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Materials and Fuels Complex

Operations Management Improvement Strategy

Idaho National Laboratory

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Materials and Fuels Complex Operations Management Improvement Strategy

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CONTENTS

FIGURES

TABLES

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ACRONYMS

5YS	Five-year investment strategy
AFF	Advanced Fuels Facility
AGS	American Glovebox Society
AHJ	Authority having jurisdiction
ALARA	As low as reasonably achievable
ALD	Associate Laboratory Director
AMP	Annual Mission Plan
AMWTP	Advanced Mixed Waste Treatment Project
ANL	Argonne National Laboratory
AOP	Abnormal Operating Procedure
APADs	Air Permitting Applicability Determinations
ARL	Analytical Research Laboratory
ARP	Alarm Response Procedure
ARPA-E	Advanced Research Projects – Energy
AS	Asset Suite
AS9	Asset Suite 9
ASME	American Society of Mechanical Engineers
ATR	Advanced Test Reactor
BCP	Baseline Change Proposal
BDSIS	Business Decision Support Information System
BEA	Battelle Energy Alliance, LLC.
BED	Building Emergency Director
BL	Backlog
BOM	Bills of Material
BWXT	BWX Technologies, Inc.
CAA	Clean Air Act
CAM	Control Account Managers
CARB	Corrective Action Review Board
CAS	Contractor Assurance
CBA	Cost Benefit Analysis
CCP	Central Characterization Project
CDI	Continual Document Improvement
CEI	College of Eastern Idaho

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Construction Field Representative
CGD	Commercial Grade Dedication
CGDIP	CGD Improvement Team
CH	Contact-handled
CHC	Complex Health Committee
CH-TRU	Contact-handled transuranic (waste)
CINR	Consolidated Innovative Nuclear Research
CM	Configuration management
CMMS	Computerized Maintenance Management System
CO	Contracting Officer
COO	Chief Operating Officer
COOP	Continuity of Operations Program
Co-op	Cooperative education
CRL	Certified Reliability Leaders
CS	Contract Specialist
CSE	Cognizant Safety Engineer
CSF	Critical Safety Functions
CVR	Component Value Ranking
CX	Categorical Exclusion
D&D	Decontamination and decommissioning
DBOT	Down-Blend Offering for Tritium
DIF	Difficulty, importance/consequence, and frequency
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
ECAR	Engineering Calculation and Analysis Report
ECC	Emergency Control Center

ECP	Environmental Compliance Permit
eCR	Electronic change request
EDMS	Electronic Document Management System
EFCOG	Energy Facility Contractors Group
EIS	Environmental Impact Statement
EJ	Engineering job
EML	Electron Microscopy Laboratory
EMT	Electrometallurgical treatment
EO	Equipment Operator
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ER	Equipment reliability
ERO	Emergency Response Organization
ERP	Equipment reliability program
ES&H	Environment, Safety, and Health
ESA	Experimental Safety Analysis
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
FASB	Fuels and Applied Science Building
FCF	Fuel Conditioning Facility
FDS	Facility Disposition Specialist
FFNMM	Fuel Fabrication and Nuclear Material Management
FM	Facility Manager
FMH	Fissionable Material Handler
FTE	Full time equivalents
FV&A	Foreign Visitors and Appointments
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
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
IFM	Idaho Facilities Management
IFR	Integral Fast Reactor
IH	Industrial Hygiene(ist)
IMCL	Irradiated Materials Characterization Laboratory
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IP	Implementation plan
IPL	Integrated priority list
IPT	Integrated project team
IRPT	Integrated Resource Planning Tool
IS	Industrial Safety
ISMS	Integrated Safety Management System
ISU	Idaho State University
IWP	Integrated Work Plan
IWTS	Integrated Waste Tracking System
JA	Joint APPOINTMENTS
KPI	Key performance indicators
L&OD	Leadership and Organizational Development
LDRD	Laboratory Directed Research and Development

LI	Laboratory Instruction
LIDAR	Light detection and ranging
LLW	Low-level waste
LO/TO	Lockout/tagout
LRSA	Low risk simple activity
LTAM	Long Term Asset Manager
M&O	Management and operations
MAR	Material at risk
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
MMH	Manual material handling
MOP	Management Observation Program
MP	Maintenance Procedure
MRM	Management review meetings
MSA	Management self-assessment
MSI	Minority Serving Institution
MSM	Master-slave manipulator
MSTI	Management Systems Transformation Initiative
MTRU	Mixed transuranic waste
MWO	Model Work Order
N&HS	National and Homeland Security
NCERC	National Critical Experiments Research Center
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFM	Nuclear Facility Manager
NFMBoK	Nuclear Facility Manager Book of Knowledge
NIMS	National Incident Management System
NNSA	National Nuclear Security Administration
NOP	Normal Operating Procedure
NRC	Nuclear Regulatory Commission
NRIC	National Reactor Innovation Center

