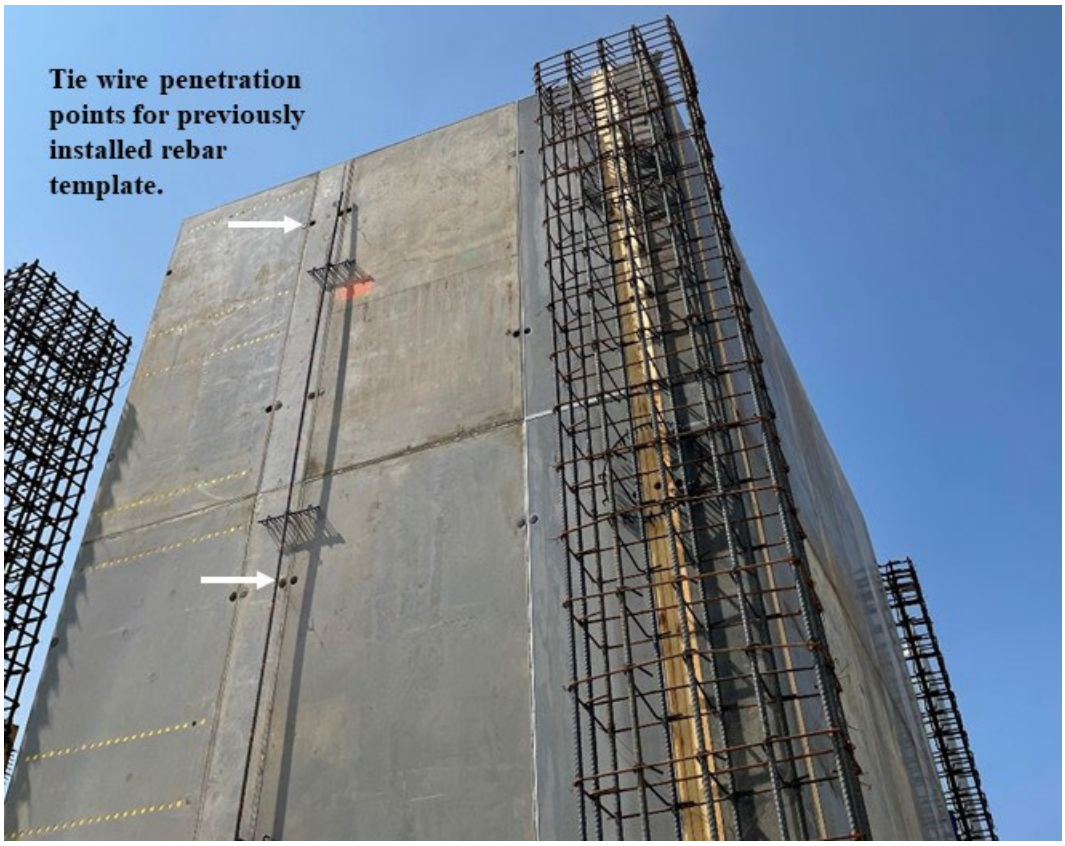


Figure 2-3. North Side of Doka Form Wall with Installed Template Bar and Tie Wire Penetration Points

Figure 2-4. Example of Rebar Tie

At approximately 1245[1], the ironworker's Foreman told IW1 about the tasks to be performed. IW1 began climbing the 26.5-foot-tall form wall at 1258 and stopped when

[1] Note that all times in this report refer to Central Daylight Time.

they neared the top, reaching a height of approximately 23 feet at 1301. IW1 was working alone on one side of the form wall, while three Harris ironworkers were on the other side of the wall, on the ground, preparing to raise a rebar template into place. Once in position, the rebar template was to be secured by the wires on the rebar tie inserted from the other side of the wall form by IW1 (Figure 2-5).

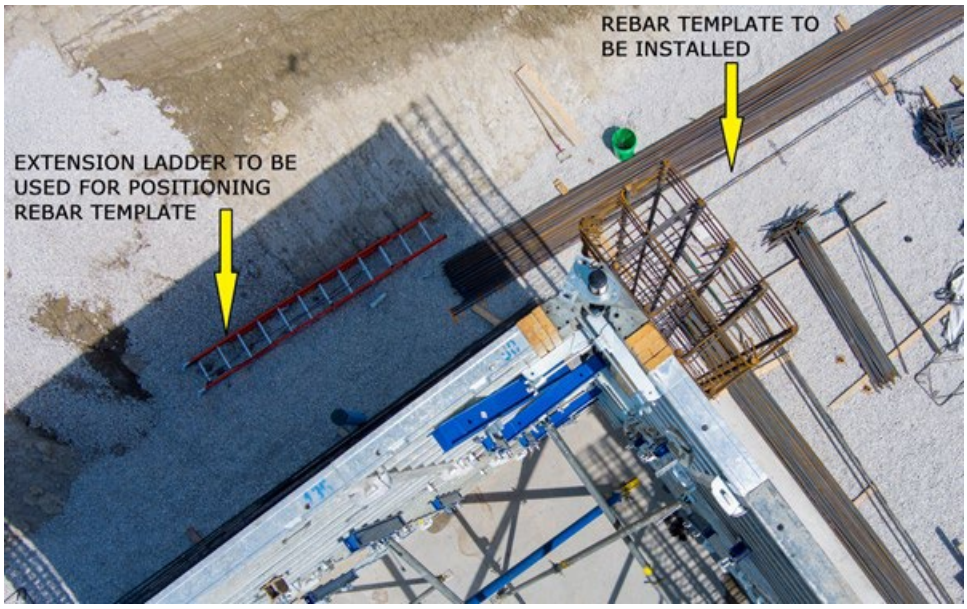


Figure 2-5. Overhead View of Rebar Template to be Installed on Opposite Side of Form Wall from IW1

In the absence of statements from IW1 or any eyewitness to the accident, the Board relied on the PIP-II video monitoring construction progress and the FNAL security camera recording from the east side of Wilson Hall to determine the actions and conditions present that may have contributed to the worker's fall. While positioned at the inside corner of the form wall near the top, IW1 had one foot on a horizontal rib of the west form wall, and the other foot on a horizontal rib of the north form wall (Figure 2-6). At 1301, both of IW1's hands were observed to grab the top edge of the form wall intersection and shortly thereafter the worker appears to engage the wall in a manner that allows them to lean back and support their weight. The means used by IW1 to initially engage themself to the form wall is not known. When IW1 repositioned themself at 1302, the means of engagement with the wall became ineffective.

The personal fall arrest system being worn by IW1 was not applied or utilized for that tentative connection. IW1 leaned back and promptly fell from the wall, falling approximately 23 feet to the concrete slab below, striking a diagonal cross brace approximately halfway down during the fall. IW1 sustained serious injuries, including head trauma.

Figure 2-6. Construction Worker (IW1) Working on Form Wall

2.2 Event Chronology

Table 2-1 summarizes the events and actions associated with the accident described in Section 2.1. The chronology table is designed to assist with the context around events on the day of the accident. A detailed depiction of the timeline associated with this accident is provided in the Events and Causal Factors Chart in Appendix L.

Table 2-1. Event Chronology Table

Date and Time	Event
11/15/2015	PIP-II CD-0[2] approved.
12/16/2022	DOE approved WCEI contract award.
12/16/2022	WCEI began execution of contract by Fermi Research Alliance, LLC.

[2] Per DOE Order 413.3B *Program and Project Management for the Acquisition of Capital Assets*, Critical Decision-0 (CD-0) documents that a mission need, such as a scientific goal or a new capability, requiring material investment exists. The mission need does not necessarily specify the facility, technology, or configuration of the project though these things are often described at some level.

Date and Time	Event
01/16/2023	Harris Rebar Placing, LLC signs contract (agreement) with Nucor.
01/25/2023	Nucor contract with WCEI executed.
02/13/2023	FRA procurement issued Notice to Proceed to WCEI.
02/15/2023	Construction contractor mobilization.
02/22/2023	WCEI submitted Harris Job Hazard Risk Analysis to FRA for comment.
02/27/2023	FRA returned Job Hazard Risk Analysis with Revise and Resubmit comments to WCEI and WCEI forwarded to Nucor/Harris.
04/07/2023	Harris workers first day working on site.
04/07/2023-05/24/2023	Rebar steel for the basemat and East form walls assembled.
05/01/2023	IW1 employed by Harris.
05/02/2023	IW1 1st day on jobsite.
05/25/2023 (0700)	WCEI Daily Jobsite Planning Meeting held.
05/25/2023	Harris Daily JTA Meeting conducted following WCEI Daily Jobsite Planning Meeting.
05/25/2023	IW1 signed Harris JTA.
05/25/2023	Morning work commenced.
05/25/2023	Assembled Doka panels lifted into place for northwest corner installation and braced.
05/25/2023	Lunch
05/25/2023 (1258)	IW1 began climbing Doka form.

Date and Time	Event
05/25/2023 (1300)	Weekly PIP- II project meeting conducted by WCEI Superintendent and attended by FRA and FSO.
05/25/2023 (1301)	IW1 reached top of Doka form approximately 23 feet up (from IW1's feet to the ground).
05/25/2023 (1301)	IW1 worked at top of the Doka form.
05/25/2023 (1302)	IW1 falls (Accident occurs)
05/25/2023 (1302)	WCEI Superintendent arrived and called for help from workers in area.
05/25/2023 (1302)	Nearby workers aid IW1, reported IW1 initially unconscious.
05/25/2023 (1302)	IW1 regained consciousness, complained that they could not breathe, Harris Foreman trying to keep IW1 calm.
05/25/2023 (1303)	WCEI Superintendent called Emergency Dispatch.
05/25/2023 (1303)	FRA Dispatch notified FRA Fire Department of fall at PIP-II Construction site.
05/25/2023 (1304)	FRA Deputy Fire Chief arrived at Dispatch Center.
05/25/2023 (1305)	FRA Fire Department personnel and emergency equipment leave station.
05/25/2023 (1306)	Batavia (IL) Mutual Aid Ambulance requested by dispatch.
05/25/2023 (1310)	Emergency Operations Center is placed on standby.
05/25/2023 (1311)	FRA Fire Department arrived on scene.
05/25/2023 (1313)	LifeStar (Chicago) Medivac Helicopter is placed on standby.
05/25/2023 (1314)	WCEI Superintendent phoned FRA PIP-II Construction ES&H Coordinator.
05/25/2023 (1314)	FRA Paramedic made first contact with IW1.

Date and Time	Event
05/25/2023 (1316)	IW1 carried on stretcher by on-site personnel from accident scene to meet FRA Ambulance 751 at the south end of the excavation.
05/25/2023 (1317)	Batavia Ambulance (Medic 51) arrived at construction site.
05/25/2023 (1317)	Landing zone changed by FRA Dispatch.
05/25/2023 (1322)	LifeStar (Chicago) Medivac was enroute to FNAL.
05/25/2023 (1322)	Ambulance 751 picked up IW1 at ramp of construction site.
05/25/2023 (1323)	Mutual aid requested for Batavia engine to prepare Landing Zone 3.
05/25/2023 (1325)	Batavia Engine E1 arrived at Landing Zone 3.
05/25/2023 (1327)	FRA Fire Chief was on FNAL location.
05/25/2023 (1329)	IW1 was transferred to Batavia Medic 51 ambulance and Medic 51 proceeded to Landing Zone 3.
05/25/2023 (1330)	FRA Fire Chief was on scene at the construction site.
05/25/2023 (1332)	Medic 51 arrived at Landing Zone 3.
05/25/2023 (1334)	FRA Leadership transmitted message to site personnel to avoid the Landing Zone 3 area.
05/25/2023 (1343)	LifeStar (Chicago) arrived at Landing Zone 3.
05/25/2023 (1351)	LifeStar (Chicago) landed at Landing Zone 3.
05/25/2023 (1354)	FRA Incident Commander sent the crew from E-704 to take pictures and document scene.
05/25/2023 (1356)	LifeStar (Chicago) medics made contact with IW1.
05/25/2023 (1359)	FRA Emergency Manager partial activation of EOC.

Date and Time	Event
05/25/2023 (1411)	LifeStar (Chicago) airlifted IW1 to Level One Trauma Center.
05/25/2023 (1426)	LifeStar (Chicago) arrived at Trauma Center with IW1.
05/25/2023 (1430)	FRA Incident Commander cleared call (terminates emergency).
05/25/2023 (1430)	FRA Security secured the accident site.
05/25/2023 (1738)	FRA issued a Stop Work to WCEI.
05/25/2023 (2143)	FRA Lab Director issued a Stop Work for hands-on work at Batavia site.

2.3 Emergency Response

Facts:

At approximately 1302 on May 25, 2023, the workers heard a yell as IW1 fell to the concrete slab from a height of approximately 23 feet. Within seconds of the accident, WCEI's Superintendent immediately came to the aid of IW1. The WCEI Superintendent called out for other workers in the area to assist.

Upon arrival, the workers find IW1 unconscious. IW1 regained consciousness and complained they were having difficulty breathing. The responding workers removed IW1's harness to address IW1's complaints and to keep IW1 calm. In addition, one of the project workers attending to IW1 used a bandana to wipe away blood from around IW1's mouth. The nearest first aid kit containing packs of disposable nitrile gloves and gauze trauma pads was located in the WCEI trailer, located outside the excavation area[3].

At 1303, the WCEI Superintendent placed a cell phone call to FRA Emergency Dispatch (FRA Dispatch) utilizing the emergency phone number they had written inside their hard hat (Figure 2-12). Within two minutes, FRA Dispatch toned out (notified) the FRA Fire Department. The on-site fire station is approximately a mile away from the accident scene. It took one minute for FRA Dispatch to notify the FRA Fire Department and an additional two minutes for the fire fighters to respond. At 1305, all first responders were enroute to the accident scene at the PIP-II construction site (Table 2-2).

[3] The SSSP submitted by WCEI and accepted by FRA, includes a specification to place a 25-person First Aid Kit in all working gang boxes.

FRA Fire Chief (C-711) was off site when notified of the accident and started their return to FNAL. The FRA Deputy Fire Chief (C-712) was in Wilson Hall, just west of the PIP-II construction site and proceeded to the FRA Dispatch Center, also located in Wilson Hall, so they could view the accident site from the security camera with coverage of the PIP-II construction site.

Table 2-2. Emergency Responders and Equipment

Responding Personnel and Equipment	Identifying Acronym
Whittaker Superintendent	WCEI Superintendent
Batavia Fire Department	BFD
FRA Fire Department	FD
Warrenville Fire Department	WFD
FRA Emergency Dispatch	FRA Dispatch
Tri Com Central Dispatch	Tri-Com
Warrenville Fire Department	WFD
FRA Fire Chief	C-711
FRA Deputy Fire Chief	C-712
Battalion Chief	B-701
DuPage County Dispatch	Du-Comm
FRA Fire Department Ambulance	A-751
FRA Fire Department Engine	E-704
Batavia Ambulance Medic 51	M-51
Batavia Engine	E-1

Battalion Chief (B-701), FRA Fire Department Ambulance (A-751), and FRA Fire Department Engine (E-704), left the fire station at 1305. At 1306, FRA Dispatch requested Level One Medical Mutual Aid assistance from the Batavia Fire Department due to the anticipated seriousness of the injuries associated with a fall from heights reported by the WCEI Superintendent. Batavia Ambulance Medic 51 (M-51) responded. FRA Emergency Manager placed the Emergency Operations Center (EOC) on standby at 1310.

The first emergency units arrived on scene by the crane on the west side of the excavation at 1311 for a response time of around seven minutes. B-701 took charge as the Incident Commander and established the Incident Command post on the west side of the excavation, illustrated as location 3 in the Overview of Emergency Response Locations Related to Accident (Figure 2-7). In Figure 2-7, LifeStar (Chicago) is shown as "Medivac".

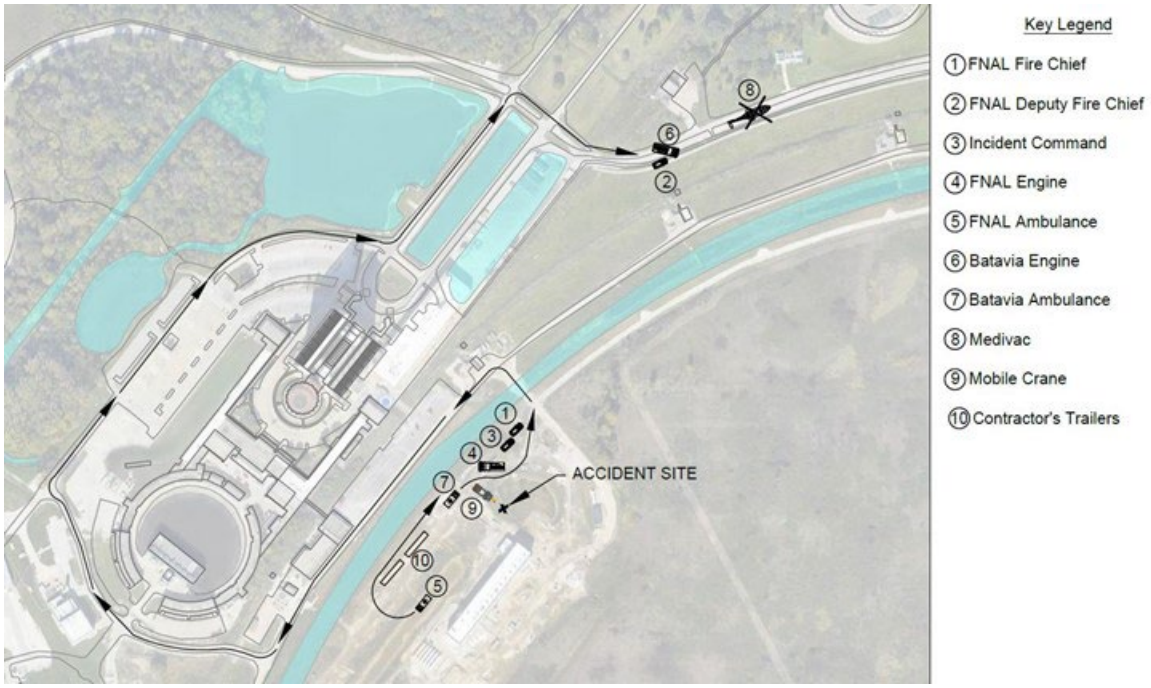


Figure 2-7. Overview of Emergency Response Locations Related to Accident

The FRA C-712 elected to let the experienced B-701 take command for the duration of the accident, and the Incident Command post was established to the west edge of the excavation and the accident scene. All initial responding units proceeded around the Main Ring Road, except for E-704 which cut through the parking lot that borders Wilson Hall's south side. They did not encounter congestion in the area. However, had there been cars or other equipment blocking this path, there could have been a delay and this path should be avoided during a response, unless necessary. Personnel from A-751 and E-704 proceeded down the long set of stairs (Figure 2-8) on the west side of the construction site and through the construction area to IW1, north of the stairs.

Figure 2-8. FRA's Fire Department (E-704) Arrives at the Accident Scene

FRA Dispatch placed a LifeStar (Chicago) Helicopter on standby (1313). FRA Fire Department personnel interviewed stated that their experience had been that patients are transported to the closest hospital due to regional policy, which in this case is a Level Two Trauma Center. Based on the injuries anticipated in this case, the FRA Paramedic and B-701 determined that direct transport to a Level One Trauma Center was in the best interest of the patient and made the decision to call for LifeStar (Chicago) support, which would result in transport to a Level One Trauma Center. During the response there was an issue with communication directly between LifeStar (Chicago) and the FRA Fire Department units on their radio frequency. Communications eventually had to be coordinated by FRA Dispatch.

At 1314, a Paramedic from A-751 ensured the scene was safe and made first contact with IW1. Medical assessment and care of IW1 was initiated. At 1314, the FRA Incident Commander requested mutual aid assistance from Warrenville Fire Department to assist with setting up a landing zone. Dispatch called LifeStar (Chicago) and was put on hold for four minutes. Ultimately, connection with LifeStar (Chicago) was completed and the helicopter was dispatched towards FNAL.

M-51 arrived on the scene near the Incident Command post at 1317. FRA and Batavia medical personnel provided additional medical treatment and prepared IW1 for transport to the responding ambulance, M-51. The Incident Commander made the decision to relocate A-751 to the edge of the construction area to load IW1. No other first responders were available; therefore, the Incident Commander moved the ambulance. IW1 was carried across the construction site (Figure 2-9) and up the south gravel ramp and dirt incline to where A-751 ambulance would eventually meet them (Figure 2-10). After arriving at A-751, IW1 was secured into A-751 at 1322 and transported to the west side of the construction site where Incident Command had been established and where

M-51 was staged. The location where A-751 received IW1 was on the hard gravel, and the drive to M-51 took less than 32 seconds. IW1 was then transferred from A-751 to M-51 at 1329 and into M-51's care.

Figure 2-9. IW1 being Carried to A-751

Figure 2-10. The South Gravel Ramp and Dirt Incline

During the time IW1 was being prepared for transport and transfer from A-751 to M-51, FRA Dispatch was arranging for a proper landing zone for LifeStar (Chicago). FRA Dispatch changed the landing zone to Landing Zone 3 at 1317. The DuPage County Dispatch (Du-Comm) advised the Incident Commander that Warrenville engine was "out of service" and could not provide support at Landing Zone 3. At 1321, the Incident

Commander then requested Batavia Engine (E-1) to provide mutual aid at Landing Zone 3. LifeStar (Chicago) was verified enroute at 1322.

At 1325, E-1 reported that they were enroute to Landing Zone 3 and arrived one minute later. FRA Fire Chief (C-711) reported being on FNAL at 1327 and FRA Fire Command advised C-711 to proceed to the construction site. C-711 arrived at the accident scene at 1330, while C-712 arrived at Landing Zone 3 at 1331 to manage the LifeStar (Chicago) medivac operation. M-51 arrived at Landing Zone 3 at 1332.

Site personnel were directed to avoid the area of Landing Zone 3 at 1334. LifeStar (Chicago) arrived at Landing Zone 3 and began their survey for landing hazards at 1343. At 1351, LifeStar (Chicago) landed at Landing Zone 3. LifeStar (Chicago) personnel made contact with IW1 at 1356 (Figure 2-11). At 1411, LifeStar (Chicago) proceeded to Good Samaritan Hospital, a Level One Trauma Center with IW1 on board. LifeStar (Chicago) arrived at the hospital at 1426. The total time from IW1 being transferred from M-51 to arrival at the hospital was 55 minutes, which was 84 minutes from the time of the accident.

Figure 2-11. Medic 51 and LifeStar (Chicago) at Landing Zone 3

While the above actions were being conducted, the Incident Commander sent the crew from E-704 to take pictures and document the scene of the accident at 1354. FRA Emergency Manager initiated a partial activation of the EOC at 1359 to support additional site activities. The Incident Commander turned the site over to FRA security at 1430. FRA leadership conducted a post-accident critique and critical accident stress debriefing for Fire Department personnel.

Analysis:

The phone number to emergency dispatch was readily available and enabled the WCEI Superintendent to place the call for help within seconds of the accident. The workers had been given a sticker for their hard hats with the emergency numbers printed on it. The WCEI Superintendent stated that the numbers on the original sticker were so small that some workers wrote the numbers inside their hard hats (Figure 2-12).

Figure 2-12. Emergency Phone Number Handwritten Written Inside Workers' Hard Hat

The FRA Fire Department was dispatched to the PIP II construction site for a worker that had fallen approximately 23 feet. It took one minute for FRA Dispatch to notify the FRA Fire Department and an additional two minutes for the fire fighters to respond and proceed to the incident.

All initial responding units proceeded around the Main Ring Road, except for E-704, who cut through the parking lot that borders Wilson Hall's south side. E-704 did not encounter congestion in the area. However, had there been cars or other equipment blocking this path, there could have been a delay and this path should be avoided during a response, unless necessary. The first unit arrived on scene at 1311, for a response time of around seven minutes.

The FRA fire department's ambulance team ensured the scene was safe and accessible while tending to IW1. Several site workers provided direct assistance to first responders, including facilitating navigation of the construction site and carrying IW1 to A-751 a

long distance over difficult terrain. In addition, the workers provided immediate and potentially life-saving assistance while preventing further injuries to IW1.

This was especially important as firefighters noted that it would have been useful to have one or two more personnel during the response. The need for assistance during the handling of IW1 and the Incident Commander having to move A-751 supports these statements. Another consideration in the response was if a first aid kit had been closer to the accident scene, such as a working gang box as referenced in the WCEI Site Specific Safety Plan (SSSP), it is more likely that workers responding to the injured worker may have utilized sealed and sanitized articles in the kit, including the use of gloves that could reduce their exposure to blood borne pathogens. This first aid kit location and failure to include first aid related training requirements are discussed further in Section 3.2.2.

The Incident Commander staged A-751 at the edge of the construction area and loaded IW1 into A-751, before proceeding 150 yards to transfer IW1 to M-51 at 1329 (Figure 2-13). The location where A-751 received IW1 was on the hard gravel, and the drive to M-51 took less than 32 seconds. During the interview with the Board, the Incident Commander made this decision based upon the available information, familiarity with equipment, and anticipated terrain at the time. This transfer added an extra three minutes to transporting IW1 to Landing Zone 3.

Figure 2-13. Transfer from Ambulance A-751 to Medic M-51

There was an initial issue with communication directly between LifeStar (Chicago) and the FRA Fire Department due to channel confusion. However, this did not impede LifeStar (Chicago) response. Communications were coordinated by FRA Dispatch.

Batavia Engine E-1 was requested to set up Landing Zone 3, as they had the manpower, GPS equipment and more experience in completing this task. Mutual Aid from E-1 was

exceptional, as they set up Landing Zone 3 in minimal time and worked well with other responders.

IW1 was transferred into M-51 at 1329 near the Incident Command and prepared for transport to a hospital. The choice of conveyance determined the total travel time for IW1 to reach the hospital. The current region-wide policy requires an ambulance to transport to the nearest hospital which, in this case, is a Level Two Trauma Center. The hospital would then decide if transfer to a Level One Trauma Center is warranted. In this emergency, FRA medical personnel determined that the extent of the injuries indicated the need for a Level One Trauma Center, so LifeStar (Chicago) was chosen. A google maps survey over three weekdays at the same time of day, averaged a drive time of less than 30 minutes for either the closest hospital, or the Level One Trauma Center where IW1 was taken by LifeStar (Chicago). The regional policy of sending ambulances to the closest hospital, which would have been a Level Two Trauma Center, was the determining factor in FRA's choice of LifeStar (Chicago). The total time of transport for IW1, including the travel time from M-51 near the Incident Command to Landing Zone 3, transfer to LifeStar (Chicago), and transport and receipt at the hospital, was 57 minutes. Use of LifeStar (Chicago) actually took over 25 minutes longer than if the ambulance had been allowed to proceed directly to the Level One Trauma Center when IW1 was transferred near the Incident Command and ready to be transported.

The transfer of the patient between the FRA and the Batavia ambulance did not have an impact on patient care, as they had to wait at Landing Zone 3 for the arrival of LifeStar (Chicago). Had the patient been taken directly by ambulance to a Level One Trauma Center, the transport time could have been cut in half, barring any unforeseen circumstances.

FRA EOC leadership made the excellent decision of sending out a message to avoid the area and to use security to close off key roads. FRA Dispatch, Mutual Aid Dispatch (Tri-Com and Du-Comm), LifeStar (Chicago), and the Batavia and FRA fire departments worked together in unison to provide the best care possible for the patient.

Although the construction site did have ramps that gave responders better access to the lower level, the FRA Fire Department had not visited the site to confirm its suitability for usage during an emergency. Review of the weekly PIP-II construction progress meeting report on May 18, 2023, revealed that the PIP-II project had planned to schedule a check-in with the Fire Department about site access, but that had not yet taken place as of the time of the accident. There was a process in place for Fire Department site visits to construction sites, but this had not yet occurred at the PIP-II LINAC construction site.

The Incident Commander made a great decision by having E-704 document the scene and take pictures before turning over the scene to FRA Security.

Identified Causal Factors:

Transportation of IW1 to the hospital was less than optimal (CF-C20)

2.4 Post-Event Accident Scene Preservation and Interim Actions

Facts:

On May 25, 2023, at approximately 1430, the PIP-II construction site was turned over to FRA security personnel and controlled from further access. The stairs on the east and west sides of the construction site, routinely used for site access, were blocked by a sign and wooden board, and site monitoring for unscheduled access conducted by security cameras (Figure 2-14). Public access to the PIP-II project video feed utilized to monitor project progress was discontinued shortly after the accident.

Figure 2-14. Barricades to Stairway Access in Place

Prior to the site being secured, actions were taken to place plastic safety covers on exposed rebar ends. It was verified that street barricades were in place at construction site access points. Most materials and equipment, except the personal protective equipment (PPE) associated with individual workers, were left in place. Controlled access to the site with FRA escorts occurred on four occasions by various organizational entities for organizational-specific accident investigation related activities between the time the site was secured after the accident, and the time the site was released back to FSO by the AIB on June 20, 2023 (Table 2-3).

Table 2-3. Access to the PIP-II Construction Site from Accident to Release of Scene by the Board

Entry Date	Purpose of Visit	Number of Personnel	Affiliation
May 31, 2023	Accident Investigation Activities	6	WCEI Nucor Harris
June 5, 2023	Accident Investigation Activities	2	DOE FSO FRA
June 7, 2023	Accident Investigation Activities	13	DOE FSO DOE Accident Investigation Board FRA WCEI Burns and McDonnell
June 14, 2023	Accident Investigation Activities	5	FRA DOE Accident Investigation Board

The site was maintained with some items on the concrete basemat left precisely as they were after the accident including a wrench and some work gloves that were not soiled by blood during the accident and therefore not removed by the first responders as part of the initial clean-up. Photographs were taken of the full body harness, two self-retracting lanyards (SRLs), positioning device and associated hooks, tool belt and straps prior to those items being placed into plastic bags (Figure 2-15).

Figure 2-15. Site Safety Equipment Attributed to IW1

Based on interviews with FRA personnel, IW1's equipment (Figure 2-16) was placed in two biohazard bags (Figure 2-17).

Figure 2-16. Equipment with Apparent Blood Stains

Figure 2-17. Materials from PIP-II Construction Site on May 25, 2023

During FRA interviews with Harris workers, the workers reported that the hard hat worn by IW1 was taken to IW1's vehicle the day of the accident and the vehicle was subsequently returned to IW1's residence later that day. Support braces and associated equipment that had been moved to allow better access to first responders were returned to their pre-fall positions by the construction crew prior to their leaving the site on May 25, 2023, to ensure safe configuration of the walls.

On June 7, 2023, with the concurrence of the Fermi Site Office, the Accident Investigation Board performed a walkthrough of the PIP-II LINAC construction site to view the condition of the site as it was preserved from the time of the accident and collect photographic evidence of site conditions, as well as discuss site configuration and conditions at the time of the accident with WCEI personnel on site during the accident. The team entered the site using the stairs on the west side of the construction site and made their way through the rebars embedded in the concrete and erected forms being prepared for the installation of the northwest exterior walls of the future LINAC facility.

The site visit was used to gather photographic evidence and directly view the configuration of the work site as it was preserved from the time of the accident, but nothing was touched or moved to preserve the scene. Members of the Board also visited the construction trailer on the west side of the construction site to view where morning meetings were conducted. Just south of the trailer was the entry point utilized by first responders to place IW1 into the ambulance. Worker safety equipment related to the accident was found and photographed on the day of the accident near this trailer, as well. The Board took the opportunity to inspect a first aid kit and safety posters in the trailer.

In addition, the Board members went to the area near the crane to view the location where the Doka forms were assembled and to see forms in various stages of assembly (Figure 2-18 and Figure 2-19). Visiting the area near the crane also provided the Board an opportunity to view the accident scene from the perspective of the Incident Commander on the day of the accident.

Figure 2-18. View of Construction Halfway Point from West Access Point

Figure 2-19. View of West Side of Doka Form Walls Showing Progress as of May 25, 2023

The Board reviewed information and conducted interviews to attempt to identify the chain of custody of the safety equipment worn by IW1 prior to and during the accident. The fall protection equipment was being stored by FRA personnel in an access-controlled room at Site 40 on the FNAL site. Four members of the Board went to inspect the evidence on June 12, 2023, at approximately 0930. Both bags were opaque and items inside were not readily identifiable (Figure 2-17). The two sealed bags related to the accident included a bag labeled "May 25, 2023 PIP-II Linac Proj. full body harness, DD self-retracting lanyard, position device", and a second bag with no label. Interviews with FRA personnel detailing the colors of IW1's equipment and description of the tool belt indicated the materials placed in the first bag were IW1's equipment worn during the accident, which included a full body harness, two SRLs, positioning device and associated hooks, tool belt and straps (Figure 2-15). The waste materials in the second bag were confirmed by Fire Department personnel to be from the clean-up of the scene.

The bags of material were left in the possession and under the control of FRA, consistent with a legal notice. The materials remain in the possession of FRA, and given that the materials were not visible, the Board relied on pictures of IW1's fall protection equipment taken prior to the equipment being placed in the bags. After departure from FNAL, the Board released the scene back to FSO on June 20, 2023.

Interim Actions

On the day of the accident, FRA took immediate actions to notify employees that a serious accident had occurred and conservatively paused all hands-on work at the Batavia

site through the Memorial Day weekend. This work pause continued until an All-Hands meeting conducted for FRA Personnel and Users and cascading small group discussions were held with all employees to discuss the impacts of the accident and the need to work safely and identify concerns in the workplace. The All-Hands meeting was conducted on May 31, 2023, at 0800, and was led by the Lab Director, Chief Operating Officer and Chief Safety Officer, followed by small group sessions. Hands-on work was resumed, except for work-at-heights, for FRA Employees and Users once these meetings were completed. Restart requirements for subcontractor work were established through a separate process.

FSO reviewed the FRA's plan for subcontractor resumption of work at heights above 4 feet, which was augmented by input from SC's Office of Safety and Security. Through a combination of observations made from FSO's field oversight and gaps identified in the FRA's written Work Resumption Plan, the FSO Manager sent a letter to the Laboratory Director on June 15, 2023, setting additional conditions and expectation on FRA's Work Resumption Plan. Additional conditions included, but were not limited to, FRA field oversight of work-at-height and at least three-day advanced notification for any additional subcontractors approved for working at heights above 4 feet.

FRA issued a Report, "Contract Iron Worker on the PIP II Linac Construction Site Fall from Height," dated July 2023. The FRA procedures for performing event investigations and causal analysis were not fully implemented as written when producing this report, such as identifying the composition of the causal analysis team. Table 2-4 presents management's response following the accident.

Table 2-4. Approximate Timeline of Management Response to Events

Date and Time	Event
05/25/2015 (1308)	FRA Chief Safety Officer was notified of the event.
05/25/2023 (1309)	FRA Director was notified of the event.
05/25/2023 (1310)	FSO Manager was notified of the event.
05/25/2023 (1310)	Deputy FSO Manager was notified of the event.
05/25/2023 (1359)	Partial activation of EOC. (EOC was on standby after initial notifications).
05/25/2023 (1737)	FRA issues a stop work order to WCEI.
05/25/2023 (2143)	FRA Lab Director issues a stop work order for all hands-on work at Batavia site through Tuesday May 30, 2023.

Date and Time	Event
05/26/2023	FRA categorized the event as meeting the following Occurrence Reporting and Processing System (ORPS) Reporting Criteria. **Subject or Title of Occurrence**: Serious fall injury at PIP-II LINAC construction site Reporting Criteria: 4B(1) - A formal shutdown of an activity or operation for safety reasons, directed by the DOE Field Element Manager, Contracting Officer or senior contractor management requiring corrective actions prior to continuing operations (e.g., a Stop Work Order).
05/31/2023	FRA holds Lab-wide All-Hands safety meeting and cascading small group safety meetings.
06/01/2023	FRA releases hands-on work at Batavia Site at conclusion of Safety Pause Exercise and cascading meetings (excluding work at heights).
06/02/2023	FRA resumes Subcontractor services except for those at heights.
06/08/2023	FRA re-starts work-at-heights for subcontractors on a case-by-case basis (does not include work at PIP-II).
06/08/2023	FRA issues updated ORPS report to add ORPS 2A(3) and 4B(1) categories: 2A(3) - Any single occurrence, injury, or exposure resulting in an occupational injury that requires in-patient hospitalization for five or more days, commencing within seven days from the date of injury. 4B(1) - A formal shutdown of an activity or operation for safety reasons, directed by the DOE Field Element Manager, Contracting Officer or senior contractor management requiring corrective actions prior to continuing operations (e.g., a Stop Work Order). Description of Occurrence: Update 6/8/2023: The ironworker remains hospitalized for greater than 5 days, meeting additional ORPS reporting criteria. The investigation into the accident is on-going.
06/14/2023	FSO directs FRA to provide documentation for restart of all upcoming work at heights by subcontractors a minimum of three days before the work (unless emergency work then ASAP) commences.
06/15/2023	FSO issues letter to FRA related to work from heights restart describing expectations for further resumption of work.

Analysis:

Post Event Accident Scene Preservation

The construction site was appropriately secured after the photos of the scene were taken, on-site personnel interviewed and dismissed, and medical clean-up activities completed. The maintenance of the site was also appropriate after the emergency response.

IW1's PPE was not tracked during or immediately after the emergency response. Review of video from the scene and interview statements from workers on site during the accident indicated that the hard hat worn by IW1 was taken by one of the crew and returned to IW1's vehicle. IW1's vehicle was subsequently taken from the site and the hard hat was not maintained on site as evidence after the accident. The location and path of travel of the full body harness, two SRLs, positioning device and associated hooks, and the tool belt and straps which were removed by workers when they responded to aid IW1, are not fully understood. During interviews and follow-up questioning with workers and first responders, all stated that they did not observe a two-way radio near IW1 after the fall or in the equipment that was removed while rendering aid.

Control of that equipment from when it was removed from IW1 to the time it was delivered to the construction trailer was not documented. However, statements of personnel and photos of the harness and associated equipment with remnants of blood indicate that the safety equipment worn by IW1 (Figure 2-15) is contained in the bag being maintained at Site 4 labeled as May 25, 2023, *PIP-II Project Full Body harness*, self-retracting lanyard, positioning device).

Although FRA personnel identified the equipment as that of IW1 and photos of the fall harness, body positioning lanyard, two SRLs, and tool belt/bag were made available to the Board, the Board noted that the actions to control the safety equipment worn by IW1 were not consistent with standard scene preservation and appropriate chain of custody. Statements from personnel and the apparent blood stains on the equipment, along with the equipment remaining behind after all personnel left the construction site, supported the designation of this equipment as belonging to IW1. During the Board Investigation, there were some delays in providing the Board access to information related to the chain of custody of IW1's PPE after the accident, and the opportunity to visually inspect evidence from the accident scene. This did not impact the Board's ability to conduct the investigation, but did extend the time required to gather facts, complete the analysis, and draw conclusions.

Interim Actions

There was proper notification to FRA and FSO management early in the event and both management teams coordinated to support the emergency response efforts. The determination that this was ORPS reportable was made on May 30, 2023, and finalized on July 25, 2023, as shown in Appendix B. Upon being notified that DOE chartered an AIB, FRA began to coordinate efforts through the FSO and offered support to the Board. The Board did identify that the FRA's resumption of work-at-heights for subcontractors was not fully or formally coordinated with FSO, which prompted follow-up meetings

between FRA's Chief Safety Officer and FSO management on and around June 12, 2023. The Board considers FSO's supplemental direction to FRA rigorous and commensurate with the significance of the hazards to workers.

Identified Causal Factors:

Actions not consistent with appropriate chain of custody (CF-C15)

3.0 Facts and Analysis

3.1 Flow Down of Requirements

Facts:

The contract between DOE and FRA includes references to Federal, State, and local laws, as well as clauses and DOE Directives. FRA is required to flow down those requirements to its lower-tier subcontractors where appropriate. Contract Section C.4, Statement of Work, includes:

> *(a) All work under this contract shall be conducted in a manner that will protect the environment and assure the safety and health of employees and the public. The Contractor shall implement an Integrated Safety Management System (ISMS) that includes an Environmental Management System (EMS).*
>
> *And*
>
> *(c)(2) Contractor shall, similarly, assure that subcontractor employees and users are trained and qualified on job tasks, hazards, and DOE and FNAL Departmental safety policies, expectations, and requirements, and shall flow applicable ES&H requirements down to subcontractors.*

The Federal regulation on workplace safety applicable to all DOE M&O contractors is 10 CFR 851, *Worker Safety and Health Program*. Other workplace safety and reporting requirements applicable to FRA are found in Attachment J.9, Appendix I of the contract:

- DOE Order 231.1B change 1, Environment, Safety and Health Reporting;
- DOE Order 232.2A change 1, Occurrence Reporting and Processing of Operations Information;
- DOE Order 225.1B, Accident Investigations;
- DOE Order 226.1B change 1, Implementation of DOE Oversight Policy; and
- DOE Order 450.2 change 1, Integrated Safety Management System.

In fulfillment of the requirements in 10 CFR 851.11, FRA developed a Worker Safety and Health Program (WSHP), which was last updated and approved by FSO on October 19, 2022. The scope of the WSHP applies to the design, construction, and operation of all the facilities at the FNAL main campus in Batavia, Illinois, and at the leased space in South Dakota associated with the LBNF Dune Project. Within the WSHP, the FRA Environment, Safety and Health Manual (FESHM) is identified as a central component through which 10 CFR 851 requirements are implemented to protect workers from occupational hazards. The FRA WSHP covers all subcontractor work, including the PIP-II Construction Project.

The contract between FRA and WCEI was signed on December 16, 2022, and flows down the provision that the subcontractor complies with all applicable Federal, State, and local laws, and WCEI is responsible for the overall safety of the PIP-II Construction Project. Excerpts from the contract include:

- *The safety of all persons employed by the Subcontractor and its subcontractors on the FNAL site, or other Government premises, or any other person who enters on the sites or premises for reasons relating to this Subcontract, shall be the sole responsibility of the Subcontractor.*

- *The Subcontractor shall give efficient supervision of the work, using its best skill and attention.*

- *The Subcontractor shall comply with FRA's environmental, safety, and health requirements for any work performed at the FNAL site, including the requirements set forth in 10 CFR 851 Worker Safety and Health Program.*

The contract establishes formal linkage between WCEI and the FRA WSHP, which encompasses relevant chapters and provisions within FESHM. Flow down of the FRA WSPH requirements is further evidenced in Section 3 of the WCEI SSSP that includes a "10 CFR 851 Acknowledgement" and hyperlink to the rule. A copy of the DOE poster on 10 CFR 851 worker rights and responsibilities (Figure 3-1) was found inside the entrance of WCEI's construction trailer, along with other information, such as fair labor standards.

Figure 3-1. DOE Poster 10 CFR 851 Worker Safety and Health Rights and Responsibilities

The contract between FRA and WCEI identifies the flow down of 10 CFR 851 requirements to WCEI's sub-tier subcontractors:

> *The prime Subcontractor may either flow down this requirement to each of its sub-tier subcontractors; or serve as a control and coordination point, requiring all sub-tier subcontractors' activities to be conducted under the prime Subcontractor's solitary Construction Environmental, Safety & Health Certification (CESHC). Acknowledgement of this flow down is required to be submitted by the Subcontractor for each sub-tier subcontractor prior to commencing work on the FNAL site.*

There are no direct references to 10 CFR 851 in WCEI's contract with Nucor, but reference is made indirectly through terms, such as Nucor will comply with all provisions of Federal, State, and local laws.

Given WCEI and Harris both submitted their respective company SSSPs for FRA's review and acceptance, and the conditions on CESHCs within the FRA-WCEI contract

(Appendix C), the Board requested a copy of the CESHC signed by Nucor, Harris, or any other sub-tier subcontractor to understand the contractual hierarchy of safety program requirements and associated 10 CFR 851 flow down. No signed CESHCs were provided to the Board for WCEI or its sub-tier subcontractors.

Analysis:

The contract between DOE and FRA has clear provisions to contractually flow down requirements to subcontractors, including safety requirements. The FRA Worker Safety and Health Program has been reviewed and approved by FSO and provides an adequate description of program requirements, as well as roles and responsibilities under 10 CFR 851. The subsequent flow down of those safety requirements are sufficiently reflected in FRA's contract with WCEI to manage and construct the PIP-II complex. Furthermore, WCEI's submitted SSSP that was accepted by FRA is considered to be well aligned with DOE's Integrated Safety Management (ISM) principles and includes acknowledgement of being subject to the requirements of 10 CFR 851.

Despite FRA's CESHC process defined in FESHM Chapter 7010, and the CESHC language included in the FRA-WCEI contract requiring sub-tier subcontractors to sign their affirmation on how 10 CFR 851 requirements will be implemented, FRA did not obtain or enforce submission of the certification statements. As such, it is unclear to the Board what FRA intended WCEI to do with the CESHC provision in the contract. Instead, the flow down of 10 CFR 851 safety requirements between WCEI and its sub-tier contractors, such as Nucor and Harris, relies on vague and indirect contractual language, introducing a lack of clarity as to when or if WCEI's submitted safety program takes primacy over safety programs that were submitted by sub-tier subcontractors at the PIP-II project.

