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Materials and Fuels Complex Operations Management Improvement Strategy for Fiscal Year 2023

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Idaho National Laboratory

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ACRONYMS

5YS	Five-year investment strategy
AFF	Advanced Fuels Facility
AHJ	Authority having jurisdiction
AL	Analytical Lab
ALARA	As low as reasonably achievable
ALD	Associate Laboratory Director
AMWTP	Advanced Mixed Waste Treatment Project
ANL	Argonne National Laboratory
AOP	Abnormal Operating Procedure
APADs	Air Permitting Applicability Determinations
ARP	Annunciator Response Procedure
ARPA-E	Advanced Research Projects – Energy
AS	Asset Suite
AS9	Asset Suite 9
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC.
BFM	Building Facility Manager
BOM	Bills of Material
BOQ	Basic Operator Qualification
BWXT	BWX Technologies, Inc.
CAA	Clean Air Act
CAPIE	Characterization and Advanced Post-irradiation Examination
CARB	Corrective Action Review Board
CAS	Contractor Assurance
CCP	Central Characterization Project
CDI	Continuous Document Improvement
CEI	College of Eastern Idaho
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Construction Field Representative
CGD	Commercial Grade Dedication
CGDIT	CGD Improvement Team
CHC	Complex Health Committee
CH-TRU	Contact-handled transuranic (waste)
CINR	Consolidated Innovative Nuclear Research

CM	Configuration management
CO	Contracting Officer
COO	Chief Operating Officer
Co-op	Cooperative education
CRADA	Cooperative Research and Development Agreements
CS	Contract Specialist
CSF	Critical Safety Functions
CX	Categorical Exclusion
DBOT	Down-Blend Offering for Tritium
DCR	Document change request
DLA	Dynamic learning activity
DM	Document Management
DOE	Department of Energy
DOE-ID	DOE Idaho Operations Office
DOE-NE	DOE Office of Nuclear Energy
DSA	Documented Safety Analysis
EAM	Emergency Action Manager
EAP	Employee Assistance Program
EBR-II	Experimental Breeder Reactor II
EC	Engineering Change
ECC	Emergency Control Center
ECP	Environmental Compliance Permit
EDMS	Electronic Document Management System
EFCOG	Energy Facility Contractors Group
EIS	Environmental Impact Statement
EJ	Engineering job
EMT	Electrometallurgical treatment
EPA	Environmental Protection Agency
ER	Equipment reliability
ERO	Emergency Response Organization
ERP	Equipment reliability program
ES&H	Environment, Safety, and Health
ESH&Q	Environment, Safety, Health, and Quality
ESTEC	Energy Systems Technology and Education Center
EVMS	Earned value management system

F&SS	Facilities and Site Services
FacReps	Facility Representatives
FACT	Functional Area Coordination Team
FASB	Fuels and Applied Science Building
FCF	Fuel Conditioning Facility
FDS	Facility Disposition Specialist
FFNMM	Fuel Fabrication and Nuclear Material Management
FMH	Fissionable Material Handler
FTE	Full time equivalents
FY	Fiscal year
GAIN	Gateway for Accelerated Innovation in Nuclear
H&R	Hoisting and rigging
HALEU	High-assay low-enriched uranium
HASP	Health and Safety Plan
HBCU	Historically Black Colleges and Universities
HEO	Heavy-equipment operator
HEU	Highly enriched uranium
HFEF	Hot Fuel Examination Facility
HLW	High-level waste
HPI	Human Performance Improvement
HPT	Health Physics Technician
HR	Human Resources
HR&D	Human Resources and Diversity
HRP	Human Reliability Program
HVAC	Heating, ventilating, and air conditioning
HWMA	Hazardous Waste Management Act
I&C	Instrumentation and control
I&D	Inclusion and diversity
iCAMS	Issues and Corrective Action Management System
ICS	Incident Command System
ICV	In-container vitrification
IDEQ	Idaho Department of Environmental Quality
IEC	Idaho Environmental Coalition, LCC
IFM	Idaho Facilities Management
IFR	Integral Fast Reactor

IH	Industrial Hygiene(ist)
ILL	Immediate Lessons Learned
IMCL	Irradiated Materials Characterization Laboratory
INL	Idaho National Laboratory
INPO	Institute of Nuclear Power Operation
INTEC	Idaho Nuclear Technology and Engineering Center
IPL	Integrated priority list
IPT	Integrated project team
IRA	Inflation Reduction Act of 2022
IRPT	Integrated Resource Planning Tool
ISA	Idaho Settlement Agreement
ISU	Idaho State University
IWP	Integrated Work Plan
IWTS	Integrated Waste Tracking System
L&OD	Leadership and Organizational Development
LCO	Limiting condition for operations
LDRD	Laboratory Directed Research and Development
LI	Laboratory Instruction
LIDAR	Light detection and ranging
LLW	Low-level waste
LO/TO	Lockout/tagout
LOSA	Laboratory Operations Supervisor Academy
LRS	laboratory review system
LRSA	Low-Risk Simple Activity
LTAM	Long-Term Asset Manager
M&O	Management and operations
MAR	Material at risk
MBTA	Migratory Bird Treaty Act
MCRE	Molten Chloride Reactor Experiment
MEAAL	Master Equipment and Activities List
MEL	Master Equipment List
MFC	Materials and Fuels Complex
MLLW	Mixed low-level waste
MOP	Management Observation Program
MP	Maintenance Procedure

MRM	Management review meetings
MSA	Management self-assessment
MSI	Minority-Serving Institution
MSTI	Management Systems Transformation Initiative
MTRU	Mixed transuranic waste
MWO	Model Work Order
N&HS	National and Homeland Security
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFM	Nuclear Facility Manager
NNSA	National Nuclear Security Administration
NOP	Normal Operating Procedure
NRAD	Neutron Radiography Facility
NRIC	National Reactor Innovation Center
NS&T	Nuclear Science and Technology
NSGI	Nuclear Services Group Inc.
NSUF RTE	Nuclear Science User Facilities Rapid Turnaround Experiments
NSUF	Nuclear Science User Facilities
NTP	National TRU Program Users Group
NTU	Navajo Technical University
O&M	Operation and maintenance
ODS	Ozone depleting substances
OJT	On the Job Training
OMI	Operations Management Improvement
ONA	Office of Nuclear Assurance
OSTI	Office of Scientific and Technical Information
OTC	Over the counter
PA	Performance Analyst
PACE	Process Architecture for Continuous Excellence
PCA	Project Controls Analysts
PdM	Predictive maintenance improvements
PDSA	Preliminary documented safety analysis
PEMP	Performance Evaluation Management Plan
PERSEC	Personnel Security
PFC	Planning and Financial Controls Specialist

PISA	Potential inadequacy in the safety analysis
PM	Preventative Maintenance
PMCR	Preventative Maintenance Change Request
PMJ	Preventive Maintenance Justification
PMO	Preventative Maintenance Optimization
PMR	Permit Modification Request
POC	Point of contact
POW	Plan of the week
PPA	Procedure Professionals Association
PPP	People Planning Process
PR	Principal researcher
PTC	Permit to construct
QA	Quality Assurance
QLD	Quality Level Determinations
R&D	Research and development
R2A2	Roles, Responsibilities, Authorities, Accountabilities
RadCon	Radiological Controls
RadIssues	Radiological Issues
RadWork	Radiological Work
RAM	Reliability, Availability, and Maintainability
RCA	Root cause analysis process
RCRA	Resource Conservation and Recovery Act
RD&D	Research, development, and demonstration
RFID	Radio-frequency identification
RHLLW	Remote-handled low-level waste
RMAC	Radioactive Material Acceptance Coordinator
ROD	Record of decision
ROM	Rough-order-of-magnitude
RPZ	Reduced pressure zone
RSWF	Radioactive Scrap and Waste Facility
RTR	Real-time radiography
RTS	Resource Tracking System
RWDP	Remote Waste Disposition Project
RWP	Radiological work permit
SAR	Safety Analysis Report

SAT	Systematic approach to training
SCMS	Sodium Components Maintenance Shop
SDD	System Design Descriptions
SEALION	Searchable Liner Online
SERP	System equipment reliability prioritization
SFP	Subcontractor field problems
SFR	Subcontractor Field Representative
SFTP	Spent Fuel Treatment Product
SLT	Senior Leadership Team
SME	Subject Matter Expert
SNF	Spent nuclear fuel
SNM	Special nuclear materials
SNPIT	Space Nuclear Power and Isotope Technologies
SOMD	Site Occupational Medical Director
SORT	STIMS OSTI Release Tool
SOU	Stipulation of understanding
SPL	Sample Preparation Laboratory
SPO	Security Police Officer
SR	Surveillance requirement
SS	Shift Supervisor
STAR	Stop, Think, Act, Review
STP	Site Treatment Plan
SWO	Subcontract Work Office
TRAIN	Training Records and Information Network
TREAT	Transient Reactor Test Facility
TRISO	Tristructural isotropic
TRU	Transuranic
TSDF	Treatment, Storage, and Disposal Facilities
TSR	Technical Safety Requirement
U of I	University of Idaho
U&IS	Utilities and Infrastructure
UDASS	Universal Drum Assay Scanning System
USQ	Unresolved safety question
VEE	Visual examination expert
VTR	Versatile Test Reactor

WAC	Waste acceptance criteria
WBS	Work breakdown structure
WCAC	Work Control Administration Center
WCUC	West Campus Utility Corridor
WDC	Work discipline code
WEO	Waste Examination Operator
WGS	Waste Generator Services
WICD	Waste Item Characterization Database
WIPP	Waste Isolation Pilot Plant
WMP	Waste Management Plan
YRA	Young Researchers Association
ZPPR	Zero Power Physics Reactor

Materials and Fuels Complex Operations Management Improvement Strategy for Fiscal Year 2023

1. INTRODUCTION

The Materials and Fuels Complex (MFC) continues to experience growth in terms of staff, research, and production. MFC operational performance consistently keeps pace with this growth. To ensure continual improvement, MFC utilizes a broad complex-wide operations management improvement strategy.

The MFC Operations Management Improvement (OMI) Strategy is complementary to the MFC Five-Year Mission and Investment Strategies and the MFC Management Plan. The OMI strategy is structured to address the management systems outlined in the Nuclear Facility Management Standard Operations Model, Figure 1.

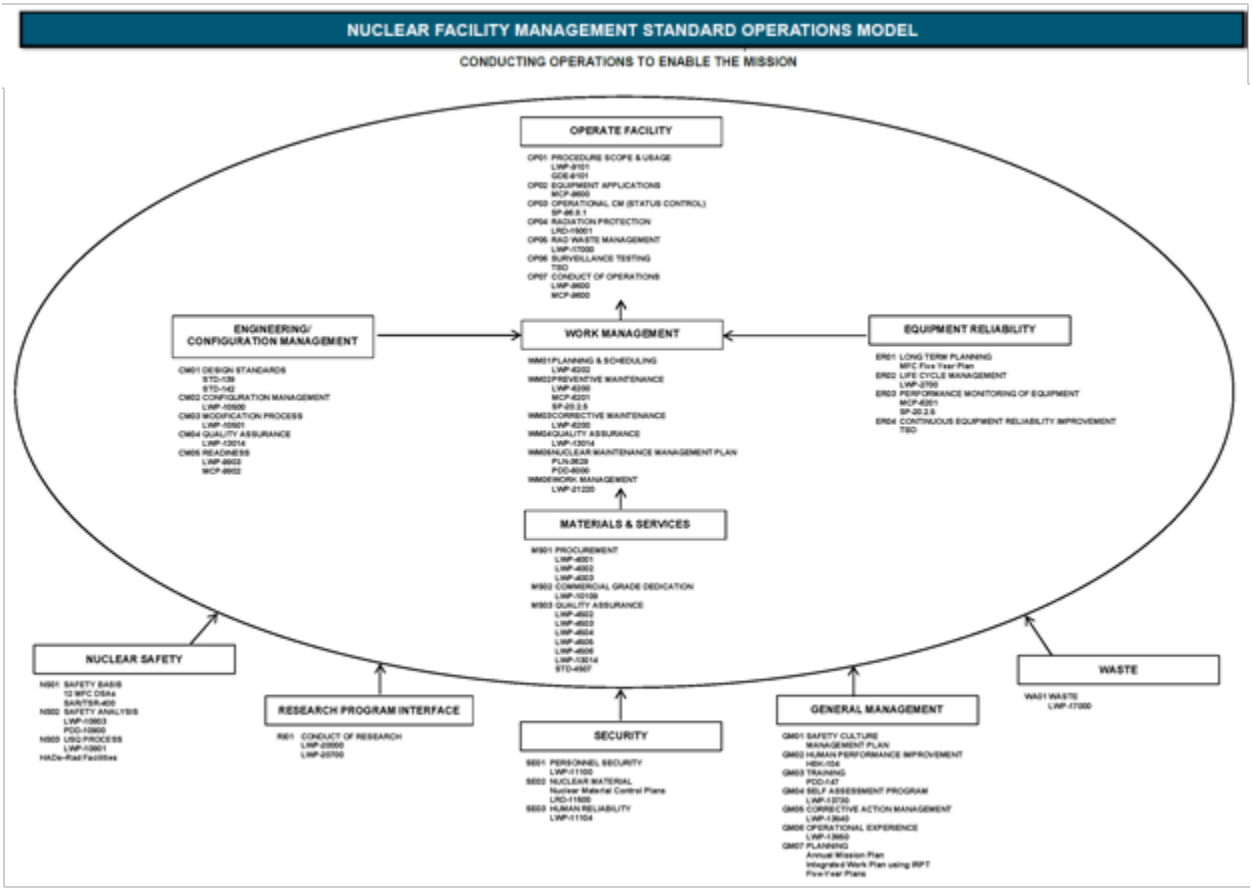

Figure 1. Nuclear Facility Management Standard Operations Model.

Selected management systems are evaluated independently in chapters that describe the performance improvements accomplished within the past 5 years, a description of improvement actions for the MFC staff that directly perform within or contribute to the management system, process improvements, and any needed equipment improvements. Chapter selection is based on a management system's need for improvement. In some cases, management systems may be combined in a single chapter. Additional chapters are added to address subject areas not formally described in the standard operations model.

The OMI strategy actions are structured to have cross cutting impacts for improvements pertaining to the entire directorate or a single division. All division improvement agendas are aligned to the OMI strategy.

The content of each chapter addresses the following:

- "A Look Back" – This section summarizes the performance improvements associated with the management system for the past 5 years through present day. The summary includes examples of prior actions taken to improve performance, and a qualitative assessment of effectiveness.
- "People" – This section describes areas of strong, acceptable, or needed improvement with respect to the ability of staff to own and execute the management system. Within this section examples are used to describe the level of performance.
- "Process" – This section addresses areas of strong, acceptable, or needed improvement with respect to processes required to effectively execute the management system. Examples are used to describe the level of performance.
- "Equipment/Tools" – This section summarizes areas of strong, acceptable, or needed improvement with respect to equipment or tools necessary to effectively implement the management system.
- "Actions FY-23" – This section describes actions for the current fiscal year.
- "Looking Forward (FY-24 and Beyond)" – This section describes actions to be taken in the following two to four years.

Goals for this strategy include, but are not limited to, the following:

- People
  - Establish a clear vision and strategy for continual improvement, which all staff are aligned to
  - Ensure roles and responsibilities for all staff are clear
  - Obtain and develop talent for current and future needs through effective recruitment, training, qualification, and establishment and maintenance of proficiency
  - Improve the training and development of the current workforce and leadership
  - Foster a learning organization that values benchmarking, independent and self-assessment, use of operating experience, and other methods of learning
  - Fully engage the workforce through inspiration, motivation, communication, participation, coaching, and fostering accountability in a positive atmosphere of mutual trust and respect
  - Manage risk through effective decision-making and conflict resolution, while involving appropriate stakeholders
  - Achieve sustained results through team commitment to mutual success and relentless pursuit of high performance.
- Process
  - Establish, maintain, and rigorously follow high quality guidance for research, engineering, operations, maintenance, radiological controls (RadCon), project management, and other disciplines within the directorate
  - Simplify documented safety analysis reports (SARs) and technical specification requirements (TSRs) to ensure proper interpretation and consistent adherence
  - Continue improvements for cause analysis quality, timeliness, and corrective action quality and effectiveness
  - Continue improvements for the work management process and its implementation
  - Improve internal oversight through better implementation of the contractor assurance (CAS) program, effective safety culture monitoring and assessment, and improved implementation of the

management observation program (MOP) and trending

- Work with external organizations to improve funding management, shared risk of funding loss, and more timely communication of future projects, experiments, and the funding necessary to prepare the MFC organization for future workload.

- Equipment
  - Improve the effectiveness and efficiency of tools, software, and other support equipment necessary to safely execute operations, maintenance, research, RadCon, and training
  - Implement effective facility and complex health committee (CHC) programs that result in improved facility system health.

2. ORGANIZATIONAL CULTURE

2.1 A Look Back

The MFC organization's culture has improved over the past 8 years. Early improvement was primarily the result of development and implementation of the MFC Management Plan. The plan defines a management model by which all managers are held accountable, and key elements of a sound culture are defined. The model continues to provide consistent expectations for management. Improvement has accelerated since the implementation of the first OMI in December 2020. This and subsequent OMIs have provided a targeted and focused approach to improving performance. Over the course of the past two fiscal years, some improvement has been achieved in every aspect covered by the OMI.

The elements of the MFC organizational culture specifically include Human Performance Improvement (HPI), Nuclear Safety Culture principles, Just Culture, Science Culture, and a set of values for MFC. Identifying these elements has allowed for each to be defined, and to facilitate improvement.

Fundamental expectations relative to HPI, Nuclear Safety Culture, and Just Culture are codified in HBK-104, "Materials and Fuels Complex Human Performance and Nuclear Safety Culture Pocket Guide." The pocket guide has been in place for approximately 6 years, and further describes key fundamental behaviors all staff need to demonstrate to support a healthy organizational culture. Improved use of the pocket guide over the past 3 years has contributed to improvements in organizational culture.

Human Performance Improvement concepts are defined in HBK-104, and each division is expected to apply these concepts to their work as deemed appropriate. After a series of Idaho National Laboratory (INL) wide events, the entire laboratory adopted the HPI concepts, developed a lab-based team with expertise, and began taking action to improve human performance at INL. The MFC Associate Laboratory Director (ALD) serves as the senior leadership champion, and MFC has established leadership for the implementation of HPI concepts INL-wide.

MFC defined a set of values that were incorporated in both HBK-104 and the "Materials and Fuels Complex Management Plan." INL established a set of values at the laboratory level that were similar in content. Together, these values continue to provide a basis for interactions inside and outside of MFC; developing performance measures; hiring staff; addressing issues and resolving conflicts; and improving inclusivity and addressing employee disabilities.

Nuclear Safety Culture principles were developed from commercial nuclear power industry guidance and are influenced by Battelle's safe conduct of research principles. The principles are used to describe and reinforce the behaviors necessary to both work with nuclear technology, and to remain free from occupational injury. Members of the MFC organization have demonstrated commitment to both nuclear and occupational safety as exemplified by typically low injury rates, and improved recognition of the special characteristics and uniqueness of nuclear technology.

MFC leadership continues to improve workforce trust and transparency using Just Culture principles by responding to events in a just manner and seeking to learn from mistakes. The Just Culture principles have resulted in improved self-reporting of errors, and an increase in staff willingness to discuss errors with fuller transparency.

The Science Culture was defined in the MFC Five-Year mission plan and receives specific evaluation in a separate part of this improvement plan.

Continued improvements in implementation of the management observation program (MOP) at MFC have contributed to ongoing improvements in field leadership effectiveness, employee performance, and promoting a sound Nuclear Safety Culture and Just Culture. Leaders are engaging employees better through open dialogue, reinforcement of good performance, and providing constructive feedback. Improvements in observation quality are resulting in improved information for identifying areas of further observation focus such as briefings, proper adherence to approved work controls, and work preparation. Observations are also identifying needed improvements in procedures and processes. MFC staff typically

respond well to coaching and feedback provided through observations.

Leaders have improved their use of HBK-104 during their interactions with staff, especially during morning meetings and briefings. Continued focus is still needed however, to strengthen discussions on HPI tool use and when tools should be applied during a specific work activity. Improved dissemination, use of lessons learned, and external operating experience has contributed to improvements in MFC organizational learning. Continued focus is needed to ensure these improvements are sustained.

2.2 People

As with any organization, the journey toward excellence is never ending. Events and assessments in support of an optimal MFC organizational culture continue to identify some vulnerabilities that exist regarding personnel performance.

In the last 3 years, aggressive and proactive action through the use of MFC Significant Lessons Learned have been used to reduce the frequency and severity of events at MFC in lockout/tagout (LO/TO), subcontractor oversight, radiological worker behaviors, pyrophoric and reactive material management, worker safety, and proper adherence to approved work controls. Recent events indicate a need to continue focused efforts to achieve sustained improvement in radiological worker behaviors.

A newly established Performance Improvement Working Group has made significant progress in fostering proactive identification of adverse trends associated with employee performance. The group maintains oversight to ensure the trends are appropriately addressed through the INL issues management process and that an acceptable amount of sustained improvement has been achieved to support closure of an adverse trend. Adverse trends currently identified and being monitored include radiological worker behaviors, achieving an appropriate level of confidence before resuming work following a work pause, verification and validation, work controls, waste management, and nuclear material control and accountability in some specific MFC facilities.

Employee observations and interviews indicate a generally sound Nuclear Safety Culture and Just Culture. High levels of trust exist, and decision-making typically reflects safety first. However, a common cause analysis on recent events, that contributed to the significant lessons learned in the effective use of work controls, indicates a need to improve in the area of having a “questioning attitude.”

2.3 Process

An annual laboratory-wide “Safety, Leadership and Engagement Culture Survey” provides insight on employee’s opinions regarding many areas of organizational culture. The FY-21 results indicate general improvement across most areas surveyed. However, three areas need continued follow-up to improve performance: manager/supervisor promotion of employee professional development, progress on simplification of programs and processes, and teamwork across organizational lines to do what is best for the laboratory. Work is ongoing to revise programs and processes across the laboratory through the Process Architecture Continuous Excellence (PACE) initiative and MFC procedure revisions continue.

Methods are in place that have improved monitoring of Nuclear Safety Culture and Just Culture, such as management observations and mission area assessments. Recent apparent cause analyses are demonstrating more focus on identifying shortfalls in specific Nuclear Safety Culture principles. Although these methods have improved monitoring, additional focus is needed in identifying adverse trends in Nuclear Safety Culture before consequential events occur. In addition, the frequency of mission area assessments has been irregular and could affect the identification of shortfalls in Nuclear Safety Culture.

2.4 Equipment/Tools

Mission area assessments, management observations, and causal analyses are the primary tools for monitoring and assessing Organizational Culture at MFC.

2.5 Actions FY-23

- Establish an MFC program that will broadly and continually monitor Nuclear Safety Culture for adverse trends and identify appropriate corrective actions. (Dave Coates, January 31, 2023)
- Work with the MFC Training organization to develop appropriate training for Nuclear Safety Culture. (Dave Coates, September 30, 2023)
- Monitor and identify further areas of focus through the MFC management observation program. (Dave Coates, September 30, 2023)
- Monitor and identify further improvement opportunities in MFC leadership and staff use and application of HBK-104. Use of HBK-104 may include but is not limited to management observations, staff meetings, activity briefings, all-hands meetings, or other interactions between staff and their leadership. (Dave Coates, September 30, 2023)
- Monitor and identify further improvement opportunities for MFC leadership and staff use and application of Department of Energy (DOE) OPEX Share, INL iShare, MFC Significant Lessons Learned, and MFC Immediate Lessons Learned (ILL). (Dave Coates, September 30, 2023)
- Improve the consistency of performing MFC Mission Area Assessments by scheduling the assessments and gaining schedule commitment further in advance. (Dave Coates, September 30, 2023)

2.6 Looking Forward (FY-24 and Beyond)

- Obtain or develop a survey tool to help improve the monitoring of Nuclear Safety Culture.

3. RESEARCH PROGRAM

3.1 Research Integrity and Review

3.1.1 A Look Back

3.1.1.1 Research Metrics

Until the end of FY-21, the only research performance metric consistently available was tabulation of published and/or submitted papers with one or more MFC authors, which contribute to impact as indicated by H index. Other metrics reported in the past include numbers of postdocs and interns hosted, numbers of external users supported, and numbers of proposals submitted. In FY-22, MFC resumed tracking the number of interns, postdoctoral appointments, INL Graduate Fellowship awardees, and joint appointments. In addition, tracking of the number of postdocs, interns, and postdocs transferring to regular hires was initiated, along with the number of SPPs and Cooperative Research and Development Agreements (CRADAs) finalized during the fiscal year.

During FY-22, there was one OMI action related to research metrics:

- GA 2022-0111: Initiate reporting of research metrics at Management review meetings (MRM). (Abdul Dulloo)

Due to a change in the format and content of MRM meetings, metrics data were no longer reported during MRM meetings. However, while the action mentioned MRM reporting specifically, the intent of the action was to ensure that data, especially for the new metrics, were being collected for tracking. The data collection for historic and new metrics did occur and a baseline consisting of FY-22 data now exists for these metrics. This information will be reported through other venues to MFC management. On that basis, the action is considered completed, and will be closed out.

3.1.1.2 Research Integrity

No notable incidents related to research or scientific integrity have been raised at MFC in recent years, including in FY-22. INL's research integrity program is overseen by the INL Chief Research Officer and is described in PDD-221, "Research Misconduct and Research Process Concerns," which addresses occasions of Research Misconduct (i.e., fabrication of data and results, falsification/manipulating/omitting to misrepresent data, plagiarism). The program calls for the appointment of an INL Research Integrity Officer and Deputy (typically appointed from the Research and Development [R&D] staff) and an Investigation Committee to investigate allegations or concerns of research and scientific integrity. MFC, along with the other mission directorates, nominates MFC staff members to serve terms as Research Integrity Officer or Deputy.

At least anecdotally, it appeared that some MFC research staff were not familiar with INL's research integrity standards or processes. INL qualifications for R&D Principal Researcher (QNRDPRIN), are documented by Form 486.02, "Principal Researcher (PR) Qualification Checklist," and for Hands-On Researcher (QNCONRES), by Form 486.01, "Hands-on Researcher Qualification Checklist." A review of the forms' checklists indicates that the qualifications address work control, integrated safety management and ES&H topics, but research integrity is not explicitly addressed.

During FY-22, INL adopted 10 principles of a strong research culture to guide current and future researchers at INL in their daily work. One of these principles is "the highest level of scientific integrity is expected." The Research Excellence Office of INL is highlighting each principle at regular intervals, and it is expected that more information will be communicated on research integrity when the principle on scientific integrity is highlighted. This should help address the lack of familiarity of researchers with the research integrity process. Furthermore, there was one related OMI action in FY-22 to disseminate information on research integrity:

- GA 2022-0112; Arrange a presentation on the INL Research Integrity Program to be delivered as part of the MFC Informational Series. (Donna O'Kelly)

The MFC Informational Series webinar on research integrity was completed on April 26, 2022. Allison Ray, who was the lead for the Research Integrity Office and the Research Excellence Lead at the time gave a talk highlighting research integrity as one of the core principles of a strong research culture.

3.1.1.3 Mission Work Planning

For each of the recent years, MFC managers have endeavored to plan for work in the upcoming fiscal year based on defined scope and planned budgets. Most MFC mission work is funded by programs managed within INL and nationally. In some cases, mission work is funded by Nuclear Science and Technology (NS&T) and National and Homeland Security (N&HS) personnel, and those personnel communicate to MFC counterparts the future scope and budget expected, usually in an ongoing manner throughout the year. Each year that process is complicated and challenged by the incompleteness of planning information available prior to the beginning of the fiscal year, which is largely attributable to the programmatic ambiguity of the federal appropriations process; DOE program managers are reluctant to commit to plans until the year's appropriations budget is approved by Congress, and even then, there is ambiguity until DOE settles on details. For that reason, NS&T and N&HS program managers can, at best, provide their impression of the upcoming plans for the year but are occasionally unable to provide detail. As a result, MFC enters each fiscal year with an unclear picture of programmatic expectations.

During FY-21, two OMI actions related to Mission Work Planning were completed:

- GA 2021-0073; Annual Workforce Planning Process
  - ALDs clarify and communicate their expectations for annual workforce planning, with a practical and manageable process to be agreed upon.
- GA 2021-0074; FY-22 Planning Schedule
  - MFC directors establish and keep to an FY-22 planning schedule.

For the first action (GA 2021-0073), the Annual Workforce Planning was completed with each ALD reviewing their staffing plans and rolling up the information across the laboratory. NS&T has committed to use the Integrated Resource Planning Tool (IRPT) for work involving MFC facilities and resources.

For the second action (GA 2021-0074), the FY-22 Planning Schedule has been established, and is updated as needed to remain current.

3.1.1.4 Research and Data Quality

During FY-22, four OMI actions related to Research and Data Quality were planned for completion:

- GA 2022-0113; Gain MFC Leadership endorsement for approach and scope of MFC Testing and Measurement Quality Guide. (Abdul Dulloo)
- GA 2022-0114; Issue Revision 0 of the MFC Testing and Measurement Quality Guide. (Abdul Dulloo)
- GA 2022-0115; Evaluate issue related to alignment of priorities for Research and Operations and, if needed, propose approach to improve. (Abdul Dulloo)
- GA 2022-0116; Evaluate issue related to cumbersome processes and, if needed, propose approach to improve. (Abdul Dulloo)

The first action (GA 2022-0113)—led by James Parry, a Technical Leadership Council (TLC) member at the time—was completed on March 15, 2022, when the approach, scope, and schedule to develop a testing and measurement quality guide for MFC was reviewed with the MFC Division Directors. The second action (GA 2022-0114) was to develop the guide. However, it became evident that, while the availability of such a guide would provide some benefits, the level of effort needed to develop the guide did not justify the return on investment, and would have taken time away from other, higher-priority activities. After consultation with the MFC TLC and MFC Division Directors, it was decided to put on hold the creation of a MFC Testing and Measurement Quality Guide and to cancel

GA 2022-0114. The decision to develop the guide will be revisited at the start of FY-24.

The third action (GA 2022-0115)—led by TLC member Daniel Murray—was closed out in February 2022 after a project charter was created and reviewed by the TLC and MFC leadership. A team consisting of both researchers and operations personnel is working on developing recommendations to improve alignment between research and operations. These recommendations are expected to be finalized in FY-23.

The fourth action (GA 2022-0116)—led by TLC member Beau Ballard—was closed out in February 2022 after a presentation on tackling cumbersome work processes was given to the TLC and MFC leadership. A team subsequently assembled to pursue this initiative is focusing on simplifying material transfer between MFC facilities.

A new issue surfaced in FY-22, DOE Order 241.1B, Admin Change 1, "Scientific and Technical Information Management," Contractor Requirements Document, requires that all scientific and technical information products produced at INL must be submitted to the DOE Office of Scientific and Technical Information (OSTI) after an appropriate institutional review. Every quarter, INL receives a report from the DOE OSTI. This report contains a list of INL related publications that were published in the public domain but were not reported to OSTI by INL. In FY-22, an examination of eight MFC publications that were released in the public domain showed that five of these publications (62.5%) had not been reported to OSTI. The cause of this issue is believed to be lack of awareness or understanding on the part of researchers of the process to go through when publishing in the public domain. To help with increasing awareness of MFC researchers, a refresher seminar will be held that will cover the requirement for public-domain publications, including journal articles, to go through laboratory review system (LRS) review and submission to OSTI through the STIMS OSTI Release Tool (SORT).

3.1.2 People

The MFC Chief Scientist leads efforts to measure and improve the MFC research culture, in consultation with the TLC.

Since MFC mission and research work is directed and administered within MFC divisions, MFC divisions are responsible for staffing the research work they support. Staffing plans are presented in the separate division 5-year plans. In general, personnel needed to support MFC Research and Integrity actions can be identified from the existing roles and staff.

3.1.3 Process

3.1.3.1 Research Metrics

Refer to Subsection 3.1.1.1 for information on research metrics tracking.

3.1.3.2 Research Integrity

The process for addressing concerns and occasions related to research integrity is described in PDD-221. This lab-wide process is sufficient for meeting MFC needs in these matters. MFC directors can consider how best to ensure personnel are familiar with research integrity expectations and PDD-221.

3.1.3.3 Mission Work Planning

Program managers and directors should continue to collaborate in entering into the IRPT the best available data at the appropriate time in the planning process and updating that data as DOE plans become clear. MFC directors should adhere to the FY-23 Planning Schedule that has been established.

3.1.3.4 Research and Data Quality

The existing process to go through LRS review and through SORT for publications intended for the public domain needs to be reviewed with MFC researchers.

3.1.4 Equipment/Tools

3.1.4.1 Research Metrics

Existing tools and/or databases are used for tracking research metrics. For example, the MFC Business Division already tracks INL publications with one or more MFC author, and University Programs track the number of interns, postdoctoral employees, and Graduate Fellowship awards.

3.1.4.2 Mission Work Planning

Annual workforce planning at MFC can be supported well using IRPT, which is now familiar to MFC leaders; the bigger concern for planning is uploading and entering information reflecting mission commitments.

3.1.4.3 Research and Data Quality

No tools are envisioned at this time.

3.1.5 Actions FY-23

3.1.5.1 Research Metrics

- Report out FY-22 research metrics. (Abdul Dulloo, January 31, 2023)

3.1.5.2 Research and Data Quality

- Hold a refresher seminar (as part of the MFC Informational Series) on the requirement for public-domain publications—including journal articles—to go through LRS review and submission to OSTI through the SORT system. (Abdul Dulloo, March 31, 2023)

3.1.6 Looking Forward (FY-24 and Beyond)

3.1.6.1 Research Metrics

- Compare year-over-year performance on key metrics.

3.1.6.2 Mission Work Planning

- MFC directors continue to establish a sustained planning rhythm and streamline the process to identify, enter, and update data in the MFC IRPT, as reflected in better fidelity in IRPT.
- MFC ALD continue to champion and encourage the use of IRPT, or a similar and compatible tool, by the NS&T and N&HS organizations for their work at MFC.

3.1.6.3 Research and Data Quality

- TLC continue to identify and work on areas of improvement for conduct of research at MFC.
- Revisit development of a MFC Testing and Measurement Quality Guide.

3.2 Mentoring

3.2.1 A Look Back

Mentoring takes on many forms, beginning during on-boarding and lasting for a career. Mentoring may fulfill different objectives at different times, such as learning the ropes of a new organization, identifying, and pursuing skills development, and charting career progression.

Mentoring and personal/professional development are related and may use similar tools. Mentors may help personnel identify and select good development opportunities, such as those offered by INL's Employee Development Network and Assessment Center. INL's Learning and Organizational Development division offers and facilitates many programs and courses. Therefore, mentoring may be considered a part of employee development.

A 2021 survey performed by the INL Young Researchers Association (YRA) of postdocs and researchers at INL, who received their last degrees within the past 10 years, found mentoring to be a high priority need within that demographic. This survey, along with other feedback received from other sources, prompted the TLC to develop a set of recommendations in FY-21 to strengthen mentoring at MFC. Three of these recommendations were turned into FY-22 OMI actions, namely:

- GA 2022-0117; Create a page on the MFC web site dedicated to mentoring. (Abdul Dulloo)
- GA 2022-0118; Announce "Mentor of the Year Award" creation. (Abdul Dulloo)
- GA 2022-0119; Seek nominees and select a winner of the FY-22 Mentor of the Year Award. (Abdul Dulloo)

While those actions were nominally assigned to the Chief Scientist, Abdul Dulloo, most of the work undertaken to complete them was led by TLC member Laura Sudderth. The first action (GA 2022-0117) was completed in July 2022, with the creation and release of the MFC Mentoring web page on the MFC Nucleus site (https://materialsandfuelscomplex.inl.gov/mentoring/SitePages/Home.aspx#).

The second action (GA 2022-0118) was completed in September 2022 when an announcement in MFC News asked for nominations for the inaugural FY-22 Mentor of the Year Award. The third action (GA 2022-0119) was also completed in September 2022 following the selection of two winners of the FY-22 Mentor of the Year Award. The winners were announced at the MFC All-Hands meeting held in October 2022.

3.2.2 People

The hiring process identifies good candidates and brings them to INL; then onboarding introduces new hires to the basics of INL. Following these activities, mentoring is needed to help employees learn how to navigate INL, how to perform work in MFC's nuclear environment, and to learn some of the specific skills needed for projects and programs at MFC. With time and experience, mentoring is expected to include additional topics that may be related to skill development (e.g., professional, technical, and managerial skills), knowledge transfer, and career development.

Given current workforce demographics and projected retirements, along with recent and anticipated growth at MFC, mentoring across generations will be critical to transfer technical and institutional knowledge to accomplish INLs mission. Much of the specialized work performed at MFC is not taught in books, schools, or training programs; rather, it is learned through practice, hands-on work, and from those who have done it before. Mentoring is an important tool in providing additional education specific to MFC.

MFC is committed to sponsoring development for all employees, including in the form of mentoring. Mentoring can occur both formally and informally. Formal mentoring may occur when an employee and mentor are matched up based on a specific skill set or development goal and follow a structured set of activities. Informal mentoring may develop between employees more organically as employees find common interests and support each other in those areas. Mentoring is often a relationship between a more experienced and a less experienced employee; however, peer-mentoring, where peers share their experiences on certain topics, can also be valuable.

3.2.3 Process

Since FY-19, MFC management has set a goal of conducting two performance reviews per year with each employee. MFC managers are expected to discuss employee development during performance reviews; these discussions should also include mentoring. Managers will help employees find mentors and will help employees become mentors to others, based on employees' career needs.

3.2.4 Equipment/Tools

Currently, mentoring occurs mostly informally and organically (employees develop relationships, and activities are not tracked). A more structured program is being instituted that will provide more training

for employees, mentors, and managers, with examples to help participants develop mentoring activity ideas.

To assist employees with mentoring, a web page dedicated to mentoring was created on the MFC Nucleus site in FY-22. This page will link MFC employees to available resources on mentoring, publicize upcoming mentoring training, and provide the opportunity to provide feedback and share lessons learned.

3.2.5 Actions FY-23

- Continue to improve mentoring through ongoing efforts led by the MFC Technical Leadership Council. (Abdul Dulloo, September 30, 2023)

3.2.6 Looking Forward (FY-24 and Beyond)

- Review mentoring relationships and look for cross-organizational opportunities to pair employees to achieve goals.
  - Mentoring relationships should cross boundaries and directorates throughout INL.
- Create a demonstrated record of mentoring a requirement for progression to the top levels of an employee's Career Series.
  - For example, employees seeking progression to Level 5 and/or Level 6 on the INL Professional Individual Contributor Career Series would be required to provide evidence that they have successfully mentored one or more junior colleagues during their careers.
  - This requirement would be a strong incentive for employees to become active mentors.
- Customize mentoring programs for participants and their needs. The opportunities for mentoring are varied and endless, and it would be beneficial to look into differentiating between mentoring and coaching.
- Make mentoring accessible to everyone and expected of MFC leaders and managers. This will result in improved employee development and retention.

3.3 University Partnerships

3.3.1 A Look Back

University engagement has steadily improved as awareness of the strategic importance of university partnerships to MFC recruiting and research collaborations has increased. Recruitment in Mission Divisions and the Engineering Division at MFC have benefited from building long-term relationships with university departments and specific university faculty. These relationships have shifted the selection of student interns from an ad hoc basis to one based on recommendations from faculty that wish to build long-term, mutually beneficial relationships and joint research programs. Productive undergraduate or graduate internships often result in new hires that are familiar with INL culture, work processes, the local area, and have completed some degree of INL training. Hiring in this way results in new employees that are immediately productive and improves employee retention.

Research collaborations resulting from university partnerships have steadily increased. These collaborations provide the opportunity for researchers to pursue personal research interests or to address critical knowledge gaps that have not been identified or funded by programs. Funded research collaborations provide the opportunity to host top-tier students as interns over multiple years, building university relationships and often resulting in an advanced degree associated with research at INL. Funded research collaborations result mostly from DOE Office of Nuclear Energy's (DOE-NE) Consolidated Innovative Nuclear Research (CINR) program, Nuclear Science User Facilities Rapid Turnaround Experiments (NSUF RTE), and INL Laboratory Directed Research and Development (LDRD) projects. There are a few ARPA-E (Advanced Research Projects – Energy) funded programs. Another avenue to foster research collaboration with universities is to enlist university faculty to serve on external advisory bodies. As an example, university faculty members are serving on the External Advisory Committee tasked to advise MFC on optimizing research and collaboration at the Sample

Preparation Laboratory (SPL) when it becomes operational.

Graduate fellowships facilitate long-term relationships between top-tier graduate students, university professors, and MFC research staff. These relationships require a 3-year funding commitment for graduate research at MFC. Postdoctoral fellowships are the traditional entry point into a research career and are increasingly common at MFC as our research culture matures. Distinguished postdoctoral fellowships (Heath, Seaborg, de Boisblanc) offer the opportunity to hire a Ph.D. researcher on a 50%-funded, 2-year appointment. Postdoctoral programs provide excellent opportunities for evaluating and hiring research staff. MFC currently has seven postdoctoral fellows, including two distinguished postdoctoral fellows.

Joint Appointments provide the opportunity for MFC staff to be embedded in a university as an instructor or member of the faculty. Joint appointments provide the opportunity for MFC staff to deliver lectures or to develop entire courses that benefit MFC and the nuclear enterprise; engage with top-tier students as potential employees; and perform research at universities. One MFC researcher currently holds an outgoing joint appointment—at the Massachusetts Institute of Technology. Joint appointments also provide the opportunity for college or university faculty to be embedded at MFC as a staff member; there is currently one incoming joint appointment at MFC—from the University of California at Berkeley (UC Berkeley).

Education programs and MFC have established a cooperative education (co-op) program that provides the opportunity for extended interaction at MFC for promising undergraduate students in engineering and other fields. Furthermore, the CAPIE Division has prepared a graduate-level class consisting of seminars led by INL experts on materials-related subject to students at the University of California at Berkeley (see resolution to OMI Action GA 2022-0123 provided below). This class can potentially be offered to other universities in the future, providing opportunities to establish long-term collaborations with these universities.

Recruitment of nuclear operators from Idaho State University's Energy Systems Technology and Education Center (ESTEC) has provided MFC with several operations personnel. The relationship could be further improved through closer association of MFC senior operations personnel with the Idaho State University (ISU) program. The College of Eastern Idaho (CEI) may also provide an opportunity to develop degree programs or training courses that are focused on meeting MFC personnel resource needs.

During FY-22, the following OMI actions related to university partnering and engagement were pursued:

- Multiple GAs; Execute university engagement strategies captured in Division 5-Year Strategy Plans. (MFC Division Directors)
- GA 2022-0120; Continue to seek opportunities to collaborate with Historically Black Colleges and Universities (HBCU) and attract faculty and students from these institutions to perform research or work at MFC. (Doug Crawford)
- GA 2022-0121; Continue to seek opportunities to collaborate with tribal universities and attract faculty and students from these institutions to perform research or work at MFC. (Abdul Dulloo, September 30, 2022)
- Multiple GAs; Each MFC Director will work with the MFC Chief Scientist to actively solicit applications from HBCUs/MSIs for at least one entry-level position. (MFC Division Directors, September 30, 2022)
- GA 2022-0122; Leverage INL's University Partnerships program to provide data for indicators of university engagement. (Abdul Dulloo, September 30, 2022)
- GA 2022-0123; Offer graduate-level class to UC Berkeley students. (Colin Judge, September 30, 2022)

The first action was assigned to each MFC Director individually, and most reported that they executed their university engagement strategies or that they will complete engagement during FY-23. As an example, the Maintenance, Infrastructure and Fabrication Director, Eric Papaioannou, participated on the ESTEC Technical Advisory Committee and supported INL's Career & Technical Education (CTE) Program by organizing a weeklong summer camp for high school students.

To fulfill the second action (GA 2022-0120), several activities were completed by owner, Doug Crawford, TREAT Director, including participating in an information-sharing meeting between INL and North Carolina A&T University (a HBCU institution), and representing MFC at a meeting held in July 2022 at INL for faculty from Minority-Serving Institutions.

For the third action (GA 2022-0121), the focus during FY-22 was on relationship-building with the Navajo Technical University (NTU). The primary contact at NTU is Dr. Peter Romine, Associate Professor and Head of Electrical Engineering & Computer Engineering. In October 2021, INL supported an effort by NTU to set up an MS program in Engineering, and MFC personnel, Abdul Dulloo and Doug Crawford, contributed to the letter of support. This type of support should enable MFC to eventually attract faculty and students from NTU.

The fourth action was assigned to each MFC Director individually, and most either completed the action or indicated that they will complete the action during FY-23. As an example, the Space Nuclear Power and Isotope Technologies (SNPIT) Division Director, Stephen Johnson, participated in a job fair event organized by HBCU institutions Clark Atlanta University, Spelman College, and Morehouse College.

The fifth action was completed with support from National University Programs. MFC now has the ability to track university engagement data indicators such as number of graduate fellowships, interns, postdocs, and joint appointments. FY-22 values for these indicators have been recorded and will serve as a baseline for future years.

For the sixth and last action (GA 2022-0123), a graduate-level class has been developed, reviewed with Professor Peter Hosemann of UC Berkeley, and scheduled to be offered in the Spring semester of 2023 to UC Berkeley students.