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
O&M	Operation and maintenance
ODS	Ozone depleting substances
OMI	Operations Management Improvement
ONA	Office of Nuclear Assurance
ORR	Operational Readiness Review
OSD&D	Over, short, damaged, and discrepant
OSHA	Occupational Safety and Health Act
OTC	Over the counter
PA	Performance Analyst
PCA	Project Controls Analysts
PD	Position description
PdM	Predictive maintenance improvements
PDSA	Preliminary documented safety analysis
PEMP	Performance Evaluation Management Plan
PEP	Project Execution Plan
PERSEC	Personnel Security
PFC	Planning and Financial Controls Specialist
PIE	Post-irradiation examination
PISA	Potential inadequacy in the safety analysis
PM	Preventative Maintenance
PMJ	Preventive Maintenance Justification
PMO	Preventative Maintenance Optimization
PMR	Permit Modification Request
POA	Plan of action
POD	Plan of the day
POW	Plan of the week
PPA	Procedure Professionals Association
PPP	People Planning Process
PR	Principal researcher
PTC	Permit to construct

QA	Quality Assurance
R&D	Research and development
RD&D	Research, development, and demonstration
R&S	Requirements and Systems
R2A2	Roles, Responsibilities, Authorities, Accountabilities
RA	Readiness assessment
RadCon	Radiological Controls
RadIssues	Radiological Issues
RadWork	Radiological Work
RAM	Reliability, Availability, and Maintainability
RCA	Root cause analysis process
RCB	Research Collaboration Building
RCRA	Resource Conservation and Recovery Act
RFI	Request for information
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
RWDP	Remote Waste Disposition Project
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
SLT	Senior Leadership Team
SME	Subject Matter Expert
SNF	Spent nuclear fuel
SNM	Special nuclear materials
SOMD	Site Occupational Medical Director

SOU	Stipulation of understanding
SOW	Statement of work
SPL	Sample Preparation Laboratory
SPOC	Single point of contact
SR	Surveillance requirement
SS	Shift Supervisor
SSA	Site Stabilization Agreement
STAR	Stop, Think, Act, Review
STP	Site Treatment Plan
SVR	System value ranking
TEV	Technical evaluation
TPM	Total productive maintenance
TPOC	Technical point of contact
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
TUA	Tenant use agreements
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
VLF	Very low frequency
VTR	Versatile Test Reactor
WAC	Waste acceptance criteria
WBS	Work breakdown structure
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
XRF	X-ray fluorescence
ZPPR	Zero Power Physics Reactor

Materials and Fuels Complex
Operations Management Improvement Strategy

1. INTRODUCTION

The Materials and Fuels Complex (MFC) has experienced substantial growth in terms of staff, research, and production in recent years. MFC operational performance has effectively kept pace with this growth. However, to capture the continuous improvement actions needed to improve effectiveness and increase the efficiency of our management systems, a broad operations management strategy is necessary.

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.

