



Independent Assessment of Work Planning and Control at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility Far Site

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ATC	Atlas Technical Consultants
BATFE	Bureau of Alcohol, Tobacco, Firearms, and Explosives
CESHP	Construction Environment, Safety and Health Plan
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DOE	U.S. Department of Energy
DPM	Diesel Particulate Matter
DRI	Direct Reading Instrument
DUNE	Deep Underground Neutrino Experiment
EA	Office of Enterprise Assessments
ES&H	Environment, Safety, and Health
ESP	Explosives Safety Program
FLRA	Field Level Risk Assessments
FR	Facility Representative
FRA	Fermi Research Alliance, LLC
FSO	Fermi Site Office
HA	Hazard Analysis
IH	Industrial Hygiene
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
JHA	Job Hazard Analysis
KAJV	Kiewit-Alberici Joint Venture
LBNF	Long-Baseline Neutrino Facility
mg/m ³	Milligrams per Cubic Meter
NFPA	National Fire Protection Association
NO ₂	Nitrogen Dioxide
OFI	Opportunity for Improvement
OSC	Operations Start Card
OSHA	Occupational Safety and Health Administration
RESPEC	RESPEC Company, LLC
SDSTA	South Dakota Science and Technology Authority
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SURF	Sanford Underground Research Facility
TLV	Threshold Limit Value
TMI	Thyssen Mining, Inc.
Warfab	Warfab, LLC
WP&C	Work Planning and Control

INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE FERMI NATIONAL ACCELERATOR LABORATORY LONG-BASELINE NEUTRINO FACILITY FAR SITE

Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of work planning and control (WP&C) at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility (LBNF) Far Site in October 2022. This assessment focused on the Fermi Research Alliance, LLC (FRA) WP&C processes for underground excavation and construction work, the flowdown of safety requirements to FRA subcontractors, Kiewit Alberici Joint Venture (KAJV) and Thyssen Mining Inc. (TMI), and its sub-tiered contractors, elements of industrial hygiene (IH), underground safety, explosives safety, and the Fermi Site Office (FSO) oversight processes for WP&C.

EA identified the following strengths:

- Since a prior EA assessment in 2019, substantial improvements have been made in the IH exposure assessment programs for FRA, KAJV, and TMI. Each organization has developed appropriate monitoring and sampling plans for periodically assessing worker exposures to underground airborne contaminants, and the skills, knowledge, and experience of the IH staffs have increased considerably. Furthermore, although each organization maintains its own IH monitoring and sampling programs for its workers, the IH staffs work collaboratively to resolve common IH challenges.
- FRA has taken a proactive approach to identify ventilation challenges in the underground and has acquired a DOE-approved 10 CFR 851 variance that allows underground work with less than the required 30 feet per minute airflow. FRA worked with the DOE Office of Environment, Health, Safety and Security and FSO to develop an as low as reasonably achievable (ALARA) abatement plan to address the anticipated inability to meet the 2016 American Conference of Governmental Industrial Hygienist (ACGIH) threshold limit value (TLV) for nitrogen dioxide (NO₂).
- FRA, KAJV, and TMI maintain emergency response resources in the event of an underground event, including emergency breathing apparatuses, a well-trained emergency response team staffed by the South Dakota Science and Technology Authority, and a properly sited and a well-outfitted underground refuge site.
- TMI has established and implemented an effective initial explosives safety training program that includes computer-based training, end-of-course exams, hands-on evaluations, and supervision of explosives handlers through on-the-job training for up to six months to ensure that explosives handlers are fully qualified before being assigned to explosive operations.

EA also identified a number of weaknesses, including the five findings listed below:

- FRA has not ensured that occupational medicine program requirements of 10 CFR 851 are implemented by FRA subcontractors, including the sharing of IH exposure data with medical professionals. (Finding)
- FRA has not verified all elements of the Occupational Safety and Health Administration respirable silica standard are implemented by FRA subcontractors. (Finding)
- FRA does not ensure that there is a clearly documented rationale and procedure for IH direct reading instrument alarm set points used to monitor airborne contaminants in the underground and does not provide workers with clear and consistent instructions for responses to alarms in the multi-employer work environment underground. (Finding)

- TMI allows equipment maintenance and electrical work to be performed without clearly defined work scope boundaries and limitations, a bounding hazard analysis, work authorization and release, and, when field level risk assessments are not used, a documented hazard analysis. (Finding)
- TMI did not ensure that explosives were protected from potential ignition sources in explosives storage magazines, using non-intrinsically safe lighting and not taking precautions to prevent a vehicle and its exhaust from coming near explosives, potentially causing ignition/detonation. (Finding)

EA also found that FSO has implemented generally effective oversight for WP&C at the LBNF Far Site. However, EA identified one finding:

- The FSO issues management process at LBNF Far Site does not categorize findings based on risk and priority, ensuring that relevant line management findings are effectively communicated to the contractors, and ensuring that problems are evaluated and corrected on a timely basis. (Finding)

In summary, FRA has developed and implemented a satisfactory WP&C framework for underground excavation and construction work at the LBNF Far Site and FSO has implemented generally effective oversight. However, until the concerns identified in this report are addressed or effective mitigations are put in place, potential vulnerabilities to the safe execution of work will remain. Of particular importance is the continued effort to refine and implement the ALARA abatement plan to reduce underground airborne contaminants below the 2016 ACGIH TLV, and better integration of occupational health services and medical surveillance with industrial hygiene sampling.

INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE FERMI NATIONAL ACCELERATOR LABORATORY LONG-BASELINE NEUTRINO FACILITY FAR SITE

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Worker Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted a follow-up assessment on October 3-7, 2022, of work planning and control (WP&C) for excavation and construction work at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility (LBNF) Far Site, which is managed by Fermi Research Alliance, LLC (FRA). This assessment followed up on the previous EA assessment of WP&C at the LBNF Far Site in 2019 and evaluated the effectiveness of the implementation of the integrated safety management (ISM) core functions (define scope of work, identify and analyze hazards, develop and implement controls, perform work safely within controls, and provide feedback and improvement) for underground excavation and construction work. This assessment also evaluated elements of the DOE safety requirements flowdown from FRA to Kiewit-Alberici Joint Venture (KAJV) and Thyssen Mining, Inc. (TMI) and its sub-tiered contractors, industrial hygiene (IH), underground safety, and explosives safety.