3.3.2 People

Division directors are responsible for the university engagement strategy for their division, with the assistance of the MFC Chief Scientist. Each division assigns personnel to engage with specific universities or technical/vocational schools that are strategically important to the division's mission. Personnel in support and operations-focused divisions engage with appropriate technical development programs and undergraduate internships. Personnel in research divisions also engage in recruiting and mentoring candidates for INL's Graduate Fellowship and Distinguished Postdoctoral Fellowship Programs.

In keeping with the INL value of inclusivity, MFC seeks to achieve an employee base that is diverse and inclusive. An important component of this effort is to foster strong relationships with universities and colleges that primarily serve students from under-represented communities. In FY-21, MFC developed and started implementing an engagement plan targeted at strengthening relationships with HBCUs and Minority-Serving Institutions (MSIs). This effort is being led jointly by the MFC Chief Scientist and the TREAT Director, working in close collaboration with the INL Talent Acquisition team. Outreach activities were initiated with HBCU and Native American universities that offer engineering or science degrees (undergraduate or graduate) and will continue in FY-23.

3.3.3 Process

University engagement strategies are identified in each division's 5-year plan. Each division should identify universities and specific faculty that are strategic to their mission area and assign personnel to engage with those universities. Engagement should include recruiting of top-tier students and development of joint research programs. Specific funding strategies may need to be developed based on available funding sources. There may be overlap in the identification of strategic universities within MFC mission areas and with NS&T; these overlaps should be identified, communicated, and coordinated. Division personnel assigned to each university leverage resources in the INL University Partnership Program to meet division goals for university engagement. As described in Subsection 3.3.1, a university engagement template was created in FY-21 to facilitate capture of university and Vo/Tech institution strategies in the 5-Year Division Strategy plans.

3.3.4 Equipment/Tools

INL has a mature University Partnerships program that assists in university engagement through undergraduate and graduate internships, graduate fellowships, postdoctoral appointments, distinguished postdoctoral fellowships, and joint appointments. Training in effective mentorship is also provided.

Interaction with vocational/technical colleges tends to rely more on personal relationships that appear to be less effective in establishing a talent pipeline; these relationships could be strengthened by developing division specific engagement strategies in this area.

Indicators of MFC performance for university engagement are being tracked and should identify specific areas of improvement.

3.3.5 Actions FY-23

- Update university engagement strategies captured in Division 5-Year Strategy Plans. (MFC Division Directors, September 30, 2023)
- Work with University Programs to increase engagement with NTU. (Abdul Dulloo, September 30, 2023)

3.3.6 Looking Forward (FY-24 and Beyond)

- Annually update engagement strategies based on lessons learned and evolving needs for research and recruitment.
- Consolidate goals for university and vocational/technical engagement into a simple set of indicators that track progress against goals and identify areas where additional focus is needed.
- Offer graduate-level class to universities other than UC Berkeley.

4. STRATEGIC PLANNING

4.1 5-Year Mission Plan

4.1.1 A Look Back

In 2016, MFC issued its first Five-Year Science Strategy and its first Five-Year Investment Strategy (5YS). The Five-Year Science Strategy served the important purposes of defining MFCs core strengths; placing the varied MFC capabilities into the context of a single R&D site serving government, industry, and university R&D objectives; outlining key research and research infrastructure needs; and defining objectives for MFC as a user facility. Annual updates were informal and consistent with the INL Lab Agenda and Lab Plan, and strategies issued by NS&T and N&HS. The strategies from the other directorates are now issued documents, but in previous years the strategies were communicated informally. In 2019, the science strategy, INL/EXT-19-52612, was retitled the "Materials and Fuels Complex Five-Year Mission Strategy FY-19 – FY-23" to reflect the increasing emphasis on supporting private initiatives to develop and demonstrate new reactor and fuel cycle technology with the goal of technology demonstration through National Reactor Innovation Center (NRIC). The strategy continues to support planned research capabilities as a necessary factor for enabling new technology and maintaining the existing reactor infrastructure; for example, through DOE-NE and National Nuclear Security Administration (NNSA) technology development programs, Gateway for Accelerated Innovation in Nuclear (GAIN), and Nuclear Science User Facilities (NSUF). In the past, the document served as a helpful reference for mission and science objectives but was of limited strategic value. As such, the scope of the document was changed in FY-21 to better focus on strategy and associated actions. With input from MFC Leadership and DOE-NE-3 staff, the FY-21 edition was released in June 2021 and incorporated the following main changes:

- Adoption of an outcome-oriented strategy, focused on delivering five key outcomes
- Addition of a chapter on Risk
- Clearer description of alignment with higher-level DOE-NE and INL mission strategies
- Streamlined main body (37 pages vs. 84 pages), with detailed information moved to appendices.

There were two OMI actions associated with Strategic Planning in FY-22:

- GA 2022-0148; The MFC Chief Scientist will update the Five-Year Mission Strategy, with input from the MFC directors and ALD, as well as from key documents such as the DOE-NE Strategic Vision, INL Laboratory Agenda, INL Laboratory Plan, and NS&T and N&HS strategic plans. (Abdul Dulloo)
- GA 2022-0149; The MFC Chief Scientist will ensure the INL Laboratory Plan is communicated to MFC staff when it has been updated and released. (Abdul Dulloo)

The MFC Five-Year Mission Strategy Plan was issued in June 2022, completing the first action (GA 2022-0148). In light of the major changes made in FY-21, only minor updates were made to the FY-22 edition. For the second action (GA 2022-0149), the Chief Scientist communicated via email the release of the FY-22 INL Laboratory Plan.

4.1.2 People

The MFC Chief Scientist is responsible for the annual update to the Five-Year Mission Strategy, with support from the MFC directors and others. Support from MFC program support personnel and document preparation personnel has been excellent, and contributions from those roles should continue.

4.1.3 Process

The MFC Chief Scientist will initiate each annual update in accordance with the intended issue date communicated by the ALD. The MFC Mission Strategy will be developed to meet objectives as communicated through the DOE-NE Strategic Vision, INL Laboratory Agenda, INL Laboratory Plan,

NS&T strategy, and N&HS strategy. It is assumed that these documents translate DOE strategies into laboratory level actions. Each MFC division updates annually a 5-year division strategy informed by both 'bottom up' and 'top down' needs in response to DOE, Lab, industry, small business, and university needs. The content of those strategies will inform the MFC Five-Year Mission Strategy.

4.1.4 Equipment/Tools

The tools used for annual updates will consist primarily of the DOE-NE, Laboratory and mission directorate strategy documents, and collaboration tools, such as meetings, videoconferencing, group directories, and email.

4.1.5 Actions FY-23

- The MFC Chief Scientist will update the Five-Year Mission Strategy, with input from the MFC directors and ALD, as well as from key documents such as the DOE-NE Strategic Vision, INL Laboratory Agenda, INL Laboratory Plan. (Abdul Dulloo, June 30, 2023)
- The MFC Chief Scientist will ensure the INL Laboratory Plan is communicated to MFC staff when it has been updated and released. (Abdul Dulloo, September 30, 2023 [annually])

4.1.6 Looking Forward (FY-24 and Beyond)

- Annual updates will include an evaluation of core strengths of MFC as compared with national and laboratory needs for the development of nuclear energy, identifying needed updates of current capabilities and establishment of new capabilities
- The scope of the strategy will include a 10-year outlook, though the planning will continue to focus on actions for the upcoming 5-years.

4.2 5-Year Funding Plan

4.2.1 A Look Back

Funding for investments in infrastructure and scientific capabilities was minimal at best during the final years of Argonne National Laboratory (ANL) management of MFC and the early years of incorporation into INL. Historically, the appropriation to INL for Idaho Facilities Management (IFM) was limited to compliance-level operations and maintenance. Without the needed investment funding, facility reliability in all nuclear and radiological research facilities at MFC decreased. The MFC ALD commissioned a 5-year investment strategy to identify investments that increase facility reliability, increase experiment throughput, and expand DOE-NE test bed research capabilities. Subsequent increases in IFM appropriations for FY-18 through FY-23 provided additional funding to specifically address items identified in the MFC 5YS. This 5YS has been integral in communicating needs that address plant health and expansion of the DOE-NE Test Bed capability that supports the NRIC mission and GAIN initiative. To date, approximately $153 million in funding has been directed to support 5YS investments. Available funds have decreased significantly in the last 3 years down from a high of approximately $56M to approximately $11M for FY-23.

4.2.2 People

MFC has a Director of Projects to oversee 5YS projects and other strategic projects and initiatives, including execution of MFC's indirect portfolio and certain programmatic projects and activities (e.g., reactor demonstrations and enabling infrastructure). These projects range from operations and maintenance efforts to capital asset projects. Execution of these projects incorporates a graded project management approach dependent upon complexity and risk. Project managers are identified to lead each project and report status and progress directly to the Director of Projects. Project managers supporting the Director of Projects are either MFC staff or project managers matrixed through the INL Project Management Office, since increasing MFC staff size is a risk given the uncertain level of future funding for 5YS work.

MFC leverages matrixed support and staff augmentation subcontracts to support the level of resources necessary to execute 5YS projects. Engineering resources are stretched thin across MFC. Traditionally, resources at MFC are staffed to execute normal operations and maintenance. Staffing levels to execute the large increases in funding and scope have been generally less than adequate, and staff augmentation expertise specific to work execution in nuclear facilities is limited. Despite these challenges, significant improvements in resource support have been realized since the inception of 5YS work execution. Service subcontracts have been established to leverage staff augmentation resources to the extent practicable. Laboratory resources matrixed from other INL organizations, such as the INL Project Management Office, are also reducing staffing impacts.

Additional resource pressure will result from additional infrastructure funds received through the Inflation Reduction Act of 2022 (IRA). A budget of $65M was appropriated through the IRA to address NE infrastructure at MFC. This work will be executed from FY-23 through FY-27.

4.2.3 Process

The primary need for process improvement is advanced planning sufficient to improve the quality of scope and cost estimates included in the 5YS. The lack of adequate advanced planning has resulted in 5YS estimates that are generally significantly less than actual costs and take considerably more time than anticipated. This is a result of poor upfront scope definition and risks inherent in executing work in aging, operational facilities with ongoing R&D missions. These deficiencies create downstream financial risks and undermine federal sponsors' confidence in MFC's ability to execute important work. Additional effort and engineering support are essential to reduce uncertainty in scope and costs. MFC has established a limited indirect budget for pre-conceptual design planning (advanced planning) to define work scope and cost estimates more accurately.

Another process improvement is identifying candidate scope to add to out-year investment profiles. A CHC was formed with the objective to populate long-term asset management (LTAM) list focused on facility reliability/plant health scope. The CHC process has matured enough to generate and incorporate LTAM scope into the 5YS planning process. The manager of MFC Operations (U040) owns the CHC process. The individual Mission Directors are responsible for implementing the process, and the MFC ALD chairs the CHC meetings.

4.2.4 Equipment/Tools

Effective incorporation of the CHC LTAM process into the 5YS process.

4.2.5 Actions FY-23

- The MFC Projects Division will initiate advanced planning with the funds granted through the IPL. (Brady Orchard, September 30, 2023 [annually])

4.2.6 Looking Forward (FY-24 and Beyond)

No additional actions beyond FY-23 have been identified at this time.

4.3 Department of Energy Performance Evaluation Management Plan

4.3.1 A Look Back

The INL Performance Evaluation Management Plan (PEMP) establishes performance measures used by the DOE to evaluate the Battelle Energy Alliance, LLC (BEA) management and operations (M&O) of INL. The PEMP is incorporated into the BEA prime contract on an annual basis. The PEMP provides a standard by which to determine whether the INL contractor is responsibly managing the Laboratory and is meeting the mission objectives and performance expectations of the Department, as stipulated within the prime contract.

The PEMP defines Performance Goals, Performance Objectives, and a set of Notable Outcomes developed in accordance with expectations set forth within the prime contract, which provides evaluation criteria considered in determining the annual BEA award fee. The Notable Outcomes within the PEMP are developed in coordination with DOE Idaho Operations Office (DOE-ID) and DOE-NE program offices, as appropriate. Table 1 illustrates the FY-23 PEMP hierarchy and primary areas of MFC involvement.

Table 1. FY-23 PEMP Areas Strongly Influenced by MFC.

Goal	Objective	Notable Outcome
GOAL 1.0 Efficient and Effective Mission Accomplishment.	Objective 1.1: Nuclear Energy.	Notable Outcome 1.1. A – Microreactor Applications Research Validation and Evaluation.
		Notable Outcome 1. 1B – National Reactor Innovation Center Test Beds (LOTUS/DOME)
		Notable Outcome 1.1. C – Transient Testing/Advanced Fuels.
		Notable Outcome 1.1E – Portable Energy for Lasting Effect (Project Pele)
	Objective 1.4: Collaborations.	Notable Outcome 1.4B – NASA Programs.
GOAL 2.0 Efficient and Effective Stewardship and Operation of Research Facilities.	Objective 2.1: Provide effective Facility Design(s) as required to Support Laboratory Programs (i.e., activities leading up to CD-2).	Design of the west campus office building has been authorized.
	Objective 2.2: Provide for the Effective and Efficient Construction of Facilities and/or Fabrication of Components (execution phase, post CD-2 to CD-4).	Notable Outcome 2.2.A. – Construction and Commissioning of new facilities/capabilities: • Sample Preparation Laboratory: – In FY-23, the project will complete installation of the shielded enclosure steel walls and hot cell liners.
	Objective 2.3: Operation and Maintenance of Facilities.	Notable Outcome 2.3.A – ATR and MFC Infrastructure Investment for reliability improvement.
		Notable Outcome 2.3.B – Maximize EBR-II driver SNF receipts at MFC in support of the 2019 Supplemental Agreement milestone.
	Objective 2.4: Utilization of facility(ies) to provide	None specified.

Goal	Objective	Notable Outcome
	impactful S&T Results and Benefits to Internal and External User Communities.	
GOAL 3.0 Sound and Competent Leadership and Stewardship of the Laboratory.	Objective 3.1: Leadership and Stewardship of the Laboratory.	None specified.
	Objective 3.2: Management and Operation of the Laboratory.	None specified.
	Objective 3.3 Contractor Value-Added.	None specified.
GOAL 4.0 Sustain Excellence and Enhance Effectiveness of Integrated Safety, Health and Environmental Protection.	Objective 4.1: Provide an efficient and effective Worker Health and Safety Program.	None specified.
	Objective 4.2: Provide an efficient and effective Environmental Management System.	None specified.

4.3.2 People

MFC senior leadership works with DOE-ID and DOE-NE to identify Notable Outcomes specific to MFC in collaboration with the NS&T organization. This effort is updated annually and PEMP content changes annually with shifting research priorities and emergent research initiatives.

4.3.3 Process

The PEMP development includes a formal process led by the BEA Contracting Officer (CO) on behalf of the two Deputy Laboratory Directors and supported by the ALDs and senior leadership. PEMP language including Goals, Objectives, and Notable Outcomes are developed, negotiated, and agreed upon by senior management from DOE-ID, DOE-NE, and INL. Specific Notable Outcomes reflect each year's research priorities and initiatives. The PEMP is a contractual document that can be amended, through formal change control, as needed during the year. These amendments may be based on changes in priorities, funding allocations, or circumstances.

Progress on PEMP Goals, Objectives, and Notable Outcomes is formally submitted to DOE-ID on a triannual basis. This effort is coordinated by the BEA CO and staff on behalf of the Deputy Laboratory Directors. Various individuals across INL have been identified as technical leads for each section of the PEMP. The leads collect progress reports from individual program and facility staff, and summarize these into sections associated with each Goal, Objective, and Notable Outcome. The input is collected and assembled into a single PEMP Trimester report that includes proposed "grades" on progress for each Goal and Objective. The PEMP Trimester report is then submitted to DOE-ID. DOE-ID reviews the report and responds with their own evaluation and grades. Closeout meetings are held between INL and DOE-ID staff to discuss these grades, and instances where grades might vary significantly between INL and DOE-ID. The DOE-ID Field Office Manager makes the final determination on grades and the final trimester report is submitted through the two contracting offices. These final grades are the basis for establishing the award fee earned annually by BEA.

In addition to measures identified in the PEMP, individual research program milestones are established by the sponsoring organizations, usually DOE-NE program offices and by INL research program leaders and executing organizations such as MFC. These are collected by MFC into a Mission

Outcomes table that is used by MFC senior leadership to monitor performance at MFC. Performance against these milestones is monitored and reported monthly to MFC senior leadership, research program technical leaders, and DOE-ID MFC technical leads.

4.3.4 Equipment/Tools

No areas of weakness with either equipment or tools impact this area.

4.3.5 Actions FY-23

- Report on PEMP progress on a trimester basis during the fiscal year. (Tiffany Leavitt, September 30, 2023 [annually])

4.3.6 Looking Forward (FY-24 and Beyond)

No additional actions for beyond FY-23 have been identified at this time.

5. HUMAN PERFORMANCE IMPROVEMENT

5.1 A Look Back

MFC has made significant strides towards improving knowledge and integrating the philosophy of HPI into all activities performed by MFC organizations within the past 5 years. Individuals, leaders, and organizations have been encouraged to integrate HPI practices into daily work activities with the ultimate goal of reducing the frequency and severity of events triggered by human error. The development of GDE-863, "INL Human Performance Improvement Resiliency Guide," in 2018 formalized INL's commitment to this philosophy and has guided the strategy to increase knowledge and integration of HPI philosophies and tools. GDE-863 identified the INL's commitment to creating a capacity for resilience for and reduction of human error; "Resilience is not the absence of mistakes, errors, or failures, but the presence of defenses and controls." The guide also defined Critical and Risk Important Steps and introduced the use of the Resiliency Scale to be used when evaluating Critical and Risk Important Steps to assist in determining the organization's level of dependency on humans to manage the capacity for resilience to manage unwanted outcomes. Thus, building a capacity for resiliency or "Failing Safely."

Since the development of GDE-863, PLN-4479, "Human Performance Improvement Plan for the Materials and Fuels Complex (MFC)," has been revised to reflect MFC's commitment to integrating the philosophy of HPI as a core fundamental of its management model and underlying belief system. The updates to PLN-4479 identified the following:

- The core and advanced HPI training for all employees to learn and use
- The need for continued proficiency of a single subject matter expert (SME) as an MFC HPI Lead
- The expectation that the MFC HPI Lead will work with staff in each MFC division to assist with continued development of HPI Practitioners
- HPI Practitioners will help embed HPI tools and concepts with personnel in their divisions
- Continued evolution of a Just Culture as "a culture of trust, learning, and accountability" in which the primary purpose is to give people the confidence to report safety issues, knowing that the organization will respond fairly
- Developed goals, actions, and timeline to achieve the ideals of the plan.

5.2 People

The overarching goal for MFC has been to re-establish a baseline for fundamental HPI knowledge and tool usage by MFC personnel. Strong progress has been achieved in developing and establishing this baseline.

- HBK-104 was created in 2017 and has been revised to include the principles of Human Performance and Just Culture that were outlined in PLN-4479.
- Each employee at MFC has been provided a copy of the new and revised handbook.
- Continuing efforts shall be taken to have at least 80% of MFC employees attend the 0INL1757, "Human Performance Improvement (HPI) Introduction" course by the end of September 2023.
- MFC personnel have been identified to attend the 0INL1758, "HPI Tool Selection and Use," training. By the end of September 2023, at least 80% of those identified employees will have attended 0INL1758.
- Course 0INL1759, "HPI for Leaders and Supervisors," has been revised and is currently being taught as an advanced course for identified leaders. By the end of September 2023, at least 80% of those identified employees will have attended 0INL1759.

Strong progress has also been made regarding the development of the HPI program at MFC through the creation and identification of the following:

- Human Performance Improvement Academy has been created to support training of new personnel joining the HPI Team.
- A Lead HPI Practitioner has been identified for MFC and is moving forward with continuing the implementation of the goals outlined in PLN-4479.

MFC is also very fortunate to have two Procedure Professionals Association (PPA) Certified Instructors available on-site, one of which is part of the Maintenance group. The PPA writer certification program is based on Human Performance Principles that are proven to improve human performance and reduce errors by employing methods to write human factored procedures and work instructions. Several certification classes have been completed with MFC personnel as well as individuals from other facilities at INL. Overall feedback from these classes has been exceptionally positive with many attendees indicating a strong desire to incorporate the principles into writing and revising documents.

One of the PPA instructors has also created a Continual Document Improvement (CDI) group specific to the MFC Planning Department. This group focuses on building consistency in documents and assisting planners in continuing to develop abilities of human factor work controls. Through this influence, discussion regarding the functional application of HPI tools in documents has permeated all planning and work activities at MFC and continues to grow.

5.3 Process

Re-establishment of baseline knowledge of HPI tools by personnel has been strong. Reminders to use HPI tools can be found in many areas and applications throughout MFC.

- A 15-minute HPI Overview presentation is provided at every new hire orientation.
- HBK-104 is readily available to all MFC personnel in hard copy, on the MFC Home page, and on the Nucleus web page.
- HPI posters and information can be found in various locations throughout MFC.
- Use of fundamental human performance tools are incorporated in personnel activities such as pre-job briefings and planning activities. Course 0INL1816, “INL Human Performance Improvement Guide 863 Workshop,” was made available to personnel in both web-based training and classroom settings in September 2020. This course provides an overview of GDE-863 and helps participants implement HPI principles and create a “Capacity for Resilience” by reducing human error and creating the ability to fail safely with the use of defenses and controls.
- Additional HPI training opportunities and resources are available on the HPI Home page on Nucleus.
- Monthly HPI tools tailgates are developed to enhance understanding of various HPI for all personnel at MFC.

Improvement is needed in developing strong procedures and work control. Procedures and work instructions are the primary interface between humans and the asset, so functionally incorporating HPI into MFC documents is paramount to reducing error. Unfortunately, most procedures at MFC contain error precursors and put the performer in Knowledge Base, increasing the chances of human error to occur. The PPA Certification class teaches how to identify the error precursors in documents as well as human factoring methods that eliminate errors and significantly reduce the opportunity for unwanted events. Encouraging personnel that develop, write, revise, review, and use work control documents to become PPA Certified will eliminate error precursors in documents resulting in procedures that are more efficient with less opportunity for human error.

5.4 Equipment/Tools

Implementation of HPI tools at MFC has been adequate. However, improvement is needed in continuing to grow the knowledge of personnel in understanding and mastering the use of HPI tools. Error precursors such as perceived time pressures, fear of speaking up, not clearly understanding how to implement HPI tools, and situations that put personnel in Knowledge Base continue to challenge the effective use of HPI tools leading to events. There are several ways to reinforce and grow the knowledge base and use of HPI tools:

- Continue to establish and train HPI Practitioners in each directorate to assist in communicating effective use of HPI tools and strengthen the ability of personnel to effectively use HPI tools in challenging situations.
- Create more dynamic learning activities (DLAs) to expand personnel knowledge and reinforce the use of HPI tools.
- Encourage participation in PPA Certification classes to give personnel the knowledge to eliminate error precursors and Knowledge Based situations from MFC documents.
- Expand CDI groups to build consistency between all forms of work control and improve writers' skill at human factoring documents.

5.5 Actions FY-23

- Continue to ensure at least one individual from each division is qualified as an HPI Practitioner. (Shawn Hill, September 30, 2023)
- MFC personnel have been identified to attend the 0INL1758, "HPI Tool Selection and Use," training. By the end of September 2023, at least 80% of those identified employees will have attended 0INL1758. (Shawn Hill, September 30, 2023)
- Course 0INL1759, "HPI for Leaders and Supervisors," has been revised and is currently being used as an advanced course for identified leaders. By the end of September 2023, at least 80% of those identified employees will have attended 0INL1759. (Shawn Hill, September 30, 2023)
- Maintain at least one individual to be the primary procedure coordinator for each facility. (Tiffany Leavitt, September 30, 2023)
- Maintain certified procedure developers and writers to teach personnel how to functionally incorporate human factored wiring into procedures. (Tiffany Leavitt, September 30, 2023)
- Create and develop an HPI refresher course for MFC personnel to expand personnel knowledge and reinforce the use of HPI tools. (Shawn Hill, September 30, 2023)

5.6 Looking Forward (FY-24 and Beyond)

Evaluate the progress of FY-23 actions and adjust these actions to provide continued improvements.

6. CONDUCT OF OPERATIONS

6.1 Procedure Scope and Usage

6.1.1 Look Back

The productivity and output demand of the MFC Document Management (DM) organization has increased on a yearly basis over the past 5 years. New capabilities within facilities, new projects, and facility growth have been significant catalysts for driving the number of changes to MFC procedures and document processes.

Document Management's significant improvements since FY-17 include the following:

- Updated DM's processes to MFC's required standards from the Procedure Professional Association's PPA AP-907-005, "Procedure Writer's Manual," and incorporated those standards into MFC-ADM-0001, "MFC Procedure Writing Instructions" and MFC-ADM-0004, "Managing MFC Documents"
- Trained employees to the new processes
- Initiated rewriting MFC operation procedures
- Completed the PPA Trainer Certification course for one member of the DM team and certified four additional DM personnel and the Business Division director
- Identified key facility procedures to update to the new format through collaboration with facility Nuclear Facility Managers (NFMs)
- Improved writing instructions for Laboratory Instructions (LIs), Normal Operating Procedures (NOPs), and Maintenance Procedures (MPs) to strengthen employees' understanding of human factored writing and to build consistency within MFC's procedures
- Updated Use Types 1 and 4 to align with standards outlined by PPA that included the removal of Use Type 2 as an option for operating procedures
- Created a method for incorporating associated forms as attachments in procedures to align with PPA and HPI requirements
- Developed "Responsible Reviewer – Review Guidelines" as an HPI tool for the review of document revisions and periodic reviews.

Even though hundreds of procedures are executed daily at MFC appropriately, the understanding and implementation of Procedure Usage at MFC has room for improvement. Findings have identified that some recent events may have been prevented if procedures had been used correctly. Improvements have been made to enhance personnel's ability to maintain procedure compliance.

Some of the MFC-wide improvements since FY-17 include the following:

- Conducted training on procedure usage for new Document Management employees
- Employed Conduct of Operations Procedure use simulators (HuPerT)
- Continued training for employees to reinforce procedure compliance requirements
- Developed MFC00199, "MFC Procedure Rewrite," training. Over 90% of the identified target audience have completed the training
- Issued a revision to MFC-ADM-9600, "Conduct of Operations for Materials and Fuels Complex Facility Operations," for clarity
- Revision of MFC-ADM-0001 requiring all NOP's to be either Use Type 1 or Use Type 4 once the procedure is converted to the new format.

6.1.2 People

The DM staff are engaged, knowledgeable, and service-oriented, as demonstrated by continued support of the programs, projects, and operations at MFC.

Document Management has experienced very little increase in staff in the past 4 years. Although head count has remained fairly constant, turnover has been, and will continue to be, an issue. As of the beginning of FY-23, 50% of the DM staff have worked at MFC 3 years or less and another 15% are retirement age. Two employees accepted positions in other divisions of the lab but have been replaced. Two additional employees will be added to support Records Management and two additional employees to help the technical writers. Fiscal years 2020 through 2022 highlighted another tool for MFC DM, the ability to effectively conduct business while telecommuting. The ability to telecommute will be a useful tool in the coming years to increase the flexibility of the group to not only attract highly qualified members to fill vacancies but retain these members as well.

The changes to the procedure process require rewriting MFC's procedures to ensure the processes are correct and HPI tools are integrated. Currently, the facilities do not have enough staff to support the rewrite initiative. The workload has noticeably increased over the last 5 years due to:

- Revising MFC's procedure processes
- Converting procedures to the updated format
- The upsurge of daily work due to new facilities and new processes
- Increased awareness of MFC's requirements to produce well-written procedures with reduced error traps.

Document Management's workload is expected to continue to increase due to the 5-year plan rewrite initiative, the creation of new facilities, and the increase of new projects.

An understanding that procedure compliance and adherence is necessary to ensure the highest probability of safe and repeatable outcomes resonates through MFC. As discussed, efforts have been made to improve procedures over the past 5 years. Along with these improvements, efforts have been made to enhance personnel's procedure usage and adherence. A significant number of operations, research, and craft personnel have been hired in the last 5 years. Continual training has been conducted across MFC, as well as training new employees to the same standards.

6.1.3 Process

Document Management processes and procedures are continually improving, striving for safe and accurate work performance. Document Management and the MFC facilities are working to eliminate ambiguous information from procedures so workers can follow the instructions safely, efficiently, and accurately, allowing the MFC and INL missions to be met in a timely manner.

To improve human performance, MFC needs to functionally incorporate human factored writing into procedures, eliminate non-value-added information, and structure work instructions to emphasize critical information. Technology improvements, innovations, and training will be valuable assets to assist in continuous improvements while refining MFC processes.

In response to the revision of MFC-ADM-0001, facilities have identified challenges in making an effective transition of some Use Type 2 procedures to Use Type 1. This warrants some additional consideration regarding the transition to determine best practices, and/or whether some intermediate solution exists that will support continued utilization of Use Type 2 procedures.

6.1.4 Equipment/Tools

Tools and equipment for electronic procedures have progressed and are robust. Document Management needs enhanced technology to promote collaboration while creating/editing the procedures with customers.

Software upgrades for Asset Suite (AS) and Electronic Document Management System (EDMS) will increase efficiency, improve configuration management (CM), and enhance human performance.

6.1.5 Actions FY-23

- Issue the following administrative procedures: (Tiffany Leavitt, March 31, 2023)
  - MFC-ADM-0008, "MFC Abnormal Operating Procedure Writing"
  - MFC-ADM-0009, "MFC Annunciator Response Procedure Writing"
  - MFC-ADM-0013, "MFC Procedure Usage."
- Continue to strengthen employees' understanding of human factored writing to build consistency within MFC's procedures by improving the writing instructions for Abnormal Operating Procedures (AOPs), and Annunciator Response Procedures (ARPs) (ongoing through the MOPs, coaching, and mentoring). (Tiffany Leavitt, September 30, 2023 [ongoing])
- Configure the PowerBi database to track the correct procedures that need to be converted, and exclude the procedures that are format-driven by templates other than TEM-6MFC. (Tiffany Leavitt, September 30, 2023)

6.1.6 Looking Forward (FY-24 and Beyond)

- Link associated work documents (forms, logs, checklists, etc.) on EDMS that are required to perform a specific task/evolution.
- Work with Training to continually update, improve, and reinforce procedure adherence.
- Continue training selected facility/support personnel to PPA standards to learn the methods for functionally incorporate human factored writing into MFC's procedures.
- Evaluate the use of dynamic procedures.

6.2 Logkeeping

6.2.1 A Look Back

Logkeeping is controlled and directed by LWP-9600, "Conduct of Operations for the Idaho National Laboratory" and MFC-ADM-9600. MFC logkeeping practices have undergone significant changes recently to update the standards and expectations of paper logs (MFC-ADM-9600, Appendix B) and electronic logs (MFC-ADM-9600, Appendix C). Further analysis of individual facility logkeeping practices has revealed that compliance or noncompliance, noteworthy practices and/or improvement issues are varied and, in many cases, distinct to each facility. Observations and findings show there are still targeted areas that have room for more improvement than others, but overall logkeeping practices have substantially improved at MFC from 5-years ago.

Significant improvements from the past 5-years include:

- Between 2018 and 2019, logs were collected on three separate occasions and sent to all Shift Supervisors (SSs) and NFMs to review. This resulted in several facilities noting good practices from other facilities and adopting these practices.
- Training delivered a DLA that involved a member of the BEA Legal Department. The objective of the training was to stress the importance of log content when defending a court case.
- The majority of MFC related logkeeping problems stem from inadequate content. Most of the actions taken over the past 3-years have been targeted around obtaining better (more complete) daily content. The information contained in a log should provide enough detail to recreate the activities that occurred during the day.
- Recent revisions to MFC-ADM-9600 updated standards and expectations and added the section for electronic logkeeping.

- All MFC facilities transitioned to eSOMS electronic logkeeping during FY-22.
- An assessment was performed during FY-22 to compare current logkeeping performance to the gaps identified during the logkeeping assessment performed in 2020.

6.2.2 People

Overall, facility personnel have adopted and made logkeeping a priority. The most recent assessment identified there are still occasional gaps in information documentation, however significant improvements have been made. Continued focus on feedback from the SS/NFMs is needed to continue to improve performance.

6.2.3 Process

A logkeeping assessment was performed in FY-22 for all MFC facilities and the findings from that assessment was compared to the one performed in 2020. The majority of the findings identified in the 2020 logkeeping assessment were addressed with the transition to an electronic logbook (eSOMS). Items such as write-overs and illegible writing are no longer issues in the new format. However, some instances of missing information and not annotating late entries still exist. There was also a gap identified in the timeliness of logbook review and approvals. Overall, the quality of the logbooks was sufficient and met the requirements of DOE O 422.1, "Conduct of Operations," LWP-9600, and MFC-ADM-9600 but, there are still gaps that need to be addressed to be in full compliance.

6.2.4 Equipment/Tools

All facilities at MFC are currently using eSOMS for electronic logkeeping.

6.2.5 Actions for FY-23

- Based on performance gaps identified during the FY-22 logkeeping assessment, ensure measures are taken to improve the guidance in MFC-ADM-9600, Appendix B and C to align performance expectations across MFC. (Shawn Hill, June 30, 2023)
- Based on performance gaps identified during the FY-22 logkeeping assessment, ensure measures are taken to perform a refocus on standards and expectations contained in MFC-ADM-9600. The particular areas of interest are compliance with the guidance on late entries and log review/approvals. (Shawn Hill, June 30, 2023)
- Benchmarking: Improve baseline logkeeping performance across MFC by periodically communicating best practices observed at MFC facilities to the NFMs and SSs. (Shawn Hill, September 30, 2023)
- Performance Review: Improve baseline logkeeping performance across MFC by periodically reviewing facility logkeeping and providing feedback to the associated facility leadership. (Shawn Hill, September 30, 2023)

6.2.6 Looking Forward (FY-24 and Beyond)

As proficiency with eSOMS progresses, investigation into further mobile technology will be pursued to give operations and research personnel the ability to document activities in the eSOMS logbook while they are still in the field.

6.3 Turnover

6.3.1 A Look Back

Turnovers and assumptions of responsibility at MFC is a structured and organized process. From the facilities, to the roundsmen and security, all have a formal way of performing turnovers. In the past few years, MFC has increased its workload and added multiple buildings and facilities in which operational and backshift duties, and new personnel have increased. One of the key elements in communicating a turnover and assumption of responsibilities is the use of narrative logs. MFC has been working on a

continuous improvement agenda to train, coach, and improve the detail of the narrative logs in order to assist in proper turnover. The use of MOPs as a tool for identifying worker behavior issues with turnovers is apparent and critical when reviewing past performance. Key improvements that have been made to improve turnover are shown in Table 2. In addition, a key focus at MFC is on human performance. While performing turnovers and assumption of duties it is important to identify and address HPI concerns and consistencies. This focus has helped train and address key HPI issues involved in turnovers.

Table 2. Recent MFC Turnover Improvements.

MFC Turnover Improvements	
Procedures/Process Improvements • MFC-ADM-9600 • LWP-9600 • DOE O 422.1 • DOE O 422.1, Chg. 3 • DOE-HDBK-1226-2019	**Training/Qualification Improvements** • QNCOP001 – INL CONOPS CORE • MCQ1303L – CONOPS PINC 12 • 000INL93 – Standards of Conduct • 00INL869 – Laboratory Excellence Program Core Training • 0INL1471 – Walkdowns and Verifications
Technology Improvements • eSOMS electronic log systems to help with turnover and trending.	**Personnel Improvements Key Personnel Development** • Strategic Hiring • Continuous improvements using MOPs • Continuing training for Human Performance Improvements

6.3.2 People

MFC personnel are highly trained and capable professionals. With the increase of workload and growth at MFC over the past few years it has been necessary to increase the size of the support team. The retention of experienced employees is a concern with the possible loss of knowledge and expertise. Recent and future changes that are being discussed, along with active progression plans, will help change that trend. MFC has tried to be proactive in the hiring processes in the past to hire and train operations personnel to fill positions due to attrition, but it is an area to always be aware of.

6.3.3 Process

The turnover and assumption of responsibility process is acceptable, and with continuous improvement and continuing training it is becoming more consistent. The description of turnovers and assumption of responsibility within MFC-ADM-9600 and LWP-9600 is descriptive and detailed. The detail required for a good turnover may contain information as to current status of facility operations, maintenance activities in progress, abnormal system conditions or lineups, out-of-service equipment, existing problems identified by off-going shift personnel, and troubleshooting activities taken or in progress. Upon reviewing how the different facilities at MFC execute this process, it is apparent that the facilities differ in how the process is implemented. However, the key aspects lined out in MFC-ADM-9600 and LWP-9600 are being used consistently at all MFC facilities. The use of management observations for identifying issues and the associated coaching is documented well in LabWay. The use of the management observations and associated conditions as lessons learned improves consistency across MFC. Additionally, the continued use of HPI tools within the process will continue to reduce error likely situations. The continued facility-specific training on the process and compliance focus, within the facility, is shown by the operator ownership in each facility.

6.3.4 Equipment/Tools

The tools needed for the turnover process are strong and continue to change and develop. With the implementation of eSOMS logkeeping and the expected progression to using eSOMS for operator rounds, the opportunity to integrate turnover sheets into eSOMS (with facility/equipment status information) will exist.

6.3.5 Actions FY-23

- For each facility (as appropriate), evaluate the integration of a turnover sheet into their utilization of eSOMS. (Shawn Hill, September 30, 2023)

6.3.6 Looking Forward (FY-24 and Beyond)

- Continue to evaluate and improve upon MFC facility turnovers.

6.4 Operational Configuration Management and Status Control

6.4.1 A Look Back

In the past 5 years, MFC facilities have increased both staffing and operational tempo, performing more research related work than at any other time in MFC history. This has resulted in facility modifications and new equipment installation in nearly every nuclear facility at MFC. Managers and supervisors have been afforded several tools to understand the status of equipment in their facilities. In the past several years, MFC has provided two electronic equipment status tools (one is now only used by RadCon, the other is not used at all), a Standard Practice (SP-96.8.1, "MFC Control of Equipment and System Status"), an equipment alignment form (FRM-1387, "Miscellaneous System/Equipment Alignment"), and guidance on control of equipment and status through LWP-9600 and MFC-ADM-9600.

Facility NFMs and SSs were consulted on the effectiveness of their operational configuration management and status control practices, and each of the responding facilities felt confident in their ability to perform those functions effectively. The tools being used range from logbook turnover (every facility reported doing this), keeping an updated status board (either manually or with an automated electronic system), or utilizing SP-96.8.1 and FRM-1387 (some used these tools infrequently while others used them routinely to verify all components in every system in the facility on a scheduled basis).

In FY-22 major procedure developments were made to address vulnerabilities with facility programmable logic controllers. Defense in-depth strategies were added to prevent remote users from accessing facility components without proper authorization, configuration management, and work control. Another development in FY-22 included electronic equipment status tracking by the U&IS Operation team using the eSOMS Narrative Log turnover sheet.

While improvements were made, there is still ample opportunity for improvement. Latent organization deficiencies are still present regarding the management and timeliness of facility drawing updates. These latent deficiencies have been contributing causes in many of the LO/TO errors in recent years. Additionally, there have also been a few examples of less than adequate configuration management and status control regarding the interface between the facility and RadCon related equipment. In one instance, failure to adequately monitor the configuration of legacy equipment caused the building evacuation voice announcements to initiate, unnecessarily evacuating the Fuel Conditioning Facility (FCF) when power was removed from a bypassed Continuous Air Monitor control cabinet. The other event occurred when Radiation Area Monitors at Irradiated Materials Characterization Laboratory (IMCL) were in service but with expired calibration. Utilizing a configuration management and status control system that tracks vital equipment calibration requirements could have prevented these issues.

Operational configuration management and status control is occurring effectively in most cases across all facilities, but as past incidents show, the pursuit towards excellence must continue.

6.4.2 People

The importance of configuration management and status control is well understood amongst operations and research personnel. Nuclear Facility Managers continue to emphasize these values through management observations and reinforcing expectations. Facility Operators have adopted the responsibility to keep supervisors informed of equipment status changes and deficiencies.

To implement the requirements of DOE O 422.1, Paragraph 2, H and DOE-STD-1039-93, "Guide to Good Practices for Control of Equipment and Status Control," INL has incorporated required elements into LWP-9600, and again locally into MFC-ADM-9600, and TREAT-ADM-3955, "Conduct of Operations for the Transient Reactor Test (TREAT) Facility." Supplemental tools available at MFC include SP-96.8.1, and FRM-1387, which are used by both MFC and TREAT.

Ultimately, decisions regarding which systems require configuration management and status control and practicing diligence in using available tools to ensure configuration management and status control is performed is paramount to this system being successful. Managers must take a conservative approach when determining which safety systems and other support systems are important to the safe operation of the facility and require status control and operational configuration management. Managers should then formalize the list of systems and ensure operators and supervisors are trained and informed on the importance of maintaining configuration management and status control of these systems. Operators must inform supervision of changes and degradation to equipment, while supervisors must find an effective way to track changes/issues.

6.4.3 Process

The majority of the current configuration control processes and procedures are acceptable and continuing to improve. However, there is deficiency in the process for timely updates and management of facility drawings. Collaboration efforts between engineering and operations personnel are being made to address this latent organizational weakness. Future actions will have a special focus towards correcting this process gap.

Operations and computer engineering personnel have teamed up to manage the facility PLC interface and remote access to improve cyber security and configuration management. These efforts will continue as MFC moves towards more rigorous controls.

DOE O 422.1 states that the Control of Equipment and Status Control program must adhere to items (a) through (j) additionally, DOE-STD-1039-93 is a "Guide to Good Practices" that DOE contractors can use to perform Control of Equipment and Status Control, while allowing the contractor to find other ways to fulfill requirements, (a) through (j). INL and MFC (including TREAT) have incorporated these practices into LWP-9600, MFC-ADM-9600, TREAT-ADM-3955, SP-96.8.1, and FRM-1387. Ongoing efforts include incorporating best practices in the HPI behaviors, procedure usage, and tracking mechanisms at each facility.

Human Performance Improvement is an area of which the most advances could be made in terms of improved status control and operational configuration management. Operations supervisors need to utilize tools and systems that are intuitive and easy to understand in order to make informed decisions about the status of safety systems and systems that are important to the safe operation of the facility. This is an essential element of supervisors making decisions that reflect "safety first."

Furthermore, understanding how and when to use the status control and operational configuration management tools accurately will assist in procedure use and adherence, effective communication practices, verification practices, and a questioning attitude, which are all discussed in HBK-104.

Procedure use and adherence is important in that it provides operations supervisors with a tool to provide written guidance for equipment configuration, FRM-1387, and allows for the manipulation of individual plant components for specific reasons. This same tool also allows the operations supervisor to communicate, through written instruction, a way to configure plant components so that compliance with other operating instructions and procedures is possible. A combination of written guidance given by the

operations supervisor and approved operation procedures ensures that no components associated with safety are operated without written instruction.

The use of a methodical system of operational configuration management and status control provides a format for clear, concise, complete, and consistent communication and transfer of critical information, all of which are essential for effective communication practices. Status boards, miscellaneous equipment/system alignment forms, live building monitoring systems, and equipment status log entries are all useful tools for communicating the status of facility equipment and components.

On systems vital to safety or related to the safe operation of the facility, operations supervisors may need to employ a mechanism for confirming the position of equipment in those systems. FRM-1387 provides operations supervisors with a tool to give written instruction to operators to perform concurrent or independent verification on any system/component whose configuration may be in question. These verification practices are an important HPI tool that operations supervisors need in their tool kit. Operations supervisors should deploy this tool when error precursors such as unexpected equipment conditions, changes from the routine, confusing indications, and out-of-service indications or equipment exist.

Clear and easy to understand tools for determining the status and configuration of important systems (status boards, checklists, schematics, electronic monitoring systems, etc.) also provide operations supervisors the opportunity to question systems that do not look right. If the tools are easy to use, then the operations supervisor can easily ascertain when systems are not aligned as they normally are or see how out-of-service equipment may affect other components in the same or adjacent systems. A questioning attitude regarding plant conditions is easier to cultivate when a clear picture is provided.

6.4.4 Equipment/Tools

Operations supervisors currently have several tools available to perform adequate status control and operational configuration management. However, these tools would still benefit from improvements, or at least could be employed in appropriate situations more often. Some facilities would benefit from a more robust form of status control, such as a P&ID used as a status board or converting from a manual status board to a live-updating electronic one. Ultimately, the individual Facility Supervisors and Managers will need to determine which form of status control and operational configuration management is appropriate. Internal benchmarking will be leveraged to provide an opportunity for each facility to evaluate best practices amongst MFC facilities. These methods will be communicated and evaluated by the Nuclear Facility Managers to determine what enhancements will be pursued.