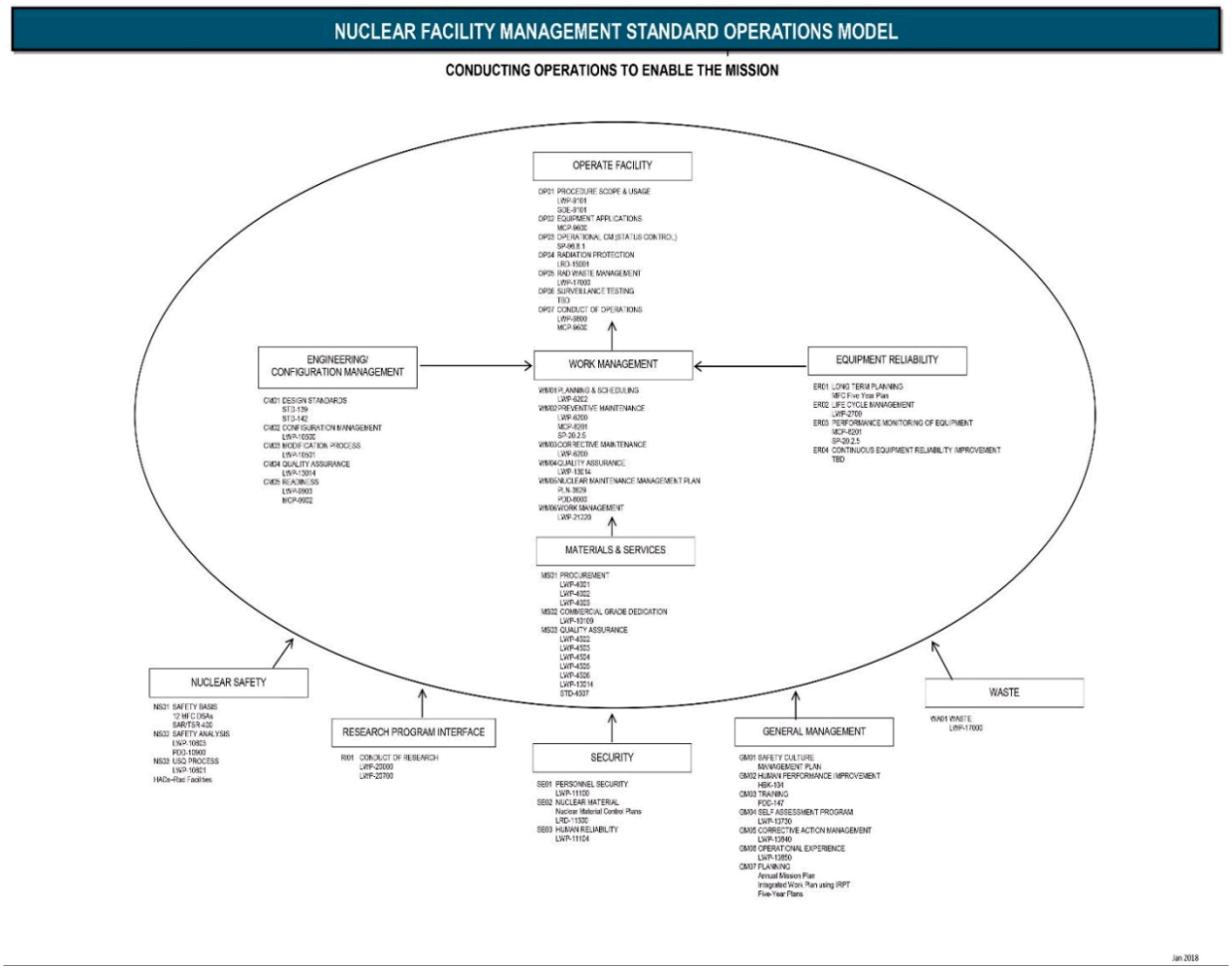

Figure 1. Nuclear Facility Management Standard Operations Model.

Each management system is evaluated independently in a chapter that describes the prior 5 years of performance improvement, 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. 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 needed 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" – This section describes actions for the current fiscal year and a description of 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, 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.
  - Improve cause analysis quality, timeliness, and corrective action quality and effectiveness.
  - Improve 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 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, radiological controls, and training.

  - Implement effective facility and complex health committee 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 5 years. The improvement has been primarily the result of the development 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 implementation of this model provided consistent expectations for management, which MFC had been previously lacking.

The elements of the MFC organizational culture specifically include Nuclear Safety Culture principles, Human Performance Improvement (HPI), Science Culture, Just 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 Nuclear Safety Culture, HPI, and Just Culture are codified in HBK-104, "MFC Human Performance and Nuclear Safety Culture Pocket Guide." The pocket guide has been in place for approximately three years, and further describes key fundamental behaviors all staff need to demonstrate to support a healthy organizational culture. Implementation of the pocket guide has contributed to improvements in organizational culture.

Nuclear Safety Culture principles were developed from commercial nuclear power industry guidance and 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.

Human Performance Improvement concepts were defined in HBK-104, and each division is expected to apply these concepts to their work as deemed appropriate. After a series of 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 leadership has improved 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.

MFC defined a set of values that were incorporated in both HBK-104 and the MFC management plan. INL established a set of values at the laboratory level that were similar in content. Together, these values provide a basis for interactions inside and outside of MFC, developing performance measures, hiring staff, and addressing issues and resolving conflicts. Recently, both INL and MFC identified a need to improve the established set of values for employee inclusivity and addressing employee disabilities.

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 5 years, events at MFC have typically been low consequence. However, the nature of these events and the recurring nature of more recent events, related to lockout/tagout, TSR compliance, contractor oversight, and radiological worker behaviors, indicates that there are opportunities for improvement with respect to HPI tool use, such as adherence to written guidance, and appropriately recognizing and mitigating risks when making decisions.

In addition, internal and independent assessments have shown that some specific Nuclear Safety Culture principles need additional focus. The principle "leaders demonstrate commitment to safety" was identified as vulnerable due to shortfalls in leadership safety messaging and effective field presence. Another principle with some vulnerability was the principle, "a questioning attitude is cultivated." This principle was identified due to a weakness in worker recognition and mitigation of risks to personal safety, associated with either personal behaviors or jobsite conditions. Lastly, the principle "organizational learning is embraced" was identified as having some vulnerability due to a weak use of operating experience, particularly external operating experience, to help reinforce safety messaging which, ultimately, results in workers occasionally demonstrating acceptance of an unnecessary risk.