Identified Causal Factors:

No indication of primacy of safety programs used by the various project organizations (CF-B19)

Requirements not being implemented as expected (CC-2/CF-C6)

3.2 SM/Work Planning and Controls Application to Construction Program

3.2.1 Define the Scope of Work

Facts:

DOE has assigned FRA the responsibility to plan and execute the PIP-II Project in a safe and responsible manner within an agreed-upon scope, cost, and schedule. As previously identified in Section 1.2 of this report, the PIP-II project has several elements that break down the work into executable pieces, including the construction of conventional facilities.

The part of the project being executed at the time of the accident is covered within Work Breakdown Structure (WBS) Item 121.6, Conventional Facilities. As identified in the Project Execution Plan (PEP), this part of the WBS covers labor, materials, travel, and costs associated with design and construction of conventional facilities including LINAC and beamline enclosures, equipment galleries, utility and cryogenic buildings, environmental mitigations, roads, and parking lots. The work being conducted on May 25, 2023, was setting up the form walls. Once both sides of the form wall are placed around the reinforcing steel, concrete will be poured into the void, creating the walls for the lower level of the LINAC facility.

The scope of work for the PIP-II project was contracted by FRA to WCEI. WCEI was responsible for the selection and installation of the form walls being used at the project. The form wall that was climbed by IW1 at the time of the accident was the Doka Framax Xlife system which had been installed by WCEI carpenters. WCEI contracted with Nucor to perform the project's work scope involving reinforcing steel. Nucor subsequently entered into a contract agreement with Harris, such that Harris was responsible for the fabrication and installation of reinforcing steel for the project. Harris employed the ironworkers tasked with installing the reinforcing steel, which included the reinforcing steel work being performed at the time of the accident.

The translation of contract requirements, as described in Section 3.1 of this report, are intended to flow from FRA through WCEI down to sub-tier subcontractors under WCEI, as there is no direct contractual relationship between FRA and sub-tier subcontractors, such as Nucor and Harris.

The contract between WCEI and Nucor includes an expectation that Nucor have an Environment, Safety and Health (ES&H) program commensurate with the complexity and nature of their work activities, and an overall commitment to safety. The terms of that contract also delineate WCEI's responsibilities to provide "…adequate protection to ensure the safety of those working above reinforced steel…". Several examples of 'protections' to be provided by WCEI to Nucor are listed in the contract, including "fall-protection anchorage points". The Doka form wall system selected, assembled, and installed by WCEI at the PIP-II project included integrated handles (Figure 3-2) that are identified by the manufacturer as compliant with OSHA requirements as personal fall arrest anchor points.

Figure 3-2. Doka Integrated Handles (Northwest Corner)

The PIP-II work instructions for ironworkers are comprised of various components, including information discussed during WCEI's daily jobsite planning meetings, Harris daily Job Task Analysis (JTA) meetings, and individual discussions between workers and their Foreman. Harris used this methodology to define their work on the project.

On the day of the accident, Harris' Job Hazard Risk Analysis (JHRA) identified the use of fall protection for climbing reinforcing steel but did not contain a description of the job activity and steps to be performed by IW1 after lunch on May 25, 2023. Note: Harris utilizes JHRA terminology to describe their hazard analysis documents.

Analysis:

The contract between WCEI and Nucor contains a host of responsibilities that clearly reside with WCEI, and those provisions appear to be consistent with their overall responsibility to provide a safe construction site for workers at the project. One of WCEI's itemized responsibilities includes making fall protection anchors available for use. WCEI's installation of the Doka form walls equipped with integrated fall protection anchors (handles) is considered to have met their contract obligation to "provide" fall protection anchor points for this formwork. Unfortunately, there is not a corresponding delineation in the contract on which party is responsible for conveying information to workers on the corresponding selection and use of fall protection anchors that have been provided.

WCEI is responsible for the selection of the form wall systems, and their carpenters are responsible for the associated installation; therefore, WCEI should be in possession of all necessary specifications and user instructions, including climbing form walls and the use of compliant fall protection anchor points for each form wall system. WCEI submitted to FRA a proposal on form wall systems to be used on the project on February 3, 2023. That submission was accepted by FRA, and it included information on both types of form wall systems the Board identified in use at the PIP-II project. Upon closer review of that submittal, it did not include information on compliant fall protection anchor points associated with the Doka system.

Some, if not all, of the Doka user instructions for their form wall products can be obtained through internet searches (Figure 3-3). Additionally, Doka includes a Quick Response (QR) code on their form wall sections to facilitate convenient access to information on the Framax Xlife system from a mobile phone. As the installer of the form walls, WCEI has a direct and immediate need to understand the specifications on those systems, as well as a responsibility in conveying information to their sub-tier subcontractors when form wall assemblies are adequately braced for climbing. During an interview with the Board, the WCEI Safety Representative stated they had no prior familiarity with the Doka system. This should have compelled WCEI to fully investigate the user instructions associated with this product to become sufficiently knowledgeable to share that information with the workforce and fulfill their oversight responsibility on the associated fall protection practices at the site.

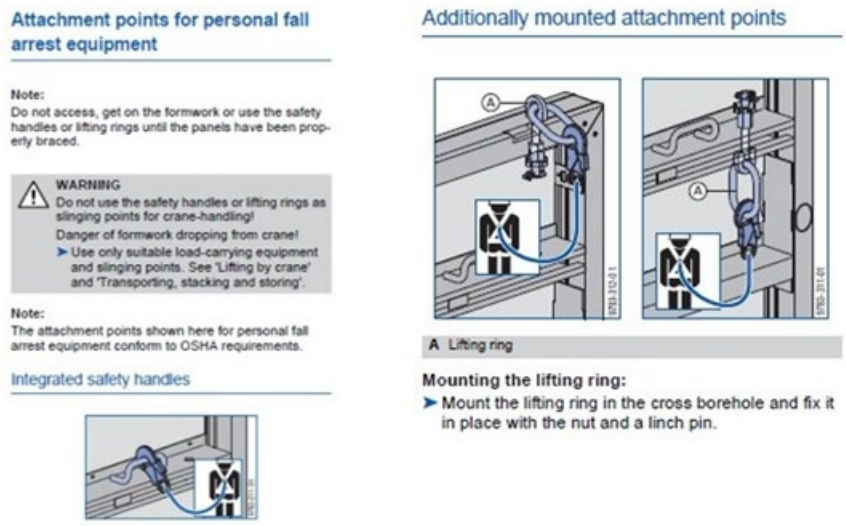


Figure 3-3. Anchor Point Information from Doka Website

Upon interviewing the Harris Placing Manager, they indicated that information on climbing form walls is the responsibility of WCEI. They also stated that climbing form walls is a customary task for ironworkers to perform. Yet the hazard analysis documentation used by Harris for briefing their workers at the PIP-II project did not include the task of climbing formwork. Collectively, these conditions identify a gap.

Harris failed to provide a hazard analysis for a task customary to their scope of work, and WCEI failed to acquire and share information needed for ironworkers to perform an anticipated task. Due diligence to protect ironworkers climbing formwork is shared between WCEI and Harris, but there was a gap in executing those responsibilities. Per the Harris SSSP, the Project Foreman is responsible to implement and enforce the SSSP and the Company Injury and Illness Prevention Program. Additionally, the Foreman is responsible to assess the safety of the operations assigned. In this capacity, the Harris Foreman should have recognized the JHRA discrepancy before assigning IW1 the task to climb the form wall and initiated an inquiry with WCEI in order to supplement the standing JTA/JHRA with information on how to perform the task safely. In doing so, the field change to the written hazard analysis should have also included full consideration of options to reduce the fall hazard risk to IW1. The resulting updated document would then have been ready to brief IW1 on the task to be performed, the hazards associated with that task, and the controls required to keep them safe. The task was assigned without the benefit of a revised hazard analysis and IW1 performed the task using techniques that relied on personal fall protection equipment or full understanding of compliant anchor points.

Furthermore, the work planning process and resulting work instructions do not contain task specific details that would allow workers to understand the details of the tasks or to ask questions about options for execution. The JHRA and JTAs that were developed from the work definition phase of the work planning process subsequently only provide general safety measures, and the lack of task-specific details flowing into the hazard analysis phase hindered the identification and mitigation of certain risks, particularly those related to climbing formwork.

Identified Causal Factors:

Used work techniques that rely upon personal fall protection equipment (CF-B6)

Scope of work not defined in sufficient detail (CF-B8)

Hazard analysis could not be adequately performed (CF-B9)

Specific Project requirements not available to subcontractor personnel (CF-C16)

Selection of compliant anchor points on Doka system not fully understood by workers and project oversight (CF-C17)

Direction of work not clear (CC-3/CF-B11a/CF-C11)

3.2.2 Analyze the Hazards

Facts:

The WCEI contract with FRA requires submittal of an ES&H Program for FRA acceptance. More specifically, Section 013100, ES&H Requirements, contains contract provisions that submitted safety programs include elements such as safety goals and ISM

principles. Both FESHM Chapter 7010 and the WCEI contract require the submitted ES&H Program to describe how hazards are identified and analyzed, how preventive controls are applied, and how a periodic inspection program is implemented. Other compulsory elements of the subcontractor's ES&H Program must include, but are not limited to:

- All subcontractor and sub-tier subcontractor employees are required to sign the analyses affecting their work thereby acknowledging understanding of the hazards and the mitigation activities.
- The name of Competent Persons will be included on the hazard analysis and communicated to all affected workforces.
- Specific procedures in the areas of fall protection, excavation, confined space, hoisting and rigging, and Lockout/Tagout may be required as job conditions dictate.

The WCEI SSSP was submitted to FNAL on February 1, 2023. FRA electronically signed WCEI's SSSP as accepted on February 2, 2023, electronically stamping the original transmittal sheet "NO EXCEPTION TAKEN," allowing the subcontractor to proceed with procurement, fabrication, manufacture, and installation.

The WCEI SSSP describes how it will manage project safety, along with requirements on how work is to be planned and hazard mitigation is to be applied. The WCEI SSSP includes guidelines further explaining that employees should be involved in all phases of the analysis, including reviewing job steps and procedures, discussing potential hazards, and recommending solutions. Workers were not involved in the development of WCEI daily jobsite plans or the hazard analysis development.

The template within WCEI's Hazard Analysis chapter, as referenced within their SSSP, describes how the hazard analysis form is to be completed, including consideration that should be given to applying a hierarchy of controls (Table 3-1). In short, 'hierarchy of controls' is a principle that line supervision should place an emphasis on the elimination of hazards first, followed by the selection of engineering controls over the use of administrative controls and PPE to protect workers.

Table 3-1. Whittaker Construction & Excavating Inc.
Job Hazard Analysis

Tasks and Procedures	Hazards	Preventative Measures Engineering Controls – Substitution – Administrative Controls - PPE
In this column, insert tasks undertaken to complete this activity. Identify all tasks and procedures associated with	In this column list all the known or suspected hazards associated with	In this column, identify the actions or equipment that are needed to remove the hazard from the task. Each preventive measure should be treated

the work project or activity that have potential to cause injury or illness to personnel and damage to property or material. Use short statements to describe the activity. Some activities will need greater detail than others. Each task should be treated as a separate item such as unloading material, stacking material, moving material, sorting material, etc. including emergency notification and emergency procedures.	each task or procedure listed.	as a separate item. Include any OSHA Standards as a reference only. Engineering controls are the most desirable level of abatement followed in order by substitution, administrative controls and personal protective equipment. Abatement actions may be combinations of engineering controls, substitution, administrative controls and PPE.

Harris submitted their SSSP for acceptance through WCEI to FRA on February 22, 2023. The Harris SSSP was primarily comprised of their JHRA. Comments from FRA's review of the Harris SSSP were provided back to WCEI, and subsequently forwarded to Harris on February 27, 2023, specifying "Revise and Resubmit" (Figure 3-4). Neither one of the SSSP submittals had a description of 29 CFR 1926.50(c) requirements for medical services and first aid, including ensuring a trained first aid provider is available, due to the predicted response times from the fire department to the construction site being greater than 3-4 minutes. Additionally, the requirements for a first aid kit in the gang box on the job site defined in the SSSP was not met.

Figure 3-4. Electronic Stamp Applied to Harris SSSP Submittal

Comments and questions provided by FRA on the Harris SSSP requested more specificity for select JHRA tasks and controls. Harris did not resubmit a revised SSSP to FRA, despite the requirement to do so, and work by Harris was allowed to commence on April 7, 2023, without FRA acceptance.

Copies of all PIP-II subcontractor Hazard Analyses submitted for FRA acceptance were requested by the Board. Among the Hazard Analyses reviewed by the Board, one included a submittal from a WCEI sub-tier electrical subcontractor. Although this Hazard Analysis was reviewed and accepted by FRA on March 9, 2023, the electrical subcontractor briefed workers on a Hazard Analysis document that had vacant spaces for the company representative's signature, and a blank space for the Supervisor's signature.

The table of contents in the Harris SSSP identified that Section 5 covers "*JHRA - Job Hazard Risk Analysis (Project Specific)*", and Section 6 covers "*JTA - Job Task Analysis (Project Specific).*" There were 27 pages of JHRA content in the SSSP, listing various tasks with corresponding risk classifications and hazard controls. There were no JTAs included in the Harris SSSP submittal, nor description of what the JTA process involves. During the Board's discussion with the Harris Placing Manager, they described the JTA as their means to create a job-specific safety plan if/when the database of JHRA's does not adequately cover a given activity. Harris ironworkers sign a daily briefing roster form with the heading "Job Task Analysis", but neither that document nor any other supplemental work planning document covered the steps and hazard controls for the task assigned to IW1 to climb the Doka form wall on May 25, 2023. None of the Harris daily JTAs or JHRA records reviewed by the Board were found to have field mark-ups to change or insert hazards unique to the site, or modification to the required controls.

The Harris SSSP signed by IW1 on May 2, 2023, and the daily JTA/JHRA signed by IW1 on May 25, 2023, provided general work steps for the task "*Build Walls in Place*" (Figure 3-5). The task descriptions and illustrations in both of those documents identify fall hazards are present when climbing rebar walls, with required controls including 100% tie-off above 4 feet.

Activity	Build Walls in Place									
	Work Steps and Tasks (Describe the tasks/steps in order)	Potential Hazards Identified for each Step/Task (Before any control measures are in place)	Probability	Severity	Initial Risk Rating	Control/Safe Work Procedure for each Step/Task (Ex. PPE, training... How do we keep them safe?)	Probability	Severity	Initial Risk Rating	Picture or Sketch
1	Locate rebar to be used for wall and move to location	Confusion among workers	4	5	20	Make sure JTA and wall tying/bracing plans are understood by all involved	2	5	10	
2	Remove dowel protection from the back face only	Impalement hazards	4	5	20	Only remove dowell protection as necessary	1	5	5	
3	Stand marked vertical bars for template Follow vertical work plan	Strain/Sprain/Cuts/Scrapes	4	2	8	Proper selection and use of PPE	2	2	4	
4	Make sure the wall is secured 4ft on center if it is going to be climbed	Improper frame up could cause worker to not be able to tie off in the proper location	4	5	20	Must be 100% tied off at or over 4 feet	1	5	5	
5	Use only engineered and approved tie back methods	Confusion among workers Failure to follow approved vertical work plan	4	5	20	Use only engineered and approved tie back methods Follow approved vertical work plan	1	5	5	
6	If a wall is going to be climbed the templates should be no further than 5ft apart for proper tie off, this only changes with the use of a areial lift	Improper tie off Unqualified/certified person using areial lift Falls from height	4	5	20	Qualified/certified persons to operate the lift Follow approved vertical work plan Lift must be inspected daily 100% tie off SRL/Lanyard hooks shall be secured when not in use	1	5	5	
7	Tie up horizontal bars to the top of the dowel out, place the remainder of the vertical bars	Wire pokes, Impalement hazards Struck-by	4	5	20	Proper selection and use of PPE Only remove dowell protection as necessary	2	5	10	
8	Tie the remainder of the horizontal bars on marks provided	Wire pokes	4	2	8	Bend wire ends as necessary PPE	2	2	4	
9	Tie the field to the specifications provided by your foreman	Confusion among workers	3	2	6	Good communication Ask questions/direction as needed	1	2	2	
10					0				0	
11					0				0	
12					0				0	
13					0				0	

Figure 3-5. Excerpt from Harris Job Task Analysis Meeting on May 25, 2023

The JHRA did not include details for tasks, risk analysis, or hazard controls for climbing formwork, including the Doka formwork system IW1 had climbed at the time of the accident. The selection of compliant anchor points for personal fall arrest systems was not identified for climbing form walls. Anchor points for climbing rebar walls/columns are fundamentally different than climbing formwork.

Analysis:

Overall, FESHM Chapter 7010 and WCEI's safety manual chapters within its SSSP adequately describe requirements and guidance to implement ISM Guiding Principles and Core Functions.

Despite FRA's 'revise and resubmit' response to Harris on their SSSP submission, this action was never undertaken by Harris. Work by Harris was, instead, allowed to proceed in an unaccepted state, and the comments originally provided by FRA were not incorporated into the Harris JHRAs used in the field as part of the daily JTA meetings. Additionally, Harris revised at least some of their JHRAs used in the field in April 2023, but the revisions still did not incorporate FRA's feedback (Appendix D).

The Harris JTA/JHRA that IW1 signed on May 25, 2023, provided general work steps and tasks for wall building activities. However, it failed to include specific details for tasks such as climbing formwork. Climbing formwork involves unique hazards and requires specialized safety measures.

The identified hazard controls in the Harris JHRA provide general safety measures, but the lack of task-specific details in the hazard analysis hindered the identification and mitigation of certain risks, particularly those related to climbing formwork. By not

conducting task-specific hazard analyses, Harris failed to ensure that all potential hazards were properly addressed, and appropriate controls were implemented. The Harris SSSP submitted for acceptance included their process for developing JHRA's, detailing how risks are evaluated and mitigated to perform work safely (Appendix E). The Nucor-Harris JHRA process specifically identifies the hierarchy of controls principles to reduce the reliance on PPE. The work assigned to IW1 was not consistent with the hierarchy of controls which would have placed a preference on the use of an aerial lift in performing work at height over the use of active fall protection. An additional hazard control option that was not included in the JHRA would have been the use of an aerial lift for installation of a retractable lanyard at the top of the form wall. This would eliminate the need for workers to attach and detach personal fall arrest lanyards during form wall climbing.

The Harris SSSP/JHRA, both in the initial submission to FRA and the version signed by ironworkers, were inadequate in providing specific details about the job activities and steps to be performed. The lack of specificity in the JHRA is also a critical omission, as it failed to identify the specific hazards associated with working on formwork. Since working on formwork requires specialized safety measures, the hazard analysis should have included a comprehensive evaluation of all tasks involved in the project to identify potential risks.

Insights gained from conversations with the Harris Placing Manager revealed that JHRAs are derived from a pre-existing database of activities maintained by the company. The PIP-II General Foreman is granted access to this JHRA library and physical copies are also retained in a binder at the project site.

During the interview with the Harris Placing Manager, it was also explained that the company engages in the development of JTAs when a specific task at a site is not sufficiently addressed by the existing JHRA. However, there is no recorded instance of any such JTA being utilized at the job site, as explained. This finding underscores the fact that the ironworkers predominantly relied on the general work activities typically performed by Harris ironworkers, rather than focusing on the specific work tasks encountered at the PIP-II construction site. Furthermore, it is notable that FRA FESHM Chapter 7010 indeed permits modifications to work plans in the field without necessitating redirection for approval; however, it stipulates that workers should receive a re-briefing subsequent to the incorporation of such changes. Harris did not utilize either the JTA option as explained by the Harris Placing Manager, or the pen-and-ink field change approach to address the activity of climbing formwork.

The WCEI Hazard Analysis used to brief all PIP-II construction workers and visitors, and obtain their acknowledgement signatures, had no marking indicating it was approved by WCEI. The Hazard Analysis package had a blank space for the "accepted by" signature for the WCEI Project Manager, as well a blank space next to the WCEI Supervisor signature line attesting that workers had received required training. The Board identified the same lack of Hazard Analysis approval for a WCEI sub-tier electrical subcontractor. Nevertheless, both of the Hazard Analyses were used to brief workers and visitors, including FRA subcontractor oversight staff and FSO representatives. In the

case of the WCEI Hazard Analysis, this discrepancy had not been recognized or resolved, despite being signed by over 100 different individuals over the 4 plus months of the PIP-II LINAC construction.

Records show the method of FRA's acceptance of safety document submittals was not consistent. In most cases, the cover page of the original submittal was returned with an electronic stamp indicating FRA's acceptance determination and whether resubmission was required. The Board also noted the words that accompanied a "revise and resubmit' electronic stamp applied to one submittal, were different from a 'revise and resubmit' stamp applied to a different submittal. The use of the electronic stamp was not found on one returned submittal, and in no case did the stamp identify the date or the name of the individual who applied it as the accepting or rejecting official.

FRA's feedback on the SSSP/JHRA submitted by Harris included several questions on the submittal package, including a question posed on the cover page returned to WCEI. By using questions instead of statements in their feedback, FRA did not promote clarity on how or where the questions would be expected to be resolved if Harris was inclined to revise and resubmit their JHRA. FRA also issued no comments in Section 3 of the submittal, "*Fall Prevention/Fall Protection Work Plan*". This could also have sent a conflicting message to Harris on the adequacy of fall protection elements in the JHRA.

In the case of the Harris workers, their daily JTA/JHRA included hazard controls but did not always include the specificity in defining work tasks to allow assessment of the hazards and required controls. See Section 3.2.3 for additional details.

FESHM Chapter 7010, Section 7.6.1, does not specify a height limit when climbing reinforcing steel vertically without the use of fall protection. Letters of interpretation issued by the Occupational Safety and Health Administration (OSHA) establish a height up to 24 feet when climbing reinforcing steel at which fall protective measures must be applied (Appendix F). The 24-foot threshold is also found in the Fall Protection chapter of WCEI's safety manual, included as part of their accepted SSSP submission.

In the absence of being able to interview IW1 and other Harris ironworkers, the Board is not able to evaluate if workers had any confusion between the OSHA construction standard requirements for fall protection when climbing rebar, and the requirements for other activities when working at height, such as climbing formwork. The 24-foot threshold would not apply to climbing formwork, from either an OSHA compliance perspective, or with regard to fall protection requirements established by WCEI or FRA.

The Harris Fall Prevention / Fall Protection Work Plan (Appendix G) that was included with their SSSP does not contain any reference to thresholds at which fall protection is required. Instead, that plan relies on fall protection information to be provided through training and/or JHRA's used in the field. Despite the Board's requests, it was unable to acquire fall protection training records, including training materials for the Harris workers. This limited the Board's ability to determine what training workers actually received. In addition, although the workers provided aid to IW1 almost immediately, the

Board was not able to assess their level of training to render first aid. The lack of the requirement for first aid provider in the SSSP is a gap that could lead to a delay in treatment for injured workers.

Identified Causal Factors:

Personal fall arrest system not connected to compliant anchor (CF- B1)

IW1 exposed to unprotected fall hazard (CF-B2)

No fall protection implemented at top of wall (CF-B3)

Hierarchy of Controls not effectively implemented (CF-B5 and C7)

No proper anchoring of their personal fall arrest system (CF-B7)

Scope of work not defined in sufficient detail (CF-B8)

Hazard analysis could not be adequately performed (CF-B9)

Failed to identify the specific hazards associated with working on formwork (CF-B10)

Flow down of requirements not adequate (CF-B18 and C14)

IW1 was not restrained from falling to the concrete pad (CF-C3)

IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma (DC/CF-B4 and C2)

3.2.3 Develop/Implement Hazard Controls

Facts:

Upon arrival at the PIP-II Construction Project, all workers are required to read and sign the WCEI Hazard Analysis. This 14-page document identifies anticipated construction activities at the site and corresponding hazards and controls required to mitigate those hazards. After workers sign the Hazard Analysis acknowledging their understanding of the terms, the Hazard Analysis is kept in the construction trailer.

FESHM Chapter 7010, and FRA's Construction Management and Safety Training course, identify that construction subcontractors must conduct and document attendance by all personnel at daily pre-job meetings, and at toolbox safety discussions conducted at least weekly. Interviews and records affirmed WCEI held daily jobsite planning meetings at 0700 to discuss planned work and anticipated hazards. These meetings were attended by WCEI staff and most sub-tier subcontractors, including Harris. Interviews also affirmed that these daily meetings included an opportunity to ask questions, and that WCEI presented focused safety topic discussions at least once weekly. Attendance at the 0700 meetings was recorded by workers printing and signing their names on a roster

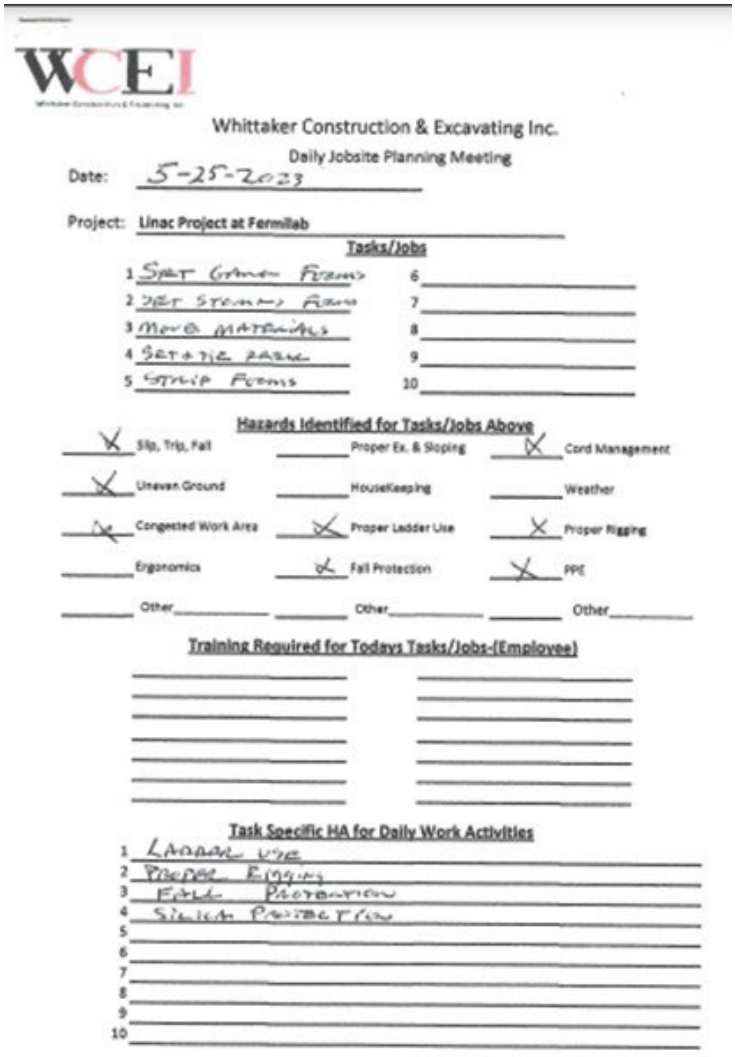
attached to the WCEI Daily Jobsite Planning Meeting form. The form is completed by the WCEI Superintendent with tasks anticipated to be performed each day, and a checklist of hazards identified as being present for the planned work. WCEI's Hazard Analysis used to brief all personnel upon arrival at the project site is not used during the 0700 daily jobsite planning meeting.

The Harris JTA/JHRA signed by IW1 on May 25, 2023, included controls such as 100% tie off for working at heights above 4 feet. The JHRA utilized the day of the accident identified the use of fall protection for climbing reinforcing steel but did not describe the controls required for climbing formwork. In addition, the JHRA did not contain a description of all work activities and steps to be performed by the ironworkers (Figure 3-5). The job task of climbing rebar was described and illustrated in the JHRA document that day, but the work IW1 was performing at the time of the accident (climbing formwork) was not included in the Harris JHRA.

As referenced in Section 3.2.2 of this report, and as specified in the FRA-WCEI contract, the name of the Competent Person(s) is to be included on hazard analysis and communicated to all affected workforces. A Competent Person for fall protection was not identified in either the WCEI or Harris daily work plans, or JHRA's where the potential for fall hazards were recognized for the planned work.

Analysis:

All workers reporting to the PIP-II construction site are briefed on the WCEI Hazard Analysis, and then sign and date the roster attached to it. The Hazard Analysis is not used by WCEI for work briefings at any time afterward. As such, workers are briefed every morning at 0700 on the tasks to be performed and the hazards expected to be encountered, but the 'daily jobsite planning' document being used for those briefings does not include the hazard controls from the Hazard Analysis (Figure 3-6). The WCEI Hazard Analysis containing the required hazard controls, required training, etc., is kept in the construction trailer; consequently, some workers went months between the time when they arrived on site without ever seeing the required hazard controls in the Hazard Analysis again.



WCEI

Whittaker Construction & Excavating Inc.

Daily Jobsite Planning Meeting

Date: 5-25-2023

Project: Linac Project at Fermilab

Tasks/Jobs

1 Set Crane Forms
2 Set Stem Forms
3 Move Materials
4 Setup Rebar
5 Strip Forms
6
7
8
9
10

Hazards Identified for Tasks/Jobs Above

X Slip, Trip, Fall	Proper Ex. & Sloping	X Cord Management
X Uneven Ground	HouseKeeping	Weather
X Congested Work Area	X Proper Ladder Use	X Proper Rigging
Ergonomics	X Fall Protection	X PPE
Other	Other	Other

Training Required for Todays Tasks/Jobs-(Employee)

Task Specific HA for Daily Work Activities

1 Ladder Use
2 Proper Rigging
3 Fall Protection
4 Silica Awareness
5
6
7
8
9
10

Figure 3-6. Example of WCEI Daily Jobsite Plan Presented at 0700 Meeting

The information covered in the WCEI daily jobsite planning meeting also routinely excluded identification on when training was required to perform select work activities. Consequently, attendees at the 0700 meeting would not be periodically reminded of the training requirements, such as the requirement to have fall protection training when 'Fall Protection' is identified as a task/hazard. By not consulting or periodically briefing WCEI employees on the PIP-II project Hazard Analysis, WCEI workers were not being adequately briefed on workplace hazards and required controls to perform their work safely.

The Harris hazard analysis signed by IW1 on May 25, 2023, was inadequate in providing specific details about the job activities and steps to be performed by the ironworkers. While the analysis mentioned the use of controls such as fall protection, it failed to include the specific task of climbing formwork that IW1 was engaged in at the time of the accident.

The lack of specificity in the JHRA is also a critical oversight, as it failed to identify the specific hazards associated with working on formwork, which was the task being performed by IW1 at the time of the accident. Since working on formwork typically requires specialized safety measures, the hazard analysis should have included a comprehensive evaluation of all tasks involved in the project to identify potential risks. This should have led to developing and implementing appropriate controls. By neglecting to address this task in the hazard analysis, the necessary controls were not developed and implemented, and thus IW1 may have had challenges performing work within controls. Additionally, this may have led to inadequate assessment for various options for performing the task, such as alternative ascent paths to the top of the wall or use of different work methodologies.

The Hazard Analyses respectively used by WCEI and Harris to brief workers did not identify a Competent Person for fall protection, contrary to the requirements in WCEI's SSSP approved by FRA. The Competent Person signature on the WCEI Hazard Analysis was from a heavy equipment operator, and that individual had not been on the project site since the initial excavation phase was completed. Identifying a Competent Person for fall protection in writing for the site, as required by the SSSP, would have directed workers to the individual that could answer questions or concerns on matters related to fall hazards or the necessary controls to reduce the risk of fall hazards.

Identified Causal Factors:

Hierarchy of Controls not effectively implemented (CF-B5 and C7)

Scope of work not defined in sufficient detail (CF-B8)

Failed to identify the specific hazards associated with working on formwork (CF-B10)

Direction of work not clear (CC3/CF-B11a/CF-C11)

3.2.4 Perform Work Within Controls

Facts:

On May 22, 2023, the Doka formwork arrived on site and assembly began on May 24, 2023. During the pre-assembly of Doka formwork sections on the ground, WCEI installed scaffold support frames for the eventual installation of a concrete pour platform. Some of the work activities associated with the Doka form wall erection were performed using an aerial lift. Previously installed Symons form walls on the east side of the project were outfitted with scaffolding and ladder access, which is different from the Doka system (Figure 3-7).

Figure 3-7. Scaffolding and Ladders on Previously Installed Symons Formwork

On May 25, 2023, IW1 was tasked to secure a template bar to the formwork. After climbing the formwork, IW1 was positioned at a height of approximately 23 feet. During this activity, IW1 was wearing but not anchoring their personal fall arrest PPE as required for any work above 4 feet. In addition, the aerial lift that was previously used by Harris ironworkers was available but was not used for this activity.

During review of the PIP-II project video footage, the Board observed some instances of what appeared to be work being performed consistent with fall protection requirements and application of the hierarchy of controls principles. Additionally, interviews with the WCEI Superintendent and carpenters affirmed ironworkers had used the aerial lift during recent activities on the site. A review of video footage identified that on May 25, 2023, a worker was using an aerial lift to access the north side of the formwork (Figure 3-8). Additionally, the ironworkers were observed implementing fall protection measures while accessing rebar assemblies on the east side of the project that day. However, there were also multiple occasions where workers were observed not adhering to fall protection requirements when working at heights above 4 feet, and above 6 feet.

The WCEI fall protection chapter includes a detailed inspection checklist for full body harnesses and associated fall protection lanyards. Inspection of fall protection equipment is to be conducted before each use, while detailed inspections are to be completed by a Competent Person at least every six months, citing ANSI A10.14-1991, *Compatibility of Personal Fall Protection System Components* criteria. The Harris daily JTA meeting held on May 22, 2023, specifically included a focus topic on how to inspect fall protection equipment. This meeting was attended by IW1 and the other Harris ironworkers present on the day of the accident. The Board was unable to discuss pre-use PPE inspection practices with Harris employees. Additionally, the Board was not able to review Harris worker fall protection PPE to see if periodic inspections were being

recorded by a Competent Person, based on the date the PPE was placed into service or manufactured.

Analysis:

The attachment of scaffold support frames during the pre-assembly of the Doka formwork was a good practice to reduce the risks of working at heights. Also noted was the extensive use of scaffolding and ladders around the construction site, which reduces the reliance on personal fall protection systems when working at height. Coupled with the presence and use of an aerial lift at the site, and observation of new ladders across the construction site, work planning and ISM principles were applied to some work activities to mitigate the hazard of working at elevation on the PIP-II Construction Project.

Figure 3-8. Construction Site with Form Walls and Aerial Lift

The above observations notwithstanding, IW1 did not engage the personal fall arrest system they were wearing when they reached the top of the form wall, despite being higher than 4 feet and the availability of suitable fall protection anchors on the formwork. This non-compliance with fall protection requirements contributed directly to the accident. The Board's review of video recordings of the construction site prior to the accident indicates poor awareness and/or poor compliance with requirements when work was performed at heights above 4 feet and above 6 feet. Harris field supervision and WCEI oversight personnel should have recognized these serious issues. In the absence of such intervention, workers can become conditioned to accepting this deviation as normal, acceptable work practices.

When Harris assigned IW1 the task to climb the form wall for installation of a rebar template, several options to reduce the risk of that activity were not applied. Examples include the use of an extension ladder by IW1 to reach the tie-off holes in the formwork. An extension ladder would have reduced the number of obstructions IW1 had to navigate. During the Board's visit to the accident scene, it confirmed the availability of extension ladders long enough to reach the locations needed to perform the assigned task. Additionally, the aerial lift available at the site could have reached the upper tie-off hole location on the formwork. The use of two-way radios to coordinate activities between workers on opposite sides of the formwork could also have been applied, thereby limiting the height IW1 needed to climb. Without this means of communication, IW1 needed to reach the top of the wall to visually check on the status of the other workers preparing the rebar template bar for installation. All of these options mentioned were immediately available to the Harris crew, and their use would have been consistent with the hierarchy of controls principles referenced in their safety program.

Harris' inclusion of a focus topic on how to perform an inspection on fall protection equipment on May 22, 2023, was considered to be appropriate, as their reliance on this equipment had become more relevant as construction progressed vertically. The Site Inspection Report signed by the Harris Superintendent and General Foreman after the accident on May 25, 2023, indicated that fall protection inspections had been performed (see Section 3.3.4 for additional details); however, no records were provided by Harris to the Board to confirm this. IW1 did not connect their fall protection PPE to a compliant anchor point. The relevance of IW1 performing or not performing a pre-use inspection on their fall protection PPE had no bearing on the accident.

Identified Causal Factors:

Personal fall arrest system not connected to compliant anchor point (CF-B1)

IW1 exposed to unprotected fall hazard (CF-B2)

Used work techniques that rely upon personal fall protection equipment (CF- B6)

IW1 was exposed to greater fall height and hazard than necessary (CF-B14)

IW1 was in a position that allowed the accident to happen (CF-C1)

IW1 was not restrained from falling to the concrete pad (CF-C3)

IW1 did not use available PPE at the top of the form wall (CF-C19)

IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma (DC/CF-B4 and C2)

3.2.5 Feedback and Improvement

Facts:

FRA, WCEI, and Harris programmatic documents do not include the requirement to conduct a post-job review for collecting feedback on the adequacy of controls to improve safety management. However, the WCEI daily jobsite planning meeting provides participants an opportunity to raise questions at the end of the meeting, and the Harris daily JTA meeting documentation periodically included information on lessons learned. Information shared at these Harris sessions included examples from other jobs which described relevant experiences and similar tasks and hazards that may be encountered on the PIP-II job site.

Three assessments related to subcontractor and sub-tier contractor Work Planning and Control (WPC) were performed in the past three years. The first two of the assessments were internal FRA assessments and the other was an external assessment.

1) *Management System Assessment on Subcontractor Work Planning and Controls (WPC)*, reviewed aspects of FESHM 7010 and their implementation to identify gaps and opportunities for improvement. This assessment was conducted between September 14, 2020, and June 30, 2021. The assessment reviewed multiple aspects of the process, including requesting/scoping, hazard assessment & review, training & onboarding, and providing assurance during the work. The report noted that no centralized contractor hazard analysis management system was available. An Opportunity for Improvement was also identified to evaluate the quality of training for Construction Coordinators/Task Managers. Additionally, the report suggested that a supplemental assessment should be completed, focusing on subcontractor WPC for services due to the wide and varied scope.

2) *Subcontractor Work Planning and Control Tripartite Assessment, reviewed* subcontractor WPC, performed by FRA and FSO assessors. This assessment was conducted between February 1, 2022, and August 30, 2022. During this assessment, the FSO identified challenges faced by smaller subcontractors where they observed numerous instances where the hazard analysis contained generic statements for the descriptions of the tasks, a single hazard analysis covering multiple work areas, and new or unanticipated hazards not being addressed within the hazard analysis.

3) An Enterprise Assessments report, Independent Assessment of Work Planning and Control at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility Far Site, January 2023, focused on the FRA's WPC processes for underground excavation and construction work, as well as the flow down of safety requirements to FRA subcontractors. The report noted that FRA's subcontractor did not conduct work under work control documents that contain clear work scope boundaries and limitations, an activity-level HA, and proper work authorization and release. The corrective action plan from the 2021 assessment of subcontractor WPC identified the issue on Construction Coordinator/Task Manager training had been

closed, indicating that a briefing sheet had been created for Construction Managers/Task Managers.

Regarding the Tripartite Assessment, FRA has several open corrective actions such as revise procedures and conduct enhanced reviews of hazard analysis to address the issue of generic statements in hazard analysis. However, no corrective actions were developed or implemented by FRA for the weaknesses of the other two assessments.

FESHM Chapter 7010 requires regular ES&H inspections and audits of a Subcontractor's ES&H Program. Additionally, Chapter 7010 states that ES&H audits should occur at six-month intervals when projects are scheduled to last more than 12 months. FRA has performed regular and routine jobsite inspections since the start of PIP-II construction. FRA ES&H inspections noted several deficient conditions such as crane and hoisting equipment, electrical, and fire prevention; no issues were noted relating to fall hazards. All deficient conditions were marked as low severity. In addition to the routine inspections, FRA ES&H staff participate in daily pre-job and weekly safety meetings. However, interviews with the WCEI Superintendent and Project Manager indicated they had not participated in any Harris daily JTA meetings. Interviews with FRA subcontractor oversight personnel and WCEI Superintendent indicated they, likewise, had not attended the Harris daily JTA meetings at any time since their work at the site began on April 7, 2023.

Analysis:

FRA, WCEI, and Harris programmatic documents do not implement a requirement to conduct a post-job review for collecting feedback. By not conducting post-job reviews, the opportunity to collect worker feedback for improving the work process is limited.

FRA has performed regular and routine jobsite inspections since the start of PIP-II construction. These inspections have resulted in multiple ES&H deficiencies and corrections in the field. However, the fact that neither WCEI Superintendent nor FRA attended Harris daily JTA meetings raises concerns regarding coordination, communication, and oversight capabilities. Possible consequences of this lack of oversight could include a lack of Harris' awareness of project-specific safety and work planning requirements, inadequate information sharing, and compromised safety measures.

The Management System Assessment on Subcontractor WPC assessments highlighted the absence of a centralized contractor hazard analysis management system at FRA. This gap indicates a lack of standardized procedures and coordination, which may contribute to inconsistencies and deficiencies in hazard analysis practices among subcontractors.

Despite the assessments identifying weaknesses in subcontractor hazard analyses and work control documents, corrective actions and necessary mitigating actions were not effectively implemented by FRA. This lack of action raises concerns about the effectiveness of the assessment process and the commitment to improving subcontractor safety practices. The similarity of this event to past assessment outcomes which were

linked to deficiencies in work task descriptions in Hazard Analysis documents for construction subcontractor work, warrants a thorough follow-up by FRA and FSO. This follow-up is essential to verify the efficacy of previous corrective actions.

The closure of the 2021 corrective action to evaluate and improve Construction Coordinator/Task Manager training was based on the development of a briefing sheet. Closing a corrective action based on the creation of a document does not necessarily demonstrate the briefing sheet had been provided to the Construction Coordinator/Task Managers for their awareness and action. The Board identified that assigned responsibilities for key project positions, including the Construction Coordinator, were not always implemented as written.

Identified Causal Factors:

Corrective Actions have not adequately resolved identified issues (CF-B15)

Lack of feedback on the necessity to describe the specific work task (CF-B21)

IW1 was not restrained from falling to the concrete pad (CF-C3)

FSO is not ensuring FRA has appropriate and effective oversight systems for the project activities (CF-C5)

Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

Requirements not being implemented by Harris as expected (CF-C12)

Worker conducted the task without the use of required fall protection (CC-1/CF-B11)

Requirements not being implemented as expected (CC-2/CF-C6)

3.3 FRA Subcontract and Subcontract Oversight Program

3.3.1 FRA Oversight

Facts:

FESHM Chapter 7010, *Construction ES&H Program*, outlines the relationships and responsibilities of FRA, the Construction Subcontractor, and sub-subcontractors. The chapter was last updated in August 2022, and serves as a guidance document for FRA employees, mirroring and clarifying FRA, Section 013100, *Environment, Safety, and Health Requirements*, which includes contractual ES&H requirements for subcontractors and sub-subcontractors involved in construction projects at FNAL. Chapter 7010 includes requirements for hazards analyses and site inspections. Submission of construction subcontractor's ES&H programs must be accepted by FRA before a formal Notice to Proceed can be issued by the Procurement Administrator.

Chapter 7010 appendices include Form F1, *Fermilab Subcontractor Injury & Illness Data Questionnaire*, which is required to be completed by prospective construction subcontractors attesting to their company's worker injury data. Form F1 data and other evaluation criteria are used by FRA to determine if a bidder has satisfied performance thresholds to be eligible to be awarded a construction contract. Upon inquiry by the Board, FRA stated that their requirements on Experience Modification Rate (EMR) in Form F1 to determine the safety performance eligibility for prime subcontractor are not applicable to lower-tiered subcontractors hired by the prime subcontractor.

FESHM Chapter 7010 requires a written Hazard Analysis for all construction work, regardless of the performing party. It also states that the Hazard Analysis should identify hazards associated with each phase of work and outline the necessary processes to eliminate or mitigate those hazards. Moreover, Chapter 7010 mandates that work should not proceed on any feature until the Construction Coordinator/Task Manager confirms that a Hazard Analysis has been prepared, reviewed, accepted, and acknowledged by the personnel involved.

The Construction Coordinator and/or Time and Material Office are responsible for ensuring that subcontractors understand the hazard analysis process and are capable of performing a thorough hazard assessment and preparing task-specific job hazard analysis. For fixed-price construction projects, the Notice to Proceed (NTP) or Purchase Order is only issued after the Construction Coordinator confirms that the Hazard Analysis has been accepted. However, for larger projects, only the Subcontractor's ES&H Program is required to be accepted prior to NTP.

The Subcontractor Safety Subcommittee (S3) provides guidance to the FRA managers concerning the safety of subcontractors working at the facility. "The S-3 is chaired by the head of the Subcontractor Safety Department and meets on a regular basis to ensure the most relevant safety information is effectively communicated to the subcontractors at Fermilab." This includes reviewing subcontractor hazard analyses for both construction and service work conducted under fixed-price, T&M, or labor hour agreement subcontracts.