6.4.5 Actions FY-23

- Develop a strategy for more timely updates to facility drawings to improve configuration management reference documents being referenced for system status, maintenance, and modifications. (Shawn Hill, September 30, 2023)
- Explore eSOMS capacity for configuration management and status control. (Shawn Hill, September 30, 2023)
- Perform internal benchmarking for best practices in configuration management/status control. (Shawn Hill, September 30, 2023)

6.4.6 Looking Forward (FY-24 and Beyond)

- Assess the current level of training regarding Operational Configuration Management and Status Control.
    - If additional training is deemed necessary, then develop training for operations supervisors detailing the importance of status control and operational configuration management.
    - This training should include an overview of the facility specific tools currently used and additional tools that are available and should also give scenario-based exercises that help illustrate the usefulness of these tools.

- Discuss lessons learned from configuration management and status control shortcomings in the past.

- NFMs and operations supervisors should review SP-96.8.1 and determine its applicability to each individual facility.
  - Review and formally declare which systems require status control and operational configuration management (all safety systems and support systems that affect the safe operation of the facility are required to adhere to the status control and operational configuration management program).
  - Document these systems and the method of status control/operational configuration management to be used with each system in the facility's administrative requirements procedure (systems that are operated in accordance with an approved operating instruction do not necessarily require status control updates unless the procedure is paused or interrupted).
- All facility managers and supervisors should/may consider bringing automated electronic status monitoring into their facilities to the maximum extent possible.
  - Facility upgrades and updates should preferentially include equipment with the capacity to incorporate into an electronic system.
- Consider including status control and operational configuration management discussions with all potential supervisors and operations managers (internal or external hires).

6.5 Lockout/Tagout

6.5.1 A Look Back

In the last 5 years, MFC has had marked improvement in the Lockout/Tagout (LO/TO) program performance based on actions taken to improve facility conditions, employee knowledge, and process rigor. These actions included corrections of multiwire branch circuits, improved system drawings, training, procedure improvements, and more rigorous procedure use and adherence. While the majority of recent LO/TOs have been successful, there are still cases where personnel fail to identify the hazard during the planning phase, or where the process is not properly implemented.

Regarding MFC-specific lessons learned over the last 5 years, LO/TOs have been identified as needing improvement in the areas of procedure use and adherence, and in utilizing HPI tools when executing the LO/TO process. When the procedure is executed properly, employees can adequately perform LO/TOs in a safe and compliant fashion. Proper use of the procedure as a tool for the performance of LO/TO activities will help prevent future LO/TO issues. Dynamic learning activities relating to procedure use specific to the performance of LO/TOs could provide opportunities to improve personnel performance at MFC for LO/TO work.

In addition to proper procedure use and adherence, other LO/TO lessons learned identified a significant number of human performance behavioral issues. Questioning attitudes and the use of STAR (Stop, Think, Act, Review) principles were noted in recent MFC LO/TO events as areas for improvement. Utilizing HPI tools and practicing proper conduct of operations principles will improve the execution of LO/TOs at MFC.

In the last 2-years, the following actions were taken to improve LO/TO implementation and performance:

- "A Timely Order to Operators" was published to provide independent review of the LO/TO planning process and independent review of the LO/TO ensure isolation devices were correctly positioned and LO/TO devices were correctly installed. The timely order also described a new engineering process to revise or create needed drawings in a timely manner.
- An MFC LO/TO Committee was formed, and a charter (CTR-493, "MFC Lockout and Tagout Committee") was developed and published to promote and achieve consistency and excellence in the execution of LO/TO activities at MFC.
- MFC Training created and implemented DLAs to support LO/TO performance.

- MFC Training developed a DLA to help with identifying and locating drawings required for LO/TOs.
- A LO/TO procedure rewrite group consisting of MFC operations, maintenance, and engineering personnel was convened to identify shortcomings in the current SP-94.0.0, "MFC Lockouts and Tagouts Supplement to LWP-9400," and to provide a procedure/process that would limit pitfalls/HPI errors.
- MFC-ADM-9400, "MFC Lockouts and Tagouts, Supplement to LWP-9400" was developed and is currently in the EDMS review process. The new procedure is used for reference and LO/TO implementation will be through the use of HPI forms.

6.5.2 People

Lockout/Tagout qualified personnel are professional and knowledgeable in their specific fields. These fields vary between qualified electrical workers, mechanics, radiological control personnel, and operations. The LO/TO program is specifically required under 29 CFR 1910, "Occupational Safety and Health Standards," and is one of the top safety programs in any industrial industry. Personnel safety is a top priority to INL and MFC. The personnel at MFC are the greatest asset to the organization, and as such, the LO/TO program is of the upmost importance to keep personnel safe.

The MFC LO/TO Committee will remain cognizant of LO/TO issues and has the authority and responsibility to correct these issues. The committee will continue to look at trends, perform periodic observations, and crosscut throughout different facilities to collect positives and negatives. The committee will develop activities to ensure correct LO/TO actions are kept at the forefront of personnel's minds by encouraging positive reinforcement. By focusing on positive reinforcement, instead of working in reactive mode to an abundance of issues, the MFC LO/TO committee will work to decrease LO/TO incidents. Additionally, the committee is responsible for recognizing personnel for outstanding LO/TO performance, and being involved in the development of LO/TO seminars, newsletters, etc. A special emphasis on reinforcing positive behaviors is important since human tendency is to follow routines.

6.5.3 Process

The LO/TO processes and procedures are acceptable and are continually improving. One of the improvement process goals includes identifying areas of the program that can be simplified and made easier to use, while still maintaining the rigor needed to ensure personnel safety from energy sources. The use of HPI tools and Human Factored Documentation will improve the clarity and usability of the LO/TO program. Additional resources or outside programs will be evaluated to consider other options or methods used to further develop the program and may lead to the development of a simpler LO/TO plan and better HPI tools. The goal is to minimize the amount of information personnel need to review when generating an adequate LO/TO.

6.5.4 Equipment/Tools

Tools and equipment for LO/TO are effective and reliable. With few exceptions across MFC, aging equipment and/or unknown changes to facility design over the past 40 years has been a significant battle for properly isolating hazards prior to performing work. Most facilities have the equipment and tools that are needed to fulfill mission goals safely and successfully. To increase HPI and efficiency, additional equipment, tools, or facility modifications are being performed to provide better understanding of the hazards and how to control them.

Equipment, system upgrades, and tools that will increase efficiency and human performance will be part of the new process that is being evaluated. New software capabilities, such as LO/TO plans developed using AS or other similar software, should be evaluated, and developed for future capabilities. Utilizing these software systems will decrease the likelihood of human error and realign MFC with private industry standard practice.

6.5.5 Actions FY-23

- Streamline LO/TO preparation documentation by using Human Factored Documentation. (Shawn Hill, December 1, 2022)
  - Complete publication of MFC-ADM-9400 and associated checklists.
- Evaluate the effectiveness of MFC-ADM-9400 and associated checklists by performing focused observations on field implementation. (Shawn Hill, June 30, 2023)
  - Discuss program effectiveness during LO/TO committee meetings to evaluate and provide feedback for program improvement agenda.
- Improve MFC personnel proficiency, awareness, attitude, and training regarding the LO/TO program. (Shawn Hill, September 30, 2023)
  - Develop, and begin implementation of, a plan for training improvement that includes MFC-specific topics for LO/TO personnel, as well as affected employees and line management.
  - Evaluate and provide suggestions to the INL training department for improvement of LO/TO training, as well as developing a LO/TO continuation training program (using the LO/TO advisory group).

6.5.6 Looking Forward (FY-24 and Beyond)

- Develop software options for LO/TO preparation.
  - Assist Engineering and Business Management in building/developing an electronic process for LO/TO preparation generation for standard preventative maintenances (PMs), as a method to improve HPI practices.
  - Implement the new electronic process and create procedures as the tools are developed.

6.6 Safety Basis Document Implementation

6.6.1 A Look Back

A review of how MFC is implementing Safety Basis documents, Safety Analysis Reports (SARs) and Technical Safety Requirements (TSRs), in the facilities was conducted; this review looked at where MFC was in the past, where it is today, and how it can improve in the future.

Based on this review, incremental improvements have been accomplished over the past few years in implementation activities at MFC through the use of MFC-ADM-0012, “Annual and Triannual Updates to MFC Nuclear Facility Safety Bases,” and MFC Safety Basis Implementation Matrix (SBIM) processes. The triennial review provides a focused mechanism to evaluate the safety analysis, TSR bases and verbiage, and supporting safety basis documents. The SBIM is an effective tool for ensuring phases of SAR/TSR development support implementation of controls in each facility.

Feedback from some NFMs conclude that phase 1 of the SBIM should be refined and streamlined due to duplication and need to incorporate best practices from previously performed and successful implementations to continually improve the process.

The INL ISRC Chairman and team completed all required SAR/TSR annual and triennial reviews to support timely submittal to DOE-ID in FY-22. There were 24 SAR/TSR submittals in FY-22 meeting all scheduled deliverables.

In early FY-23 it was discovered that TSRs at FCF material at risk (MAR) controls were not implemented fully from the 2013 approval and implementation of the safety basis. The Potential Inadequacy in the Safety Analysis (PISA) process was entered (MFC-USQ-2022-702) and determined that the safety basis did need to be revised. The SBIM process was not in place at the time of initial implementation, but the triennial review of the safety basis as implemented in MFC processes, identified this gap in FY-23. Utilizing a thorough review cycle, the triennial review was able to catch this gap enabling FCF operations to improve implementation. More data will be collected from the triennial

review and submittal of the remaining safety basis.

INL identified and categorized facilities at MFC that meet the requirements of Hazard Categories and published that list in LST-715, "INL Hazard Category 1, 2, and 3 Nuclear Facilities." Those facilities are listed in Table 3 below.

Table 3. MFC Facilities categorized as Hazard Category 1, 2, and 3 Nuclear Facilities.

No.	Facility/Activity Name Hazard Category	Building(s)/ Structure(s)	SAR/TSR
1.	Analytical Laboratory (AL) Hazard Category 3	MFC-752	SAR/TSR-401
2.	Fuel Conditioning Facility (FCF) Hazard Category 2	MFC-709/765	SAR/TSR-403
3.	Fuel Manufacturing Facility (FMF) Hazard Category 2	MFC-704	SAR/TSR-404
4.	Hot Fuel Examination Facility (HFEF) Hazard Category 2	MFC-785	SAR/TSR-405
5.	Irradiated Materials Characterization Laboratory (IMCL) Hazard Category 2	MFC-1729	SAR/TSR-418
6.	Material Security and Consolidation Facility Hazard Category 2	CPP-651	SAR/TSR-416
7.	Neutron Radiography Facility (NRAD) Hazard Category 2	MFC-785	SAR/TSR-406
8.	Radioactive Scrap and Waste Facility (RSWF) Hazard Category 2	MFC-771	SAR/TSR-407
9.	Remote-Handled Low-Level Waste (RHLLW) Disposal Hazard Category 2	B21-630/632	SAR/TSR-419
10.	Space and Security Power Systems Facility (SSPSF) Hazard Category 2	MFC-792A	SAR/TSR-408
11	Transient Reactor Test Facility (TREAT) Hazard Category 2	MFC-720 MFC-724	SAR/TS-420
12.	Zero Power Physics Reactor - Reactor Cell/Workroom/Vault (ZPPR-RC-W/V) Hazard Category 2	MFC-775/776/777	SAR/TSR-412

There are also several nuclear transportation activities that fall under the Hazard Categorization of level 3 and above that impact MFC, shown in Table 4.

Table 4. Nuclear Transportation activities at MFC that are Hazard Category 3 and above.

No.	Facility/Activity Name Hazard Category	Safety Bases
1.	Intra-INL Transportation and MFC Inter-Facility Transfers Hazard Category 2	SAR/TSR-413
2.	Transport Plan for Transfer of Material between MFC, ATR Complex, and AMWTP Hazard Category 2	PLN-3243
3.	Transfer of EBR-II Driver Fuel between INTEC and MFC Hazard Category 2	PLN-3524
4.	Transport Plan for the Transfer of SFTP Between MFC and INTEC Hazard Category 2	PLN-4517
5.	Transport Plan for the Transfer of the BRR Cask Hazard Category 2	PLN-4518
6.	Transport Plan for the Transfer of Irradiated Experiments between ATR and HFEF Hazard Category 3	PLN-4609
7.	Transport Plan for the Transfer of the 55-Gallon RH-TRU Overpack Hazard Category 2	PLN-4949
8.	Transport Plan for the Transfer of RH-LLW in the HFEF-5 Cask Hazard Category 3	PLN-5495

The SPL PDSA-423 is approved to support construction of the Hazard Category level 3 (HC-3) nuclear facility supporting structural material analysis.

All facilities identified had safety basis documents prepared as required by DOE per 10 CFR 830, “Nuclear Safety Management - Quality Assurance Requirements.” MFC facilities upgraded their safety basis documents to meet DOE-STD-3009-94, “Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis,” during the past several years to meet the 17-chapter format and guidelines of that document. Major changes to safety basis documents are driving updates to the DOE-STD-3009-2014 format and new nuclear facilities coming online. Facilities that have been or are being updated to DOE-STD-3009-2014 include IMCL, SPL, and FCF.

MFC safety analysis documents are now standardized with a few exceptions.

- NRAD followed DOE-STD-3009-94, with appropriate consideration of format and content for research reactor safety analysis reports as described in GDE-470, “Documented Safety Analysis (DSA) Conversion Guide for the Neutron Radiography Reactor Facility (NRAD).”
- TREAT followed Reg. Guide 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants,” and NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.”
- Transportation safety basis documents, which include SAR/TSR-413 and other Transportation Plans, followed 10 CFR 830 Subpart B, DOE-STD-3009-94, DOE-STD-1027-92, “Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports,” DOE O 460.1D, “Hazardous Materials Packaging and Transportation Safety,” and PDD-2500, “INL Transportation Safety Document (TSD).”

SAR-400, "INL Standardized Safety Analysis Report" and TSR-400, the INL Standardized SAR and TSR, were also developed in the standardized format based on DOE-STD-3009-94. These documents were developed to relieve the repetition each facility would have in certain chapters of the facility SAR. SAR-400 and TSR-400 deal with standardized definitions and usage rules, generic limiting conditions for operations (LCOs) and surveillance applications, and other common areas such as siting, INL-wide programs, and emergency response.

In 2018, Office of Nuclear Assurance (ONA) performed a TSR Implementation Review at MFC, TREAT, and Advanced Test Reactor (ATR). ONA teamed with representatives from each complex to develop scenario-based questions that tested conceptual knowledge of TSRs. Generic hypothetical questions were developed to assess performance across facilities applying the general LCOs and SRs, as well as facility-specific questions to ensure operators had sufficient knowledge to navigate their facility's TSRs. Results indicated a weakness related to SAR/TSR-400 knowledge.

A periodic review was conducted at MFC during Quarter 2 of FY-22 for SAR/TSR-400 level of knowledge and was completed by ONA in February 2022, similar to that completed in 2018.

ONA conducted TSR level of knowledge interviews of the NFMs at MFC in February 2022. Fifteen qualified NFMs and three NFMs in training were interviewed by a panel of current and former ONA Nuclear Inspectors. The NFMs in training were included in the interviews for their own professional development. Their responses are not included in this report. The level of knowledge interview utilized scenario-based questions to evaluate usage of facility specific TSR and TSR-400 applications. Additionally, questions evaluating general TSR usage principles were included. Recommendations from the report include:

- Strengthen formal TSR usage training at the NFM level
- Re-enforce the regular use of facility specific TSR and TSR-400, rather than relying on memory
- Strengthen the verbiage in TSR-400 to require facilities to include delay period usage in their TSR if they intend to use it (i.e., change should to shall)
- Clarify implications of the use of the 25% extension time
- Conduct a proficiency evaluation for facilities that rarely enter specific facility modes prior to entering those modes.

6.6.2 Process

10 CFR 830, Subpart B, "Safety Basis Requirements," establishes safety basis requirements for Hazard Category 1, 2, and 3 DOE nuclear facilities. The MFC facilities that have been categorized as Hazard Category 1, 2, and 3 can be found in Table 3 above. The MFC activities categorized Hazard Category 3 or above can be found in Table 4 above. Furthermore, 10 CFR 830 requires that the contractor must perform work in accordance with the DOE-approved safety basis for a Hazard Category 1, 2, or 3 DOE nuclear facility and, in particular, with the hazard controls that ensure adequate protection of workers, the public, and the environment.

The contractor responsible for a Hazard Category 1, 2, or 3 DOE nuclear facility must establish and maintain the safety basis for the facility. In establishing the safety basis for a Hazard Category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must:

- Define the scope of the work to be performed
- Identify and analyze the hazards associated with the work
- Categorize the facility consistent with DOE-STD-1027-92
- Prepare a DSA for the facility

- Establish the hazard controls upon which the contractor will rely to ensure adequate protection of workers, the public, and the environment.

6.6.3 Actions FY-23

- Add Asset Suite Engineering Change (EC) training to FY-23 continuing or gap training to increase proficiency. (Tiffany Leavitt, June 30, 2023)
- Incorporate a designated NFM into periodic reviews and inspections of INL SAR/TSR-400 SMP reviews. Communicate results to NFMs site wide. (Roberta Jordan, June 30, 2023)
- Complete conversion of MFC Criticality Control Lists to Safety Management Program TSRs in accordance with 3-year review of MFC DSAs. (Tony Koonce, June 30, 2023)
- Improve and increase training, and level of knowledge in facility-specific safety basis documents and the INL SAR/TSR-400 document, including evaluation, and diagnostic skills. Recommend adding SAR/TSR-400 to the NFM continuing training program, where appropriate. (Tiffany Leavitt, June 30, 2023)

6.6.4 Looking Forward (FY-24 and Beyond)

- Continue to monitor, identify, and address deficiencies in MFC SAR/TSR content and implementation.
- Institutionalize NFM participation in INL SAR/TSR-400 SMP periodic reviews long-term. Adding NFMs across the INL will bring hands-on perspective and provide feedback into the SAR/TSR program management.

7. RADIOLOGICAL PROTECTION

7.1 A Look Back

Radiological Controls (RadCon) performance at MFC is strong. Over the last 5 years Radiological Work (RadWork) has continued to increase and Radiological Issues (RadIssues) have continued to decline. Technology upgrades have allowed for more reliable measurement capability and efficiency increases throughout the organization. Detailed facility characterization has been performed to clearly define source term and refine controls. With few exceptions throughout the last 5 years, performance has improved, and issues have decreased, which has resulted in providing consistently safe, efficient, and reliable radiological coverage and compliance surveys to support the INL and MFC mission.

Since FY-16 many improvements have been made to the MFC RadCon organization. The more significant improvements include the following improvements in Table 5.

Table 5. MFC RadCon significant improvements from FY-16 to FY-22.

MFC RadCon Improvements		
Air Sampling Improvements • Barcode accountability • Electronic database • Air-Flow Studies of each facility • Instrumentation upgrades and understanding increases (iCAMS and Alpha 7a Upgrades).	**RadCon Count Room Improvements** • Automatic data entry • Direct link to air sample database • Barcode readers on instruments • Alpha spectroscopy capability • Significant software upgrades • Aegis HPGe detection capability purchased to support Tier 2 release • Series 6LB Proportional Counter purchased.	**Dosimetry Improvements** • Increased routine measurement periods • Dosimetry requirement reductions • Nano-Dots for extremity estimation.
Technology Improvements • Real-time boundary monitoring • Radiation Area Monitor upgrades (ongoing) • Continuous Air Monitor upgrades (ongoing) • Electronic Dosimetry upgrades • Handheld Detector upgrades • Electronic Forms (several) • Electronic Radiation Work Permit approval • SENTINEL upgrades • Radiation Generating Device/Source Database • Modernized	**Training/Qualification Improvements** • Incorporated key radiological aspect courses into GDE-880, "Key Radiological Aspects for MFC Facilities" • Eliminated classroom trainings • Streamlined the qualification process • Created field office qualifications • Implemented RadWorker awareness campaign • Established MFC RadCon Continuing Training Plan.	**Radiological Control Improvements** • Increased contamination control device capabilities • Reduced RadCon coverage requirements • Reduced routine survey requirements • Streamlined radiation work permits • Defined and refined Soil Handling • Evaluated and implemented new gloves and gauntlets for Manipulator Repair Group gloveboxes.

MFC RadCon Improvements		
contamination detection instruments: iPCM12, Ludlum M-215, Sirius 5 HFM, Bladewerx ASM.		
Facility Characterization Improvements • Characterized and defined source term for nearly all facilities • Updated Underground Radioactive Material Area Map • Defined Underground Radioactive Material Area Controls • Updated Glovebox classifications.	**Procedure/Process Improvements** • MCP-139, "Radiological Control Surveys and Logkeeping" • MCP-9, "Radiological Control Log Keeping" canceled, information was combined with MCP-139 to streamline requirements • MCP-187, "Radiological Control Posting and Labeling" • LI-15002, "Radiological Control Activities and Norm Determination at MFC" • EPI-56, "MFC Facility Emergency Radiological Monitoring" • LWP-15017, "Radiological Release Surveys" • ALARA Goal Changes • MCP-3352, "Temporary Shielding" • GDE-906, "Good Radiological Work Practices."	**Personnel Improvements** • Key personnel development • Key strategic hires • Hiring strategy refined • Succession planning • Multiple certifications obtained • Multiple degrees obtained

7.2 People

RadCon staff are engaged, knowledgeable, and service-oriented, and are capable of supporting the mission and goals of MFC today and tomorrow. RadWork at MFC has continued to increase and future growth is anticipated as more facilities are brought online. In FY-21, RadCon hired a computer software engineer to support the current and planned technology upgrades in processes and equipment at MFC.

Although head count has not increased much, turnover has been, and will continue to be, an issue. Over 60% of Health Physics Technicians (HPTs) have worked at MFC 5 years or less. Roughly 40% of Radiological Engineers have worked at MFC 5 years or less. The RadCon Management team is also young, having significantly changed in FY-20 and again in FY-22, including changes to the MFC RadCon Manager position and a Field Manager position. While retention of employees has been an issue in the past, recent changes (FY-20) to pay grades and progression plans aim to change that trend. Attrition, due to retirement/age, will pose a significant challenge to RadCon over the next 5 years. A 5-year staffing plan has been developed to counter that challenge.

Over the last 5 years, RadCon and RadWorker training has been acceptable to maintain qualifications, but significant improvement is needed to address upcoming work and to increase human performance. RadCon Training needs to improve proficiency in facility-specific areas, whereas RadWorker Training needs to improve in general proficiency and understanding. RadCon and RadWorker decision-making,

with few notable exceptions, has been acceptable. However, events such as the elevated airborne contamination event in HFEF March FY-22, the Radiochemistry Laboratory contamination events in August of FY-19 and July of FY-22, multiple personnel, and equipment contamination events at IMCL, and multiple qualification lapses and boundary violations throughout FY-20 indicate that increases in MFC personnel training, awareness, attitude, and proficiency are needed. RadCon proficiency and understanding, as well as RadWorker understanding and awareness, will increase as the RadCon organization continues to focus on continuous improvement throughout the program.

7.3 Process

RadCon processes and procedures are acceptable, and continued improvements are being made to make these processes and procedures strong and efficient. RadCon program managers diligently work to streamline procedures and processes. In FY-21 and continuing through FY-22 that included changes to several procedures and processes, including survey completion and documentation as well as an improved temporary shielding procedure. RadCon Management is committed to identifying additional areas in which improvements can be made.

To improve human performance in RadCon, streamlining of RadCon documentation is needed, technology improvements and innovation must continue, and the previously mentioned increase in training, awareness, attitude, and proficiency are all critical. To improve processes and procedures in RadCon, continued diligence and constant improvement in the program is needed.

One of the more significant RadCon organization initiatives is the programmatic addition of an irradiated and volumetrically contaminated materials release program. This process uses the Tier II release process methodology as described in DOE-STD-6004-2016, “Clearance and Release of Personal Property from Accelerator Facilities,” and the recently approved ANSI N13.12-2013 screening levels as the pre-approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property. This process has been under evaluation by the RadCon Home Organization for several years.

A Technical Basis Document was written documenting the use of the In Situ Object Counting System (ISOCSTM) characterized AegisTM High Purity Germanium (HPGe) detector in conjunction with a low background shielded enclosure to provide the appropriate detection capabilities to assay volumetric radioactivity at levels specified in ANSI/HPS N13.12 2013.

DOE Operating Experience Level 3 OE-3: 2021-01 March 2021, “Implementation of Pre-Approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property at DOE Field Elements,” provides for the use of ANSI 13.12-2013 volumetric levels as DOE O 458.1, “Radiation Protection of the Public and Environment,” pre-approved authorized limits for the release of personal property with potential volumetric contamination. The use of the ANSI 13.12-2013 values requires the approval of the DOE-ID Field Element Manager and issuance of technical guidance from DOE. A DOE Technical Standard, “Implementing Release and Clearance of Property Requirements” is currently in RevCom for review and approval. It is anticipated to be approved early in FY-23.

BEA will request DOE-ID Field Element Manager approval for the use of ANSI 13.12-2013 volumetric radioactivity screening levels for clearance as pre-approved authorized limits for the release of potentially volumetrically contaminated personal property after the Technical Standard is approved.

The RadCon Home Organization is working concurrently with the DOE Field Element Manager to obtain required approval of the derived (INL specific) DOE O 458.1compliant Tier II release process. Once completed, process changes, training, and procedure improvements to facilitate the new release program will be rolled out. This action was first added to the MFC RadCon Improvement Agenda for FY-21 and the level of support will continue through FY-23 with expected project completion and implementation scheduled for September 2023.

7.4 Equipment/Tools

Tools and equipment for RadCon are continuously improving and some of the most advanced instruments are currently deployed into the field. With few exceptions across MFC, obsolete equipment

has been replaced and technology improvements are ongoing. All MFC facilities have the radiological equipment and tools necessary to fulfill mission goals safely and successfully. However, some facilities are lacking upgraded instrumentation or are lacking instrument quantities to be truly efficient. Since facilities are lacking in radiological equipment and tools, the MFC RadCon Organization has worked with facility management to increase, and standardize, radiation detection equipment. Installation of new equipment that is on-site in the remaining facilities is necessary for completion. To increase HPI efficiency, RadCon equipment is being connected together via a network to be easily accessed from any networked computer. Networking RadCon equipment will allow faster recovery of facilities, greater reliability of detection and equipment, and an ability to efficiently view and evaluate radiological conditions in facilities. The cost estimates for implementation of HORIZON in MFC facilities have been provided to the MFC divisions. Approval is needed from the divisions in order for HORIZON to be installed for full implementation across MFC.

Further equipment and tools that will increase efficiency and human performance include upgraded stack counters in the RadCon count room as well as completion, and full implementation of the HORIZON network, gamma and alpha spectroscopy capability additions, liquid scintillation counting equipment upgrades, and computer and IM upgrades for RadCon.

7.5 Actions FY-23

- Streamline RadCon documentation:
  - Coordinate with the RadCon Home Organization to implement the new RadCon Log Survey Application including procedure changes, training, and development of a user's guide. (Alan Carvo, September 30, 2023)
  - Implement RadCon Log Survey Application. Improve MFC personnel proficiency, awareness, attitudes, and training regarding RadCon. (Alan Carvo, September 30, 2023)
  - Continue to cross-qualify HPTs in multiple field offices. (Alan Carvo, September 30, 2023)
- Improve RadCon's processes and procedures:
  - Continue to support RadCon Home Org in development and deployment of automated Instrument 441.XXX Forms. (Alan Carvo, September 30, 2023)
  - Select and Hire a RadCon Mentor. (Alan Carvo, June 30, 2023)
  - Qualify and Mentor HPTs hired in FY-22. (Alan Carvo, September 30, 2023)
  - Continue development and support evaluation of a one-piece OSL/badge holder that is acceptable for use per DOELAP requirements. (Alan Carvo, September 30, 2023)
  - Coordinate with Waste Generator Services (WGS) to develop and implement a path forward for MFC Fuel Fabrication items in the old TREAT warehouse building. (Alan Carvo, September 30, 2023)
  - Collaborate with the home org to implement the Tier 2 release process for activated materials and submit to DOE for review/approval. (Alan Carvo, September 30, 2023)
  - Identify the general tasks that can be completed without HPT coverage and evaluate opportunities to expand this to additional tasks. (Alan Carvo, September 30, 2023)
- Improve MFC Radiation Detection Capabilities:
  - Implement HORIZON in one additional facility in FY-23. (Alan Carvo, September 30, 2023)
  - Complete installation of the latest MK3 upgrade kit which includes upgraded displays and firmware of the entire ICAM fleet. Begin using newly purchased Aegis HPGe detector in support of the Tier II volumetric release program. (Alan Carvo, September 30, 2023)
  - Complete evaluation and implementation, if selected, for Bladewerx SabreADM for portable alpha spectroscopy. (Alan Carvo, September 30, 2023)

7.6 Looking Forward FY-24 and Beyond

- Continue improving MFC personnel proficiency, awareness, attitudes, and training regarding RadCon.
  - Develop additional facility-specific training for HPTs and update continuing training plan.
  - Annually evaluate the impact the plans are having and adjust the plans as necessary for continued improvement.
  - Develop and implement awareness and education topics for facility management personnel and their responsibilities in implementing Radiological Control Program requirements.
  - Evaluate HPTs for progression candidates for future Lead, Supervisors, and Radiological Engineers.
- Continue improving RadCon's processes and procedures.
  - Assist RadCon Home Org with development and implement electronic forms to replace dosimetry forms, radiological work permit (RWP) request form, RWP peer review form, RadCon evaluation form, source check out sheets, source inventory, and remaining instrument check sheets for Continuous Air Monitors and Radiation Area Monitors.
  - Develop and implement a barcode system for instrument checks that ties into the RadCon Documentation System.
  - Develop a "dashboard" for RadCon staff that includes information at a glance from RadCon applications that can be accessed from one place. This would include actions needs for the air sample application, new Log Survey application, HORIZON viewing, RadCon status board for instrumentation, RWP review application, and Area Monitors on teleview. This could feasibly include RadCon metrics for management. The information would be based on the user role and the information needing to be seen.

8. ENVIRONMENTAL

8.1 A Look Back

MFC Environmental has had a strong performance record over the past 5 years. MFC has not received an environmental notice of violation during the previous 5-year period. The MFC Environmental internal and external assessment program ensures it is continually evaluating program element effectiveness and identifying areas for improvement. Stakeholder engagement has been a high priority with particular focus on regular communication with Idaho Department of Environmental Quality (IDEQ) permit writers and DOE counterparts and building relationships with other environmental personnel across the DOE Complex. The group is actively looking for improvements in technology to maintain environmental compliance, improve efficiency, and simplify processes (e.g., electronic inspection forms and radio-frequency identification [RFID] to fulfill chemical inventory tracking). For the past 5 years, performance has generally been strong, and issues have been relatively minor and quickly resolved with mitigations put in place to prevent recurrence. Aggressive actions in waste management have been taken to correct minor deficiencies, including tracking/trending and revamping waste management training and procedures. The documentation and approval obtained through the environmental group is crucial for performing research at MFC and maintaining compliance with the environmental regulations. MFC Environmental strives to continually support Operations and other support organizations in the success of INL and MFC missions.

Since FY-18 many improvements have been made in the MFC Environmental organization. The most significant improvements are shown in Table 6.

Table 6. MFC Environmental Improvements.

MFC Environmental Organization Improvements		
Technology • Completed project to use RFID for the management of mixed waste inventory. • Initiated planning for RFID technology for chemical management. • Used LIDAR for the documentation of cultural resources. • Developed electronic Resource Conservation and Recovery Act (RCRA) inspection forms. • Developed web-based requirements tracking database. • Implemented new electronic spill notification tool. • Identified remote monitoring needs for stored waste.	**Waste Management** • Total amount of waste shipped off-site in cubic feet and total number of shipments sent off-site per year: FY-18 34,100 ft^3 50 FY-19 17,867 ft^3 58 FY-20 34,428 ft^3 58 FY-21 19,022 ft^3 66 FY-22 18,303 ft^3 68 • Performed baseline monitoring of stored waste in Sodium Storage Building. • Eliminated decades-old liability with the disposition of the remaining ~35,000 individual, highly engineered, sodium-filled Zero Power Physics Reactor (ZPPR) plates utilizing alternate off-site technology. • Completed disposition of excavated soil from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites to the Idaho CERCLA Disposal Facility and off-site. • As part of High-Level Waste (HLW) Program development, a HLW Program Implementation Plan, HLW Determination Process document, and Quality Assurance Program Plan have been written.	**RCRA** • Implemented the Hazardous Waste Generator Improvements rule. • Completed and implemented multiple permit modifications for the continual improvement of RCRA permitted Treatment, Storage, and Disposal Facilities (TSDF). • Maintained Accountable Nuclear Materials program for the management and tracking of accountable nuclear material that will become mixed waste. • Implemented the electronic inspection system for the inspection of hazardous/mixed waste in RCRA permitted facilities. • Implemented the electronic inspection system for TAAs/SAAs. Supported development of waste management training and operator aids to improve worker understanding of RCRA waste.

Wastewater and Potable Water

- Closed old sanitary sewage lagoons under State and CERCLA regulations.
- Completed the connection of the two industrial wastewater system pipelines with one monitoring location as part of the West Campus Utility Corridor (WCUC) project, implemented new operation and maintenance procedures, and revised the corresponding plan of operation.
- Closed Industrial Waste Ditch as a permitted reuse unit.
- Completed and passed required 10-yr sewage lagoons seepage tests.
- Supported the repair and/or replacement of several cracked industrial wastewater, cooling water, and potable water pipes, while improving the piping materials and configurations as practicable.

Training/Qualification

- Attended vendor provided sodium/sodium potassium alloy handling training.

Other Regulatory Areas

- Participated in (and founding member of) DOE's Migratory Bird Treaty Act (MBTA) working group.

Clean Air Act (CAA)/National Emission Standards for Hazardous Air Pollutants (NESHAPs)

- Obtained approval from the Environmental Protection Agency (EPA) to allow the use of modified emission factors for calculating radioactive emissions.
- Implemented ozone depleting substances (ODS) tracking database to ensure compliance with reporting and maintenance regulations for refrigerant equipment.
- Revised refrigeration appliance service/repair documentation to conform to new regulations.
- Prioritized and completed stack upgrades.
- Developed dose calculator tool for new projects.
- Developed/revised INL Permit to Construct (PTC) facility Implementation Plans.
- Completed INL PTC MFC record management surveillance and corrective actions.
- Completed Air Permitting Applicability Determinations (APADs) to provide a baseline for operations/processes at ZPPR, Sodium Components Maintenance Shop (SCMS), MFC-753, Analytical Laboratory, and Water Chemistry Lab as a best management practice.

National Environmental Policy Act (NEPA)	CERCLA	Personnel Improvements/ Key Personnel Development
• Home organization implemented new NEPA Environmental Review Process as the method used to evaluate a new project, proposal, procurement, decision, or activity for potential environmental impacts. • Implemented Environmental discipline review process of new electronic engineering change process.	• Completed CERCLA improvement activities, including a "CERCLA Coach's Playbook" that summarizes steps to take for various scenarios (based on those encountered at MFC). • Closed old sanitary sewer lagoons as a CERCLA site. • Home organization added a CERCLA lead position and staff member. • Completed a Health and Safety Plan (HASP) that covers work in MFC CERCLA institutional control sites. • Completed sampling/analyses of Sample Preparation Laboratory construction site and found no contaminants of concern.	• Cross-trained back-ups for various environmental media. • Planned for succession. • Presented at conferences including the International Waste Management Symposia. • Hired and mentored summer interns annually. • Hired three new MFC Environmental staff members. • The new ESH Functional Area Coordination Team (FACT) Environmental Subgroup was reestablished in May of 2021. Like the ESH FACT, the primary objectives of this group are broadening the environmental network within Amentum projects.

8.2 People

The Environmental staff at MFC possess a wealth of knowledge with most staff having 20-30 years of experience in the environmental arena. However, attrition due to retirements or advancement will pose a significant challenge to the environmental group in the upcoming 1-5 years. A 10-year resource management plan has been developed to counter that challenge and three new, earlier-career, environmental staff members have been hired. Environmental staff established and are now improving an MFC environmental qualification program. Back-ups have been identified for each environmental media and functional leads strive to cross-train their back-ups to provide depth of knowledge. Most MFC Environmental staff also serve as INL Technical Points of Contact or Program Environmental Leads in various environmental disciplines. Staff development in recent years includes presenting at conferences, including the International Waste Management Symposia. This and other venues provide positive exposure to INL and the environmental group from MFC. Environmental staff also participate in a DOE complex-wide environmental community of practice with other DOE contractors to communicate common interests, discuss issues, and share lessons learned.

MFC Environmental staff present several training classes on topics including: TSDF RCRA Inspector, Waste Generator Services Temporary Accumulation Areas, RCRA Contingency Plan for MFC Emergency Action Managers (EAMs), and New ODS Regulations.

8.3 Process

The Environmental group at MFC provides instructions for performing environmental planning, compliance, and protection during the course of conducting work. These instructions are used in conjunction with other appropriate procedures (e.g., operating, maintenance, construction, safety, and health) and environmental permits. Environmental staff are involved in facility morning meetings, design reviews, work order approvals, assessments, and work planning walk downs.

The MFC Environmental group implemented several INL programs at MFC and developed, or helped develop, many facility procedures. RCRA Permit requirements have been implemented into facility specific procedures in accordance with the TSDF Environmental Compliance procedure. Permit implementation matrices were developed for all regulatory permits at MFC to ensure requirements are appropriately flowed down into operating documents. The Accountable Nuclear Material Plan for mixed waste has been implemented into facility specific procedures for the FCF, FMF, Fuels and Applied Sciences Building (FASB), HFEF, and AL. MFC Environmental staff developed or revised INL Permit To Construct Implementation Plans for FCF, FMF, IMCL, and Utilities and Infrastructure (U&IS) Support. Environmental staff revised the INL Refrigeration Appliance Service/Repair Form to align with ODS regulation revisions and the ODS tracking database.

Efforts to strengthen the CERCLA program in collaboration with project, Facilities and Site Services, MFC operations, and environmental home organization personnel have been successful in rebuilding internal expertise in this area.

The NEPA review process for engineering jobs has been improved as Environmental is being routed requests for discipline reviews from the new electronic engineering change system.

8.4 Equipment/Tools

Tools and equipment for environmental compliance are being improved with upgraded stack monitoring, NEPA compliance with new Environmental Compliance Permit (ECP) process, RFID, and electronic RCRA inspection forms. In addition, permit-required equipment, such as flow meters and stack monitoring instrumentation, is maintained as part of the MFC calibration and preventive maintenance process.

Inflation Reduction Act-funded water and wastewater projects will greatly improve the aging utility infrastructure at MFC. Environmental will support (Reuse Permit modifications/compliance, IDEQ plans and specifications approvals, ECP coverage, CERCLA issues) repairing, replacing, and/or upgrading deep well pumps, piping, valves, hydrants, lift stations, cooling water systems, sumps and drains, control systems, network monitoring, electrical systems, etc. This 5-year effort includes the construction of the industrial wastewater flow meter flume and sampling station upgrade project (design complete and approved by IDEQ), which will greatly improve flow measurement capability and sampling activities.

8.5 Actions FY-23

- Complete Hazardous Waste Management Act (HWMA)/RCRA permit modification: Permit Modification to update superior or equivalent information and to update changes to SCMS solidification station. (Alan Carvo, September 2023)
- Install new industrial wastewater flow meter flume and sampler and construct protective building. (Alan Carvo, September 2023)
- Down select from the options identified for implementing RFID technology for chemical management at MFC and perform a demonstration of RFID capability. (Alan Carvo, September 2023)
- Complete sample plan and characterize the southwest corner of CERCLA site ANL-74 and revise ANL-74 area reduction risk assessment paper as necessary to satisfy DOE-ID; submit to EPA/IDEQ. (Alan Carvo, September 2023)

- Place electronic forms for satellite accumulation areas and temporary accumulation areas into production. (Alan Carvo, September 2023)
- Develop a policy for retaining contaminant history of abandoned-in-place underground piping. (Alan Carvo, September 2023)
- Submit request to remove institutional controls from the CERCLA site ANL-01 ditches to the regulatory agencies. (Alan Carvo, September 2023)
- Reduce environmental and safety liability by reducing the inventory of legacy equipment no longer needed at MFC by 1,000 cubic feet. (Alan Carvo, September 2023)
- Complete sample plan and characterize ANL-71 legacy septic system. (Alan Carvo, September 2023)
- Develop a database and process for the active management of materials in the MFC East Laydown area. (Alan Carvo, September 2023)
- Coordinate with WGS and RadCon to dispose of legacy MFC Fuel Fabrication division items located at the TREAT warehouse. (Alan Carvo, September 2023)

8.6 Looking Forward (FY-24 and Beyond)

- Increase environmental awareness through regular communication, particularly related to the NEPA process and ISO 14001.
- Improve and develop CERCLA Program internal subject matter expertise.
- Improve APAD coverage for MFC facilities by developing APADs for MFC buildings with no coverage or combining multiple APADs for one facility into one combined APAD to ease interpretation and compliance.
- Implement staffing plan actions.
- Technology:
  - Develop RFID for chemical management.

9. SAFETY & HEALTH

9.1 A Look Back

The MFC Occupational Safety and Health Group continues to experience and adapt to changes in recent years. In recent years, the COVID-19 Pandemic dominated environmental conditions and operational influences. However, despite these distractions and aside from COVID-19 exposures, injury rates for mishaps resulting in medical treatment dropped approximately 60% from FY-20 levels. Much of this reduction can be attributed to a consistent emphasis on individual employee situational awareness, focus on preventive efforts to reduce ergonomic vulnerabilities, promotion of employee wellness programs, and a sitewide commitment to diligent application of work controls. While many injuries in FY-22 were associated with overexertion, awkward movement, and body position, these categories were reduced by nearly 50% below the level suffered in FY-21, substantiating effective mitigation, leadership, and employee awareness efforts. The primary objective of the MFC Safety and Health organization must remain to educate and empower the workforce to understand behaviors that heighten risk and the behaviors and tools available to help protect from mishaps.

In recent years, several improvements have been made to MFC's Safety and Health Program and organization. Some of the more significant improvements include:

- Hazard Control Program Improvements:
  - Completion of fire barrier remediation throughout non-nuclear facilities
  - Machine guarding improvements
  - Direct workforce engagement in situational awareness familiarization
  - Fall protection assessment, inventory, and training
  - Remote manipulator ergonomics assessment
  - Fire and emergency communications network improvements
  - Confined space evaluations and inventory
  - Fire extinguisher inventory and placement optimization
  - Crane descender training
  - Asbestos abatement, inventory, and data management improvements
  - Fire protection systems risk and reliability analysis
  - Hand protection improvements
  - Specialized ventilation system assessments
  - Foot protection assessment
  - Walking/Working surface assessment.
- Resource Management Improvements
  - Organizational communication improvements and lessons learned sharing
  - Advancement of dual-discipline qualifications
  - OSH team dynamics assessment and values determination
  - Leadership development emphasis
  - University outreach to support diversity and inclusion.

9.2 People

In FY-22, MFC Safety and Health organizational capacity has been significantly impacted due to succession and the tragic, untimely, passing of a valued employee. This impact has been exacerbated by a very competitive labor market. The professionals who make up the MFC Safety and Health organization are a valued strength within the MFC and Environment, Safety, Health, and Quality (ESH&Q) community and have been sought for their expertise resulting in two employees having been promoted to other INL positions. Recruitment and retention efforts have been mixed. Fire protection engineering capability was bolstered earlier in FY-22, securing an experienced fire professional with facility design and system engineering expertise. Efforts to retain incumbent staff have been largely successful with timely compensation adjustment.

Throughout the MFC Safety and Health organization, the experience range across industries is impressive. Many employees come from other nuclear industry sectors, while others have had successful prior careers in chemical and materials processing, aerospace, hazardous waste, system engineering, and construction, each offering valuable insights into MFC's unique research pursuits.

Current personnel recruitment efforts are focused on early to mid-career candidates to invest in tailored professional development and career longevity. Capability expansion and skilled worker succession must be stressed. Emphasis will remain to promote a flexible approach to expedite new employee development, and innovative methods to expand in-house discipline qualifications. Capability and planning will need to be developed to anticipate skill and capacity demands. Similarly, qualification processes will need to be honed to efficiently on-board and activate new employees to apply their unique skills as soon as possible to the MFC mission. Incumbent personnel are motivated to expand their capabilities, pursuing, and attaining dual qualification beyond their primary discipline, to provide greater organizational flexibility in meeting broad mission challenges across MFC.

9.3 Process

MFC Safety and Health has demonstrated an ability to address the unique needs of the MFC mission. This has been substantially due to the core technical excellence of services provided by veteran safety and health professionals in applying hazard control programs. The growing technical credibility of the organization is earning the respect of MFC operational counterparts, who are relying increasingly on safety and health SMEs to help resolve unique hazardous conditions, such as toxic and unhealthful environments, complex fire protection systems, fall hazards, and hazardous material controls. The MFC Safety and Health organization must be mindful of not only the safest means of performing work, but also the most efficient means of safely achieving objectives. Long-term hazard control and mitigation efforts must continue to be sponsored through completion with a focus on the most efficient and practical approach to protecting personnel and MFC assets. This approach necessitates a close and respected relationship with ESH&Q Home Organization to assure risk trades, regulatory interpretations, and decisions are meeting professional expectations for injury and illness prevention.