2.3 Process

Although there is regular review of safety performance from a hazard control program perspective, there is currently nothing in place that promotes a regular internal assessment of performance against the Nuclear Safety Culture principles. The principles receive some internal review during mission area assessments, however, these assessments occur, at best, once every two years for every mission area. This potentially contributes to an inaccurate picture of Nuclear Safety Culture performance across the MFC organization and prevents a real-time, proactive approach to determining and taking action regarding identified vulnerabilities. External assessments of Nuclear Safety Culture occur but are infrequent. Furthermore, root-cause and apparent-cause evaluations rarely address shortfalls in adhering to Nuclear Safety Culture principles as part of post-event causal analyses.

MFC leadership implementation of the Management Observation Program rarely results in identifying usable trends of undesired worker behaviors and has not yet provided a means by which to take proactive action to address adverse trends before events occur. A review of observations over the past several years indicates most observations do not identify improvement opportunities and are primarily focused on improving and maintaining workforce trust and transparency. Although promoting a Just Culture is important to maintaining employee trust and transparency, a similar focus has not been placed on maintaining employee responsibility and accountability for desired performance.

2.4 Equipment/Tools

There are currently no specific equipment or tools associated with Culture at MFC.

2.5 Actions FY-21

- Improve MFC leadership implementation of the Management Observation Program through improved expectations for performance observation and identification of adverse trends (Dave Coates, July 30, 2021).
- Improve MFC leadership use of HBK-104 during interactions between leaders and the workforce, in order to reinforce desired behaviors associated with all aspects of MFC organizational culture. Key interactions should include management observations, staff meetings, pre-job briefings, all hands meetings, and performance planning and reviews (Dave Coates, September 30, 2021).
- Update management communication plans to identify the proper forums and methodologies for leaders to better reinforce Nuclear Safety Culture principles and the use of HPI techniques with the workforce (Dave Coates, September 30, 2021).

2.6 Looking Forward (FY-22 and Beyond)

- Develop and implement expectations, and revise guidance, as appropriate, to include a review of performance with respect to Nuclear Safety Culture principles in any root-cause evaluation and apparent-cause evaluation performed in response to events at MFC.

- Develop employee guidance, methods, tools, and training to improve the application of Nuclear Safety Culture principles. The guidance and methods should be consistent with HBK-104 and INL's Integrated Safety Management System Guiding Principles.

- Improve MFC leadership's ability to regularly monitor, assess, and act on vulnerabilities in Nuclear Safety Culture by developing and implementing a recurring MFC Nuclear Safety Culture monitoring and assessment program. The program should provide regular reviews of recent events and other pertinent data to determine performance with respect to each of the Nuclear Safety Culture principles as described in HBK-104. The reviews should incorporate behaviors associated with Nuclear Safety, Occupational Safety, and Just Culture. The program should also provide for the development and implementation of appropriate corrective actions.

3. RESEARCH PROGRAM

3.1 Research Work Control

3.1.1 A Look Back

Research work control (i.e., laboratory instructions) at MFC has remained unchanged over the past 5-years. Individual Directorates (and the facilities the directorates perform research in) have control as to the level of detail (specifically Section 5, "Instructions" of procedures) included in the work control. While the Operations group has had several focused improvement areas (i.e., Material Handling and Lock Out/Tag Out), there has been very few coordinated efforts at improvement at MFC for the research work control, except those mainly driven by incidents needing immediate attention (i.e., the green pellet fire at FASB). However, individual facilities have made improvements in research work control that are aligned with the need of the facility.

From a historical perspective, this level of stability in research work control is in contrast to the previous 5-year period (2010-2015) where a philosophical debate as to the level of detail, the actions of support personnel (mainly Health Physics support), and which template (research vs. nuclear operations) was to be used at MFC created constant change and confusion among research staff. This approach also meant that, in some instances, personnel who were not experts and would not be performing the research activities would create cumbersome procedures that introduced unneeded activities, that diminished the effectiveness of processes, and unduly hindered the researcher without providing any additional safety measures. The top-down approach to the content of the work control was not effective in engaging research staff in the procedure development process or in providing a useful document to be used and referenced by the research staff. The top-down procedure development process is only mentioned in order to inform and provide reasoning as to why this type of approach should not be repeated.

Research scope and productivity, measured by peer reviewed publications and research staff increase, at MFC has increased significantly over the past 5-years. Research activities involve a wide range of skill sets and hazards, and are performed in nuclear facilities, radiological facilities, and non-radiological facilities. The work is performed by staff permanently assigned to MFC, staff matrixed to MFC, and visitors to MFC.

While the format of the work control is the same, the level of detail in the research work control varies greatly between facilities at MFC. For research with the same level of hazards and quality implications, some facilities tend toward expert-based work control, while other facilities have more procedural based work control. The difference in the format of work controls between facilities can make procedure compliance difficult for personnel that work in multiple facilities and increases confusion about the role and importance of the work control.