In accordance with the *Plan for the Independent Assessment of Work Planning and Control for the Long Baseline Neutrino Facility Far Site of the Fermi National Accelerator Laboratory, October 2022*, this assessment included FRA work activities within DOE leased space at the Sanford Underground Research Facility (SURF). DOE leases space, managed by FRA, in the underground facility from SURF. SURF, managed by the South Dakota Science and Technology Authority (SDSTA), leases underground space in the former Homestake Gold Mine in Lead, South Dakota, to support various research projects, including the Deep Underground Neutrino Experiment (DUNE) project. EA also evaluated the effectiveness of Federal oversight by the Fermi Site Office (FSO).

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms “best practices, deficiencies, findings, and opportunities for improvement (OFIs)” as defined in the order.

As identified in the assessment plan, this assessment considered objectives and criteria from DOE Guide 226.1-2A, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*, appendix D, *Activity Level Work Planning and Control Criterion Review and Approach Documents with Lines of Inquiry*. EA used elements of criteria and review approach document (CRAD) EA-30-07, Rev. 0, *Federal Line Management Oversight Processes*, to collect and analyze data on FSO oversight activities related to WP&C. EA also used objectives and criteria from EA CRAD 32-03, Rev. 1, *Industrial Hygiene Program*; CRAD EA-32-10, Rev. 0, *Construction Safety*; and CRAD EA-32-01, Rev. 1, *Explosives Safety*.

EA observed the planning and implementation of 46 onsite work activities associated with the excavation and construction activities above and below ground. EA examined key activity-level work control documents, such as WP&C plans and procedures, build plans, job hazard analyses (JHAs), manuals,

analyses, and policies. EA also interviewed key personnel responsible for developing and executing the associated programs and walked down relevant portions of specific facilities.

Appendix A lists the members of the assessment team, the Quality Review Board, and management responsible for this assessment.

EA conducted a previous assessment of WP&C at the LBNF Far Site in 2019, as documented in the EA report, *Work Planning and Control Assessment at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility Far Site, November 2019*. This EA assessment examined the completion and effectiveness of corrective actions for the finding described in the previous assessment. Results of the corrective action assessment are included in section 3.6 of this report.

3.0 RESULTS

3.1 DOE Safety Requirements Flowdown

This portion of the assessment evaluated whether FRA has appropriately flowed down 10 CFR 851, *Worker Safety and Health Program*, and DOE prime contract (DE-AC02-07CH11359) safety requirements to its subcontractors and sub-tier contractors performing construction in DOE-leased space at SURF.

FRA's contracts with KAJV and TMI contain the appropriate DOE safety and health requirements, including compliance with 10 CFR 851 and the DOE acquisition regulation clause 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution*. The *FRA LBNF/DUNE Integrated Environment, Safety and Health Management Plan* and *LBNF Far Site Construction Environment, Safety and Health Plan* (CESHP) appropriately implement ISM for the Far Site. FRA appropriately flows down safety requirements in subcontracts primarily by including the CESHP in the contracts with KAJV and TMI. The CESHP is an effective basis for FRA's approval of each subcontractor's environment, safety, and health (ES&H) plan.

The CESHP and the KAJV and TMI ES&H plans generally address specific safety and health requirements. The KAJV sub-tiered contracts with Muth Electric and Atlas Technical Consultants (ATC) and the TMI sub-tiered contracts with Warfab, LLC (Warfab) and RESPEC Company, LLC (RESPEC) appropriately flow down safety requirements, requiring sub-tier contract work to be performed in accordance with the KAJV and TMI ES&H plans, respectively. Sub-tier contractor work was appropriately integrated with the KAJV and TMI ES&H plans and work control documents. For example, KAJV's build plan, *Pull test of 1 1/4" Dia Hilti Side Monorail Anchor Rods*, effectively integrated KAJV and ATC work tasks, including the use of the operations start card (OSC), a mini hazard analysis (HA) prepared daily for the work activities to be performed, prepared jointly by KAJV and ATC. Also, TMI's build plan, *TMI-SUB-EXC-4850-33.2.3-PLN-INS-North and South Monorails*, appropriately integrated TMI and Warfab work tasks, including a daily Warfab-completed field level risk assessment (FLRA) for welding and grinding tasks performed during the installation of monorails in the cavern roof.

While the CESHP and the KAJV and TMI ES&H plans are generally adequate, contrary to 10 CFR 851 and the DOE prime contract, these ES&H plans do not address all requirements. (See **Deficiency D-FRA-1**.) The identified implementation gaps include:

- The KAJV and TMI ES&H plans do not implement the 2015 version of the National Fire Protection Association (NFPA) 70E, *Standard for Electrical Safety in the Workplace*, contrary to 10 CFR 851.23(a)(14).
- The TMI ES&H plan does not implement the 2016 American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 0.025 milligrams per cubic meter (mg/m³) for silica per 10 CFR 851.23(a)(9).
- DOE-STD-1090-2011, *Hoisting and Rigging*, is not fully implemented in FRA's CESHP and its contracts with KAJV and TMI or in the FRA-approved KAJV and TMI ES&H plans, contrary to the DOE prime contract.

When ES&H plans do not address all regulatory and DOE contract requirements, contractors may not apply the safest methods for controlling hazards, thereby not meeting DOE expectations for safely performing work.

DOE Safety Requirements Flowdown Conclusions

Contracts for FRA with KAJV and TMI generally include the appropriate DOE ES&H requirements, including compliance with ISM and 10 CFR 851. Construction safety requirements are generally flowed down to the sub-tier subcontractors, except for several requirements not being fully implemented in ES&H plans.

3.2 Work Planning and Control Institutional Programs

This portion of the assessment evaluated the FRA, KAJV, and TMI institutional programs for WP&C, underground safety, and IH.

Work Planning and Control Programs

FRA has developed an appropriate WP&C framework that includes the involvement and collaboration of KAJV and TMI to support implementation of the core functions of ISM during excavation and construction work at the LBNF Far Site. FRA, TMI, and KAJV meet daily, weekly, and monthly at safety coordination meetings to review current work tasks and results from KAJV quality assurance observations to ensure that safety requirements are addressed when planning and executing work at the LBNF Far Site.

The CESHP and the KAJV and TMI ES&H plans implement a generally adequate and well documented integrated safety management system (ISMS) in accordance with DOE Policy 450.4A, *Integrated Safety Management Policy*. The ES&H plans provide direction for defining the scope of work; hazard identification, analysis, and control through the JHA process; work authorization and release; work performance instructions; and worker briefings (pre-job briefings).