With the variety of technical challenges, the volume of process controls and associated documentation can be overwhelming. Entrusting process discipline alone cannot assure personnel safety. More pervasive methods of engaging employees are necessary to leverage the attention of the entire workforce. The MFC Safety and Health organization must be prepared to contribute to communication and engagement strategies that encourage greater leadership and employee integration with injury prevention efforts at MFC.

Improvements are also necessary to assure ESH&Q Home Organization and MFC-deployed safety, health, and fire protection resources are effectively and seamlessly integrated to meet the MFC mission. This must be a feature consideration in goals for improving hazard control and injury prevention efforts. Similarly, it must be a priority for MFC-deployed staff to assure MFC objectives are considered in process development of improvement efforts undertaken by the ESH&Q Home Organization that may be beneficial to MFC operations.

9.4 Equipment/Tools

Tools and equipment for Safety and Health programs are strong. With few exceptions, IH monitoring equipment, fall protection equipment, and other personal protective equipment is well suited to the potential hazards associated with the MFC mission. Improvements in equipment monitoring and maintenance, such as inventory and configuration management tools, are integrated into overall process improvement strategies. MFC Safety and Health personnel have also frequently contributed recommendations for hazard control equipment improvements to MFC Operational representatives.

In FY-22, MFC Safety and Health representatives engaged in development of a Requirements Tracking System specifically tailored to assist with proactively planning safety, industrial hygiene, and fire protection tasking. Implementation of this system will contribute to more effective utilization of resources.

There has been significant investment in recent equipment acquisitions. The Noraxon® Portable Motion Analysis Laboratory, will be leveraged to assist in identifying manual labor vulnerabilities, including manipulator operations and material handling tasks. The Noraxon® Laboratory will also be key in determining less intensive manual interface options to reduce potentially harmful body motions. In addition, a pending procurement for SlateSafety© heat stress physiological monitoring technology has the potential to significantly improve opportunities to preclude debilitating heat stress illness vulnerability at MFC.

Work venues are anticipated to continue to diversify. Telecommuting technology will continue to be called upon to ensure greater engagement through a variety of circumstances.

9.5 Actions FY-23

9.5.1 Restoring Organizational Resource Capacity

- Recruit two industrial hygienists and one industrial safety professional. (Alan Carvo, September 30, 2023)
- Qualify new personnel with expedited training and effective mentoring. (Alan Carvo, September 30, 2023)
- Adjust assignments of U840/H150 staff to leverage seniority of incumbent personnel retaining the most challenging tasks and sustain development opportunities of new employees. (Alan Carvo, September 30, 2023)
- Encourage continued participation in the FACT Industrial Hygiene subteam. (Alan Carvo, September 30, 2023)

9.5.2 Optimizing Assessment Strategies

- Launch tailored Resource Tracking System (RTS), populating with recurring task and assessment assignments. (Alan Carvo, September 30, 2023)
- Complete workplace exposure monitoring map to identify future monitoring targets and prioritize collection of current exposure measurements. (Alan Carvo, September 30, 2023)
- Formulate safety/health observation schedule to ensure significant risks are routinely monitored. (Alan Carvo, September 30, 2023)
- Identify targets for reduction in hazardous exposure program participation, including hearing conservation, where personnel are not working in areas routinely vulnerable to those exposures. (Alan Carvo, September 30, 2023)

9.5.3 Completing Nuclear Facility Fire Barrier Remediation

- Ensure remediation contract is implemented and effectively monitored to completion. (Alan Carvo, September 30, 2023)
- Facilitate close out barrier-related conditions and corrective actions. (Alan Carvo, September 30, 2023)

9.5.4 Developing and Implementing Remote Manipulator Ergonomic Corrective Actions

- Work with MFC operational and ESH&Q representatives to: (Alan Carvo, September 30, 2023)
  - Formulate manipulator administrative controls appropriate to reduce vulnerability to ergonomic exposures
  - Evaluate inspection and maintenance provisions to reduce unplanned manipulator failures
  - Improve training content and retention in physical conditioning and system capabilities
  - Develop Noraxon® demonstration(s) to encourage awareness of industrial ergonomic stressors.

9.6 Looking Forward (FY-24 and Beyond)

9.6.1 Bolstering Investment in Resource Planning

- Explore and formulate processes to forecast resource needs, establish succession development programs, and determine the needs of operational counterparts. This will focus on developing long-term intern relationships to develop immediate permanent hiring options in event of incumbent staff attrition. It also includes further expansion of dual qualification among incumbent staff, bolstering of recruitment pools with broadened relationships with diverse universities educating students in safety and health programs. Whenever possible, overlap of newly hired staff with exiting staff is desired to allow for better turnover prior to the loss of staff due to attrition or other opportunities.

9.6.2 Implementing Technology to Improve Occupational Safety and Health Processes

- Continue to evaluate technological advancements to streamline processes, reduce human performance errors, and improve safety and health performance at MFC. Technologies such as Noraxon® Portable Motion Analysis Laboratory and SlateSafety© Bio Trac will be assessed for integration with operations in a non-intrusive manner to provide greater insights into workplace processes, conditions, and employee health maintenance.

9.6.3 Assessing MFC Safety Systems

- Conduct regular ad hoc and targeted assessments of various MFC and INL safety systems to evaluate performance and identify areas requiring improvement. As corrective actions are identified and fully implemented, follow-on assessments will be conducted to determine the effectiveness of corrective actions.

10. CONTRACTOR ASSURANCE

10.1 A Look Back

Prior to 2016, the performance analyst (PA) function was carried out by staff specialists embedded in each division as an ancillary duty. The PA staff were organized under a single work organization manager with the intent to bring consistency to the function. The PAs initially reported directly to the Business Division director, for approximately 1-year, until a department manager was put in place with contractor assurance (CAS) expertise. The new manager's strong technical experience was immediately beneficial to the MFC organization and contributed to good development of the PA staff. The PAs improved understanding of CAS along with increased experience contributed to further improvements in PA performance. PAs were ultimately assigned two divisions each and provided those divisions with CAS support. PAs were also assigned to lead functional areas (management observations, assessments, lessons learned, corrective action review board [CARB], etc.) to support the MFC organization and to become more knowledgeable in all areas of CAS. In addition, the manager rotated PAs through different assignments, which led to further knowledge, proficiency and efficiency gains, and better overall implementation of CAS processes.

The current department manager was rotated into the position in January 2021. This manager's goal is to foster a robust performance improvement culture in which managers and employees' value self-critical, candid, and objective evaluation of performance against standards of excellence and effectively resolve noted gaps, commensurate with the risk. The manager works closely with the MFC Chief Operating Officer (COO), and the Business and Operations division directors to improve MFC performance.

MFC's Performance Assurance program continues to mature. In 2022 the following were achieved:

- The CARB continues to demonstrate increased focus on the quality and timeliness of corrective actions. Action owners are working with their PAs to provide substantive updates, which reinforces management ownership of performance and promotes quality discussions in the CARB beyond timeliness alone. These efforts and the increased ownership have resulted in more timely closure and reinforced the expectation for rigorous action management. CARB membership has been strategically expanded to increase the number of members who critically evaluate cause analyses and their corrective actions for adequacy.
- To maximize the learning opportunity from events, Immediate Lessons Learned (ILLs) are crisply written and distributed throughout MFC within days of the event. Sixty-one ILLs were issued in FY-22 and are being converted for distribution beyond MFC via OPEXShare and INL's new iShare software tool. In a few instances, managers encouraged those involved in the events to share their learnings directly with their co-workers, making the lesson more compelling. In at least one case, a lesson learned shared during the morning meeting prompted timely recognition of a similar potential issue in a different facility. Early recognition of the potential issue enabled avoiding a non-compliant situation. One Significant Lessons Learned was also issued to promote reflection and action on an adverse performance trend regarding effective use of work control. The common cause analysis revealed a weakness in an underlying principle: "A questioning attitude is cultivated." Subsequent emphasis on this fundamental principle will motivate employees to more routinely critically engage and in turn, improve the quality of work and manner in which it is performed.
- DOE's Office of Enterprise Assessments (EA-31) conducted an independent assessment of the "BEA Management of Safety Issues at the INL MFC." The assessment ran from September 2021 through January 31, 2022 and evaluated issues management performance at both MFC and in INL's Emergency Management organization. The assessors issued four findings and several weaknesses. MFC took immediate and appropriate actions to mitigate the noted inadequacies. The two most significant adjustments made in response to the assessment include narrowing the Performance Improvement Working Group's focus to identify and oversee mitigation of adverse trends and increasing rigor in MFC issues screening practices.

- Two working groups were maintained to promote consistent and effective improvement actions in two broad performance areas: pyrophoric and reactive materials management, and hazardous and mixed hazardous waste management. The pyrophoric materials working group continued to oversee the adequacy and pace of corrective actions. The hazardous and mixed hazardous waste group has integrated stakeholders from throughout MFC to align standards, improve instructional materials, and coordinate in-field inspections to judge compliance.
- The Performance Improvement Working Group has significantly matured during FY-22 to systematically identify and respond to adverse performance trends at MFC. The group considers issues, events, MOPs, and SME input on various performance/program areas, and cognitive perspectives to identify potential trends. Once identified, potentially adverse trends are entered into LabWay for tracking, validated to confirm there is indeed an adverse trend, assigned for mitigation, and monitored to closure. A guide has been drafted and is being used to promote effective and methodical trend management at MFC. Some of the adverse trends managed during FY-22 include Constant Air Monitor alarms in FMF and ZPPR, Maintenance Repair Group glovebox glove and gauntlet holes, hazardous and mixed hazardous waste management issues, Radiation Worker practices, proceeding with unearned confidence, and nuclear material inventory tracking weaknesses.
- The MOP continues to mature. The ongoing emphasis on performing and documenting in-field, interactive observations continues to yield high participation rates and improved observation quality in FY-22. Observations are being considered for performance trends. Observations have identified weak performance in pre-job briefings, procedure use and adherence, and work preparation and coordination.

10.2 People

Contractor Assurance staff are engaged and service-oriented. Staffing levels remain at five employees. Two new hires are intended to improve MFC's ability to conduct critical, objective, and timely assessments of events and emerging trends.

10.3 Process

MFC management uses assessments to review, evaluate, inspect, test, check, survey, or audit, to determine and document whether items, processes, systems, or services effectively meet specified requirements. Assessments also identify operational strengths, deficiencies, and opportunities for improvement. Assessments required by regulation are performed to verify compliance and determine effectiveness of program requirement implementation. Risk-based assessments are conducted at management discretion if further information is needed to understand adverse conditions, trends, or performance-related issues to develop appropriate corrective actions. Understanding which assessments are necessary and developing risk-based assessments is an area that needs focus and improvement. Two new hires to the CAS group are intended to improve MFC's ability to conduct critical, objective, and timely assessments of events and emerging trends.

Issues management is BEA's process for documenting and resolving a broad range of workplace conditions and issues, including identifying and reporting issues, categorizing issue significance, analyzing causes, tracking the timely completion of corrective actions, and analyzing and communicating trends to management.

A causal analysis is performed on events and trends when necessary. This is an analysis of facts and conditions surrounding an issue, trend, or event to identify causes. A causal analysis provides a basis for understanding the complex factors involved in an event or trend, and for development of appropriate corrective actions to prevent recurrence of the issue. A causal analysis can identify when it is appropriate to perform an extent of conditions across MFC.

Fact findings and critiques are conducted to identify, document, preserve, and report the facts surrounding an event—or other area of concern—to understand the event, determine causes, and recommend corrective actions. Fact findings and critiques are opportunities for workers and managers to

come together to fully understand the environment, decision-making, tools, and procedures that were involved in an event.

Lessons learned are used to communicate issues, events, and best practices between BEA and industry partners to maintain high awareness of behaviors or circumstances that resulted in or contributed to events. There is also the opportunity to recognize and promote best practice behaviors. Operational excellence requires use of internal and external operating experience to minimize the likelihood of undesirable behaviors and promote noteworthy practices. BEA embraces the philosophy that lessons learned are lessons applied.

Management observations promote engagement between managers and employees. Observations enhance management's understanding of employee functions, skills, and abilities. Management observations provide the opportunity to build positive relationships and to address employees' concerns. These observations build trust between the employee and the manager. Consistent and well-executed management observations reinforce INL Values and the MFC trust model.

10.4 Equipment/Tools

Multiple tools are used by CAS staff. These tools are designed to understand an organization from an individual's performance, to programs, processes, and organizational culture. The proactive tools are management observations, assessments, lessons learned, and MRMs. The reactive tools are cause analysis, event investigations, and HPI investigations.

LabWay is the software tool provided by DevonWay that facilitates CAS with implementation of issues management, assessments, improvement agendas, and management observations.

INL's iShare and OPEXSHARE are software tools enabling sharing the lessons learned beyond MFC and even INL.

10.5 Actions FY-23

- Further mature the Performance Improvement Working Group's ability to identify and respond to adverse trends and publish the group's framing guide. (Dave Coates, September 30, 2023)
- Publish a guide to document the more rigorous approach being taken to judge conditions/issues for significance. (Tiffany Leavitt, January 31, 2023)
- Evaluate 5% of completed assessments for quality using an MFC developed grading standard and providing constructive feedback to the authors. (Tiffany Leavitt, September 30, 2023)
- Raise the S&T community's engagement in driving performance improvement by soliciting their assistance in identifying and managing issues/trends, and sharing lessons learned. (Tiffany Leavitt, September 30, 2023)

10.6 Looking Forward (FY-24 and Beyond)

- Develop directors and managers to take clear ownership for performance improvement:
  - Strike a healthy balance between using CAS tool "experts," such as CAS staff, and deepening management ownership for performance improvement.
  - Provide regular coaching and mentoring at all levels.
- Assist MFC managers with applying CAS tools to achieve the following:
  - The picture of excellence is well known
  - Problems are prevented and mistakes avoided
  - Performance gaps are analyzed, prioritized, and efficiently, effectively solved
  - Performance improvement is ingrained as a core business practice
  - Performance monitoring drives continuous improvement.

11. PERSONNEL DEVELOPMENT

11.1 Personnel Selection

11.1.1 A Look Back

Personnel selection encompasses all actions associated with selecting personnel for a specific position through the first year of service. This includes selecting a new hire from outside of the laboratory, new assignments, and internal transfers to MFC.

The function of staffing is outlined in the "Materials and Fuels Complex Management Plan" (pages 35-42) and defines the processes used over the last 5-years. MFC has been consistent in using the criteria outlined in the "Materials and Fuels Complex Management Plan" handbook. The criteria considered are key attributes such as integrity, service attitude, work ethic, and the right technical skill set for every new hire or transferring employee.

Group interviews have been conducted, and prior to travel restrictions associated with COVID-19, all interviews had been conducted at MFC. These on-site interviews included meeting with a broad group of employees and a tour of MFC. Directors, or their delegates, have participated in second interviews confirming management selection. These additional interviews provide an opportunity for directors to lead and develop their management team in the interview process, especially for those who hire infrequently. This additional interview ensures a questioning attitude to guard against an unconscious bias from entering the decision-making process. In the past directors have rejected candidates that were presented to them as they did not meet their expectations. Another best practice, that has been adopted for many roles, is the inclusion of customers or stakeholders from outside of MFC in the interview process. Behavior based questions are used and a diverse interview team is selected. For positions that are a direct report to a division director, it is expected that an interview with the ALD, or delegate will be conducted.

Recently, several internal employees have applied to postings and when selected, the employees home organization makes a counteroffer for them to stay in their current role. This is an area for improvement. While MFC cannot dictate what other organizations do, MFC can ensure management is engaging with employees to determine their career aspirations and provide solid development plans that help employees see their contribution to the mission.

11.1.2 People

Hiring managers, interviewers, and HR are the key people involved in the personnel selection process. Each have specific roles and responsibilities.

11.1.2.1 Hiring Managers

If recruiting efforts are successful, there will be a strong diverse candidate pool where managers can seek to hire the best talent qualified for the position. Managers conduct a thorough resume review against a set of criteria, while being mindful of any unintentional bias that might influence interviewing decisions.

11.1.2.2 Interviewers

When selected to participate in the interview process, interviewers have a responsibility to be prepared for a meaningful conversation. Interviewers should be provided with the resumes, job posting, and any other information relevant to the position. A pre-interview conversation with the interview team should take place to discuss the flow of the interview. During interviews, candidates are also interviewing the team and develop a first impression of the way business is conducted. During the interview the candidates will also decide if they want to be part of the department's team.

11.1.2.3 Human Resources

Human resources balances providing support to the hiring manager, with providing a great experience for candidates. There are system and workflow challenges throughout the entire hiring process. The hiring process takes the HR business partner, recruiter, staffing consultant, compensation analyst, HR administrative assistant, medical, and security roles all working collaboratively to improve processes. It is requested that each partner engage in open-minded discussions so improvements can be made.

11.1.3 Process

During the selection process, there are many hand-offs that not only create an error likely situation but are difficult to track and follow progress. Feedback and recommendations for process improvements which affect experience in the field and in selecting candidates include some of the following areas:

- Managers need a matrix indicating how each applicant answered screening questions and whether the candidate met the minimum qualifications.
- Managers need to complete resume reviews in a timely manner. Failing to review resumes does not present the right impression to potential candidates and is not fair to the manager's current employees who are waiting for additional resources to support the work scope.
- Coordinating schedules for the interview team is cumbersome. It is suggested HR does the initial security screen once candidates are identified to be interviewed and then the hiring manager's administrative assistant can work directly with the candidate to schedule interview. Once travel resumes, this would streamline that portion of the process as well.

In the MFC management model the process for personnel selected to fill matrixed positions within MFC has been documented. These efforts should continue. Additionally, it has been requested that positions assigned to support work at MFC without being matrixed shall also be interviewed by the assigned manager. This is an area where management is not included on the front side of the decision-making process but informed after the fact and is an area for improvement.

Currently, job offers are reviewed by managers and in some cases, by the directors to ensure salary recommendation is competitive with the market. To hire the best talent, INL's salary recommendations need to be competitive, which will be at or above the current market, in order to lead the market for talent supporting nuclear energy. Frequent and regular engagement with the compensation and benefits department is critical to ensure INL is staying relevant in the market.

11.1.3.1 Post-Offer Acceptance

After the offer is accepted there is an opportunity for improved communication between HR, hiring managers, and the candidate. Once the candidate has accepted the position, every interaction the selected candidate experience contributes to how they view their INL career. If HR or the hiring managers fail during this time, all the recruiting efforts put into finding the right candidate and the managers put into interviewing, will be difficult to recover from. Challenges in the process include the following:

- Offer contingencies are taking about 6 to 8 weeks to complete.
- Onboarding classes fill up fast which could push a start date out further.
- There is a need for an improved method of communication between all parties as selected candidates move through the process.
- Managers need to be more engaged with the candidate during this time.

- Improvement can be made in the actual new employee onboarding experience. There is a need for better communication as candidates prepare for the new employee onboarding. During COVID-19, there were several ways employees may on-board and managers are not sure which method is being used.
- MFC should consider how to conduct MFC New Employee Onboarding with the increase in teleworking arrangements. Content for future classes should be reviewed annually to ensure continued relevance.

11.1.3.2 First-Year Onboarding

Managers have a responsibility to work diligently to create an inclusive work environment and for those who relocated to the area, to help them feel included in the local community. Suggesting new employees get involved with the INL Newcomers group could be a good avenue to support their transition into the area. Managers, group leads, and mentors need to have frequent conversations with employees, talking about the mission, their work scope, and career aspirations. These suggestions are outlined in the "Materials and Fuels Complex Management Plan" handbook, pages 37-38.

Completing the new employee checklist is one of the first tasks managers are required to complete. A simple action to assign the position description to the employee is another area for improvement. Assigning the position description to the employee does not happen automatically; and involves emails or requests. Therefore, a better method for completing this step needs to be identified.

11.1.4 Equipment/Tools

The applicant tracking system INL uses is Taleo. The system is cumbersome, processes slowly, and user experience is less than adequate. There is an opportunity to continue to provide recommendations to improve manager and, possibly, candidate experience.

MFC would like to explore the development of a dashboard to track where candidates are throughout the entire process.

11.1.5 Actions FY-23

Actions for FY-23 are on hold and will be re-evaluated for FY-24.

11.1.6 Looking Forward (FY-24 and Beyond)

- Benchmark best practices and tools for personnel selection from other Laboratory organizations and collect recent hire input regarding experiences.

11.2 Professional Development

11.2.1 A Look Back

For the last 10-years, MFC has been proactive in providing development opportunities to employees. In 2013, the operations staff specialist role was established. Employees with the right skill sets and aptitude for leadership were selected to participate in a rotational assignment. The intent of this assignment was to provide employees with a wide variety of experiences, covering all aspects of operations, to better prepare them to take the next leadership role in within 18 to 24 months. Staff jumped right into the new role and became very busy in the newly assigned duties. Staff enjoyed the role and became critical to the day-to-day operations in the facility. However, many of the employees serving in the staff specialist roles were not as interested in moving to the more stressful leadership positions and instead were content remaining in the staff specialist position.

For years, feedback gathered during Employee Engagement Surveys consistently identified professional development and feedback from managers as an area of opportunity. Since FY-15, the MFC leadership team has taken a more proactive and strategic approach to professional development. Division directors were allocated indirect funds within their division to support employees with development opportunities. In FY-20 alone, MFC invested approximately $1,700,000 in professional and workforce development funds. These funds covered newly hired technicians during training in Basic Operator Qualification (BOQ) school, initial training for newly hired crafts, year-long craft helper program, and short-term funding for scientists and engineers while they completed initial INL training before they can charge to direct programs. This number does not include laboratory funded employee education, courses that are available for free, or activities that are developmental and included in day-to-day work.

In FY-19, the Leadership and Organizational Development (L&OD) group within HR developed a series of tools to support these efforts. A professional development program titled, “My Development Journey” was developed and presented across INL. The program walked employees and managers through all steps of the development journey. MFC quickly adopted the process and required that all managers would include a development conversation with each employee during a mid-year review. Workbooks were printed and provided to every employee and manager in the MFC Work Organization. Employees were encouraged to dive into the content and be prepared for conversations with their manager. In FY-19, a metric was established to measure progress. While the content and quality of each conversation is difficult to measure, 80% of MFC employees participated in a mid-year conversation with their manager.

Across the MFC leadership team, division directors have prioritized employee attendance in laboratory sponsored training, such as INL Way and Leadership Immersion, and have been proactive in recommending key leaders to participate in the newly formed Assessment Center. This prioritization allows MFC to ensure the experiences are provided to those leaders that need to be ready for the next assignment.

MFC has always been proactive in using rotational assignments as a means of development. This process should be continued to build leaders for the future.

11.2.2 People

MFC has always been mindful of roles and skill sets that have the greatest risk of attrition. MFC needs to use professional development opportunities to design great workforce experience.

While progress has been made, there is still an opportunity to help employees make the connection between activities they are participating in and development. There is still an illusion that unless an employee attends a conference, they are not receiving professional development. Meanwhile, some employees equate development with a promotion. Employees have been provided a laundry list of development opportunities that could be done virtually during this year of COVID-19. Virtual conferences and free webinars in a variety of subjects are now being provided by numerous vendors which are free, or at a reduced cost, which allows MFC to provide additional opportunities to more employees.

Part of MFC’s strategic professional development plan needs to include increased focus on future attrition. Approximately 30% of home organization employees are age 55 and over. As future roles are considered, MFC needs to take a strategic approach to review and identify the skill sets needed for the future. Development of a way to visually see skill gaps, potential attrition, and staffing forecasts would be beneficial in identifying areas needing improvements.

A Leadership Bootcamp, like the monthly NFM seminar, is needed to provide all leadership with real-time training and discussion on a variety of topics to continue to build leadership and management skills. A yearly schedule will be developed with the seminar.

A balanced approach to the staff role is essential. Currently, processes are cumbersome and time consuming. Until processes become more streamlined, it will take additional staff to support work. It is

suggested that divisions ensure one person performing the staff role is being provided opportunities to be prepared for the next leadership role. Additional funding is not necessary as they would charge time as any other staff support would charge time. This employee should gain experiences in conduct of operations, CAS, training, HR, risk management, employee safety, etc. Time to complete training and have actual experiences in each area will provide a stronger leader for the future.

Currently MFC has 60 employees participating in degree seeking education programs, with 40 seeking degrees through the University Partnership Program. As a laboratory, INL does not track employees who may be seeking degrees which could be funded through sources outside of INL, such as the GI Bill. A possible option for the future would be to work with university partners and develop a degree program that encompasses all aspects of operations management. The above topics are not just INL related topics, but topics that are relevant to every section of industry. Topics could include financial accounting, risk management, industrial safety, business ethics, etc. Courses provided by ISU or University of Idaho (U of I) would then fall under laboratory level funding. Consideration for work experience should be factored into coursework credits, like the Human Resources and Diversity (HR&D) Bachelors program at ISU.

Leveraging university connections could be broadened into developing a program which could provide educational opportunities in the crafts disciplines. Opportunities structured like apprenticeships should be explored, where an employee gains experience along with their education program.

Employees nearing retirement might not be as interested in participating in the professional development journey. For those employees, a knowledge transfer goal and/or mentoring goal should be established as part of their annual performance goal. L&OD has a defined process for knowledge transfer and for single points of failure. These goals could be tied to variable pay recognition.

MFC needs to leverage SMEs and provide brown bag sessions that cross the full spectrum of each work discipline, from administrative programs to senior scientists. On the scientific and engineering side, presentations are already being held. It is essential to ensure these presentations continue and are broadcast for all workers to expand their knowledge. Organizing these types of technical seminars would be a great development opportunity.

11.2.3 Process

MFC has always been challenged with determining a way to track development without it becoming another burdensome process. A step within the My Development Journey process is to implement the People Planning Process (PPP). Prior to COVID-19 changing the way meetings are held, the personnel development team had begun to meet with each division to collect data for use with the PPP. At this point the PPP is an excel spreadsheet which contains the training each person completed, as well as the experiences they may want to have. This activity is also tied into succession planning. A method of continuing to collect this data needs to be revisited so the process can continue until it is possible to return to meeting in groups.

The capability to upload documents, professional development plans, or areas of recognition in the Annual Review Tool is needed. Having this data as part of the employee conversation is valuable for continuing the conversation around development. DOE requires contractors complete one annual review conversation. The tool should support ongoing conversations and not be closed until the end of the calendar year.

11.2.4 Equipment/Tools

L&OD is rolling out Mind Tools, available online and as an app, which contains a variety of development topics employees can easily access and complete. The tool is available on Nucleus, and at the following link: https://www.mindtools.com/community/welcome. These activities can be done independently or can be completed within a workgroup. Employees can structure their own plan with options for a 15-minute read, a weeklong course, or any of the other thousands of topics which are available. Managers can also assign topics to an employee development plan. These activities can take place during a commute, on a 15-minute break, or even when on lunch. Employees own their development, so management can encourage employees to choose to use Mind Tools for opportunities to grow. Activities completed in this app will earn points which tie into the Virgin Pulse program adding to points gained during other health and wellness activities.

The Assessment Center has been established where employees can experience real-life work simulations. Observations from this experience, coupled with feedback from a variety of other sources, such as 360 review, and Hogan Assessments, are assimilated together and provided to the employee and manager for a deeper dive into their development. Leveraging these insights provides a whole picture to the employee and indicates where employees need to focus their professional development. MFC Division Directors will continue to prioritize attendance in this program.

INL courses such as INL Way for new managers, Leadership Immersion, Outward Mindset, and a variety of other INL courses are also avenues for promoting development.

There is a need for a simplified method to track succession planning, development, knowledge transfer. MFC will explore how our business intelligence analyst can take the data in the PPP spreadsheet, information from TRAIN, and other sources and display it in a manner that is meaningful and actionable.

11.2.5 Actions FY-23

- Develop MFC Management Model Leadership Sessions. (Janice Cook, September 30, 2023)
- Explore ways to display the data captured in the PPP. (Janice Cook, September 30, 2023)

11.2.6 Looking Forward (FY-24 and Beyond)

- Develop Leadership Bootcamp monthly topics.
- Organize monthly brown bag development topics, identify the target audience, and send out reoccurring invites.
- Explore opportunities for a manager in training program, including funding, curriculum, and work discipline codes (WDCs).
- Explore how to visually display and connect succession planning with attrition with professional development for managers and individual employees.
- Explore educational opportunities for under-represented communities.

11.3 Inclusion and Diversity

11.3.1 A Look Back

Inclusion and diversity (I&D) are critical to laboratory outcomes and are now represented in the INL values. MFC expects the leadership team to embrace and drive an inclusive environment through diversity of thought, ideas, perspectives, talents, and experiences. MFC wants everyone to bring their best selves to work because they are valued as unique individuals. MFC is passionate about efforts to remove barriers and is dedicated to building an environment where inclusive diversity fuels growth and drives innovation.

It is important for everyone to feel like their contributions matter and MFC is continuously looking for an increase in diversity of thought. In FY-19, MFC took a proactive approach to expand the dialogue

around creating a more inclusive environment. MFC established the following goals:

- Analyze specific WDCs to identify key skill sets to focus on during recruiting efforts and establish goals for top areas of opportunity.
- Increase recruiting efforts and presence in HBCUs and target specific skill sets.
- Division directors leverage their university partnerships to seek a broader and more diverse candidate pool.
- Include diversity candidates in succession planning.
- Ensure interview teams have a diverse panel of participants.
- Increase university R&D engagement using the under-represented metrics.
- Start recruiting interns earlier in the academic year.

Improvements have been made in some areas; however, in other areas, more work is still needed. The number of diversity candidates identified in succession planning has been expanded, managers have worked to ensure diverse interview teams where possible, and the leadership team has met with the I&D team to review the MFC metrics over the last 5 years. Those results indicated that MFC trends were positive, and progress has made in many areas related to I&D and, in some cases, advanced beyond a few other organizations in the laboratory, particularly as they relate to learning. The MFC management team, and a majority of the staff, have also participated in a series of courses focused on I&D from Mind Gym. The goal of these courses was to create an open atmosphere where everyone felt psychologically safe, a sense of belonging was created, and everyone felt free to ask questions.

Collecting the data to analyze specific WDCs has been difficult. National and market data provided by a vendor to HR is not easily manipulated, is unclear, and has not provided the right information for accurate analysis. As indicated by the I&D review, strides in hiring and promoting within MFC have been made, however, there is still room for progress. Additional information needs to be gathered to determine which universities will provide the skill sets needed for MFC mission work.

Continued focus on the items above along with those items discussed in the recruiting portion of the OMI will help attain goals of attracting an inclusive, diverse, and talented workforce that will help MFC accomplish its mission of securing our nuclear energy future.

11.3.2 People

MFC will continue to partner with HR in obtaining data useful in making decisions. Subsection 11.4 explores opportunities to increase presence during the advertisement posting process. Additionally, the recruiting team has been asked to continue to post positions in areas that attract a more diverse population. By increasing the viable populations that read and see postings, MFC will attract a more diverse candidate pool to be considered for each position. In turn, this will increase opportunities for hiring the best and brightest in the industry.

Once MFC has a more diverse population, the efforts to create a more inclusive environment should guide decisions and efforts. An inclusive environment is an engaged workforce that knows their ideas and opinions matter to everyone in the organization. These efforts include ensuring all employees are provided development opportunities, open and honest performance feedback, and are rewarded for their efforts.

MFC leadership engagement and representation on I&D councils internal and external to INL continues to be an important commitment from the leadership team. Currently, MFC leadership is represented on four of the five INL leadership councils. This helps model to the MFC workforce the importance of inclusion topics and MFC's commitment to improving work performance through I&D. MFC must also actively and appropriately identify, recognize, and reward worker participation and championing of inclusion, including identifying personnel for award nominations as appropriate.

11.3.3 Process

The process for obtaining MFC labor statistics as they pertain to I&D has been very difficult. MFC will need to continue to request the information to support decisions.

One area that can change the diversity in the workforce is a change to the relocation policy. Since 55% of the workforce at the site facilities are non-exempt, different options for relocation need to be considered. If the diversity of the laboratory is going to change, then hiring will need to expand beyond the local market which is already saturated and does not reflect the diversity of the National Laboratory system. Currently, managers will often overlook candidates due to the challenges in seeking a relocation exception. Non-exempt workers can often bring a skill set that is as unique as those of exempt employees which is needed at the laboratory. However, while it is standard practice for the Laboratory to reimburse exempt employees for relocation expenses, non-exempt employees are generally not reimbursed for relocation expenses, unless burdensome justifications and paperwork are provided. Even in those circumstances, the relocation reimbursement may be rejected. The current relocation policy offers non-exempt relocations as exceptions only with a typical package of $5,000. The laboratory needs to provide this benefit to this critical workforce, just as they do an exempt worker. The local labor market is saturated and not equipped to adequately supply the skill set currently needed in general, making it especially challenging to attract and hire an increasingly diverse group.

While there are two options for training in the area, ESTEC and CEI, competition for these unique skill sets is quite high. Once students have graduated, their skill sets are in demand and they are often hired by other companies, both local and out-of-area. One local vendor shared that if they could hire every graduating welder across the entire State of Idaho, they would still not have enough employees to perform the work they have been contracted to do at the laboratory. INL must leverage hiring non-exempt employees from outside of the area which will provide an opportunity to increase diversity in a multitude of ways—thought, experiences, and background to name a few. Failing to acknowledge that non-exempt employees possess a critical skill set deserving of this benefit is not acceptable. This is a huge opportunity to change the diversity within the workforce.

In preparation for the future development of advanced fuels and construction of new reactors, it is vital that MFC expands the market area search to ensure the workforce is ready to meet the mission. The laboratory must also use a relocation benefit as one tool to attract key employees to the Laboratory.

11.3.4 Equipment/Tools

HR has provided some tools to support managers as they work to increase their I&D strategies. The INL Culture Wizard Tool is available at the following web address: https://inl.culturewizard.com/app/onboarding?._T=~A9IYY. This tool is an interactive online learning resource designed to enhance managements cultural acumen. This tool helps avoid faux pas, build cultural agility, and maximize effective communication. Efforts should be made to ensure managers are aware of this tool and use it as a resource for improvement.

Building on MFC's proactive approach in bringing various content from Mind Gym to the MFC workforce, it is important to continue efforts to raise awareness around conscious and unconscious bias for continued improvement. Continuing training on hiring a diverse workforce and creating an inclusive workplace should be conducted. Listed in Table 7 are a few of the workshops and other tools used to train teams on the MFC I&D goals which can help accelerate cultural change:

Table 7. Workshops for training teams on MFC I&D Goals to accelerate cultural change.

MFC I&D Goal Workshops	
Breaking Bias	Respect Me
One of Us	Did You Hear
Building Bridges	Knowing Me, Knowing You
Your Impact on Others	Leading Inclusively
Respect Me	Micro messages

MFC expects the entire team to embrace and drive inclusive leadership by fostering a culture of inclusion through integrated technology solutions, diversity of thought, ideas, perspectives, talents, and experiences. All these inclusion workshops are designed to move participants from rudimentary awareness to inclusive leadership actions.

MFC should explore opportunities to increase integrated employment or volunteer opportunities with organizations such as BestBuddies.com or local Development Workshop for the skill sets that could work in the MFC environment. MFC will continue to take steps in training managers the benefit of being inclusive.

11.3.5 Actions FY-23

- Engage with HR's Inclusion & Diversity to bring Building Bridges Sessions to MFC. Ensure and track participation including hybrid workers. (Janice Cook, March 31, 2023)

11.3.6 Looking Forward (FY-24 and Beyond)

- Evaluate additions of skill development, hiring, and cultural awareness initiatives supporting individuals with disabilities at MFC and in the broader community. Examples could include engagement with existing local organizations and others like Best Buddies.
- Continued engagement with HR&D staff to develop meaningful training and development for leadership and the workforce and ensuring participation by MFC staff when courses are offered.

11.4 Recruiting

11.4.1 A Look Back

For the last 5 years, MFC has relied on traditional INL recruiting practices, such as attendance at job/career fairs, technical conferences, postings on the INL website and job clearinghouses, and some technical sourcing of candidates for specific jobs. A reach into a broader pool of applicants was needed. After budget reductions eliminated all recruiting staff, progress was made in rebuilding a strong recruiting staff with the right talent to recruit and source candidates. The recruiting staff have begun to find new and innovative ways to reach a broader segment of the market and a more diverse audience.

In FY-19, it was determined that INL needed to have a stronger presence in the American Nuclear Society, so a marketing campaign was funded by NS&T, ATR, and MFC for monthly ads in *Nuclear News*. Recruiters provided input on the content, but a more strategic approach with a compelling and consistent message in the ad campaign is needed if this type of branding campaign for broader media is to continue.

Several years ago, MFC changed the structure of all MFC postings and developed an introductory paragraph to be used. This change influenced other organizations to begin to advertise their postings in a new way.

MFC envisions a world where recruiting is a seamless process, where recruiters know and understand the skill sets needed in MFC facilities and staff roles. In partnership with managers, recruiters can develop a strong network to source candidates in advance and develop pipelines for positions in the future. To support those efforts, MFC will maintain the Integrated Nuclear Staffing Plan, which is discussed in Chapter 11.5, "MFC Staffing Plan." This will assist HR in understanding the hiring needs across the nuclear platform to source talent in advance of openings.

11.4.2 People

Internships are a great opportunity to bring talent into the organization and build a pipeline for the future. As indicated by the figures below, MFC has incrementally increased intern and post-doc numbers.

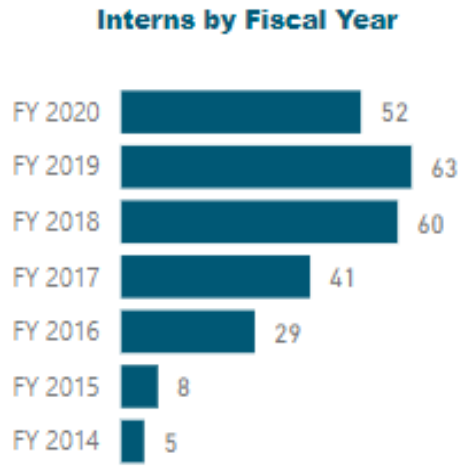

Figure 2. Number of Interns by fiscal year.

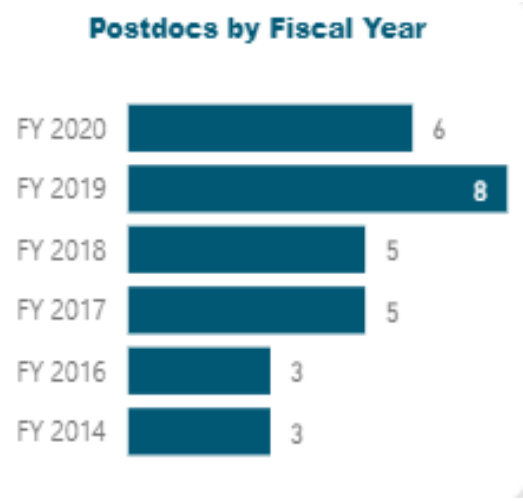

Figure 3. Number of Postdocs by fiscal year.

Recently the University Partnerships program conducted an assessment matching the skill sets needed at the laboratory with the best universities with needed MFC skills. This information should be provided to managers as a foundation of where to focus their attention. To attract and hire the best interns, managers are expected to post and offer intern opportunities early. Because most of MFC's interns are hired during the spring and summer months, managers will be expected to post and offer spring and summer interns by the end of September of the prior year. Each division should establish an annual internship goal.

Managers should also be more methodical in terms of using the Seaborg and Russ Heath fellowship programs. There is a need to reach out to university contacts, identify their best students, hire these students as interns, if possible, establish relationships, and then mentor these students during the fellowship application process. It is suggested that indirect funding is provided at the laboratory level to support this professional endeavor.

Postdocs are an important part of the nuclear pipeline strategy. It is generally expected that postdocs will remain in a post-doc role for at least 1-year before being converted to regular staff. In the event there is not an open position within the division the post-doc was hired, there should be a mechanism for retention, such as transfer to another relevant organization in order to maintain the human capital investment.

11.4.3 Process

The overall hiring process is cumbersome. Recruiting support is not needed for all positions; however, given the administrative burden and an inefficient work structure that does not streamline the flow of work, recruiters are unable to expand their current recruiting volume. Nevertheless, efforts are underway to improve the process. A change that has been very well received is the skills intake call.

Managers share the skill sets they are seeking and describe a day in the life of that position. Tweaking the process slightly will add additional benefit. Additional changes that would benefit the overall process include the following:

- The WDC is not established by the recruiter, but by a staffing consultant who might not look at the position description until after that call. The staffing consultant should join the call or review the position description in advance so the level and WDC can be discussed during the intake call.
- A discussion on the availability of finding that skill set in the market should be included in this call.
- Managers need to be briefed on how the recruiting team is supporting the "entire" recruiting process for any given position.
- Recruiters should discuss the best marketing method for that position including social media, print, or other outlets.
- Managers need to know all the places their positions are getting posted, how the job scraping works, especially managers who only post occasionally.
- Job posting verbiage should be reviewed using the Textio program which instantly shows recruiters the effectiveness and quality of the job posting to an external audience. This would be helpful in ensuring the verbiage is reaching the broadest and most inclusive audience.

Job postings differ from position descriptions in that they are crafted from a marketing perspective, with the intent to reach a broad and diverse audience via job boards, social media, and networking. Continued efforts to edit verbiage to increase impact is necessary.

Managers need to know about the suite of resources used to support recruiting efforts. Currently the following is a list of the additional resources used:

- **LinkedIn.com**: Unlimited search and a job post package
- **LinkedIn.com Diversity Groups**: Including Women in Energy, Blacks in Energy, INROADS, Hispanics in Energy, etc.
- **Entelo.com**: Ten sourcing seats and three automated sourcing seats; the Envoy tool within Entelo can source candidates based on requirements input by the recruitment team, can send "blind" resumes to managers, and can contact any professional in its database
- **AmericasJobExchange.com**: Local and nationwide posting, Talent Cast, and Office of Federal Contract Compliance Programs fulfillment
- **ClearanceJobs.com**: Unlimited search and unlimited daily scrape job posting
- **ClearedJobs.com**: Unlimited search and a job post package
- **Dice.com:** Unlimited search and a job post package
- **EnergyCentralJobs.com:** Unlimited search and unlimited daily scrape job posting
- **NuclearStreet.com:** Unlimited search and a job post package
- **AmericanNuclearSociety.com:** Unlimited search and a job post package
- **Indeed.com:** 30 professional contracts per month and unlimited daily scrape job posting
- **DiversityJobs.com:** Unlimited search and unlimited daily scrape job posting
- **VetJobs.com:** Unlimited daily scrape job posting
- **AfricanAmericanHires.com:** Unlimited daily scrape job posting
- **DisabilityJobs.net**: Unlimited daily scrape job posting

- **AllHispanicJobs.com**: Unlimited daily scrape job posting
- **LatinoJobs.org**: Unlimited daily scrape job posting
- **AllLGBTjobs.com**: Unlimited daily scrape job posting
- **AsianHires.com**: Unlimited daily scrape job posting
- **WeHireWomen.com**: Unlimited daily scrape job posting.

For some positions that are going to be left open for a longer timeframe, or when managers have contacts at universities or organizations, a flyer needs to be created to support that effort. Recruiters should encourage the same level of urgency and request the flyers be available the same day the job posting goes live. Working with the MFC communication partner would speed up the process as they understand the Complex and have the relevant pictures for the flyer. A base template could be developed that would shorten the time needed to publish the flyer.

The laboratory has developed a "Dual Career" program to assist employees who have a spouse, or partner who needs to find career resources. In the event a candidate has a spouse, or partner seeking employment, managers should engage the Dual Career center through their recruiter.

MFC also needs to explore options to bring candidates' significant others to the area to determine if relocation to Idaho will meet family desires.

When a candidate visits Idaho for a job interview, a standard recruiting package should be provided by the recruiting team that contains relevant community and INL information. This welcome package will provide insights to the area and answers questions. Additional media marketing needs to be readily supplied for managers to share with candidates.

11.4.4 Equipment/Tools

Since the recruitment process is cumbersome, the biggest opportunity MFC has is to leverage the data that is available and display it in a more meaningful manner to support recruiting efforts, such as a dashboard. This dashboard could contain the information which should be provided to managers during the process. Information as to where the candidate pool reached and attracted candidates would also be valuable.

Recruiters established a uniquely specific email alias nucjobs@inl.gov as a main point of contact for interested individuals who may not find a current suitable position posted to INL's careers page. This address has accompanied many job postings and advertisements. MFC managers should consider including it on documents or business cards to be shared at a conference or job fair.

11.4.5 Actions FY-23

- Continue to explore opportunities to provide dashboard showing new hires moving through the hiring process. (Janice Cook, September 30, 2023)

11.4.6 Looking Forward (FY-24 and Beyond)

- Develop a variety of recruitment-focused media to communicate benefits of working at MFC facilities.