The effectiveness of research work control varies across MFC facilities and is due to a variety of causes. The documentation is cumbersome and can contain 'important' information that serves to muddy information pertinent to the research/experiment at hand. Unfortunately, in work control, when everything is deemed important, then nothing is important.

The hazard tables are not prioritized in order of the importance of the hazards, are too long, and are not always prescriptive as to the mitigations (i.e., Radiological hazards - follow RWP and good radiological practices, chemical use). The relative importance of hazards and critical steps is lost, and work control can be viewed as an administrative requirement, rather than a tool that adds value to quality, performance, and safety.

The change processes for work control varies from facility to facility, depending on staffing. Some facilities have dedicated staff to perform changes, while others employ operators to perform this function.

Either way, the change process does not support efficient conduct of research activities. When a problem is identified (i.e., an incident occurs), researchers are typically overwhelmed by the event investigation process, indicating that researchers were not adequately prepared for the event and were inadequately prepared for the investigation process. This may also indicate more work to be done in the area of "just culture" at MFC.

In some specific cases, improvement efforts have been successful, and have revealed that there must be a separation from the operations work control model. A few procedures have been developed where an expanded scope allowed for researchers to make necessary adjustments within the controls developed. This has proven to provide reasonable bounding for the scope, appropriate controls for the research without overly restrictive/prescriptive steps and allowed for the creativity essential to successful research.

3.1.2 People

The research staff at MFC has increased greatly over the past 5-years. The Analytical Research Laboratories (ARL) Directorate has added 15 researchers, (9 with advanced degrees), the Fuel Fabrication Directorate has added 9 new research staff (6 with advanced degrees), and the Characterization and Advanced PIE Directorate has added 23 research staff (20 with advanced degrees). The MFC directorates have been extremely successful in attracting world class talent to support the research programs. However, the number of senior staff has declined over the same period, leaving fewer mentors to guide new researchers.

The new research staff have a varied level of experience, however, most have little to no experience working in the National Laboratory system (this may also vary by facility). INL provides little training in conduct of research/conduct of operations for new research staff. This training is vital to understanding the role and purpose of the work control in the various facilities, like many activities, this can vary from facility to facility at MFC. In contrast, new operators in the facility are trained through basic operator qualification school to ensure a consistent knowledge base. This process also provides a cadre of more experienced mentors in the field, although the quality and quantity of mentoring appears to vary by Facility/Director/SS within the division.

The involvement of researchers in the work control process is typically relegated to the "Instructions" (Section 5) and "Hazard and Mitigations" (Section 2) for hazards unique to the research within procedures. The researchers then review work control and are involved in the walk down process. More involvement of the researchers in the development of procedure content will give researchers a sense of ownership in the document, which should lead to increased quality and more consistent procedure usage. Empirical observations indicate that junior researchers have limited knowledge of research risks, impacts of errors, or the acceptable level of risk for research activities at MFC.

The effort and time required for the extremely important task of mentoring should not be minimized, especially given the limited support of the researchers' fundamental skills development. More experienced experts available for consultation on a wide range of research topics would be beneficial. However, it is important to realize that not all experts are experts in all topics, especially in the extremely varied facilities and research activities encountered at MFC. The level of expertise of mentors may be improved through the improvement of the principal researcher (PR) program within each division, allowing for more expertise and dedicated mentors to assist in research and development (R&D) work. Additional information for mentoring is provided in Subsection 3.4 of this document.

The recruitment of research staff seems to be dependent on the research needs and positions to be filled, as some positions are easily filled with excellent candidates and others have proved difficult to fill with qualified individuals. Typically, the research performed at MFC sells itself. The ability to perform research that is done nowhere else in the world is often appealing to scientists and attracts top talent. Given the appeal and importance of the research, new researchers to the laboratory often do not understand the requirements of conducting research in a high-hazard nuclear environment. New scientists,

with little experience at National Laboratories, must be conditioned to the following: a slower pace of work, performing research in a nuclear research environment, observance of safety precautions, the heightened sense of awareness that must be maintained, and for conducting research in a structured environment as they begin a career at MFC. Again, this may be performed and reinforced by improving the mentoring at MFC.

Overall, research staff are capable, and want to perform work within the work control system. The lack of baseline knowledge in conduct of research requires improvement, especially in the mentoring process. The lack of senior research staff available to mentor new individuals poses a challenge to junior researchers. Mentoring is essential to the development of the new researcher's work and safe/compliant execution of the work. In addition, the PR program is not consistently used and is lacking in PRs, and currently inadequate to support increasing research activities at MFC.