In the case of the PIP-II LINAC Construction Project, WCEI's SSSP was approved by FRA on February 1, 2023. The SSSP specifies various potential hazards associated with the PIP-II project, such as fall hazards. WCEI also submitted a Hazard Analysis on January 31, 2023, which noted potential fall hazards. The WCEI Hazard Analysis was accepted with comments by FRA on February 2, 2023, noting "Make Corrections and Proceed". The WCEI Hazard Analysis did not identify the job task of rebar installation, nor the hazards associated with such work. It was noted that the WCEI Project Manager and the Supervisor/Task Lead did not sign or date the Hazard Analysis.

The lack of formal acceptance was also the case for the Harris JHRA submittal. When WCEI submitted the Harris SSSP to FRA for review and acceptance, it omitted the task of climbing form wall activity and associated hazards. FRA provided comments requesting more specificity for other work evolutions and instructions to revise and resubmit. Despite this request, WCEI failed to revise and resubmit the Harris

SSSP/JHRA to FRA, as required, and Harris work was allowed to commence on April 7, 2023, without all the required approvals (Figure 3-4). On May 25, 2023, Harris used a JHRA that resembled the work tasks and steps of those in the original SSSP submitted to WCEI, but with none of the specific Job references or "Developed By", "Reviewed By", or "Approved By" information completed, or changes requested by FRA addressed.

FRA Quality Assurance Manual, Chapter 12080, *Fermilab Assessment Program*, directs PIP-II Project Management to plan and conduct regularly scheduled self-assessments of their projects to identify and correct problems that would hinder the achievement of their mission, objectives and performance requirements. These assessments will focus on performance and program implementation, and the effectiveness of the programs in meeting contractual and regulatory requirements. The FRA Construction Coordinator completes weekly reports covering many of these objectives.

FESHM Chapter 7010 requires regular ES&H inspections and audits of a Subcontractor's ES&H Program. Moreover, Chapter 7010 states that ES&H audits should occur at six-month intervals when projects are scheduled to last more than 12 months. FRA has performed regular and routine jobsite inspections since the start of PIP-II construction. FRA ES&H inspections noted several deficient conditions, such as crane and hoisting equipment, electrical, and fire prevention. No issues were noted relating to fall hazards. All deficient conditions were marked as low severity. In addition to routine inspections, FRA ES&H participates in daily pre-job and weekly safety meetings. FRA subcontractor oversight staff had attended daily pre-job meetings for WCEI's electrical subcontractor but had not attended any Harris daily JTA meeting since their first day on site, April 7, 2023.

Analysis:

Overall, FESHM Chapter 7010 and associated forms and appendices adequately provide processes to objectively evaluate construction subcontractors' ES&H performance. Templates and checklists provided sufficient means to facilitate consistent subcontractor submissions to help ensure compulsory elements are included in contract specifications. However, implementation of the program requirements was not always fulfilled.

FRA's program that establishes safety performance requirements on the eligibility of construction subcontractors is not applied to sub-tier subcontractors. There is nothing that would prevent FRA from inserting provisions into their contract with prime construction subcontractors to require a similar means of vetting the safety performance of their lower-tiered subcontractors. The absence of such a flow down could place construction projects at risk through the participation of sub-tier subcontractors that have under-performed relative to their industry peers in protecting workers from hazards.

In addition, FESHM does not contain a defined process to ensure current versions of documents are being used in the field. This was a contributing factor as to why unaccepted versions of safety documents (i.e., JHRA) were being used in the field.

To augment FRA's technical capabilities, some of the PIP-II Project Management positions were subcontracted, including the Conventional Facilities Deputy Manager and the Construction Coordinator. Specific roles and responsibilities are defined in the FRA-WCEI contract for these two positions as the Design Coordinator and Construction Coordinator, respectively. Additional roles and responsibilities for Construction Coordinators are defined in FESHM Chapter 7010 and FRA's Quality Assurance Manual, Chapter 12140, *Event Response Program*. Not all those responsibilities were carried out as described in FRA's written programs.

It was observed that the hazard analysis submitted by Harris was not accepted by FRA, yet work was permitted to commence. Examples of this issue are as follows:

1. FESHM Chapter 7010 lacks a defined process to ensure that the field is using the most up-to-date versions of documents.
2. Harris daily JTA meetings involve only Harris personnel, excluding other relevant stakeholders.
3. PIP-II Project personnel are not adequately overseeing the processing and currency of subcontractor safety documents at the job site.

Additionally, FRA failed to identify that Harris was not using the current accepted version of the JHRA. This lack of awareness was due to unclearly defined roles and responsibilities within the FRA project team in the LINAC management chain, which was confirmed through interviews with project management. When Harris submitted their JHRA to FRA for review, they omitted the activity of working on formwork and its associated hazards. Despite this omission and the lack of a hazard analysis for that specific task, Harris proceeded with the work.

Furthermore, a discrepancy existed between the statements made by the Harris Placing Manager and the actual practices at the PIP-II site regarding JHRAs and JTAs. The manager mentioned that changes to JHRAs should go through the home office and that JTAs should supplement JHRAs under different conditions. However, these practices were not implemented. If the JHRA had described the activity of working on formwork, the JTA could have provided specific details about the worker job tasks.

As mentioned earlier and in Section 3.2.5, FRA ES&H personnel participated in daily pre-job and weekly safety meetings. However, neither FRA subcontractor oversight personnel nor WCEI management attended Harris' daily JTA meetings since their work at the site began on April 7, 2023. The absence of FRA's and WCEI's attendance at these meetings meant they lacked crucial knowledge about how Harris was addressing safety requirements and conducting work. Consequently, FRA and WCEI could not ensure the implementation of safety requirements or the use of current and approved documentation in the field.

In summary, FRA's failures to recognize incomplete work documentation, unapproved hazard analyses, and non-compliant work practices on the PIP-II project indicate a

breakdown in the review and approval process. This breakdown allowed work to proceed without proper hazard mitigation measures in place, posing risks and safety concerns.

Identified Causal Factors:

Work was allowed to be performed without sharing safety information utilizing unapproved safety plans (CF-B16)

Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

LINAC Complex Project personnel are not ensuring subcontractor safety documents are properly processed and up to date at the job site (CF-C10)

Requirements not being implemented by Harris as expected (CF-C12)

Requirements not being implemented as expected (CC-2/CF-C6)

3.3.2 Whittaker Oversight

Facts:

Provisions of the contract between FRA and WCEI identify that WCEI is responsible for the safety of all persons employed by WCEI and its subcontractors on the FNAL site, as exemplified by the following principles:

- WCEI is also solely responsible for directing and supervising its employees and takes all reasonable precautions in the performance of the work to protect the health and safety of employees, sub-subcontractor employees, FRA employees, and members of the public, to minimize danger from all hazards to life and property, and to prevent injury to any employees or other persons.
- All subcontractors or any other person who enters onto the PIP-II construction site shall be the sole responsibility of WCEI, and they shall comply with all applicable environmental, safety, health, and fire protection laws, regulations, orders, and requirements (including reporting requirements), including those of DOE.
- WCEI shall comply with FRA's environmental, safety, and health requirements for any work performed at the FNAL site, including the requirements set forth in 10 CFR 851.
- WCEI will have a dedicated, full-time subcontractor Safety Representative on the project.

A review of WCEI daily jobsite planning meeting attendance records indicate two WCEI Safety Representatives were on site for a period of a couple weeks in early April, after which only the WCEI Safety Representative specified in the Key Personnel section of the contract was at the PIP-II construction site. Records show the WCEI Superintendent, Project Manager, and Safety Representative were consistent in their attendance at the

0700 daily jobsite planning meetings. Interviews with the WCEI Superintendent and Project Manager indicated that neither had attended a daily briefing held by its sub-tier subcontractors, including the daily JTA meetings held by Harris ironworkers.

Notable provisions of the contract agreement between WCEI (Subcontractor) and Nucor (Installer) include:

- Subcontractor reserves the right to periodically audit the Safety Programs of the Installer.
- A second infraction of a previously cited action or condition could result in termination of the Contract.

Based on interview statements from the WCEI Superintendent, WCEI had not requested copies of training records for Harris workers for task-specific activities, including activities that require the completion of training by both OSHA and the contract. Despite multiple requests by the Board, WCEI was unable to provide copies of training for Harris employees, including but not limited to fall protection training, aerial lift training and scaffold user training.

The WCEI Safety Representative stated they conducted routine walkthroughs of the construction site to identify safety issues, and among the things evaluated was the use of fall protection anchor points. Based on a review of video recordings, workers at the PIP-II site were consistently observed to be wearing full body fall protection harnesses. The WCEI Safety Representative stated that they had not previously encountered the Doka form wall system. During the Board's initial discussions with WCEI project management, personnel indicated that both the Doka wall integrated handles and holes in the wall form are suitable fall protection anchor points. Upon subsequent discussions, WCEI representatives indicated that only the integrated Doka form wall handles are acceptable fall protection anchors.

As already noted in Section 3.2.2, the FRA-WCEI contract requires inclusion of the name of the Competent Person to be identified within the WCEI Hazard Analysis. Additionally, the contract between WCEI and Nucor requires the name of the Competent Person(s) be included in the hazard analysis and communicated to all affected personnel. Neither WCEI's Hazard Analysis nor daily jobsite planning meetings identify a Competent Person for work being performed. WCEI, likewise, did not enforce that a Competent Person be identified in sub-tier contractor documentation being used for daily work execution.

Analysis:

The contract between WCEI and Nucor includes important provisions regarding the conduct of independent assessments of work activities and penalties for repeated infractions. Interview with the WCEI Safety Representative identified that they would confirm workers are properly tied-off when working at elevation. During periodic inspections of the job site, the WCEI Safety Representative stated they may occasionally have to remind a worker to do things, such as putting on their safety glasses, but

commented that they otherwise did not consider there to be problems with workers not using their fall protection. Interviews with WCEI construction workers and other sub-tier subcontractors at the project generally regarded the construction site to be very well maintained and that they wouldn't have any reluctance to express a safety concern. Additionally, workers indicated the WCEI Superintendent was the principal person communicating what hazards are anticipated for the work to be performed each day, and WCEI allowed individuals to ask questions at the end of the daily jobsite planning meetings.

Attendance records affirm the routine presence of the WCEI Superintendent, Project Manager and Safety Representative at the construction site; however, neither the WCEI Superintendent nor the Project Manager had attended a daily briefing held by the Harris work crew. The WCEI Safety Representative who was responsible for ensuring all workers reporting to the PIP-II construction site review and sign the WCEI Hazard Analysis upon their arrival, did not ensure IW1 had signed this briefing. This is notable as the WCEI briefing included the task "forming", and associated requirement for use of fall protection for work above 6 feet, which was an activity not included within the Harris JHRA.

The lack of familiarity by WCEI project managers with the Harris daily JTA meetings missed important opportunities to understand the rigor of daily work planning and hazard controls being communicated by their subcontractors engaged in high hazard work activities. This significantly limited WCEI's ability to fulfill their responsibility for the overall safety of the PIP-II project.

Neither of the WCEI Safety Representatives had seen the Doka form walls in use before. The WCEI Superintendent indicated they had used them at least once in a previous project. During the Board's first day on site when visiting the accident scene, the WCEI Superintendent and Project Manager indicated that it was acceptable to use the integrated handles and holes in the Doka form walls as fall protection anchor points. During interviews conducted by the Board the following day, their response to the same question had changed, indicating that only the integrated handles were acceptable fall protection anchor points, while the holes can only be used with a special Doka hardware attachment. The Board's interview with the WCEI Safety Representatives occurred after their company's accident investigation report was released. At that time, the WCEI Safety Representatives continued to mention holes in the Doka forms as acceptable anchor points for fall protection. The limited familiarity with the Doka fall protection anchors by WCEI project personnel indicates they had not reviewed that information prior to the accident. As such, the WCEI project staff, including their Safety Representative, would not have been in a position to convey information on Doka approved anchor points to its workers, or effectively enforce compliance with the use of approved anchor points. This was evidenced by interviews with WCEI carpenters in which they, likewise, stated adequate anchor points for the Doka system included both handles and holes in the formwork.

WCEI personnel only had a partial understanding of Doka's designated fall protection anchors after their company accident investigation was complete, indicating weakness in the rigor of their event investigation process.

Upon reviewing video recordings of PIP-II project work activities, specifically, during the installation phase of the Doka form walls on May 24, 2023, and May 25, 2023, multiple instances were observed of workers climbing form walls above 6 feet without the use of 100% tie-off using personal fall protection. Workers were consistently noted to be wearing full body fall protection harnesses, but the deliberate motion of workers attaching and detaching their fall protection equipment to form wall anchor points was not always observed. Based on these observations, the Board concludes that supervisors, project management, and safety oversight personnel had not recognized that non-conforming work practices were taking place, specifically for work that required 100% tie-off with active fall protection systems. Based on interview statements from WCEI personnel responsible for safety oversight, they did not fully understand what constituted an acceptable anchor point for the Doka system at the time of the accident. Unfortunately, the Board was unable to interview Harris ironworkers to determine if they had familiarity with the manufacturer's designated anchor points for personal fall arrest.

Identified Causal Factors:

IW1 exposed to unprotected fall hazard (CF-B2)

WCEI supervisors, project management, and safety oversight personnel allowed non-conforming work practices to go unchallenged (CF-B12)

Lack of feedback on the need to use fall protection (CF-B13)

Work was allowed to be performed without sharing information, and using unapproved safety plans (CF-B16)

IW1 was not restrained from falling to the concrete pad (CF-C3)

WCEI personnel not aware of the Doka form approved anchor points for site compliance (CF-C4)

Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

Selection of compliant anchor points on Doka system not fully understood by workers and project oversight (CF-C17)

IW1 conducted the task without the use of required fall protection (CC-1/CF-B11)

3.3.3 Nucor Oversight

Facts:

The Nucor contract with WCEI specifies that Nucor agrees to be bound by the terms of the agreement between WCEI and FRA, which includes a requirement to have an ES&H Program incorporating the Integrated Safety Environmental Management (ISEM) philosophy. The ISEM philosophy includes performing work within controls and providing feedback for continuous improvement, both elements of oversight. Nucor subsequently entered into a contract agreement on the workforce/labor to complete the "reinforcing steel and couplers" installation work of the Nucor contract with WECI by subcontracting with Harris Rebar Placing, LLC. The subcontract between Nucor and Harris also included language as follows:

> *"Terms and Conditions: Installer agrees: that the specific terms and conditions of this Agreement will be a direct flow down of the agreement between Subcontractor and its Customer, together with the scope of work as described herein; to be bound to Subcontractor by all the terms and conditions of the agreement between Subcontractor and its' Customer with respect to the Work to be performed by Installer,"*

where the installer is Harris, the Subcontractor is Nucor and its customer is WCEI. Nucor did not submit a separate ES&H program but did include Nucor on an SSSP submitted by Harris. The oversight of the work activities was performed by Harris employees.

Analysis:

There were no records provided that demonstrate Nucor employees conduct oversight of work activities at the PIP-II construction site. Nucor involvement in the ISEM process was limited to passing along standard corporate JHRA templates to the Harris team to be included in the SSSP submittal and for use in Harris daily JTA meetings. No substantive direct involvement in the day-to-day work activities was noted for Nucor personnel, however, all FESHM Chapter 7010 requirements were still required. The Harris SSSP was submitted with a Nucor cover sheet but no additional information beyond the Harris Rebar Placing, LLC SSSP information. Separate submittals and approvals were not completed as required by the applicable contracts or FRA FESHM requirements. The Board was not clear if the SSSP submitted by Harris was intended to be a joint submittal from Nucor, or if WECI or FRA evaluated the document in that context. The multiple tiers of subcontractors with similar names and affiliations have contributed to the confusion and incomplete safety documentation on the PIP-II project, further exacerbated by a lack of ES&H certifications stipulated by FRA's contract provisions.

Despite the WCEI-Nucor contract stating there is a direct flow down of the requirements from the FRA contract with WCEI, the WCEI-Nucor contract documents do not include a listing to ensure the complete set of requirements is available to flow down to Nucor. The Harris contract with Nucor also required all of these requirements, up to and

including the FRA-WCEI contract, be flowed down as part of the subcontract agreement with Nucor. This complicated and cascading list of requirement sets makes work planning processes challenging. In addition, the multiple business elements that documents passed through, and lack of on-site presence/awareness by parties responsible for daily work planning, limit the ability of workers to be engaged in the hazard analysis process, which is identified as a compulsory element of the WCEI safety program.

Identified Causal Factors:

Flow down of requirements not adequate (CF-B18 and C14)

No indication of primacy of safety programs used by various project organizations (CF-B19)

Work is not adequately defined, with identified hazards and applicable development and implementation of hazard controls (CC4/CF-B20)

3.3.4 Harris Oversight

Facts:

The Harris SSSP submittal, and corresponding company Injury and Illness Prevention Program (IIPP) identify responsibilities for various individuals associated with the PIP-II project. Among those responsibilities, the Harris Superintendent is to ensure that all inspections, reporting, and records required by this SSSP, and the Company IIPP are being completed and submitted. Additional responsibilities for the Harris Superintendent include, but are not limited to:

- Providing SSSP orientation for new project employees.
- Directing and monitoring supervisors in maintaining compliance with SSSP.
- Monitoring the site for hazards or unsafe working conditions through personal observations and keeping a written record of these inspections.
- Ensuring new employees are drug screened and oriented to the site.
- Conducting safety interviews of new employees and documenting these interviews.

The Harris IIPP also assigns select responsibilities to the Harris Foreman/General Foreman including, but not limited to:

- Instruct new employees in their job site duties and communicate the importance of complying with the company safety policies and procedures.
- Inform all employees of changed conditions that pose potential hazards that may occur and what action employees can take to avoid unsafe conditions.

- Verify that operators are qualified, fit, and have received required training to operate equipment or vehicles safely.

There are two Harris Superintendents listed in the submitted SSSP, and only one of the two individuals has records of receiving FRA Subcontractor Orientation training. That training took place on April 26, 2023, approximately two weeks after the start of Harris on-site work at the PIP-II Construction Project on April 7, 2023. A review of WCEI daily jobsite planning meeting records indicate the Harris Superintendent visited the site again on May 16, 2023. On the day of the accident and days leading up to the accident, there were both a Harris Foreman and General Foreman at the PIP-II site.

Harris' JHRA/SSSP submittal to WCEI, which was subsequently forwarded to FRA for acceptance, include the following Harris safety program commitments:

- Daily and jobsite safety inspections shall be conducted using the Weekly Safety Training and Instruction Form.
- Forklift and Aerial Lift inspection shall be conducted before each shift.
- A copy of all inspection forms shall be filed with the SSSP, and a copy returned to the office with the weekly paperwork.
- "Toolbox" safety meetings shall be held several times a week. All safety meetings shall be documented. Random site safety surveys shall be conducted. A written report of the survey shall be copied to the Nucor Harris Rebar Rockford Inc. Office.

Records provided to the Board document that regular Harris toolbox meetings took place.

During the factual accuracy phase of this accident investigation report, the Board was provided new information consisting of two Site Inspections Reports signed by the Harris Superintendent (Appendix H). The first inspection checklist was signed by the Harris Superintendent on April 26, 2023. The checklist identified that all of the program elements were either "compliant" or "not applicable". Among the items listed as "not applicable" at that time were:

- Have the Fall Protection Plan(s) been reviewed and signed by everyone on the site; and
- Has the deck/formwork been inspected and signed off by the general/formwork contractor?

The Harris Superintendent and General Foreman signed another site inspection checklist on May 25, 2023, after the accident. This inspection noted it was conducted from the site perimeter, as the immediate construction area was closed after the accident. All checklist items were marked as either "compliant" or "not applicable", with an exception that the checkbox was left blank for "Is specialized PPE req'd (fall protection, respirators, gas monitoring". The checkbox item regarding 'formwork inspection sign off' was again

marked not applicable. Both of the inspection checklists completed by Harris identified that 2-way radios were available.

The first day of IW1's employment by Harris was May 1, 2023. The first day of Doka form wall installation vertically on the basemat slab was May 24, 2023. The Harris Foreman assigned IW1 the task of climbing the form wall, then went around to the other side of the form wall. Video recordings from the west side of the construction project show IW1's torso above the top edge of the Doka form wall. The same video sequence does not show an extension ladder staged vertically for workers to accept the tie wires from the west side of the wall, or that the rebar template had been positioned vertically. During interviews with workers, statements were made that they did not use radios or any supplemental means to communicate between workers on opposite sides of form walls. IW1 was higher on the form wall than the uppermost wall form penetration in order to tie the rebar template.

Analysis:

During interviews with the Board, the Harris Placing Manager stated that changes to the JHRA should go through the home office and that JTAs should be used to supplement JHRAs if conditions are different. This characterization of JTAs was different than in practice, as reference to JTAs at the PIP-II site was associated with the worker sign-in page for the Harris daily briefing. In that application, only the JHRAs contained hazard control information for work tasks and steps.

The WCEI daily jobsite planning meeting attendance rosters indicate that the Harris Superintendent responsible for oversight of the Site Safety program had only been on the site two times in 38 days. The infrequency of safety inspections by the individual(s) responsible for conducting inspection would have greatly limited their ability to understand job site conditions and work practices. The absence of early and frequent safety inspections by the employer was especially relevant as IW1 had only started work as a Harris employee beginning May 1, 2023. It would, therefore, be difficult for the Harris Superintendent to ascertain IW1's awareness of workplace hazards and controls, or mentor such performance, in accordance with the responsibilities assigned to the Harris Superintendent in their company SSSP for new workers.

Upon review of the Site Inspection Reports completed by the Harris Superintendent, the Board questioned the quality and rigor that went into them. Examples include Harris selecting "not applicable" for completion of fall protection training on April 26, 2023. Affirming the completion of such training in advance of working at height seems appropriate. That same inspection element was checked as "compliant" after the accident, but the Board was not provided copies of any Harris fall protection training records, despite multiple requests. The Harris site safety inspection completed on May 25, 2023, also recorded "not applicable" for the checklist element "Has the deck/formwork been inspected and signed off by the general/formwork contractor". The Board is unable to reconcile how this could be identified as not applicable when Harris ironworkers had already been climbing form walls at the PIP-II site. Perhaps if the site inspection reports had been completed with more rigor, Harris would have recognized

that information on the Doka form wall inspection status, as well information on formwork anchor points needed to be acquired from WCEI.

At the time of the accident, it had been less than two full days since the Doka form walls were stood vertically at the project, and up to that point, much of the work on the Doka form walls had been performed by WCEI carpenters using an aerial lift. Upon returning from lunch on the afternoon of May 25, 2023, IW1 was tasked to climb the Doka form wall and the Foreman promptly moved to a location where they were no longer able to witness IW1's activities. Considering that IW1 was a relatively new employee to Harris, and the installation was underway of a different form wall system than was being used elsewhere on the project, this lack of direct supervision did not afford IW1 feedback on their fall protection work practices as IW1 climbed the form wall. Consequently, IW1 is put into a position to make these decisions on their own.

The task to be performed by IW1 that required them to climb the form wall was to vertically install a rebar template on the west side of the Doka form wall, near the northwest corner. This required coordination between IW1 and other ironworkers on the west side of the form wall, such that once workers move the rebar template from a horizontal position to a vertical position, they would accept the tie wires inserted through the form wall holes by IW1, and then wrap them around the rebar template. Video records from the west side of the construction site show IW1 at the top of the form wall but does not show the extension ladder in a position to accept the tie wires from IW1. Consequently, IW1 was observed waiting at the top of the form wall until they can visually confirm the other ironworkers are ready. It is during this waiting period that the video recordings show IW1 falling from the form wall.

IW1 was assigned to perform a task in such a fashion where the only means to protect them from the fall hazard was by using their personal fall arrest system 100% correctly. Given the distance climbed and approximate spacing of anchor points, IW1 would have had to use approximately four different anchor points to climb the wall, requiring approximately seven individual actions of attaching and detaching their fall arrest PPE to approved anchor points, then applying their positioning hook once they were in position to perform work. These estimates do not take into consideration the obstructions that needed to be navigated around in the corner of the form wall, in addition to IW1 then having to perform all of those actions in reverse to safely climb down the wall.

When the task to climb the form wall was assigned to IW1, there were no steps in their daily work planning document that described this activity, and therefore no hazard analysis had been performed or protective controls identified. Other types of climbing activities were identified in the daily work plan, but they were different than climbing form walls. Once Harris Line Supervision realized ironworkers needed to climb form walls, they should have recognized that the document workers were briefed to did not cover this task. The Harris SSSP included steps on their company hazard analysis process:

> *Step 4 – List controls that need to be in place for each task and hazard to help reduce the risk factor.*

Unfortunately, risk reduction principles were not applied, and Line Supervision's choice of hazard control placed total reliance on the worker using their personal fall arrest system, despite other options being readily available. Furthermore, there was no supplemental documentation to brief the worker on the assigned task. Extension ladders suitable to reach the required work elevation were available at the site, reducing the risk posed by obstructions on the form wall when climbing. An aerial lift was also staged nearby and was capable of accessing the upper penetration for the rebar template installation. If IW1 was not qualified to operate the aerial lift, other Harris ironworkers that had been using the aerial lift at the site could have been assigned this task. Lastly, Harris had two-way radios available to allow communication between workers on opposite sides of the form wall. Using radios would have reduced IW1's risk factor such that they would not have needed to climb to the top of the wall to check on the progress of the workers on the other side. Coordination between workers was essential to successfully install the rebar template. The height to reach the upper work task elevation would have been approximately 6 feet lower than the elevation from which IW1 fell. Instead, IW1 had to rely on direct verbal and visual communication with their coworkers. The communication and coordination challenge presented by form walls is not present with rebar columns.

As discussed in Section 3.2.1 and 3.2.2 of this report, the contract between WCEI and Nucor/Harris assigns responsibility to WCEI in providing fall protection anchor points at the PIP-II project site. Based on interviews with WCEI project personnel, they did not have a full understanding of the designated fall protection anchor points for the form wall system that IW1 had climbed. As such, WCEI project leadership would not have been in a position to accurately describe compliant use of the anchor points to its workers and other sub-tier subcontractors that have a need to understand such information for their safety. It was incumbent upon WCEI to be both knowledgeable in the Doka fall protection anchor points for briefing site workers, and in enforcing fall protection compliance.

Identified Causal Factors:

IW1 exposed to unprotected fall hazard (CF-B2)

No fall protection implemented at top of wall (CF-B3)

Hierarchy of controls not effectively implemented (CF-B5 and C-7)

IW1 conducted the task without the use of required fall protection (CF-B11)

Lack of feedback on the need to use fall protection (CF-B13)

IW1 was exposed to greater fall height and hazard than necessary (CF-B14)

IW1 was not restrained from falling to the concrete pad (CF-C3)

Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma (DC/CF-B4 and C2)

3.4 Training and Qualification

Facts:

FESHM Chapter 7010 requirements on subcontractor orientation training were flowed down into the contract between FRA and WCEI. Prior to the first day of arrival at FNAL, FRA security sends each subcontractor an email with a unique QR code to allow them initial access through the FNAL security gate. To be issued a badge for subsequent site visits, each subcontractor must minimally complete the FRA Subcontractor Orientation training and General Employee Radiation Training (GERT). Required training specified in the WCEI contract includes:

- FRA Subcontractor Orientation training and GERT, one hour.
- Safety Boot Camp, provided by FRA, one hour.

For the PIP-II Construction Project, the Subcontractor Orientation and GERT training courses are presented together by a member of the FRA subcontractor oversight staff at 0730 on the first day an individual arrives at the project. Retraining on the orientation and GERT training courses is required every two years. The FRA training instructor provides a blue card to each participant to demonstrate completion of the training, after which subcontractors are customarily escorted to Security. Subcontract workers are required to present the blue card to FRA security in order to receive a site access badge. These badges are active for the anticipated duration of their participation in the project.

Upon review, the FRA Subcontractor Orientation training includes reference to various environmental health and safety program requirements, such as hazardous noise, radiation safety, worker rights and responsibilities, and Stop Work authority for immediately dangerous to life and health conditions. Each of the seven guiding principles of DOE's ISM are also covered in the training. Information presented on how to report a medical emergency applies the same contact number for reporting environmental spills, fires and other types of emergencies. The training makes clear that dialing 911 is not appropriate for reporting site emergencies, and the full number (630-840-3131) must be dialed if the call is not made from a campus land line.

A review of records provided to the Board on the status of training provided by FRA to WCEI employees and their lower-tiered subcontractors working at the PIP-II site, identified several individuals received Subcontractor Orientation training, but completion dates were missing from GERT. Records identify that all Harris employees on site the day of the accident, including IW1, had received FRA Subcontractor Orientation and GERT training.

FRA's Subcontractor Orientation training content on fall protection and personal fall arrest systems is depicted in the slide in Figure 3-9 below.

Figure 3-9. FRA Subcontractor Orientation Training Slide - Fall Prevention / Protection

FESHM Chapter 7010, Section 6, *Training Requirements*, defines the qualifications for subcontractor Safety Representatives, based on the scope and complexity of the project. WCEI's submitted SSSP included the qualifications and experience for their Safety Representative. The WCEI Safety Representative is identified by name in the FRA-WCEI contract within the Key Personnel section.

Chapter 7010, Section 7.6.3, covering fall protection training states:

- *The Subcontractor will maintain on site individual employee training records.*

Chapter 7010 identifies that subcontractor training records for select high hazard activities must be provided for each worker in advance of performing work. Among this list of high hazard activities includes:

- Fall Protection;
- Scaffolding; and
- Aerial (Boom) & Scissor Lifts.

FRA's PIP-II project team did not request or review training records in advance from subcontractor personnel that are assigned 'high hazard work', as required in Chapter 7010, Section 6.4.4. Based on interviews with the Board, FRA oversight staff were not familiar with this procedural requirement.

In response to the Board's request for records after the accident, WCEI provided up-to-date training records for some of their workers on the training courses for Fall Protection; Scaffolding; and Aerial (Boom) and Scissor Lifts, while other training records were absent, and some training certificates had expired. WCEI's Hazard Analysis does not identify the Competent Person for scaffolding inspections by the WCEI contract. Up-to-date training records were furnished for the WCEI worker identified by the WCEI Superintendent as being their scaffold inspector.

Training slides used by WCEI for select project activities were provided to the Board for Rigging Safety, Scissor Lifts, and Skid-Steer training. The aerial lift at the PIP-II project is not a scissor lift. Additionally, the PIP-II project equipment includes both a skid steer loader and a telehandler.

FRA uses an on-boarding checklist to identify and track the completion of various orientation elements for staff entering the Subcontractor Oversight group. Such a checklist was used for the ES&H Subcontractor Oversight lead for the PIP-II Construction Project who joined FRA in September 2022. The checklist showed completion of nearly all elements, ranging from discussions on familiarity with Human Resources and services, to job-specific expectations. Training requirements are tracked separately, and upon review, the subcontractor oversight staff had up-to-date training for all required courses, including OSHA 30-hour construction safety training, where appropriate.

The Board reviewed 30 days of WCEI daily jobsite planning records from prior to the accident. On only two occasions was 'required training' checked, and both of those instances were for Rigger Training. These same planning meeting records listed fall hazards on many different days but fall protection training was not marked as required training. Similarly, required training had not been listed on the daily jobsite plan for aerial lift operation, scaffold user, or scaffold inspectors. Discussion with the WCEI Superintendent indicated that training records on fall protection, scaffold user, or aerial lift operation were not requested from sub-tier subcontractors, including Harris.

The Board requested records for Harris employees on fall protection training and activities that present fall hazards (e.g., aerial lift operation, scaffold user, etc.) but did not receive any response to this request, with the exception of FRA-provided training.

Analysis:

Some disparities in FRA orientation training records were noted by the Board for PIP-II subcontractors. This condition could have been identified by FRA through an audit of their training records, or periodic coordination between PIP-II Project Management Group and Security to review such records. Additionally, FRA's training record roster of subcontract workers at the PIP-II project only identified the worker's company affiliation in 33% of the entries. This significantly limits the FRA project team's ability to monitor and track completion of actions, such as allowing a particular company to resume operations after a stand-down.

A training certification form is included in the WCEI Safety Manual, Chapter 11, which is part of their accepted SSSP. Despite requests by the Board, no copies of fall protection training records/certifications for WCEI's subcontractors were provided.

Interviews confirmed FRA's PIP-II Project Management did not request or review training records from subcontractor personnel that are assigned or anticipated to be engaged in 'high hazard work', as required in FESHM Chapter 7010, Section 6.4.4. Additionally, PIP-II construction oversight staff were not familiar with this procedural requirement. By not obtaining subcontractor fall protection training records in advance, FRA missed an important opportunity to affirm WCEI was fulfilling its responsibility to manage safety training and qualification for its employees and all lower tier subcontractors.

Interviews with the WCEI Superintendent affirmed lower-tiered subcontractors were not required or requested to provide proof of training completion for select work activities. Harris employees were allowed to use the aerial manlift at the PIP-II site without providing proof of operator training qualifications for this equipment. Upon the Board's inquiry, WCEI management stated they made the presumption the ironworkers were qualified. The training materials provided by WCEI to the Board would not adequately cover all of the equipment being operated at the PIP-II project.

FRA's orientation training provided to construction subcontractor was regarded by the Board as providing a commensurate level of detail for orientation purposes on topics such as fall protection, fall arrest systems and other fall protection related topics such as scaffold and ladder use. As FRA would not intend this orientation-level training to meet the requirements on fall protection training in the OSHA standard, equipment and job-specific training for each worker using fall protection equipment would be necessary to meet regulatory requirements. Unfortunately, no employee training records were provided to the Board by Harris.

The one-hour Safety Boot Camp training, identified in the WCEI contract as required, was initially scheduled to be presented by FRA in the March/April timeframe, but had not yet been held as of the date of the accident. Part of the rationale communicated to the Board for postponing this training was to wait until more trades and overall project personnel were present on site to promote attendance. This seemed logical given the training is not driven by a regulatory requirement outside of the terms of the contract; however, this could have been an additional opportunity for FRA to communicate its expectations on safety to the PIP-II construction workers, including Harris ironworkers.

Overall, there appears to be an established process to help ensure FRA's personnel assigned to perform oversight of construction subcontractors are receiving training and have the appropriate qualifications to perform their job. However, it is not readily apparent if the suite of on-boarding elements includes mandatory reading of select FESHM chapters, especially Chapter 7010. The lack of awareness on the FESHM Chapter 7010 requirement to obtain advanced copies of subcontractor training records for high hazard work, and the lack of acquiring safety program certification statements from

individual subcontractors, indicates responsibilities are not clearly defined in Chapter 7010, nor understood by key project personnel.

Identified Causal Factors:

Work was allowed to be performed without confirmation of worker qualifications (CF-B17)

FRA personnel were not aware of the FRA requirements to review training records (CF-C13)

Direction of work not clear (CC3/CF-B11a/CF-C11)

3.5 Contractor Assurance

Facts:

A contractor assurance system (CAS) is established by DOE Clause H.13, of the *Contractor Assurance System*, of the prime contract between DOE and the M&O contractor (FRA) that is owned jointly by DOE as sponsor/steward, FRA as holder of the Prime Contract, and the Laboratory as performer of the work. At FNAL, the CAS is described through the *Contractor Assurance System Description* document (no document number), dated January 2022. The CAS is managed and overseen through the FRA Laboratory Director and Director of Contractor Assurance.

FRA executes Clause H.13 of the prime contract by employing ten management systems (Finance, Procurement, Environment, Safety & Health (ES&H), Quality, Engineering, Information Systems, Partnerships, Safeguards and Security, Property and Infrastructure, and Human Resources) that encompass all work activities and applies to all personnel performing work at FNAL and FNAL-leased spaces, including subcontractors and guests. The management systems are periodically reviewed and improved through a variety of devices including self-assessments, peer reviews, benchmarking efforts, and operational readiness reviews.

As identified in FRA documentation, the CAS, at a minimum, must include ten key attributes. These attributes include items, such as:

- A comprehensive description of the assurance system, with processes, key activities, and accountabilities clearly defined;
- A method for verifying/ensuring effective assurance system processes; rigorous, risk-based, credible self-assessments, and feedback and improvement reviews to assess and improve FRA's work process and to carry out independent risk and vulnerability studies;
- Identification and correction of negative performance/compliance trends before they become significant issues;

- Integration of the assurance system with other management systems including ISM; and
- Continuous feedback and performance improvement.

Management System Owners (MSOs) are to attend and actively participate in forums with other MSOs to discuss Management System-related topics, such as compliance, policies, and processes; collaborate to resolve issues and concerns; and discuss CAS improvement opportunities.

The Services Oversight Group (SOG) consisted of the Director of Contractor Assurance, Chiefs, Deputy Chiefs, Divisions and Section Heads, Project Leaders and Office Heads, and the Chair of the Enterprise Risk Management Board (ERMB). The FSO serves as an observer. The SOG is to ensure that the assurance process provides the information needed to monitor lab performance, as well as identify and track issues that arise through an awareness of changes in the Laboratory's operating environment, applicable laws and regulations, assessments, and the various review processes of the Laboratory.

The last review of the FRA CAS program was a CAS Peer Review conducted in July 2020. Overall, the review was based primarily on assessing the CAS program as developed by FRA and little on implementation. The review identified that the program met the elements of the DOE H.13 CAS clause described above, and that the CAS description was up to date at the time.

Interviews with FRA CAS personnel identified that elements of the CAS program are undergoing modifications to improve the program. One of the modifications is to the SOG. The SOG was discontinued at the end of calendar year 2022, as it was not providing the expected results to address identified issues. The SOG was reconstituted as the Performance Assurance Committee and had its first meeting in June 2023. In addition, the MSOs are now called Requirements Owners, aligning with their role to implement specific requirements needed to be met by the Laboratory. Since the CAS description was last updated in January 2022, the document has not been updated to address the changes in the CAS program, and FSO has not been able to formally review, comment, or approve the updated system description.

Analysis:

The priority of the CAS program is to ensure the program and organization meet CAS requirements, and ensuring flow down, execution, and implementation of requirements, and confirmation of effectiveness has been entrusted to the applicable functional areas. While these are important, it is equally important to ensure that the developed program is effective in identifying and correcting issues to drive continuous improvement and is providing both FRA and FSO management prioritized and risk-based information on site and operational status, enabling appropriate decision making. The Performance Assurance Committee has been under development as a successor to the SOG since the last SOG meeting at the end of 2022; however, the first meeting of the new Performance Assurance Committee just occurred in June of 2023, indicating a lapse in senior management engagement in the CAS program. In addition, FSO has also not reviewed or

approved the new CAS program description, indicating collaboration and transparency of the principal tenets of CAS could be strengthened. This has affected FSO's ability to assess the FRA CAS program.

Identified Causal Factors:

Corrective actions have not adequately resolved identified issues (CF-B15)

FSO is not ensuring FRA has appropriate oversight systems for the project activities (CF-C5)

3.5.1 Assessment Program

Facts:

The FRA CAS program identified the need to contain elements of an assessment program with sufficient internal controls, identified roles and responsibilities, and oversight systems in place and operating properly to ensure the following:

- the prompt identification of deficiencies and opportunities for improvement;
- the prompt and accurate reporting of deficiencies and improvement opportunities to the responsible laboratory managers, DOE, or other authorities; and
- the timely and effective implementation of corrective actions.

The FRA *Quality Assurance Manual* identifies that the Quality Management System is "one of the management systems" that is a part of the CAS. Sections are identified for both conducting management and independent assessments. Items identified in assessments having Lab-wide impact are to be identified and reported at the SOG and other senior management team meetings for awareness and action.

Also, in the interviews it was identified that assessments conducted as a part of the FRA CAS or QA programs do not directly assess subcontractor construction work, but the requirements in the contract language have been developed and are sufficient to ensure that the subcontractors meet requirements and conduct work safely. Rather, FRA is relying on FRA personnel outside of the CAS organization and WCEI personnel to ensure that subcontractors are meeting requirements and conducting work safely through their walkdowns of the site.

Analysis:

The assessment program defined by the FRA CAS program is basing the success of the program on assessments performed by the implementing program and supporting organizations. Assessments on the PIP-II Construction Project, to date, have not been completed to assess the flow down of the requirements from the FRA contract to WECI, or to subsequent sub-tier contracts with Nucor or Harris (or other sub-tier subcontractors). Assessments of the oversight or performance of these sub-tier contractors to these requirements have also not been completed. By not conducting

assessments of the WCEI Oversight Program, or Nucor and Harris' implementation of the requirements, a gap in the CAS program has developed and is preventing FRA from understanding whether WCEI, Nucor, or Harris are effectively implementing safety and health requirements at the PIP-II project.

Identified Causal Factors:

WCEI/Nucor/Harris Oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

FRA not aware of how hazards are being addressed (CF-C18)

3.5.2 Corrective Action Status and Adequacy from Prior Construction Accidents

Facts:

Review of the DOE ORPS did not identify any prior construction related accidents and identified only one ORPS incident that involved fall protection over the last five years. This report was related to the installation of HVAC systems by a service subcontractor not involving construction. Corrective actions were developed for issues identified in assessments as discussed in Section 3.2.5 above.

Interviews with FRA personnel identified that the CAS program is an umbrella program for addressing issues and is used to connect the documents to ensure issues are properly addressed.

The Board requested that FRA provide any corrective actions related to fall protection for construction activities to address this charge question. FRA did provide a set of corrective actions which were reviewed by the Board. Based on the review, the Board did not identify any corrective actions that addressed fall protection related to construction issues.

Analysis:

Corrective actions for several assessments for subcontractor activities have identified deficiencies related to weaknesses in subcontractor oversight, lack of specific details associated with hazard analysis, and the level of knowledge of Construction Coordinators and Task Order managers on subcontracts (refer to Section 3.2.5). These recurring deficiencies, coupled with similar factors associated with the IW1 fall accident, indicate that the CAS has not been fully successful in assuring that the assessment program and associated corrective action plans are effective.

Identified Causal Factors:

WCEI/Nucor/Harris Oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (CF-C8)

FRA not aware of how hazards are being addressed (CF-C18)

3.5.3 Enterprise Risk Assessment

Facts:

FRA has implemented an Enterprise Risk Management Program (ERMP) that establishes the requirements applicable to all levels at the Laboratory and provides a standardized approach to attempt to identify, analyze, mitigate, monitor, and communicate risks.

The FRA Risk Matrix is used to evaluate the overall characterization of an identified risk by determining each risk's probability and severity, which develops an overall risk level. The risk level then serves as the basis for prioritization and mitigation decisions. FRA's highest level (Tier I) risks are mapped based on the probability and impact to identify levels of management attention (Figure 3-10).

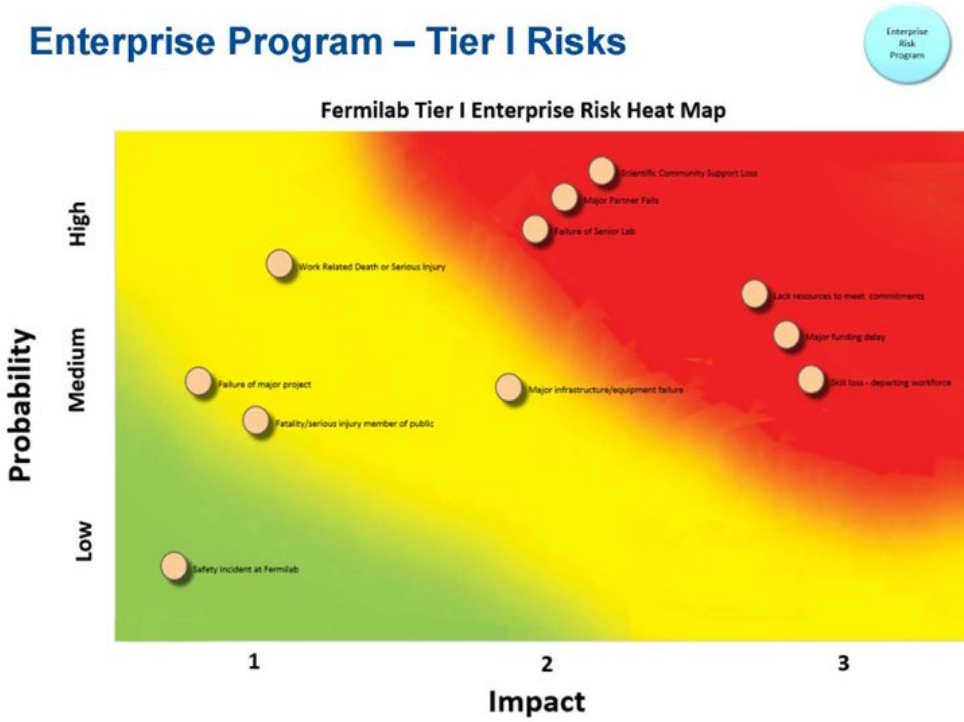


Figure 3-10. FRA Tier I Enterprise Risk Heat Map Corrective Action Status and Adequacy from Prior Construction Incidents

According to the Program criteria, the Risk associated with this accident would be classified as "Work Related Death or Serious Injury." Impact is the component of the risk that describes its actual or potential impact and FRA rated this type of incident as Medium (Impact Level 2). Probability is the risk component that characterizes the likelihood of occurrence and was considered High, with a greater than 20% probability of occurring.