The KAJV and TMI ES&H programs are appropriate for their scope of work. KAJV and TMI ES&H program scopes effectively combine Occupational Safety and Health Administration (OSHA)-based construction programs (e.g., work at heights and fall protection, dropped object protection, and hot work) with underground safety programs and TMI standard operating procedures (SOPs), e.g., SOPs for ground support work applications such as installing bolts and shotcrete (sprayed concrete) to prevent rock movement. The FRA, KAJV, and TMI ES&H program areas are staffed with qualified and experienced professionals with many years of experience in their respective areas of expertise including construction and tunnel excavations.

Since the 2019 EA assessment, substantial improvements are evident in the IH exposure assessment programs for FRA, KAJV, and TMI. FRA, KAJV, and TMI have each developed appropriate monitoring and sampling plans for periodically measuring worker exposure to silica, nitrogen dioxide (NO₂), dust, diesel particulate matter (DPM), carbon monoxide (CO), and noise. The knowledge and experience of the staffs performing IH monitoring and sampling has increased considerably since 2019, and the procedures for performing exposure assessments, calibrating IH instruments, and processing IH samples are consistent with guidelines established by the American Industrial Hygiene Association. FRA, KAJV, and TMI have incorporated experienced and knowledgeable professional industrial hygienists to manage their IH programs. KAJV has contracted with a large IH consulting firm to develop IH sampling plans and procedures and review sampling results, and locally employs ES&H coordinators who are well-versed in IH sampling and monitoring. TMI has contracted with an IH subject matter expert (SME) from the University of Arizona with over 20 years of IH experience in mining operations who provides training, mentoring, instrument calibration, and consulting services. FRA also uses IH matrix support from the Fermi National Accelerator Laboratory Environment, Safety and Health Division.

Furthermore, although the FRA, KAJV, and TMI IH organizations maintain their own IH monitoring and sampling programs for their workers, the IH staffs work collaboratively to resolve common IH challenges. The routine interface between the SDSTA, FRA, KAJV, and the TMI and FRA IH SMEs has improved the overall IH sampling and monitoring programs in the multi-employer underground.

Work is effectively controlled through build plans (construction work packages that include a JHA) for each discrete construction work activity listed in *Definable Features of Work*. KAJV and TMI use experienced engineers as work planners to develop build plans. The JHA process for build plans is led by qualified work planners and appropriately involves miners and ES&H SMEs to identify hazards and controls. TMI appropriately supplements build plan work instructions with SOPs for repetitive and routine tasks such as equipment operation. Review and approval of KAJV/TMI build plans, JHAs, and TMI SOPs is adequately controlled through software that routes documents through miner shift leads, appropriate SMEs, and management of all three organizations. Once approved, start of work is appropriately authorized in preparatory phase meetings.

KAJV and TMI effectively integrate work performance with sub-tier contractors. KAJV sub-tier contractor Muth Electric replaced lights in the Ross Warehouse, satisfactorily using KAJV OSCs to perform a lockout/tagout and replace lights. KAJV sub-tier contractor ATC assisted KAJV workers performing bolt pull tests, integrating well with the KAJV build plan/JHA. TMI sub-tier contractor Warfab welded and grinded monorails using the TMI build plan/JHA, Warfab-completed FLRAs, and the TMI-issued hot work permit.

The FRA, KAJV, and TMI training program supports the safe performance of work through appropriate training and qualification processes, including required underground emergency response training. KAJV's training is adequately described in its ES&H plan, including use of the Life Saving Actions Program and OSC (a mini-HA tool) and ES&H program-specific training, including underground requirements. TMI's training program for miners working on site is adequately described in its ES&H plan, *Safety Management Plan*, sec. 3.6, *Skill-Specific Training*, and M-SOP-16201-FSCF, *Operator Training & Assessment*. TM-SOP-11500-FSCF, *Electrical Awareness*, appropriately requires TMI's qualified electrical workers to possess a South Dakota State Journeyman's License.

FRA, KAJV, and TMI appropriately recognize the importance of involving workers in the WP&C process. Workers are involved in the identification and control of hazards through completion of OSCs and FLRAs (mini-HA forms) for the work to be performed that shift, supplementing build plan JHAs. Workers are encouraged to actively participate in the pre-job and OSC/FLRA briefings. In addition, each

TMI miner completes a 5-Point Card, an extensive checklist of work area hazards, equipment inspections for all operated mobile equipment, and post-job performance feedback.

While build plans are an effective work control mechanism, contrary to the requirements of 48 CFR 970.5223-1(c)(5), *Integration of Environment, Safety, and Health Into Work Planning and Execution*, FRA, KAJV, and TMI WP&C programmatic documents do not implement the requirement to conduct a post-job review for collecting feedback on the adequacy of controls to improve safety management. (See **Deficiency D-FRA-2**.) By not conducting post-job reviews, the opportunity to collect worker feedback for improving the work process is limited. Build plans do not specify that a post-job review should be performed, and post-job reviews are not conducted or documented for OSCs or FLRAs, including those not covered by build plan HAs.

Work Planning and Control Institutional Program Conclusions

FRA LBNF Far Site WP&C processes appropriately address ISM and the CESHP; and the KAJV and TMI ES&H plans provide generally appropriate direction for WP&C. Substantial improvement in the IH programs and exposure monitoring is evident since the 2019 EA assessment. However, WP&C programmatic documents do not require post-job reviews to be conducted.

3.3 Work Planning and Control Implementation

This portion of the assessment evaluated FRA and subcontractor implementation of the WP&C institutional programs through the core functions of ISM: defining the scope of work, identifying and analyzing hazards, developing and implementing hazard controls, performing work within controls, and providing feedback and improvement.

Defining the Scope of Work

KAJV and TMI work scope definitions in build plans, SOPs, OSCs, and FLRAs for observed work were sufficiently detailed and adequate to permit identification of hazards and specification of necessary controls for surface and tunneling activities. Daily OSCs and FLRAs were adequate for describing the scope of work to be performed that shift. For example, EA observed TMI's work of installing 20-foot CT-Bolts™, which was adequately described in the FLRA and performed within the scope. However, contrary to the CESHP, sec. 4.3.3; 48 CFR 970.5223-1(c)(1); and 10 CFR 851.22(a), TMI's work to maintain equipment and the underground electrical power distribution system is not conducted under work control documents that contain clear work scope boundaries and limitations, an activity-level hazard analysis, and proper work authorization and release. (See **Finding F-TMI-1**.) Working without an appropriate work control document could result in workers being exposed to substantial hazards that are not fully identified or controlled.