11.5 Personnel Training and Qualification

11.5.1 A Look Back

The MFC Training organization implements 91 nuclear qualification programs that support 11 nuclear facilities and the five types of positions associated with each facility—management, supervisor, operators, technicians, and technical staff. Within the past 5-years the organization has seen three different training managers, and an 80% turnover of employees. These staffing issues have led to challenges in delivering training services. Despite this, operator and craft qualifications have been maintained and new or modified facilities have been brought online with a competent work force. In

February 2020, a large-scale training assessment was completed at MFC using DOE training objectives and criteria and a team of 16 professionals to determine the quality of all nuclear qualification programs associated with MFC. The assessment looked at evidence from the past 3-years. Out of the 11 nuclear facility training programs and their five nuclear positions reviewed, one facility (SSPSF) received an overall rating of "Highly Effective," four (NRAD, ZPPR, HPTs, and Technical Staff) received an overall rating of "Effective," and the remaining programs received an overall rating of "Marginally Effective." Some of the issues found in the assessment included a weak Support Manager qualification program, inconsistent supervisor training, a weak Continuing Training Program, a weak Training Program Evaluation program, inadequate classrooms, and labs for conducting training, and weaknesses in the administration of formal On the Job Training (OJT).

Since FY-15 a few improvements have been made to the MFC Training organization. The more significant improvements include the following:

- The development of HPI DLAs, where operators and technicians receive hands-on practice applying HPI principals and tools.
- The startup of RHLLW, with associated Management Self Assessments (MSAs) and RHs, which found no training issues—all newly qualified operations personnel were ready and qualified to operate the facility.
- For the first time in years, the MFC Training department is fully staffed.
- In early FY-20 it was determined by MFC Training management to conduct a full DOE-STD-1070, "Guidelines for Evaluation of Nuclear Facility Training Programs," training assessment for all MFC nuclear qualification programs to baseline current training practices and standards to enable a more focused corrective action strategy.

11.5.2 People

Refer to Subsection 11.5.5.

11.5.3 Process

MFC Training follows the Systematic Approach to Training (SAT) process. The SAT process is a methodology for managing training programs and is required by DOE O 426, "Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities." INL Laboratory-wide Manual 12, "Training and Qualification," includes procedures and processes for how the SAT process is to be implemented.

11.5.4 Equipment/Tools

MFC has access to two acceptable classrooms in building MFC-1727 for conducting training. Classrooms and labs for conducting site-wide ES&H courses including Rad Worker training, LO/TO training, Respirator training, First Aid, and others needs improvement. Training facilities for these topics are located on the top floor of the old Experimental Breeder Reactor II (EBR-II) power plant where it is difficult to control noise and other distractions, and difficult to control temperature extremes.

The off-the-shelf examination software tool, LXR, is difficult to use and is no longer supported by the developer. Thousands of exam bank questions are at risk if this software malfunctions.

Also, the availability of hoisting and rigging (H&R) equipment to support regular practical exams needs improvement. Practical H&R exams are consistently being canceled because the equipment is not available.

11.5.5 Actions FY-23

- Improve the quantity and quality of operational drills to better prepare facility staff (both nuclear and radiological) to respond to upsets, abnormalities, and emergencies. (Tiffany Leavitt, August 31, 2023)

- Evaluate the feasibility of conducting LO/TO and Conduct of Operations training at MFC, by MFC instructional staff. (Tiffany Leavitt, August 31, 2023)
- Evaluate the feasibility of revising PDD-147, "MFC Nuclear and Radiological Facility Training Program" to move appendices to a standalone administrative document. (Tiffany Leavitt, September 30, 2023)

11.5.6 Looking Forward (FY-24 and Beyond)

- Improve the quality of formal OJT at MFC by involving line managers in the occasional observation and feedback of checkouts.
- Improve the SS qualification program to strengthen the technical, problem solving, and managerial skills of Facility Supervisors and to allow for technically competent outsiders to qualify as Facility Shift Supervisors without having first qualified as Facility Operators.
- Develop and deliver additional facility systems training to strengthen operations knowledge. Develop this training for use in classrooms and/or self-study and include, where applicable, technology such as "Augmented/Virtual Reality" to strengthen delivery.
- Identify H&R equipment frequently used at MFC including selected types of aerial lifts, forks lifts, and cranes that can be dedicated and maintained for the purpose of training, including practical exams.
- Identify and procure an exam administration software that can automatically create qualification exams for operators and supervisors per DOE requirements. Then begin the process of converting the existing exam bank and exam profiles to the new software. This conversion will take several years to complete.
- Develop an NFM "Book of Knowledge" to assist NFM candidates through the qualification process.
- Continue identifying and dedicating H&R equipment frequently used at MFC for the purpose of training, including practical exams.
- Continue the development and delivery of DLAs to support the mastery of HPI and Conduct of Operations Skills.
- Improve the training of researchers working at MFC to strengthen their knowledge of and application of Nuclear Safety Culture, HPI Culture and Conduct of Operations Culture.
- Coordinate all NFMs and SSs attendance at the Institute of Nuclear Power Operation (INPO) First Line Supervisor Academy.

11.6 Continuing Training

11.6.1 A Look Back

Continuing training programs are established to maintain and enhance the knowledge and skills of personnel who perform functions associated with engineered safety features and safety-related systems as identified in facility DSAs.

For positions identified in PDD-147, continuing training programs must be structured commensurate with specific position needs and be administered on a cycle not to exceed 2-years.

Continuing training at MFC consists of completing training on a significant facility system and component changes, applicable procedure changes, applicable industry operating experience, selected fundamentals with emphasis on seldom-used knowledge and skills necessary to assure safety, and other training as needed to correct identified performance problems.

MFC-specific continuing training is training that is being formally planned, developed, delivered, and tracked to ensure key topics are included. In addition to this formal continuing training, it is recognized that all MFC employees, including nuclear qualified personnel, receive unplanned and sometimes less formal training in the form of management discussions, safety meetings, design meetings, critique meetings, DSA discussions, required readings for revised procedures, vendor training, facility modification discussions, and other just-in-time facility training that maintains and improves worker knowledge and skills.

11.6.2 People

Continuing training is required for MFC nuclear operators and their supervisors, MFC nuclear maintenance personnel, and other nuclear technicians supporting MFC including Laboratory Technicians, Laboratory Researchers, HPTs, Quality Inspectors, Qualified Fissionable Material Handlers (FMHs), and Waste Examination Operators (WEOs). Continuing training is also required for MFC nuclear technical staff.

11.6.3 Process

Continuing training required for MFC nuclear operators and their supervisors is documented on a "2-year Continuing Training Plan" using INL Form 361.72, "Continuing Training Plan," and within discipline-specific job codes included within each worker's electronic training plan. It is expected that the 2-year plans will contain at least 40 hours/year of facility-specific continuing training for most MFC facilities and 20 hours/year for facilities with fewer systems and procedures.

Continuing training required for MFC nuclear maintenance personnel is documented on a "2-year Continuing Training Plan" using INL Form 361.72 and within discipline-specific job codes included within each worker's electronic training plan. It is expected that the 2-year plans for Electricians, Instrument and Control Technicians, HVAC Technicians, Mechanics, heavy-equipment operators (HEOs), Manipulator Repair Technicians, and Carpenters will contain at least 20 hours/year of craft-specific, MFC-wide, and facility-specific continuing training.

Other nuclear technicians supporting MFC, including Laboratory Technicians, Laboratory Researchers, HPTs, Quality Inspectors, Qualified FMHs, and WEOs, will be required to complete MFC-wide, and nuclear facility-specific continuing training in addition to training already included on their discipline-specific job codes. Training for these other technicians is not required to be documented in a "2-year Continuing Training Plan."

Continuing training for MFC nuclear technical staff is documented within discipline-specific job codes already included within each worker's training plan. In addition to this training, the MFC System Engineer, Cognizant System Engineer, Rad Engineer, Fire Protection Engineer, and Facility Disposition Specialist (FDS) will be required to attend MFC-wide and nuclear facility-specific continuing training. Training for these technical staff personnel is not required to be documented in a "2-year Continuing Training Plan."

Other nuclear technical staff supporting MFC, including Quality Engineers, Criticality Safety Engineers, Safety Analysts, Industrial Safety Engineer, and Industrial Hygienist, receive continuing training from their discipline-specific support organizations. MFC-specific continuing training for these positions is considered and provided when needed, as part of the change management processes associated with facility modifications (EJs), procedure revisions (DCRs), and DSA upgrade checklists.

11.6.4 Equipment/Tools

The Training Records and Information Network (TRAIN) supports the management and conduct of employee training necessary to ensure assigned tasks are completed in a safe and competent manner for the protection of workers, facilities, and the environment at INL. TRAIN provides all INL employees with online, real-time access to reports, including training plans, schedules, status, and history. This enables the employee to monitor and maintain their training, facilitates the administration of training, and supports a timely and informed decision by management in making job assignments.

11.6.5 Actions FY-23

Refer to Subsection 11.5.5.

11.6.6 Looking Forward (FY-24 and Beyond)

No additional actions identified at this time.

11.7 Training Staff

11.7.1 A Look Back

Since 2005 the MFC Training department has been organized with one trainer supporting multiple facilities and taking on the workload by themselves. This model worked when the MFC personnel count was at much lower levels and the trainers had fewer facilities. Under this model, as the organizations grew, trainers became overworked and unable to keep up with the constant changes. This led to training material updates lagging far behind the facilities and issues of training material being constantly out of date. Over the last 2-years, the MFC Training department has had a shift in how workload is distributed and how instructors are tasked to keep up with the constant state of change and growth that MFC has seen. Instructors and training coordinators are teamed together to support each other and customers. Teams were built around the knowledge level of the current staff to encourage mentoring and sharing of talents.

11.7.2 People

Training staff consists of a training manager, 12 instructional analysts/developers, one drill coordinator, and three training coordinators. This staff supports MFC organizations involved in operating nuclear and radiological facilities by:

- Assuring that operations, maintenance, technical staff, technicians, supervisors, and managers receive the necessary training to perform their job assignments in a safe and efficient manner
- Maintaining and improving operations and maintenance, personnel and technical staff, technicians, supervisors, and manager performance through structured continuing training programs.

Although head count has slightly increased, turnover has been, and will continue to be, an issue. Currently 50% of the instructional staff have worked at MFC two years or less and 70% of the training coordinators have been in the position for fewer than 2-years. Attrition, due to retirement, will pose a significant challenge to MFC Training over the next 5 years. While most training staff are new to MFC, and to training, they are engaged, service-oriented, and eager to learn.

The goals of the MFC Training program are to:

- Assure that personnel operating nuclear facilities are properly trained to perform their assignments in a safe and efficient manner
- Maintain and improve operating proficiency through structured requalification and recertification plans
- Conduct training programs that meet DOE and laboratory-specific requirements
- Ensure all personnel are trained and maintain qualifications specific to their area of assignment which fosters a safe and productive work environment.

11.7.3 Process

MFC Training follows the SAT process. The SAT process is a methodology for managing training programs. It is an orderly, logical approach to determining what people must know and do for a particular job. The SAT process ensures that people are prepared for their work by having the necessary knowledge, skills, abilities, and attitudes to do their job.

MFC instructional analysts/developers are qualified in accordance with INL Manual 12 implementing procedures which includes instruction on subjects such as TSRs, facility operating characteristics and principles, operating limits and their bases, and facility-specific knowledge for the material the instructors will present.

Instructional analysts/developers are responsible for the analysis, design, development, and evaluation of initial and continuing training programs for the qualification and certification of MFC personnel. Training staff are responsible for implementing initial and continuing training programs for qualifications and certifications identified within PDD-147. Instructional staff provide facility line management with the support necessary to ensure that personnel in the operating organization are qualified to perform their job functions.

11.7.4 Equipment/Tools

TRAIN supports the management and conduct of employee training necessary to ensure assigned tasks are completed in a safe and competent manner for the protection of workers, facilities, and the environment at INL. TRAIN provides all INL employees with online, real-time access to reports, including training plans, schedules, status, and history. This enables the employee to monitor and maintain their training, facilitates the administration of training, and supports a timely and informed decision by management in making job assignments.

11.7.5 Actions FY-23

- Increase the amount of continuing training offered to instructional staff at MFC to improve overall knowledge of the SAT process. (Tiffany Leavitt, August 31, 2023)
- Hire at least one new trainer with technical background to support microreactor training programs. (Tiffany Leavitt, August 31, 2023)

11.7.6 Looking Forward (FY-24 and Beyond)

- Incorporate Augmented Reality in Training Modules.
  - Develop and pilot augmented reality training for operators or maintenance personnel.

11.8 MFC Staffing Plan

11.8.1 A Look Back

Every year, HR requests a staffing plan be developed. MFC has completed the activity but has not turned the plan into a strategic plan with associated key actions. For a staffing plan to be effective MFC will need to continually review, refine, and then determine how to fund hiring decisions that are in advance of attrition or program arrival. There have been recent successes (see list below), but MFC looks forward to the advances that are planned for the next 5-years.

- Following the workforce reductions in 2012, to prepare for future work, the laboratory funded a workforce development pool to hire and train nuclear facility technicians in preparation for the return of direct work.
- In MFC's organization management funding pool, line items have been added for specific skill sets that have been difficult to find.
- When possible, hiring is done in advance of attrition.
- MFC realized in 2020 the need to fund an increase of three Full Time Equivalents (FTEs) in FY-21 for the operations area to support more direct work and build a pipeline of leaders.

Developing a staffing strategy goes beyond determining the number of people that will be hired. The strategy must include maintaining and retaining a competent and satisfied workforce, skilled for the right roles at the right time to meet mission goals now and in the future. Reinvention includes considering the changing business landscape and skills needed to continually meet the needs of the future. MFC should

consider the challenges that the historic FY-20 presented. Computer technologies such as robotics or new computer programs should be considered. Similarly, consideration should be given to which processes should be eliminated; then steps should be taken to change the way work has always been performed. All areas will be considered from a strategic point of view and routine discussions will be held.

11.8.2 People

Collaborating across the nuclear platform can be a very positive endeavor for MFC employees because opportunities for professional development will increase. Employees will gain a stronger understanding of the INL mission and naturally become more engaged as they see themselves as an integral part of that vision, and a stronger pipeline will be developed. The following efforts will also support an integrated staffing plan:

- Recruiting efforts with a focus on diversity will be critical to meeting the needs of the entire nuclear platform.
- Increased efforts in university engagement to influence curriculum needs.
- Succession planning has been conducted at the leadership team level and has been completed for management positions in some areas. A more planful approach of critical resources, across the entire organization, including single points of failure will be completed.
- Cross directorate professional development discussions need to be facilitated by HR to better understand what options are available for employees across the entire complex.
- The use of subcontractors and staff augmentation can be a key component to a staffing plan. Determining which work should be completed by a subcontractor and monitoring how long they perform the work is key to the successful use of this type of resource.

11.8.3 Process

11.8.3.1 Integrated Nuclear Staffing Plan

In FY-19, MFC provided data for an Integrated Nuclear Staffing Plan. Meetings were held with each division to discuss potential future projects in the next 5 years along with resources needed if that work came to fruition. Layered into this plan included potential attrition. HR complied the information into one staffing plan with the intent to share with outside stakeholders to prepare for the future workforce needs.

With the structure of the INL's Integrated Nuclear 5-year Staffing Plan developed, it is expected the staffing plan will be reviewed annually and finalized by May of each year. This annual planning process provides consistent planning and is a snapshot in time that serves as a baseline for talent acquisition and hiring execution. Funding shifts, mission needs, and staff movement (and attrition) dictate evolving staffing needs. As such, staffing planning requires ongoing conversations between management, program managers, customers, and stakeholders. These conversations will enable real-time updates to budgets in the IRPT which will result in increased agility in responding to staffing needs in concert with the annual staffing plan.

11.8.3.2 INL Nuclear Staffing Executive Board

The ALDs of ATR, MFC, and NS&T met in early FY-20 and agreed to set up an "INL Nuclear Staffing Executive Board." The board would be formally chartered, and accountable for the enterprise-wide strategic nuclear staffing and development. A foundational document for the board will be the "INL Integrated Staffing Plan." The plan was suggested to begin with operational and planned new nuclear facilities as the focus of this effort. This board is not responsible to make day-to-day hiring decisions, but responsible for determining the strategic approach.

- Included in the scope of this committee would be:
    - Accountability for executing nuclear facility strategic and tactical staffing including long-term plans and short-term actions for hiring and retention.

  - Authority, as required, for establishment of nuclear enterprise-wide processes, such as approval authority for nuclear operations, scientists, and applied engineering promotion criteria.
  - Authoring and maintaining the INL Nuclear Staffing Plan.
- The board will address cross organization development, establishing staff development plans that may involve directed transfers to grow the nuclear staff, supervisors, and leaders of the future. Having cross-qualified personnel will give greater assurance that critical positions will be adequately staffed.
- Recruiting efforts will typically be coordinated, with cross-organizational interviews and decision input utilized on appropriate positions.

During the regularly scheduled meetings of the executive board, decisions around progress and acceptance of work, as well as decisions on funding positions in advance of attrition or arrival of programmatic work will be made. This executive board will provide transparency across the nuclear platform and ensure the nuclear messaging is clear, consistent, and united in a strategic plan.

Hiring efforts must include staffing for new nuclear projects such as NRIC initiatives, GAIN, and the Versatile Test Reactor (VTR). Inclusion of this work in the decision-making process must be strategically mitigated to avoid undesirable impacts in current organizations. The staffing of new nuclear organizations must also be strategically aligned with INL objectives, and alignment will involve using the operating facilities for pools of trained personnel to support current and newly emerging work.

Establishing the INL Nuclear Staffing Executive Board will be the next step in building the collaborative environment across the nuclear platform. The board will:

- Establish the lead and future chairman
- Write a charter and submit to INL Laboratory Directory for approval
- Review the Integrated Nuclear Staffing Plan with regular data updates to include potential new programmatic work and attrition
- Establish routine meetings of all stakeholders which include to:
  - Conduct discussions on potential future work
  - Review and status of accepted work
  - Operational status of facilities and ability to complete work
  - Dashboard review of all relevant human capital data
  - Conduct discussions of critical skill gap areas and staffing needs from the balance of the Laboratory
  - Make decisions on hiring for future work and determine how those positions can be funded.

11.8.3.3 Skills Gap Analysis

Developing a staffing strategy goes beyond determining the number of people to hire. The strategy must include maintaining and retaining a competent and satisfied workforce, skilled for the right roles at the right time to meet mission goals now and in the future.

To better position MFC for the workforce of the future, the framework for a skills gap analysis needs to be developed. It is important to consider the changing business landscape and skills needed to continually meet the needs of the future. MFC should consider computer technologies, such as robotics or new computer programs. To perform work in a different way, MFC will need to consider what skill sets are needed to accomplish that change. To accomplish this all areas will be considered from a strategic point of view and routine discussions will be held to determine ways to change how work is performed. As MFC proactively evolves for the future, consideration should be given on what can be eliminated, what can be started, and what needs to stay the same.

11.8.4 Equipment/Tools

MFC needs to explore the best method of compiling the information contained in the Integrated Nuclear Staffing Plan, forecasted attrition, and resources planned in the IRPT. MFC's business intelligence analyst is to develop a dashboard which would visually display the above information and allow it to be reviewed at the INL Nuclear Staffing Executive Board quarterly meeting.

11.8.5 Actions FY-23

- In partnership with HR Business Partner, Scott Wallin, establish INL Nuclear Staffing Executive Board. (Scott Wallin, September 30, 2023)
  - Establish the lead and future chairman.
  - Write a charter and submit to INL Laboratory Directory for approval.
- Plan and conduct one quarterly executive board meeting that shall include the following: (Scott Wallin, September 30, 2023)
  - Information on potential future work
  - Review of work already accepted
  - Operational status of facilities and ability to complete work
  - Dashboard review of all relevant human capital data.

11.8.6 Looking Forward (FY-24 and Beyond)

- Establish cross directorate meetings to understand future programmatic needs to ensure data in staffing plan represents similar timing and captures program depth.
- The INL Nuclear Staffing Executive Board will:
  - Maintain the Integrated Nuclear Staffing Plan with regular data to include potential new programmatic work and attrition
  - Establish routine meetings of all stakeholders
  - Develop dashboard with staffing plan, attrition, and current planned resources
  - Develop succession plans deeper into the organization (PPP actions are included in the Professional Development section [Subsection 11.1] of this publication)
  - Establish cross directorate meetings to understand future programmatic needs to ensure data in staffing plan represents similar timing and captures program depth
  - Establish a process for entering the staffing plan into the IRPT.
- Quarterly Executive Board meetings should include:
  - Discussion of critical skill gap areas and staffing needs from the balance of the Laboratory
  - Decisions on hiring for future work and how those positions can be funded.
- Establish an annual INL staffing plan exercise.
- Continue to build relationships with key leaders across nuclear platform.
- Begin to build the framework for an employee skills gap analysis. Skills needed now, skills needed for future, skills of current employees, and how to identify those deltas.

12. FUNDING/BUDGET CONTROLS

12.1 Integrated Resource Planning Tool

12.1.1 A Look Back

For years, INL senior leadership has asked for a total cost to operate each facility at MFC and why it costs what it does. Despite working to a specific budget amount, it has been difficult to clearly communicate a cost. MFC managers and programmatic managers used a variety of methods to budget; spreadsheets and the web-based INL Cost Estimating Tool are two of the methods that were used. During this process, the resources needed to perform direct work was vague. There has always been a disconnect between the number of MFC personnel NS&T has planned to perform work within their work packages, and the number of personnel who charged those work packages. Additionally, there is not an easy method to determine where the discrepancies were.

Over the past 5 years, MFC has made great strides in the development and implementation of the IRPT. This tool was developed to create the integrated work plan (IWP). By planning specific activities, the IWP more accurately addresses the full scope of work required to operate and maintain facilities and achieve the mission at MFC. The IWP is a bottoms-up, resource-loaded plan that incorporates research activities, operations, maintenance, and other requirements in an integrated fashion, by fiscal year, allowing for prioritization and risk management. The fundamental purpose of the tool is to align budget with mission outcomes. In addition, the IWP provides:

- Full budgetary transparency both internally and externally
- Managers the flexibility to manage at tailored levels that make sense for each situation
- Divisional integration to make necessary budget adjustments
- Surety that the organization is right sized to meet the mission
- Surety that MFC priorities align to mission commitments
- Better understanding of resources needed to perform work
- Better understanding of what it costs to operate and maintain each facility and ultimately, MFC as a whole
- Ability to plan work into the out-years. A large advantage of the tool is the ability to plan into the out-years. The typical INL business systems look at the next fiscal year, with reporting always in a backwards-looking view. The IRPT has the ability to plan work in the out-years in preparation for future staffing needs.

MFC began developing the tool in FY-16. Every year, additional capability and features were added to make it easier to input, export, and analyze data. The scope of work planned in the tool has incrementally increased each year. Hiring decisions are now determined based on resource planning.

In FY-20, the tool gained some use outside MFC. Several divisions within N&HS began using the tool to understand the demands on their workforce.

For FY-21, NS&T has agreed to let MFC enter some of their programmatic work into the tool as a pilot. This will allow NS&T to determine whether use of the data from the tool would add value to their work planning process.

12.1.2 People

Management and division Control Account Managers have grown in understanding and ultimately use of the tool. Users at all levels need to see the value in the data analysis and forecasting the tool can provide. MFC hired a business intelligence analyst who has the skills and ability to use a suite of business intelligence tools to develop a dashboard which can display the data in a visually meaningful manner.

The MFC Business Manager has fully embraced the use of the tool and has led the organization into being an advocate with their divisional customers. The FY-21 MFC work packages were entered into the tool prior to October 1, 2020, even though there is not an approved budget. This data was exported from the tool to the business systems. This was done with the support of the Planning and Financial Controls Specialists (PFCs) working side by side with the division contacts.

One intent of the tool is to facilitate communication between support organizations and division work at MFC. In previous years, meetings were held between Engineering, RadCon, Maintenance, and division directors to understand what activities were missed in planning and what could be expected in the upcoming year. This communication was valuable to all organizations. These same types of meetings should be conducted every year to ensure open dialogue between all MFC parties. As more BEA directorates use the tool, these discussions will expand from within MFC to outside MFC.

Currently, the only way to increase headcount to be ready to support programs, is to financially carry resources above those needed to support base operations. This can be done in the short-term using indirect funding from an organization management rate increase that supports general training and qualification of new hires. Longer-term there needs to be a collaborative strategic investment plan by research programs and MFC to support hiring and development of research qualified support staff. This should be a financially shared responsibility across the directorates.

Continual improvement in communication between division directors and programs is necessary to understand the scope of potential out-year research baselines. In many cases training and qualification can take up to one year to provide a nuclear facility operator that can support R&D.

12.1.3 Process

The IRPT manages the day-to-day resource planning. With the addition of dashboards, it will become a simple and easy way to review work and will become even more valuable. The IRPT planning process is simple and is improving each year. The vision for using the IRPT is to review budget performance, employee resource needs, milestones, and performance against programmatic work each month. There are gaps between the current state of the IRPT and the end goal of where the system should be. Examples include:

- The data in the IRPT is used to make hiring decisions and continued development to better demonstrate those gaps are ongoing.
- Disciplined structured monthly review meetings are key, reviewing base operation and maintenance (O&M) funding as well as program spending plans.
- Visualization of progress against programmatic work is key to understanding and prioritizing work.
- As more INL directorates begin using the IRPT, a strategic approach to future development should take place. A strategic advisory group should be formed so changes to the IRPT that benefit all BEA directorates can be approved. Looking at the IRPT from a strategic approach will require communication across all directorates as to what information is beneficial.
- Integrating other tools, such as P6, is also needed for full planning perspective (import/export as needed).
- Integrating the IPL into the IRPT will help to understand resources needed to perform work if funding is awarded.
- Integrating the Nuclear Staffing Plan into the IRPT.

12.1.4 Equipment/Tools

The IRPT has developed significantly since is its conception

- A laboratory level decision will need to be made about the web-based cost estimating tool. There are good features in the CET. Decisions regarding merging the two will need to be made.
- Integration with P6 will be necessary for a smooth transition in the planning life cycle, from planning to scheduling to importing into the INL budgetary systems.

12.1.5 Actions FY-23

- Continue development and refinement of dashboards so end users can perform analysis for meaningful decision-making. (Janice Cook, September 30, 2023)

12.1.6 Looking Forward (FY-24 and Beyond)

- Explore options to identify and track milestones in the IRPT for visibility and reporting purposes.

13. WORK EXECUTION AND CONTROL

13.1 MFC Maintenance Planning

13.1.1 A Look Back

MFC Work Control has made progress in improving consistency by incorporating a process document, MFC-ADM-2026, "MFC Maintenance Work Control Process," and completely revising the MFC Planner Qualification. This revised qualification now sets the standard for how a planner will effectively perform tasks at MFC. Work Control also took steps to close identified gaps on multiple processes:

- Qualified one of the planners as an HPI practitioner.
- Instituted a quarterly CDI group to increase consistency between Planners. Developed an agenda and attendance, recorded each week, to work on consistency and addressing the 18 PPA error traps.
- Presented the PPA Overview to the entire maintenance department. This provided an understanding of how PPA writing follows HPI principles and the benefits to following the PPA writing guide.
- Developed a feedback loop for tracking to be able to show that the feedback coming from work is resolved. This process has improved crafts perception of the feedback loop and reduced lost packages.

Scheduling continues to obtain better data, improving the adherence meetings. Distributing the plan of the week (POW) schedule earlier in the day has increased the time for foremen preparation. Scheduling has developed a long-range schedule to track jobs that will require significant resources, support a vendor being on-site, or results in an outage. This allows for better forward planning across MFC.

13.1.2 People

MFC Work Control experienced four position openings as personnel retired, moved to other positions, etc. These vacancies were filled by one external hire and three craft personnel joining planning on a rotational assignment. MFC Work Control continues to see growth of Maintenance Work Requests from facilities as MFC continues to do more projects, install equipment, build new facilities, and perform more research. Workload increase in conjunction with Planner turnover has caused a significant growth in the backlog.

MFC scheduling continues to improve and evaluate the current processes for continuous improvement. In FY-22 one scheduler moved from scheduling into an entry level planner role.

13.1.3 Process

Implementation of the Maintenance Work Management in iQ Work Smart has increased the overall flow of work through Work Control. Work package flow was not well defined, and packages ended at many different locations creating multiple failure points. All work packages now flow through the Work Control Administration Center (WCAC), which allows for improved tracking of the package from start to finish and allows for data capture of feedback. The new flow has increased the data for feedback and will help to decrease lost work control packages. The feedback process loop has been designed, tested, and implemented to help with tracking and providing data to the crafts once complete. MFC-ADM-2026 was developed and supersedes SP-20.2.6, "MFC Supplement to LWP-6200 and GDE-6200." The new administrative procedure fills the gaps with iQ Work Smart.

Planners continued to integrate HPI and PPA into the work order and workflow process. Adaptation of the new MFC-ADM-2026 and the addition of a Qualified HPI practitioner closed multiple known gaps.

Regular schedule adherence meetings drive improvement throughout maintenance. Initially, MFC completed an average of 79% of scheduled work and maintenance averaged 83%. As maintenance continued to improve, averages increased to 89% across MFC, with maintenance averaging 97% in the last month of FY-22. This outcome is attributed to a concerted focus on INPO Maintenance

Fundamentals, assigning resolutions to performance gaps, and addressing issues in preparation.

13.1.4 Equipment and Tools

SharePoint dashboard and metrics pages continue to evolve and become a mainstay of work package creation and tracking. An automated personal leave (PL) calendar was designed, tested, and implemented. The PL calendar has been established for the maintenance department to help capture and plan time off in an easy-to-use system. Employees now request time off per an online request form that is emailed to their supervisor/manager. Once the manager approves the request it is automatically added to a calendar that can be filtered.

The Planner's computer monitors, computers, and workspaces have been upgraded to improve efficiency. Telecommuting has allowed planners to more efficiently respond to issues that come after hours.

P6 information transfer from AS continues to be an issue, but the scheduling department does catch inconsistencies with this program. The P6 group is currently rebuilding the database to improve the communication.

13.1.5 Actions FY-23

- Reduce the number of current work orders in FINISHED status by 50% and ensure zero work orders in FINISHED status older than 270 days. (Eric Papaioannou, September 30, 2023)
- Reconfigure work control and hire two foremen to assist WCM in daily tasks. WCM currently has 29 direct reports which causes an extreme amount of time needed for time billing, performance reviews, etc. (Eric Papaioannou, March 31, 2023)
- Use the feedback data loop tracking tool to establish the maximum number of days for feedback to be resolved by the planner. This will allow the work control manager to create a new standard for the planning group. (Eric Papaioannou, September 30, 2023)
- Use H/APPR data tracking tool to set the maximum number of days that a work order can be in H/APPR. The work control manager will ensure all work orders are within the allowed maximum number of days. This will allow the work control manager to create a new standard for the work order reviewers. (Eric Papaioannou, September 30, 2023)
- Qualified HPI practitioner will create MFC planner initial course. This new course will improve consistency, quality, and effectiveness in work order development. (Eric Papaioannou, September 30, 2023)
- In collaboration with Work Execution Manager (WEM), establish a metric with a corresponding performance objective of achieving greater than 95% for MFC maintenance schedule adherence. (Eric Papaioannou, September 30, 2023)
- In collaboration with WEM and the Preventive Maintenance Coordinator (PMC), create a new maintenance SharePoint site for use by all MFC personnel that is linked from the MFC Homepage. (Eric Papaioannou, June 30, 2023)

13.1.6 Looking Forward (FY-24 and Beyond)

- Establish a work order library area for storage of work packages that are not currently being worked.
- Establish a performance adherence metric in Work Control for consistency, using MFC-ADM-2026 and CDI information as the standard.
- Maintain maintenance schedule adherence of greater than 95% and look for improvement opportunities.

13.2 Work Execution

13.2.1 A Look Back

The MFC maintenance team worked with INL's K-12 Education Program to launch the INL Future Corps program, aimed at preparing the workforce of the future and preparing students for careers not only in traditional STEM positions like researchers and engineers, but also STEM-adjacent jobs such as technicians, operators, crafts, and skilled labor. The MFC team planned and executed highly engaging, hands-on learning experiences as part of the work-based learning program for the first cohort of high school students on-site at MFC in July. MFC employees served as hosts, and mentors for the students, training them on valuable skills, competencies, and employability for their future, and providing them with real-world work experience. The event-filled week was a success, as all students expressed their enjoyment with the experiences provided by MFC Maintenance. This included welding a complex sculpture, operating both a manual and robotic manipulator, building and painting a wooden toolbox, bending conduit, creating an electrical system from a drawing, and operating heavy equipment. The students also mentioned they appreciated the consistent emphasis on ownership of personal safety. This evolution displayed the maintenance team's ability to ensure safe work is conducted, even when working with students with little or no hands-on experience.

As part of an ongoing effort, maintenance continues to repair the remaining Edison circuits at MFC. During FY-22, the maintenance electricians repaired an additional 14% of Edison circuits. A significant challenge to converting the circuits was the availability of electrical components due to supply chain constraints. This challenge is being addressed and maintenance expects to correct an additional 6% of the remaining Edison circuits in FY-23. Maintenance has developed a dashboard that tracks the number of Edison circuits remaining. The dashboard is a detailed report that includes live data on inspections performed, Edison circuits remaining to be repaired, repairs over time, outstanding work orders, and a monthly report that highlights tasks expected to be completed in the next month. The report also discusses hurdles and challenges in completing these Edison circuit repairs and is shared with the DOE.

The maintenance team established weekly meetings held with the foremen and qualified leads to discuss and develop their leadership abilities. The leaders from the U&IS group are also invited and attend as available. Discussions include the MFC Management Plan, INPO Conduct of Maintenance (INPO 18-002), My Development Journey, and lessons learned. The maintenance team has also implemented a formal meeting agenda to ensure topics are adequately addressed, tasks are followed up to completion, and management expectations are clearly communicated.

Schedule adherence has continued to be a focus area for maintenance. In FY-22, the department has seen an increase in involvement from Operations and Engineering departments. In addition to the bi-weekly schedule adherence meeting, reporting has been established and is sent to the MFC directors to communicate issues and delays across MFC that interfere with performing scheduled work on time. To ensure the maintenance department is on a positive trend, a 9-month analysis of schedule adherence was conducted. The analysis found that the average schedule adherence improved from 85% to just over 90%. This is evidence of the department's focused implementation of INPO Maintenance Fundamentals and concerted effort to achieve best-in-class performance.

Human Performance errors have dropped dramatically across the department with the high level of attention given to HPI, which indicates sustainability to the improvements made including performing the work safely and correctly the first time—with the correct parts, pertinent documents, and resources.

To increase ownership at the first line leader level, the department has started requiring foremen to perform two management observations monthly. This has resulted in an increased awareness of the deficiencies in the individual crafts, and increased sharing of lessons learned between the groups. The culture has started to shift to one that actively seeks out opportunities for improvement and individuals looking forward to being held accountable for their performance.

The maintenance department led the way on ensuring MFC adheres to procedures outlined in iQ Work Smart. The management team ensured all maintenance personnel understood how to navigate through iQ Work Smart. Subsequently, maintenance personnel have been able to explain to personnel across MFC how to read and execute Work Management knowledge articles. Members of the maintenance team attended NFM seminars to answer questions and improve understanding surrounding iQ Work Smart processes. Additionally, the maintenance department clarified to other departments how work packages are closed out in accordance with iQ Work Smart.

13.2.2 People

All maintenance foremen have qualified as HPI Practitioners in FY-22. The newly hired foremen are anticipated to qualify as HPI Practitioner in FY-23. By having the first line leaders well-versed in HPI, the team has found opportunities to increase the resilience in activities performed, improve pre-job briefs, and more effectively implement mitigations to reduce mistakes. The newly hired foremen are working to qualify HPI practitioner in parallel with qualifying as an MFC Maintenance foremen.

The maintenance management team recognized that the maintenance department needed improvement in implementing and practicing the guidance provided in the MFC Management Plan. The maintenance management team implemented an increased focus on ensuring the expectations outlined in the MFC Management Plan are continuously met. This focus included weekly in-depth discussion during the weekly foremen meeting and resulted in the entire maintenance management team having an improved understanding of how to plan, organize, staff, lead, assess, and improve.

The maintenance team recognized a gap in being able to support cask shipments and source recovery commitments due to a lack of qualified leak testers. In response, an I&C technician qualified as a leak tester provided support across INL while replacement leak testers were contracted and hired.

The maintenance team has reintroduced the “My Development Journey” from Employee Development Network and intend to include all craft and technicians—with the foremen leading the way and allowing their team members time to pursue personal development. This will open avenues for everyone on the team to truly develop in the areas that they personally want to develop in. The maintenance team has actively used LinkedIn Learning and MindTools to utilize the resources available more effectively for development at INL. Additionally, the department sent the management team to develop as leaders at INPO, Laboratory Operations Supervisor Academy (LOSA), Leadership Immersion, Outward Mindset Seminars, and Crucial Learning Classroom Courses. All maintenance managers have joined at least one of the INL Leadership Councils to challenge ourselves to rethink how we work, interact, and collaborate with the team at INL.

13.2.3 Process

The maintenance department recognized that place keeping was inconsistent across MFC. The maintenance team created a procedure that outlines the place keeping process for maintenance work orders. This team developed a training curriculum to ensure all craft and foremen understood how to consistently place keep. The maintenance management team took the initiative and developed a PowerPoint presentation, an approved exam bank, and qualified as subject matter presenters to teach the course. This procedure improved consistency in how maintenance work is conducted across MFC and has been a contributing factor to minimizing errors in FY-22, as evident in management observations.

Previously, the WEM was acting as the foreman for the Quality Assurance (QA) personnel that are based at MFC. As part of the effort to improve schedule adherence, accountability of the QA personnel was transferred to the QA leadership INL-wide. This has resulted in improved management of QA resources and allowed the WEM to better focus on the development of the maintenance foremen.

During the MFC Radiological Worker Assessment conducted in FY-22, the assessment team recognized that the maintenance department’s process for conducting pre-job briefs was a contributing factor to minimizing errors. The maintenance department’s practice of documenting every pre-job brief continues to drive MFC towards best-in-class performance.

13.2.4 Equipment/Tools

An adverse trend was identified with an increase in holes found in the manipulator repair enclosures at HFEF and FCF. Both facilities identified that the number of holes found had dramatically increased and that the underlying causes for the increase were unknown. A chartered team was assembled to help identify and find solutions to the adverse trend. Objectives of the team included providing status updates of progress, identify suitable replacements, and gather pertinent feedback from key players. As a result of the teams' efforts, several improvements have been made and tools have been developed including a glove/gauntlet issue tracking tool, consistent glove issue reporting standard, new glove leak testing method, identifying a suitable replacement, and improved glove use and decontamination practices. These efforts led to a significant reduction in holes found in gloves. Prior to the implementation of the chartered team, approximately 30 holes a month occurred—this has been decreased to one hole in the past 3 months.

Despite many supply chain shortages and transportation limitations in FY-22, the maintenance department expanded the equipment available for use and replaced aging equipment. This included the purchase of industrial snow removal equipment, articulating 4x4 forklift, improved handheld voltmeter, improved handheld voltage testing equipment, various office equipment, leak testing machines, and wireless headsets.

Several of the groups in maintenance recognized the need to improve overall organization of their shop workspace and purchased storage equipment, heavy duty work benches, and various office equipment. This has resulted in a more professional and organized workspace.

13.2.5 Actions FY-23

- To improve the quality and trackability of walkdowns, the department will develop a planning walkdown checklist and workability walkdown checklist. (Eric Papaioannou, March 31, 2023)
- To build upon, and continue involvement in local outreach activities, ensure all foremen are prepared with a curriculum and all required materials are on-site and available to repeat participation in the INL Future Corps program. (Eric Papaioannou, June 1, 2023)
- The management team will develop and implement a qualification tracking tool. This tool will result in greater transparency in qualification progress of all maintenance personnel. (Eric Papaioannou, September 30, 2023)
- To further professionally develop the foremen, ensure all maintenance foremen attend INPO First Line Leadership Essentials conference, LOSA, and Crucial Learning Series as available. Additionally, the department will ensure newly hired managers in the department qualify as HPI Practitioners. (Eric Papaioannou, September 30, 2023)
- All foremen must complete at least two management observations per month. (Eric Papaioannou, September 30, 2023)
- Evaluate the formation of a Fix It Now team to maximize flexibility in responding to emergent issues and minimize both the time it takes to correct them and the ever-growing LRSA backlog. (Eric Papaioannou, September 30, 2023)

13.2.6 Looking Forward (FY-24 and Beyond)

- To build upon, and continue involvement in local outreach activities, ensure all foremen are prepared with a curriculum and all required materials are on-site and available to repeat participation in the INL Future Corps program.

13.3 Preventive Maintenance

13.3.1 A Look Back

The PMC and other maintenance personnel improved the usability of the Monthly Preventive Maintenance (PM) Forecast Report and the Bi-Weekly Division Specific Incomplete PM Reports sent out to operations, maintenance, and engineering personnel. The Monthly Incomplete PM Forecast Report has been updated to include 2 months of generated PMs beyond the current month. This provides facilities a snapshot of upcoming PMs and the opportunity to prepare for execution. The Bi-Weekly Division Specific Reports have been optimized by including the most relevant information including, but not limited to due dates, late dates, current PM status, and notes about why the PM has not been completed. Improved communication between groups will increase efficiency in completing needed preventive maintenance.

Multiple model work orders (MWOs) in the PM program were found lacking adequate engineering justification for the preventive maintenance being performed. A list of 245 MWOs was given to the engineering group to provide the required parameters for continued maintenance. The System Engineering Manager provided justification for the continued use of these work orders through an Interoffice Memorandum.

The PM program at MFC was strengthened by the implementation of MFC-ADM-2025, "MFC Preventive/Predictive Maintenance Program Administration," which replaced SP-20.2.5, "MFC Preventive/Predictive Maintenance Program - Supplement to MCP-6201." MFC-ADM-2025 supplements the use of iQ Work Smart by clarifying the roles and responsibilities of the PMC, responsible engineers, and facility managers. It also specifies expectations for administration of critical PMs, non-critical PMs, and how to handle at risk PMs.

In order to better follow the intent of DOE G 433.1-1A, "Nuclear Facility Maintenance Management Program Guide," Section E.2.1.2.6, the PMC has implemented and started using a new set of frequency codes within AS. The new codes reflect the guidance of limiting the performance window to ±25% of the PM interval not to exceed 90 days regardless of the interval. In addition, codes were created for PMs with no grace allowed in the performance window without an engineering justification. Use of the new codes has enabled more effective facility maintenance scheduling and improved consistency with PM frequencies.

Key Performance Indicators (KPI) for measuring PMC performance were implemented which will show trends and possible areas for improvement. These KPIs include Preventative Maintenance Change Requests (PMCRs) waiting for PMC approval and PMCRs set to finish status in a week.

The PM group recognized that the backlog of PMCRs waiting for the PMC's approval was too high (often at 70 or more PMCRs). The group set a goal of reducing the backlog to 10 or less waiting for review. Through a focused effort on completing the reviews, removing PMCRs no longer relevant, and training PMC assistants to process PMCRs, the goal was met in 3 months.

13.3.2 People

At MFC, the PMC does not have a back-up. This is considered a single point of failure. To ensure continuity of operations and the execution of continuous improvements, a maintenance foreman has learned the duties and responsibilities of the PMC.

The team has identified that a portion of the planning group lacks the knowledge on how to accept and complete AS planning assignments. This has led to PMs not being planned in a timely manner, or the PMC not being aware of when assignments are complete. If the PMC is not notified when a planner has completed an assignment, then the PM workorder, although ready for printing, may not be generated. The PMC team will instruct the planning group on the proper way to accept and complete planning assignments and why it is important to use this function within AS.

13.3.3 Process

The PMC has recognized the need to identify incorrect PM calculation type parameters used within AS and correct them. The calculation type entry determines how the PM's early date, due date, and late date are calculated. If the wrong calculation type is used, the dates maintained by AS will be incorrect, or in some cases will not be calculated at all. The PMC and maintenance personnel have been fixing the errors as they are found, but a more concerted effort will happen during FY-23.

13.3.4 Equipment/Tools

No areas of weakness with either equipment or tools have been identified at this time.

13.3.5 Actions FY-23

- Perform a tailgate training for the planning group on the PMCR process and the R2A2's of a planner regarding Asset Suite. (Eric Papaioannou, December 31, 2022)
- Build an AS report to show all due PMs rather than just generated PMs to enhance the forecast report usability by facilities. (Eric Papaioannou, March 31, 2023)
- To calculate PM dues dates more accurately, update 50% of current PMID calculation types from A to C. (Eric Papaioannou, September 30, 2023)
- Evaluate creating a backup PMC position to ensure there is not a single point of failure within the department. (Eric Papaioannou, September 30, 2023)

13.3.6 Looking Forward (FY-24 and Beyond)

- Update remaining 50% of current PMID calculation types from A to C. This will more accurately calculate PM due dates.

14. SECURITY

14.1 Emergency Preparedness

14.1.1 A Look Back

Continued improvement of the Emergency Response Organization (ERO) team stability and the quality of drills was recognized by all 41 ERO personnel being qualified or requalified by the total evaluated evacuation exercise held on October 11, 2022. Only six drills were required to accomplish this, as opposed to seven drills the previous year.

The Emergency Management organization continued its laboratory level Incident Command System (ICS) implementation by continuing the design and development/revision of training courses in preparation for eventual delivery to various laboratory audiences. This is the first innovation of its kind in the DOE Complex. MFC ICS expertise was enhanced by a focused classroom course given to all SS and EAMs.

Credential badges have now been issued to all ERO personnel. The format was coordinated with INL Security and will minimize the time for ERO personnel to pass through security control points during emergency incident response.