In addition to the ERMP, FRA also utilizes a risk register and describes project risks in the PEP for each major construction project as required by DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

The PIP-II PEP Section 5.3, *Risk Management*, provides six high-level risks for the Early Conventional Facilities subproject (Cryogenic plant building and site work) in the October 2020 version of the PEP provided to the Board. There were risks identified for other elements of the project, including the LINAC construction for a Major ES&H incident. A Major ES&H incident is identified as an item "such as a significant accident, incident, or near-miss on the FNAL site, which has the potential for a work stoppage until investigations are completed, jeopardizing the ECF subproject baseline goals."

Mitigation actions for this risk are identified as "standard FNAL work planning process including the development of the PIP-II Safety Assessment Document, incorporating ES&H requirements into the subcontract documents and selection criteria as well as maintaining a vigorous safety program and adequate level of staffing for project ES&H support and oversight at the project, laboratory, and DOE level."

The Environment, Safety, Health and Quality (ESH&Q) portion of PEP Section 8.1, *Risk Management*, identifies the process for mitigating ES&H risks, including construction, and are included in PIP-II Integrated ES&H Management Plan. Section 8.7, *Environment, Safety, and Health*, identifies that the PIP-II *Integrated Management Plan* meets the requirements of the FNAL ES&H Manual. Concerns will be managed through the stages of the project, including construction, and includes ISM, hazard analyses, and other applicable requirements.

The PIP-II Project has also established a risk register for the project and identified Risk RT-121-01-019 for a Major ES&H incident on FNAL Site. The risk is described to cover if there is a significant accident, incident, or near-miss on the FNAL site, then there is potential for a work stoppage until investigations and associated corrective actions are completed, jeopardizing the project's cost and schedule goals. The described risk mitigations include maintaining a vigorous safety program and adequate level of staffing for project ES&H support and oversight at the Project, Laboratory, and DOE level. The specific actions listed include FRA PIP-II Construction Managers provide daily assistance/oversight, including construction safety, heavy equipment inspection, and independent oversight. All on-site activities follow the FRA ES&H manual. Contractors are to follow the FRA WSHP to facilitate development of a contractor specific ES&H Plan. "Frequent methods of communication and feedback deployed to facilitate safety will include; daily tailgate meetings, weekly contractor meetings, etc. Job Safety Analyses (JSA) written for all contractor and high-risk activities." The risk responses are described as ongoing oversight and planning.

Analysis:

FRA has an Enterprise Risk Management and assessment process to identify and prioritize institutional risks that have the potential to impact the Laboratory's ability to meet their commitments to DOE and execute the mission. The designation of a work-

related death or serious injury in the ERM is high probability and low impact which is inconsistent with the project risk register described previously, and the mitigation measures described in the Program Plan. Delays of multiple weeks on the project with relative certainty due to the high probability contained in the project risk register warrant additional focus by the project team.

The Program is currently being revised and the new iteration of the supporting processes and programs are not fully matured, based on the current status of supporting documents. The Project risk register includes an evaluation of a serious injury to a worker at the PIP-II construction site and associated mitigation measures, many of which are in place at the project. The PEP reflects a risk of a construction accident in the early phases of the project but has not been updated for three years.

The risk register for this project was light for a project of this size and magnitude. In addition, the cost and schedule impacts associated with a "Major ES&H incident" was ranked as low probability (10%), with no cost impact and just 1-3 months of schedule impact. This was not a construction risk; it was a project management risk. The registry and associated probabilities, cost and schedule impacts are not typical of similar projects.

Identified Causal Factors:

Work is not adequately defined, with identified hazards, and applicable development and implementation of hazard controls (CC-4/CF-B20)

Direction of work not clear CC-3/CF-B11a/CF-C11

3.6 Fermi Site Office Oversight

Facts:

FSO's general organization structure (Figure 3-11) includes three major divisions that report to the FSO Site Office Manager and Deputy Manager, and a special direct report position:

- Mission Integration and Projects Division (8 staff including Supervision);
- Business Division (6 staff including Supervision);
- Operations Division (7 staff including Supervision and dedicated LBNF Dune field oversight); and
- LBNF Dune Federal Project Director (FPD), consisting of a single Supervisory General Engineer.

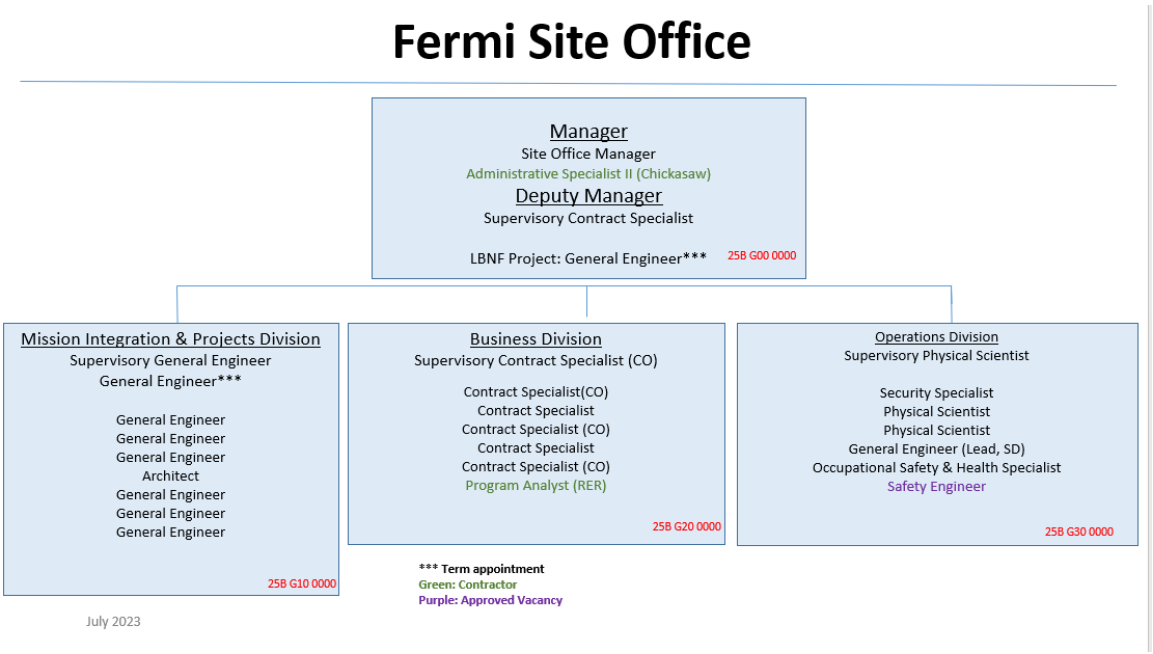


Figure 3-11. FSO Organizational Chart

There are no current vacancies within FSO's organizational structure/approved staffing plan. The FSO Manager has been concurrently serving as the Acting Argonne Site Office Manager for approximately one year. FSO has a suite of internal procedures to facilitate their delivery of SC's mission objectives and responsibilities. Upon the Board's review of FSO procedures, many are beyond the scheduled date for reissue.

At a high level, FSO responsibilities for safety oversight are identified in FSO procedure 4.4, *ES&H Functions, Responsibilities, and Authorities Program Manual* (FRAPM). Responsibilities for program areas including 10 CFR 851, *Operating Experience/Lessons Learned*, and ES&H Reporting are assigned to FSO's Operations Division Director, while other program responsibilities, such as ES&H Oversight (DOE Order 226.1B) and the FSO Technical Qualifications Program (TQP), are assigned to the FSO Manager.

Table 2 in the FRAPM includes more specific responsibilities for all major job classifications within the FSO, including Management, FPDs, Facility Representatives, and Subject Matter Experts (SME).

Details on the implementation of FSO's oversight responsibilities are included in various procedures, including FSO's Oversight Program Description. There are two principle FSO Operations Division staff members that provide construction safety oversight at FNAL's main campus, including the PIP-II project:

- Occupational Safety and Health Specialist; and
- A Safety Engineer.

Based on the FRAPM, the responsibilities for these two positions are classified as "SME", which is distinct from the responsibilities assigned to Facility Representatives. Some of the responsibilities for SMEs identified in the FSO Oversight Program Description include:

- Evaluating assigned contractor programs for compliance with applicable standards through on-going knowledge of the FRA technical and operational programs;
- Attending FRA ES&H committee meetings, and cultivate an awareness of developing issues and concerns; supported by recorded observations;
- Leading or participating in FSO assessments; and
- Using oversight to facilitate early identification and effective resolutions for issues and concerns.

FSO has one designated Facility Representative, and that individual covers a host of programs including, but not limited to, radiation protection and accelerator operations. This staff member is a fully qualified Facility Representative, but their oversight does not customarily include construction project safety. The two SMEs that are responsible for construction safety oversight are both enrolled in the FSO technical qualification program, which includes both Parts A and B of DOE's General Technical Base. Additionally, FSO management has assigned one SME to complete DOE's Industrial Hygiene qualification standard, and the other SME to complete the Occupational Safety and Health qualification standard. The qualification status for both staff members is currently in-progress. Some mentoring has taken place between FSO's Safety Engineer and another member of the Operations Division who possessed considerable construction safety experience, but that individual left FSO employment mid-way through 2022.

Visits to the PIP-II construction site are predominantly performed as scheduled weekly visits by the FSO PIP-II Deputy FPD, accompanied by the two Operations Division SMEs referenced above. These visits are coordinated to include FRA's project management personnel, FRA's lead for PIP-II subcontractor oversight, the WCEI Superintendent, and the WCEI site Safety Representative, making the overall number of walkthrough participants between approximately five and nine individuals. Representation from normal attendees may change, and scheduled visits to the site are weather conditional. The FSO Manager expects FPD's to be sufficiently experienced and responsible in recognizing unsafe work conditions at construction sites, and not be completely reliant upon Operations Division staff to monitor project safety. This expectation is consistent with responsibilities assigned to FPD's in the FRAPM:

> *Ensure that the Environment, Safety and Health (ES&H) requirements and Quality Assurance requirements are properly implemented.*

FSO's Operations Division staff record field oversight activities in an internal system Performance Assessment Reporting System (PARS). Observations from periodic visits to the current phase of the PIP-II Construction Project site have taken place since

groundwork started for the LINAC excavation in February 2023. In addition to internally logging field photos and observations into the PARS system, FSO shares the results of their construction walkthrough observations with FRA's construction safety oversight group. As part of their visits to the PIP-II construction site, FSO personnel have occasionally attended WCEI's 0700 daily jobsite planning meetings.

The FSO Manager establishes the oversight program objectives and strategy, including expectations for staff in the FSO Oversite Program Description. The FSO Operations Division Director is responsible for developing the FSO annual assessment schedule consistent with the Program description. The baseline schedule identifies assessments mandated by rules, Directives, or other regulatory requirements, and is supplemented by an evaluation of program areas where FSO has identified performance concerns, as well as higher risk programs that have not been recently evaluated. FSO management holds a meeting with FRA leadership to share its draft annual assessment plan for consideration in coordination and timing. Additionally, coordination is made with the SC Office of Safety and Security to ensure any outside assessment resources are available to support the assessment schedule. FSO uses assessment results to evaluate FRA programs. FSO conditionally approved FRA's most recent revision to its Worker Safety and Health Program on October 19, 2022.

FSO identified a negative performance trend in excavation-related utility strikes, shoring concerns, and similar issues in the FY2021 – FY2022 time frame. These concerns were communicated to FRA which prompted them to create an Excavation Subpanel to the S-3. The purpose of the Excavation Subpanel is to:

- Improve on communication;
- Draw past experience and future events;
- Consider the needs for additional training; and
- Continue to examine the processes.

The Excavation Subpanel continues to meet regularly and provides updates to the parent S-3 committee as a regular agenda item. Both the subpanel and S-3 include an invitation to and attendance by the FSO.

Consistent with SC's Performance Evaluation and Management Plan (PEMP) process, the FSO Contracting Officer issued a contract modification to insert the FY2023 performance plan into the FRA contract for the current annual rating period. This performance plan included SC's standard eight goal areas, and an additional seven Notable Outcomes. Five of the seven Notable Outcomes are associated with Goals one and two and define expectations on project performance and progress set by the SC program offices that provide project funding to FRA. There were no Notable Outcomes for construction project safety performance, for PIP-II or any other project, in the FY2022 or FY2023 PEMP.

The scope of SC's standard Goals and Objectives include criteria that FSO can use to evaluate the construction project's performance. Examples include PEMP Objective 2.2:

"*Provide for the Effective and Efficient Construction of Facilities and/or Fabrication of Components,*" and Objective 5.1, "*Provide an Efficient and Effective Worker Health and Safety Program*."

The PEMP Notable Outcome inserted in Goal 4, *Laboratory Leadership and Stewardship*, references an agreed set of performance expectations between FSO and FRA:

> *In order to position FRA to meet future success and deliver on mission, FY2023 must be a year of cultural and functional change. Implement an agreed to set of facility and systems changes in FY2023 that assure fundamental change in the lab footing for FY2024.*

For the 2022 PEMP, FSO noted that FRA still has challenges assuring that hazard analyses detail all work steps and the identification of associated hazards. FSO also identified a vulnerability exists in FRA maintaining different work planning tools, thereby creating confusion around approval authorities and who authorizes a final work package, including hazard analyses.

Analysis:

Several FSO procedures and manuals are beyond their specified review frequency, and do not fully reflect current staffing and assignments. FSO has been executing its major responsibilities in safety oversight, such as reviewing and approving FRA's WSHP. FSO's most recent conditional approval of the WSHP reflected an understanding of an operational safety vulnerability in receiving pressure safety systems from international partners. FSO does perform periodic (quarterly) analysis of the information gathered in PARS and has recently created risk maps to track areas where oversight activities are being performed and associated potential hazards in those areas. These efforts indicate an initial phase of performance tracking and trending, with the potential to evolve into more useful tools in applying FSO resources in areas with the greatest opportunity for impact.

Based on interviews, there are no standing processes to communicate upcoming PIP-II construction activities from the FPD and Deputy FPD to the Operations Division staff. Such information may be acquired through other means, but Operations Division staff are not otherwise invited to meetings or have ready access to project work schedules. This limits SME's awareness of activities which they may have a heightened interest in observing. This placed a high reliance on FSO's weekly scheduled visits to the PIP-II construction site for monitoring construction safety.

The two Operations Division staff members providing primary oversight of construction safety are relatively junior in their experience with construction safety. FSO's Oversight Program Description identifies that Facility Representatives are used to provide oversight and acquire awareness for both laboratory operations and construction. FSO has only one designated Facility Representative, and that individual is assigned to non-construction operations oversight. FSO's FRAPM includes the following excerpt:

> *The Facility Representatives should spend a significant amount of their time in their assigned facilities observing operations and assessing operating conditions.*

There are no similar expectations in the FRAPM on the amount of time SMEs are expected to spend conducting assessments in the field. Interviews with Operations Division staff and FSO management affirmed there are no other procedures, performance plan goals, etc. that set expectations on time to be spent in the field by SMEs, formally or informally. FSO management expressed it is giving consideration to creating a Facility Representative position(s), with the intent to include construction safety oversight as a primary responsibility.

Despite a minor inconsistency in the Oversight Program Description and staffing plans regarding Facility Representatives, FSO has assigned qualification requirements to Operations Division staff, and has a formal process to track completion of those assigned competencies. Documentation was provided to the Board demonstrating that FSO conducts construction safety observations and has identified safety concerns to FRA. An example of following through on safety oversight is the creation of the FRA Excavation Subpanel. FSO's oversight has had a value-added impact on site safety. The Excavation Subpanel continues to meet with FSO participation, and performance in that program area has improved. Additionally, FSO's recent participation in the FY2022 Tripartite (joint) Assessment of subcontractor WPC has provided FSO with insight into some of the systemic issues that need to be addressed by FRA for subcontracted work.

Based on interviews with FSO personnel visiting the PIP-II Construction Project, their observations of work have been largely conducted from the perimeter of the site, and have not included directly interacting with WCEI's tradespersons, or lower-tier subcontractors. Physically witnessing the construction site from the perimeter may have been practical weeks prior to the accident; however, the subsequent installation of the form walls would have made it impossible to effectively witness all of the work activities on the construction project, including climbing form walls. FSO personnel have occasionally attended WCEI's 0700 daily jobsite planning meeting, but they had never attended a Harris daily JTA meeting. Consequently, SMEs were unable to convey information to the Board on how sub-tier construction contractors conducted their pre-job meetings or where the task-specific work plans for lower-tiered subcontractors were maintained. This condition was consistent with the lack of familiarity by FRA construction oversight personnel in how lower-tier subcontractors manage their pre-job briefings. The absence or reluctance to interact with lower-tiered subcontractors or monitor work activities up close is not considered to be a reflection of the relative inexperience of FSO's Operations Division staff, but rather an acceptance of the practices that have been used during the conduct of weekly group visits to the construction site. Field oversight personnel should recognize larger group visits present limitations to their effectiveness in identifying safety conditions. Full access to the job site by FSO is essential to perform their oversight responsibilities effectively.

FSO's FY2023 PEMP midyear performance feedback in PEMP Section 5.1 includes a balance of positive and negative performance aspects of FRA's safety program. FRA's

construction safety program was specifically credited by FSO for the high presence of FRA oversight personnel at construction sites. FSO's overall appraisal of FRA's safety program in the FY2022 PEMP Objective 5.1 recorded a "B" performance rating. This performance rating suggests FSO's safety oversight personnel have been able to critically evaluate and provide justification to FSO management to support a rating which is below the Department's 'meets expectation' level of performance.

Based on feedback from FSO management, the SC Program Offices have generally avoided inserting expectations on project safety performance in their PEMP Notable Outcomes, instead deferring to the FSO for appraisal of construction project safety, consistent with the SC PEMP process. Enhanced communications between the Site Office and the SC Program Offices on safety performance and expectations for the project could improve this process.

Identified Causal Factors:

FSO lacked full situational awareness of the robustness of the FRA oversight program (CF-B13a)

FSO is not ensuring FRA has appropriate and effective oversight systems for the Project activities (CF-C5)

4.0 Causal Analysis and Results

4.1 Events and Causal Factors Analyses

As mentioned in Section 1.1 of this report, causal factors are the events and conditions in the accident sequence that contributed to the unwanted result. Causal factors are determined by analyzing the facts identified by the Board to determine what led to the accident. The Board used several analytical techniques to determine the causal factors of the accident, including barrier, change, human performance, and event and causal factor analyses, as described below.

4.1.1 Barrier Analysis

After a basic chronology of events was developed, the Board performed a barrier analysis of the accident. Barriers are those administrative or physical elements that could have prevented the accident situation from affecting the worker. To start the barrier analysis, the Board chose a target (the person or item to be protected – IW1) and the hazard (what the person or item is to be protected from – fall from height). Based on the analyses of the facts, the Board determined how the particular barrier performed on allowing the hazard to impact the target and identified causal factors.

There were 17 barriers identified and analyzed by the Board.

The Barrier Analysis Worksheet is presented in Appendix I.

4.1.2 Change Analysis

A complimentary review of the facts to the barrier analysis is the change analysis. The change analysis looks at the facts and examines the differences between the facts identified in the accident scenario against conditions expected to be in place in an ideal or accident-free scenario and identifies the changes between the two scenarios. Based on these differences, the Board identified how the changes caused undesired results or outcomes related to the event and identified causal factors.

There were 27 changes identified and analyzed by the Board.

The Change Analysis Worksheet is presented in Appendix J.

4.1.3 Human Performance Improvement

The goal of Human Performance Improvement (HPI) is to facilitate the development of a facility structure that recognizes human attributes and develops defenses that proactively manage human error and optimize the performance of individuals, leaders, and the organization. Human Performance was analyzed to determine if it played a part in this accident. Human error is not a cause of failure alone, but rather the effect or symptom of deeper trouble in the system. A review of Human Performance is a review of an individual's abilities, tasks, and operating environment to determine if the organization supports them for success. The analysis was based on the TWIN technique described in

DOE HDBK-1208-2012, *Accident and Operational Safety Analysis*, Volume II. TWIN stands for the human performance attributes identified in Figure 4-1.

HUMAN PERFORMANCE ATTRIBUTES

Task Demands. Specific mental, physical, and team requirements to perform an activity that may either exceed the capabilities or challenge the limitations of human nature of the individual assigned to the task; for example, excessive workload, hurrying, concurrent actions, unclear roles and responsibilities, or vague standards.

Work Environment. General influences of the workplace, organizational, and cultural conditions that affect individual behavior; for example, distractions, awkward equipment layout, complex tagout procedures, at-risk norms and values, work group attitudes toward various hazards, or work control processes.

Individual Capabilities. Unique mental, physical, and emotional abilities of a particular person that fail to match the demands of the specific task; for example, unfamiliarity with the task, unsafe attitudes, level of education, lack of knowledge, unpracticed skills, personality, inexperience, health and fitness, poor communication practices, or low self-esteem.

Human Nature. Generic traits, dispositions, and limitations of being human that may incline individuals to err under unfavorable conditions; for example, habit, short-term memory, fatigue, stress, complacency, or mental shortcuts.

Figure 4-1. Human Performance Attributes

The HPI Analysis is presented in the Human Performance Indicators Worksheet in Appendix K, and the results are included as a part of the Barrier Analysis to identify causal factors.

4.1.4 Events and Causal Factors Analysis

Events and Causal Factors (E&CF) Analysis starts with identifying facts and identifying them as either a chronological sequence of events or the conditions associated with an event – such as the worker arrived on the site at 0815 and the sky was blue when IW1 arrived. The events and conditions may or may not contribute to the unwanted result, as determined through the barrier and change analyses. However, they do establish a timeline and the conditions leading up to the accident and the response following the accident.

As stated previously, events and conditions are facts. Based on the Board's understanding of these facts, the Board determined which to include in the analyses. No analysis can be performed if there are no facts to support the analysis. The causal factors

identified in the analyses are placed in the appropriate portions of the E&CF chart and tied to the supporting facts; and the direct, contributing, and root causes are identified on the chart. As a result, the reviewer can identify in a graphical way the chain from facts to causal factors, up to and including the root causes.

The E&CF chart is located in Appendix L.

4.2 Direct, Contributing, and Root Causes

The Board assessed the causal factors and determined, based on the definitions included in Section 1.1, as to whether a causal factor individually or as a group was either a direct, contributing, or root cause. The direct, contributing, and root causes, as identified by the Board, are included below.

4.2.1 Direct Cause

The direct cause of an accident is the immediate event or condition that caused the accident.

The Board concluded that the direct cause of this accident was that IW1 fell approximately 23 feet to the concrete pad resulting in serious injuries, including head trauma.

4.2.2 Contributing Causes

Contributing causes are events or conditions that collectively with other causes increased the likelihood or severity of an accident, but that individually did not cause the accident.

The Board identified the four (4) contributing causes of the accident and its consequences. The contributing causes were:

- Worker conducted the task without the use of required fall protection;
- Requirements not being implemented as expected;
- Direction of work not clear; and
- Work is not adequately defined with identified hazards, and applicable development and implementation of hazard controls.

4.2.3 Root Causes

Root causes are causal factors that, if corrected, would prevent recurrence of the same or similar accidents.

The Board identified the root cause of the accident was that FRA has not assured that ISM was effectively implemented within the PIP-II project.

5.0 Conclusions and Judgments of Need

These direct, contributing, and root causes, are further analyzed by the Board to identify its CONs and, ultimately, its JONs. Table 5-1 below summarizes the CONs and JONs as determined by the Board. Appendix M includes the summary of causal factors identified by the Board and their location in this report.

CONs are those items that the Board considered significant and are based on the facts and pertinent analytical results.

JONs are managerial controls and safety measures believed by the Board to be necessary to prevent or minimize the probability or severity of a recurrence of this type of accident resulting in a fatality. JONs are derived from the CONs and causal factors and are intended to assist managers in developing corrective actions and fostering continuous improvement. These JONs are linked directly to the causal factors, which are derived from the facts and analysis. They form the basis for corrective action plans, which must be developed by line management.

Based upon the findings of this accident investigation, the Board concluded that this accident and the resulting injury was preventable. Use of an approved anchor point and available fall protection would have prevented IW1 from falling approximately 23 feet to the concrete surface.

A recurring issue identified by the Board was the number of errors, omissions, and incomplete documents. The Board determined this to be a systemic lack of attention to detail in managing project documentation.

Table 5-1. Conclusions and Judgments of Need

Causal Factors	Conclusions	Judgments of Need
B6, B7, B8, B9, B10, CC1/B11, B13, B14, B19, CC4/B20, B21, C1, C4, CC2/C6, CC3/CF-B11a/C11, C12, C17, C18, RC	CON-1: Work tasks were not defined in sufficient detail, which did not allow for adequate identification of hazards and hazard controls to be developed.	JON-1: FRA PIP-II Project Management needs to ensure all subcontractors are defining work tasks prior to work.
B5/C7, B10, CC1/B11, B13, B14, CC2/C6, CC3/CF-B11a/C11, C12, C19, RC	CON-2: FRA, WCEI, Nucor, and Harris Management did not ensure that the principles of hierarchy of controls were implemented to evaluate opportunities to reduce worker exposure to hazards during work execution.	JON-2: FRA PIP-II Project Management needs to ensure all subcontractors develop processes to ensure that all work is thoroughly analyzed, hazard controls are developed and

Causal Factors	Conclusions	Judgments of Need
	CON-3: FRA, WCEI, Nucor, and Harris Management has not ensured that hazard controls are developed, implemented, and that work is performed within those controls.	implemented, and work is performed within those controls.
B15, CC2/C6, C8, C12	CON-4: FRA Management failed to mitigate previous work control deficiencies and implement effective corrective actions which would be expected in a robust feedback and improvement system.	JON-3: FRA Management needs to ensure work control deficiencies found during assessments are mitigated, and effective corrective actions are implemented in a timely manner as a part of their feedback and improvement system.
B1, B2, B3, DC/B4/C2, B6, B7, B14, C3, C4, CC2/C6, C8, C12, C17, C18	CON-5: Subcontractor management was not fulfilling safety program requirements resulting in safety practices not being implemented.	JON-4: FRA PIP-II Project Management needs to ensure FRA and its subcontractors conduct ongoing field verification of project compliance with accepted safety plans and performance of work.
B1, B2, B3, DC/B4/C2, B14, CC2/C6, C8, C12	CON-6: FRA failed to ensure that the accepted safety requirements and work practices were being implemented by all sub-tier subcontractors to execute work. CON-7: FRA processes allowed multiple and widespread issues within the project to go unrecognized. CON-8: The FRA CAS Program has been in transition and operating for many months without FSO review and approval. CON-9: Determining the overall health and effectiveness of the FRA CAS program is secondary to ensuring that the program is compliant with requirements.	JON-5: FRA needs to evaluate the proper frequency and independence in assessing worker safety program performance at the PIP-II Construction Project. JON-6: FRA needs to complete the CAS Program revision, obtain FSO approval and ensure effective implementation at the PIP-II project and across the entire Lab.
B18/C14, C9, CC3/CF-B11a/C11, C16, C17, C18	CON-10: FRA allowed WCEI to flow down requirements, including DOE safety requirements, to lower-tier subcontractors through	JON-7: FRA needs to establish procurement processes that clearly require the flow down of requirements to all levels of

Causal Factors	Conclusions	Judgments of Need
	indirect reference; thereby limiting awareness of applicable requirements for the execution of the work.	subcontractors to ensure that all requirements are available to all subcontractors.
B18/C14, B12, B13, B14, B16, B19, CC4/B20, B21, C1, C4, CC2/C6, C8, C10, CC3/CF-B11a/C11, C12, C16, C17, C18, C19	CON-11: FRA PIP-II personnel are not fully aware of FESHM and contract requirements resulting in ineffective project oversight. CON-12: FRA failed to provide sufficient oversight of WCEI's, and Harris's critical work planning processes. CON-13: FRA responsibilities are not clearly assigned, as FESHM requirements were not written in a methodical manner to ensure full implementation and with defined responsibilities for all requirements. CON-14: The number of errors, omissions, and incomplete documents indicates a systemic weakness and lack of attention to detail in managing project documentation. CON-15: The lack of inclusion of medical services and first aid requirements from 29 CFR 1926.50(c) in the WCEI and Harris SSSPs is a gap that could lead to a delay in treatment for injured workers. CON-16: FRA failed to ensure that the safety documentation acceptance process was completed for all sub-tier subcontractors and allowed documents that had not been accepted for use to execute work.	JON-8: FRA PIP-II Project Management needs to clearly define, communicate, and execute project roles and responsibilities.
B17, C4, C13, C17	CON-17: FRA and subcontractor Management failed to ensure construction subcontractors had the required training to execute	JON-9: FRA Management needs to ensure construction subcontractors are properly

Causal Factors	Conclusions	Judgments of Need
	assigned work activities per FRA requirements, including high hazard work activities.	trained and qualified to execute work activities.
CC2/C6, C15	CON-18: FRA did not follow accident response and field preservation requirements.	JON-10: FRA needs to establish roles and responsibilities and protocols for accident response, and scene preservation.
B13, B13a, C5	CON-19: The FSO oversight approach on the PIP-II project has allowed gaps in the FRA CAS program that permitted weakness in subcontractor work processes. CON-20: FSO's oversight did not apply the degree of independence needed to assess PIP-II project work plans and execution or assess the effectiveness of FRA's CAS performance.	JON-11: FSO needs an oversight strategy that incorporates sufficient independence and is based on integration of project information.
C20	CON-21: Despite minor deficiencies, the FRA emergency response addressed the accident and ensured IW1 was attended to with appropriate medical care and transported to an appropriate Level One Trauma Center for further treatment. CON-22: Taking the helicopter resulted in a longer transportation time compared to using an ambulance. This option was not optimal for transportation time to a hospital. CON-23: FRA should advocate with regional emergency response agencies for improved FNAL patient transport protocols to ensure the best patient outcome.	JON-12: FRA needs to complete an analysis and meet with regional emergency response agencies.

6.0 Accident Investigation Board Members Signatures

Michael Weis — August 29, 2023

Michael Weis — Date
DOE Accident Investigation Board Chairman
U.S. Department of Energy
Office of Science
Director, Office of Safety and Security

Barton Drummond — August 29, 2023

Barton W. Drummond — Date
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of ES&H Reporting and Analysis, EHSS-23
DOE Fire Protection Annual Report Program Manager

Thomas M. Wirgau — August 29, 2023

Thomas M. Wirgau — Date
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of Enterprise Assessment
Safety and Occupational Health Manager

Steven J. Neilson — August 29, 2023

Steven J. Neilson — Date
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of Science, Office of Science and Security
Safety and Occupational Health Manager

Nathan A. Morley — August 29, 2023

Nathan A. Morley — Date
DOE Accident Investigator and Board Member
U.S. Department of Energy
National Nuclear Security Administration
Office of Environment, Safety, and Health
General Engineer

Board Members

Chairman	Michael Weis U.S. Department of Energy Office of Science Director, Office of Safety and Security
Member	Thomas M. Wirgau U.S. Department of Energy Office of Enterprise Assessment Safety and Occupational Health Manager
Member	Nathan A. Morley DOE Accident Investigator and Board Member U.S. Department of Energy National Nuclear Security Administration Office of Environment, Safety, and Health General Engineer
Member	Barton W. Drummond U.S. Department of Energy Office of Environment, Health, Safety and Security ES&H Reporting and Analysis, EHSS-23
Member	Steven Neilson U.S. Department of Energy Office of Science Office of Science and Security Safety and Occupational Health Manager

Advisors/Team Coordinator

Consultant/Advisor	Dr. Michael Ardaiz, MD, MPH, CPH U.S. Department of Energy Chief Medical Officer
Consultant/Advisor	James M. Durrant III U.S. Department of Energy Chief Counsel Office of Science
Consultant/Advisor	Steven M. Thiede U.S. Department of Energy General Attorney General Law Division, Office of Chief Counsel – North Office of Science
Consultant/Advisor	Peggy Caradonna Division Manager, Modernization Project Office Brookhaven National Laboratory

Administrative Coordinators

Administrative Coordinator/ Technical Editor	Susan M. Keffer Project Enhancement Corporation
Technical Editor	Iris A. Shreve Project Enhancement Corporation
Technical Editor	Meredith K. West Project Enhancement Corporation

Appendices

APPENDIX A

Accident Investigation Board Appointment Memoranda

Department of Energy
Office of Science
Washington, DC 20585

May 26, 2023

MEMORANDUM FOR MICHAEL WEIS
DIRECTOR, OFFICE OF SAFETY AND SECURITY
OFFICE OF SCIENCE

FROM: JUSTON K. FONTAINE
DEPUTY DIRECTOR FOR OPERATIONS
OFFICE OF SCIENCE

SUBJECT: Accident Investigation at Fermi National Accelerator Laboratory

BACKGROUND: On May 25, 2023, a construction incident occurred on the Proton Improvement Plan – II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL) in Batavia, IL. During an activity involving formwork, a subcontract worker fell approximately 25 feet. Initial information indicates that the individual suffered head trauma and multiple broken bones. Fermi Research Alliance, LLC (FRA), the operator of FNAL, is currently conducting an internal fact-finding analysis.

Over the past several years, the Laboratory has continued to put effort into processes to deal with the substantial increase of construction work and overseeing subcontractor work activities. Laboratory and Fermi Site Office leadership have been actively working to improve culture and these efforts are still in process. Efforts to institutionalize processes and shift to process based versus expert based operations have been challenging over this period of time.

ACTION: In order to determine the facts and circumstances related to the construction incident as well as any contributing factors at FNAL, I am directing that an investigation be conducted to identify causal factors, including a review of any relevant policies, procedures, work practices, or actions related to the incident. The review should also explore, as appropriate, an extent of condition. This review should include, but is not limited to the following:

1. Determine the facts leading up to the incident.
2. Review the adequacy of the Laboratory's immediate response, interim actions, and extent of condition evaluation in response to this incident.
3. Assess the application of the construction program to include processes of training, planning of hazards, oversight, safety measures, oversight, and the work controls in place.
4. Assess the procedures for and actions taken to conduct, document, and perform the construction activities underway and provide for safe execution.
5. Conduct a causal analysis, using recognized methodologies, as needed, to determine the root and contributing causes of the incident that led to the injury.
6. Review and assess the status and adequacy of corrective actions from prior construction incidents at FNAL in the last three years for relevance and adequacy to prevent reoccurrences.

7. Evaluate whether broader systemic weaknesses are present in the Laboratory's construction safety program.

CHARGE: While this incident may not yet meet the determination criteria provided in DOE O 225.1B Appendix A, given the seriousness of the event and the injuries sustained to the individual, as well as the likelihood that the incident may result in the criteria of DOE O 225.1B, Appendix A, item 2.a.(2) (any single accident that results in the hospitalization for more than five calendar days, commencing within seven calendar days of the accident, of one or more DOE, contractor, or subcontractor employees or members of the public due to a serious personal injury or acute chemical or biological exposure), I am formally appointing an Accident Investigation Board (AIB).

You are appointed as the Board Chairperson and are to conduct this investigation in accordance with DOE O 225.1B. In this capacity, you are to lead a DOE investigation team comprised of Federal employees, with laboratory support as appropriate, to investigate the incident. This initial memorandum will be followed by subsequent charge, which formally identifies the AIB members, including a qualified accident investigator. In discussions with the Director, Office of Environment, Health, Safety and Security, that office is actively working to identify individuals that can serve in this capacity.

Please provide a draft report no later than July 21, 2023, which includes findings, causal analysis, and recommendations aimed at identifying and correcting deficiencies that contributed to the construction incident as well as any broader programmatic weaknesses or lessons learned that would improve future activities. If, during the course of the review, specific critical items of an urgent nature are identified, please address these issues immediately and provide a summary of findings.

cc:
Jessica Halse, Associate Deputy Director for Operations
Roger Snyder, Fermi Site Office Manager
Todd Lapointe, Director, Office of Environment, Health, Safety and Security

Department of Energy
Office of Science
Washington, DC 20585

June 1, 2023

MEMORANDUM FOR MICHAEL WEIS
DIRECTOR, OFFICE OF SAFETY AND SECURITY
OFFICE OF SCIENCE

FROM: JUSTON K. FONTAINE
DEPUTY DIRECTOR FOR OPERATIONS
OFFICE OF SCIENCE

SUBJECT: Amended Charge for Accident Investigation at Fermi National Accelerator Laboratory

On May 26, 2023, the attached memorandum was issued to establish a DOE investigation team to investigate an incident that occurred during construction at the Proton Improvement Plan – II (PIP-II) project site at the Fermi National Accelerator Laboratory (FNAL) on May 25, 2023.

At that time, although the incident had not yet met the determination criteria for a formal accident investigation, given the seriousness of the event and the injuries sustained to the individual, the attached May 26, 2023, memorandum appointed you as the Accident Investigation Board (AIB) Chairperson for an accident investigation to be conducted in accordance with DOE O 225.1B. Subsequent to the issuance of the initial charge, the incident now meets the criteria of DOE O 225.1B, Appendix A, item 2.a.(2) (any single accident that results in the hospitalization for more than five calendar days, commencing within seven calendar days of the accident, of one or more DOE, contractor, or subcontractor employees or members of the public due to a serious personal injury or acute chemical or biological exposure).

You are appointed as the Board Chairperson and are to conduct this investigation in accordance with DOE O 225.1B. The AIB will be composed of the following additional members:

- Nathan Morley, National Nuclear Security Administration – Trained Accident Investigator
- Tom Wirgau, Office of Enterprise Assessments
- Steven Neilson, Office of Science
- Bart Drummond, Office of Environment, Health, Safety & Security

The Trained Accident Investigator is appointed from the list provided by the Office of Environmental, Health, Safety & Security. Expertise in construction safety or other necessary disciplines from DOE or the National Laboratories may be utilized, if necessary, to ensure appropriate investigation of this incident.

All members of the AIB, by this letter and in consultation with their respective management, are released from their regular duty assignments to serve on the AIB, during the period the AIB is convened.

The action and charge as communicated in the attached memorandum issued on May 26, 2023, remain the same for this appointed AIB.

Attachment

cc:
Jessica Halse, Associate Deputy Director for Field Operations, Office of Science
Todd Lapointe, Director, Office of Environment, Health, Safety & Security
Nathan Morley, National Nuclear Security Administration
Tom Wirgau, Office of Enterprise Assessments
Steven Neilson, Office of Science
Bart Drummond, Office of Environment, Health, Safety & Security

APPENDIX B

DOE ORPS Reports

SC--FSO-FNAL-FERMILAB-2023-0007 NOTIFICATION

Occurrence Report
After 2017 Redesign

FERMI National Accelerator Lab.(BOP)

(Name of Facility)

Balance of Plant - Infrastructure (Other Functions not specifically listed in this Category)

(Facility Function)

FERMI National Accelerator Laboratory	FERMI National Accelerator Lab.
(Site)	(Contractor)
Name: Scott Tingey	**Telephone No.:** (630) 840-2555
(Facility Manager/Designee)	
Name: APARICIO, ANGELA M	**Telephone No.:** (630) 840-3701
(Originator/Transmitter)	
Name:	**Date:**
(Authorized Classifier (AC))	

Occurrence Report Number: SC--FSO-FNAL-FERMILAB-2023-0007

Serious fall injury at PIP-II Linac construction site

Report Type and Date: NOTIFICATION

	Date	Time
Notification:	05/30/2023	21:15 (ETZ)
Initial Update:		(ETZ)
Latest Update:		(ETZ)
Final:		(ETZ)

Report Level: H

Division or Project: Proton Improvement Plan II (PIP-II)	**Secretarial Office:** SC - Science
	CUI?: No

System, Bldg., or Equipment: PIP-II Linac construction site

Reviewed for Public Release: **Plant Area:** PIP-II Linac site

Date and Time Discovered: 05/25/2023 13:34 (CTZ) **Date and Time Categorized:** 05/26/2023 14:16 (CTZ)

DOE HQ OC Notification:

Date	Time	Person Notified	Organization
NA	NA	NA	NA

Other Notifications:

Date	Time	Person Notified	Organization
05/26/2023	14:16 (CTZ)	Lia Merminga	FNAL-DIR
05/26/2023	14:16 (CTZ)	Amber Kenney	FNAL-CSO
05/26/2023	14:16 (CTZ)	Roger Snyder	DOE-FSO
05/26/2023	14:16 (CTZ)	Whitney Begner	DOE-FSO
05/26/2023	14:16 (CTZ)	Scott Tingey	FNAL-COO

Subject or Title of Occurrence: Serious fall injury at PIP-II Linac construction site

Reporting Criteria:

4B(1) - A formal shutdown of an activity or operation for safety reasons, directed by the DOE Field Element Manager, Contracting Officer or senior contractor management requiring corrective actions prior to continuing operations (e.g., a Stop Work Order).

Description of Occurrence:

Around 1 PM on Thursday, May 25th, a subcontracted iron worker was tying rebar at the top of concrete wall forms when they fell approximately 25 feet onto the concrete floor. The worker was air lifted to a local trauma center, and is still hospitalized.

Is Subcontractor Involved? Yes

Name: Whitaker Construction & Excavation Inc., Harris Rebar - Nuc

Immediate Actions Taken and Results: During the emergency response, emergency notifications were sent to all personnel advising to avoid the area. The injured worker was air lifted to a local trauma center and

remains hospitalized.

The PIP-II Linac construction site stopped work, and the lab issued a work stop on all work at heights.

That evening, the lab director issued a stand down on all hands-on work, with a safety pause meeting scheduled for the morning of Wednesday, May 31st. Personnel are expected to review their procedures, complete all training, and review their work plans and hazard analyses during the stand down.

Fermilab has initiated fact gathering to facilitate the investigation, while the subcontractor completes their own investigation. The PIP-II Linac subcontractor has been issued a Stop Work Order.

ISM:

2) Analyze the Hazards
3) Develop and Implement Hazard Controls
4) Perform Work Within Controls
5) Provide Feedback and Continuous Improvement

Cause Code(s):

Description of Cause:

Corrective Actions

(* = Date added/revised since final report was approved.)

Lessons Learned:

Similar Occurrence Report Numbers:

HQ Keyword(s):

HQ Summary:

Facility Representative or Designated DOE Representative:

Uploaded Documents: **No Files Found**

Updated Report Information:

SC--FSO-FNAL-FERMILAB-2023-0007 FINAL

Occurrence Report
After 2017 Redesign

FERMI National Accelerator Lab.(BOP)

(Name of Facility)

Balance of Plant - Infrastructure (Other Functions not specifically listed in this Category)

(Facility Function)

FERMI National Accelerator Laboratory	FERMI National Accelerator Lab.
(Site)	(Contractor)
Name: Scott Tingey	**Telephone No.:** (630) 840-2555
(Facility Manager/Designee)	
Name: APARICIO, ANGELA M	**Telephone No.:** (630) 840-3701
(Originator/Transmitter)	
Name:	**Date:**
(Authorized Classifier (AC))	

Occurrence Report Number: SC--FSO-FNAL-FERMILAB-2023-0007

Serious fall injury at PIP-II Linac construction site

Report Type and Date: FINAL

	Date	Time
Notification:	05/30/2023	21:15 (ETZ)
Initial Update:	06/09/2023	07:02 (ETZ)
Latest Update:	07/24/2023	09:52 (ETZ)
Final:	07/25/2023	13:26 (ETZ)

Report Level: H

Division or Project:
Proton Improvement Plan II (PIP-II)

Secretarial Office: SC - Science

System, Bldg., or Equipment: PIP-II Linac construction site	**CUI?:** No
Reviewed for Public Release:	**Plant Area:** PIP-II Linac site
Date and Time Discovered: 05/25/2023 13:34 (CTZ)	**Date and Time Categorized:** 05/26/2023 14:16 (CTZ)

DOE HQ OC Notification:

Date	Time	Person Notified	Organization
NA	NA	NA	NA

Other Notifications:

Date	Time	Person Notified	Organization
05/26/2023	14:16 (CTZ)	Lia Merminga	FNAL-DIR
05/26/2023	14:16 (CTZ)	Amber Kenney	FNAL-CSO
05/26/2023	14:16 (CTZ)	Roger Snyder	DOE-FSO
05/26/2023	14:16 (CTZ)	Whitney Begner	DOE-FSO
05/26/2023	14:16 (CTZ)	Scott Tingey	FNAL-COO

Subject or Title of Occurrence: Serious fall injury at PIP-II Linac construction site

Reporting Criteria:

2A(3) - Any single occurrence, injury, or exposure resulting in an occupational injury that requires in-patient hospitalization for five or more days, commencing within seven days from the date the injury.
4B(1) - A formal shutdown of an activity or operation for safety reasons, directed by the DOE Field Element Manager, Contracting Officer or senior contractor management requiring corrective actions prior to continuing operations (e.g., a Stop Work Order).

Description of Occurrence:

Around 1 PM on Thursday, May 25th, a subcontracted ironworker was tying rebar at the top of concrete wall forms when they fell approximately 25 feet onto the concrete floor. The worker was air lifted to a local trauma center, and is still hospitalized. No other workers were injured in the event.

Update 6/8/2023:
The ironworker remains hospitalized greater than 5 days, meeting additional ORPS reporting criteria. The investigation

into the accident is on-going. DOE Facility Representative concurred with the update.

Update 7/21/2023:
Immediately following the fall, the injured ironworker was discovered to be wearing a personal fall arrest equipment, including a harness, two 6-foot self-retracting lifelines (SRLs), and one positioning hook. The ironworker was discovered face down on the concrete pad. A coworker immediately attended to the ironworker and checked if there was an impalement, but did not find any.