Identifying and Analyzing Hazards

In general, TMI and KAJV adequately identified and analyzed hazards for observed work. Job-specific JHAs adequately identified hazards for five build plans, and five TMI SOPs were appropriately detailed and properly identified hazards. TMI appropriately integrated sub-tier contractor underground work (Warfab welding/grinding of monorails and RESPEC installation of 24V wiring) in TMI build plans/JHAs/hot work permits with the subcontractors completing a daily FLRA for the subcontractors' scope of the work. Hazards for this integrated work with TMI sub-tier contractors were adequately identified. TMI FLRAs adequately identified hazards associated with installing split-set and CT-Bolts for observed underground work.

KAJV OSCs for observed above ground workers (referred to as the Bull Gang) adequately identified work hazards. KAJV's training matrix identified the two Bull Gang workers and showed that they were properly trained for the equipment that they were observed operating. The KAJV OSC for observed Muth Electric work in the above ground warehouse accurately identified the hazards for lockout/tagout and replacement of light fixtures. KAJV OSCs for observed underground work properly identified hazards associated with conducting pull tests on rock bolts for the monorail.

Developing and Implementing Hazard Controls

Underground Construction

Reviewed hazard controls were generally developed and effectively implemented through build plans, SOPs, OSCs, FLRAs, and hazard-specific permits (e.g., permits for hot work and work at heights). Build plans appropriately reference applicable SOPs and list hazard-specific permits required to perform the work. SOPs properly identify hazards, controls, and safe operating requirements of tools and equipment for repetitive tasks, such as TM-SOP-35300-FSCF, *Development Mucking Procedure*, and TM-SOP-35486-FSCF, *Twenty Foot CT Bolt U/G Handling and Installation*. TMI established an effective practice of placing continuous red rope lights on the active mucking routes to alert underground personnel to potential movement of Load Haul Dump loaders.

Arc flash labeling was observed on electrical distribution equipment feeding underground excavation equipment power centers. Even though no work on electrical equipment was observed underground during this assessment, EA observed the use of a yellow electrical department isolation lock to secure the rock breaker controls while TMI awaited replacement parts. The isolation was performed in accordance with TM-SOP-14403-FSCF-*Lock Out and Isolation*. However, TMI did not apply arc flash labeling to this equipment, underground power centers, or other fixed equipment supporting excavation to communicate the electrical arc flash hazard and personal protective equipment needed to safely conduct electrical maintenance. (See **OFI-TMI-1.**)

OSCs and FLRAs generally identify hazards and appropriate controls for shift-specific tasks, including hot work and work at heights permits, when needed. However, EA identified the following weaknesses with TMI's implementation of hazard controls:

- Contrary to American National Standards Institute Z358.1, *Standard for Plumbed and Portable Eyewash Stations*, as specified in the OSHA interpretation of 29 CFR 1926.50 (g), the TMI-provided eye wash stations were more than 300 feet from shotcreting and grouting work areas, rather than the required travel distance of approximately 55 feet. (See **Deficiency D-TMI-1.**) When eye wash stations are not located near the hazard, a worker's eyes are more likely to be severely injured before medical attention can be obtained.
- Contrary to 29 CFR 1910.178(a)(4), *Powered Industrial Trucks*, TMI did not obtain written manufacturer approval or approval by a qualified registered professional engineer to operate a telehandler with a man-basket attachment. (See **Deficiency D-TMI-2.**) Not evaluating the use of powered industrial truck attachments (including total load weights on telehandlers and adjusting load charts, as needed) could result in exceeding load limits, stability issues, and hazards to personnel.
- Communication between workers during an observed elevated work evolution was difficult due to high ambient noise levels. The worker in the man-basket used both hands to hang cable, causing them to shout directions to the telehandler operator instead of using hand signals. The workers' use of respirators and the operation of diesel equipment in the area compounded the communications problem. (See **OFI-FRA-1.**)

Industrial Hygiene

FRA recognized that maintaining ventilation as required by OSHA 29 CFR 1926.800(k)(3) in the developing caverns would not be achievable. Underground ventilation is not always sufficient to reduce exposures to airborne contaminants, such as NO₂ and silica, particularly in locations where diesel-powered equipment is being used or during mucking activities conducted in smaller spaces. FRA has received a DOE-approved 10 CFR 851 variance to the OSHA 29 CFR 1926.800(k)(3) standard that allows the performance of underground work with less than the required 30 feet per minute linear velocity of airflow. Exposure monitoring results indicate that exposures to silica and NO₂ can be elevated and occasionally rise above the 2016 ACGIH TLVs. During the period of August 27, 2021, through January 21, 2022, 34 of 70 full-shift respirable silica breathing zone samples (or 49%) were above the ACGIH TLV for silica, and as of September 2022, 1,048 of 1,962 NO₂ exposures (53%) exceeded the 2016 ACGIH TLV for NO₂.

Worker over-exposures to silica are mitigated through engineering and administrative controls and requiring exposed workers to wear half-face air purifying respirators with a P100 filters which is adequate for protection against silica concentrations in the underground measured to date. Similarly, worker exposures to NO₂ are also minimized through engineering controls (e.g., ventilation, tier three and four diesel equipment) and DRI alarms. However, the only effective respiratory protection available for control of NO₂ is supplied air (airline or self-contained breathing apparatus), which according to FRA is not feasible for use and introduces additional hazards in an underground construction work environment. FRA, KAJV, and TMI implement generally adequate controls to minimize NO₂ as established in an FSO-approved NO₂ abatement plan. The plan was developed in consultation with DOE's Office of Environment, Health, Safety and Security, and includes local ventilation controls to keep airborne concentrations of NO₂ as low as reasonably achievable (ALARA). NO₂ worker exposures to date have not exceeded the NO₂ abatement plan individual occurrence reporting threshold of 3 parts per million. Designated workers appropriately wear DRIs, which detect airborne contaminants instantaneously, and alert the worker when alarm setpoints have been exceeded.