14.1.2 People

The Emergency Management organization continues to show a level of dedication throughout MFC to the all-volunteer organizations as evidenced by:

- The ICS training and credentialing activities mentioned above
- A continued increase in people actively inquiring about service on an ERO team
- The addition of one Area Warden Coordinator to better provide for a timely accountability process.

Going forward the focus will be on a persistent pursuit to keep the ERO teams staffed, especially with Area Wardens, Area Warden Coordinators, and Personnel Accountability Leaders.

14.1.3 Equipment and Tools

The MFC emergency control center (ECC) equipment and decision-making tools are state of the art. A dedicated Emergency Management-specific IT FTE ensures it is up to date and integrates well with all laboratory assets.

14.1.4 Actions FY-23

- Staff the ERO watch bill by stabilizing the number of qualified Area Wardens, adding one Area Warden Coordinator, and one additional Personnel Accountability Leader to further compensate for the telecommuting population of those positions, and boost ERO's ability to man the rotating on-shift teams. (Eric Papaioannou, September 30, 2023)
- Continue researching the Area Warden posture to improve efficiency, and to include adjusting/increasing building-clearing tasks given to Area Wardens. (Eric Papaioannou, September 30, 2023)

14.1.5 Looking Forward (FY-24 and Beyond)

- Continue implementation of the ICS concept at MFC to function seamlessly with Emergency Management, Security, Fire Department, RadCon, and the rest of the laboratory. This will greatly enhance communication, recognized incident management authority, and the ability to integrate response with the rest of the laboratory's EROs. MFC application of new training will follow briefings to all levels of INL management.

The Emergency Management organization will constantly monitor ERO positions, strength, and telecommuting impact, and add actions in the FY-24 version of the OMI if adjustment is needed.

14.2 Personnel Security

14.2.1 A Look Back

The Laboratory Protection Division at INL is one of the broadest divisions in terms of the number of staff and the variety of programs maintained. Security Programs and Services at INL encompasses, and is responsible for, a wide range of security interests including: the classification office, physical security, safeguards, security investigations, personnel security (PERSEC), Human Reliability Program (HRP), and Foreign Visitors and Appointments.

PERSEC is an element in the overall protection strategy of the Laboratory Protection Division at INL. This organization encompasses DOE Access Authorization (clearances), Employment Processing, Badging, and HRP. PERSEC ensures that anyone visiting or working at INL, whether a prime contractor employee, subcontractor, or visitor, is authorized and that all individuals needing access to classified matter and/or special nuclear materials (SNM) have the required access authorization. PERSEC is responsible for properly and efficiently processing INL employees for DOE security clearances, and to ensure that all employees, contractors, subcontractors, and visitors meet DOE badging requirements.

PERSEC requirements are outlined in DOE O 473.3, "Protection Programs Operations" and DOE O 472.2, "Personnel Security." INL implements these requirements through several LWPs and MCPs:

- LWP-11100, "Personnel Security"
- LWP-11101, "Pre-Employment/Suitability Investigations for Determining Employment/Access Eligibility"
- LWP-11102, "Unclassified Foreign Visits and Assignments"
- LWP-11104, "Human Reliability Program"
- MCP-11100, "INL Personnel Security Functions for DOE Access Authorization"
- MCP-11101, "INL Personnel Security Badging Functions"
- MCP-11102, "INL Personnel Security Employment Processing Functions."

Within the past several years the Safeguards and Security Directorate has undergone a significant reorganization and hired many new personnel. Some positive outcomes have resulted from the reorganization and growth of this directorate. These include an improved website and access to procedures and required documents, a new visitor request process, and a badging office located at MFC. However, very little has been done to improve the Foreign Visitors and Appointments process, and the process for determining access to documents that personnel need to perform their job functions is difficult and cumbersome. Paperwork, such as the SF-86, for initial clearance, and required for re-certification, is difficult to navigate and error likely. Access to staff with the experience and knowledge to navigate these forms is lacking. Consistency in hiring and disciplinary actions related to reporting for clearance seekers and holders is also lacking. There are several situations that employees and their managers have encountered that are not explicitly discussed within implementing procedures. This has led to inconsistent management of this program and its requirements. History, process, challenges, and suggestions for HRP are described in a separate chapter.

14.2.2 Process

The process of hiring for any position within a national laboratory is lengthy, first requiring a basic background check. This process is made more difficult for any position requiring a DOE "L" or "Q" clearance which requires submittal of an SF-86, active investigation, and interviews. Often newly hired employees wait many months to obtain the appropriate clearance to perform their intended job functions. This can be frustrating for many new hires especially those that have been hired from private industry or academia. While not as widespread, there have been some instances of potential employees disclosing previous drug use from states that have legalized recreational and/or medicinal drug use. Typically, this ends up with them not advancing through the security screen and unable to be offered a position with INL/MFC.

Additional challenges are encountered when hiring a foreign national employee. Hiring of foreign nationals has grown at MFC particularly for highly specialized scientific and instrumentation roles. While they are not eligible for clearances they are working with peers and within facilities where certain programmatic work requires specific clearance levels. Because of this, foreign nationals end up being restricted from certain areas of otherwise common workspace. The security plans of foreign nationals often limit these individuals to specific buildings, during certain hours of the day, and days of the week. Making matters worse they are unable to access many documents or work applications to perform the job they were hired to do.

For existing employees, the requirements to renew a clearance can be confusing, difficult, and take several days to weeks to complete cumbersome questionnaires, such as the SF-86. Access to individuals that are well versed in these activities is difficult, as there are not many POCs lab-wide, and none identified at MFC. Furthermore, employees that hold current clearances remain unsure and unclear on what types of activities must be reported to their manager or to security personnel. Often incidents and occurrences that should have been reported are discovered by investigators during the clearance renewal. On the other hand, some staff are quick to report things such as misdemeanor traffic citations to management that are not required to be reported.

There are numerous challenges that both potential and existing employees encounter that relate to PERSEC. The result of these challenges is an increased difficulty to attract and retain some highly qualified individuals. The requirements and rules for reporting security related activities for both the clearance holder and their management is difficult to navigate and know. For most clearance holders and hosts of foreign national employees the only training required is an annual web-based refresher course.

14.2.3 Actions FY-23

- Evaluate and determine whether the required training for clearance holders is adequate or should be adjusted. (Tim Hyde, March 31, 2023)
- Provide a point of contact (POC) for clearance paperwork and related concerns at MFC to help staff with this process. (Tim Hyde, March 31, 2023)
- Provide MFC a POC for PERSEC much like our POC for physical security. (Tim Hyde, March 31, 2023)

14.2.4 Looking Forward (FY-24 and Beyond)

- Work with PERSEC to evaluate specific foreign national individual exemptions for specific facilities or areas.

14.3 Human Reliability Program

14.3.1 A Look Back

The Human Reliability Program (HRP) is a security and safety reliability program designed to ensure that individuals who occupy positions affording access to certain materials, nuclear explosive devices, facilities, and programs meet the highest standards of reliability as well as physical and mental suitability. This is done through increased evaluation of an individual's financial condition, mental wellbeing, and physical health. These evaluations are also accompanied by increased random drug and alcohol testing (The HRP program implements requirements of 10 CFR part 712 the criteria of which is described in LWP-11104 INL specific details are described in PLN-11101, "Human Reliability Program Implementation Plan."). Currently there are several hundred employees at MFC who are actively monitored and evaluated in the HRP. While the majority of these employees are security police officers (SPO) who report to safeguards and security management, there are a number of MFC employees within this program that report directly to MFC management. Currently the Security Programs and Services Division of the Safeguards and Security Directorate manages the HRP at INL.

Improvements have been made but more still could be done to help HRP documents provide clear and concise requirements for participants and for supervisors and managers of HRP personnel. Furthermore, there are several situations that HRP employees and their managers have encountered which are not explicitly discussed within implementing procedures. This has led to what appears to be inconsistent implementation of this program and its requirements.

14.3.2 People

Individuals under HRP have several requirements they are personally responsible for. Additionally, there are several key positions (described in PLN-11101) to ensure compliance with HRP requirements.

- HRP employees are responsible for the following actions:
  - Completing a life change index each year and reporting of any life change issues to the psychologist.
  - Ensuring that after 40 or more hours of missed work due to sickness or injury they are evaluated by designated medical professional for an HRP return to work evaluation.
  - Reporting all medical conditions (physical and mental) that require medication or treatment.
  - Reporting **all** prescription medicine and any over the counter (OTC) medications that may impair judgement or ability to perform HRP functions.
  - Reporting for drug and alcohol testing after being notified by HRP supervisor.
  - Monitoring personal and coworker's behaviors for changes.
- HRP supervisors are responsible for the following actions:
  - Completing initial and annual HRP Supervisor's Report to aid psychologist in their decisions.
  - Updating a job task analysis form each year for HRP employees.
  - Receiving and issuing requests for drug and alcohol testing of HRP employees.
  - Removing HRP employees from HRP duties if HRP management official temporarily removes HRP employee from HRP, there is reasonable belief an HRP employee is not reliable, or employee displays questionable behaviors or conditions.
  - Reporting the removal of an HRP employee from HRP duties to the HRP management official.
- HRP certifying officials are responsible for the following actions:
  - Receiving notice from the HRP management official if an HRP employee is temporarily removed from HRP.
  - Maintaining authority to approve employee reinstatement to HRP.

- Ensuring DOE PERSEC office reviews certification documents.

- The HRP management official is responsible for the following actions:

NOTE: *It is important to note here that the final authority for HRP certification resides with DOE. BEA performs the administration and execution and turns over recommendations to DOE for acceptance or rejection.*

  - Receiving written communications from the Site Occupational Medical Director (SOMD) and psychologist including work restrictions, temporary removal from HRP, reinstatement recommendations, and positive drug/alcohol testing results.
  - Notifying HRP supervisor of temporary removal of an HRP employee from HRP.
  - Notifying the HRP certifying official of removal or reinstatement of HRP employees.
  - Evaluating all individuals for initial or recertification to HRP communicates concerns to HRP certifying official and DOE-ID PERSEC.
  - Providing initial training for HRP participants and HRP supervisors.
  - Providing written notification to HRP employee within five business days of their temporary removal from HRP.

- The SOMD, or designee, is responsible for the following actions:

  - Performing annual medical assessment of HRP employees.
  - Recommending temporary removal of HRP employees from the program.
  - Imposing restrictions on HRP employees.
  - Approving the use of regulated medications including narcotics. (This is noted in the employee medical file and not HRP file.)
  - Providing written return to work recommendations for HRP employees to the HRP management official.
  - Conducting rehabilitation evaluations and subsequent recommendation to HRP management official.
  - Determining frequency of drug/alcohol testing for HRP employees that are reinstated to HRP.
  - Ensuring training of medical staff to fulfill HRP duties.
  - Making medical based decisions and recommendations based on testing results.

- The INL designated psychologist is responsible for the following actions:

  - Conducting all psychological assessments of HRP candidates and HRP employees including return to work evaluations.
  - Requesting information from INL Employee Assistance Program (EAP) counselors related to HRP employees.
  - Conducting rehabilitation evaluations.
  - Determining frequency of drug/alcohol testing for HRP employees that are reinstated to HRP.

14.3.3 Process

Initial training for HRP involves required reads, a required training course, and an “Initial Briefing” for HRP participants and HRP supervisor by the HRP management official. HRP participants are required to complete an annual refresher training. The SOMD ensures initial and annual refresher training is complete for medical personnel related to HRP duties.

If an HRP candidate tests positive for alcohol or illegal drugs they are disqualified as an HRP candidate. If an HRP participant tests positive for alcohol or illegal drugs they are temporarily removed from HRP. Randomized drug and alcohol testing are described as an hourglass sampling method with randomized testing days, but at least one test per year is required. HRP employees may be tested for drugs or alcohol following an incident, unsafe practice, or due to reasonable suspicion. If the employee's position description specifies maintaining the HRP certification then disciplinary action, likely leading to termination, will be the result of not maintaining the requirements.

Issues outside of work like a DUI, that indicate a potential judgement and reliability problem will likely result in removal from HRP. There is then a process for increased monitoring that allows an individual to potentially stay in the program. The agreement set up through EAP and medical, generally result in abstinence commitments and increased monitoring. This agreement is referred to as a Stipulation of Understanding (SOU). Self-disclosures also result in a path that likely results in program removal and an SOU.

Several situations are described in the HRP guidance documents; however, many situations involving other scenarios have been encountered at MFC. Determinations made by designated medical professionals are conveyed per procedure to the "HRP management official" whom is not the employees line management. This makes accurate and timely information unavailable to the employee's manager. Many of the decisions that HRP supervisors are required to make end up being subjective due to a lack of access to pertinent medical information.

14.3.4 Equipment/Tools

Medical facilities and staffing on-site at MFC are required to implement the HRP effectively and are currently going through expansion and renovation.

14.3.5 Actions FY-23

- Provide direct feedback/comments to LWP-11104 and PLN-11101 document owner for improvements based on MFC experience/lessons learned. (Tim Hyde, September 30, 2023)
- Address HRP surveillance and escort requirements for upgrades and facility modifications, current operational staff cannot maintain the current workload. (Tim Hyde, May 31, 2023)
- Develop an Information Security section for the FY-24 OMI. (Tim Hyde, September 30, 2023)

14.3.6 Looking Forward (FY-24 and Beyond)

- Evaluate and determine if the required training for HRP is adequate or should be adjusted based on position/decision authority. If additional training is deemed necessary, creation of a training video is suggested using current HRP Program leadership.
- Develop a User Guide to help HRP employees with decisions. (Improve HRP webpage/interface.)
- Evaluate and review/update HRP Supervisor's Report, Form 472.07, "Human Reliability Program (HRP) Supervisor's Report."
- Develop a more timely and accurate way for HRP supervisors to be informed of decisions made by others about their HRP employees.
- Consider a master list of OTC drugs that are permitted under HRP. (Determine whether this exists for those in the program already; this would greatly benefit HRP employees and HRP supervisors.)
- Continue to improve the reference material.

15. INFRASTRUCTURE MANAGEMENT

15.1 Subcontracted Construction and Modification Performance

15.1.1 A Look Back

In FY-22, the volume of construction work and subcontracted MFC plant modifications was significantly higher than the 5-year average. For FY-22 work on the Sample Preparation Laboratory; Security Building Demolition; Maintenance and Infrastructure Building HVAC and Network Upgrade; Engineering Office Building and ZPPR Support Wing HVAC systems upgrade; and infrastructure piping repairs dominated this area. Multiple small projects and modifications were also completed. Overall performance was outstanding. The few events and issues that occurred were handled without any significant issues in timely notification, investigation, and corrective actions, with negligible delays and increase in cost.

The OMI action taken in FY-22 (creation of FRM-3246, "U&IS Turnover Checklist") proved to be a valuable tool in ensuring contracted construction and major maintenance projects fulfill operations expectations before the projects are eligible for partial or final turnover to the owner. FRM-3246 will continue to assist in improvement of U&IS SSC configuration management inadequacies.

Monthly collaboration meetings between MFC Projects Division, Construction Services, and U&IS Management ensured all groups were informed of current issues and priority shifts. Additionally, all affected are both aware of and prepared to handle upcoming fiscal year scheduled projects.

In FY-22 there were numerous failures in infrastructure support systems (e.g., fire and potable water, cooling water, sanitary waste, and electrical distribution). The integration of communication between Facilities and Site Services (F&SS), MFC PMO, and MFC U&IS divisions allowed rapid response to these failures, most of which have been repaired and placed back in service.

15.1.2 People

The U&IS Department increased Building Facility Manager (BFM) staff in FY-22 to six BFMs. Five of the six BFMs are fully qualified and bring different industrial and construction backgrounds to the team. The BFMs perform the daily work release for all subcontracted work occurring outside nuclear and radiological facilities, which comprise most of the subcontracted construction and modification projects being executed across MFC. Typically, each BFM is responsible for two major construction projects, as well as the day-to-day maintenance for their assigned buildings. These construction projects add significant scope to the BFM workload in addition to the daily landlord responsibilities for 70+ support buildings and their tenants. In support of construction and plant-modification projects the MFC Move Coordinator (the sixth BFM) completed 275 move requests in FY-22. Maintenance/U&IS departments share a newly hired administrative assistant to relieve the BFMs of many of ancillary duties associated with move coordination, maintenance outages, excess coordination, and building/system health assessment form documentation. Recent adjustments to base pay have minimized differences in pay, but significant differences in work scope for the job family remain.

F&SS continues to hire new Construction Field Representatives (CFRs) and project managers to replace those lost to attrition and to keep pace with upcoming projects. Hiring of new CFRs and project managers ensures pre-planning and field oversight is provided for critical activities associated with F&SS managed projects. Despite adding staff, it is not possible for CFRs to be present for every critical activity that may be occurring on any given day.

Two of the U&IS BFMs also hold the qualification of Subcontractor Field Representative (SFR) to ensure subcontract vendors perform work in accordance with appropriate safe work practices. There are process improvements that should be considered to assign the responsibility more appropriately.

15.1.3 Process

Construction processes, subcontracted modification processes, and project management processes have yet to be revised by the Process Architecture for Continuous Excellence (PACE), formerly

Management Systems Transformation Initiative (MSTI). These processes have the same common gaps and issues associated with all INL management systems and are navigated via a network by knowing who to call for help. Until these processes are streamlined, and the gaps are removed, planning, preparation, and execution of major construction projects and subcontracted services will continue to be less than optimal.

Interface with Project Management, Engineering, and Construction Services during implementation of the new FRM-3246, revealed the necessity of another action that will greatly increase checklist efficiency for partial and final turnovers. For subcontract vendor services at MFC the Subcontract Work Office (SWO) assigns SFRs to specific activities. Ideally the SFR is familiar with the work and the facility the work will be performed in. Due to the amount of vendor services and the increased scope of work MFC is experiencing, there are times SFRs are covering services in facilities in which they are not the most qualified SFR, or they are assigned to SFR duties in locations and at times that take them away from other work. Currently, MFC does not have enough qualified SFRs for the number of facilities.

15.1.4 Actions FY-23

- Develop and publish a U&IS Project Expectations & Integration Checklist for use by BFMs to ensure facility owner project-deliverables are included in the project planning and award process. (Eric Papaioannou, September 30, 2023)
- Collaborate with Project Management, Engineering, and Construction Services to ensure these groups understand the purpose and benefit of the Checklist. (Eric Papaioannou, September 30, 2023)
- Collaborate with home organization SMEs and close gaps identified in the performance of SFR oversight of work conducted at MFC. (Eric Papaioannou, September 30, 2023)

15.1.5 Looking Forward (FY-24 and Beyond)

- Continue to monitor performance in the subcontracted work execution area and respond accordingly in out-years.

15.2 Building Management

15.2.1 A Look Back

Since 1994, building management at MFC has been mostly reactive (when failures occurred, actions were taken, and personnel were assigned to correct the issue). Very little remodel/upgrade activities were pursued to replace aging infrastructure, such as HVAC, sanitary waste, potable/fire protection, roofing, windows, and siding. Growth of MFC mission scope has increased the need for new support buildings and upgrades of existing buildings and infrastructure.

U&IS has a budget to accomplish day-to-day performance of preventive maintenance. There is also funding set aside for prioritized major maintenance projects. Due to the age of many of the support buildings, many of the installed systems are reaching the end of life. HVAC systems are a challenge to maintain in operational status. Minor breakdowns are numerous causing a backlog in preventative maintenance which compounds the situation, and many of the systems are long beyond end of life and replacement components are unavailable. For the abovementioned reasons, MFC is using outside contractors to replace failed systems as funding comes available. The current HVAC preventive maintenance backlog requires a new solution.

In FY-22, the U&IS Asset Health Tracking Spreadsheet was created to enable prioritization of administrative/support-building repair/upgrade needs. Comprehensive assessment forms were completed, and information entered for all U&IS managed structures. The assessments are intended to be performed annually to ensure the spreadsheet remains updated.

15.2.2 People

U&IS BFMs are the managers that own and oversee all activities associated with MFC administrative and support buildings (currently 70+ buildings and growing to support mission growth) not owned by

NFMs. The BFMs collaborate with Project Management, Construction Services, Engineering, ES&H, Fire Protection, Security, Campus Development, and Nuclear Operations to facilitate daily work release of U&IS support service operations. These operations include maintenance and repair of existing infrastructure and construction of new infrastructure. They are directly supported by the U&IS Backshift Nuclear Operators (BNOs) group and the U&IS Laborer/Custodial group. Senior Staff and System Engineers round out the department.

15.2.3 Process

When maintenance activities are required, BFMs schedule the MFC Maintenance Department personnel to perform most of the preventive and corrective maintenance on U&IS support systems with specialized craft personnel.

U&IS BNOs are able to perform minor maintenance activities that do not require specialized training and Laborers support both groups to assist with non-skilled tasks associated with the maintenance.

Currently, most preventive maintenance activities that service U&IS support systems and structures are performed using work orders that stipulate specialized craft personnel to perform all of the work tasks. With many of the support systems, some of those tasks may not require the expertise of the specialized craft personnel (filter and belt changeout on HVAC systems is an example as it does not require knowledge of the refrigeration system). Identification of tasks that may be performed by lessor qualified groups may reduce the amount of backlog in certain cases.

15.2.4 Actions FY-23

- Collaborate with MFC Maintenance Planning and Engineering departments to determine if non-refrigeration system HVAC maintenance tasks can be re-assigned to personnel not qualified as an HVAC Technician. (Eric Papaioannou, September 30, 2023)
- Develop a map of all of MFC HVAC systems, include their current health and maintenance status. (Eric Papaioannou, September 30, 2023)
- Collaborate with MFC Maintenance Planning department and revise U&IS HVAC system work order models to include support personnel in applicable tasking. (Eric Papaioannou, September 30, 2023)

15.2.5 Looking Forward (FY-24 and Beyond)

- Continue to monitor performance in the building management area and respond accordingly in out-years.

15.3 Backshift Operations

15.3.1 A Look Back

The MFC Complex supports research and development work that is almost entirely performed Mondays through Thursdays, from 0700–1730. Currently, there are also approximately 10 nuclear-operations personnel that work rotating shifts at FCF and HFEF. Work outside of the normal work schedule is considered backshift operations. All 28 of the nuclear/radiological facilities and the 70+ administrative and support facilities/buildings are required to be in ready status 24/7/365. Backshift operations comprise significantly more time (126 of the 168 hours in a week) than normal work time.

The U&IS Backshift Nuclear Operations group is responsible for monitoring and first-response/notification associated with all MFC support SSCs, and operation of all U&IS owned support systems. The group also performs minor preventive and corrective maintenance on U&IS support systems that does not require specialized qualifications (HVAC, I&C, electrical, carpentry, etc.).

Throughout the winter, Laborers assign a backshift group to work snow removal in preparation for the Monday through Thursday, normal work-schedule at MFC employees.

In FY-22, a third of the BNOs were lost to attrition due to retirement, job changes, and COVID-19-related issues. Five operators and an operator helper were hired to bring the group to full

complement from recent and anticipated attrition; these new hires are in qualification status. Post-COVID-19 policy adjustments now allow for rehire of previously qualified personnel.

Recently, it was determined that the 14 MFC support systems that BNOs operate had outdated, incorrect, or non-existent descriptive information available to support BNO study and training for operator qualification. A subcontractor was hired to develop standardized description documents, training and qualification materials including test banks. The subcontractor will also update prints and procedures as the correct information is validated.

15.3.2 People

The BNO's group is comprised of 12 personnel, eight personnel that support 12-hr rotating shift operations, two on each of the four crews; and four personnel split evenly into two sliding 12-hr dayshifts. Due to their breadth of operations responsibility (normal, emergency, and first response notifications) associated with the number of facilities and support systems, the qualification process is extensive. Five laborers work backshift throughout the winter to perform snow removal and related tasks associated with cold-weather preparations. During all backshift time periods, a U&IS Shift Duty Manager (one of the BFMs) is available for dissemination of responsibilities associated with response to any MFC abnormal condition.

15.3.3 Process

The BNOs are responsible for operations and monitoring of mission support systems. These systems are required round the clock. On backshift, the group monitors U&IS and Mission related systems and reports to the on-duty Shift-Duty Manager for direction regarding abnormal conditions. All abnormal events that occur on backshift are reported to the on-rotation BNOs and they follow response and reporting processes in accordance with approved procedures. The BNOs are the first line of defense during backshift.

Part of the BNO responsibility is planning for LO/TO. The majority of this operations task is performed by the sliding 12-hr dayshift portion of the group. The four operators split evenly into two crews that work either Monday through Thursday or Wednesday through Friday. This ensures that the busiest LO/TO scheduled days (Wednesday and Thursday) have the highest number of personnel working 12-hr days. The sliding 12-hr dayshift personnel also cover the majority of BNO rotating-shift PL time.

U&IS operates the majority of systems at MFC. As such they are responsible for a significant share of hazard mitigation that allows maintenance and repair.

In addition to Laborers assigned to work backshift for snow removal in the winter, the Heavy Equipment Operator group is called out to remove snow whenever the event appears to be more than the Laborer group can stay ahead of, or on the shifts that the Laborers are not scheduled for.

Eight of the highest-priority systems contracted for study/training material development near completion and will be incorporated into the MFC Training department materials for BNO training and qualification. The remaining systems are scheduled for completion by mid-FY-24. The completed system descriptions and associated reference materials (containing correct information) have already proven to be beneficial for engineering and maintenance processes.

15.3.4 Actions FY-23

- Collaborate with MFC Training to initiate integration of the newly developed training materials for future BNO qualification. (Eric Papaioannou, September 30, 2023)
- Examine the completed study/training material and determine the need and priority of performing the same level of development for the remaining six systems and implement accordingly. (Eric Papaioannou, September 30, 2023)

15.3.5 Looking Forward (FY-24 and Beyond)

- Continue to monitor adequacy of backshift operations and respond accordingly in out-years.

16. EQUIPMENT RELIABILITY

16.1 A Look Back

The Reliability group's mission is to develop, implement, and sustain a world class predictive maintenance program where equipment is monitored and maintained to minimize unplanned system downtime and to establish a culture within MFC that incorporates equipment reliability (ER) into the design of new systems for future installation(s)—ensuring that the ER group supports MFC and INL in completing their mission.

Prior to 2016, MFC had no specific equipment reliability program (ERP) or processes beyond standard PM. In 2016, MFC contracted Nuclear Services Group Inc. (NSGI) to perform an ERP assessment and develop a plan for implementing a reliability program at MFC. The program has grown and developed since 2016, with the primary focus on the workstreams shown below:

- Predictive Maintenance (PdM) Improvements – As of November 2022, there are 1,036 pieces of equipment being monitored across MFC and Idaho Nuclear Technology and Engineering Center (INTEC).
  - Utilizing Vibration, Thermography, Oil Analysis, Motion Amplification, Ultrasound, and Motor Current Analysis, as described in MFC Predictive Maintenance Program guide PRD-394, "MFC Predictive Maintenance (PdM) Program."
- Equipment Reliability Suites (ERSuites) – A software system that tracks the 5-year investment strategy, system health reports, and predictive technologies condition monitoring.
  - LTAM – As of November 2022, there are 133 issues/projects in LTAM for MFC.
  - SystemIQ – As of November 2022, there are 46 system health reports in SystemIQ.
  - PlantIQ – As of November 2022, there are 1,036 pieces of equipment are actively monitored by the reliability group.
- Reliability, Availability and Maintainability (RAM) review process – Provide RAM review as part of the EC process and in accordance with MFC-ADM-3007, "Reliability, Availability, and Maintainability RAM Standard."
  - The RAM process is being incorporated into new reactor projects (MCRE, LOTUS, etc.) and many other ECs supporting MFC facilities and equipment upgrades.
- PM Optimization (PMO) – Developed a process to review and update existing PMs to ensure MFC equipment is being maintained correctly, while gathering needed information. The ER group works with System Engineers to continue updating maintenance strategies across MFC.
- System Equipment Reliability Prioritization (SERP) Process – The SERP is a criticality analysis for systems and equipment at MFC. All MFC systems (including SPL) have SERP values and over 6,000 individual pieces of equipment have been through this process.
- Troubleshooting and Root Cause Analysis (RCA) process – The Reliability Group works with facilities and System Engineers to understand equipment anomalies and understand the root cause of these anomalies. Examples include using thermography camera for roof inspections to identify roof leaks, ultrasonic inspections to detect compressed gas leaks, MFC-768 air compressor RCA, and RPZ backflow preventor failure RCA.
- Professional and Personnel development – As of November 2022, the ER group has 20 certifications in predictive technologies (Vibration, Thermography, Ultrasound, Oil Analysis, Motor Testing, and Motion Amplification).

16.2 People

The MFC ER Team consists of two Reliability Engineers, two Predictive Maintenance Analysts (one specializing in Thermography and one specializing in Vibration/Tribology), and the group lead. The team is cross-trained and able to support other team members as needed, while still encouraging each team member to become a subject matter expert in their own respective areas.

The ER group has experienced attrition due to personnel moving into other MFC projects and retirements. However, the group has successfully backfilled these open positions with qualified and talented individuals. The group seeks to add a dedicated position in the future that will oversee the ultrasonic testing/lubrication and tribology program for MFC facilities. One goal for each of the PdM Analysts is to obtain at least a Level 3 Certification in their primary technologies (as applicable), and the Reliability Engineers will obtain at least a Level 2 Certification in the technologies associated with their engineering disciplines.

16.3 Process

Currently, within the ER group, several processes will help achieve the MFC/INL mission. In FY-22 and continuing into FY-23, the ER group has focused work efforts primarily in four areas, as shown below–while continuing to support other work streams, such as SERP, PMO, and RCA, as needed.

- Grow and develop the PdM program – In FY-22 the PdM program added 64 pieces of equipment across MFC and INTEC. The ER group analyzed 2,194 equipment tech exams in FY-22. PdM work orders are completed by MFC maintenance personnel. Maintenance personnel collect the PdM data and provide that information back to the PdM Analysts for review, trending, and load new tech exam into PlantIQ.
- Support RAM process – As part of the EC process the reliability group provides a discipline review. The ER group utilizes MFC-ADM-3007 for the RAM standard in this process. The ER group works with Engineers and Project Teams to develop PM/PdM strategies, reliable equipment design, failure modes effects on analysis reports, spare part determinations, precision installation requirements, startup, acceptance requirements, etc.
- Support facility reliability needs – The ER group participates in facility health committee meetings and supports facility needs by providing PdM services, such as thermography roof inspections, wireless vibration sensor installations, ultrasonic leak inspections, motor analyses, etc.
- Professional Development – The ER group attends several PdM trainings and conferences each year to ensure the group continues to develop knowledge and skills. In FY-22, group members attended Reliable Plant, Motor Current Analysis, Transformer Management, Ultrasonic Inspection, and Thermography trainings, with plans to continue attending trainings and conferences in FY-23.

Some processes still require additional development and implementation within MFC – the first being development of PM strategies for spare parts. Currently, there is no standardized practice for developing PM strategies for spare parts. Implementation of this work effort will require close interface with warehouse, procurement, and maintenance personnel to ensure spare parts are properly maintained at MFC.

A second initiative requiring additional development and implementation is equipment lifecycle management. This process will include an obsolescence review of current equipment to determine which equipment needs to be added into long-term planning. This review will be formed in accordance with national standards, such as ANS 3.14, “Aging for Non-Reactor Nuclear Facilities.” This effort will require System Engineers to determine mitigation strategies for critical equipment. Reliability will be an integral part of the lifecycle of new and existing equipment and systems.

16.4 Equipment/Tools

The MFC PdM program utilizes the following suite of tools and software to evaluate equipment health:

- Vibration – MFC utilizes vibration analysis to monitor rotating equipment such as pumps and fans using the SKF Vibration tool (CMXA 80, 75), and SKF @ptitude analysis software to monitor bearing health, detect degradation mechanisms, and ensure proper installation and startup acceptance.
- Thermography – MFC utilizes thermography analysis to monitor mechanical equipment, roofing systems, radiological waste containers, and electrical equipment such as panels, disconnects, and breakers using FLIR infrared imaging hardware (E8, E85, T620 Cameras), and FLIR software for analysis.
- Tribology – MFC utilizes subcontracted services with Bureau Veritas for mechanical oil analysis and SDMyers for oil-filled transformer oil analysis.
- Ultrasonic – MFC utilizes a Ludeca SDT270, SDT 340, LUBExpert and Fluke ii900 ultrasonic tools for leak detection, electrical faults, bearing lubrication, and bearing degradation diagnosis.
- Motion Amplification – MFC utilizes RDI motion amplification hardware and software for rotating equipment degradation mechanism diagnosis.
- PdM Database – The MFC PdM team utilizes PlantIQ in ER suites to track PdM health and status reports on MFC equipment.
- Motor Current Analysis – MFC utilizes PDMA hardware and software to perform both energized and de-energized tests to determine motor health and analyze for degradation mechanisms.

16.5 Actions FY-23

- Continue to grow and develop the PdM program. (Stuart Jensen, September 30, 2023)
  - Interface with TREAT to identify and add equipment into PdM program
  - Continue to issue tech exams in PlantIQ based on PdM data to System Engineers and Facility Managers for review.
- Continue to support EC process and RAM analysis: (Stuart Jensen, September 30, 2023)
  - Provide discipline reviews for ECs
  - Implement the RAM process in support of new Reactor Demonstration projects
  - Support System Engineers with PMO for next 20% of MFC critical systems.
- Support MFC facilities with reliability needs. (Stuart Jensen, September 30, 2023)
  - Install wireless vibration sensors on FCF crane to assist in remote troubleshooting of crane issues
  - Utilize PdM Ultrasonic technologies to identify potential issues such as compressed gas leaks, and exhaust ducting leaks
  - Establish a PM process for MFC spare parts.
- Continue professional development within the ER group. (Stuart Jensen, September 30, 2023)
  - Attend continuing trainings and conferences to continue personnel knowledge development
  - Support PdM training needs of MFC Maintenance personnel as needed.

16.6 Looking Forward (FY-24 and Beyond)

- Professional and personnel training plans for the PdM group:
  - Continue to train MFC Maintenance personnel in Vibration, Thermography, Tribology, Motion Amplification, and Ultrasonics.

  - Continue to cross-train and certify ERP group members in all PdM technologies.
  - Acquire and train a dedicated Tribology Analyst (Lubrication Champion) for MFC.
  - Support PdM Analysts in pursuit of 4-year Engineering degrees.
- Continue to grow PdM program at MFC and other INL facilities to ensure reliable equipment supports mission needs.
- Continue to utilize ERSuites or Lumada to track system health reports, equipment condition, and 5-year investment strategy.
- Develop system/equipment life cycle management processes and procedures:
  - Develop a Long-Term planning process and procedure
  - Migrate forward-looking equipment issues into LTAM
  - Create obsolescence review standard.
- Support other INL facilities that are developing ER programs.

17. ENGINEERING/CONFIGURATION MANAGEMENT

17.1 Design Standards

17.1.1 A Look Back

System Engineering responsibilities have been assigned to engineers across MFC. All 2,400+ systems now have at least one engineer identified as the responsible engineer to oversee maintenance and modifications. Similar types of equipment/systems have generally been assigned to the same engineer. A comprehensive spreadsheet resides on the MFC homepage under Engineering that identifies the engineer responsible for each system. This has proved beneficial to the MFC planning organization, facility operations and management. Furthermore, efficiency has been gained in reducing duplication efforts across facilities for similar systems by multiple engineers. Specialized small engineering groups have been established to cover common systems that are maintenance heavy where one engineer is not able to perform all the work i.e., HVAC and Hot-Cell support systems.

During FY-22, an Engineering Codes and Standards Series was implemented to reinforce the use of required codes and standards for engineering at MFC. This series provided introductory information to all new engineers and a basic review for experienced engineers on required codes and standards. This series aided engineers in selecting required applicable consensus-based codes and standards as required for their work at MFC. Engineering is required to follow applicable codes and standards for work at MFC.

MFC has had several issues with code implementation in terms of determining what constitutes adequate electrical guarding for electrical conductors. Two significant process changes were made to improve this situation. The MFC Facility Modification Process has been changed to require the authority having jurisdiction (AHJ) to review electrical equipment prior to acceptance testing rather than prior to placing into service (as the code requires). In addition to this new requirement, a standard for electrical guarding was created for MFC in 2020. The standard for electrical guarding will aid the design engineer by giving clear guidance for the needs of MFC, such as in gloveboxes and hot cells, with examples to better understand the standard for electrical guarding of conductor at MFC.

With the progression of the construction of the SPL facility it was prudent to involve System Engineers early in the construction phase for vendor data review and assistance in finalizing systems and equipment. During FY-22 System Engineers were assigned to assist construction development. Two additional engineers were hired to cover mechanical and electrical systems in the facility and to assist with commissioning support. In addition, the Master Equipment List (MEL) was developed, and essential drawing determinations begun.

Another major improvement in the use of standards was to introduce an evaluation section to the EJ form. The evaluation section can be used for many purposes, but typically is used to explain or document design decisions that were made for the design. In this regard, the use of codes and code interpretation can be documented on how the design met codes or standards. This section of the process requires signatures of a technical checker, as well as approval by the engineering manager or technical integrator. After full implementation and training of engineering personnel, the evaluations section has proven valuable to document the correct interpretation of national codes and standards, as well as standards imposed by procedure by the INL.

The following is a list of guides and standards that were completed in FY-22:

- Standard for electrical panel schedules:
  - SP-20.3.14, “MFC Electrical Circuit Directories,” was developed to provide instructions and identify responsibilities and information required for the creation of electrical circuit directories or panel schedules at the MFC. This procedure was reviewed and evaluated by the MFC Engineering group over the course of several months. This latest revision provides a consistent guide for displaying the information necessary for panel directories at the MFC by updating current NFPA 70 requirements and industry standards.

- Standard for engineering information located on the D30 Equipment Panel in AS:
  - STD-232, "Master Equipment List (MEL) Standard," is a standard guide describing where information will need to be placed in AS for each piece of equipment. This guide will provide consistency on where information will be located for each piece of equipment in the MEL. Originally this improvement was being written for the MFC, however, it was expanded to include the entire INL.
- Guide for locating engineering records in EDMS/Archives:
  - GDE-55070, "MFC-Drawing Search Guide," has been written and approved. This guide (GDE) was created for finding and retrieving drawings at the MFC. This guide includes how to find the drawings and how to retrieve them from stored document control boxes. This will aid all future engineers to find and retrieve drawings lost to the document control archives.
- Guide for correcting drawings used for LO/TO:
  - GDE-984, "Guidance for Physical System Configuration Management Data Change During LO/TO at MFC," was written and issued in May of 2022. This guide gives specific guidance to both Operations and Engineering on how to handle a drawing change for the performance of LO/TO if the drawing does not match existing plant conditions.

17.1.2 People

MFC is continuing to strengthen the discipline-centric element of the current organization by expanding it deeper and aligning personnel into discipline-specific work groups while maintaining assignment to facility systems. Strengthening the role of each engineering discipline is accomplished by delegating engineering work approval authority to discipline leads and supporting professional development through growth assignments and formal training. MFC Engineering wants to perform most of the design work involving core MFC competencies such as nuclear ventilation, remote handling, etc., in-house rather than subcontracting or sending work to other engineering groups. MFC Engineering will continue to prioritize technical capabilities when adding staff and focus on professional development for training junior engineers and external engagement for senior engineers.

Only the correct mix of disciplines will make it possible to cover all of the codes and standards with a resident engineer that can act as an expert in the vast variety of design work conducted at a national laboratory with nuclear experiments. The unique talents for experimental equipment such as furnaces, gloveboxes, and remote hot cell design must be created from within the directorate. These disciplines are in addition to the required disciplines of electrical, mechanical piping, and structural engineering, generally required for facility modifications. MFC is targeting expertise through hiring in code areas such as nuclear ventilation and structural engineering.

17.1.3 Process

Currently the engineering process requires the responsible engineer to list all the codes and standards that are applicable for a modification. With limited existing design basis documentation, the engineer relies on their expertise, the review of technical checkers, and the technical integrator (engineering manager) to capture the codes and standards that apply. Additional standards are listed in STD-139, "INL Engineering Standards" and STD-142, "INL Nuclear Engineering Standards." These standards identify standards and practices that are followed by the INL and the codes and standards that are more rigorous than commercial industry. These standards are continually updated to remain in compliance with changing national and DOE standards. In the future the code of record, system design description, and applicable codes and standards will be information that will be attached to each system or piece of equipment in the AS MEL. This will create efficiency in not only the conduct of engineering process but in engineering excellence at the INL.

Major additions have been added to AS for fields in the MEL database that will require revision tracking. Engineers were required to make informed decision related to their assigned systems which included quality level, environmental qualification, safety system designation, seismic category and if the

system is TSR-related. The information was loaded into the AS Master Equipment Data Base for all equipment. This information will be a quick reference for all equipment at the MFC.

17.1.4 Equipment Tools

All the codes and standards for engineering work will need be electronically captured within AS. The use of AS will allow engineering to track the code of record and standards used at the MFC to enable quality engineering work. A monumental effort by all System Engineers will be needed to get the codes and standards data entered into the AS database. The process will take many years to complete and will start with the active safety and defense in-depth systems. All other systems will follow as system design descriptions are written and the facility configuration information is loaded.

AS will also allow engineers to identify approved models for specific equipment items, such as HEPA vacuums, and attach engineering and quality standards to the procurement catalog ID. This will simplify and standardize selection and procurement of equipment subject to specific standards.

17.1.5 Actions FY-23

- Create a standard for electrical cable maintenance at MFC. This standard will provide guidance on the testing and/or replacement of electrical cables due to obsolescence or end of life. (Stuart Jensen, September 30, 2023)
- Create a standard or guide for pressure relief devices. The standard or guide should include use of pressure relief devices and guidance for maintenance and replacement. (Stuart Jensen, September 30, 2023)
- Create a standard or guide for the procurement of gloveboxes. MFC has spent years developing a standard protocol for the procurement and required quality in ordering gloveboxes from fabrication vendors. (Stuart Jensen, September 30, 2023)
- Create a guide for SKM Modeling of Electrical Systems at the INL. This guide should include how models are stored, retrieved, and reviewed. (Stuart Jensen, September 30, 2023)

17.1.6 Looking Forward (FY-24 and Beyond)

The design standards for INL and MFC continue to change and be updated. As the codes change, MFC will need to update the list of codes and standards followed and keep trained personnel updated on changes. This will need to be accomplished in two ways: processes, and personnel. The current list of codes and standards will need to be updated to remain current with industry and with DOE updates. MFC personnel will need to be trained and kept current through use of planned professional development.

- Update or create Code of Record for MFC facilities.
- Many design standards that are specific to MFC or the INL will need to be created. Writing standards that will clarify the general national standards and the of the best standard design practices for the INL will provide efficiency for design engineers and procurement of fabricated engineered items. It is the goal of MFC management to look for creating standards and helpful guides for the code compliance of codes that may be either difficult to interpret or need clarification for specific applications at the INL or MFC.

17.2 Configuration Management

17.2.1 A Look Back

MFC has worked under PLN-4656, "MFC Configuration Management Program Implementation Plan," for several years to update or create (where none existed) essential drawings for the various facilities. Most facilities have completed this first stage of configuration management (CM) recovery.

With the onset of COVID-19, essential drawing updates took a setback as engineers were required to work from home and drawing verifications were not achievable. During 2021 and 2022 priority was given to complete the drawings that were due in 2020, along with those due in 2021 and 2022. Essential

drawings are almost complete for 2020, 2021, and 2022.

The information for quality level, environmental qualification, safety system designation, seismic category and if the system is TSR-related was loaded to the AS MEL database for all equipment at MFC. These fields in AS are considered revision tracked and will require a formal engineering change to modify them in the future. Once quality level determinations (QLDs) have been made for all equipment at MFC it will allow the elimination of the current QLD process.

17.2.2 People

Staffing has continued to be a challenge as demand for engineering services has increased due to the number of facility modifications, new facilities, and new equipment has increased. Filling those positions with the best System Engineers with the correct disciplines has been a constant challenge. Additionally, subcontracting has needed support and has had limited success in relieving the burden on engineering staff. Positions are targeted based on expertise, which has created a challenge to fill positions.

MFC has a CM engineer responsible for assigning all the equipment/component ID numbers for all new equipment at MFC, in addition to, tracking all of the facility modifications for the modification process. In addition, MFC hired an equipment coordinator to assist in the task of equipment numbering and tracking equipment. The addition of an equipment coordination will resolve one of the major issues of tracking portable equipment. A program is being developed to better track portable equipment with an AS tool crib so that maintenance can be tracked, and the location of equipment is known. The equipment coordinator is working through the MEL to verify its data against the reality in the facilities.

The MEL will need a large amount of additional data added to each piece of equipment at the MFC to make the data base more usable and support processes updated around AS. Processes such as quality level designation will no longer depend on additional databases but will be unified under AS. MFC will also build a bill of materials linking equipment to the catalog data.

17.2.3 Process

The AS data base is the current and future data base for CM. With the implementation of version 9 of Asset Suite (AS9), EDMS will be linked to equipment and all configuration documentation will be linked in AS. Asset Suite will fundamentally change the way modifications are performed at MFC. With the implementation of AS9, all facility modifications will be tracked and controlled in the confines of a single data base. Changing of all documentation including drawings, operating procedures, changes to permits, hazard evaluations, analysis, and all documents relating to the modification will be tracked and modified through the AS data base. The process will have drivers to ensure all related documents that need to be modified during a modification will be identified and changed. This change will ensure all the proper authorizations and approvals are documented in one place and will be packaged into one organized comprehensive place that can be tracked during the modification and retrieved after the modification is complete.