Video footage of the construction site shows the ironworker began climbing the formwork at 12:58:15 pm, reaching the top at 1:01:40 pm, a period of about 2 minutes and 35 seconds. Climbing formwork required that workers utilize dual lanyards; attaching one lanyard, climbing up a step, clipping in the second lanyard before relocating the first lanyard, and so forth. It is not known whether the ironworker was utilizing one, both, or neither lanyards during their climb. Upon reaching the top, the ironworker can be seen peering over the top of the formwork to the opposite side, and they appear to position themselves. It is not known if the ironworker attempted to attach one or both of their pelican hooks from the SRLs to any attachment points at that point in time. What is known is that at 1:02:40 pm, the ironworker begins to fall. There is no indication of either of the SRLs initiating. Further, the event review team did not observe any apparent defects to the equipment from photographs taken after the incident. Based on the available evidence, it was concluded that the cause of the fall was the direct result of the ironworker not attaching one or both of their SRLs to an attachment point per OSHA requirements.

Is Subcontractor Involved? Yes

Name: Whitaker Construction & Excavation Inc., Harris Rebar

Immediate Actions Taken and Results: During the emergency response, emergency notifications were sent to all personnel advising to avoid the area. The injured worker was air lifted to a local trauma center and remains hospitalized.

The PIP-II Linac construction site stopped work, and the lab issued a work stop on all work at heights.

That evening, the lab director issued a stand down on all hands-on work, with a safety pause meeting scheduled for the morning of Wednesday, May 31st. Personnel are expected to review their procedures, complete all training, and review their work plans and hazard analyses during the stand down.

Fermilab has initiated fact gathering to facilitate the investigation, while the subcontractor completes their own investigation. The PIP-II Linac subcontractor has been issued a Stop Work Order.

ISM:

2) Analyze the Hazards
3) Develop and Implement Hazard Controls
4) Perform Work Within Controls
5) Provide Feedback and Continuous Improvement

Cause Code(s):

A3B1C01 - Human Performance Less Than Adequate (LTA); Skill Based Errors; Check of work was LTA
-->couplet - A4B3C11 - Management Problem; Work Organization & Planning LTA; Inadequate work package preparation
A6B1C03 - Training deficiency; No Training Provided; Work incorrectly considered â€œskill-of-the-craftâ€
A3B1C03 - Human Performance Less Than Adequate (LTA); Skill Based Errors; Incorrect performance due to mental lapse
-->couplet - A4B3C11 - Management Problem; Work Organization & Planning LTA; Inadequate work package preparation
A3B3C06 - Human Performance Less Than Adequate (LTA); Knowledge Based Error; Individual underestimated the problem by using past events as basis
-->couplet - A4B3C11 - Management Problem; Work Organization & Planning LTA; Inadequate work package preparation
A4B1C01 - Management Problem; Management Methods Less Than Adequate (LTA); Management policy guidance / expectations not well-defined, understood or enforced

Description of Cause:

Direct Cause: Ironworker failed to identify and utilize appropriate attachment points for their personal fall arrest equipment.

Root Cause: The general subcontractor, sub-tier subcontractor, and FRA oversight staff relied on skill-of-the-worker qualifications to identify and implement use of appropriate attachment points when climbing formwork.

Contributing Cause #1: Ironworker may not have had concerns, may have believed they had adequate tie-offs; concrete carpenters and laborers interviewed stated that they had adequate tie-offs available to them. Ironworker used their judgement to identify and use anchorage points.

Contributing Cause #2: WCEI/Harris relied on union hall to provide fall protection and form-specific training to iron workers.

Contributing Cause #3: Complacency related to checking personal fall protection system (including connections) prior to use.

Corrective Actions

(* = Date added/revised since final report was approved.)

1. Revise FESHM Chapter 7060: Fall Protection to require minimal user-input fall protection systems and develop an approval processfor justified dual-lanyard system use.

   Target Completion Date: 09/08/2023 **Completion Date:**

2. Revise FESHM Chapter 7060: Fall Protection to require that a written Hazard Analysis must include any/all critical steps even if presented in training, including specifically addressing appropriate tie-off (anchorage) points. Critical steps must be verbally discussed with workers at the pre-job briefing.

   Target Completion Date: 09/08/2023 **Completion Date:**

3. Enforce the existing requirement for all subcontractors performing high hazard work (e.g. confined space, fall protection, excavation, etc.) to submit training records of personnel performing the work to FRA, as required by FESHM Chapter 7010: ES&H Program for Construction and Specification Section 013100 - ES&H Requirements. Clarify the requirements and expectations to FRA's Task Managers, Construction Coordinators, and Service Coordinators

   Target Completion Date: 09/08/2023 **Completion Date:**

4. FRA oversight, including Task Managers, Construction Coordinators, Service Coordinators, ES&H, project management, etc., will enforce the expectation of performed personal protective equipment inspections and will audit the safety check process routinely (and document in Predictive Solutions).

   Target Completion Date: 09/08/2023 **Completion Date:**

5. Review ongoing fall protection work activities, re-evaluate and minimize, to the greatest extent, any work that requires the use of dual-lanyard climbing.

   Target Completion Date: 09/08/2023 **Completion Date:**

6. Assess other high hazard work activities for opportunities to minimize user-input activities, and minimize to the greatest extent to reduce the risk of errors.

   Target Completion Date: 10/20/2023 **Completion Date:**

7. For ongoing fall protection work activities, require that subcontractors clearly identify for workers the approved tie-off (anchor) points to be utilized for the specific task being performed.

   Target Completion Date: 09/08/2023 **Completion Date:**

Lessons Learned:

Utilization of dual lanyards for climbing is an error likely task, and while the practice is acceptable per OSHA standards, it is recommended that the practice be minimized to the greatest extent possible.

Written work plans and/or hazard analyses must be explicit in identification of appropriate anchorage points when utilizing fall arrest equipment, rather than relying on the skill-of the-worker.

Similar Occurrence Report Numbers:

HQ Keyword(s):

01I--Inadequate Conduct of Operations - Safety System Actuation/Evacuation
01U--Inadequate Conduct of Operations - Unplanned Interruption of Operations
08D--OSHA Reportable/Industrial Hygiene - Injury
08H--OSHA Reportable/Industrial Hygiene - OSHA Safety Noncompliance
11G--Other - Subcontractor
12H--EH Categories - Injuries Requiring Medical Treatment Other Than First Aid
14E--Quality Assurance - Work Process Deficiency
14G--Quality Assurance - Procurement Deficiency

HQ Summary:

On May 25, 2023, a subcontracted iron worker was tying rebar at the top of concrete wall forms when they fell approximately 25 feet onto the concrete floor. The injured worker was air lifted to a local trauma center and remains hospitalized. During the emergency response, emergency notifications were sent to all personnel advising to avoid the area. The Proton Improvement Plan II (PIP-II) Linac construction site stopped work, and the lab issued a work stop on all work at heights. That evening, the lab director issued a stand down on all hands-on work, with a safety pause meeting scheduled for the morning of May 31. Personnel are expected to review their procedures, complete all training, and review their work plans and hazard analyses during the stand down. Fermilab has initiated fact gathering to facilitate the investigation, while the subcontractor completes their own investigation. The PIP-II Linac subcontractor has been issued a Stop Work Order.

Facility Representative or Designated DOE Representative:	I reviewed and concurred with the Labâ€™s ORPS report. Fermilab completed an accident investigation for this event, conducted a casual analysis and proposed corrective actions. A separate and independent investigation was conducted by a DOE appointed Accident Investigation Board (AIB) which is yet to publish its findings. FSO will be monitoring implementation of Fermilabâ€™s corrective action plan which must include addressing findings from the AIBâ€™s final report. -Gumi Mabvuta 7/25/23 Entered by: Madiar, Rachel A Date: 07/25/2023
Uploaded Documents:	**No Files Found**
Updated Report Information:	

ORPS

SIGNATURE PAGE

Title: Serious Fall Injury at PIP-II Linac Construction Site

Circle all that apply: Notification Update Final

DOE Facility Manager/Designee

Signature: GUMINDENGA MABVUTA Digitally signed by GUMINDENGA MABVUTA Date: 2023.07.21 15:21:21 -05'00' Date:

Printed Name: Gumi Mabvuta

Facility Manager/Designee

Signature: Scott Tingey, UID:stingey Digitally signed by Scott Tingey, UID:stingey Date: 2023.07.24 08:06:58 -05'00' Date:

Printed Name:

APPENDIX C

Excerpts from Fermi Research Alliance, LLC – Whittaker Construction & Excavating, Inc. Contract Section 013100

Below are excerpts from Fermi Research Alliance, LLC (FRA) – Whittaker Construction & Excavating, Inc. (WCEI) Contract Section 013100 on Construction Environmental, Safety & Health Certifications (CESHC).

Definitions:

Construction Environmental Safety & Health Certification: An official, binding document prepared by the Subcontractor, bearing the signature of a responsible manager of the subcontracting company that defines the safety and health practices and responsibilities necessary to conduct operations on Fermilab property in a safe manner.

From section 1.8 within section 013100:

A.To ensure acceptance to 10 CFR 851, the Subcontractor will complete and submit the attached Construction ES&H Certification.

B.The Construction ES&H (CESH) Certification will be submitted with the Subcontractor proposal and reviewed by FRA prior to the award of the subcontract.

C.The CESH Certification will encompass the work of any and all lower-tier subcontractors involved in activities under this Subcontract, and it will include the Subcontractor's methods to enforce the elements of the safety program for all personnel on the construction worksite.

1.The Subcontractor's CESH Certification will include the following, at a minimum:

a.A statement of the subcontractor's commitment to provide a safe and healthful construction worksite for all employees including Subcontractors' employees and FRA personnel;

b.A signature of a responsible manager of the subcontracting company;

c.Provide Name, title and qualifications of the designated site Safety Representative and designated alternates;

d.Occupational Medicine Program, including identifying the qualified occupational medicine services provider;

e.Procedures for coordinating safety and health with lower-tier subcontractors and with FRA personnel on the construction worksite;

APPENDIX D

Harris Ironworkers JHRA Examples

Below are three examples of differences between three JHRAs covering the same task for Harris Ironworkers to "Unload Truck With Crane."

Example #1. FRA's Revise and Resubmit Comments Sent Back to Harris (2-27-23)

FRA identified two comments/questions in this particular JHRA that needed to be included with the Harris revision and resubmission:

Restraint of loads on trucks, and

Use of ladders for personnel accessing loads on trucks.

The document header identifies that this JHRA is affiliated with the PIP-II project, and the lower right corner identifies this document being revised 2-22-23.

JHRA (Job Hazard Risk Analysis)

NUCOR HARRIS REBAR

Job Number: 26000086 - 03722672
Job Name: PIP II LINAC COMPLEX
Jobsite address: KIRK RD/PINE ST., BATAVIA, IL 60510
GC Name: WHITTAKER CONSTRUCTION
Superintendent: [redacted]
Competent Person: TBD

Developed By- [redacted] Signed- [redacted] Date- 20-Dec-22
Reviewed By- #N/A Signed- #N/A Date- #N/A
Approved By- #N/A Signed- #N/A Date- #N/A

*All loads must remain strapped while trucks move on site. If loads are unstrapped and the truck needs to move, the load needs to be re-strapped.

Activity: Unload Truck with Crane

	Work Steps and Tasks (Describe the tasks/steps in order)	Potential Hazards Identified for each Step/Task (Before any control measures are in place)	Probability	Severity	Initial Risk Rating	Control/Safe Work Procedure for each Step/Task (Ex. PPE, training... How do we keep them safe?)	Probability	Severity	Initial Risk Rating	Picture or Sketch
1	Pre-Establish location of Loading/Unloading Zone	Injury's to the public and others	4	5	20	Confirm pre-established location of unloading zone	2	5	10	
2	Stay clear while driver unstraps the load (load may shift)	Load may shift/crushing hazard	4	5	20	Stay clear while driver unstraps load	2	5	10	
3	Inspect rigging to be used	Rigging failure/improper rigging	5	5	25	Maintain rigging log and pre-use inspection	1	5	5	
4	Ensure driver is clear of picking operation before you start to unload	Injury to driver	4	5	20	Make sure driver is clear of operation	1	5	5	
5	Place rigging on rebar bundles in appropriate spots (use quarter points if possible)	Load shift, struck by, unsecured bar	4	4	16	Proper rigging technique/certified rigger	2	4	8	
6	Place tag line on the end of the bundle of rebar, make sure not to hook the tag line to the bundle wire	Can't maintain control of the load	4	4	16	Proper use and placement of tagline	2	4	8	
7	Make sure to center the crane over the load that is to be picked (don't forget to account for boom deflection)	Load could strike truck cab, load can shift	5	4	20	Center up the crane over load and account for boom deflection.	1	4	4	
8	Place the hooks from the crane into the eye of the choker	Improper rigging techniques	5	5	25	Experienced qualified/certified rigger	2	5	10	
9	Signal the operator to hoist up easy with the load	Improper signaling	5	4	20	Experienced qualified/certified signalman	1	4	4	
10	Communicate "OVER HEAD" as the load begins to swing away	Struck by overhead load	3	4	12	Communicate **OVER HEAD** as the load begins to swing away	2	4	8	
11	When picking bags, be sure to follow manufactures approved connection and visually inspect bag	Bag failure	5	5	25	Must inspect bag for damage	2	5	10	
12	When picking PT cables, nylon slings must be used	Cable failure	4	4	16	Must use nylon slings in a basket hitch	1	4	4	
13							0		0	

Will ladders be used to access the trailers? Steps from the truck to the trailer? If ladders are to be used ensure that they are secured. No jumping down from the trailer.

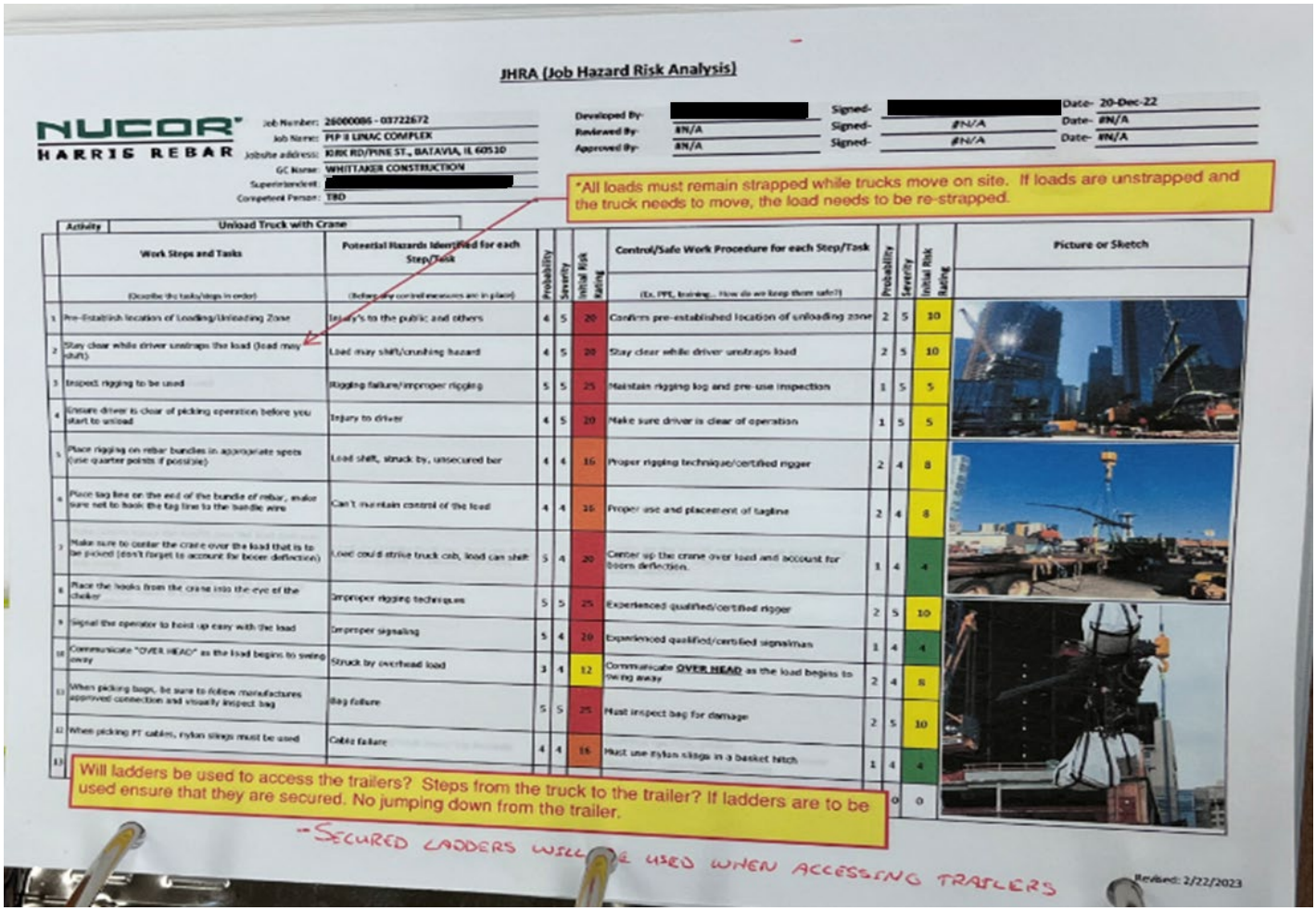
Revised: 2/22/2023

Example #2. Hard Copy Mark-up of JHRA Maintained by WCEI Project Manager

The bottom of the page includes WCEI's annotation prospectively addressing how the FRA comment is to be dispositioned by Harris on the use of ladders for personnel accessing loads on trucks.

However, there is no annotation as to how the comment is to be addressed on restraint of loads on the bed of the truck (highlighted in yellow near the top of the page).

WCEI did not ensure Harris fulfilled the 'revise and resubmit' requirement applied by FRA.



Example #3. JHRA Used for Harris Ironworker Daily Job Task Analysis Meetings (up through day of the accident, 5-25-23)

Harris did not revise and resubmit this and other JHRA's as stipulated by FRA's feedback provided to them on 2-27-23 through WCEI.

The lower right corner of this document indicates it was revised on 4-19-2023, but it still doesn't address/resolve the comments provided by FRA in February 2023.

Additionally, the heading on this JHRA no longer makes reference to the PIP-II project, or identification on who developed or approved the JHRA.

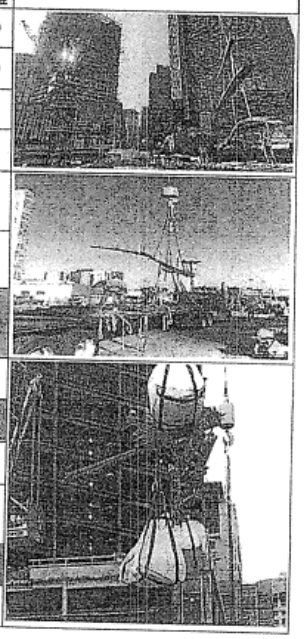
JHRA (Job Hazard Risk Analysis)

NUCOR® HARRIS REBAR

Job Number:	#N/A	Developed By-	Name	Signed-	Name	Date-	3.14.22
Job Name:	#N/A	Reviewed By-	#N/A	Signed-	#N/A	Date-	#N/A
Jobsite address:	#N/A	Approved By-	#N/A	Signed-	#N/A	Date-	#N/A
GC Name:	#N/A						
Superintendent:	#N/A						
Competent Person:	#N/A						

Activity: Unload Truck with Crane

	Work Steps and Tasks (Describe the tasks/steps in order)	Potential Hazards Identified for each Step/Task (Before any control measures are in place)	Probability	Severity	Initial Risk Rating	Control/Safe Work Procedure for each Step/Task (Ex. PPE, training... How do we keep them safe?)	Probability	Severity	Initial Risk Rating	Picture or Sketch
1	Pre-Establish location of Loading/Unloading Zone	Injury's to the public and others	4	5	20	Confirm pre-established location of unloading zone	2	5	10	
2	Stay clear while driver unstraps the load (load may shift)	Load may shift/crushing hazard	4	5	20	Stay clear while driver unstraps load	2	5	10	
3	Inspect rigging to be used	Rigging failure/Improper rigging	5	5	25	Maintain rigging log and pre-use inspection	1	5	5	
4	Ensure driver is clear of picking operation before you start to unload	Injury to driver	4	5	20	Make sure driver is clear of operation	1	5	5	
5	Place rigging on rebar bundles in appropriate spots (use quarter points if possible)	Load shift, struck by, unsecured bar	4	4	16	Proper rigging technique/certified rigger	2	4	8	
6	Place tag line on the end of the bundle of rebar, make sure not to hook the tag line to the bundle wire	Can't maintain control of the load	4	4	16	Proper use and placement of tagline	2	4	8	
7	Make sure to center the crane over the load that is to be picked (don't forget to account for boom deflection)	Load could strike truck cab, load can shift	5	4	20	Center up the crane over load and account for boom deflection.	1	4	4	
8	Place the hooks from the crane into the eye of the choker	Improper rigging techniques	5	5	25	Experienced qualified/certified rigger	2	5	10	
9	Signal the operator to hoist up easy with the load	Improper signaling	5	4	20	Experienced qualified/certified signalman	1	4	4	
10	Communicate "OVER HEAD" as the load begins to swing away	Struck by overhead load	3	4	12	Communicate **OVER HEAD** as the load begins to swing away	2	4	8	
11	When picking bags, be sure to follow manufactures approved connection and visually inspect bag	Bag failure	5	5	25	Must inspect bag for damage	2	5	10	
12	When picking PT cables, nylon slings must be used	Cable failure	4	4	16	Must use nylon slings in a basket hitch	1	4	4	
13			0	0	0		0	0	0	



Revised: 4/19/2023

APPENDIX E

Nucor Harris Rebar JHRA Risk Rating Chart Steps

JHRA (Job Hazard Risk Analysis)

NUCOR HARRIS REBAR

RISK RATING CHART STEPS

STEP 1 - LIST TASK STEPS IN ORDER
STEP 2 - LIST THE CORRESPONDING HAZARDS FOR EACH TASK
STEP 3 - DETERMINE THE RISK RATING FOR EACH TASK AND HAZARD WITH NO CONTROLS IN PLACE
STEP 4 - LIST CONTROLS THAT NEED TO BE IN PLACE FOR EACH TASK AND HAZARD TO HELP REDUCE THE RISK FACTOR
STEP 5 - DETERMINE FINAL RISK RATING FOR EACH TASK, HAZARD AND CONTROL
STEP 6 - REVIEW WITH ALL TEAM MATES PARTICIPATING IN THE TASK AND ALL SIGN OFF ON TRAINING FOR THIS TASK

RISK RATING CHART DEFINITIONS

PROBABILITY RATING		
5	ALMOST CERTAIN	EXPECTED TO OCCUR IN MOST CIRCUMSTANCES
4	LIKELY	WILL PROBABLY OCCUR IN MOST CIRCUMSTANCES
3	POSSIBLE	COULD OCCUR AT SOME TIME
2	UNLIKELY	NOT LIKELY TO OCCUR IN NORMAL CIRCUMSTANCES
1	RARE	MAY OCCUR ONLY IN EXCEPTIONAL CIRCUMSTANCES
SEVERITY RATING		
5	SEVERE	DEATH OR PERMANENT DISABLING INJURY
4	MAJOR	HOSPITAL ADMISSION REQUIRED
3	MODERATE	MEDICAL TREATMENT REQUIRED
2	MINOR	FIRST AID REQUIRED
1	INSIGNIFICANT	INJURIES NOT REQUIRING FIRST AID

COLOR CODES		
PROB X SEV =	WHAT IT MEANS	WHAT TO DO
20 - 25 SEVERE	STOP! ELIMINATE/REMOVE HAZARD IMMEDIATELY	INVOLVE SUPERINTENDENT AND/OR SAFETY DEPT.
15 - 16 MAJOR	STOP! STEPS REQUIRED TO SUBSTITUTE HAZARDOUS SUBSTANCE OR USE LESS HAZARDOUS PROCESS	INVOLVE GENERAL FOREMAN AND/OR SUPERINTENDENT
5 - 12 MODERATE	WATCHING HAZARDS FOR CHANGE	NEW CONTROLS MAY BE NEEDED AS HAZARDS CHANGE
1 - 4 MINOR/INSIGNIFICANT	FOLLOW ADMINISTRATIVE PRACTICES AND PROCEDURES AND USE REQUIRED PPE	REVIEW PROCEDURE(S) WITH TEAMMATES DOING TASK

SIMPLY MULTIPLY THE CORESPONDING PROBABILITY RATING BY THE POTENTIAL SERVERITY RATING AND FOLLOW THE GIVEN COLOR'S DIRECTION
****NEVER PUT YOURSELVES OR OTHERS AT RISK. SPEAK UP IF A PROCEDURE IS NOT UNDERSTOOD OR INCORRECT****

RISK RATING MATRIX

NUCOR HARRIS REBAR

Severity	Probability: Almost Certain (5)	Likely (4)	Possible (3)	Unlikely (2)	Rare (1)
Severe (5)	25	20	15	10	5
Major (4)	20	16	12	8	4
Moderate (3)	15	12	9	6	3
Minor (2)	10	8	6	4	2
Insignificant (1)	5	4	3	2	1

Hierarchy of Hazard Controls Table	
1. Eliminate	Removing the hazard
2. Substitute	Replacing a hazardous substance/process with a less hazardous one
3. Engineering Controls	Redesigning a process/equipment to make it less hazardous
4. Warnings	Using signage, alarms, warning lights and tapes, etc.
5. Administrative Controls	Adopting safe work practices/procedures or providing appropriate training
6. P.P.E.	Using personal protective equipment

Revision: 2/22/2023

APPENDIX F

OSHA Letter of Interpretation on 29 CFR 1926.501 Regarding Fall Protection When Climbing Reinforcing Steel

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at https://www.osha.gov.

May 19, 1997
Mr. Fred H. Codding
National Association of
Reinforcing Steel Contractors
10382 Main Street
P.O. Box 280
Fairfax, VA 22030

and

Mr. Stephen D. Cooper
Executive Director
International Association of Bridge, Structural
and Ornamental Iron Workers
1750 New York Avenue, N.W., Suite 400
Washington, D.C. 20006

Dear Messrs. Codding and Cooper:

This is in response to your letters of July 18, and August 5, 1996, in which you requested an interpretation of the Occupational Safety and Health Administration's (OSHA) policy regarding fall protection for employees climbing or moving on preassembled reinforcing steel assemblies.

Through the promulgation of the existing standard, section §1926.501(b)(5), OSHA clearly indicates that Subpart M applies to construction work performed on vertical surfaces, such as rebar structures. In response to your December 1994 presentation of information, the Agency issued a letter acknowledging that fall protection is not necessary for employees climbing or moving on built-in-place rebar assemblies at heights below 24-feet.

OSHA has completed its review of the materials submitted regarding the pre-assembled rebar assemblies. Those submissions have raised issues which indicate that the Agency

should reevaluate section §1926.501(b)(5) to ensure that the standard addresses appropriate fall protection for employees working on pre-assembled rebar assemblies.

OSHA will soon be initiating further rulemaking on Subpart M and will raise an issue regarding fall protection for employees performing construction work on either built-in-place or pre-assembled rebar assemblies. The Agency will seek additional information regarding safe industry practice, including any experience in using fall protection systems or alternative measures on rebar assemblies. The requirements of section §1926.501(b)(5) will be based on the record produced through this rulemaking.

Pending the completion of supplemental rulemaking, OSHA will not cite violations of section §1926.501(b)(5) for employees climbing or moving on rebar assemblies. In lieu of complying with section §1926.501(b)(5), the Agency will allow the construction industry to continue current practices for work on rebar assemblies.

Employers are still required to protect employees working on rebar assemblies from fall hazards [as provided in section §1926.501(b)(5)] once those employees have reached their work stations or have moved to points at least 24-feet above a lower level.

We look forward to your participation in the future rulemaking on the rebar topic and, as always, thank you for your interest in the safety of the construction workers of America. If we can be of any further assistance, please contact us by writing to the Office of Construction Standards and Compliance Assistance, U.S. Department of Labor - OSHA, 200 Constitution Avenue, N.W., Room N3621, Washington, D.C. 20210.

Sincerely,

Russell B. Swanson, Director
Directorate of Construction

Link to the letter: https://www.osha.gov/laws-regs/standardinterpretations/1997-05-19

APPENDIX G

Harris Fall Prevention / Fall Protection Work Plan
Submitted with Harris SSSP

SECTION 3: FALL PREVENTION / FALL PROTECTION WORK PLAN

The purpose of this plan is to:

Supplement our standard safety policies and procedures by providing safety standards specifically designed to cover fall protection on this project and:

Ensure that employees are trained and made aware of the safety provisions which are to be implemented by this plan prior to the start of placing reinforcing steel.

This fall protection plan addresses the use of conventional fall protection at a number of areas on the project, as well as identifying specific activities that require unconventional means of fall protection.

This plan is designed to enable **Harris Rebar Placing LLC.** employees to recognize fall hazards on this project and to establish the procedures that are to be followed in order to prevent falls to lower levels or through openings in walking/working surfaces. Each employee will adhere to these procedures except when doing so will expose the employee to a greater hazard. When this is the case, the employee shall notify management of the exposure, which shall be addressed before proceeding further.

It is the responsibility of the on-site safety supervisor to implement this fall protection plan. The safety supervisor is responsible for continual observational safety checks of the work area and to enforce the safety policies and procedures. Foremen shall be responsible for identifying and seeing that unsafe acts or conditions are corrected as required. Employees are responsible for understanding and adhering to the procedures of this plan, following the instructions of the foreman, and notifying management of unsafe conditions or acts.

APPENDIX H

Site Inspections Reports Dated April 26, 2023, and May 25, 2023, Completed by Harris Superintendent

Harris Rebar

Site Inspection Report

26000086 Project No. | Apr 26 2023 9:00 Am Date/Time | Whittaker Contractor

Fermi Linac Project Name | [redacted] | [redacted] Inspection Conducted By

Pour 1 Base Slab Location/Area of Audit | [redacted] Supervisor/Foreman Signature

*C = Compliant NC = Noncompliant N/A = Not Applicable

Jobsite Information	C	NC	N/A	Location/Remarks/responsible party
Is there a copy of the company's Site Specific Safety Plan on site	X			Jesse w/ Tri Taylor
Are numbers for the nearest medical center posted	X			
Have all site specific safe work plans been reviewed and signed off	X			
Does the JTA's cover all hazards for the current work being conducted	X			
Have members of the crew been orientated	X			
Are all current safety meetings, hazard assessments and SWP reviews posted	X			
Are the emergency procedures and contact information available	X			
Is the first aid kit available and adequately stocked	X			
Is a list of first of first aid attendants current and posted	X			
Is there a plan for extreme weather: Hot/Cold	X			
Stair Towers / Ladders	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Have all stair tower / scaffolds been tagged and inspected in the required time	X			two stair cases north & South
Are scaffolds/stair towers/ ladders free of ice, mud, snow debris etc.	X			
Is scaffold / stair tower adequately braced and free of excess movement	X			
Are ladders secured against movement at a 4:1 ratio, 3' past landing, 3' lap	X			
Tools / Equipment	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Are all tools / equipment inspected and in proper working order	X			Fire dept inspected also
Damaged / defective tools / equipment tagged and removed from service	X			
Are all required guards in place	X			
Are the proper / appropriate tools available	X			
Are tools and equipment properly stored	X			
Are there adequate fire extinguishers available on site and have they been properly inspected	X			
Access / Egress	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Is proper access/egress to work area provided	X			
Are all access / egress points identifiable and accessible	X			
Are walkways free from material and debris	X			
Housekeeping	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Is the job site well maintained and free from excessive material and debris	X			Clean site / off loading first loads for base mat
Are there appropriate waste disposal bins available and used as required	X			

Site Inspection Report

Are all materials properly stored, organized and secured as required	✓			
Are surfaces maintained and free of excessive oil, ice, snow etc.	✓			
Are all exposed dowels protected	✓			
PPE	C	NC	N/A	Location/Remarks/responsible party
Is all required PPE available to all workers	✓			
Is PPE properly stored and maintained	✓			foremans truck / Job trailer
Is all required PPE worn by al workers	✓			
Slab Decks / Formwork	C	NC	N/A	Location/Remarks/responsible party
Has the deck/formwork been inspected and signed off by the general/formwork contractor			✓	
Are there unprotected openings, gaps, leading edges or other similar hazards			✓	
Are guardrails in place and complete with top rail, mid rail and toe boards			✓	
Is all formwork adequately braced for installation of rebar			✓	
Have the forms been cleaned of excess concrete or similar debris			✓	
Rigging / Hoisting	C	NC	N/A	Location/Remarks/responsible party
Has the vertical lift plan been reviewed and signed off by all on site			✓	JHRA offload with crane
Has all rigging and hoisting equipment inspected IE: slings	✓			
Are tag lines available and used as required	✓			
Are adequate warnings given for overhead loads	✓			
Is an adequate means of communication available and used	✓			radios
Are there any critical or non-routine lifts? Plans?	✓			
Excavations	C	NC	N/A	Location/Remarks/responsible party
Are there excavations / trenches on site	✓			
Is the trench/excavation properly barricaded with adequate signage	✓			orange snow fence
Is there adequate sloping or benching system in place	✓			
Trench / excavation free from water, runoff, signs of sloughs or cave in's	✓			
Are there proper access / egress points IE: ladders every 25'	✓			
Fall Protection / Specialized PPE	C	NC	N/A	Location/Remarks/responsible party
Have the Fall Protection Plan(s) been reviewed and signed by everyone on site			✓	
Is specialized PPE req'd (fall protection, respirators, gas monitors)			✓	
Are proper anchor points available and used			✓	
Has Fall Protection /Specialized equipment been inspected prior to use			✓	
Work Decks / Scaffolds	C	NC	N/A	Location/Remarks/responsible party
Is work deck / catwalk properly braced			✓	
Are there guardrails in place with top rail, mid rail and toe boards			✓	
Are walkway planks adequately installed and secured			✓	
Hot Work	C	NC	N/A	Location/Remarks/responsible party
Is there hot work being performed on site	✓			monthly
Is there a hot work permit program required on site	✓			
Is there a completed hot work permit for any hot work in progress	✓			
Is there a fire extinguisher in the affected work area	✓			

Site Inspection Report

26000086 — Project No.
5/25/23 — Date/Time
Whittaker Const — Contractor
Fermi Lab — Project Name
XXXXXXXXXXXX — Inspection Conducted By
LF1 LF2 Ext Walls — Location/Area of Audit
XXXXXXXXXXXX — Supervisor/Foreman Signature

Area is closed at the moment
Inspected the best we can see

*C = Compliant NC = Noncompliant N/A = Not Applicable

Jobsite Information	C	NC	N/A	Location/Remarks/responsible party
Is there a copy of the company's Site Specific Safety Plan on site	X			
Are numbers for the nearest medical center posted	X			All located in Job trailer
Have all site specific safe work plans been reviewed and signed off	X			
Does the JTA's cover all hazards for the current work being conducted	X			
Have members of the crew been orientated	X			
Are all current safety meetings, hazard assessments and SWP reviews posted	X			
Are the emergency procedures and contact information available	X			
Is the first aid kit available and adequately stocked	X			
Is a list of first of first aid attendants current and posted	X			
Is there a plan for extreme weather: Hot/Cold	X			
Stair Towers / Ladders	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Have all stair tower / scaffolds been tagged and inspected in the required time	X			Job made stairs
Are scaffolds/stair towers/ ladders free of ice, mud, snow debris etc.	X			
Is scaffold / stair tower adequately braced and free of excess movement	X			
Are ladders secured against movement at a 4:1 ratio, 3' past landing, 3' lap	X			
Tools / Equipment	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Are all tools / equipment inspected and in proper working order	X			truck and gang boxes
Damaged / defective tools / equipment tagged and removed from service	X			
Are all required guards in place	X			
Are the proper / appropriate tools available	X			
Are tools and equipment properly stored	X			
Are there adequate fire extinguishers available on site and have they been properly inspected	X			
Access / Egress	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Is proper access/egress to work area provided	X			
Are all access / egress points identifiable and accessible	X			
Are walkways free from material and debris	X			
Housekeeping	**C**	**NC**	**N/A**	**Location/Remarks/responsible party**
Is the job site well maintained and free from excessive material and debris	X			Very clean site
Are there appropriate waste disposal bins available and used as required	X			

Site Inspection Report

Are all materials properly stored, organized and secured as required	X			
Are surfaces maintained and free of excessive oil, ice, snow etc	X			
Are all exposed dowels protected	X			
PPE	C	NC	N/A	Location/Remarks/responsible party
Is all required PPE available to all workers	X			
Is PPE properly stored and maintained	X			
Is all required PPE worn by al workers	X			
Slab Decks / Formwork	C	NC	N/A	Location/Remarks/responsible party
Has the deck/formwork been inspected and signed off by the general/formwork contractor			X	
Are there unprotected openings, gaps, leading edges or other similar hazards			X	
Are guardrails in place and complete with top rail, mid rail and toe boards			X	
Is all formwork adequately braced for installation of rebar			X	
Have the forms been cleaned of excess concrete or similar debris			X	
Rigging / Hoisting	C	NC	N/A	Location/Remarks/responsible party
Has the vertical lift plan been reviewed and signed off by all on site	X		X	
Has all rigging and hoisting equipment inspected IE: slings	X			
Are tag lines available and used as required	X			
Are adequate warnings given for overhead loads	X			
Is an adequate means of communication available and used	X			Two way radios used
Are there any critical or non-routine lifts? Plans?			X	
Excavations	C	NC	N/A	Location/Remarks/responsible party
Are there excavations / trenches on site	X			• Sloped and retained
Is the trench/excavation properly barricaded with adequate signage	X			with plastic Sheeting
Is there adequate sloping or benching system in place	X			
Trench / excavation free from water, runoff, signs of sloughs or cave in's	X			
Are there proper access / egress points IE: ladders every 25'	X			
Fall Protection / Specialized PPE	C	NC	N/A	Location/Remarks/responsible party
Have the Fall Protection Plan(s) been reviewed and signed by everyone on site	X			
Is specialized PPE req'd (fall protection, respirators, gas monitors)				
Are proper anchor points available and used				Area shut down / we will get look once allowed in
Has Fall Protection /Specialized equipment been inspected prior to use	X			
Work Decks / Scaffolds	C	NC	N/A	Location/Remarks/responsible party
Is work deck / catwalk properly braced			X	
Are there guardrails in place with top rail, mid rail and toe boards			X	
Are walkway planks adequately installed and secured			X	
Hot Work	C	NC	N/A	Location/Remarks/responsible party
Is there hot work being performed on site	X			monthy through on site
Is there a hot work permit program required on site	X			fire Dept
Is there a completed hot work permit for any hot work in progress	X			
Is there a fire extinguisher in the affected work area	X			

APPENDIX I

Barrier Analysis Worksheet

Hazard: Fall from height				Target: Workers			
Barrier	Did the Barrier perform: In place	In use	Effective	Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
Personal Fall Arrest System	Partially	No	No	IW1's personal fall arrest system was not connected to suitable anchor point as required for work at height	No proper anchoring of their personal fall arrest system. **CF-B7** Personal fall arrest system not connected to compliant anchor point **CF-B1** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CP3	T3 T5 T7 W4 N6
Using anchor points	Yes	No	No	IW1 did not connect their personal fall arrest system to the available anchor points in their proximity.	Personal fall arrest system not connected to compliant anchor point **CF-B1** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CP3	T5 W4 I1 N6

Hazard: Fall from height				Target: Workers			
Barrier	Did the Barrier perform: In place	In use	Effective	Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
Personal Fall Arrest Equipment inspection	Partially	Unknown	N/A	Unknown if pre-use inspection was performed, but IW1 received safety briefing on May 22, 2023, on fall protection equipment inspections. • IW1 present at briefing on equipment inspections. • Individuals required to perform their own PPE pre-use inspections. • Unknown if daily briefing addressed the PPE being used or pre-use inspection of PPE.	Safety equipment not utilized. therefore, it is unclear if safety inspections had any effect on this accident. AIB unable to physically inspect fall protection equipment.	CR4 CP2 CP3 CP5	T3 T5
Hierarchy of Controls	Partially	No	No	A hierarchy of controls (elimination, substitution, engineering controls, administrative controls, PPE) was not used based on the following examples: Use of scaffolding or similar means that limit exposure to a fall hazard were not practical for the limited duration of the work activity, and due to incumbrance from gang form wall supports. Fall prevention principles were not applied. Without scaffolding IW1 climbed the form wall using techniques that rely upon personal fall protection equipment.	The use of PPE is the last element of the hierarchy of controls as the action was taken without the use of available equipment at the site, and therefore, the Hierarchy of Controls was not effectively implemented **CF-B5**, and IW1 used techniques that rely upon personal fall protection equipment. **CF-B6**.	CR4 CP3	T7 N5

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				The aerial lift was not selected by Nucor to perform the task at the highest elevation despite being available and previously used by ironworkers. By not using the aerial lift or assigning the task to an ironworker qualified to operate the aerial lift, IW1 performed vertical climbing using techniques that required active fall protection. Ladders were not selected by Harris to perform the task despite ladder being available. By not using a ladder, IW1 performed vertical climbing including navigating around obstructions on the form wall.			
Define the Scope of Work	Partially	No	No	The JHRA's work steps lacked the specificity on the work assigned to IW1 and did not include information on climbing Doka formwork.	By not defining the scope of work in the sufficient detail **CF-B8**, the subsequent hazard analysis could not be adequately performed. **CF-B9**	CR1 CP2 CP4	T6 T7 W2
Analyze the Hazards	Yes	Partially	No	The scope of work for the activity assigned to IW1 was not described in the JHRA or supplemented during the work planning stage. Methodology selected to access elevated work location relied entirely on IW1's use of PPE and	No proper anchoring of their personal fall arrest system. **CF-B7** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3**	CR2 CR3 CP4 CP5	T8

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				anchor point to protect them from fall hazards.	IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4** Failed to identify the specific hazards associated with working on formwork. **CF-B10** Since working on formwork typically requires specialized safety measures, the hazard analysis should have included a comprehensive evaluation of all tasks involved in the project to identify potential risks. This should have led to developing and implemented appropriate controls.		
Safety briefing	Yes	Yes	No	Documentation of the safety briefings did not include the work task of climbing the form wall. The absence of IW1 assigned task being covered in the JHRA/briefing relies upon the workers skill of the craft or specific verbal instructions from the Foreman.	IW1 conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CP2 CP7	I2
WCEI Oversight	Yes	No	No	As manager of the overall construction project and safety, rigorous expectations on safety performance were not established,	WCEI supervisors, project management, and safety oversight personnel allowed non-conforming work practices to go unchallenged,	CR4 CR5 CP1	N3 T6

Hazard: Fall from height				Target: Workers			
Barrier	Did the Barrier perform: In place	In use	Effective	Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				allowing gaps in Nucor safety programs and performance of work. Oversight failed to recognize incomplete work documentation, use of unapproved hazard analyses and non-compliant work practices.	**CF-B12** specifically for work that required 100% tie-off with active fall protection PPE. Lack of feedback on the need to use fall protection. **CF-B13** Worker conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CP7	
Harris Oversight	Yes	No	No	Foreman assigned task to IW1 and did not stay to observe the activity, despite IW1 being a new employee to Harris, and the form wall system was new to the project.	Foreman was not in a position to observe work to ensure IW1 was performing the work as assigned and lacked the opportunity to provide feedback on the need to use of fall protection. Lack of feedback on the need to use fall protection. **CF-B13** Worker conducted the task without the use of required fall protection. **CF-B11**	CR4 CR5 CP1 CP7	--

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
					IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**		
FRA Oversight	Yes	Partial	No	Oversight failed to recognize incomplete work documentation, use of unapproved hazard analyses, non-compliant work practices, and emergency plan response for rendering first aid. Rigorous expectations on safety performance were not established, allowing gaps in WCEI and Harris safety programs and performance of work. FRA subcontractor oversight personnel had not attended the Harris' daily Job Task Analysis meetings at any time since their work at the site began on April 7, 2023. FRA personnel allowed non-conforming work practices to go unrecognized and to be able to provide feedback, specifically for	FRA personnel were unaware of and could not correct improper use of PPE when climbing form walls. Lack of feedback on the need to use fall protection. **CF-B13** Flow down of requirements not adequate. **CF-B18/C14** Worker conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CR5 CP1 CP7	T6

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				work that required 100% tie-off with active fall protection PPE.			
FSO Oversight	Yes	Yes	No	Visits to the construction site were in conjunction with weekly project meetings and were predictable, not independent and based on planned work. Visits did not include sub-tier subcontractor interaction. Did not provide oversight of the FRA systems, including the FRA CAS program, to assure proper subcontractor performance.	FSO lacked full situational awareness of the robustness of the FRA oversight program, including CAS. **CF-B13a**	CR4 CR5 CP1 CP7	T6
Communication	Partially	Partially	No	Ironworkers used direct communication to coordinate with workers on the opposite side of form wall. Could not directly communicate through the wall.	Introduced unnecessary risk by climbing to the top of the form wall. IW1 was exposed to greater fall height and hazard than necessary. **CF-B14** Worker conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CP6	I4 N5

Hazard: Fall from height				Target: Workers			
Barrier	Did the Barrier perform: In place	In use	Effective	Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
Contractor Assurance	Yes	Yes	Partially	Corrective actions from prior subcontractor assessments (i.e., generic work plans, and construction coordinator training) were not fully effective, and self-assessments had not identified systemic weakness in project implementation. FRA lacked full situational awareness that would potentially identify weaknesses and corrective actions taken. FSO lacked the full situational awareness of the robustness of the FRA oversight program, including CAS.	Workers being briefed on work plans that were not fully reviewed and approved. Insufficient awareness of sub-tier subcontractor work. FSO and FRA personnel were unaware of and could not correct improper use of PPE when climbing form walls. Lack of feedback on the need to use fall protection. **CF-B13** Corrective actions have not adequately resolved identified issues. **CF-B15**	CR5 CP1	T6 T7
Clear Roles and Responsibilities	Partial	No	No	FRA project management personnel and subcontractor oversight personnel were not clear of all responsibilities related to their job and safety documents, especially in FESHM 7010. Multiple subcontractor arraignments contributed to the lack of clear roles and responsibilities of who was responsible for implementation of safety aspects of the project, including the anchor points, and associated training.	Work was allowed to be performed without sharing safety information, and using unapproved safety plans **CF-B16** Work was allowed to be performed without confirmation of worker qualifications. **CF-B17** Worker conducted the task without the use of required fall protection. **CF-B11** Direction of work not clear. **CF-B11a**	CP1 CP2	T7 T8

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				No identification of Competent Person for fall protection to allow workers to know who to approach with job related questions.	IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**		
Flow down of requirements				Lack of specificity in the various sub-tier contracts and multiple flow downs of unlisted safety requirements and confusion in documentation constructs (JHRA vs JTA), which was not recognized by multiple levels of oversight personnel and personnel signing off daily work Job Task Analysis Meeting rosters. DOE safety requirements not flowed down to all subcontractors. OSHA requirements used exclusively by Harris. FRA did not meet its contractual requirements and internal processes to ensure that DOE safety requirements were being implemented by subcontractors.	Flow down of requirements not adequate. **CF-B18/C14** Nucor Harris dissociated from having responsibility for safety on working on form walls. DOE specific requirements not implemented on the work site. No indication of primacy of safety programs used by the various project organizations. **CF-B19** Use of unapproved safety methods, such as the use of anchor points and JHRAs, with no mention of the specific task or associated hazards was a missed opportunity to appropriately define the work task, identify hazards, and develop and implement hazard controls. **CF-B20**	CR1 CR4 CP1 CP3 CP5	T6 T7 N4

Hazard: Fall from height Barrier	Did the Barrier perform: In place	In use	Effective	Target: Workers Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
				FESHM Chapter 7010 requirements are not assigned to address implementation.			
Training				Site Orientation Training requirements on fall protection not followed by IW1, or the fall hazard control in Harris Daily Job Task Analysis Meeting signed the day of the accident (100% tie off for climbing above 4 feet.) *The Board was unable to interview ironworkers to understand if they are aware of or understand training requirements on fall protection or selection of anchor points for the Doka form wall system.*	By not following the fall protection training requirements, IW1's fall was not arrested by their PPE attached to a compliant anchor point. Worker conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**	CR4 CP3	I2 N3 N4 N5 N6
Feedback and Improvement				WCEI Superintendent, FRA, nor FSO attended Harris pre job meetings. Consequences of this lack of oversight could include a lack of Harris' awareness of project-specific safety and work planning requirements (JHRA), inadequate information sharing, and compromised safety measures.	Project management and safety personnel responsible for feedback and improvement were unaware of and could not correct inadequate JHRA documentation on use of form wall climbing requirements. Lack of feedback on the necessity to describe the specific work task. **CF-B21**.	CF4 CF5	N4

Hazard: Fall from height				Target: Workers			
Barrier	Did the Barrier perform: In place	In use	Effective	Why did the Barrier Fail?	How did the Barrier effect the accident?	ISM	HPI
					Worker conducted the task without the use of required fall protection. **CF-B11** IW1 exposed to unprotected fall hazard. **CF-B2** No fall protection implemented at top of wall. **CF-B3** IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-B4**		

APPENDIX J

Change Analysis Worksheet

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
WHAT **Conditions, occurrences, activities, equipment**	IW1 not secured to the wall	IW1 tied off to wall at approved anchor points	• Readily available anchor points and PPE not engaged to attach IW1 to the form wall. • Hazard analysis requirements for elevated work not met. • IW1 was not restrained from falling to the concrete pad.	• IW1 was in a position that allowed the accident to happen. **CF-C1** • IW1 lost contact with the form wall. • IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-C2**
	IW1 looking over the top of the form wall	IW1 concentrating on job, and only climbs formwork to the height necessary to reach upper penetration for rebar template installation	• IW1 not focused on their situation. • IW1 does not use available fall protection PPE. • Worker exposed to a greater fall hazard consequence than necessary.	• IW1 was not restrained from falling to the concrete pad. **CF-C3** • IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-C2**
	Project staff unfamiliar with Doka (Gang) Form	Manufacturer specification and user instructions reviewed and applied by project personnel.	• Connection points and practices are different from other form wall system (Symons) used on the project.	• Doka was not the only form wall type used at the site.