While significant progress in the development and implementation of IH controls is evident, as described in sections 3.2 and 3.6 of this report, EA identified the following three weaknesses: (1) implementation of requirements for an occupational medicine program as required by 10 CFR 851; (2) implementation of silica regulations as defined in OSHA regulation 20 CFR 1926.1153; and (3) a clear rationale and procedure for DRI alarm set points and responses has not been documented:

- Contrary to section 3 of the CESHP, KAJV and TMI have not included implementing procedures for occupational medical requirements in their ES&H plans, including the sharing of IH occupational exposure monitoring results with a qualified occupational medical provider for review and advice as required by 10 CFR 851 appendices A(6) and A(8). (See **Finding F-FRA-1**) Not coordinating exposure information with qualified occupational medical providers may lead to insufficient medical surveillance programs or other medical administrative controls (e.g., work shift remedies) not being identified or implemented.
- Contrary to OSHA 29 CFR 1926.1153, the KAJV and TMI IH programs are not in full compliance with all requirements for respirable crystalline silica. For workers who wear respirators for more than 30 days per year, KAJV and TMI have not adequately documented in their silica programs the silica medical surveillance programs available to them at no cost, contrary to OSHA 29 CFR 1926.1153(h). Interviewed TMI workers were not knowledgeable of the silica medical surveillance program. The TMI action level for silica of 0.050 mg/m³ as documented in the TMI ES&H manual, *Safety Management Plan*, sec. 4.4, *Silica Exposure*, exceeds the action level of OSHA 29 CFR 1926.1153(b). Not all of the required elements of a silica training program required by OSHA 29

CFR 1926.1153(i) are included in worker training programs (e.g., review of OSHA 29 CFR 1926.1153 contents, silica medical surveillance program, and identity of the competent person). TMI silica exposure monitoring results are properly posted in the underground office, which meets the notification requirements. However, this notification process is cumbersome and does not inform workers of corrective actions to be taken to reduce employee exposure below the TLV, contrary to 29 CFR 1926.1153(d)(2). (See **Finding F-FRA-2**) Workers who are not properly informed when exposures exceed the ACGIH TLVs may not fully understand the potential health effects of exposures exceeding the TLVs and what corrective actions are being taken to reduce the hazards.

- Contrary to 10 CFR 851.21 and .22, DRI alarm setpoints for NO₂, CO, and other hazardous gases detectable by DRIs used by TMI and KAJV are inconsistent and conflicting (for example, the DRI setpoint for CO is set at 25 ppm by KAJV, whereas the DRI setpoint for CO by TMI is set at 50 ppm), lack a documented technical basis, and are not communicated to workers either through training or work documents. (See **Finding F-FRA-3**.) Without documented direction, ES&H professionals and workers do not have a clear understanding of how to respond to DRI alarms uniformly between FRA, KAJV, TMI, and their sub-tier contractors while working underground. Additionally, procedures for defining and evaluating spurious DRI alarms have not been documented. Work documents (i.e., build plans and hazard analyses) do not address DRI alarms or actions to be taken by workers in the event of an alarm, and workers are not adequately informed of DRI alarm actions through training or pre-job briefings.

To protect workers from silica exposures over the TLV of 0.025 mg/m³, FRA, KAJV, and TMI underground workers are appropriately required to wear respirators with P100 particulate filters in most of the underground where there is silica/dust-producing work. Signage was properly posted at entrances to areas requiring respirators. Although TMI was observed effectively using wet rock drilling and the frequent wetting of drift road surfaces to reduce silica exposure to workers, EA identified the following (See **OFI-TMI-2**):

- The grout pump operator was observed opening cement bags by hand to feed the mixing pump. The operator was wearing a respirator, but silica sampling of this activity has not been conducted.
- The remote operator of the shotcrete truck was observed standing downwind from the shotcrete location, instead of the recommended practice of standing upwind to minimize exposure to silica and dust.

Emergency Preparedness

FRA, KAJV, and TMI maintain adequate emergency response resources for events in the underground. All workers carry a 10-minute emergency breathing apparatus to provide time to access one of the designated locations with a self-contained breathing apparatus with 1-hour oxygen availability. This equipment allows workers to exit the underground area or travel to the properly sited refuge chamber near the bottom of the shaft to await rescue instructions. However, although all workers and visitors going underground are trained in the use of the rescue breathing apparatus, hands-on training with the device is not provided. (See **OFI-FRA-2**.)

The emergency services provided by SDSTA are adequate to support underground work. This includes maintaining an emergency response team (ERT) with underground emergency medical services and a properly sited and well-outfitted underground refuge site sufficient to handle the number of LBNF Far Site workers. Trained personnel from SDSTA conduct a weekly visual examination of the refuge site for air and power. The ERT appropriately trains once a month following Mine Safety and Health Administration standards and guidance. In addition, 21 automated external defibrillators, an underground ambulance, and stoke baskets for moving injured personnel are located underground. Paramedic services

provided by KAJV on the surface adequately provide emergency medical services until injured workers are transported to medical facilities, if needed.

Performing Work Within Controls

Planned work is appropriately authorized and released, pre-job briefings and OSC/FLRA cards are effective, and stop/pause work authority is well understood. Build plans were appropriately authorized in preparatory phase meetings and released for work following completion of initial phase meetings conducted by the project quality manager for all three shifts. Observed TMI pre-job briefings for excavation activities adequately described the activities to be performed that shift, reviewed potential conflicting activities in work areas, reviewed KAJV safety oversight observations from the previous day, and discussed safety share items. FLRA cards were properly written, reviewed, and signed by affected miners. Stop/pause work authority was appropriately emphasized in build plans; interviewed workers were aware that they had this authority and stated that they could stop work without retribution.

Observed work, including ground support installation, mucking operations, and work performed by subcontractor, was performed safely per work control documents. TMI excavation work was performed in accordance with the build plans, JHAs, SOPs, and FLRAs. Ground control management and methods for the caverns as excavation progresses are adequately outlined in REP/GCMP/001, *Ground Control Management Plan*, which was appropriately prepared by an architecture/engineering firm for the project. TMI installation of rock bolts was appropriately performed in accordance with the completed FLRA, TM-SOP-35430-FSCF-*Ground Support with Bolting Jumbo*, and TM-SOP-35486-FSCF-*Twenty Foot CT Bolt U/G Handling and Installation*. Scaling, drilling, bolting, and welded wire mesh installation were properly performed remotely with the operator and bolter helper under supported ground.