With the full implementation of the MEL database in AS, all equipment information will be located in one area with a foundation of equipment. This means looking up a piece of equipment in AS you will be able to see the maintenance history and all associated documentation for that piece of equipment. The availability of this information will aide in LO/TO. When preparing LO/TO, operations will have access to the drawings and information to prepare the LO/TO, therefore eliminating not only the time it takes to find drawings but also providing help to get the correct drawing, eliminating possible errors. Having the documents tied to equipment will also assist the engineer performing facility modifications, as the engineer will be able to identify what documents will need to be revised in the EC. However, building these links will take time and attention from System Engineers.

A major process improvement that will be implemented with the use of AS9 is how quality levels will be identified for equipment. With the implementation, quality level will be identified with each piece of equipment, eliminating the need to search another data base for the quality level. Not only will this create the ease of seeing the quality level with the equipment in AS, but it will also eliminate the process for the creation of quality levels in a separate data base. This will create efficiency for both quality level identification and using a separate process to justify and approve the quality level for equipment. Since the existing process is onerous it is often applied at a high-level, leaving some ambiguity about the quality levels of components. The AS process will remedy this.

The equipment numbering procedure has been revised to include the process to be used for numbering portable equipment. SP-30.1.0, "MFC Equipment and Component Numbering," is also being revised to include labeling of portable equipment. A process is being developed and will be implemented in FY-23. An implementation plan for portable equipment is being developed for the process that will include tracking portable equipment and ensuring this equipment is easily locatable and that it is receiving preventive maintenance.

17.2.4 Equipment Tools

Asset Suite and the implementation of the EC process has been implemented and engineers are trained on the process. Several information meetings have been held to address specific elements of the EC process where questions were addressed. Engineers are becoming familiar with the process and are using it for system maintenance and modifications.

The use of a single engineering tool to standardize and organize the engineering, maintenance and operational information is essential for the success of CM. Asset Suite is a powerful data base that has multi-functional use for integrating all three of these functional areas. AS9 will need the effort of all three functional areas to be successful. It will take years to enter and integrate all the information that will be necessary to make the data standardized and organized to make MFC fully proficient in configuration management.

17.2.5 Actions FY-23

- Plan and execute an assessment of the configuration managements process at MFC. (Stuart Jensen, September 30, 2023)
- Obtain metrics for the Engineering Change process to assess the efficiency of EC closeout. (Stuart Jensen, September 30, 2023)
- Continue Codes and Standards Information Series meetings for engineers. (Stuart Jensen, September 30, 2023)
- Continue updating essential drawings for the facilities identified in PLN-4656. (Stuart Jensen, September 30, 2023)
- Develop and implement a data loader tool to assist loading information into AS. This new tool will assist the System Engineers in loading information by system, this will eliminate having to enter data individually for each piece of equipment. (Stuart Jensen, September 30, 2023)
- Upon implementation and training on the guide and data loader the System Engineers will begin entering data into AS for each piece of equipment. Each engineer will create a plan with dates to complete entering equipment information for all systems assigned to the engineer. (Stuart Jensen, September 30, 2023)
- Write an implementation plan for Portable Equipment at MFC. The plan must include tracking portable equipment and ensuring this equipment is easily locatable and that it is receiving preventive maintenance. (Stuart Jensen, September 30, 2023)

17.2.6 Looking Forward (FY-24 and Beyond)

- Continue with updating essential drawings for the facilities identified in accordance with PLN-4656.
- Create system design descriptions (SDDs) for systems; at present in general these only exist for active safety systems, as required by DOE O 420.1C, "Facility Safety."
  - SDDs will be developed for all systems that are classified as Type "MOD" in the Engineering Change process prior to EC closeout.
  - Assigned System Engineers will write SDDs and include lists of safety-related and defense in-depth equipment/components.
  - The new AS has built CM into its workflows and data structures and will continue to populate CM documentation as it is developed.
- Once an assessment is completed for equipment labeling, conduct a recovery program to ensure all MFC is correctly labeled with the correct equipment IDs.
  - Several facilities do not have the correct labels or alternate labels that can be error precursors for both operations and maintenance.
  - This has been a legacy issue that will need to be corrected for excellence in operations.
- Looking forward a fully integrated approach to CM will have a single data base to organize all the engineering and operational information for equipment at MFC. Areas of improvement are found below:
  - Updated essential facility drawings with a process to verify every 5-years
  - Changed the facility modification process to account for MFC-specific CM requirements
  - Updated unique equipment/component identification numbers and facility tags
  - Identified defense in-depth systems and evaluate to provide justifiable level of system engineering rigor.

17.3 Modification Process

17.3.1 A Look Back

Several years ago, MFC had issues with the lab-wide engineering modification process. The process lacked rigor, was vague, and there were systemic issues with the turnover from engineering to the facility. MFC developed its own facility modification process to fix these problems and to create a robust engineering change process that was clear and compliant with the host of DOE regulations for nuclear facility changes and configuration management. Creating a process that was clear and enabled a broad range of modifications was challenging. The creation of this process necessitated a procedure that covered all phases of change from initiation, design, turnover, and closeout. Since this time, the process has worked and been more effective. Several audits and reviews have looked at the process and confirmed that it is much improved.

The notable inherent problems resulted from the procedure being too long and the form to document the modification process was not electronic. The process still involves a host of required signatures for each phase of the process. The current process requires expert knowledge through checking, that requires the entire package to be physically routed to each approver systemically creating a less efficient process. Having a fully electronic process will allow significant increases in efficiency and a process to capture all the documentation and information involved for facility modifications.

After 1-year of implementation of the EC process and engineers using the engineering process maps in iQ Work Smart, it was determined that enhancements were needed to provide additional guidance on how to execute an EC. As a result, 35 process maps and the associated step details were revised. This extremely large task was completed over a 6-month period. This enhancement also required updates to the EC configuration in AS. All changes were validated by creating ECs in the TEST region of AS. These

enhancements aim to greatly improve the implementation of the EC module for the INL. This update, in addition to the continual technical assistance on a daily basis to engineers on ECs has proven effective to the efficient use of AS the vehicle for EC. The upgrade to AS, and the ability to now have EDMS documentation available in AS, will allow AS to become the primary configuration management database for the INL.

Understanding the manpower limitations and the facility needs for engineering support; an evaluation was undertaken in 2018 to determine the weaknesses and threats within the Engineering Division. There was an identified need to make improvements in CM, as well as support the modifications and new upgrades of equipment and systems within facilities. Facility Management was also asking for additional engineering support for upcoming projects due to their anticipated need over the next 5 years. Part of this evaluation included a bottom-up estimate of the system engineering needs to staff MFC. The following Table 8 identifies new hires to date.

Table 8. MFC Engineering Directorate new hires.

Department	Full Time Position Hire	Hired
U710 System Engineering	FCF Process Engineer	1
	System Engineer	5
	Equipment Reliability Lead	1
	SPL System Engineer	2
	Hoisting & Rigging and Manual Material Handling	1
	HVAC Sys Engineer	2
	Equipment Reliability Support	1
U720 Mechanical and Electrical Engineering	Electrical Engineer	6
	Equipment Coordinator (Configuration Management)	2
	Mechanical Engineer	8
U780 MFC Drafting	Drafter	3

17.3.2 People

Engineering provides the technical basis for safe, useful, and reliable SSCs to further the MFC mission. All necessary functions including design, nuclear safety, procurement, construction oversight, fabrication, quality assurance, specification of maintenance, and modification are integral to the engineering scope and responsibility.

Currently the Engineering Division has less staff than is needed to keep up with the pace of work at MFC. This is largely due to growth in base funding not keeping pace with escalation, plus growth in facility buildouts, combined with a lack of program planning for long-term needs. Many programs fail to recognize, and therefore, fail to plan and communicate the need for MFC system engineering to support their work. For basic support to the anticipated design and system engineering needs in FY-23 MFC Engineering is short of staffing in the following positions:

- 3 Mechanical System Engineers
- 2 Mechanical Design Engineers
- 2 Electrical Engineers
- 1 I&C Engineer
- 3 Drafters

- 1 Structural Engineer.

17.3.3 Process

The modification process performed by engineering is currently well defined at MFC. A major process improvement is the implementation of Engineering Change within AS. With this new change to the facility modification process, MFC has a managed system that will allow an outside organization to request an engineering effort in a straightforward process to allow the engineering organization to assign the correct System Engineers and will help the requestor get the correct disciplines involved for the success of the design, implementation, and eventual installation, turnover, and closeout of the necessary documents, and CM information.

With the implementation of AS9, MFC Engineering will be in the lead for defining engineering processes. Engineering is counting on this change to remove longstanding roadblocks to improved CM, such as the inability to access EDMS documents from AS, the lack of a usable equipment tree, and the difficulty of creating efficient process flows. MFC Engineering has investing time and attention to defining and refining the AS engineering process workflow implemented for AS9.

Keeping track of the location of EJs by the responsible engineer has always been time consuming. In addition, engineers have numerous responsibilities while implementing a facility modification, which includes providing EJ status to the Configuration Management Engineer. With the AS upgrade and use of EC, the status of ECs can be easily determined by running reports on each building, responsible engineer, Technical Integrator, etc. In addition, engineers will no longer have to keep track of paper EJs, as the ECs will be electronically stored within AS. Approvals at various stages of the EC life cycle can be electronically routed for review and approval and Engineering Management can easily determine what progress is being accomplished by viewing the EC in AS. The AS to EDMS interface capability allows the engineer to load documents, drawings, and records against the proper equipment and/or Master Equipment and Activities List (MEAAL) system. Facility documentation can be loaded against the equipment and/or MEAAL system, the engineer no longer has to spend days determining what documentation will require revisions because prior to initiation of a facility modification, the documentation will be readily available in AS.

17.3.4 Equipment/Tools

The use of a single engineering tool to request engineering and drafting support at MFC will help outside organizations obtain the critical support they need for facility modifications and installation of future scientific capabilities. The organization requesting engineering services will only have to fill out the scope of work, need dates, and basic information on an easy user interface. The request will then route to an engineering board that will categorize the request to determine the level of engineering rigor and assign the work to the appropriate engineering for execution. All the engineering work will be electronically captured within AS. The use of AS will allow engineering to track the status of the work through all phases of the facility modification process.

The new AS9 provides engineers with a user friendly process flow and data repository for defining engineering specifications, procurement, inventory, CM condition monitoring, and maintenance throughout the lifecycle of systems and facilities.

The engineering change module of AS has dramatically changed the facility modification process at MFC. AS will not only be a tool used for both controlling and tracking the change but can also be relied upon to ensure the correct documents and facility configuration information are modified to reflect the change.

A data loading tool, i.e., a dashboard, will be made available to allow engineers to mass load documents, drawings, records, technical notes, action requests, etc., against the selected MEL hierarchy. The data loading tool will improve the efficiency of loading various information as it can be mass loaded into AS, instead of individually loading the documentation against equipment one step at a time. The engineer’s efficiency while performing a facility modification will drastically increase once

documentation has been loaded against the appropriate MEL hierarchy, as they will be able to easily review what documents require a revision. These documents will be added to the Affected Documents List within the EC and will be revised accordingly during the EC lifecycle.

17.3.5 Actions FY-23

- Continue to address staffing needs to broaden existing disciplines and fill needed discipline in the areas of HVAC, Gloveboxes and Enclosures, and Civil/Structural. (Stuart Jensen, September 30, 2023)
- Implement the CM process to ensure all facility configuration information is placed in a consistent place in AS and easy to retrieve based on equipment numbers. (Stuart Jensen, September 30, 2023)

17.3.6 Looking Forward (FY-24 and Beyond)

- The new EC process, which has been fully integrated with CM, will provide correct facility information for future modifications. It will take several years to build the databases of information around the MEL structure and to mature the AS EC process.

17.4 Quality Assurance (Design)

17.4.1 A Look Back

In 2016, MFC Engineering started the process of integrating the functional organizations within the engineering directorate. Quality, procurement, subcontracting, warehousing, and receipt inspection were combined into the engineering organization. This change has facilitated collaboration in the design process and has created a culture where quality and ways to verify quality is considered early on in the design process.

Engineering has established functional groups that leverage areas of expertise to create efficiency and consistency throughout the facilities in design and configuration. An example is the glovebox group that works to provide a consistent approach in glovebox design and facility integration. Other areas of improvement include the following:

- Altered the EJ process to account for MFC-specific requirements.
- Created nuclear specification and commercial specification for fabrication work.
- Integrated quality into the engineering organization, which has allowed for participation and feedback in the design process.
- Integrated procurement engineering to assist in specification development while also establishing procurement strategies early in the process.
- Ensured drawings have been through a do/check/approve process.
- Conducted a rewrite of MSTI INDEX, “Commercial Grade Dedication” to be a clear and efficient process which also included comprehensive classroom training given by the SME.

17.4.2 People

The number of items being procured, and the total value has held steady since 2020. Improvements such as a standard practice for quality clauses and competent staff has allowed MFC to be successful at maintaining the quality of products. Additional quality engineers are needed to support the increasing number of reactor demonstration projects. Quality engineering is involved early on in developing quality implementation plans for reactor developers to ensure clear roles and responsibilities exist between BEA and the reactor developers. As these projects progress into design and fabrication, quality engineering shall ensure DOE-STD-1189, “Integration of Safety Into the Design Process,” is followed.

17.4.3 Process

New processes for engineering in AS were deployed early in FY-21 and include engineering change and procurement engineering. With the engineering process completely housed in AS, engineering decisions are documented and attached to the equipment in AS. This will allow easy retrieval of design basis information and create greater efficiencies when performing modification or maintenance. Bills of Material (BOMs) will be created that contain the information necessary to properly procure and accept items. The BOM links the procurement catalog ID to the facility equipment, a process which has been lacking. Design basis information such as drawings, specifications, safety analysis, Commercial Grade Dedication (CGD) plans can be a part of the catalog ID when needed and the acceptance activities will be verified for the items end use. For the first time a clear connection to the items end use, design information, requirements, and acceptance activities will be available in one place.

17.4.4 Equipment Tools

The AS implementation of engineering change and procurement engineering modules, along with the BOM, will improve the quality of engineering deliverables. The design information, as well as the history of design changes, will be contained within in AS. Asset Suite will link important documents such as drawings, specifications, and others to the equipment.

17.4.5 Actions FY-23

- Mature the process for creating BOMs within AS. (Stuart Jensen, September 30, 2023)
- Implementation of a safety analysis review in the BOMs. (Stuart Jensen, September 30, 2023)

17.4.6 Looking Forward (FY-24 and Beyond)

As MFC becomes the leader in reactor and fuel demonstration and testing and MFC Engineering continues to move forward, facility modifications will continue. These facility modifications will require an agile team that is able to incorporate customer requirements into the needed facility configuration changes, either through construction or maintenance activities. Being flexible, creative, and precise in MFC's design approach is key. Additionally, the quality of these outputs will be a necessity to innovate and accommodate customer demands without failure or delays due to design errors.

Looking forward, a fully integrated approach to quality in design will be implemented which will have early involvement of all stake holders and a well-developed acquisition strategy well ahead of procurement/construction. Leveraging lessons learned from projects such as SPL, Uranium silicide, and the MARVEL project will aid MFC Engineering in developing further efficiency in design quality.

The following are planned areas of improvement for FY-24 and beyond:

- Reconcile INL drawings with fabricated red-line drawings combining abilities of ProCore and AS software.
- Create CAT-IDs and common procurement strategies that span multiple facilities that aligns with the Code of Record (e.g., anchors, valves, PLCs, and other identified items).
- Broaden the use of MFC Engineering's standard for model-based design definition and fabrication.

18. MATERIALS AND SERVICES

18.1 Procurement

18.1.1 A Look Back

In mid-2015, the Nuclear Material Acquisition Group was formed at MFC and has seen tremendous growth in recent years. The Nuclear Material Acquisition Group was able to manage a large business volume increase by incorporating process improvements and implementing a customer focused strategy that included increased engagement with facilities and project individuals. The acquisition group was integrated within engineering and includes procurement specialists (contracts and materials), material coordinators, procurement engineers, quality engineers, warehouse personnel, and receipt inspectors.

In FY-21 and FY-22 the acquisition group saw growth in reactor demonstration projects. This growth stretched the group and necessitated additional quality and procurement engineering personnel to support quality activities such as vendor qualification, quality implementation plans, and surveillances. The additional personnel are funded by the projects they support.

The acquisition group focuses on customer service and strives to be the path of least resistance for programs at MFC. The group has embraced this culture and thereby gained the trust of MFC organizations. The acquisition group is now involved early and often in procurement strategies and problem-solving discussions. The group also realizes the need for continuous improvement and is looking for ways to provide tools to customers, so the procurement process is transparent.

The acquisition group completed implementation of the Bill of Material Process, Item Equivalency Process, and retired the Quality Level Determination database. The Bill of Material Process and Item Equivalency process are now in AS and compliment the Engineering Change process. Quality levels are now determined within the process that is applicable for ordering materials and services.

Improvements have been made to informal processes for tracking and staging of material, which has decreased the time to process and improved error rates. The acquisition group continues to hold meetings with facilities to provide up to date status on procurements. These meetings have been beneficial to AL, HFEF, and specific projects such as MARVEL.

18.1.2 People

An effective procurement organization at MFC can support the facilities and projects from time of order to delivery of SSCs. Communication is essential to the success and therefore, the accountability of individuals in the process needs to be as un-siloed as possible. Currently the acquisition organization consists of a mix of matrixed individuals, direct reports, and other individuals who are not matrixed. Risks of organizational changes or business process changes of matrixed organizations can have a negative impact on the acquisition organization. Currently good relationships exist with the quality and procurement organizations. However, changes to those organizations can have a negative impact on the direction of the MFC acquisition organization.

Changes within the procurement home organization has created challenges. Materials and Services are now split between two different home organization managers, which creates more communication lines that need to be maintained. Procurement still believes in a centralized organization which conflicts with the vision of the MFC acquisitions group.

18.1.3 Process

The overall procurement process is mature and well known by the individuals who use it on a frequent basis. Room for improvement exists in some of the formal and informal processes for procurement. Informal processes have been improved using Jira for material coordinators to track assignments. An MFC online material request form has been implemented and has been effective at improving the quality of the requests, as well as the time it takes to process the request. The procurement engineering module within AS provides efficiencies as items will contain all the needed information to facilitate efficient procurements.

18.1.4 Equipment Tools

The staging area is near capacity and often material must be sent to West One for storage until the work begins. To facilitate current and future MFC growth a larger staging area is necessary. Currently the staging is located on a mezzanine upstairs in MFC-781. Ideally, staging would be on the ground floor as these items are high turnover and generally are allocated to work orders within 6-months. Additional helpful tools would be scanners and tracking equipment that would make it easier to stage, locate, and manage stored material.

18.1.5 Actions FY-23

- Add a Project Quality Engineer supporting MFC projects such as SPL and Microreactor projects. (Stuart Jensen, September 30, 2023)
- Add a Procurement engineer supporting MFC facilities and projects. (Stuart Jensen, September 30, 2023)
- Implement Bill of Materials by adding a Material coordinator to support and to have working meetings with planners and engineers. (Stuart Jensen, September 30, 2023)

18.1.6 Looking Forward (FY-24 and Beyond)

Needs for the group are growing as reactor demonstration projects increase, adding complexity to the procurement process. The group is seeing a need for added service functions such as Specification, and Statement of work creation. The procurement group's expertise is uniquely qualified to fill that need. Efficient and transparent purchasing processes will be vital to accomplish the needed modifications and improvements at MFC. The groups' goal is to have an organization that is fully capable of assisting with all needs in the MFC procurement process, however, this can only happen when customer oriented, and technically competent individuals are in key positions.

For the future the acquisition group will need to continue to grow as MFC grows. The expertise needed going forward is different than it was 2 years ago. The acquisition groups need experienced and qualified procurement engineers, material coordinators, and quality engineers. The challenge is anticipating MFC's growth and adjusting to those needs. Processes have been developed, retired, and improved and now the acquisition group will focus on execution of these processes with only minor improvements moving forward.

Two items needed for the future will be:

- New warehouse for staging and storage of spares
- Staging improvements using AS instead of spreadsheets.

18.2 Quality Assurance (Procurement)

18.2.1 A Look Back

In the last 5-years, MFC has driven significant organizational paradigm changes in quality assurance. MFC stood up the Nuclear Acquisitions organization aimed at co-locating functions that had previously been siloed with improved efficiency as the primary objective. In addition to the organizational change, MFC began a cultural change effort. In the previous paradigm, engineering relied solely on QA to determine procurement acceptance requirements and procurement strategy. This paradigm resulted in procurement acceptance strategies not always in alignment with the design basis. Cultural and paradigm shift in process at MFC requires engineering to determine procurement acceptance requirements and strategy. Engineering is best positioned to do this, being most familiar with the design. QA has been integrated into the engineering process by aiding engineering in identifying and determining appropriate quality acceptance requirements. In that, QA assists engineering in selecting procurement acceptance requirements and executes that acceptance plan.

The primary source of MFC's success and improvement has been a cross-functional organization coupled with the right people. In addition to the organizational improvements, program changes have improved quality. Some of these improvements include:

- A standardized online request form designed to eliminate duplicate procurement requests
- An online material coordinator workload management tool
- General build to print fabrication specifications for both QL-3 and QL-1 orders
- Collaborating with senior leaders across the lab to provide consistent quality execution of the procurement acceptance process (CGDIT)
- Implementation of the AS Procurement Engineering Module
- Development of quality implementation plans for reactor developers
- Implementation of the Bill of Materials.

SPL is an example of a cross functional team matching the procurement acceptance strategy to the scope of work. SPL is a first of a kind in the DOE Complex in that CGD is the primary procurement acceptance method for a safety-significant construction project. Currently this acceptance process is also being employed to support MCRE, LOTUS, DOME, and PELE.

MFC has been the laboratory leader in this regard resulting in the MFC Nuclear Acquisition team being asked to lead complex-wide efforts to improve procurement quality assurance. MFC intends to continue this improvement trajectory and retain the complex-wide leadership role.

18.2.2 People

Developing and executing a right sized quality acceptance plan requires a unique understanding of engineering, quality assurance, and procurement. Previous organizational structure has siloed these functions as part of a serial process where procurements were passed from one organization to another with minimal integration as the procurement progressed. Given the unique blend of skills required to develop and execute a right sized quality acceptance plan, organization, process, training, and Roles, Responsibilities, Authorities, Accountabilities (R2A2s) must be aligned to ensure an integrated process.

18.2.2.1 Organization

With support from senior management, a Nuclear Acquisition organization with procurement/contract specialists and quality engineers co-located with engineering is required.

18.2.2.2 Process

Process control can be achieved via a combination of written direction (i.e., procedures, guides, and templates) and SMEs guiding the process. These are proportional in that where minimal written direction is available, the primary process control is a SME. Conversely, where detailed written direction is documented, the process is less reliant on SMEs. The process is currently heavily dependent on SMEs.

18.2.2.3 Training

There is no training specific to specification of procurement quality requirements. A training on specifying technical and quality requirements for acceptance of quality and safety effecting items should be considered moving forward.

18.2.2.4 R2A2s

Clear definition of roles and responsibilities with regards to the procurement acceptance process that align with the above defined organizational structure is required for successful execution of the procurement acceptance process. Those roles are as follows:

- Engineering:

  - Define technical and quality requirements.
- Quality Engineering:
  - Consult Engineering on possible acceptance strategies and methods. Execute selected acceptance strategy.
- Procurement/Contracts administrator:
  - Manage scopes of work defined by engineering. Consult with engineering on procurement acceptance strategies.

18.2.3 Equipment/Tools

Procurement quality is an administrative process that does not require capital equipment. Tools employed by procurement are software and administrative tools. Examples are AS, Jira, and a variety of process controls designed to ensure consistent/quality procurement execution.

18.2.4 Actions FY-23

The vision for FY-23 in terms of procurement quality improvement is focused on increased transparency, integration, and collaboration between facilities, research, engineering, procurement, quality, and the supply chain. This effort will drive for greater collective ownership of end item quality. As the nuclear supply chain continues to diminish, responsibility for end item quality and nuclear safety falls to the purchaser. To this end, MFC plans develop processes that acknowledge the supply chains unfamiliarity with nuclear safety terminology and develop procurement specifications that specify procurement acceptance activities in a manner that is understandable to commercial fabricators, constructors, and suppliers. Below is a list of improvements to be integrated into the MFC procurement acceptance process:

- Evaluate general use items in the MFC warehouse. The evaluation will look at all general use items in the warehouse and evaluate the items against their end use to determine if the items can be used as is or are good candidates to be upgraded to commercial. If the items cannot be used as is and are unable to be upgraded, the items will be excessed. (Stuart Jensen, September 30, 2023)
- Develop acceptance activities for reactor developers. This is needed when traditional procurement methods, such as a purchase order, is not used and CRADA's are used in place of purchase orders. (Stuart Jensen, September 30, 2023)
- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training Regarding Procurement Quality. (Stuart Jensen, September 30, 2023)
- Ensure proper training and awareness of MFC-ADM-2065, "MFC Procurement Clause Requirements," by the MFC Engineering group. (Stuart Jensen, September 30, 2023)

18.2.5 Looking Forward (FY-24 and Beyond)

FY-24 will see MFC continuing to lead the way in procurement quality. The following are planned areas of improvement for FY-24 and beyond:

- Identify spare equipment/spare parts and equipment obsolescence issues.
- Create a training module for specification of technical and quality requirements for acceptance of quality affecting items for engineering.

19. NUCLEAR SAFETY

19.1 A Look Back

The MFC Nuclear Safety Engineering department has maintained quality nuclear safety support for existing nuclear facilities while gaining valuable experience during the beginning of operations for the two new facilities within the department, RHLLW, and IMCL. Additionally, the department developed the preliminary documented safety analysis (PDSA) for the new SPL facility. The SPL PDSA was the first and precedent setting DSA following the newest revision of DOE-STD-3009.

Over the past 2-years, the MFC Nuclear Safety Engineering department has been working to identify and document a safety related equipment list (for all Safety Class and Safety Significant SSCs). This effort resulted in input to System Engineering for the creation of the MEL for MFC, which was a specific request from the MFC ALD. The goal of this MEL is to provide a quick and accurate reference to Operations and Engineering for use when abnormal conditions arise, and timely decision-making is paramount.

The lower threshold for evaluating whether shielding should be considered as safety significant was included in MFC safety bases. This allows MFC Nuclear Safety to quickly identify when shielding is not required to be safety significant, quickly accelerating hazards and accidents analyses, while increasing the efficient use of resources.

All criticality control lists for MFC facilities were removed from TSRs and placed within the newly developed Criticality Safety Management Program. This will enhance the Operational flexibility of MFC Nuclear Facilities and reduce the vulnerability of violations for errors in the program that do not affect safety. Safety significant noncompliance will continue to receive oversight interest through other regulatory frameworks.

The MFC Nuclear Safety department has supported the development and implementation of the new radioactive and nuclear material tracking system, NUTRON. NUTRON is currently being deployed at all Radiological Facilities at INL. MFC Nuclear Safety will continue to support the development of this program for future adoption by Hazard Category 2 and 3 facilities at MFC.

19.2 People

MFC Nuclear Safety staff present a broad range of experience, education, and diversity; all benefiting the ability of the department to fulfill its mission. The department staff' education range incudes: Chemical Engineers, Nuclear Engineers, Structural/Civil Engineers, and a Health Physicist. The experience range for the staff also spans several generations, from young professionals in the workforce to seasoned veterans in the field of Nuclear Safety Analysis, with over 20 years' experience. This culminates in a department focused on mentoring younger staff, while also being fully engaged in new developments and able to meet the challenges at MFC. Even though the department has been understaffed for 2 years now, the department has been able to meet all deliverables and deadlines. Hiring efforts have been successful in past, but attrition has resulted in two vacancies to be filled in FY-23.

MFC is seeing a growth in work projection over the next 5-10 years. This will present unique challenges to the MFC Nuclear Safety department. Namely, an increased scope of activities to be analyzed considering new reactor technology is one of the primary emphases of the new work. MFC is also planning to add new nuclear facilities to MFC, which will add an increased demand for nuclear safety support. To address the increase in demand and complexity of new programs, MFC Nuclear Safety now comprises two departments, MFC Non-Reactor Nuclear Safety and Advanced Nuclear Safety departments.

19.3 Process

Nuclear Safety processes and procedures are outlined in Laboratory-wide Manual 18, "Nuclear Safety." These processes and procedures are acceptable but undergoing continuous improvement to make

them stronger. MFC Nuclear Safety diligently works with the Program Lead to streamline procedures and processes for use laboratory-wide which included several changes to procedures and processes in FY-22. Significant improvements have been made to the USQ process and analysis guidance documents. Additionally, MFC-ADM-0012 was created to better describe and outline the day-to-day work at MFC in Nuclear Safety. This procedure was implemented, and valuable feedback has been provided to allow for procedure improvements in FY-23. While efficiency has been gained, there is more work to be done.

19.4 Equipment/Tools

Tools and equipment for MFC Nuclear Safety are strong. Nuclear Safety tools include validated software and computers, and the knowledge and experience of the staff members. Even though MFC Nuclear Safety is strong related to existing software packages associated with analysis needs, the new staff may not have the breadth of knowledge for the spectrum of computer codes used by the department. This requires emphasis be placed on increasing the analytical knowledge of the nuclear safety staff, concentrating on the newer staff members. Along with dose consequence, shielding calculations, and air dispersal analyses, the department has also chosen to increase the structural analysis capabilities of the group with a strategic addition to the group.

Fiscal years 2020 through 2022 highlighted another tool for the MFC Nuclear Safety department, the ability to effectively perform work via telecommuting. Telecommuting will be a useful tool in the coming years to increase the flexibility of the group to not only attract highly qualified members to fill vacancies made by retirements, but retain these members as well, reducing the cost of attrition.

19.5 Actions FY-23

- Safety Basis Development: (Stuart Jensen, September 30, 2023)
  - Work with Operations to continue to determine and refine the best units for accounting Material at Risk (MAR) for each nuclear facility.
  - Rewrite SAR/TSR-403 for FCF to bring to date with the latest version of DOE-STD-3009 due to major modifications at FCF.
  - Rollover Hazard Classification process to the new version of DOE-STD-1027. The newer version of STD-1027 has different Threshold Quantity Values (TQVs) for HC-2 and HC-3. These new TQVs will need to be added to MTS, LIMBS, MTG, and NUTRON. Historical Hazard Categorizations will be updated as needed during revisions of their documentation for future modifications.
- Safety Analysis: (Stuart Jensen, September 30, 2023)
  - Use the development of Critical Safety Functions (CSF) outlined above to improve the Operability Review process.
  - Identify an approach toward defining the lower threshold quantity for material to be tracked by facility Radioactive Material Acceptance Coordinators (RMACs). This will facilitate improvements in the procedures associated with transport activities of radioactive and nuclear material, as well as reduce the uncertainty associated with material tracking at each facility when material is transferred from one to the other.
  - Continue to develop and perform better cooperation and communication between Criticality Safety staff and Nuclear Safety staff as follow-up on corrective actions performed due to recent TSR violations.
- Potential Inadequacy in the Safety Analysis (PISA)/USQ Process Implementation: (Stuart Jensen, September 30, 2023)
  - Work with the program office and implement the revision to LWP-10801/LWP-10800 at MFC.
  - Work with the Laboratory program office for nuclear safety to continue to develop categorical exclusion (CX) criteria for occasions that should not be within the USQ process.

- TSR Implementation: (Stuart Jensen, September 30, 2023)
  - Use revision round table meetings and newly developed TSR writing guide to work with facilities to develop TSR controls that are clear and concise in their wording and implementable by Operations to preclude future TSR violations due to interpretation of the control.
  - Review Surveillance Requirements associated with Specific Administrative Controls written in Limiting Condition for Operations format during triennial reviews to remove the impact of missed surveillances and the required actions associated with SAR-400.
- Critical Safety Functions: (Stuart Jensen, September 30, 2023)
  - Complete the rollout of each Safety SSC for all facilities at MFC and determine the appropriate format to present the information to Operations.
  - Work with Operations on understanding and implementing the different measures and limits for Criticality Safety terms, such as U5E.

19.6 Looking Forward (FY-24 and Beyond)

- Implement the approach toward defining the lower threshold quantity for material to be tracked by facility RMACs. This will facilitate improvements in the procedures associated with transport activities of radioactive and nuclear material, as well as reduce the uncertainty associated with material tracking at each facility when material is transferred from one to the other.
- Personnel Development:
  - Increased need to hire staff and allow the newly hired staff opportunities to shadow Operations staff, in order to instill an understanding and appreciation for operational challenges to benefit the department in developing safety bases and controls that fit well within each nuclear facility at MFC.
  - Improve the analytical capabilities of the operations group to deepen expertise in technical issues related to nuclear safety.
- Process and procedure improvements for the next 5 years will concentrate on the following five areas:
  - Safety Basis development
  - Safety Analysis
  - PISA/USQ process implementation
  - TSR implementation
  - Critical Safety Function definition and usage.
- Safety Basis Development:
  - Continue to work with Operations within each facility to effectively communicate the importance of Plutonium Equivalent Gram in DSAs and determine if alternate representation is needed for day-to-day operations for the facility staff.
  - Continue to improve documentation of safety bases and supporting analyses.
  - Support the development of nuanced criteria within NUTRON to support its release to each Hazard Category 2 and 3 facilities at MFC.
- Safety Analysis:
  - Continue to build analytical skills within the department to alleviate the need for outside support for nuclear safety analyses. Specifically, increase the departments proficiency in RSAC, ORIGEN, MCMP, and other currently used codes. A specific area of development will be the ability of the department to independently perform shielding calculations and structural analyses.
  - Work with Radiological Control to produce a paradigm to be included into MAR calculations for each MFC nuclear facility to allow for the exemption of low-level sources that are equivalent to commercially available material that is already exempted from MAR calculations.

- Review the use of Contractor Approved Lists and develop consistency in controls for SSCs used in multiple facilities.

- PISA/USQ Process Implementation:
  - Work with the Laboratory program office for nuclear safety to continue to develop CX criteria for occasions that should not be within the USQ process.
  - Continue to work with NFMs to appropriately annotate when the PISA process is required to be entered normal and abnormal occurrences within the facility.
- TSR Implementation:
  - Develop a consistent format of control types across the MFC facilities to facilitate reduced human error for Operations staff qualified in multiple facilities or transfer to new work locations.
  - Continue to review and revise TSR controls to better conform to the guidelines of DOE G 423.1-1B, “Implementation Guide for use in Developing Technical Safety Requirements.”

20. NUCLEAR MATERIAL MANAGEMENT

20.1 A Look Back

MFC manages a substantial inventory of contact-handled and remote-handled (primarily SNF) accountable nuclear material. The major quantities of contact-handled nuclear material are associated with ZPPR fuel, unirradiated fast reactor fuel and associated fabrication scrap, and feedstock materials. These materials are typically managed by the Fuel Fabrication and Nuclear Material Management (FFNMM) Division. The remote-handled inventory is primarily associated with sodium-bonded spent SNF associated with the EBR-II reactor and is typically managed by the MFC Production Facilities Division.

The overarching strategic nuclear material management goal is to maintain and enhance the capability to efficiently support excess material disposition and programmatic missions while minimizing the number of facilities and locations that are required to manage significant quantities of special nuclear material. To this end, MFC continues to advance its efforts to ensure needed nuclear material is readily available to meet anticipated programmatic needs (including feedstock for advanced fuel development and qualification activities), while minimizing the inventory of excess nuclear material stored at MFC.

On a need to know basis, additional details regarding INL's accountable nuclear materials and associated management strategies can be found in PLN-4585, "Idaho National Laboratory Nuclear Material Management Plan."

In the last 5 years, more than 750 kg of contact-handled excess special nuclear material (plutonium and enriched uranium) and more than 1,000 kg of source nuclear material (depleted uranium, natural uranium, and thorium) has been successfully processed and shipped off-site. Multiple new equipment capabilities were developed and activated to enable these accomplishments.

The special nuclear material shipments primarily consisted of transfers of legacy highly enriched uranium (HEU) and excess ZPPR plutonium fuel. The HEU was primarily in the form of legacy unirradiated EBR-II/ATR/ZPPR fuel and associated fuel fabrication scrap. The HEU was subsequently shipped to BWX Technologies, Inc. (BWXT) facilities recovery and subsequent reuse as feedstock for new nuclear fuel fabrication under an NNSA down-blend contract. The ZPPR plutonium fuel was inspected, repackaged, and shipped to a new programmatic owner. Shipment of these SNMs had many impacts: freed up significant vault storage space in FMF and ZPPR, transitioned these valuable materials for beneficial reuse, and demonstrated continued progress towards removal of excess nuclear material from the State of Idaho.

Removal of the large quantities of source nuclear material (primarily depleted uranium), along with large quantities of non-nuclear materials, that were stored in MFC-784 was key in freeing up this area to support new missions. MFC-784 was subsequently renamed the Advanced Fuels Facility (AFF), transitioned from a nuclear facility to a radiological facility to facilitate more efficient operations, and installed multiple new advanced fuel manufacturing systems. These new systems have subsequently proven to be key in supporting rapid manufacture of many unique test articles for TREAT and ATR irradiation.

The receipt of EBR-II SNF from INTEC wet storage to MFC continues to be a top priority to ensure the Idaho Settlement Agreement (ISA) commitment for the complete removal of all spent fuel from wet storage is met. These shipments are received at both FCF and RSWF. The treatment of EBR-II driver fuel in FCF has resulted in recast of more than 1,300 kg of the recovered enriched uranium product into new low-dose 'Regulus' ingots to make the high-assay low-enriched uranium (HALEU) material more conducive for efficient reuse by advanced reactor programs. Production of the regulus shape has been facilitated through development of a drip cast crucible method. This arrangement allows for the recast of the traditional 30 to 40 kg HALEU through a stacked set of crucibles with the lower portion having interconnected cascading pockets enabling the molten uranium to flow into them. The result has been the production of a smaller and lower radiation level uranium ingot, known as regulus, intended to support

glovebox-based fuel fabrication needs associated with advanced reactor concepts.

20.2 People

The division staff working on the various nuclear material management efforts are highly trained and many require "Q" clearances and HRP certification. Several years of training and on-the-job experience are typically needed before a new fissile material handler is considered to be fully qualified and efficient. Various operations staff personnel are also key in planning, equipment development, and processing support functions in order to maintain efficient operations and develop enhanced capabilities. Sufficient associated RadCon, Safeguards, Engineering, and Crafts support personnel are also routinely relied on outside of the directly assigned Division staff.

Over the last decade, the FFNMM Division has taken a load-leveled staffing approach to contact-handled nuclear material management by maintaining a core staff of roughly 10 FTEs focused on routine excess material processing and shipments. This allows for a consistent funding level (currently about $5M, plus yearly escalation) and minimum perturbation of the staffing level. The current and out-year nuclear material management work scope priorities have typically been planned around this consistent resource base. However, a number of prior personnel have been moving on to other opportunities while broader FFNMM workload has increased, which has resulted in an understaffed situation that has been negatively impacting legacy material processing throughput. FFNMM staffing and succession planning actions are actively underway to minimize these impacts until the personnel resources can be brought back up to an adequate level again.

Production Facilities necessary staffing is more directly dictated by regulatory and legal commitment drivers associated with the ISA, and by staffing levels necessary to meet the HALEU demand requirements communicated by DOE. These commitments have recently required significant additional staffing actions, as funding has allowed. FCF transitioned to a 12-hour work shift in 2019 and is anticipated to expand to 24 hour per day operations in 2024 as described in the baseline plan in PLN-6098, "Treatment Plan for Irradiated Sodium-Bonded Driver Fuel and the Production of High-Assay Low-Enriched Uranium." The additional staff have included operational technicians, RadCon technicians, engineers, manipulator repair specialists, and a host of other administrative personnel necessary to support the fuel treatment and HALEU production requirements.

20.3 Process

FFNMM strives to identify and implement enhancements to nuclear material processing approaches. For contact-handled material processing, such enhancements typically focus on developing more efficient processing approaches; incorporating HPI factors; identifying and eliminating unnecessary analyses; leveraging existing equipment and experience where practical; and negotiating efficient material transfer requirements with material recovery and disposal sites. Evaluation of potential processes for future disposition of excess legacy plutonium material has been initiated, but the approach and timing to implementing such efforts will be dependent on the impacts from expected Molten Chloride Reactor Experiment (MCRE) fuel fabrication and other potential fuel fabrication efforts that may arise in the meantime.

FFNMM will continue to evaluate existing INL nuclear material inventories to determine material that is likely excess, and to develop disposition pathways for such material to the extent practical. Identification of potential nuclear material feedstock gaps for pending programmatic missions will also continue. FFNMM will characterize and evaluate whether existing INL material could meet those needs, attempt to identify, and obtain desired material within the DOE Complex to the extent practical, and develop capabilities to supply general-purpose R&D quantities of feedstock material. FFNMM is also currently assisting with identifying and supplying near-term small-quantity enriched uranium (as authorized by DOE) from various remaining INL legacy materials to support advanced HALEU fuel development efforts where practical.

Production Facilities have continued to utilize the pyrometallurgical equipment originally deployed in FCF during the mid-90s as part of the Integral Fast Reactor (IFR) experiment. Upon cancelation of the IFR project, the majority of the equipment was repurposed for the electrometallurgical treatment (EMT) of the sodium-bonded irradiated driver fuel and blanket elements produced during EBR-II's 30 years of operation. The process was identified in the Environmental Impact Statement (EIS) and corresponding Record of Decision (ROD) issued in September 2000 as the preferred method for treating the irradiated material and has been in operation since that time. The process has undergone several changes recently to accommodate revisions in the safeguards and security policy at the facility, as well as integrating the HALEU production process into the traditional treatment system. Additionally, DOE and the State of Idaho agreed to an acceleration of the timeline identified for treatment of the irradiated EBR-II driver fuel inventory to be completed prior to December 31, 2028, as opposed to the original deadline of January 1, 2035. This has necessitated a renewed focus on increasing facility and process availability as well as process efficiency. A significant effort is currently underway to install a new high temperature vacuum atmosphere furnace (Multi-Function Furnace) intended to reduce a portion of the process reliability risks associated with single point failure in the treatment process.

20.4 Equipment/Tools

FFNMM has developed, installed, and successfully operated multiple custom systems to process the various forms of excess contact-handled nuclear material to meet disposition requirements. This has included the following:

- HEU processing glovebox
- Multiple systems for dismantlement of legacy fuel assembly configurations
- New thermal vacuum distillation furnace system for separation of metallic sodium from various fuel forms
- New/modified nuclear material containers
- New oxidation furnace system.

Significant legacy equipment was also removed from multiple contact-handled nuclear material facilities to free up valuable floor space to support advanced fuel manufacturing and other programmatic efforts. The primary equipment yet to be developed is associated with disposition of excess legacy plutonium materials. At a minimum, this will include new process equipment for casting scrap oxidation, mechanical disassembly, size reduction, blending, characterization, packaging, and disposal. Once MCRE fuel fabrication is complete, or if it does not occur, then the new indirect-funded general-purpose gloveboxes that are scheduled for FMF installation in FY-23 could house this legacy plutonium processing equipment. Alternatively, a new dedicated plutonium processing glovebox could be procured and installed in FMF.

As mentioned in the Subsection 20.3, Production Facilities continues to operate much of the equipment originally installed in conjunction with the IFR program in the mid-90s. Primary amongst this equipment are two molten salt electrorefiners used to electrochemically separate the uranium from the bond sodium and fission products generated during irradiation. The remainder of the original equipment includes chopping mechanisms used to size reduce the elements prior to placement in the electrorefiner, as well as high temperature vacuum atmosphere induction furnaces used to distill salt away from the recovered uranium and cast the metallic uranium into ingots of various size. DOE has provided additional funding through the 2018 Plant Health Investment Initiative to support acquisition of the afore mentioned multi-function furnace which will enhance the distillation and uranium casting capabilities, and alleviate the constraints associated with the heavily subscribed cathode processor, which is currently used for all salt distillation activities, as well as HALEU production for recasting into the regulus shape. The Plant Health Investments also funded the establishment of an expanded fuel inspection workstation which was commissioned in 2022 and has also supported development of a new style electrode assembly intended to increase the operating efficiency of the electrorefiners. DOE is also supporting investments in FCF's

material handling equipment to refurbish or replace the aging through wall tele-manipulators, as well as the overhead electro-mechanical manipulators.