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			• WCEI techs and specs submittal to FRA on the Doka form walls did not have information on vertical climbing and anchor points from the manufacturer. • Ironworkers need to be aware of differences in safe use practices required when working on two different types of form systems. • WCEI not able to articulate the requirements or enforce requirements.	• Selection of compliant anchor points on Doka system not known by workers. • WCEI responsible for selection and installation of form systems, including fall protection anchor points. • WCEI personnel not aware of the Doka form approved anchor points for site compliance. **CF-C4**
	Harness equipment from different companies	Harness equipment comes as a complete unit	• Harness equipment may not work together as a single unit. • Wearer is comfortable with the equipment being used.	• Harness status is not applicable to this event as IW1 was not connected to the form wall at the time of the fall. • Harness equipment was not able to be reviewed by the Board.
	Limited Subcontractor management/oversight engagement and awareness.	Thorough understanding of sub tier subcontractor work.	• Processes needed to identify ensure issues are being resolved. • Identification of issues involved with	• FSO/FRA not aware of how issues are being addressed. • FSO is not ensuring FRA has appropriate and effective

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			subcontractor work practices are available for future reference to identify gaps.	oversight systems for the Project activities. **CF-C5** • Requirements not being implemented as expected. **CF-C6**
	FRA did not provide follow-up to their WP&C assessment	Previously identified issues are effectively addressed to prevent reoccurrence	• Generic work plans continued to be identified. • Project management personnel not fully aware of their responsibilities.	• FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors. **CF-C8** • Requirements not being implemented as expected. **CF-C6**
	Stop work requirements not implemented for use of tie-offs	Stop work was utilized when proper climbing techniques not being utilized	• Requirements not being implemented. • Work continued without PPE being used properly.	• No one observed IW1 not tied off to the form wall.
	Fermi Ambulance (A-751) sent to the top of the excavation access to retrieve IW1 because of unknown access conditions	Batavia Ambulance (M-51) sent directly to the accident scene to retrieve IW1 based on known access conditions	• Had not yet conducted ramp access as planned. • M-51 has advanced lifesaving equipment not available in A-751. • Unclear as to whether M-51 was able to access the excavation.	• Additional handoff conducted needed to be conducted. • Added 3 minutes to the time IW1 reached M-51. • IW1 exposed to a higher level of risk.

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			• IW1 transported in A-751 to M-51. • Needed an extra transfer of IW1 from A-751 and to M-51.	• Took longer for IW1 to reach the ambulance with advanced lifesaving equipment. • Did not influence the overall quality of care to IW1 following the fall.
	FRA communication with LifeStar (Chicago) had issues	FRA could effectively communicate with LifeStar (Chicago)	• LifeStar (Chicago) person wasn't familiar with receiving calls when the first FRA call came in for standby support. • LifeStar (Chicago) was using a different frequency for emergency communications than the FRA and Batavia emergency responders. • No direct communications between FRA Dispatch and LifeStar (Chicago) helicopter.	• FRA needed to develop a work around to communicate with LifeStar (Chicago). • No protocols for identifying landing zones available. • Unknown if this change influenced the overall quality of care to IW1 following the fall.
	Waited for medical helicopter to arrive to transport IW1	IW1 transported directly to a Level One Trauma Center	• Needed to follow local emergency response agreements.	• The time for IW1 to be transported to the Level One Trauma Center was increased by ~22 minutes.

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			• Could not directly go to a nearby Level One Trauma Center by ambulance. • Needed to wait for LifeStar (Chicago) to arrive, land, and take charge of IW1.	• Transportation of IW1 to the hospital was less than optimal. **CF-C20**
	First Aid material at work trailer	First Aid material at accident location	• First Aid kit approximately 150 yards away from accident scene.	• First Aid kit not used. • FRA and Harris provided initial care with what was available before emergency responders arrived. • Did not influence the overall quality of care to IW1 following the fall.
WHEN **Occurred, identified, facility status, schedule**	Right after lunch	Work conducted not after a break	• Getting back into work mode. • Need to wait for others to get back from lunch.	• Board unable to talk with ironworkers to establish whether this was relevant in causing the accident.
WHERE **Physical location, environmental conditions**	Working in a new corner wall configuration	Working from flat panel configuration	• Limited space configuration for climbing. • Different working conditions and hazards. • Needed to climb around obstructions.	• IW1 climbs wall straddling the corner rather than using manlift. • Hierarchy of Controls not effectively implemented. **CF-C7**

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			• Manlift could access location for inserting the rebar tie in the upper corner penetration.	
WHO **Staff involved, training, qualification, supervision**	Work conducted by multiple subcontractors	Work conducted by a single subcontractor under a fully reviewed and approved safety program and supporting documents	• Worker's employer not responsible for all the performance elements, such as fall protection anchors. • Requirements need to flow down through multiple contractors. • Oversight needs to be conducted at multiple levels. • Additional contract language needs to be followed to flow down requirements, including DOE requirements, to all subcontractors, and share technical information, such as anchor points.	• Harris/WCEI/FRA oversight was insufficient to determine implementation of requirements by subcontractors. **CF-C8** • Harris/WCEI/FRA not aware of how work is being conducted on the Project. **CF-C10** • DOE requirements not being flowed down to subcontractors. **CF-C9** • Requirements not being implemented as expected. **CF-C6**
	Several members of the Conventional Facility PIP-II LINAC Management Chain responsible for critical	PIP-II Project responsibilities are clearly defined and personnel with capabilities and	• Roles and responsibilities for the FRA project team in the LINAC management chain need to be clearly	• Roles and responsibilities for the FRA project team in the LINAC management chain are not clearly defined and

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
	elements of project execution are not FRA employees	authorities are assigned to complete these tasks	defined and understood by the PIP-II project team. • LINAC Complex project personnel with assigned responsibilities are unclear of those responsibilities or their authorities to execute those responsibilities. • Management was unable to identify who was responsible to ensure that Harris was using the current accepted versions of the work documents.	understood by the PIP-II project team. • LINAC Complex Project personnel are not ensuring subcontractor safety documents are properly processed and up to date at the job site. **CF-C10** • Direction of work not clear. **CF-C11**
	Harris daily job task analyses meetings only attended by Harris personnel	FSO, FRA, WCEI routinely attend Harris daily job task analyses meetings to identify what is being discussed and documents utilized by Harris	• Knowledge not available of how Harris was addressing safety requirements and conducting work. • Identification that Harris was not using the FRA current accepted version of the JHRA was not made.	• Implementation of requirements by Harris not understood FSO/FRA/WCEI. • Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors. **CF-C8** • Requirements not being implemented by Harris as expected. **CF-C12**

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
	No clear FRA document approvals and current version of documents not being used	Documents clearly show FRA document approvals, and the current version is identified for use	• Did not meet FESHM roles and responsibility requirements. • FESHM does not contain a defined process that current versions of documents are being used in the field. • QA requirements on use of current versions of documents not being implemented. • Unclear as to which document to use. • Documents used in the field did not show FRA acceptance or reflect the FRA comments.	• Everyone identifies they coordinate activities in their areas. • Everyone believes they are doing their part. • Implementation of expected requirements not conducted. • Requirements not being implemented as expected. **CF-C6**
	Relied on acceptance of Union training	Ironworkers receive site specific training	• Relied on union assertion of ironworkers training and qualification. • Lack of flow down of project requirements to ironworkers. • Additional site-specific climbing requirements not	• FRA personnel were not aware of the FRA requirements to review training records. **CF-C13** • Ironworkers not familiar with local requirements and operated based on previous experience.

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			addressed in Union training. • 10 CFR 851 training requirements not confirmed. • Training records not reviewed prior to performing work as required in the FESHM 7010, Section 6.4.4.	• Flow down of requirements not adequate. **CF-C14** • Requirements not being implemented as expected. **CF-C6**
HOW **Control chain, hazard analysis monitoring**	Chain of Custody techniques not used on bags of material retrieved from the incident site	Chain of Custody is maintained for accident scene material	• Loss of accountability of evidence. • Roles and responsibilities not clearly identified. • Potential to alter evidence exists. • Evidence not available for visual inspection during subsequent investigations to determine condition of IW1's PPE.	• Actions not consistent with appropriate chain of custody. **CF-C15** • Delay in providing the Board access to information related to the chain of custody, and the opportunity to visually inspect critical pieces of evidence. • Extended time to collect facts, and conduct analyses and draw conclusions.
	Harris daily job task analyses meetings include JHRAs pulled from a library of activities commonly	Current site-specific work tasks and hazard control documents are available at the job	• Project specific tasks and hazard control requirements not identified.	• Specific Project requirements not available to subcontractor personnel. **CF-C16** • Selection of compliant anchor points on Doka system not

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
	performed by ironworkers, and not supplemented with safety information that are specific to the job task	site and used to brief workers	• Harris JTA process or field changes to JHRA not applied to cover climbing form walls. • Signatures on JHRAs used for the work for developers and approvals are often missing.	fully understood by workers and project oversight. **CF-C17** • FRA not aware of how hazards are being addressed. **CF-C18** • FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors. **CF-C8** • Direction of work not clear. **CF-C11** • Requirements not being implemented by Harris as expected. **CF-C12** • Requirements not being implemented as expected. **CF-C6**
	Harris's hazard control documents do not address working on Doka form walls and associated hazards	Current site-specific work tasks and hazard control documents for Doka form walls are available at the job site and used to brief workers	• Applicable hazards not addressed. • Hazards involved in using the Doka form walls are not addressed or used to brief ironworkers.	• FRA not aware of how hazards are being addressed. **CF-C18** • Direction of work not clear. **CF-C11** • Requirements not being implemented by Harris as expected. **CF-C12**

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
				• Requirements not being implemented as expected. **CF-C6**
	Safety documents in various stages of review and approval are being used or referenced by organizations working on the PIP-II project	Everyone has access to and tracking of the current, approved/accepted documents	• Auto Desk Build and IMPACT are document routing programs not available to all organizations involved in the PIP-II document process. • Work is allowed to commence without proper development and acceptance of safety documents.	• LINAC Complex Project personnel are not ensuring subcontractor safety documents are properly processed and up to date at the job site. **CF-C10** • Non-current documents were being used on project work.
	No Harris training on climbing Doka form walls	Ironworkers have proper training on working on Doka forms	• Ironworkers know requirements.	• Requirements not being implemented by Harris as expected. **CF-C12** • Requirements not being implemented as expected. **CF-C6**
	IW1 working on form wall	Manlift used to access work location	• IW1 needs to be secured to form wall. • Manlift could access location for inserting the	• Hierarchy of Controls not effectively implemented. **CF-C7**

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			rebar tie in the upper corner penetration. • Hierarchy of Controls principles not followed.	• IW1 climbed form wall with PPE. • IW1 did not use available PPE at the top of the form wall. **CF-C19** • IW1 not secured to form wall. • IW1 was not restrained from falling to the concrete pad. **CF-C3** • IW1 was in a position that allowed the accident to happen. **CF-C1** • IW1 lost contact with the form wall. • IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma. **CF-C2**
	No pre-emergency assessment conducted to assess access into the excavation	Pre-emergency assessment conducted to assess access to the bottom of the excavation	• Fermi Fire Department is not aware of the excavation conditions to reach IW1. • Incident Commander needed to make rapid on the spot emergency decisions on what equipment to use, its	• Decision made to carry IW1 up the South ramp to A-751 instead of bringing A-751 to the basemat at the bottom of the excavation. • Decisions made to use A-751 made on incomplete site information.

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
			placement, and utilization based on incomplete information.	• IW1 transported in A-751 to M-51. • Extra transfer of IW1 needed to be made. • Added 3 minutes to the time IW1 reached M-51 that had advanced life safety support. • Did not influence the overall quality of care to IW1 following the fall.
OTHER	Lawsuit pending, no contact notice issued.	No lawsuit, full access to Harris ironworkers for interviews and records (training, inspections, etc.)	• Legal conditions do not conflict with the AIB process. • Potential lawsuit taking priority over the Board's activities. • Cannot talk to ironworkers including IW1. • Evidence not available to the Board for investigation.	• All evidence and testimony not available to allow Board to fully evaluate causality and judgments of need. • Potential lawsuit taking priority over the Board's activities. • Evidence not available to the Board for direct inspection. • Did not influence the accident.
	Evidence kept as biowaste	Evidence preserved for investigation and available for physical inspection by AIB	• Chain of custody not preserved. • Reliance on photos, interviews, and video of evidence/PPE.	• Control of evidence not well maintained. • Evidence not available during subsequent investigations to

Factors	Accident Situation	Prior, Ideal or Accident-Free Situation	Difference	Evaluation of Effect
				determine condition of IW1's PPE or potential causality. • Board could not determine if all proper PPE was present on IW1's harness. • Did not influence the accident.

APPENDIX K

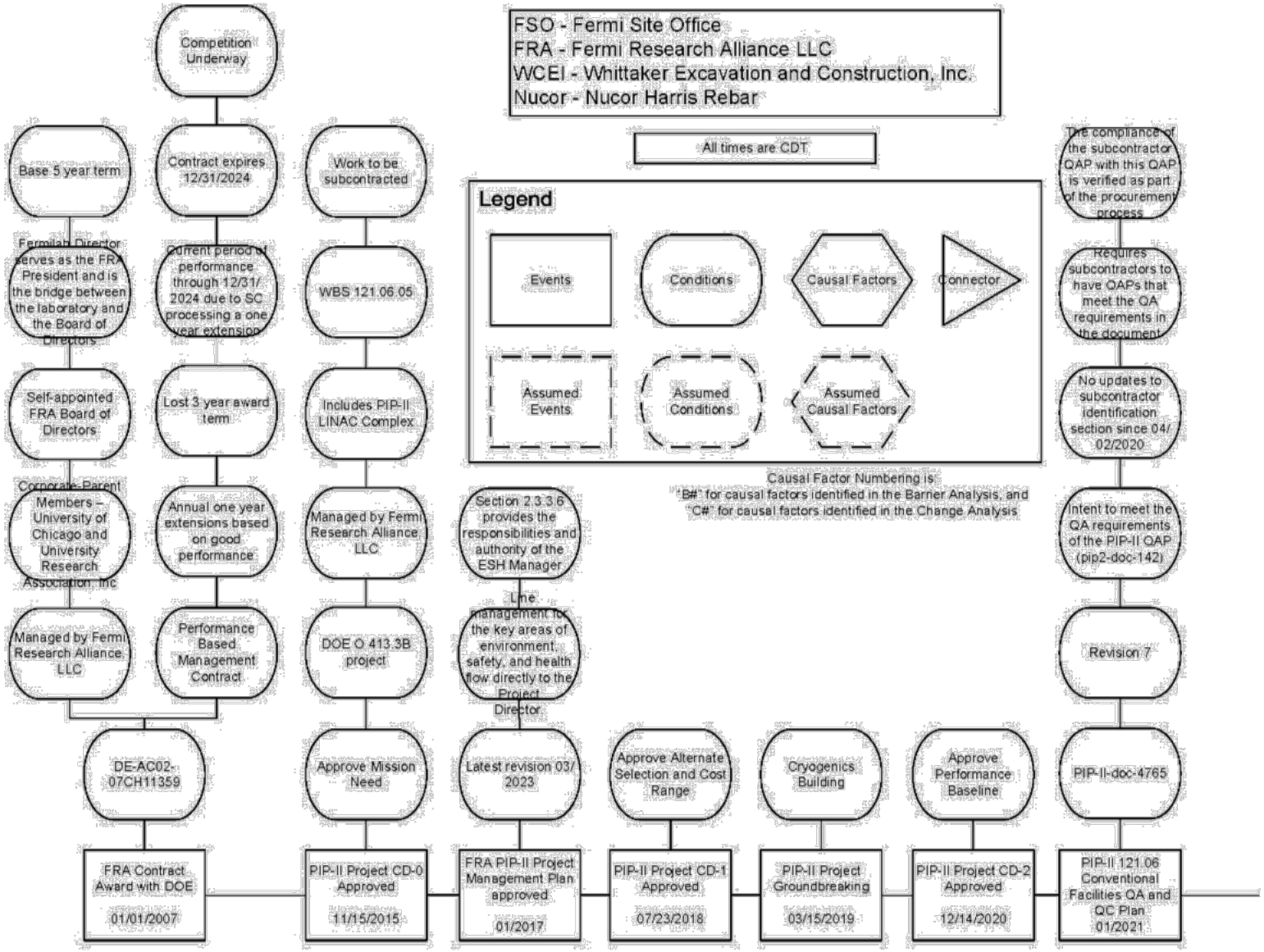
Human Performance Indicators Worksheet

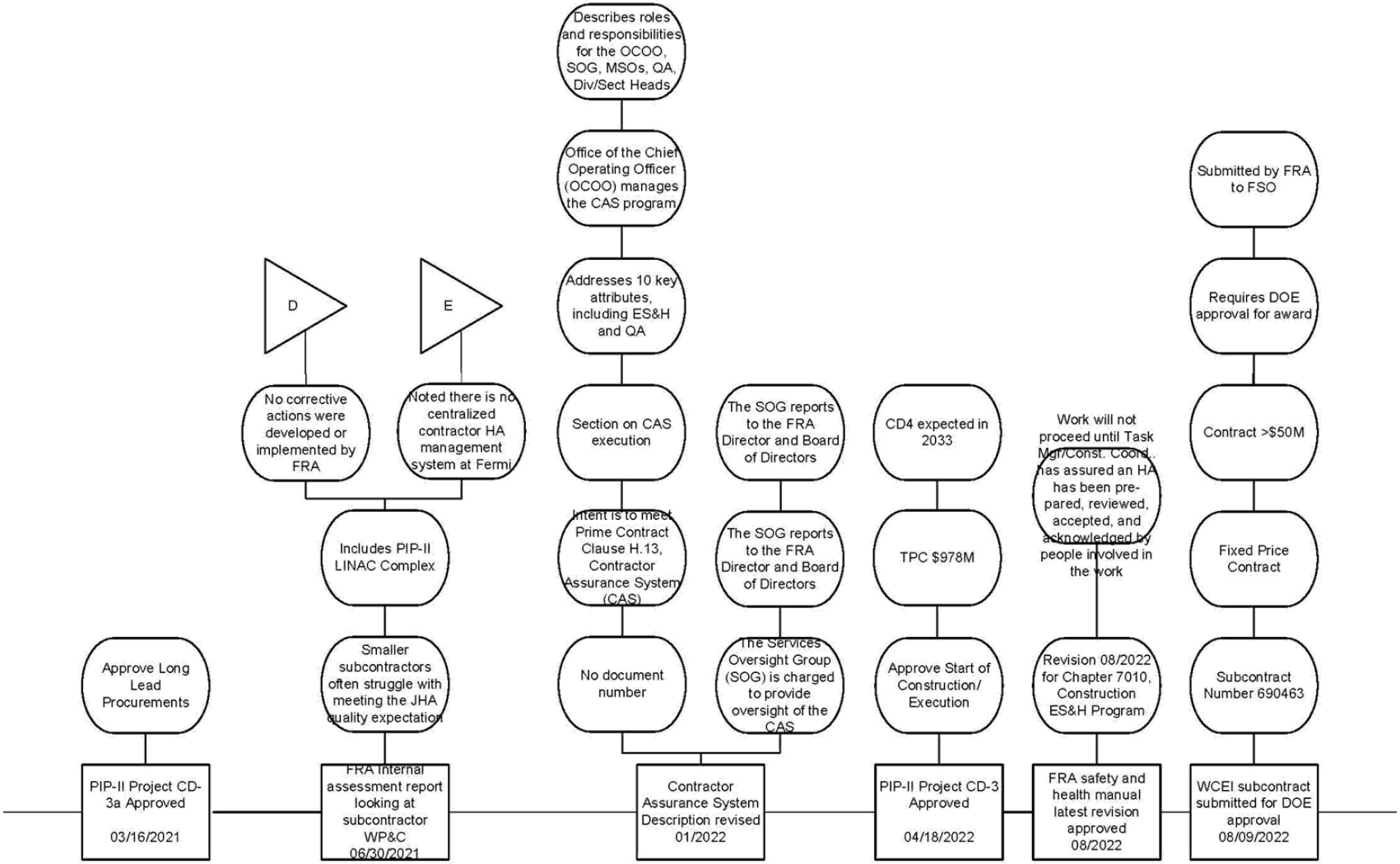
HP Error Precursor	*Action*
T3: Simultaneous, multiple actions	IW1 needed to ensure that his fall protection was connected to the form wall and identify if the other ironworkers were ready to begin the work on the other side of the form wall.
T5: Irreversible actions	IW1 failed to connect their fall protection PPE into an approved anchor point prior to leaning backwards.
T6: Interpretation requirements	Project personnel did not understand what, and where, the approved Doka fall protection anchor points were. Requirements were not adequately flowed down and assessed for effectiveness.
T7: Unclear goals, roles, or responsibilities	It was unclear amongst the subcontractors who had responsibilities to identify the proper anchor points.
T8: Lack of or unclear standards	Information on the appropriate anchor points approved for fall protection on the Doka Form Wall system was not clear amongst all contractors working on the Project, nor was a search conducted to find information on Doka anchor requirements.
W2: Changes / Departure from routine	Two different wall forms were on the worksite (Doka and other) with no briefing provided as to what the differences were between the two forms on site.
W4: Workarounds	IW1 used a workaround by engaging the wall in a manner that let them support their weight without using their fall protection equipment.
I1: Unfamiliarity with task / First time	The need to climb the Doka form wall had just been started onsite the previous day.
I2: Lack of knowledge (faulty mental model)	WCEI supervision lacked knowledge of the Doka wall form and appropriate anchor points and was thereby unqualified to even discuss proper use with IW1.

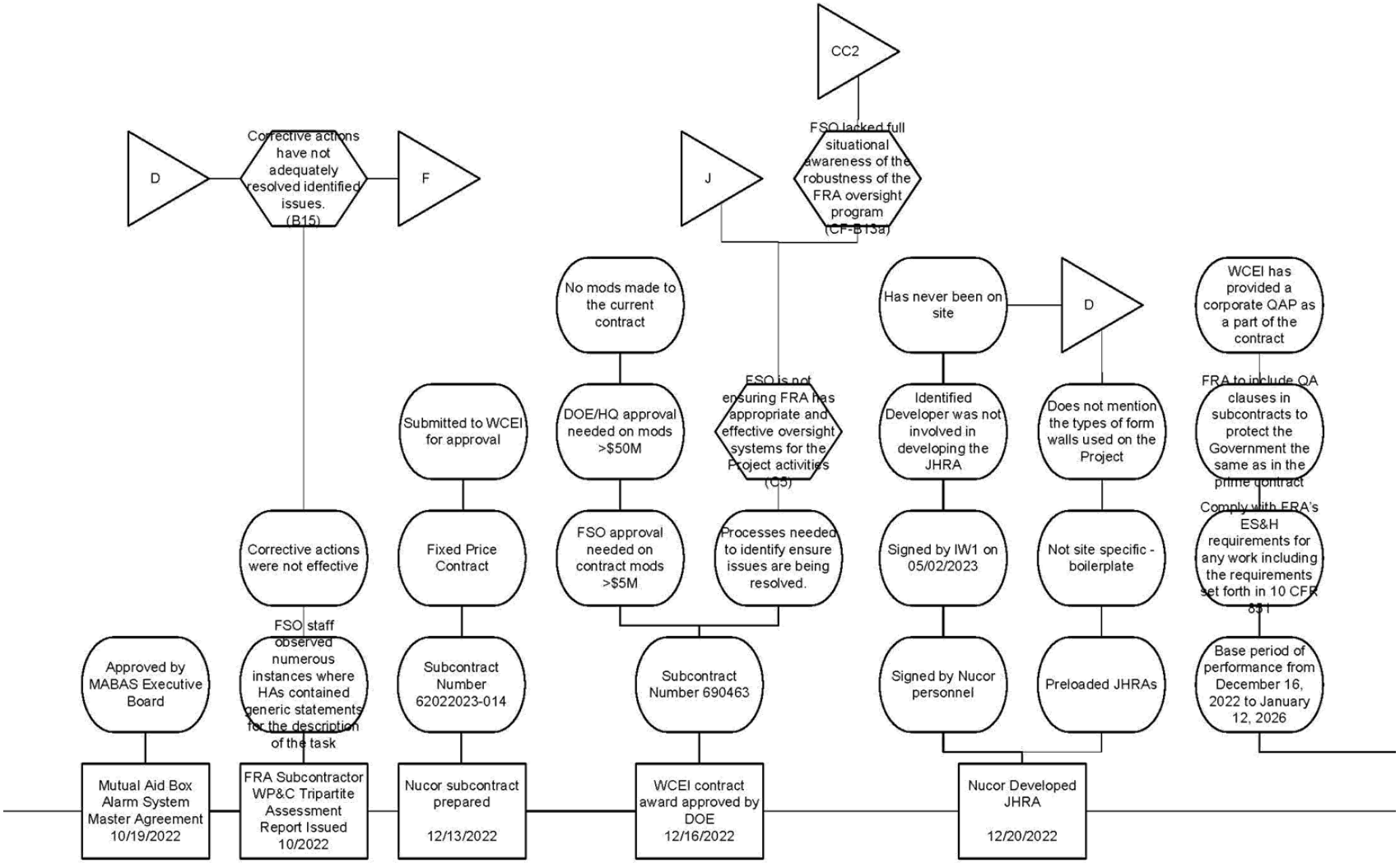
I4: Imprecise communication habits	No radios or direct voice communications were used between IW1, the supervisor, or other workers on site and IW1 had to climb to the top of the wall.
N3: Assumptions	WCEI supervisor assumed IW1 was familiar and proficient in fall protection use and Doka wall forms.
N4: Complacency / Overconfidence	The WCEI supervisor was overconfident that IW1 could perform the work. Flow down of requirements were assumed to be implemented as expected.
N5: Mind-set (intentions)	IW1 had the mind-set that they could climb the wall without needing to consider other options (ladder or aerial lift). Both IW1 and WCEI had the mindset that no direct communications or supervision was necessary for this evolution to be safely conducted.
N6: Inaccurate risk perception	IW1 had an inaccurate risk perception that they could climb the Doka wall form as this was like others they had climbed before. IW1 had an inaccurate risk perception they could climb past the work area, reach the top of the work form, and connect into a secure anchor point.

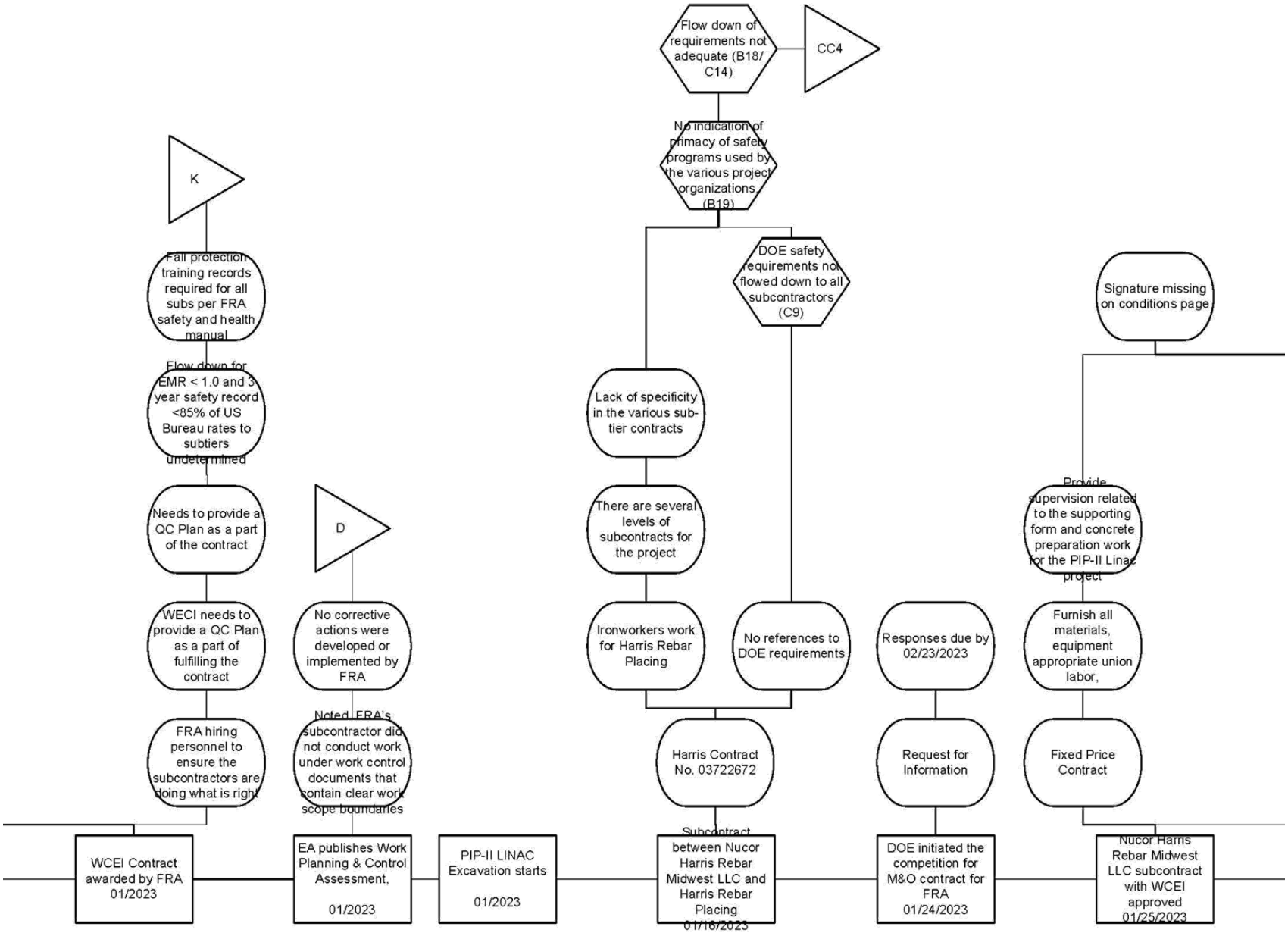
APPENDIX L

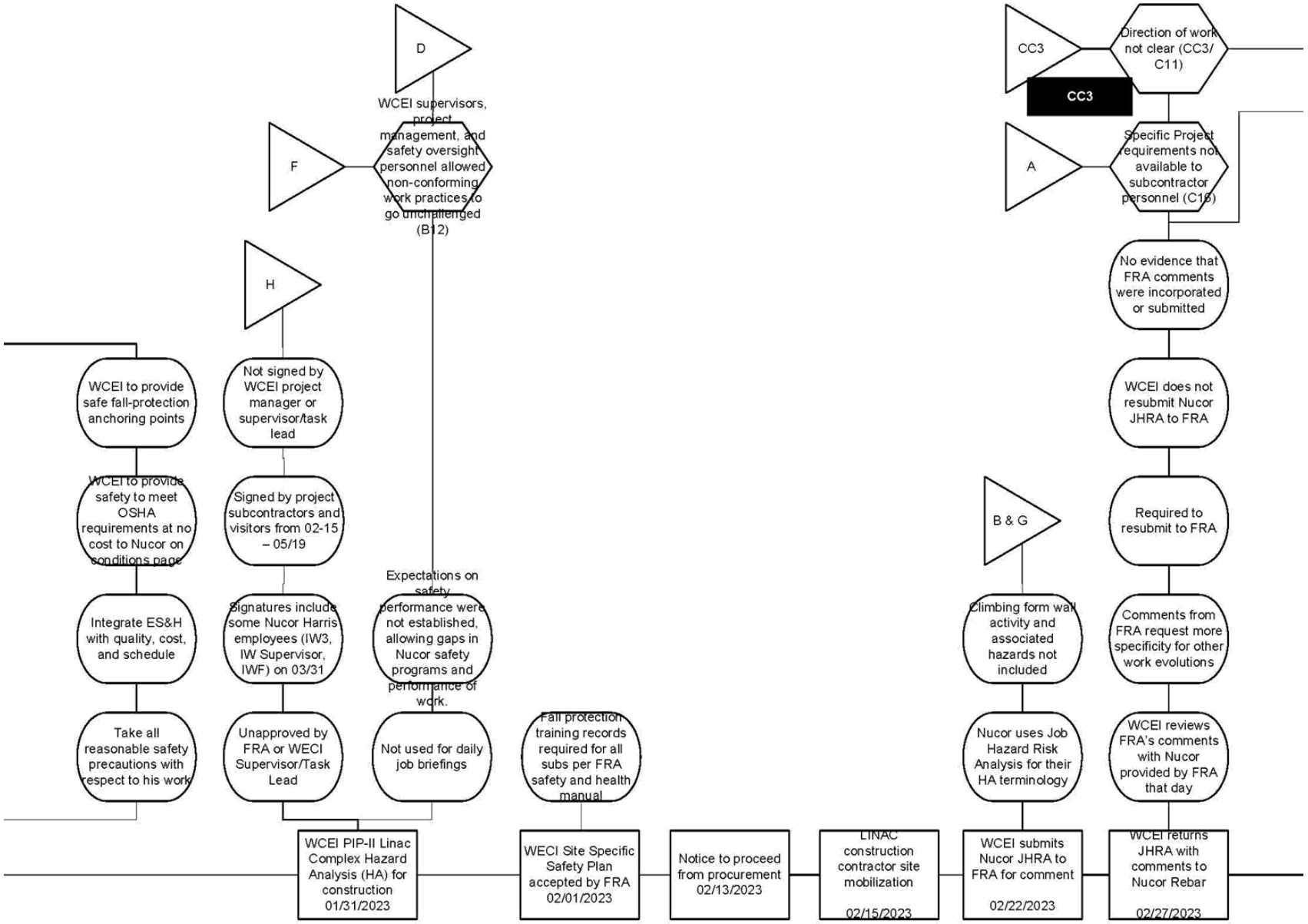
Events and Causal Factors Chart

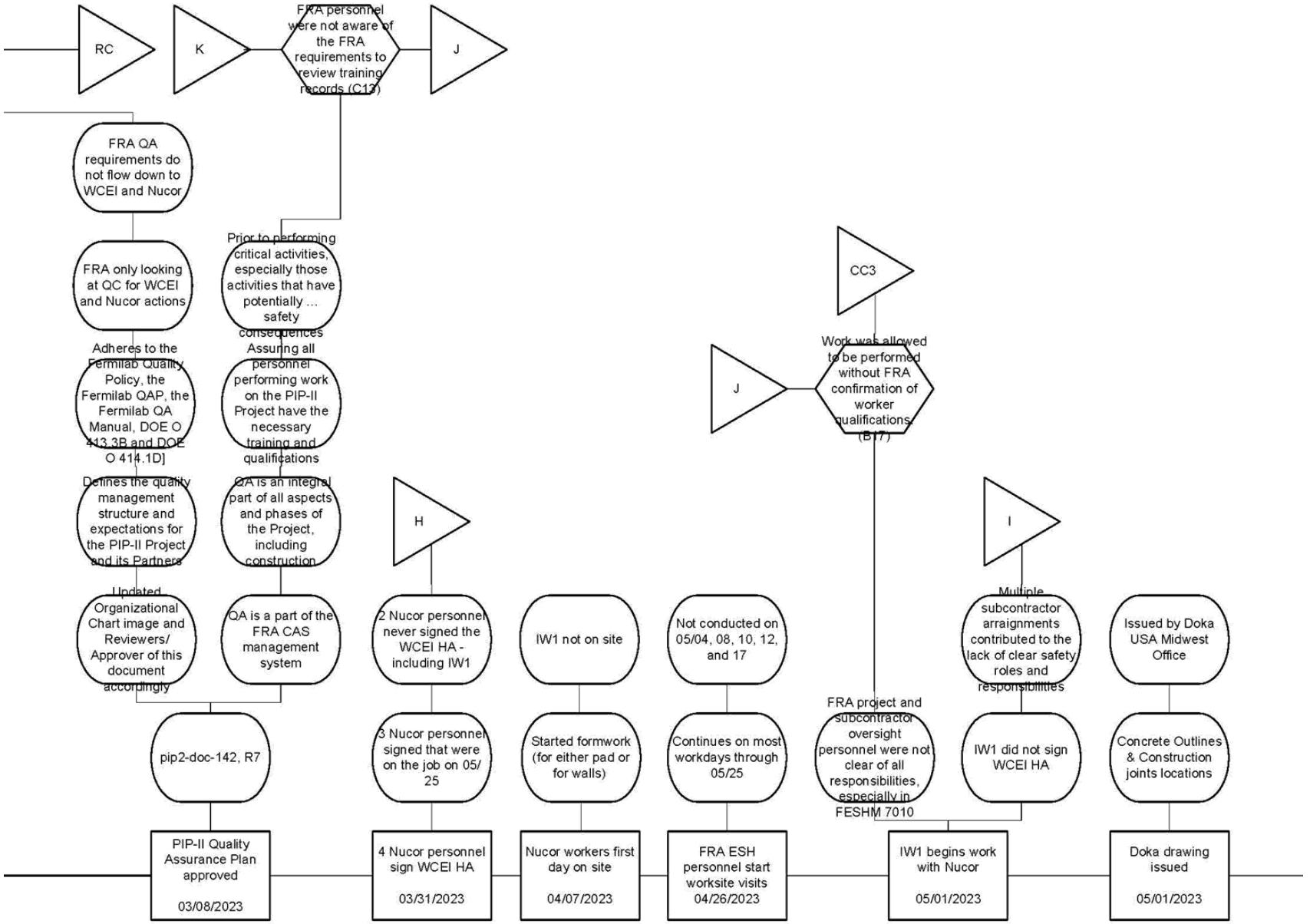


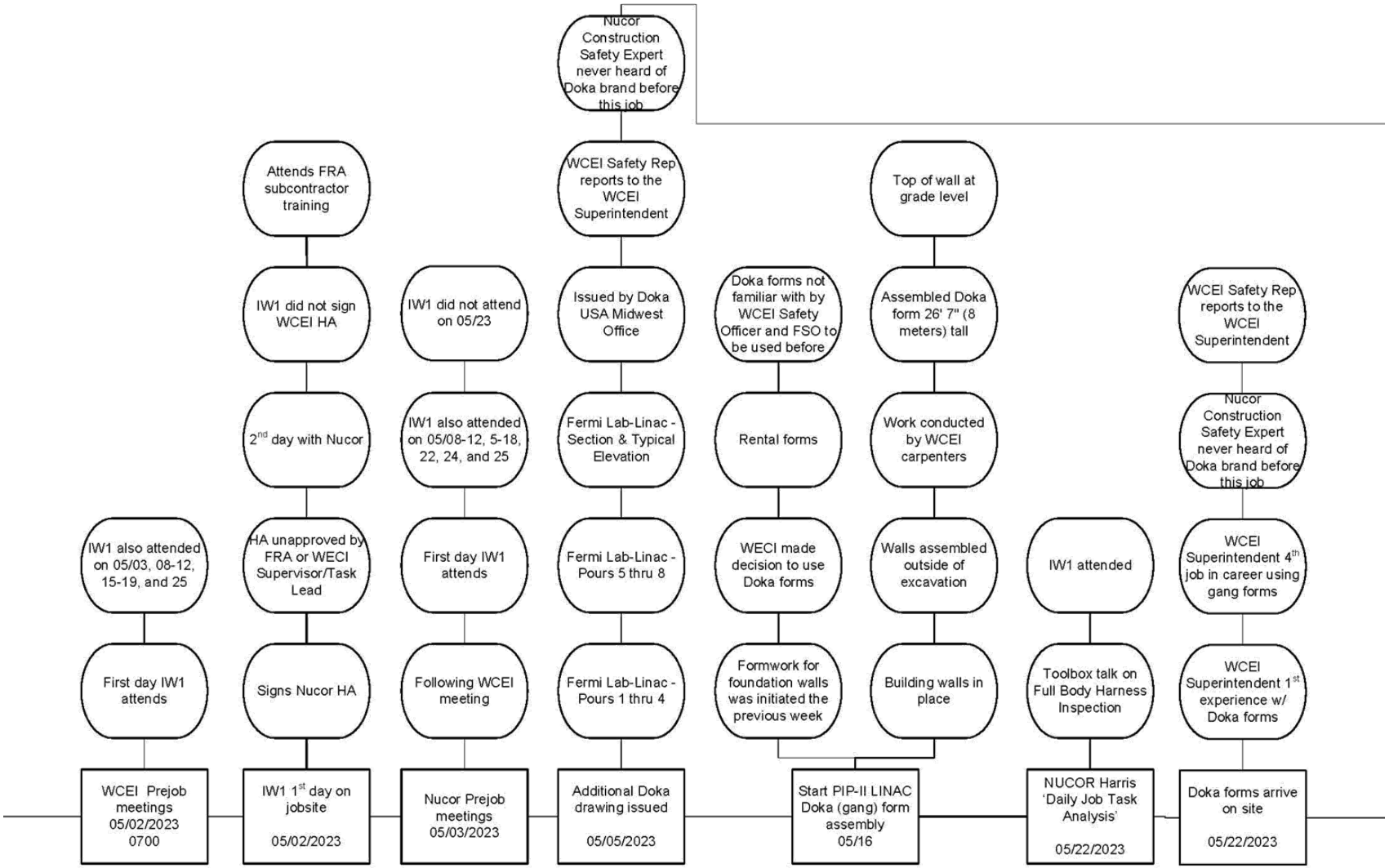

Describes roles and responsibilities for the OCOO, SOG, MSOs, QA, Div/Sect Heads
Office of the Chief Operating Officer (OCOO) manages the CAS program
Addresses 10 key attributes, including ES&H and QA
Section on CAS execution
Intent is to meet Prime Contract Clause H.13, Contractor Assurance System (CAS)
No document number
Contractor Assurance System Description revised 01/2022
D
No corrective actions were developed or implemented by FRA
E
Noted there is no centralized contractor HA management system at Fermi
Includes PIP-II LINAC Complex
Smaller subcontractors often struggle with meeting the JHA quality expectation
FRA internal assessment report looking at subcontractor WP&C 06/30/2021
Approve Long Lead Procurements
PIP-II Project CD-3a Approved 03/16/2021
The SOG reports to the FRA Director and Board of Directors
The SOG reports to the FRA Director and Board of Directors
The Services Oversight Group (SOG) is charged to provide oversight of the CAS
CD4 expected in 2033
TPC $978M
Approve Start of Construction/ Execution
PIP-II Project CD-3 Approved 04/18/2022
Work will not proceed until Task Mgr/Const. Coord., has assured an HA has been pre-pared, reviewed, accepted, and acknowledged by people involved in the work
Revision 08/2022 for Chapter 7010, Construction ES&H Program
FRA safety and health manual latest revision approved 08/2022
Submitted by FRA to FSO
Requires DOE approval for award
Contract >$50M
Fixed Price Contract
Subcontract Number 690463
WCEI subcontract submitted for DOE approval 08/09/2022