3.1.3 Process

One of the most important processes that needs to be improved is the ability to do timely changes to work documents. The process of generating work control for research activities is currently inefficient, requires inputs from personnel that are overburdened (typically ES&H), and often struggles to meet the needs of the research community. As discussed previously, various facilities have different degrees of support to facilitate the generation of work control, therefore some researchers' experience may be better than others. Researchers are asked to stop and change the work control if something is not correct or if something needs to be adjusted due to changes in the research. Typical times to revise work control documents range from days to weeks, depending on the changes, reviews needed, expertise of the person supporting the changes, etc. The process of changing the work control should be simplified to encourage consistent and correct work control documents, while still having the needed review of senior experts with accountability. In addition, improvements can also be made in ensuring the work control documents allow for flexibility, so that minor changes in the work that do not have an effect on the controls in place could be made without having to go through the entire review process again. With all changes being considered, it is important not to compromise or short circuit the Integrated Safety Management System (ISMS) process.

Compliance to research work control needs improvement. Researchers are not complying because the work documents are viewed as something done to meet Nuclear Operations' needs, with little to do or with little value to the researcher's work. There were at least five LabWay items in FY-20, detailing less than adequate use of work control documents for research. Over the last several years, the focus of management observations has been on work control and usage of work control in the various MFC facilities on several occasions.

The inclusion of HPI tools into the work control process needs improvement. Currently the HPI tools are introduced into the briefings/discussions of work. Inclusion of the HPI tools into the work control, in the correct spot, seems a prudent action to stimulate job specific applications for specific jobs or equipment.

A review of the LWP-15031, "Radiological Control Confinement/Containment Determination," process should be performed. While this activity will fall under the radiological control improvement strategy, the scientists at MFC spend a significant amount of time performing these calculations to support research activities. The review should focus on action levels and developing bounding calculations to facilitate lower activity work more efficiently.

3.1.4 Equipment/Tools

The common tool used for the creation, review, or modification of the research work control is the electronic change request (eCR) system. As discussed before, the system is typically used by specialists who enter the information. The documents are then electronically sent out to approvers. While it is

efficient, typically it takes "chasing" people down to status the progress. Researchers are typically not involved, nor do they want to be, but are reliant on how busy/motivated/bothered the individuals involved are in order to get the reviews completed and the final approval needed for the document or changes. While workable and efficient for information transfer, the attention of the reviewers is often less than desirable for efficient processing of the documents.

A means to perform fast changes to work control needs to be resurrected or used on a more routine basis is needed. The ability to redline a procedure to affect quick changes should be discussed and employed. The ability to generate a process such as a "notebook procedure" for one-time activities should be considered and evaluated, especially if the major hazard (radiological material) can be removed for the validation of the procedure. The proposed "notebook procedure" would still require IH and management approval (technical and facility) before utilization.

3.1.5 Actions FY-21

- Evaluate laboratory work controls from other National Laboratories and Industry (Donna O'Kelly, September 30, 2021)
  - Form a small, motivated working group to identify the best attributes from others' work control processes
  - Obtain input from the MFC research community on suggested changes to work control
  - Work with the Radiological Control team to provide input to the LWP-15031 process
- Demonstration of Work Control Changes (Donna O'Kelly, September 30, 2021)
  - For a given task, prepare work control in a new format for review
  - Solicit input from support organizations
  - Solicit input from larger research audience
- Improve MFC Researcher Education (Donna O'Kelly, September 30, 2021)
  - Provide short, effective conduct of research/operations seminars to research staff
  - Hold continuing education lessons on a routine basis to reinforce points of concern or emphasis
  - Recruit senior researchers to participate in the education process

3.1.6 Looking Forward (FY-22 and Beyond)

- Develop New Tools to Improve Efficiency of Current System
  - Realize R&D is dynamic and ever-changing
    - Ensure developed methods are bounded (i.e., critical review of scope)
    - Have a process for expanding boundaries with reviews and expert advice
  - Take suggestions from working group/scientist to develop needed tools
  - Evaluate the feasibility of Research Work Support System or Electronic Work Control (like Sentinel) for research activities
- Improve PR role at MFC
  - Create a goal for each division to train/mentor PR candidates
  - Track progress in LabWay
  - Support and promote PR among research staff
  - Include mentoring in release of work or in prerequisite of work control.
- Replace work control on periodic review with new form/format

  - Replacing in cycle will reduce cost of revisions
- Continue to improve work control process and efficiencies based on feedback
  - Work to develop continuous improvements to work control
  - Fine tune processes or improvements developed
- Develop effective communication with research community
  - Seek input on routine basis for concerns problems
  - Continue education/concerns over issues or events
  - Develop better lessons learned that are easily available.