20.5 Actions FY-23

- FFNMM contact-handled material management targets for FY-23 include the following:
  - Complete the LLW disposal of the excess portion of the 50 kg of impure UO_2 recovered from the Sandia sodium debris bed experiments, freeing up storage space for research, development, and demonstration (RD&D) customers and retiring this longstanding DOE liability. (This is a full cost recovery effort for the NNSA material owner.) (Tim Hyde, September 30, 2023)
  - Utilize the new casting furnace in the SNM glovebox to fabricate kilogram quantities of uranium feedstock/products for RD&D customers. (Tim Hyde, September 30, 2023)
  - Complete at least one off-site shipment of excess special nuclear material. (Tim Hyde, September 30, 2023)
  - Process more than 50,000 grams of enriched uranium in support of advanced fuel development, recovery, or disposal efforts. (Tim Hyde, September 30, 2023)
- Production Facilities material management actions for FY-23 include the following:
  - Using research from the MEDE process treatment of sodium-bonded blanket elements, develop a scale-up strategy for NE and EM funding consideration. (Tim Hyde, September 30, 2023)
  - Complete receipts of the irradiated EBR-II inventory from wet storage at the INTEC facility. (Tim Hyde, September 30, 2023)
  - Complete the production of 725 kg of HALEU in regulus form. (Tim Hyde, September 30, 2023)
  - Complete installation and commence operation of the multi-function furnace. (Tim Hyde, September 30, 2023)
  - Complete configuration revisions to the Metal Waste Form Furnace in HFEF and commence production of HALEU regulus in HFEF. (Tim Hyde, September 30, 2023)

20.6 Looking Forward (FY-24 and Beyond)

- FFNMM contact-handled material management actions for several years beyond FY-24 include the following primary targets.
  - Complete processing and packaging of legacy EBR-II/FFTF HEU fuel casting scrap.
  - Negotiate and perform multiple high-mass excess HEU shipments to BWXT facilities for recovery under the DBOT (Down-Blend Offering for Tritium) contract, facilitating reuse of this enriched uranium and freeing up vault storage space for RD&D missions.
  - Develop the glovebox and processing equipment capabilities necessary to process and package legacy Pu scrap for disposal or potential reuse.
  - Mentor and hire staff as needed (or to the extent funding allows) to ensure sufficient experienced staff remain available to accomplish the remaining equipment development and excess material disposition activities.
  - Continue to work with the NNSA Office of Nuclear Material Integration and other DOE programs/sites to evaluate and develop potential end state requirements, disposition paths, equipment capabilities, and regulatory actions needed to ultimately deal with all of MFC's remaining excess nuclear material.
- Production Facilities material management actions for several years beyond FY-24 include the following primary targets.
  - Continue with retrieval and treatment of the EBR-II Driver Fuel.
  - Prepare FCF for the transition to 24-hour per day operations.
  - Continue with integrated HALEU production in FCF as well as HFEF.

- Configure the MK-V electrorefiner for treatment of EBR-II driver fuel.
- Continue with the refinement of strategies and subsequent disposition of cladding hulls resulting from the electrochemical treatment process.
- Develop a treatment method to address the inventory of non-candidate material and implement based on available funding.
- Support scale-up research into innovative pyrochemical separations concepts and development of related waste form associated with advanced fuel cycle concepts.
- Installation and operation of a multi-function furnace.
- Installation and operation of an integrated bottle inspection station.
- Continue evaluation of EBR II product electrorefining polishing feasibility to expand potential utilization.

21. RADIOLOGICAL WASTE MANAGEMENT

21.1 Legacy Waste Management

21.1.1 A Look Back

DOE-NE is responsible for the storage, management, and disposition of a number of legacy waste and SNF inventories including irradiated, sodium-bonded, uranium-based material from the EBR-II reactor; sodium-contaminated, contact-handled (CH) and remote-handled mixed transuranic waste (MTRU); remote-handled mixed low-level waste (MLLW); CH-MLLW; EBR-II driver SNF and blanket material; and ATR SNF. Collectively these items are all managed under the INL Site Treatment Plan (STP) as directed by the consent order between DOE and the IDEQ, or under the 1995 ISA and subsequent associated agreements. All legacy liabilities and associated disposition costs are detailed in LST-1149, "INL Other Legacy Environmental Liabilities Register," current revision.

Additional legacy waste management regulatory drivers include DOE O 435.1, "Radioactive Waste Manual," which addresses management and disposition of LLW, transuranic (TRU) waste, high-level waste (HLW), and RCRA which establishes requirements for managing mixed waste (waste that is both hazardous and radioactive) and non-radioactive, hazardous waste.

MFC Operations has refined its legacy waste management strategy since 2015 to establish pathways for off-site treatment and disposition; develop a multi-year, sustainable funding strategy; and maintain core on-site capabilities for current compliance (STP) and future needs.

Reducing MFC legacy waste liabilities over the last 5 years has seen an increase in visibility and funding priority as compared to prior years. This is critical as the MFC mission continues to expand and shows our commitment to INL stakeholders that the Laboratory is committed to reducing its environmental liabilities and legacy waste inventories.

Legacy waste is defined as waste that was existing at INL during the contract transition in 2005 and has no responsible program for disposition. Legacy waste is further defined as waste generated during BEA contract and prior to the established waste generator service center recovery model that has no existing program responsible for funding disposition.

Table 9 below details a summary of legacy waste reduction progress since 2015.

Table 9. Summary of legacy waste reduction progress since 2015 (not including SNF).

Waste Stream	Facility Location	Updated Inventory Reference	Regulatory Driver
RH-LLW	RSWF, HFEF, and FCF	LST-1149	DOE O 435.1
RH Mixed LLW	RSWF and SSB (RWDP Backlog)	LST-1149 and INL Site Treatment Plan	INL STP
CH Mixed LLW	SSB (SCMS Backlog)	LST-1149 and INL Site Treatment Plan	INL STP
RH-TRU Waste[a]	RSWF, HFEF, FCF, and AL	LST-1149	DOE O 435.1
CH-TRU Waste[b]	FMF and AL	LST-1149	DOE O 435.1
ZPPR Na Plates	Disposition of this inventory occurred in FY-21 and the liability has been eliminated	Inventory Eliminated	DOE O 435.1
Lithium Hydride (Na-cont.)	Disposition of this inventory occurred in FY-19 and the liability has been eliminated	Inventory Eliminated	INL STP
ZPPR Calandria Tubes	Disposition of this inventory occurred in FY-19 and the	Inventory Eliminated	DOE O 435.1

Waste Stream	Facility Location	Updated Inventory Reference	Regulatory Driver
(Na-cont.)	liability has been eliminated		
Fermi Drums	Disposition of this inventory occurred in FY-18 and the liability has been eliminated	Inventory Eliminated	DOE O 435.1
Tin Bismuth (Na-cont.)	Disposition of this inventory occurred in FY-18 and the liability has been eliminated	Inventory Eliminated	INL STP
a. Ship to EM Contractor - INTEC for RH-TRU WIPP Certification. Ongoing waste stream. b. Ship to EM Contractor - AMWTP for CH-TRU WIPP Certification. Ongoing waste stream.			

21.1.2 People

Performance of this waste management area is strong; however, the level of expertise in waste management and in particular treatment of reactive waste streams needs improvement. Attrition has reduced the number of personnel with previous experience. Hiring activities in this area has focused on previous experience and educational backgrounds.

Legacy waste is actively managed by the residing facility with disposition support provided by the Production Facilities Division Waste Management Integration group, TSDF operations, dedicated Project Management staff, and WGS. Each of these organizations maintain qualified personnel to support waste management needs as applicable.

Since 2017 there have been new areas of training development that support MFCs TRU program and RHLLW Facility. Specifically, the WEO qualification which was created to be a “like-for-like” visual examination expert (VEE) qualification as required in TRU waste certified programs under the Central Characterization Project (CCP). This WEO qualification must be carried by anyone who characterizes or packages TRU waste. The qualification ensures individuals are knowledgeable of the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria (WAC), and WEOs are provided quarterly refresher training where lessons learned are also shared. As part of startup of the RHLLW Disposal Facility, an FDS was hired and new training/qualification was developed that ensures the FDS is knowledgeable in DOE O 435.1 LLW requirements, facility WAC, and facility performance assessment requirements.

Training and qualifications related to Sodium (Na) and Sodium Potassium (NaK) treatment capabilities are maintained by TSDF operations personnel. Since 2018, the Production Facilities Division has hired six operators to cross-qualify at TSDF, RSWF, and the RHLLW Disposal Facility. This cross-qualification provides operational flexibility where resources can be shifted to support operations as needed; however, Na and NaK treatment experience and expertise has been significantly reduced. TSDF has lost much of this expertise due to personnel attrition. Production Facilities management utilizes off-site Na and NaK specific training for new staff to bridge the gap in expertise and experience as part of its training program. Maintaining qualified and experienced staff is critical to supporting not only STP activities but also treatment of Na and NaK waste generated by current and future MFC R&D activities. Future programs are currently evaluating the use of Na and NaK and research activities in FCF and TREAT will be generating new quantities of Na and NaK.

21.1.3 Process

Legacy Waste Management processes are strong. This is due to a number of factors which include the following:

- Strong coordination between MFC waste generating facilities (Bi-weekly waste management meetings)

- Implementation and reinforcement of HPI tools—in particular, a questioning attitude which is essential when dealing with "unknowns" related to legacy waste streams
- Current MFC capabilities; and partnerships with off-site entities.

With sustained, dedicated investment funding, MFC will continue to make progress in reducing its legacy waste liabilities. MFC has established a waste management group that ensures current waste generating activities have a path for future disposition which also avoids adding to the INL STP. All newly generated reactive waste must be treated within 1-year to avoid adding to the STP.

The preferred treatment approach for some of the more challenging waste streams is identifying off-site treatment capabilities from commercial vendors whenever possible. PLN-4588, "Disposition Plan for Current and Future Reactives and Other Environmental Liabilities," has been revised to reflect the strategy for establishing a path for off-site treatment capabilities for the identified inventories, with the potential for application against future reactive waste or materials on a case-by-case basis. Identifying off-site treatment as the preferred approach considered several factors, including how quickly the respective inventories could be dispositioned, realizing efficiencies by focusing on more than one off-site treatment provider, total life-cycle cost savings, and INL capabilities associated with disposition that should be retained, expanded, or retired with respect to the enduring mission of the INL. This plan also provides the key activities, preliminary cost estimates, and high-level schedule that are required to implement the preferred approach. The MFC FYS reflects this approach and funding profile to support.

MFC has recently partnered with Veolia to demonstrate a new treatment approach to deactivate elemental sodium using its GeoMelt In-Container Vitrification (ICV) process. This has been successfully applied to the treatment of the Fermi Drum inventory, ZPPR Na Plates, and Calandria Tubes. In addition, BEA, using EM funding, is executing a proof-of-concept demonstration with the objective of developing and demonstrating a prototype system to improve the Remote Waste Disposition Project (RWDP) liner retrieval process at RSWF. This system has been designed to provide a size-reduced liner, thereby, improving the efficiency of downstream waste handling and processing/disposition. The proof-of concept demonstration successfully occurred in FY-21 and included a coupled demonstration of the advanced liner retrieval system and GeoMelt treatment. It is anticipated that this alternative RWDP liner disposition approach will significantly reduce cost and schedule associated with the INL STP.

Incorporating innovation where possible is critical. Thus, engagement with outside entities such as active participation with Energy Facilities Contractors Group (EFCOG) Waste Management Groups, DOE National TRU Program Users Group (NTP), as well as engagement with international consortia and institutions such as the European Commission funded THERAMIN and PREDIS is vital to this legacy waste management strategy to leverage and understand industry technology advances in managing challenging waste streams.

One area that will require sustained investment is establishing a future CCP TRU Waste Certification Program. MFC will continue to utilize the EM contractor at Advanced Mixed Waste Treatment Project (AMWTP) until the mission can no longer support receipt of BEA contact-handled transuranic waste (CH-TRU) due to downsizing operations to support plant closure. This is anticipated to occur in the 2026 timeframe.

MFC will need to continue to support maturing an HLW program for management of cladding hulls and metal waste forms associated with past and current EMT of EBR-II driver SNF and blanket materials which have historically been managed as in-process materials. Included in this evaluation is continued analysis of the revised DOE interpretation of the statutory term of HLW which could provide alternative disposal pathways for candidate materials (i.e., cladding hulls and/or MWF). Engagement with NE-ID counterparts and appropriate EM-HQs program leadership will be necessary to continue to explore applicability of these candidate materials against the revised statutory interpretation.

21.1.4 Equipment/Tools

Equipment and tools supporting legacy waste management are acceptable with areas of needed improvement. Inventory tracking of legacy waste has seen significant improvement due to new databases being utilized at MFC. Those include the Waste Item Characterization Database (WICD) which is primarily used for tracking TRU waste items and is being expanded to track non-routine LLW items as well. In addition, Searchable Liner Online (SEALION) was created to track the physical configuration, radiological data (e.g., source term, transuranic content, fissile content, and direct gamma radiation reading), RCRA characterization data, contents descriptions, and a variety of other legacy waste management data for RSWF. This database has seen expanded use in other MFC waste storage facilities for tracking legacy waste inventories.

Other areas of unique waste management capabilities at MFC include SCMS which provides capabilities that are critical to this legacy waste management strategy. There are two distinct programmatic and regulatory-compliance functions. The first is a radiological control work tent that provides MFC the capability to open containers of radioactive waste for inspection and, usually, subsequent waste management activities such as sizing or repackaging. SCMS also provides permitted mixed waste treatment. The SCMS employs a water-wash (reaction) vessel, caustic-carbonation system, neutralization, and stabilization unit. Treatment technologies permitted at SCMS include deactivation, water-reaction, neutralization, open/melt/drain, repackaging, and stabilization capabilities. MFC will need to retain these on-site waste characterization and treatment capabilities to ensure support for future reactor programs and R&D activities.

As reactor programs and nuclear R&D activities continue to expand at MFC, MFC will need a dedicated Waste Management Facility. This has been captured in the 5-year investment strategy as the Waste and Materials Management Facility. Required capabilities include:

- Sorting and segregation
- Advanced characterization systems
- Na and NaK treatment capabilities
- Headspace gas sampling for TRU waste containers
- Storage of contact-handled and remote-handled wastes pending off-site disposition
- TRUPACT-II loading capability for shipping TRU waste to the WIPP.

Benefits of a dedicated Waste Management Facility will provide safe and secure storage of radioactive wastes, cost reduction opportunities by efficiently handling and packaging waste, and risk reduction of unnecessary waste handling which also aligns with MFC's as low as reasonably achievable (ALARA) principles.

21.1.5 Actions FY-23

21.1.5.1 High-Level Waste

- Support HLW program maturity. (Robert Miklos, September 30, 2023)

21.1.5.2 Transuranic Waste

- Continue efforts to characterize and package legacy RH-TRU waste from HFEF and FCF Hot Cells. (Robert Miklos, September 30, 2023)
- Ship at least two RH-TRU ISCs to the Idaho Environmental Coalition, LCC (IEC) contractor for TRU certification processing and shipment to WIPP for disposal. (Robert Miklos, September 30, 2023)

21.1.5.3 RWDP Backlog – Advanced Retrieval Project

- Continue RWDP backlog reduction activities (retrieve, package, ship) for GeoMelt. (Robert Miklos, September 30, 2023)

21.1.5.4 Remote-Handled Low-Level Waste

- Continue to retrieve and ship RH-LLW liners from RSWF to the RHLLW Disposal Facility and work off the RH-LLW backlog at RSWF. (Robert Miklos, September 30, 2023)

21.1.6 Looking Forward (FY-24 and Beyond)

21.1.6.1 Transuranic Waste

- Relocate the UDASS from HFEF to the SCMS Facility.

21.1.6.2 SCMS Backlog – Site Treatment Plan Milestone

- Support treatment activities for the $6m^3$ milestone. To be completed by the end of FY-24.

21.1.6.3 RWDP Backlog – Advanced Retrieval Project

- Continue RWDP backlog reduction activities (retrieve, package, ship) for GeoMelt.

21.1.6.4 Remote-Handled Low-Level Waste

- Continue to retrieve and ship RH-LLW liners from RSWF to the RHLLW Disposal Facility and work off the RH-LLW backlog at RSWF.

21.2 Newly Generated Waste

21.2.1 A Look Back

MFC manages various newly generated radioactive waste streams as part of its nuclear energy R&D mission. MFC waste management processes and requirements ensure environmental stewardship responsibility and compliance with DOE O 435.1 requirements, which address management and disposition of LLW, TRU waste, and HLW, and in compliance with the RCRA, which establishes requirements for managing mixed waste (waste that is both hazardous and radioactive) and non-radioactive hazardous waste. The MFC Production Facilities Division in partnership with the INL Waste Management Program (WMP) and WGS, has developed a mature waste management program that provides treatment and disposal paths for MFCs diverse waste streams, and evaluates alternative paths for the more challenging radioactive wastes associated with MFCs mission.

Since 2015, MFC Operations and the INL Waste Management Program have incorporated several improvements, specifically in the areas of cost recovery models, TRU program development which aligns with establishing a future MFC WIPP certified program, and enhanced waste generator training. In addition, these organizations have managed the newly generated waste streams to ensure expedient off-site treatment and disposal pathways. This avoids adding to the INL STP as directed by the consent order between DOE and the IDEQ or creating new legacy waste environmental liabilities.

21.2.2 People

Performance in this area is considered acceptable with some areas needing improvement. Since 2017, new areas of training have been developed to enhance the performance of MFC's TRU waste program, RHLLW Disposal Facility operations, and waste transfer activities. Specifically, the WEO qualification was created and implemented as a comparable VEE qualification for certified TRU waste programs under the national CCP standard. This WEO qualification must be held by anyone who characterizes or packages TRU waste to ensure the waste will be acceptable for disposal at the WIPP. The qualification ensures individuals are knowledgeable of the WIPP WAC, and WEOs are provided quarterly refresher training where lessons learned are also shared. As part of startup of the RHLLW Disposal Facility, an FDS was hired, and a new training/qualification program was developed that ensures the FDS is knowledgeable in DOE O 435.1 LLW requirements, facility WAC, and facility performance assessment

requirements.

Training and qualifications related to Na and NaK waste treatment capabilities are maintained by TSDF operations personnel. However, Na and NaK waste treatment experience and expertise has been significantly reduced due to personnel attrition, hiring new personnel, and a lack of operational opportunities for Na and NaK processing. Production Facilities management utilizes off-site Na and NaK specific training for new staff to bridge the gap in expertise and experience as part of its training program. Maintaining qualified and experienced staff is critical to supporting treatment of Na and NaK waste generated by current and future MFC R&D activities. While off-site treatment may be the preferred option for applicable reactive waste streams, MFC will need to maintain the capability/resources of treating reactive wastes on-site.

The INL WMP subcontracts with Atkins Nuclear Secured, LLC to provide waste management services and support to INL facilities. This INL support group is known as WGS. Atkins along with the INL WMP have an established training and qualification program for their WGS representatives which ensures individuals are qualified and proficient to provide guidance on the proper characterization and compliant packaging and shipping requirements of waste containers from LLW, MLLW, and TRU waste streams for disposal.

In FY-22, an opportunity for improvement was identified by the MFC Waste Management Improvement Working Group to provide additional hands-on training in the areas of identifying, characterizing, and managing LLW and MLLW, primarily for new operators and support groups (e.g., Maintenance, Radiological Control Technicians). A significant effort was supported by the MFC Waste Management Integration NFM and MFC Training in FY-22 to supersede the current LLW training to MFDLA045, MFC Radioactive Waste Generator Training. This new training will cover areas lacking in the previous training in greater detail, will include a Dynamic Learning Activity, and also expand the MFC Training audience. The end goal is to improve MFC waste management processes and performance, and to ensure MFC waste generators have the knowledge and tools necessary to be successful and reduce/eliminate errors.

21.2.3 Process

Newly generated waste management processes are strong. This is due to a number of factors which include the following:

- Strong coordination between MFC waste generating facilities that include holding bi-weekly waste planning meetings
- Implementation and reinforcement of HPI tools—in particular, actively employing a questioning attitude, which is essential when dealing with “unknowns” related to newly generated waste streams
- Current MFC capabilities, and partnerships with off-site entities.

MFC in conjunction with the INL WMP and WGS has established a waste management program that ensures current waste generating activities have a path for future disposition which also avoids adding to the INL STP and INLs environmental liabilities.

Historically, funding of waste management characterization and disposition activities was provided by the generating facility, project, or program. This became problematic when newly generated wastes were not dispositioned within the year they were generated, and projects/programs no longer had the funding required to proceed with managing their wastes from cradle-to-grave. This led to an accumulation of legacy wastes in MFC R&D facilities that is still being managed to this day. To remedy this, the INL WMP created a cost recovery model for MFC. This waste cost recovery program provides a funding mechanism for disposition of all newly generated hazardous, radioactive, and mixed waste. Specifically, the WMP administers six service centers that collect revenue from MFC programs and projects to pay waste disposition costs and programmatic elements. The INL WGS service center collects revenue and pays disposition costs for waste with a readily available disposition path and establishes disposition paths for new waste streams prior to generation. The INL RH Waste Service Center collects revenue for newly

generated RH waste that are dispositioned at the INL RHLLW Disposal Facility or will be dispositioned when the backlog at WIPP is eliminated.

MFC has partnered with Veolia to demonstrate a new treatment approach to deactivate problematic elemental sodium and other reactive waste using its GeoMelt ICV process. This process has been successfully applied to several legacy waste streams and will be added to the suite of on-site and off-site capabilities for treating newly generated reactive wastes. This process not only deactivates sodium and other reactives using an innovative approach but can accept much more complex physical configurations as feedstock than traditional treatment technologies. The robust nature of the process requires much less head end processing, resulting in lower worker risk associated with chemical hazards and radiological exposure. The process provides a strong addition to the suite portfolio of waste treatment technologies that will allow current and future R&D projects more flexibility in planning and implementing more innovative R&D approaches. Establishing a wide spectrum of treatment technologies provides principal investigators with one of the major tools needed to get research concepts through NEPA and other approval processes. Meeting stakeholder expectations in treating waste is one of the key factors in moving research from conceptual and bench scale processes into larger scale applications such as test beds and production facilities.

Incorporating innovation, where possible, is critical. Thus, engagement with outside entities such as active participation with EFCOG Waste Management Groups, DOE NTP, as well as engagement with international consortia and institutions such as the European Commission funded THERAMIN and PREDIS is vital to the MFC waste management strategy to leverage and understand emerging industry technology advances in managing challenging waste streams. Innovative technologies will also support newly generated waste disposition paths and a wider spectrum of research activities.

One area that will require continued investment, is establishing a future CCP TRU Waste Certification Program. MFC will continue to utilize the EM contractor at AMWTP until the mission can no longer support receipt of BEA CH-TRU waste due to downsizing operations to support plant closure. This is anticipated to occur in the 2026 timeframe.

Looking at FY-22 and beyond, MFC will also need to continue to support maturing a HLW program for management of cladding hulls and metal waste forms associated with past and current EMT of EBR-II driver SNF and blanket materials which have historically been managed as in-process materials. Included in this evaluation is continued analysis of the revised DOE interpretation of the statutory term of HLW which could provide alternative disposal pathways for candidate materials (i.e., cladding hulls and/or MWF). Other initiatives, such as HALEU, include fuel reprocessing that will generate HLW as the processes emerge from bench scale to full scale operations. Engagement with NE-ID counterparts and appropriate EM-HQs program leadership will be necessary as waste management continues to explore the applicability of these candidate materials against the revised statutory interpretation.

21.2.4 Equipment/Tools

Equipment and tools supporting newly generated waste management are acceptable, with areas of needed improvement. Inventory tracking of radioactive wastes utilizes the Integrated Waste Tracking System (IWTS). The system is used to track the life cycle of all containerized waste through generation, storage, treatment, processing, and ultimate disposition. IWTS is an NQA-1 Quality Level 2 system and is used for a variety of waste tracking activities in addition to waste characterization, waste stream profiling, waste disposition, compliance with WAC for on and off-site TSDFs, annual and environmental reporting, RCRA management units, and other activities. IWTS provides all information necessary for facilities to properly manage and demonstrate inventory compliance with RCRA regulations, DOE O 435.1, state permits, and facility-specific requirements. An improvement MFC has incorporated for tracking TRU wastes is the WICD. This software captures the pertinent RCRA characterization data and cost charging data for individual waste items or packages as they are generated; after which, this data can be reported and summarized to the final waste container for certification and uploading to IWTS. WICD was initially developed for TRU waste generating facilities and has since been expanded to include LLW.

Other areas of unique waste management capabilities at MFC include SCMS which provides capabilities that are critical to this waste management strategy. There are two distinct programmatic and regulatory-compliance functions. The first is a radiological control work tent that provides MFC the capability to open containers of radioactive waste for inspection and, usually, subsequent waste management activities such as sizing or repackaging. SCMS also provides permitted mixed waste treatment. The SCMS employs a water-wash (reaction) vessel, caustic-carbonation system, neutralization, and stabilization unit. Treatment technologies permitted at SCMS include deactivation, water-reaction, neutralization, open/melt/drain, repackaging, and stabilization capabilities. MFC will need to retain these on-site waste characterization and treatment portfolio capabilities to support future reactor programs and R&D activities.

The preferred treatment approach for some of the more challenging waste streams is identifying off-site treatment capabilities from commercial vendors whenever possible. In some cases, the limiting factors effecting this strategy are sustained funding to maintain off-site capability and shipping constraints. Several factors are considered, including how quickly the respective inventories could be dispositioned, realizing efficiencies by focusing on more than one off-site treatment provider, total lifecycle cost savings, and current INL capabilities.

In FY-22, MFC procured an ANTEC Universal Drum Assay and Segregation System (UDASS) which will provide enhanced characterization of waste containers. This screening tool has the potential to demonstrate that some containers may screen out as LLW rather than TRU waste. The current approach for characterizing waste containers is overly conservative in many cases. This system could also be used in a future WIPP certification program at MFC. The system is currently located in HFEF and will be used to assay contact-handled waste containers.

As reactor programs and nuclear R&D activities continue to expand at MFC, MFC will need a dedicated Waste Management Facility. This has been captured in the 5-year investment strategy as the Waste and Materials Management Facility. Required capabilities include:

- Sorting and segregation
- Advanced characterization systems
- Na and NaK treatment capabilities
- Headspace gas sampling for TRU waste containers
- Storage of contact-handled and remote-handled wastes pending off-site disposition
- TRUPACT-II loading capability for shipping TRU waste to the WIPP.

Benefits of a dedicated Waste Management Facility will provide safe and secure storage of radioactive wastes, cost reduction opportunities by efficiently handling and packaging waste, and risk reduction of unnecessary waste handling which also aligns with MFCs ALARA principles.

MFC Waste Management is currently evaluating alternative thermal treatment technologies, such as Vitrification and Pyrolysis, which would remove certain hazardous characteristics in CH-TRU wastes including destruction of Oxidizers, neutralization, or conversion of corrosives (acids and bases) into non-corrosive compounds, and conversion of reactive materials to non-reactive forms. This would ensure any hazardous constituents are ultimately removed from the waste thereby mitigating any potential unknown risks associated with R&D and TRU waste packaging activities.

21.2.5 Actions FY-23

- Develop an MFC TRU certification strategy that identifies infrastructure needs and equipment to support future CCP characterization activities such as real-time radiography (RTR), headspace gas sampling, drum assay, and loading of shielded container assemblies for RH-TRU waste and TRU Pact-II containers for CH-TRU. (Robert Miklos, September 30, 2023)

- D&D legacy EBR-II support equipment in SCMS. (Robert Miklos, September 30, 2023)
- Complete SCMS Seismic Analysis to support future hazard categorization upgrade. (Robert Miklos, September 30, 2023)
- Perform off-site engineering scale vitrification on TRU surrogate materials. (Robert Miklos, September 30, 2023)
- Complete installation, system startup, and operating procedures for the UDASS in HFEF. (Robert Miklos, September 30, 2023)
- Procure SCMS Perma-Con structure to upgrade existing waste examination containment tents in MFC-793 and MFC-793C. (Robert Miklos, September 30, 2023)

21.2.6 Looking Forward (FY-24 and Beyond)

- Install SCMS Perma-Con in MFC-793C.
- Upgrade SCMS to a Hazard Category 2 Nuclear Facility.
- PDSA and SAR development, readiness activities, etc.

22. PROJECT MANAGEMENT

22.1 A Look Back

MFC Project Management has experienced significant growth over the past several years with an increase in demand for projects requiring coverage. The increase is a result from an influx in funding for major Plant Health projects, expanding RD&D capability sustainment efforts, core investments in supporting infrastructure, and a concerted effort to improve the management of traditional and non-traditional projects at MFC. Construction procurement volume increased nearly 325% between 2016 and 2021. In FY-21, a record 156,000 craft labor hours were recorded in support of projects at MFC, representing nearly 45% of the total INL construction volume; similar levels were experienced in FY-22 and are projected to increase substantially in FY-23. Similarly, programmatic RD&D activities at MFC have increased 230% over the past 5 years, requiring increased integration, coordination, and management to concurrently meet programmatic objectives and maintain facility operations. This unprecedented growth is expected to continue based on continuing investment in MFC's nuclear infrastructure and planned advanced reactor demonstrations at MFC.

The MFC Project Management division was established in FY-18 with a focus on improving project management oversight, improving project delivery, and providing transparency for project reporting. To establish core principles and processes, the initial division focus was placed on construction projects. Additional project management resources were obtained, and efforts were focused on improving integration with construction management resources. Each year, the competencies of the division have increased as efforts have continued to focus on implementation of sound project management principles to advance the mission. During FY-22, MFC successfully championed the expanded implementation of ProCore construction management software as a standard tool to be more broadly implemented across INL beginning in FY-23. Revision of the project construction transfer form was completed to provide improved clarity on the difference between partial and final transfer and construction turnover and project completion. Additionally, MFC led the development of revised scheduling special conditions to increase subcontractor rigor in construction schedules.

Improvements on reporting methodology to demonstrate work accomplishment, development of baselines that support effective resource management, allocation of funding, compliance with established requirements, and the ability to support various reporting requests have been important objectives at MFC over the past several years. Over the past several years, project reporting has been better aligned to provide visibility into individual project performance. This alignment has considered INL's earned value management system (EVMS) guidelines and principles, as well as INL policies, procedures, and customer needs, with requirements tailored based on the size and complexity of the project.

Implementation of project management principles at MFC has consistently evolved in a positive direction over the last several years. This positive trend is reflected in successful completion of INL's first line-item capital construction project in 2018; the RHLLW Disposal Project; award and execution of the SPL construction project—INL's largest capital construction project; development of mission need statements for the LOTUS test bed and a new fuel fabrication capability; and consistent execution of plant health investments and other infrastructure improvement projects at MFC. Projects are executed at MFC in accordance with applicable project management system procedures/processes, which have continued to improve and evolve at the Laboratory and field level. A MFC project planning checklist aid has been completed to help the planning process and improve consistency in the application of project management principles across projects of varying complexity and size.

During FY-22, personnel were assigned to support the MCRE project, with a senior-level program manager assigned to aid in ensuring coordination of INL NS&T/MFC resources, reporting, execution of work scope, and to ensure consistent interfaces with the public partners, DOE-HQ, and DOE-ID. Similar staffing models may be explored for other reactor demonstration projects.

With the establishment of the MFC Projects Division, additional structure has been established for plant health projects, line-item capital construction projects, and key supporting infrastructure investments. Improvement and growth opportunities remain to ensure ongoing investments, regardless of funding source/type, are aggregated, consistently managed, and incorporated/prioritized as part of a risk-based set of projects in the MFC portfolio. The demand for application of sound project management principles, including project controls, in the execution of work scope at MFC has increased dramatically over the years commensurate with increased direct and indirect investments in MFC's unique nuclear RD&D infrastructure.

Based on the significant growth and successful establishment of MFC expectations for project management, additional fidelity in the organizational structure of the division is now needed to respond to and execute continued investment in core infrastructure, while enabling programmatic capability establishment and execution of programmatic RD&D activities more effectively. The increased workload has grown such that continued successful management of the MFC project portfolio cannot be sustained without negatively impacting personnel. Establishment of a vertical line structure, centered around core project areas, will enable the more consistent and timely application of processes to successfully deliver mission outcomes.

22.2 People

The project management staff at MFC comprises people with strong work ethic and integrity. Project management personnel experience ranges from newly hired to very seasoned individuals with diverse experience. Each contributes significantly to project success across the MFC and INL. Personnel work as a team to provide lessons learned and new ways to approach problems. Project personnel work in close coordination with numerous work groups including engineering, environmental, safety, quality, researchers, management, crafts, and construction personnel.

INL and MFC continue to have a need for new project manager resources and personnel as demand increases and normal attrition occurs. A significant portion of the personnel supporting project execution at MFC have worked at MFC less than 5 years. Personnel retention will remain a significant issue due to other demands at INL and other opportunities outside the laboratory. Attrition, due to retirement/age, will also pose a significant challenge over the next 5 years. Understaffing of construction support (e.g., industrial hygiene, construction quality, and safety) is a current issue which results in a demanding workload for the few individuals supporting multiple projects. This work/stress load will no doubt contribute to turnover issues at facilities across INL.

The need for improved training, increased mentoring, and efforts to address attrition will continue to be a challenge to ensure personnel resources are in place to support the expanding demand while ensuring compliance with applicable EVMS standards and principles, contractual requirements, lab procedures, DOE orders, and other driving regulations. An understanding of the complexities of appropriate application of project management principles to MFC work scope is critical, particularly considering the wide breadth of facilities, support systems, research programs, and requirements, and the added complexities associated with conducting work in operational nuclear facilities.

Based on the significant increase in workload and project complexity over the past 5 years and the expected growth over the next 5 years, the project management workforce (Project Managers, Project Controls, construction management, construction safety, construction quality) is strained. The increased workload has been largely absorbed with minimal changes in staffing. However, the additional projected volume of new work on the horizon will require recruiting already difficult to acquire, experienced staff to meet the growing demands in support of the MFC mission.

22.3 Process

Project development and management is guided by INL procedures and guidelines that align with industry standards and best practices. Many of these processes/ procedures are based on DOE O 413.3B, "Program and Project Management for the Acquisition of Capital Assets," which provides a structured framework for execution of line-item capital asset projects. Appropriate application of sound project management principles to other projects is paramount to meeting programmatic objectives and goals. Appropriate tailoring of requirements for small capital asset projects, operating-funded projects/activities, and RD&D activities is critical to effectively manage these projects/activities while ensuring execution is cost-effective and expeditious.

A clearly defined scope is not always obvious for all projects/activities based on the nature of the activity/system, the various R&D capabilities that exist, and the age of MFC's facilities. A consistent approach for defining the scope of a project is needed to ensure projects are appropriately defined and to prevent scope creep. In recognition of the uncertainties that exist with certain scopes of work, these uncertainties need to be documented during initial project planning and accounted for when considering funding requirements/profiles. Estimates, which may or may not be informed by facility personnel, are often shared and customer expectations established before the scope is well defined. Using industry established pre-planning processes to define scope, develop appropriate risk informed cost and schedule estimates, and ensure requirements are well understood could help better manage a budget, as opposed to managing to a funding amount. This requires an experienced project manager who is actively engaged and has a good base understanding of the requirements, including facility-specific requirements, necessary to ensure all aspects of a project are covered during the planning phase and carried through execution and closeout.

For large, visible projects there are well-defined implementation and execution requirements, administrative and reporting requirements, regularly scheduled internal review meetings, DOE/customer status meetings, and high management scrutiny and expectation. Smaller projects, however, require less rigor, yet the volume is high. As a result, these smaller projects require significant effort, but follow a less standardized process. While compliant, efficiency could be improved by implementing a unified business system approach for the collection of already available electronic data in lieu of the labor intensive, manual collection process. Systematic data collection would also reduce errors associated with manual data collection.

The introduction of the reactor demonstration projects exposed gaps related to inexperience in administering and executing this type of work at the INL. Simple items (e.g., INL taking ownership of project partners equipment at no cost, providing security clearances for non-subcontracted partners, transfer of project funding from partners to the INL) do not have established INL processes and require much more energy to solve.

Development of a portfolio of appropriately planned MFC projects, including projects not "owned" by MFC, would enable leadership to balance resources across all activities, identify "peaks and valleys," aid in prioritizing activities, and support more effective internal (project staffing and staffing forecasts, engineering resources, support personnel, etc.) and external (union and subcontractor) communication of needs increasing the overall probability of successful execution.

Construction processes and procedures are acceptable but can improve with the implementation of industry best practices. Due to staffing shortages and increasing construction demands, construction oversight personnel are responsible for far more projects than they can reasonably be expected to manage. Essential tasks, such as daily reports, are not always completed the day of, or in some instances are not completed at all, thus limiting the usefulness of said reports. Far too much time is spent in the office reviewing plans, writing reports or correspondence, or approving Subcontractor Field Problems/Changes. This limits the time that can be spent in the field overseeing active construction work. Construction program managers are working diligently to streamline procedures and processes to allow personnel to work more efficiently and enable them to have a greater presence in the field.

22.4 Equipment/Tools/Training

While there is a suite of tools available to project personnel, there remains a need for improvement of existing tools and implementation of industry standard tool sets. The IRPT tool was established at MFC in recent years and while it helps to better understand a single point in time overall resource needs at MFC, it does not update to reflect the monthly changes that have occurred or are forecasted to occur. The IRPT tool is also not efficiently integrated with the other project management and EVMS processes required by the laboratory. During FY-21, the MFC Projects Division successfully implemented the Empower Analytics Software for the MFC Plant Health Portfolio, reducing data collection time and allowing for value-added analysis. Expansion to all MFC projects represents an opportunity for improvement as it would significantly streamline the monthly analysis and reporting process.

Recent roll-out of new laboratory-wide tools such as the EC process via AS and Ariba procurement front-end have been met with mixed reviews. Additional training on these tools is needed to support more effective use. New project managers have also expressed a need for improved training/mentoring and clear understanding of R2A2s, which can vary significantly depending upon the type of project/activity being supported.

An integrated project team (IPT) is a crucial tool that enables project execution success and should be established very early in the planning process. Appropriately trained support staff such as facility and engineering professionals, construction management, project controls analysts (PCAs), procurement specialists, and cost estimators are critical members of the IPT. The IPT ensures project requirements are identified early to establish realistic baseline scope, schedules, and estimated costs. With the growing project volume, effective establishment, and use of project-specific IPTs will be critical to successful project execution.

Continued emphasis on adoption of new and expansion of existing tool sets to streamline project execution activities is needed. Consistent development and sharing of lessons learned across the MFC project portfolio coupled with trending of project metrics to evaluate what is driving changes, delays, etc. (e.g., is it the design, working to specific MFC requirements and other facility programmatic milestones taking precedence over construction, and/or subcontractor specific [the subcontractor underbid and expect to make up costs via change orders]) will improve future project planning and execution.

22.5 Actions FY-23

- Re-structure the MFC Projects Division, including possible re-alignment of the Project Management home organization-work organization relationship, to support current and projected workload in support of infrastructure investment and mission delivery. (Brady Orchard, June 30, 2023)
- Expand use of Empower Analytics Software reporting tool to support indirect-funded investment reporting and incorporate INL indirect-funded investments into monthly MFC review meetings. (Brady Orchard, March 31, 2023)
- Establish quarterly meetings to forecast upcoming MFC projects including resource forecasting and potential conflict/issues resolution. Consider use of procurement portal for upcoming projects resulting from these meetings. (Brady Orchard, June 30, 2023)
- Establish formal Work Organization relationship between Construction Management and MFC Projects Division. (Brady Orchard, September 30, 2023)
- Create a standard file location, naming convention, and project folder setup for MFC projects. (Brady Orchard, June 30, 2023)
- Review existing project execution metrics (e.g., construction change codes, risk realization) metrics and define improvements in process/reporting. (Brady Orchard, September 30, 2023)
- Evaluate practicality of implementing a Best Value Contract Award methodology versus the standard use of low-price, technically acceptable methodology to ensure awarded construction subcontracts

truly represent the best value to the government when considering technical capability, cost, and past performance. (Brady Orchard, September 30, 2023)

- Support lab-wide efforts to increase the number of qualified construction subcontractors to support the increasing construction volume. (Brady Orchard, September 30, 2023)
- Establish a working presence and partnership with NS&T leadership to assist with and the review of reactor demonstration proposals prior to submission. (Brady Orchard, September 30, 2023)

22.6 Looking Forward (FY-24 and Beyond)

- Continue to expand monthly project reviews to those beyond plant health-funded projects to expand learning opportunities and provide performance feedback on a broader group of projects/activities at MFC.
- Establish active Project Manager engagement in advanced planning of critical work scope to ensure realistic scope, budget, and schedule expectations are established upfront and that facility/program requirements are met.
- Develop expectations and process to ensure RD&D estimates appropriately reflect resources (personnel and infrastructure) required to support the work scope, the facility(ies) can support the work scope, and that assumptions and strategies are appropriately vetted by all Stakeholders.
- Support/enable modernization of the vendor data system that integrates with AS/Ariba, EDMS, and others.
- Develop targeted training (e.g., nuances of nuclear facilities, org structure, POCs) for MFC project management staff to improve staff competency.
- Continue to improve integration of Project Management, Construction, Engineering, and Facility staff.
    - Co-locate Construction Management and Project Management Staff at MFC.
    - Expand use of Project Engineer role beyond large capital projects.
    - Review construction and project management processes to ensure consistency in R2A2s and hand-off/interaction with facility management.
    - Improve R2A2s and expectations for the Project Manager and CFR roles to improve communication lines/expectations, improve Project Manager field oversight, and improve construction work oversight.
    - All key resources needed to successfully enable the MFC project portfolio are aligned and coordinated through the MFC Projects Division to ensure consistency in application of processes and communication and improvement. Clear R2A2s established with support organizations and interfaces documented.
- Evaluate improving various tools used by project management personnel:
    - The interface between IRPT and other EVMS reporting tools (P6, Cobra, etc.)
    - Ariba material tracking process
    - Ariba requisition status updates
    - Replacement of the Vendor Data System.
- Improve new hire and continuing education process:
    - OJT checklist
    - List of important contacts
    - Mentoring
    - Recurring learning meetings for MFC-specific training, lessons learned, information sharing.

- Improve the establishment of and adherence to budgets vs monitoring of funding to support effective use of project management principles.
- Improve subcontractors short range schedule reporting – consider use of a standardized format.
- Conduct an external assessment of MFC Projects Division structure, processes, and performance.
- Improve/standardize the process for documenting a tailored project management approach.
- Establish a standardized Work breakdown structure (WBS) structure template for capital asset construction projects and other project types.
- Establish consistent reporting requirements/thresholds for MFC projects.
- Trend project execution metrics and identify additional areas to improve processes and systems.
- Strengthen support for field leadership and teams by better defining R2A2s and processes and improving tools for subcontractor performance management.
    - Ensure all project staff understand:
        - Their roles, responsibilities, accountabilities, and authorities
        - All project expectations
        - INL processes, tools, and procedure sets that are applicable to the work.
    - Ensure all projects are considering the use of common industry tools used at INL to effectively measure and manage subcontractor performance.
- Evaluate development of a standard look-a-head schedule template for Subcontractors to use so all construction projects are consistent.
- Improve pre-award shaping (e.g., the pre-bid process of developing the scope of the project starting with the client request and engineering and continuing with review and refinement by other key contributors [e.g., safety, environmental, construction, quality] to detail the specifications and address constructability issues).

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SAR-400, “INL Standardized Safety Analysis Report”

SAR-401, “Safety Analysis Report for the Analytical Laboratory (MFC-752)”

SAR-403, “Safety Analysis Report for the Fuel Conditioning Facility”

SAR-404, “Safety Analysis Report for the Fuel Manufacturing Facility”

SAR-405, “Safety Analysis Report for the Hot Fuel Examination Facility”

SAR-406, “Safety Analysis Report for the Neutron Radiography Reactor Facility”

SAR-407, “Safety Analysis Report for the Radioactive Scrap and Waste Facility (MFC-771)”

SAR-408, “Safety Analysis Report for the Space and Security Power Systems Facility (MFC 792A/792)”

SAR-412, “Safety Analysis Report for the Zero Power Physics Reactor Complex (MFC-775/776/777)”

SAR-413, “Safety Analysis Report for Intra-INL Transportation and MFC Inter-Facility Transfers”

SAR-416, “Safety Analysis Report for the Material Security and Consolidation Facility (MSCF)”

SAR-418, “Safety Analysis Report for the Irradiated Materials Characterization Laboratory”

SAR-419, “Safety Analysis Report for the Remote-Handled Low-Level Waste Disposal Facility”

SAR-420, “Transient Reactor Test (TREAT) Facility FSAR”

SP-20.2.5, “MFC Preventive/Predictive Maintenance Program – Supplement to MCP-6201”

SP-20.2.6, “MFC Supplement to LWP-6200 and GDE-6200”

SP-20.3.14, “MFC Electrical Circuit Directories”

SP-30.1.0, “MFC Equipment and Component Numbering”

SP-94.0.0, “MFC Lockouts and Tagouts Supplement to LWP-9400”

SP-96.8.1, “MFC Control of Equipment and System Status”

STD-139, “INL Engineering Standards”

STD-142, “INL Nuclear Engineering Standards”

STD-232, “Master Equipment List (MEL) Standard”

TREAT-ADM-3955, “Conduct of Operations for the Transient Reactor Test (TREAT) Facility”

TS-420, “Technical Specifications for the TREAT Facility”

TSR-401, “Technical Safety Requirements for the Analytical Laboratory (MFC-752)”

TSR-403, “Technical Safety Requirements for the Fuel Conditioning Facility”

TSR-404, “Technical Safety Requirements for the Fuel Manufacturing Facility”

TSR-405, “Technical Safety Requirements for the Hot Fuel Examination Facility”

TSR-406, “Technical Safety Requirements for the Neutron Radiography Reactor Facility”

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