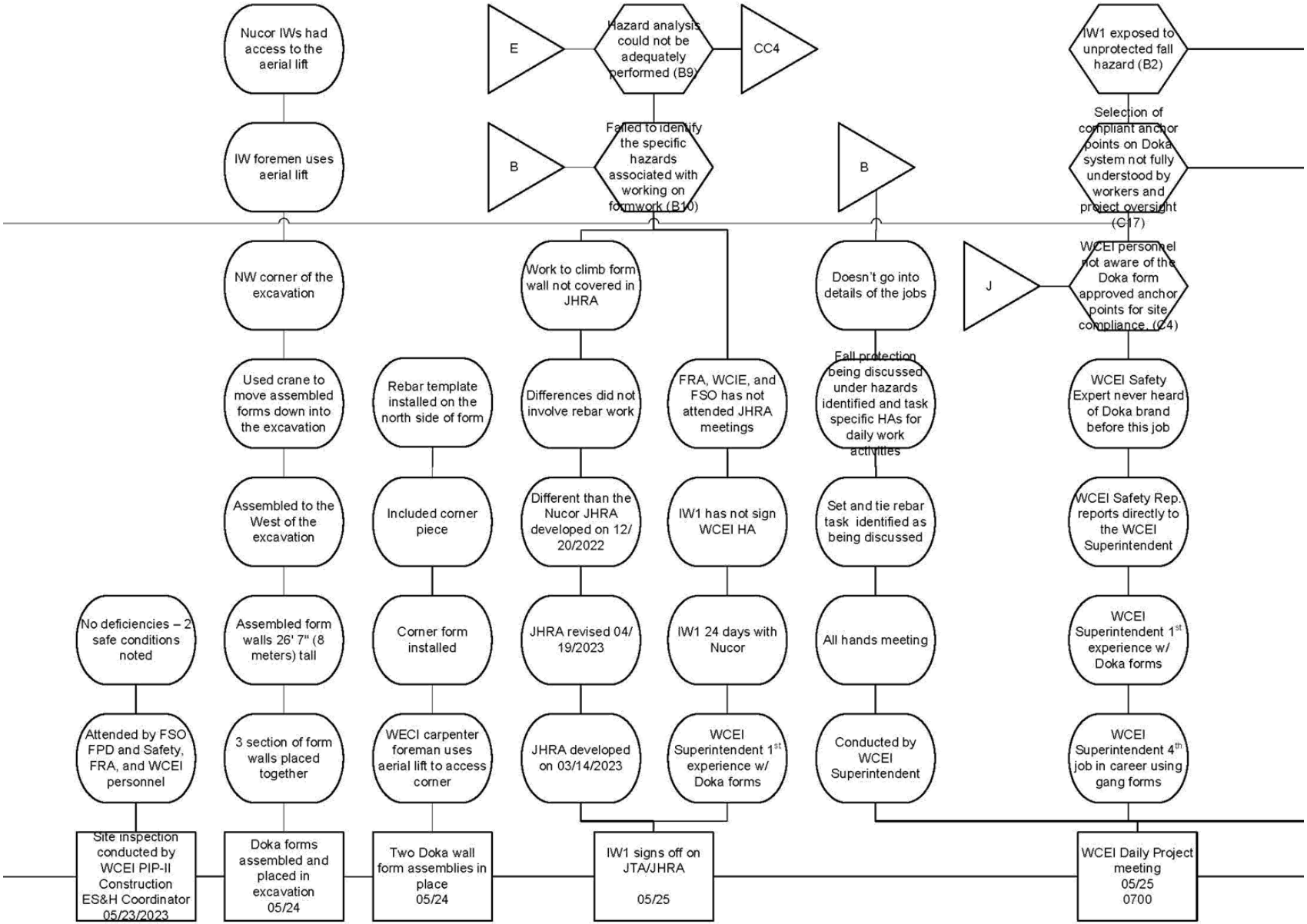

CC2
D
Corrective actions have not adequately resolved identified issues. (B15)
F
J
FSO lacked full situational awareness of the robustness of the FRA oversight program (CF-B13a)
No mods made to the current contract
Has never been on site
D
WCEI has provided a corporate QAP as a part of the contract
Submitted to WCEI for approval
DOE/HQ approval needed on mods >$50M
FSO is not ensuring FRA has appropriate and effective oversight systems for the Project activities (C5)
Identified Developer was not involved in developing the JHRA
Does not mention the types of form walls used on the Project
FRA to include QA clauses in subcontracts to protect the Government the same as in the prime contract
Corrective actions were not effective
Fixed Price Contract
FSO approval needed on contract mods >$5M
Processes needed to identify ensure issues are being resolved.
Signed by IW1 on 05/02/2023
Not site specific - boilerplate
Comply with FRA's ES&H requirements for any work including the requirements set forth in 10 CFR 851
Approved by MABAS Executive Board
FSO staff observed numerous instances where HAs contained generic statements for the description of the task
Subcontract Number 62022023-014
Subcontract Number 690463
Signed by Nucor personnel
Preloaded JHRAs
Base period of performance from December 16, 2022 to January 12, 2026
Mutual Aid Box Alarm System Master Agreement 10/19/2022
FRA Subcontractor WP&C Tripartite Assessment Report Issued 10/2022
Nucor subcontract prepared 12/13/2022
WCEI contract award approved by DOE 12/16/2022
Nucor Developed JHRA 12/20/2022

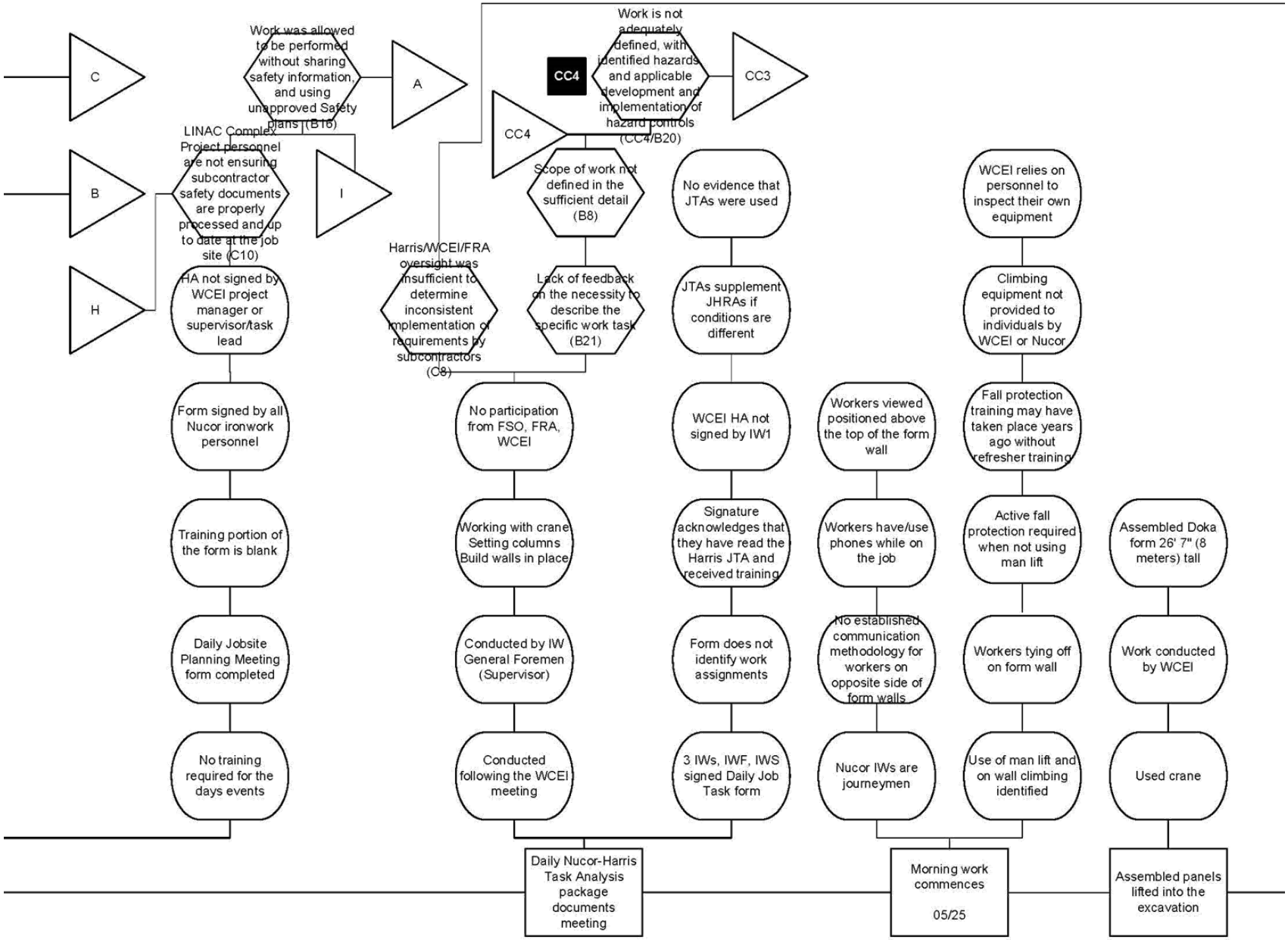

Flow down of requirements not adequate (B18/ C14)
CC4
No indication of primacy of safety programs used by the various project organizations (B19)
DOE safety requirements not flowed down to all subcontractors (C9)
K
Fall protection training records required for all subs per FRA safety and health manual
Flow down for EMR < 1.0 and 3 year safety record <85% of US Bureau rates to subtiers undetermined
Needs to provide a QC Plan as a part of the contract
WECI needs to provide a QC Plan as a part of fulfilling the contract
FRA hiring personnel to ensure the subcontractors are doing what is right
D
No corrective actions were developed or implemented by FRA
Noted FRA's subcontractor did not conduct work under work control documents that contain clear work scope boundaries
Lack of specificity in the various sub-tier contracts
There are several levels of subcontracts for the project
Ironworkers work for Harris Rebar Placing
No references to DOE requirements
Harris Contract No. 03722672
Responses due by 02/23/2023
Request for Information
Signature missing on conditions page
Provide supervision related to the supporting form and concrete preparation work for the PIP-II Linac project
Furnish all materials, equipment appropriate union labor,
Fixed Price Contract
WCEI Contract awarded by FRA 01/2023
EA publishes Work Planning & Control Assessment, 01/2023
PIP-II LINAC Excavation starts 01/2023
Subcontract between Nucor Harris Rebar Midwest LLC and Harris Rebar Placing 01/18/2023
DOE initiated the competition for M&O contract for FRA 01/24/2023
Nucor Harris Rebar Midwest LLC subcontract with WCEI approved 01/25/2023

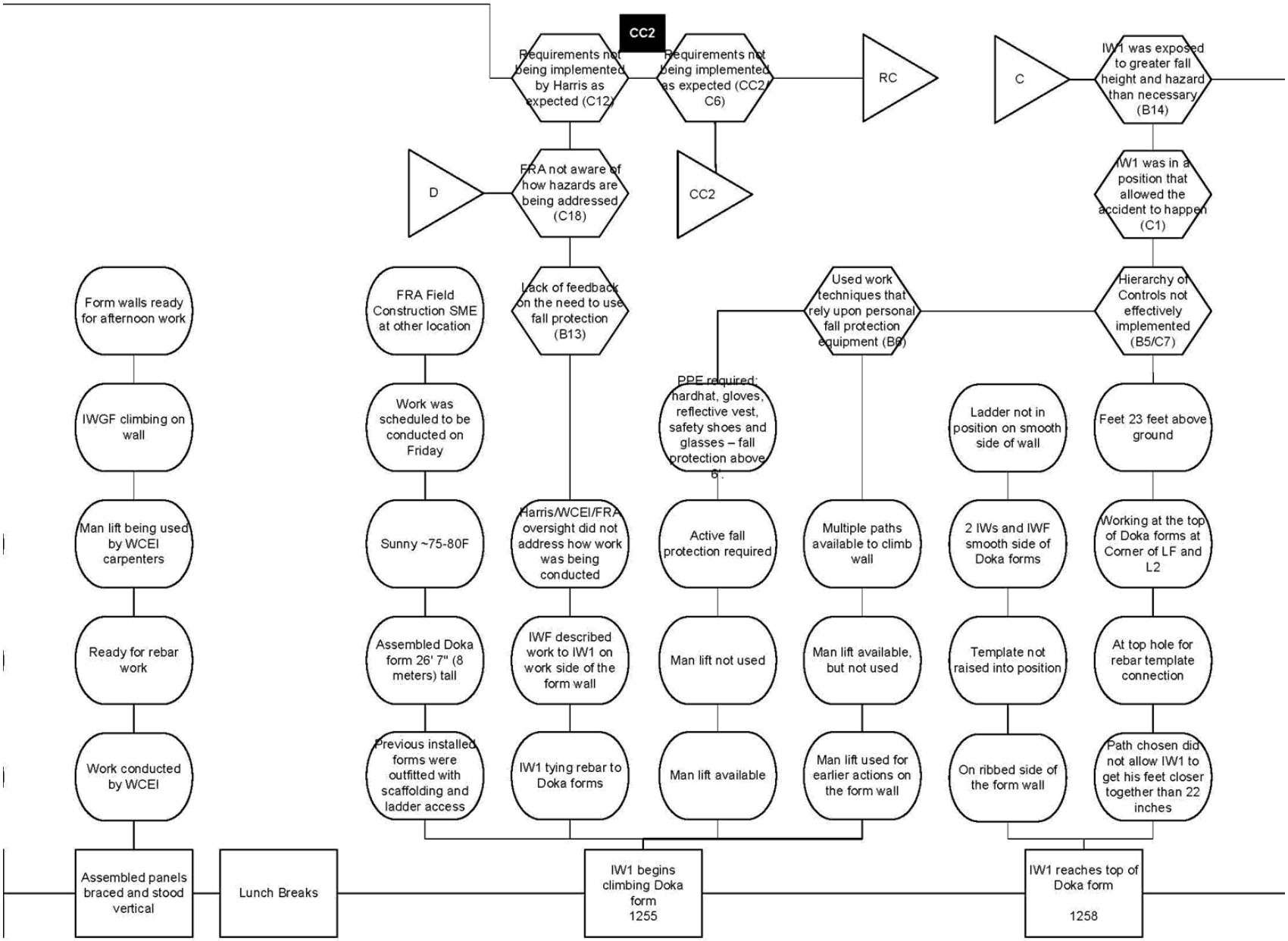

D
WCEI supervisors, project management, and safety oversight personnel allowed non-conforming work practices to go unchallenged (B12)
F
H
CC3
Direction of work not clear (CC3/ C11)
CC3
A
Specific Project requirements not available to subcontractor personnel (C18)
No evidence that FRA comments were incorporated or submitted
WCEI does not resubmit Nucor JHRA to FRA
Required to resubmit to FRA
Comments from FRA request more specificity for other work evolutions
WCEI reviews FRA's comments with Nucor provided by FRA that day
WCEI returns JHRA with comments to Nucor Rebar
02/27/2023
B & G
Climbing form wall activity and associated hazards not included
Nucor uses Job Hazard Risk Analysis for their HA terminology
WCEI submits Nucor JHRA to FRA for comment
02/22/2023
LINAC construction contractor site mobilization
02/15/2023
Notice to proceed from procurement
02/13/2023
WECI Site Specific Safety Plan accepted by FRA
02/01/2023
Fall protection training records required for all subs per FRA safety and health manual
Not used for daily job briefings
Expectations on safety performance were not established, allowing gaps in Nucor safety programs and performance of work.
Not signed by WCEI project manager or supervisor/task lead
Signed by project subcontractors and visitors from 02-15 – 05/19
Signatures include some Nucor Harris employees (IW3, IW Supervisor, IWF) on 03/31
Unapproved by FRA or WECI Supervisor/Task Lead
WCEI PIP-II Linac Complex Hazard Analysis (HA) for construction
01/31/2023
WCEI to provide safe fall-protection anchoring points
WCEI to provide safety to meet OSHA requirements at no cost to Nucor on conditions page
Integrate ES&H with quality, cost, and schedule
Take all reasonable safety precautions with respect to his work

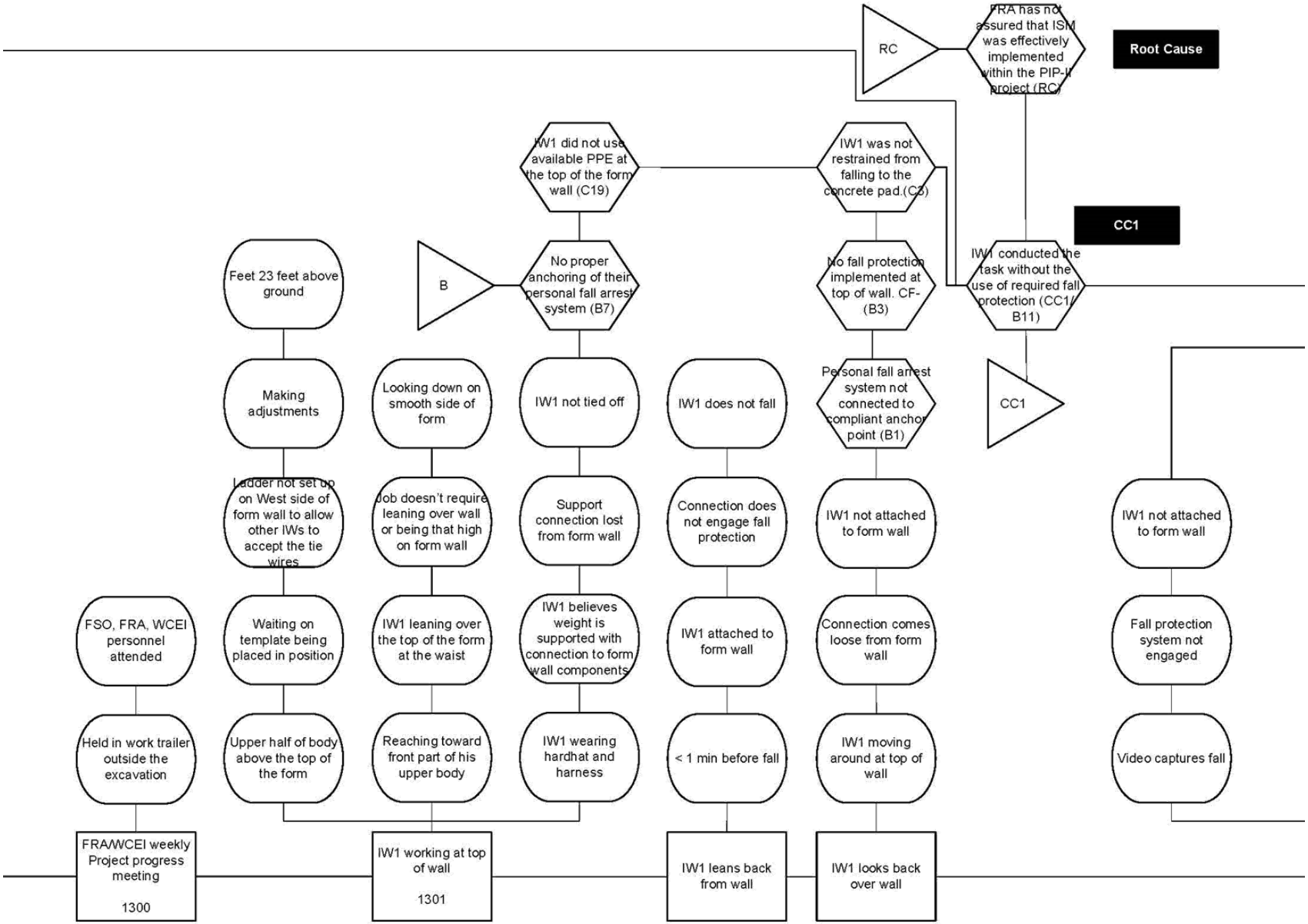

RC
K
FRA personnel were not aware of the FRA requirements to review training records (C13)
J
FRA QA requirements do not flow down to WCEI and Nucor
FRA only looking at QC for WCEI and Nucor actions
Prior to performing critical activities, especially those activities that have potentially ... safety consequences
Assuring all personnel performing work on the PIP-II Project have the necessary training and qualifications
Adheres to the Fermilab Quality Policy, the Fermilab QAP, the Fermilab QA Manual, DOE O 413.3B and DOE O 414.1D]
QA is an integral part of all aspects and phases of the Project, including construction
Defines the quality management structure and expectations for the PIP-II Project and its Partners
Updated Organizational Chart image and Reviewers/ Approver of this document accordingly
QA is a part of the FRA CAS management system
pip2-doc-142, R7
PIP-II Quality Assurance Plan approved
03/08/2023
H
2 Nucor personnel never signed the WCEI HA - including IW1
3 Nucor personnel signed that were on the job on 05/ 25
4 Nucor personnel sign WCEI HA
03/31/2023
IW1 not on site
Started formwork (for either pad or for walls)
Nucor workers first day on site
04/07/2023
Not conducted on 05/04, 08, 10, 12, and 17
Continues on most workdays through 05/25
FRA ESH personnel start worksite visits
04/26/2023
CC3
J
Work was allowed to be performed without FRA confirmation of worker qualifications (B17)
FRA project and subcontractor oversight personnel were not clear of all responsibilities, especially in FESHM 7010
IW1 begins work with Nucor
05/01/2023
I
Multiple subcontractor arraignments contributed to the lack of clear safety roles and responsibilities
IW1 did not sign WCEI HA
Issued by Doka USA Midwest Office
Concrete Outlines & Construction joints locations
Doka drawing issued
05/01/2023

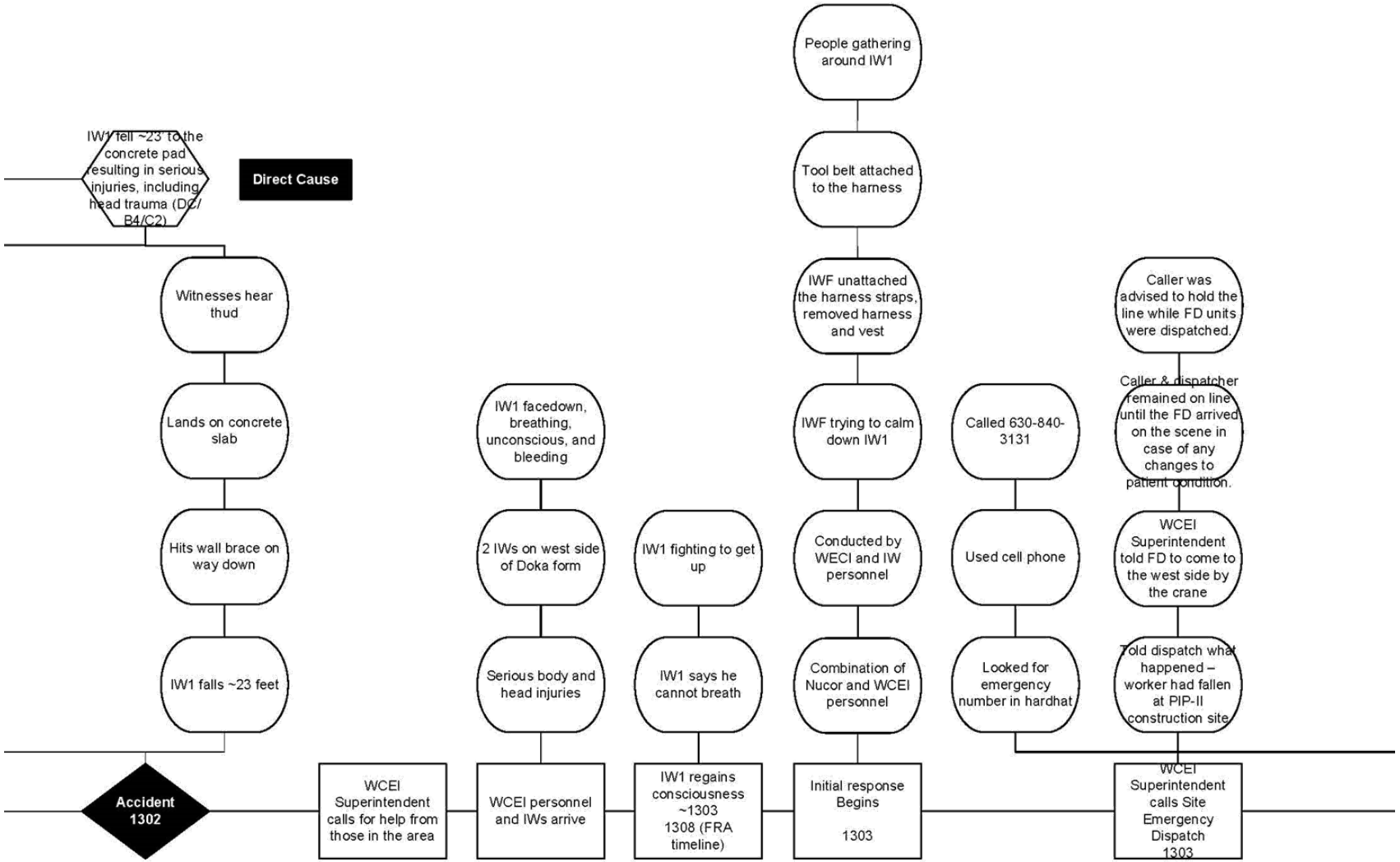

Nucor Construction Safety Expert never heard of Doka brand before this job
Attends FRA subcontractor training
WCEI Safety Rep reports to the WCEI Superintendent
Top of wall at grade level
IW1 did not sign WCEI HA
IW1 did not attend on 05/23
Issued by Doka USA Midwest Office
Doka forms not familiar with by WCEI Safety Officer and FSO to be used before
Assembled Doka form 26' 7" (8 meters) tall
WCEI Safety Rep reports to the WCEI Superintendent
2nd day with Nucor
IW1 also attended on 05/08-12, 5-18, 22, 24, and 25
Fermi Lab-Linac - Section & Typical Elevation
Rental forms
Work conducted by WCEI carpenters
Nucor Construction Safety Expert never heard of Doka brand before this job
IW1 also attended on 05/03, 08-12, 15-19, and 25
HA unapproved by FRA or WECI Supervisor/Task Lead
First day IW1 attends
Fermi Lab-Linac - Pours 5 thru 8
WECI made decision to use Doka forms
Walls assembled outside of excavation
IW1 attended
WCEI Superintendent 4th job in career using gang forms
First day IW1 attends
Signs Nucor HA
Following WCEI meeting
Fermi Lab-Linac - Pours 1 thru 4
Formwork for foundation walls was initiated the previous week
Building walls in place
Toolbox talk on Full Body Harness Inspection
WCEI Superintendent 1st experience w/ Doka forms
WCEI Prejob meetings 05/02/2023 0700
IW1 1st day on jobsite 05/02/2023
Nucor Prejob meetings 05/03/2023
Additional Doka drawing issued 05/05/2023
Start PIP-II LINAC Doka (gang) form assembly 05/16
NUCOR Harris 'Daily Job Task Analysis' 05/22/2023
Doka forms arrive on site 05/22/2023

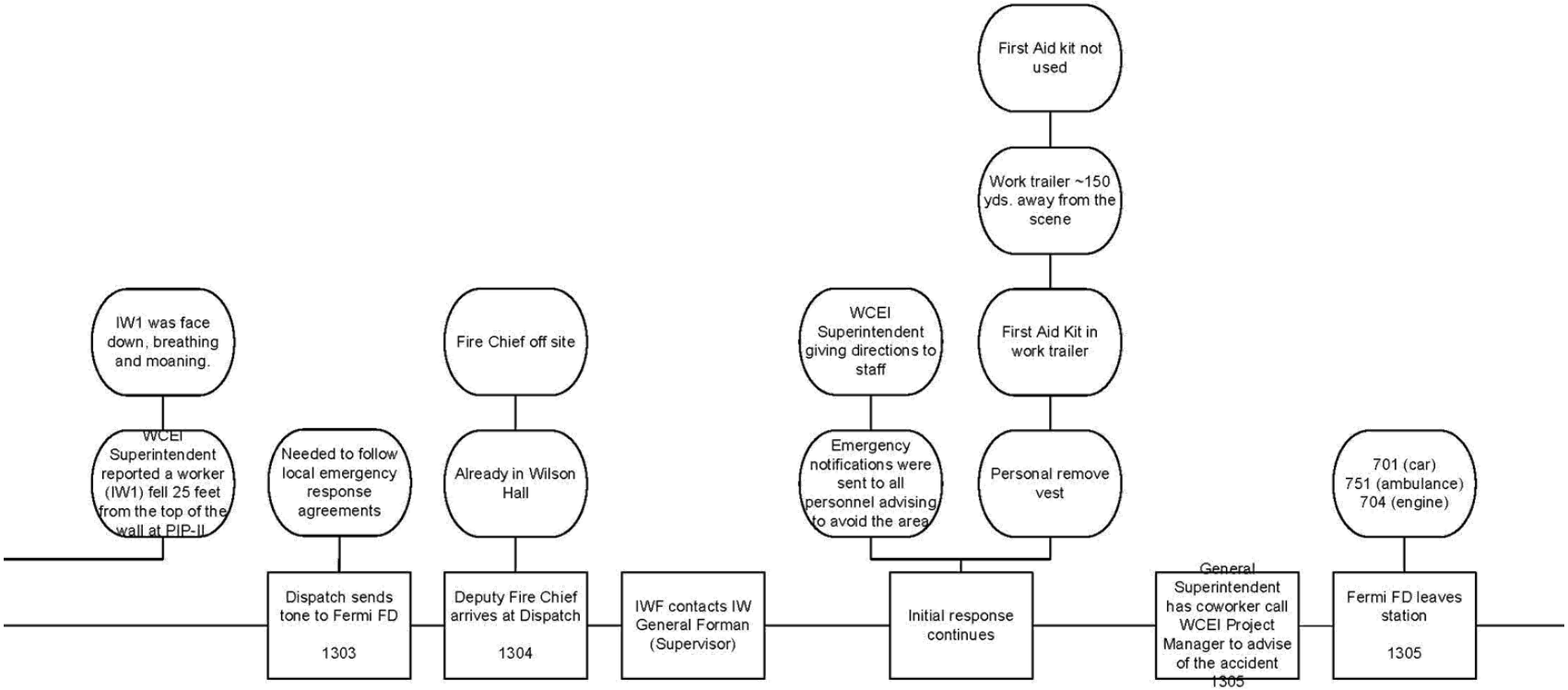

Nucor IWs had access to the aerial lift
IW foremen uses aerial lift
NW corner of the excavation
Used crane to move assembled forms down into the excavation
Assembled to the West of the excavation
Assembled form walls 26' 7" (8 meters) tall
3 section of form walls placed together
Doka forms assembled and placed in excavation 05/24
No deficiencies – 2 safe conditions noted
Attended by FSO FPD and Safety, FRA, and WCEI personnel
Site inspection conducted by WCEI PIP-II Construction ES&H Coordinator 05/23/2023
Rebar template installed on the north side of form
Included corner piece
Corner form installed
WECI carpenter foreman uses aerial lift to access corner
Two Doka wall form assemblies in place 05/24
E
Hazard analysis could not be adequately performed (B9)
CC4
B
Failed to identify the specific hazards associated with working on formwork (B10)
Work to climb form wall not covered in JHRA
Differences did not involve rebar work
Different than the Nucor JHRA developed on 12/ 20/2022
JHRA revised 04/ 19/2023
JHRA developed on 03/14/2023
FRA, WCIE, and FSO has not attended JHRA meetings
IW1 has not sign WCEI HA
IW1 24 days with Nucor
WCEI Superintendent 1st experience w/ Doka forms
IW1 signs off on JTA/JHRA 05/25
B
Doesn't go into details of the jobs
Fall protection being discussed under hazards identified and task specific HAs for daily work activities
Set and tie rebar task identified as being discussed
All hands meeting
Conducted by WCEI Superintendent
J
IW1 exposed to unprotected fall hazard (B2)
Selection of compliant anchor points on Doka system not fully understood by workers and project oversight (C17)
WCEI personnel not aware of the Doka form approved anchor points for site compliance. (C4)
WCEI Safety Expert never heard of Doka brand before this job
WCEI Safety Rep. reports directly to the WCEI Superintendent
WCEI Superintendent 1st experience w/ Doka forms
WCEI Superintendent 4th job in career using gang forms
WCEI Daily Project meeting 05/25 0700

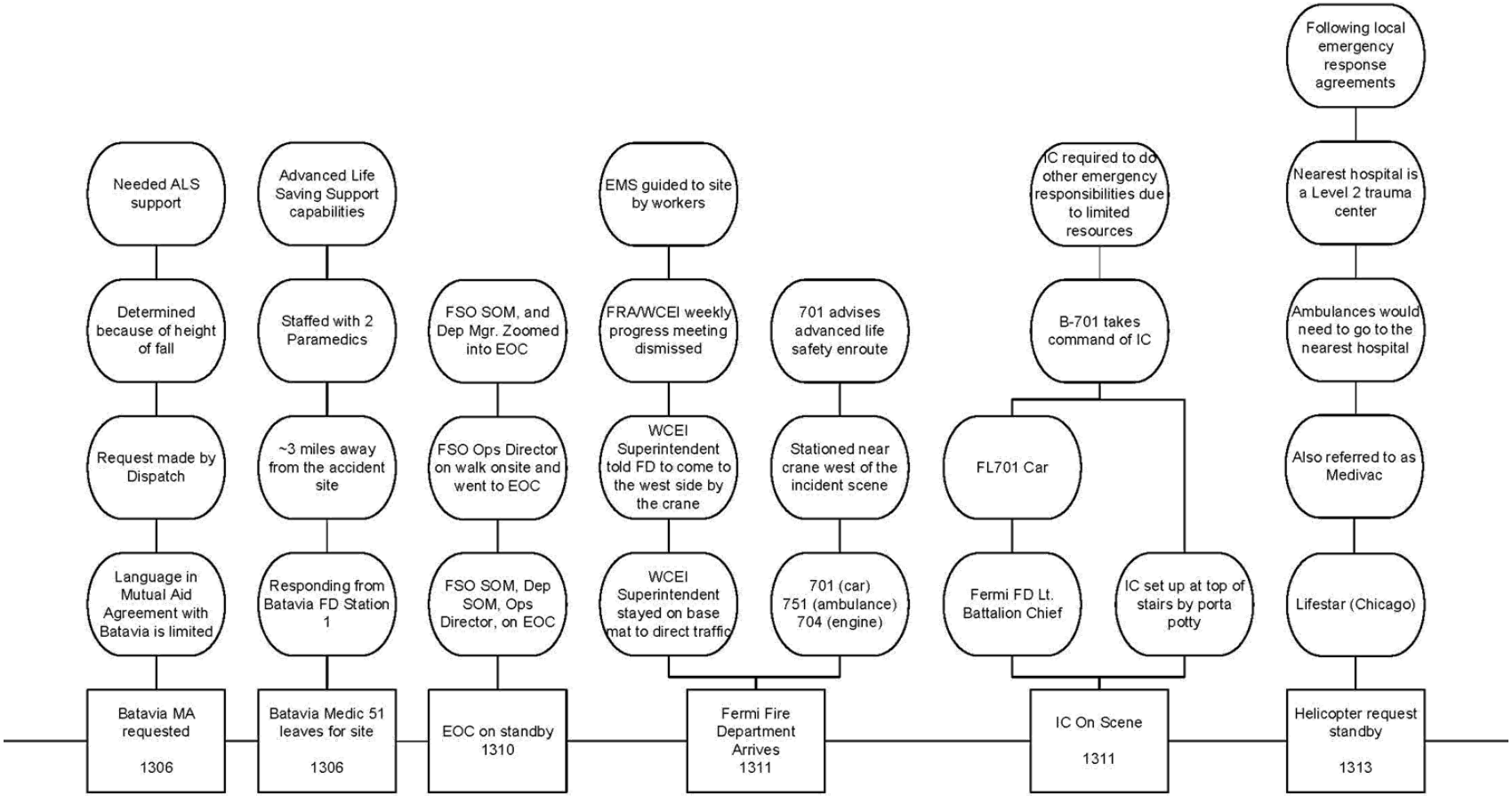

C
B
H
Work was allowed to be performed without sharing safety information, and using unapproved Safety plans (B16)
A
LINAC Complex Project personnel are not ensuring subcontractor safety documents are properly processed and up to date at the job site (C10)
I
HA not signed by WCEI project manager or supervisor/task lead
Form signed by all Nucor ironwork personnel
Training portion of the form is blank
Daily Jobsite Planning Meeting form completed
No training required for the days events
CC4
Work is not adequately defined, with identified hazards and applicable development and implementation of hazard controls (CC4/B20)
CC3
CC4
Scope of work not defined in the sufficient detail (B8)
Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors (C8)
Lack of feedback on the necessity to describe the specific work task (B21)
No participation from FSO, FRA, WCEI
Working with crane Setting columns Build walls in place
Conducted by IW General Foremen (Supervisor)
Conducted following the WCEI meeting
No evidence that JTAs were used
JTAs supplement JHRAs if conditions are different
WCEI HA not signed by IW1
Signature acknowledges that they have read the Harris JTA and received training
Form does not identify work assignments
3 IWs, IWF, IWS signed Daily Job Task form
Workers viewed positioned above the top of the form wall
Workers have/use phones while on the job
No established communication methodology for workers on opposite side of form walls
Nucor IWs are journeymen
WCEI relies on personnel to inspect their own equipment
Climbing equipment not provided to individuals by WCEI or Nucor
Fall protection training may have taken place years ago without refresher training
Active fall protection required when not using man lift
Workers tying off on form wall
Use of man lift and on wall climbing identified
Assembled Doka form 26' 7" (8 meters) tall
Work conducted by WCEI
Used crane
Daily Nucor-Harris Task Analysis package documents meeting
Morning work commences 05/25
Assembled panels lifted into the excavation

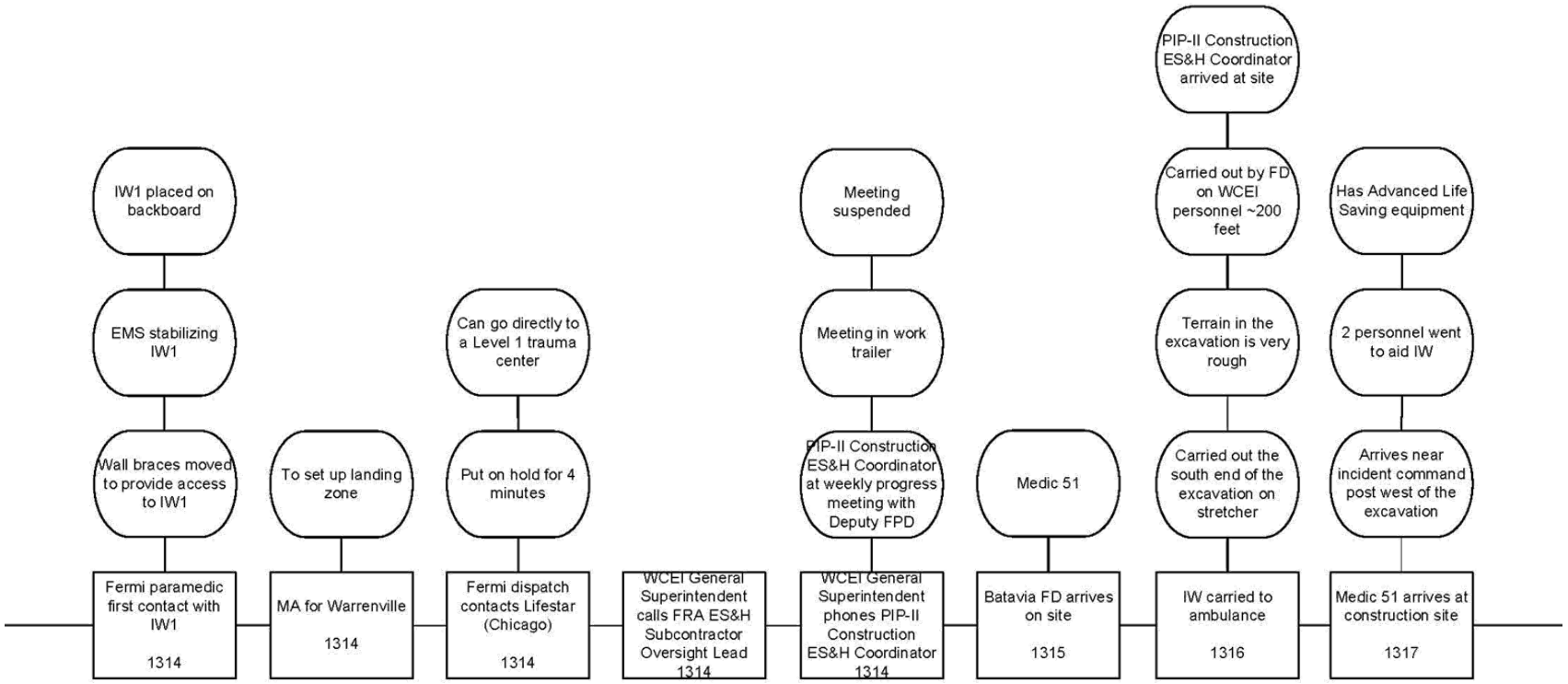

CC2
Requirements not being implemented by Harris as expected (C12)
Requirements not being implemented as expected (CC2/C6)
RC
C
IW1 was exposed to greater fall height and hazard than necessary (B14)
D
FRA not aware of how hazards are being addressed (C18)
CC2
IW1 was in a position that allowed the accident to happen (C1)
Form walls ready for afternoon work
FRA Field Construction SME at other location
Lack of feedback on the need to use fall protection (B13)
Used work techniques that rely upon personal fall protection equipment (B6)
Hierarchy of Controls not effectively implemented (B5/C7)
IWGF climbing on wall
Work was scheduled to be conducted on Friday
PPE required: hardhat, gloves, reflective vest, safety shoes and glasses – fall protection above 6'.
Ladder not in position on smooth side of wall
Feet 23 feet above ground
Man lift being used by WCEI carpenters
Sunny ~75-80F
Harris/WCEI/FRA oversight did not address how work was being conducted
Active fall protection required
Multiple paths available to climb wall
2 IWs and IWF smooth side of Doka forms
Working at the top of Doka forms at Corner of LF and L2
Ready for rebar work
Assembled Doka form 26' 7" (8 meters) tall
IWF described work to IW1 on work side of the form wall
Man lift not used
Man lift available, but not used
Template not raised into position
At top hole for rebar template connection
Work conducted by WCEI
Previous installed forms were outfitted with scaffolding and ladder access
IW1 tying rebar to Doka forms
Man lift available
Man lift used for earlier actions on the form wall
On ribbed side of the form wall
Path chosen did not allow IW1 to get his feet closer together than 22 inches
Assembled panels braced and stood vertical
Lunch Breaks
IW1 begins climbing Doka form 1255
IW1 reaches top of Doka form 1258