3.2 Laboratory Space Management/Lines of Demarcation and MOUs

3.2.1 A Look Back

The MFC has experienced tremendous growth in research output, scientific instrumentation, and personnel growth in the last 5 years. Part of this growth is due to the awareness that MFC will be a major player in the development of advanced nuclear fuels and support is needed to ensure MFCs aging facilities are ready to meet the challenge. MFC has seen the addition of several new facilities since 2015, such as the Irradiated Materials Characterization Laboratory (IMCL) and the Research Collaboration Building (RCB). Another building under construction, tentatively called the Administrative Building, will house offices and a new cafeteria, and is expected to be occupied in 2021. The Sample Preparation Laboratory (SPL) broke ground in 2020; construction is expected to take 3 years. Several more facilities to address fuel development and fabrication are planned. While the addition of these new facilities provides needed relief to difficult working conditions, it does not solve the issue of office space and laboratory space for the impending workload of the coming decades.

The efficiency of laboratory space utilization varies across the individual MFC facilities. Over the last 5 years, many division directors have started to address the issue of space utilization in their directorates. Some issues that hinder the ability to efficiently manage laboratory space include:

1. A lack of modernization/aging facilities with ineffective/inefficient layouts
2. Legacy, obsolete, and/or out-of-service items that have been left in place
3. Competition for the same limited space and time resources
4. A lack of funding
5. Resistance to excess unneeded items because they may be useful in the future
6. A lack of time to effectively manage space utilization.

The first four issues require a coordinated, long-term strategy, while the remainder may be addressed by the facilities, individually and as a team.

Far-reaching experiments have been carried out over the course of MFC's history. However, many items had been abandoned in place, and a disposal legacy had accumulated in and around the various facilities. Historically, site management would designate a "clean-up" day for personnel to devote to cleaning up in and around the facilities, but this effort was a temporary band-aid with no long-term solution.

In May 2017, an effort began to remove excess materials and equipment from the MFC grounds. Pallets and scrap metal which had accumulated around the exterior of many facilities was collected and temporarily stored in the northeast corner of the MFC site (which was designated as a temporary holding location for such trash and debris), and later taken offsite to a permanent disposal location. Since that

time, site construction projects and renovations, such as the utility corridor, dome renovation, RLWTF, RCB, and the Admin Building, have utilized the northeast corner of the MFC site as a temporary storage area prior to permanent disposal. As a result, an inventory of 122 cargo containers located on the MFC site was made. Owners were required to inventory the contents of the cargo container and determine their continued need. This effort led to the removal of approximately 50 cargo containers. The remaining cargo containers are stored in the northeast corner of MFC.

Laboratory space management at MFC has been met with varying degrees of improvement over the last 5 years. Facilities with the most improvement changed work practices and worker and manager mindsets; established sound, agreed upon practices; held workers and managers accountable; and developed management tools and processes that supported both people and products.

3.2.2 People

Effective laboratory space management in nuclear and radiological facilities is one of the strategies employed to assist in the safe and efficient operation of mission and facility activities. Many facilities have embraced the realization that effective laboratory space management – housekeeping – in nuclear and radiological facilities is an important aspect of a safe working environment and have embarked on campaigns and programs to revamp and revitalize laboratory spaces. While the function of MFC as a whole is for the development of advanced nuclear fuels, the functions of each facility may vary widely. As such, the philosophy regarding laboratory space management will be similar for all the facilities; however, the implementation will be individualized to meet the operating needs of the facility.

The ARL and Hot Fuel Examination Facility (HFEF) have incorporated various aspects of 5S methodology into the management of their laboratory spaces. 5S methodology is a method of efficiently and effectively organizing workspaces, storing inventory, maintaining spaces, and ensuring long-term compliance. It is a team effort and involves everyone in the organization. The term 5S originates from five Japanese words that are defined as follows:

- Seiri – Sort. Get rid of outdated and unused items and materials.
- Seiton – Set in order. Organize for ease of use.
- Seiso – Shine. Clean it up and keep it clean.
- Seiketsu – Standardize. Develop an on-going schedule and incorporate it.
- Shitsuke – Sustain. Make it a habit. Help others make it a habit.

3.2.3 Process

At the beginning of the improvement effort, a team composed of members from each of the groups in the ARL met to discuss a 5S strategy, which included determining responsibilities, and developing an implementation plan (IP) and schedule. The IP documented the state of the laboratory before clean-up and the desired state after implementation of the modified 5S strategy, and established responsibility zones that "belonged" to various work groups. The IP was then presented to the ARL staff.

One simple, but important aspect of this effort, that was also seen in the larger MFC clean-up, was the establishment of a temporary storage location to hold items that were being discarded from laboratory spaces. Items being discarded were placed in the temporary storage area and "red-tagged" to indicate the items disposition path. Work groups, generally a technical working group, were provided with guidelines, and given the responsibility of cleaning up and de-cluttering workspaces with the support of laboratory management, Radiological Controls (RadCon), and Waste Generator Services (WGS). During this effort it was important for managers to remain actively involved to allay fears that are associated with disposing of perceived 'useful' equipment/instrumentation. It was also important to be aware of the tendency to hoard. Embarking on the endeavor as a partnership, staff and managers worked together to ensure that

items marked for disposal were agreed upon, changes made to work areas were acceptable to those working in the areas, and storage locations for both consumables and permanent items were agreeable.