Observed mucking operations were performed safely following the completed FLRA and TM-SOP-35300-FSCF-*Development Mucking Procedure*. Haulage ways (transportation passages) were properly maintained wet for dust control, and vehicle spotters appropriately coordinated movement of equipment with mucker operators. EA observed good coordination and spatial awareness as crews moved about the underground, and proximity alarms were appropriately used to alert equipment operators of workers near them.

Feedback and Improvement

FRA provides satisfactory oversight of the excavation project through its LBNF project team, including two onsite ES&H coordinators. Training records, interviews, and observations of work activities demonstrated that FRA ES&H coordinators were knowledgeable of the types of work supported and provided effective oversight of WP&C. FRA adequately uses the software Predictive Solutions for documenting day-to-day observations and trending issues to help identify improvement actions. FRA provides satisfactory SME support to the ES&H coordinators, such as IH and fire protection, to perform oversight. One reviewed assessment report, *LBNF Far Site Visit Excavation Assessment 9/27 – 9/30/2021*, was well-documented and adequately assessed IH and WP&C implementation. Reviewed daily reports prepared by KAJV in its role as construction manager/adviser documented effective work observations and provided meaningful feedback to FRA, KAJV, and TMI on work progress, safety concerns, improvement suggestions, and any events that occur. EA also observed effective discussions of weekly feedback reports during a TMI pre-job briefing for excavation activities.

Interviews with TMI supervisors and reviewed build plan revisions demonstrated that supervisors are using these documents to capture feedback on work processes and identify issues that arise during work performance to make long-term improvements. TMI shift leads, safety coordinators, and construction managers review and sign FLRAs and 5-Point Cards each day, which also record accidents, injuries, and

unsafe conditions. However, as discussed in section 3.2 of this report, FRA, KAJV, and TMI have no requirements to provide post-job reviews for build plans, OSCs, or FLRAs.

Work Planning and Control Implementation Conclusions

KAJV and TMI work scope definitions in build plans, SOPs, OSCs, and FLRAs for observed work were sufficiently detailed and adequate to permit identification of hazards and specification of necessary controls. In general, KAJV and TMI adequately identified and analyzed hazards. Reviewed hazard controls were generally developed and effectively implemented, and observed work was performed safely per work control documents. Feedback and improvement processes were generally adequate. However, EA observed weaknesses associated with equipment maintenance and electrical work being performed without clearly defined work scope boundaries and limitations, not maintaining eye wash stations within the required travel distance, and not obtaining written manufacturer approval to operate a telehandler with a man-basket attachment. Additional weaknesses were identified in the following areas: (1) occupational medical requirements of 10 CFR 851 were not implemented by FRA subcontractors; (2) all elements of the OSHA silica standard were not addressed; and (3) a clear rationale and procedure for DRI alarm set points and responses has not been documented.

3.4 Explosives Safety

This portion of the assessment evaluated TMI's explosives safety program (ESP) associated with construction activities, including training and qualification on, transportation and storage of, and handling and use of explosives.

TMI's ESP, documented in TM-SOP-35200-FSCF, *Underground Blasting Safety*, and TM-SOP-35213-FSCF, *Underground Explosives, Handling, and Transport*, adequately addresses applicable explosive operations and activities in accordance with the requirements of 10 CFR 851, appendix A.3.(b), and DOE-STD-1212-2019, *Explosives Safety*. Interviewed personnel were knowledgeable of the ESP. The arrival, storage, and use of explosives were adequately documented for the reviewed explosives inventory, ensuring the proper accounting of explosives materials. TM-SOP-35213-FSCF provides generally adequate instructions for workers to report stolen or lost explosives. However, contrary to 27 CFR 555.30, *Reporting theft or loss of explosive materials*, TM-SOP-35213-FSCF does not address reporting required information about stolen or lost explosives to the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATFE). (See **Deficiency D-TMI-3.**) Not reporting such information impedes BATFE's ability to investigate.

Training and Qualification

TMI has established and implemented an effective initial explosives safety training program that ensures that explosives handlers are fully qualified before being assigned to explosives operations or an explosives transport vehicle. Section 5 of TM-SOP-16201-FSCF adequately addresses the training process. Section 5.4 of TM-SOP-35213-FSCF appropriately requires all TMI employees to be vetted by the BATFE Federal Explosives Licensing Center prior to employment, before being deemed as an "employee possessor" able to handle explosives. The three explosives safety training modules that EA reviewed provide an adequate program for the initial training and qualification of ESP personnel. The interviewed safety training coordinator stated that explosives handlers undergo on-the-job training (OJT) for up to six months, and an interviewed explosives handler confirmed that they were closely supervised when handling explosives during OJT. However, there is no formal documentation requiring six months of supervised OJT. TMI's *Training Matrix* appropriately provides employee training information for managers to effectively track training and operator requalification schedules, the need to provide training on updated SOPs, and operator proficiency.

Further, TMI has established TM-SOP-16201-FSCF, sec. 5.1.7.(b), which appropriately specifies requirements for random assessments (audits) of worker skills and competency. However, contrary to TM-SOP-16201-FSCF, sec. 5.1.7.(b), random assessments of worker skills and competency with explosives that include performance activities such as handling, transport, loading into the rock face (area to be excavated), and electric initiation are not being performed. (See **Deficiency D-TMI-4.**) The lack of such assessments could allow unsafe behaviors and performance issues to persist.

Transportation and Storage

Observed transportation and storage activities were generally performed in accordance with the ESP. Receipt documentation for the shipment of explosives received during the assessment appropriately identified the qualified transport personnel, explosives description, packaging, and provisions for any damaged shipments.

Explosives storage magazines are properly sited for the weight of the stored explosives and separated to ensure the explosives' compatibility in accordance with 27 CFR 555.201-224, subpart K. TMI has established and implemented a generally adequate magazine safety self-assessment program. Section 5.2 of TM-SOP-35200, *Underground Blasting Safety*, requires weekly inspections to ensure that explosives are properly stored in manufacturer's packages, magazines are free of combustible materials, explosive permits are current and available, and inventory sheets are accurate. Thirty-six reviewed weekly inspections issued since January 2022 met TM-SOP-35200 requirements. EA observed that explosives were properly stored in manufacturer's shipping containers until their use, in accordance with DOE-STD-1212-2019, sec. 32.2.1. EA observed that TMI maintains an accurate annual inventory of explosives in accordance with TM-SOP-35200. However, although transportation and storage activities were generally adequate, EA identified the following weaknesses:

- TMI did not ensure that explosives were protected from ignition/detonation sources in explosives storage magazines. (See **Finding F-TMI-2.**)
 - Contrary to 10 CFR 851.23(a)(13); NFPA 70, sec. 504.10(B)(1) through (B)(5); and DOE-STD-1212-2019, sec. 36.4.3, light emitting diode (LED) rope lighting not rated for use in the vicinity of explosives (i.e., not intrinsically safe) was observed in all three magazines. Use of non-approved electrical lighting is an explosive hazard. In response to EA's identification of this issue, TMI management immediately removed the LED rope lighting.
 - Contrary to DOE-STD-1212-2019, sec. 33.1.4, TMI did not take appropriate precautions to prevent the exhaust of an observed transport vehicle from presenting an ignition source. The vehicle exhaust tailpipe was within approximately four inches of explosives, risking fire and/or detonation. Additionally, inadvertent movement of the vehicle could crush the explosives and cause detonation. On October 7, 2022, FRA reported this incident as a near miss in the Occurrence Reporting and Processing System (SC-FSO-FNAL-FERMILAB-2022-0018).
- Contrary to DOE-STD-1212-2019, sec. 32.1.2, TMI did not place placards on or near each magazine door specifying explosive and personnel limits and general safety precautions to be observed during work in the magazine. (See **Deficiency D-TMI-5.**) Not posting required placards inhibits the communication of worker safety precautions in magazines.

Handling and Use

Blasting was not observed during the assessment. As confirmed during interviews, explosives managers and blasters have extensive experience and knowledge of blasting techniques and explosives safety. Proper personnel limits (two handlers and one safety observer) were observed during a material inventory

and magazine inspection in accordance with DOE-STD-1212-2019, sec. 14.2. TMI established an effective “brass in/brass out” process in the underground in addition to the brass in/brass out process (a personnel accountability method where individuals post a brass tag on a board on the surface prior to going down in the hoist to the underground) used at the surface to track personnel going underground. The additional brass in/brass out process in the underground was used to ensure all personnel were properly stationed behind blast doors prior to blasting.

Explosives Safety Conclusions

TMI has established and implemented a generally adequate ESP that addresses training and qualification on, transportation and storage of, and handling and use of explosives. However, EA identified weaknesses associated with the requirements for reporting stolen or lost explosives, assessments of worker skills and competency, magazine lighting, prevention of crushed or ignited explosives due to improper transport vehicle use, and magazine placards.

3.5 Fermi Site Office Oversight

This portion of the assessment evaluated the adequacy of the FSO processes for overseeing and evaluating construction WP&C operations performed by KAJV/TMI and the implementation of specific FSO processes, including operational awareness activities, oversight personnel training and qualification, and issues management.

FSO has procedures that provide an effective overall approach to oversight of the LBNF by establishing the functions, responsibilities, authorities, and processes for conducting safety oversight. FSO 4.9, *Oversight Program Description*, contains the safety and health requirements necessary for achieving ISM objectives and establishes functional responsibilities and authorities for the execution of authorized work.

Through interviews and document reviews, the LBNF Far Site Facility Representative (FR) demonstrated knowledge of assigned facilities and performed effective operational awareness oversight. The LBNF Far Site FR conducts weekly operational awareness activities with FRA’s LBNF ES&H coordinator and LBNF ES&H specialist that are documented in the FSO FR log. The LBNF FR reviews the contractors’ work schedules and plans and attends the contractors’ daily operations status meetings, TMI weekly progress meetings, and pre-activity meetings. FSO developed a *Workforce Management Plan* that includes strategic direction, resource requirements, current staffing, and workforce gaps. However, the *Workforce Management Plan* does not provide a FR staffing analysis that is consistent with DOE-STD-1063-2021, *Facility Representatives*, sec. 4.2.4 and 5.1. (See **Deficiency D-FSO-1**.) Performing a staffing analysis inconsistent with DOE-STD-1063-2021 could result in FR staffing levels that are insufficient to maintain effective oversight.

Through interviews and document reviews, EA confirmed that the LBNF Far Site FR has completed training necessary to complete the Technical Qualification Program; however, the FR is awaiting the final approval of the Qualifying Official and is not yet fully qualified. In the November 5, 2021, memorandum, *Assignment of [LBNF FR] to pursue Technical Qualification Program*, the FSO Manager assigned the LBNF Far Site FR to complete qualification by July 3, 2022.

FSO does not have an effective issues management process at the LBNF Far Site. The LBNF Far Site FR enters issues identified during weekly operational awareness activities into a database. However, contrary to DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, sec. 4.b.(4), the FSO issues management process at LBNF Far Site does not categorize findings based on risk and priority, ensuring that relevant line management findings are effectively communicated to the contractors, or ensuring that problems are evaluated and corrected on a timely basis. (See **Finding F-FSO-1**.)

Weaknesses in the FSO issues management process can result in FSO not ensuring corrective action plans are developed to address findings (see section 3.6), contrary to DOE Order 227.1A.

Fermi Site Office Oversight Conclusions

FSO has established and implemented generally comprehensive processes for overseeing and evaluating WP&C for excavation and construction operations performed by KAJV/TMI. FSO conducts adequate operational awareness oversight. However, EA identified weaknesses in FSO's FR staffing analysis and issues management process.

3.6 Finding Follow-up

This portion of the assessment examined the completion and effectiveness of corrective actions for the finding documented in the November 2019 EA report.

Finding F-FRA-1 of the November 2019 EA report identified a lack of a comprehensive IH program, including initial or baseline surveys and periodic resurveys and/or exposure monitoring, as appropriate, of all work areas to identify and evaluate potential worker health risks, contrary to 10 CFR 851. Based on EA's review with respect to the concerns about baseline surveys and periodic resurveys and/or exposure monitoring, KAJV and TMI IH program personnel have developed and implemented IH monitoring and sampling programs that meet the requirements of 10 CFR 851. KAJV and TMI have also developed detailed sampling plans that describe the baseline and periodic resampling requirements for silica, NO₂, DPM, CO, and dust, the primary underground airborne contaminants. KAJV and TMI ES&H support staffs have received training on monitoring and sampling equipment and procedures. Hundreds of samples for silica, NO₂, DPM, and dust have been recorded and analyzed.