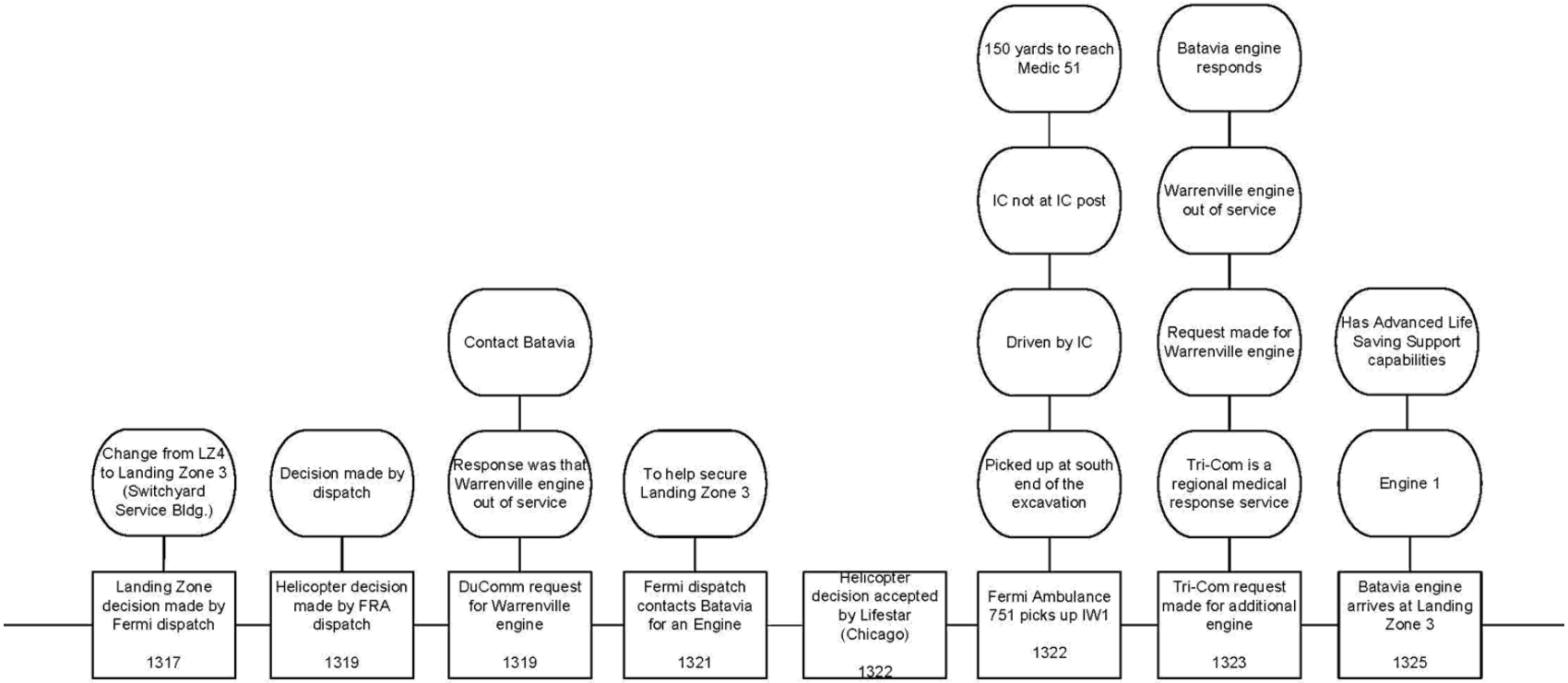

RC
FRA has not assured that ISM was effectively implemented within the PIP-II project (RC)
Root Cause
IW1 did not use available PPE at the top of the form wall (C19)
IW1 was not restrained from falling to the concrete pad.(C3)
CC1
Feet 23 feet above ground
B
No proper anchoring of their personal fall arrest system (B7)
No fall protection implemented at top of wall. CF-(B3)
IW1 conducted the task without the use of required fall protection (CC1/B11)
Making adjustments
Looking down on smooth side of form
IW1 not tied off
IW1 does not fall
Personal fall arrest system not connected to compliant anchor point (B1)
CC1
Ladder not set up on West side of form wall to allow other IWs to accept the tie wires
Job doesn't require leaning over wall or being that high on form wall
Support connection lost from form wall
Connection does not engage fall protection
IW1 not attached to form wall
IW1 not attached to form wall
FSO, FRA, WCEI personnel attended
Waiting on template being placed in position
IW1 leaning over the top of the form at the waist
IW1 believes weight is supported with connection to form wall components
IW1 attached to form wall
Connection comes loose from form wall
Fall protection system not engaged
Held in work trailer outside the excavation
Upper half of body above the top of the form
Reaching toward front part of his upper body
IW1 wearing hardhat and harness
< 1 min before fall
IW1 moving around at top of wall
Video captures fall
FRA/WCEI weekly Project progress meeting
1300
IW1 working at top of wall
1301
IW1 leans back from wall
IW1 looks back over wall

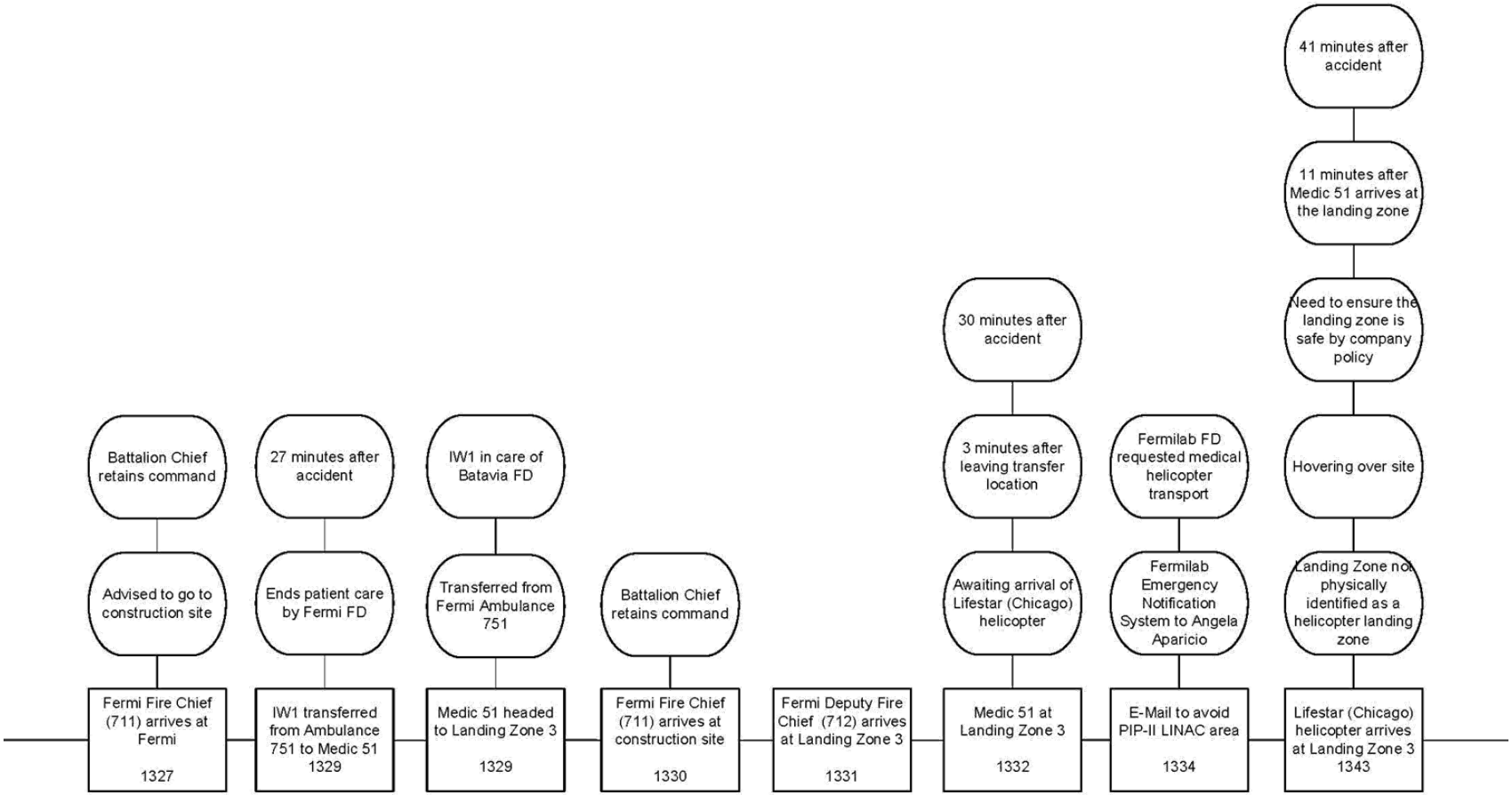

IW1 fell ~23' to the concrete pad resulting in serious injuries, including head trauma (DC/ B4/C2)
Direct Cause
Witnesses hear thud
Lands on concrete slab
Hits wall brace on way down
IW1 falls ~23 feet
Accident 1302
WCEI Superintendent calls for help from those in the area
IW1 facedown, breathing, unconscious, and bleeding
2 IWs on west side of Doka form
Serious body and head injuries
WCEI personnel and IWs arrive
IW1 fighting to get up
IW1 says he cannot breath
IW1 regains consciousness ~1303
1308 (FRA timeline)
People gathering around IW1
Tool belt attached to the harness
IWF unattached the harness straps, removed harness and vest
IWF trying to calm down IW1
Conducted by WECI and IW personnel
Combination of Nucor and WCEI personnel
Initial response Begins
1303
Called 630-840-3131
Used cell phone
Looked for emergency number in hardhat
Caller was advised to hold the line while FD units were dispatched.
Caller & dispatcher remained on line until the FD arrived on the scene in case of any changes to patient condition.
WCEI Superintendent told FD to come to the west side by the crane
Told dispatch what happened – worker had fallen at PIP-II construction site
WCEI Superintendent calls Site Emergency Dispatch
1303

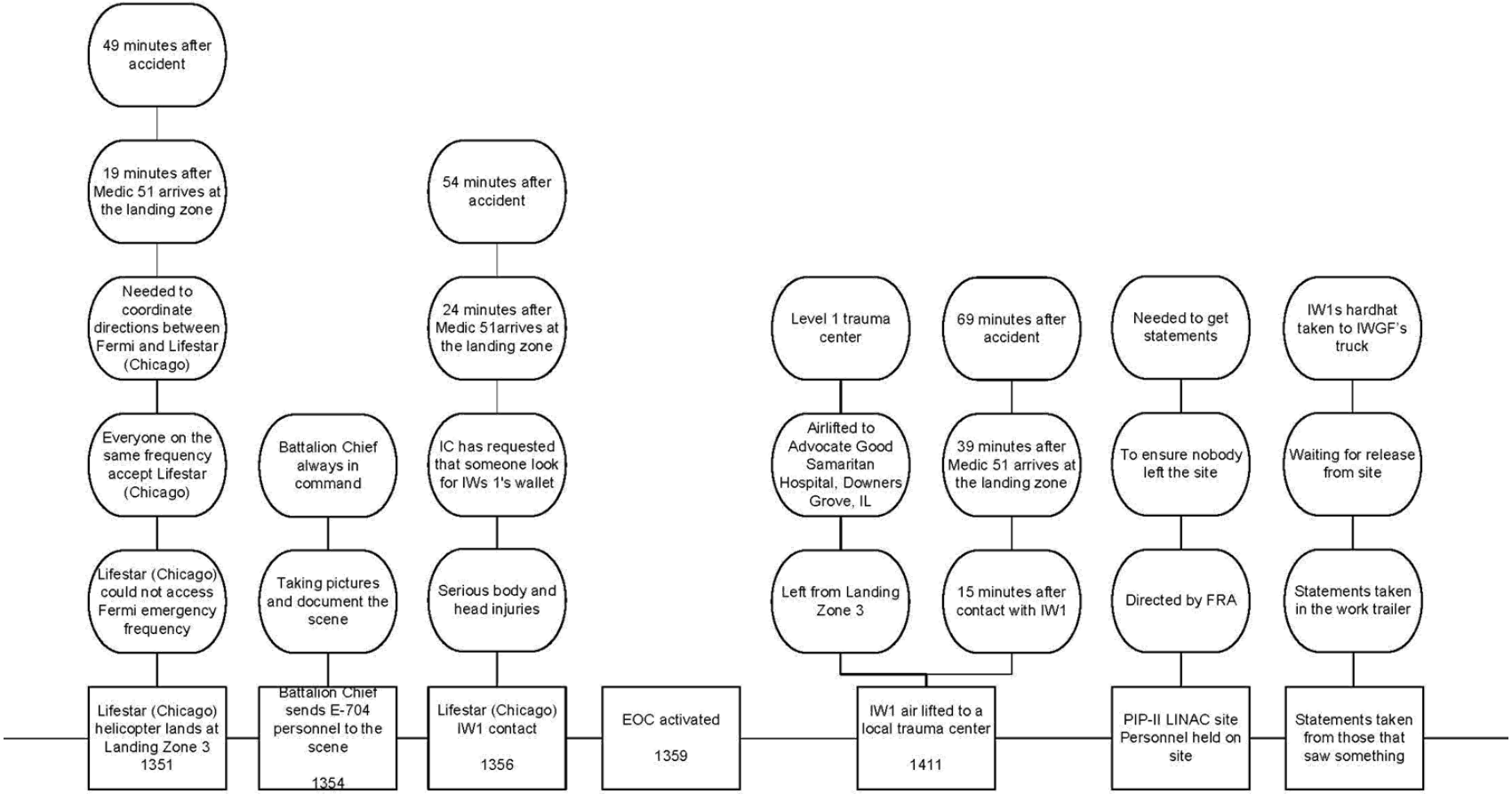

First Aid kit not used
Work trailer ~150 yds. away from the scene
IW1 was face down, breathing and moaning.
Fire Chief off site
WCEI Superintendent giving directions to staff
First Aid Kit in work trailer
WCEI Superintendent reported a worker (IW1) fell 25 feet from the top of the wall at PIP-II
Needed to follow local emergency response agreements
Already in Wilson Hall
Emergency notifications were sent to all personnel advising to avoid the area
Personal remove vest
701 (car)
751 (ambulance)
704 (engine)
Dispatch sends tone to Fermi FD
1303
Deputy Fire Chief arrives at Dispatch
1304
IWF contacts IW General Forman (Supervisor)
Initial response continues
General Superintendent has coworker call WCEI Project Manager to advise of the accident
1305
Fermi FD leaves station
1305

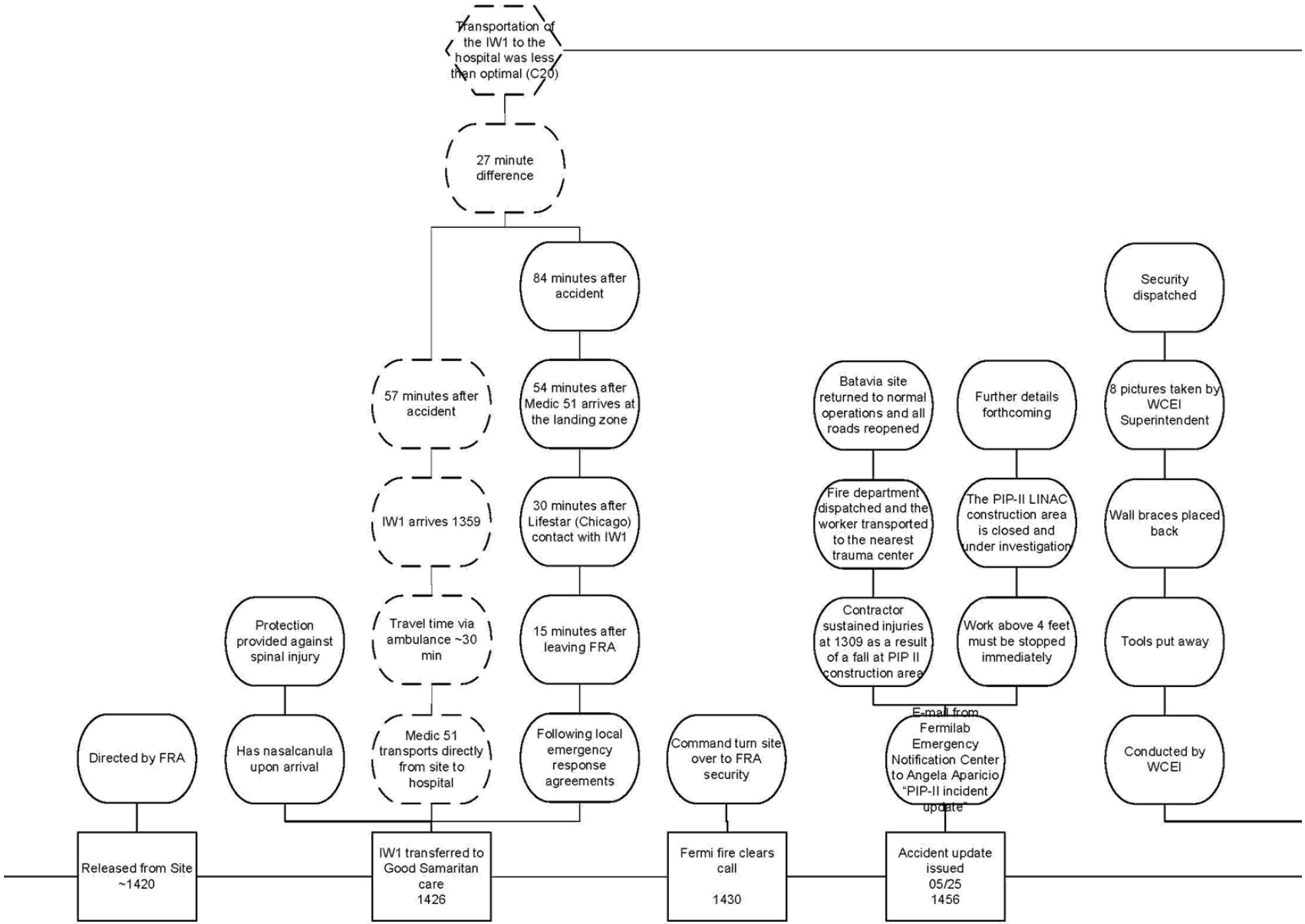

Batavia MA requested
1306
Needed ALS support
Determined because of height of fall
Request made by Dispatch
Language in Mutual Aid Agreement with Batavia is limited
Batavia Medic 51 leaves for site
1306
Advanced Life Saving Support capabilities
Staffed with 2 Paramedics
~3 miles away from the accident site
Responding from Batavia FD Station 1
EOC on standby
1310
FSO SOM, and Dep Mgr. Zoomed into EOC
FSO Ops Director on walk onsite and went to EOC
FSO SOM, Dep SOM, Ops Director, on EOC
Fermi Fire Department Arrives
1311
EMS guided to site by workers
FRA/WCEI weekly progress meeting dismissed
WCEI Superintendent told FD to come to the west side by the crane
WCEI Superintendent stayed on base mat to direct traffic
701 advises advanced life safety enroute
Stationed near crane west of the incident scene
701 (car)
751 (ambulance)
704 (engine)
IC On Scene
1311
IC required to do other emergency responsibilities due to limited resources
B-701 takes command of IC
FL701 Car
Fermi FD Lt. Battalion Chief
IC set up at top of stairs by porta potty
Helicopter request standby
1313
Following local emergency response agreements
Nearest hospital is a Level 2 trauma center
Ambulances would need to go to the nearest hospital
Also referred to as Medivac
Lifestar (Chicago)

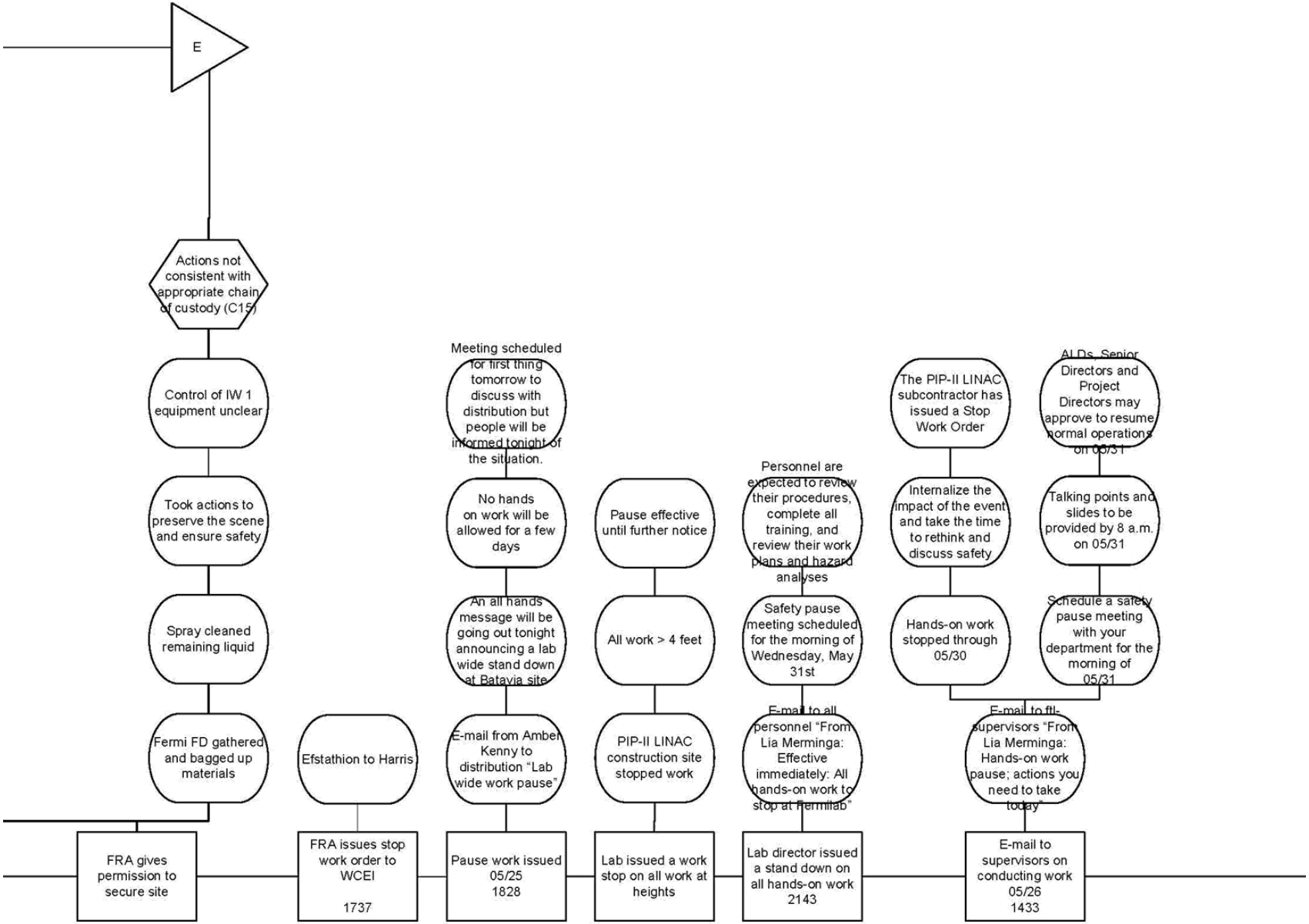

Fermi paramedic first contact with IW1
1314
IW1 placed on backboard
EMS stabilizing IW1
Wall braces moved to provide access to IW1
MA for Warrenville
1314
To set up landing zone
Fermi dispatch contacts Lifestar (Chicago)
1314
Can go directly to a Level 1 trauma center
Put on hold for 4 minutes
WCEI General Superintendent calls FRA ES&H Subcontractor Oversight Lead
1314
WCEI General Superintendent phones PIP-II Construction ES&H Coordinator
1314
Meeting suspended
Meeting in work trailer
PIP-II Construction ES&H Coordinator at weekly progress meeting with Deputy FPD
Batavia FD arrives on site
1315
Medic 51
IW carried to ambulance
1316
PIP-II Construction ES&H Coordinator arrived at site
Carried out by FD on WCEI personnel ~200 feet
Terrain in the excavation is very rough
Carried out the south end of the excavation on stretcher
Medic 51 arrives at construction site
1317
Has Advanced Life Saving equipment
2 personnel went to aid IW
Arrives near incident command post west of the excavation

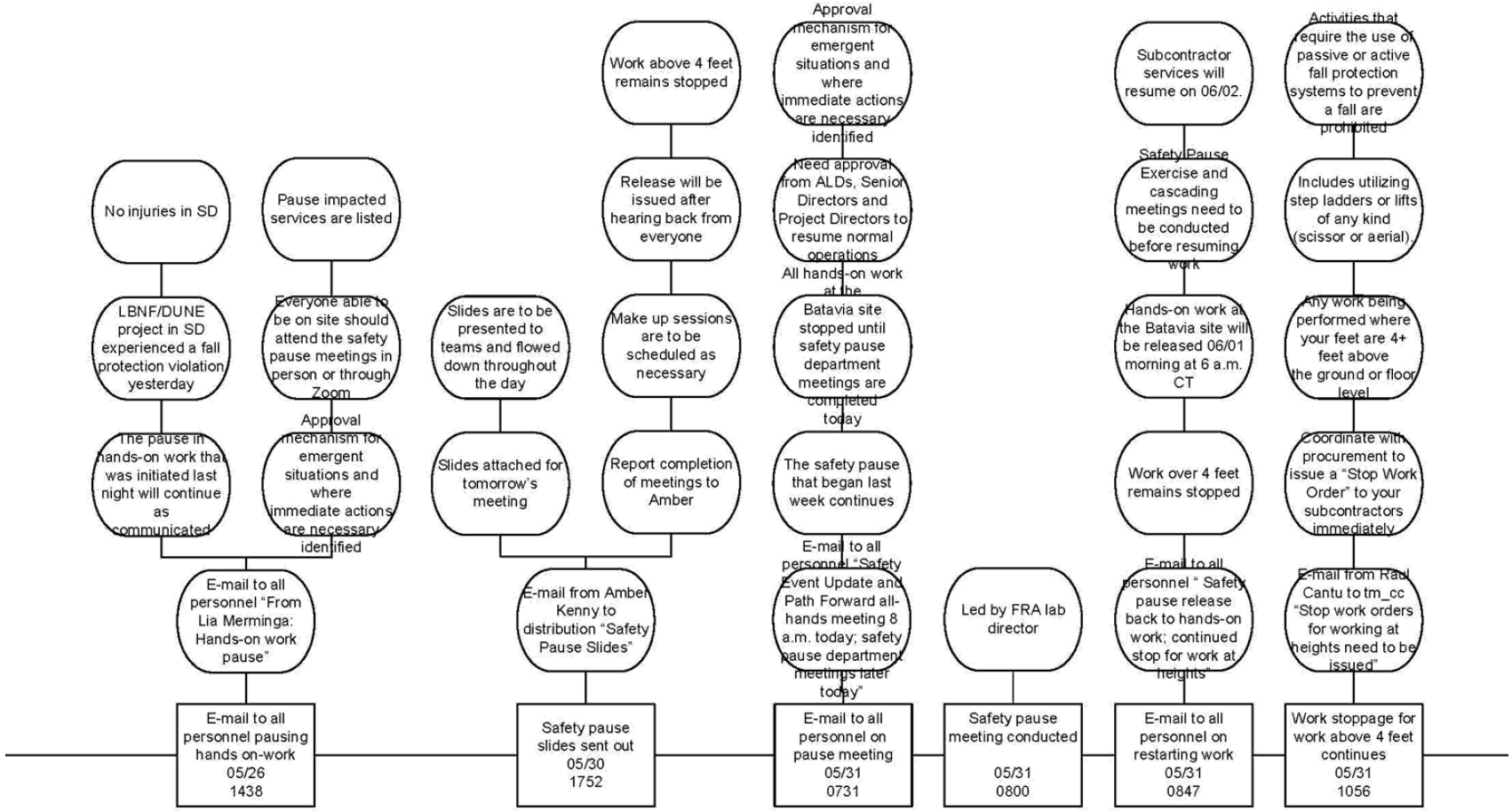

Change from LZ4 to Landing Zone 3 (Switchyard Service Bldg.)
Landing Zone decision made by Fermi dispatch
1317
Decision made by dispatch
Helicopter decision made by FRA dispatch
1319
Contact Batavia
Response was that Warrenville engine out of service
DuComm request for Warrenville engine
1319
To help secure Landing Zone 3
Fermi dispatch contacts Batavia for an Engine
1321
Helicopter decision accepted by Lifestar (Chicago)
1322
150 yards to reach Medic 51
IC not at IC post
Driven by IC
Picked up at south end of the excavation
Fermi Ambulance 751 picks up IW1
1322
Batavia engine responds
Warrenville engine out of service
Request made for Warrenville engine
Tri-Com is a regional medical response service
Tri-Com request made for additional engine
1323
Has Advanced Life Saving Support capabilities
Engine 1
Batavia engine arrives at Landing Zone 3
1325

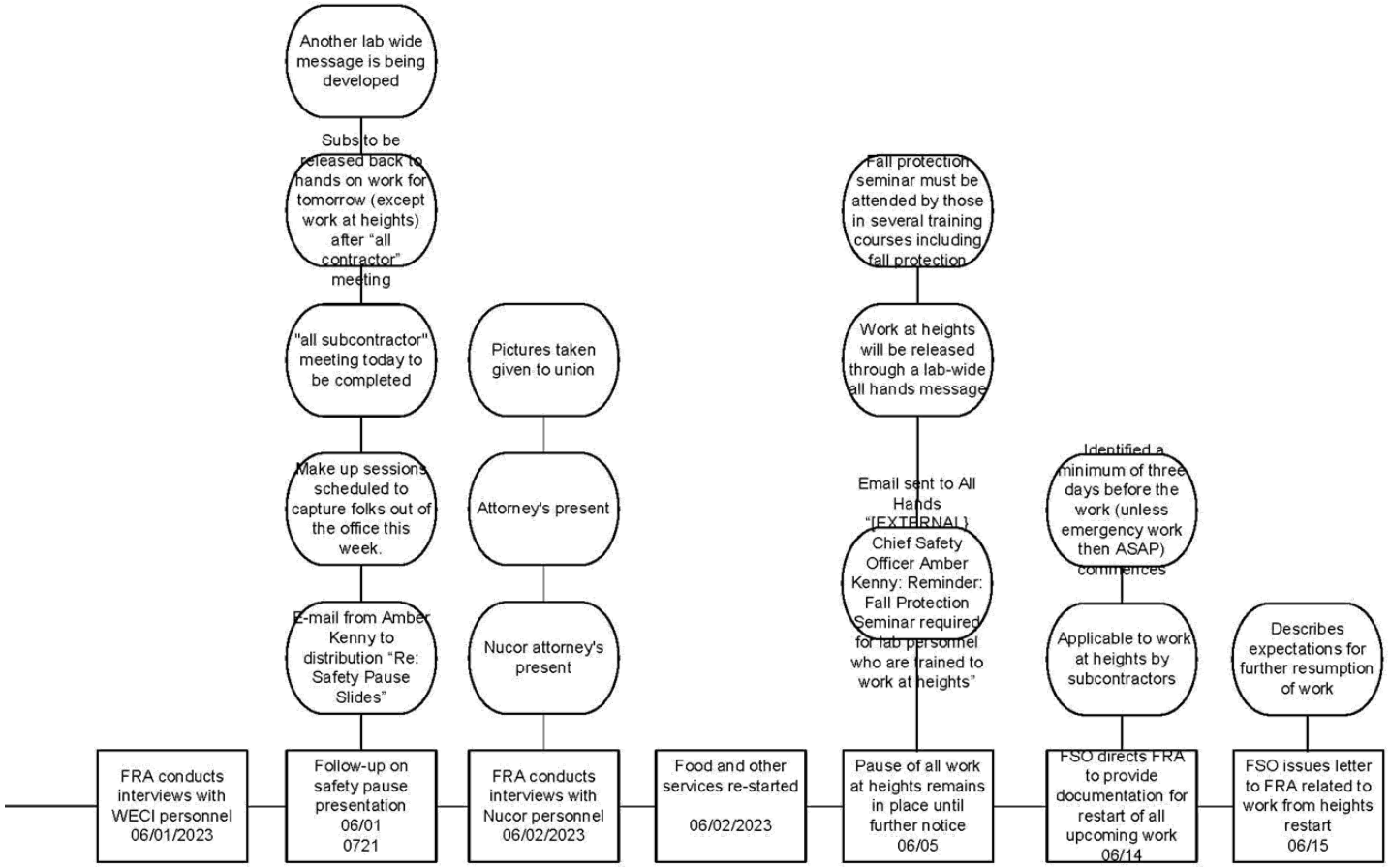

Fermi Fire Chief (711) arrives at Fermi
1327
Advised to go to construction site
Battalion Chief retains command
IW1 transferred from Ambulance 751 to Medic 51
1329
Ends patient care by Fermi FD
27 minutes after accident
Medic 51 headed to Landing Zone 3
1329
Transferred from Fermi Ambulance 751
IW1 in care of Batavia FD
Fermi Fire Chief (711) arrives at construction site
1330
Battalion Chief retains command
Fermi Deputy Fire Chief (712) arrives at Landing Zone 3
1331
Medic 51 at Landing Zone 3
1332
Awaiting arrival of Lifestar (Chicago) helicopter
3 minutes after leaving transfer location
30 minutes after accident
E-Mail to avoid PIP-II LINAC area
1334
Fermilab Emergency Notification System to Angela Aparicio
Fermilab FD requested medical helicopter transport
Lifestar (Chicago) helicopter arrives at Landing Zone 3
1343
Landing Zone not physically identified as a helicopter landing zone
Hovering over site
Need to ensure the landing zone is safe by company policy
11 minutes after Medic 51 arrives at the landing zone
41 minutes after accident


49 minutes after accident
19 minutes after Medic 51 arrives at the landing zone
Needed to coordinate directions between Fermi and Lifestar (Chicago)
Everyone on the same frequency accept Lifestar (Chicago)
Lifestar (Chicago) could not access Fermi emergency frequency
Lifestar (Chicago) helicopter lands at Landing Zone 3 1351
Battalion Chief always in command
Taking pictures and document the scene
Battalion Chief sends E-704 personnel to the scene 1354
54 minutes after accident
24 minutes after Medic 51arrives at the landing zone
IC has requested that someone look for IWs 1's wallet
Serious body and head injuries
Lifestar (Chicago) IW1 contact 1356
EOC activated 1359
Level 1 trauma center
Airlifted to Advocate Good Samaritan Hospital, Downers Grove, IL
Left from Landing Zone 3
69 minutes after accident
39 minutes after Medic 51 arrives at the landing zone
15 minutes after contact with IW1
IW1 air lifted to a local trauma center 1411
Needed to get statements
To ensure nobody left the site
Directed by FRA
PIP-II LINAC site Personnel held on site
IW1s hardhat taken to IWGF's truck
Waiting for release from site
Statements taken in the work trailer
Statements taken from those that saw something


Transportation of the IW1 to the hospital was less than optimal (C20)
27 minute difference
84 minutes after accident
54 minutes after Medic 51 arrives at the landing zone
30 minutes after Lifestar (Chicago) contact with IW1
15 minutes after leaving FRA
Following local emergency response agreements
57 minutes after accident
IW1 arrives 1359
Travel time via ambulance ~30 min
Medic 51 transports directly from site to hospital
Protection provided against spinal injury
Has nasalcanula upon arrival
Directed by FRA
Released from Site ~1420
IW1 transferred to Good Samaritan care 1426
Command turn site over to FRA security
Fermi fire clears call 1430
Batavia site returned to normal operations and all roads reopened
Fire department dispatched and the worker transported to the nearest trauma center
Contractor sustained injuries at 1309 as a result of a fall at PIP II construction area
Further details forthcoming
The PIP-II LINAC construction area is closed and under investigation
Work above 4 feet must be stopped immediately
E-mail from Fermilab Emergency Notification Center to Angela Aparicio "PIP-II incident update"
Accident update issued 05/25 1456
Security dispatched
8 pictures taken by WCEI Superintendent
Wall braces placed back
Tools put away
Conducted by WCEI


E
Actions not consistent with appropriate chain of custody (C15)
Control of IW 1 equipment unclear
Took actions to preserve the scene and ensure safety
Spray cleaned remaining liquid
Fermi FD gathered and bagged up materials
FRA gives permission to secure site
Efstathion to Harris
FRA issues stop work order to WCEI
1737
Meeting scheduled for first thing tomorrow to discuss with distribution but people will be informed tonight of the situation.
No hands on work will be allowed for a few days
An all hands message will be going out tonight announcing a lab wide stand down at Batavia site
E-mail from Amber Kenny to distribution "Lab wide work pause"
Pause work issued
05/25
1828
Pause effective until further notice
All work > 4 feet
PIP-II LINAC construction site stopped work
Lab issued a work stop on all work at heights
Personnel are expected to review their procedures, complete all training, and review their work plans and hazard analyses
Safety pause meeting scheduled for the morning of Wednesday, May 31st
E-mail to all personnel "From Lia Merminga: Effective immediately: All hands-on work to stop at Fermilab"
Lab director issued a stand down on all hands-on work
2143
The PIP-II LINAC subcontractor has issued a Stop Work Order
Internalize the impact of the event and take the time to rethink and discuss safety
Hands-on work stopped through 05/30
ALDs, Senior Directors and Project Directors may approve to resume normal operations on 05/31
Talking points and slides to be provided by 8 a.m. on 05/31
Schedule a safety pause meeting with your department for the morning of 05/31
E-mail to ftl-supervisors "From Lia Merminga: Hands-on work pause; actions you need to take today"
E-mail to supervisors on conducting work
05/26
1433


No injuries in SD
LBNF/DUNE project in SD experienced a fall protection violation yesterday
The pause in hands-on work that was initiated last night will continue as communicated
E-mail to all personnel "From Lia Merminga: Hands-on work pause"
E-mail to all personnel pausing hands on-work 05/26 1438
Pause impacted services are listed
Everyone able to be on site should attend the safety pause meetings in person or through Zoom
Approval mechanism for emergent situations and where immediate actions are necessary identified
Slides are to be presented to teams and flowed down throughout the day
Slides attached for tomorrow's meeting
E-mail from Amber Kenny to distribution "Safety Pause Slides"
Safety pause slides sent out 05/30 1752
Work above 4 feet remains stopped
Release will be issued after hearing back from everyone
Make up sessions are to be scheduled as necessary
Report completion of meetings to Amber
Approval mechanism for emergent situations and where immediate actions are necessary identified
Need approval from ALDs, Senior Directors and Project Directors to resume normal operations
All hands-on work at the Batavia site stopped until safety pause department meetings are completed today
The safety pause that began last week continues
E-mail to all personnel "Safety Event Update and Path Forward all-hands meeting 8 a.m. today; safety pause department meetings later today"
E-mail to all personnel on pause meeting 05/31 0731
Led by FRA lab director
Safety pause meeting conducted 05/31 0800
Subcontractor services will resume on 06/02.
Safety Pause Exercise and cascading meetings need to be conducted before resuming work
Hands-on work at the Batavia site will be released 06/01 morning at 6 a.m. CT
Work over 4 feet remains stopped
E-mail to all personnel " Safety pause release back to hands-on work; continued stop for work at heights"
E-mail to all personnel on restarting work 05/31 0847
Activities that require the use of passive or active fall protection systems to prevent a fall are prohibited
Includes utilizing step ladders or lifts of any kind (scissor or aerial).
Any work being performed where your feet are 4+ feet above the ground or floor level
Coordinate with procurement to issue a "Stop Work Order" to your subcontractors immediately
E-mail from Raul Cantu to tm_cc "Stop work orders for working at heights need to be issued"
Work stoppage for work above 4 feet continues 05/31 1056


FRA conducts interviews with WECI personnel 06/01/2023
Another lab wide message is being developed
Subs to be released back to hands on work for tomorrow (except work at heights) after "all contractor" meeting
"all subcontractor" meeting today to be completed
Make up sessions scheduled to capture folks out of the office this week.
E-mail from Amber Kenny to distribution "Re: Safety Pause Slides"
Follow-up on safety pause presentation 06/01 0721
Pictures taken given to union
Attorney's present
Nucor attorney's present
FRA conducts interviews with Nucor personnel 06/02/2023
Food and other services re-started 06/02/2023
Fall protection seminar must be attended by those in several training courses including fall protection
Work at heights will be released through a lab-wide all hands message
Email sent to All Hands "[EXTERNAL] Chief Safety Officer Amber Kenny: Reminder: Fall Protection Seminar required for lab personnel who are trained to work at heights"
Pause of all work at heights remains in place until further notice 06/05
Identified a minimum of three days before the work (unless emergency work then ASAP) commences
Applicable to work at heights by subcontractors
FSO directs FRA to provide documentation for restart of all upcoming work 06/14
Describes expectations for further resumption of work
FSO issues letter to FRA related to work from heights restart 06/15

APPENDIX M

Causal Factors Summary and Locations

Causal Factors		Report Section
CF-B1:	Personal fall arrest system not connected to compliant anchor point.	3.2.2, 3.2.4
CF-B2:	IW1 exposed to unprotected fall hazard.	3.2.2, 3.2.4, 3.3.2, 3.3.4
CF-B3:	No fall protection implemented at top of wall.	3.2.2, 3.2.4, 3.3.4
DC/ CF-B4/CF-C2:	IW1 fell ~23’ to the concrete pad resulting in serious injuries, including head trauma.	3.2.2, 3.2.4, 3.3.4
CF-B5/C7:	Hierarchy of Controls not effectively implemented.	3.2.2, 3.2.3, 3.3.4
CF-B6:	Used work techniques that rely upon personal fall protection equipment.	3.2.1, 3.2.4
CF-B7:	No proper anchoring of their personal fall arrest system.	3.2.2
CF-B8:	Scope of work not defined in sufficient detail.	3.2.1, 3.2.2, 3.2.3
CF-B9:	Hazard analysis could not be adequately performed.	3.2.1, 3.2.2
CF-B10:	Failed to identify the specific hazards associated with working on formwork.	3.2.2, 3.2.3
CC-1/ CF-B11:	IW1 conducted the task without the use of required fall protection.	3.2.2, 3.2.5, 3.3.2, 3.3.4
CC-3/ CF-B11a/ CF-C11:	Direction of work not clear.	3.2.1, 3.2.3, 3.3.3, 3.4, 3.5.3
CF-B12:	WCEI supervisors, project management, and safety oversight personnel allowed non-conforming work practices to go unchallenged.	3.3.2, 3.3.4
CF-B13:	Lack of feedback on the need to use fall protection.	3.3.1, 3.3.2, 3.3.4

Causal Factors		Report Section
CF-B13a:	FSO lacked full situational awareness of the robustness of the FRA oversight program.	3.6
CF-B14:	IW1 was exposed to greater fall height and hazard than necessary.	3.2.4, 3.3.4
CF-B15:	Corrective actions have not adequately resolved identified issues.	3.2.5, 3.5
CF-B16:	Work was allowed to be performed without sharing safety information and using unapproved safety plans.	3.3.1, 3.3.2
CF- B17:	Work was allowed to be performed without confirmation of worker qualifications.	3.4
CF-B18/ CF-C14:	Flow down of requirements not adequate.	3.1, 3.3.2, 3.3.3
CF-B19:	No indication of primacy of safety programs used by the various project organizations.	3.1, 3.3.3
CC-4/ CF-B20:	Work is not adequately defined, with identified hazards, and applicable development and implementation of hazard controls.	3.3.3, 3.5.3
CF-B21:	Lack of feedback on the necessity to describe the specific work task.	3.2.5
CF-C1:	IW1 was in a position that allowed the accident to happen.	3.2.4
CF-C3:	IW1 was not restrained from falling to the concrete pad.	3.1, 3.2.2, 3.2.4, 3.2.5, 3.3.2, 3.3.4
CF-C4:	WCEI personnel not aware of the Doka form approved anchor points for site compliance.	3.3.2
CF-C5:	FSO is not ensuring FRA has appropriate and effective oversight systems for the Project activities.	3.2.5, 3.5, 3.6

Causal Factors		Report Section
CC-2/ CF-C6:	Requirements not being implemented as expected.	3.1, 3.2.5, 3.3.1
CF-C8:	Harris/WCEI/FRA oversight was insufficient to determine inconsistent implementation of requirements by subcontractors.	3.2.5, 3.3.1, 3.3.2, 3.3.4, 3.5.1, 3.5.2
CF-C9:	DOE requirements not being flowed down to subcontractors.	3.1
CF-C10:	LINAC Complex Project personnel are not ensuring subcontractor safety documents are properly processed and up to date at the job site.	3.3.1
CF-C12:	Requirements not being implemented by Harris as expected.	3.2.5, 3.3.1
CF-C13:	FRA personnel were not aware of the FRA requirements to review training records.	3.4
CF-C15:	Actions not consistent with appropriate chain of custody.	2.4
CF-C16:	Specific Project requirements not available to subcontractor personnel.	3.2.1
CF-C17:	Selection of compliant anchor points on Doka system not fully understood by workers and project oversight.	3.2.1, 3.3.2
CF-C18:	FRA not aware of how hazards are being addressed.	3.5.1, 3.5.2
CF-C19:	IW1 did not use available PPE at the top of the form wall.	3.2.4
CF-C20:	Transportation of IW1 to the hospital was less than optimal.	2.3