Although KAJV and TMI took some actions to address the November 2019 EA finding, FRA did not develop a detailed corrective action plan or include such a plan in the FRA issues management system (iTrack), contrary to DOE Order 227.1A, sec. 4.f.(1), and FRA issues management system procedure QAM 12030, *Quality Assurance Manual*, sec. 5.1.1. (See **Deficiency D-FRA-3**.) Not performing corrective actions or effectiveness reviews of those corrective actions allows the causes of issues to persist and the issues to recur. The November 2019 EA finding was not entered into iTrack until October 3, 2022. At the time of this assessment, corrective actions for this finding had not yet been developed, contrary to DOE Order 227.1A. Additionally, elements of a comprehensive IH program (such as silica and occupational medical programs) remain under development by FRA subcontractors, as discussed in previous sections of this report.

4.0 BEST PRACTICES

No best practices were identified during this assessment.

5.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1, *Implementation of Department of Energy Oversight Policy*, to manage the corrective actions and track them to completion.

Fermi Research Alliance, LLC

Finding F-FRA-1: FRA has not ensured that occupational medical program requirements are implemented by FRA subcontractors, including the sharing of IH exposure data with medical professionals. (10 CFR 851 appendices A(6) and A(8))

Finding F-FRA-2: FRA has not verified that all elements of the OSHA respirable silica standard are implemented by FRA subcontractors. (OSHA 29 CFR 1926.1153(b); (d)(2); (h) and (i)).

Finding F-FRA-3: FRA does not ensure that (1) there is a clearly documented rationale and procedure for DRI alarm set points used to monitor IH airborne contaminants in the underground, and (2) does not provide clear and consistent instruction for worker responses to DRI alarms in the multi-employer work environment underground. (10 CFR 851.21 and .22; 10 CFR 851, appendix A(6)(a); and FSO-approved NO₂ abatement plan)

Thyssen Mining, Inc.

Finding F-TMI-1: TMI's equipment and underground electrical maintenance work is performed without work control documents that contain clearly defined work scope boundaries and limitations, a bounding activity-level HA, and proper work authorization and release. (48 CFR 970.5223-1(c)(1); 10 CFR 851.22(a); CESHP, sec. 4.3.3)

Finding F-TMI-2: TMI did not ensure that explosives were protected from potential ignition sources in explosives storage magazines, using non-intrinsically safe lighting (10 CFR 851.23(a)(13); NFPA 70, sec. 504.10(B)(1) through (B)(5); and DOE-STD-1212-2019, sec. 36.4.3) and not taking precautions to prevent a vehicle and its exhaust from coming near explosives, potentially causing ignition/detonation. (DOE-STD-1212-2019, sec. 33.1.4)

Fermi Site Office

Finding F-FSO-1: The FSO issues management process at LBNF does not categorize findings based on risk and priority, ensuring that relevant line management findings are effectively communicated to the contractors, and ensuring that problems are evaluated and corrected on a timely basis. (DOE Order 226.1B, sec. 4.b.(4))

6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

Fermi Research Alliance, LLC

Deficiency D-FRA-1: FRA did not ensure that KAJV and TMI ES&H plans implement the 2015 version of NFPA 70E; the TMI ES&H plan implements the 2016 version of the ACGIH TLV for silica; and the CESH and the KAJV and TMI ES&H plans fully implement hoisting and rigging requirements of DOE-STD-1090-2011. (10 CFR 851.23(a)(9) and (14); 10 CFR 851.20(b)(3); and DOE prime contract DE-AC02-07CH11359)

Deficiency D-FRA-2: FRA procedures do not require post job reviews, nor did FRA ensure that KAJV, and TMI implementing procedures require a post-job review to be conducted for build plans, OSCs, or FLRAs. (48 CFR 970.5223-1(c)(5))

Deficiency D-FRA-3: FRA did not develop a corrective action plan for the November 2019 EA finding (F-FRA-1 in EA report *Work Planning and Control Assessment at the Fermi National Accelerator Laboratory Long-Baseline Neutrino Facility Far Site, November 2019*). (DOE Order 227.1A, sec. 4.f.(1); QAM 12030, sec. 5.1.1)

Thyssen Mining, Inc.

Deficiency D-TMI-1: TMI did not provide eye wash stations within the required travel distance of approximately 55 feet. (American National Standards Institute Z358.1, *Standard for Plumbed and Portable Eyewash Stations*, as specified in the OSHA interpretation of 29 CFR 1926.50 (g))

Deficiency D-TMI-2: TMI did not obtain written manufacturer approval or approval by a qualified registered professional engineer to operate a telehandler with a man-basket attachment. (29 CFR 1910.178(a)(5))

Deficiency D-TMI-3: TM-SOP-35213-FSCF does not address reporting required information for stolen or lost explosives (i.e., manufacturer or brand name; manufacturer's marks of identification; quantity; description and United Nations identification number, hazard division number, and classification letter, per 49 CFR 172.101 and 173.52; and size) to the BAFTE. (27 CFR 555.30)

Deficiency D-TMI-4: TMI does not conduct random assessments of worker skills and competency for the performance of activities related to explosives. (TM-SOP-16201-FSCF, sec. 5.1.7.(b))

Deficiency D-TMI-5: TMI did not place placards on or near each magazine door specifying explosive and personnel limits and general safety precautions to be observed during work in the magazine. (DOE-STD-1212-2019, sec. 32.1.2)

Fermi Site Office

Deficiency D-FSO-1: FSO has not conducted the FR staffing analysis, consistent with DOE STD-1063-2021. (DOE-STD-1063-2021, secs. 4.2.4 and 5.1)

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified four OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered only as

recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

Fermi Research Alliance, LLC

OFI-FRA-1: Consider, in coordination with KAJV and TMI, providing workers with equipment that is compatible with other personal protective equipment to facilitate effective communication in high ambient noise areas.

OFI-FRA-2: Consider providing hands-on training for donning and using the emergency breathing apparatus for all LBNF Far Site workers and visitors going underground. The DOE Accident Investigation Board investigated an underground fire at the Waste Isolation Pilot Plant and identified hands-on training in the use of emergency breathing apparatuses as a necessary control to prevent or minimize a recurrence of issues experienced during the fire.

Thyssen Mining, Inc.

OFI-TMI-1: Consider applying arc flash labeling on underground equipment to facilitate communication of the electrical arc flash hazard and personal protective equipment needs for safely conducting electrical maintenance.

OFI-TMI-2: Consider conducting an IH exposure assessment to quantify silica exposures when opening cement bags by hand, and ensure workers are standing upwind during dust producing work activities.

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: October 3-7, 2022

Office of Enterprise Assessments (EA) Management

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Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
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