The change in the ARL was vast – large pieces of equipment were removed from the facility, all drawers and cabinets in the facility were cleaned out, dedicated storage space was identified for consumables, and workspaces were cleaned and organized. An estimated 80% of items removed from drawers and cabinets were discarded. This has significantly reduced the number of unneeded and unwanted items and increased available storage space in laboratory areas. Additionally, the clean-up effort has provided neater, cleaner, and safer working spaces on laboratory benches, since the amount of clutter has decreased. This effort alleviated some of the stress associated with working in an aging facility by providing a more organized, less cluttered working environment, which is useful regardless of the age of a facility. The effort also assisted in the various room renovation efforts by decreasing preparation time.

Providing guidelines and expectations for the implementation of 5S and then allowing staff to adapt in a manner that suited their work environment, but respected the areas common to all, allowed for everyone in the facility to take ownership in the endeavor and have the confidence to voice their opinion and speak up when things begin to get out of order. With the current renovation efforts in the ARL, the 5S clean-up effort is ongoing and evolving.

HFEF has also adopted and incorporated aspects of 5S methodology into the facility. HFEF is a busy facility with very limited office and storage space. The facility has applied 5S principles to the third floor of the facility. Specific locations were assigned to appropriate personnel; the area was cleared of unneeded, unwanted, and legacy materials; and spaces for specific pieces of equipment were clearly marked and identified. A checklist was developed to aid in the review and removal of items; this checklist will also be used when reviewing the areas to ensure they are being maintained in an appropriate manner. The facility is currently working to implement 5S on the main floor, and HFEF has further plans to incorporate 5S principles in the main hot cell and basement of the facility. Adoption of the 5S methodology is providing HFEF a template for methodically and systematically organizing the facility and is opening needed space for people, equipment, and supplies.

3.2.4 Actions FY-21

- Other MFC facilities should adopt a 5S methodology and modify the methodology to suit the needs of the respective facility. It is understood that modifications would be needed (Tim Hyde, September 30, 2021).
    - Fabrication facilities have limited floor space but are expected to fabricate a variety of different fuels and need to explore warehousing options for maintaining equipment and instrumentation unique to separate fuel types.
    - Fabrication facilities would also need to implement procedures for removing/installing such equipment in a timely manner.
- For successful Laboratory Space Management, personnel at all levels of the facility organization must be involved, from the technicians to the division directors, and support organizations must be aware and supportive of the efforts (Eric Papaioannou, September 30, 2021).
    - Assign one person to spearhead the effort to initial completion.
    - Creation of a temporary storage location and that ‘red tags’ are utilized to identify items for disposal.
    - An ongoing commitment to sustain and maintain the initial efforts will be required.
- Creation of an MFC plan view that will clearly display the responsible party for geographical areas, physical assets, and necessary system boundaries. (Eric Papaioannou, September 30, 2021)

- It is not evident that MFC has office space to meet personnel needs in the coming years. Develop a plan to ensure that permanent staff, support staff, such as safety professionals and waste generator services professionals, visiting scientists/users, and temporary staff, such as interns, have sufficient office space to conduct office work as needed (Eric Papaioannou, September 30, 2021).

- Hold a meeting with cognizant personnel from MFC, ATR, TREAT, F&SS, ES&H, and NS&T to discuss the following objectives in support of developing a cask management program (Bob Miklos, due June 30, 2021):

    - Determine ownership of non-DOT casks/containers
    - Determine maintenance and cognizant engineering authority
    - Identify PM/CM Funding of non-DOT casks/containers
    - Determine appropriate storage locations of non-DOT casks/containers and support equipment

3.2.5 Looking Forward (FY-22 and Beyond)

- Revisit the possibility of donating equipment and instruments that are no longer being used but are still functional to universities and colleges.

    - Allow learning institutions – particularly those serving disadvantaged communities that do not have a lot of funding – to provide faculty and students access to instruments that may not be state-of-the-art but still fit for purpose.

    - Some of the equipment may be radiologically contaminated, but many universities and colleges have radioactive materials licenses and could receive and handle contaminated equipment subject to the requirements of their respective licenses.

3.3 Research Integrity and Review

3.3.1 Look Back

3.3.1.1 Research Metrics

As of the end of FY-20, the only research performance metric available is tabulation of published and/or submitted papers, with emphasis in recent years increasing on journal publications, which contribute to impact as indicated by H index. As indicated in Table 1, publication rate from MFC authors and co-authors has increased in recent years, attributable primarily to staff growth (i.e., more research staff) and publication incentives in the Characterization and Advanced PIE Division, and to a lesser extent, staff maturation in the ARL Division. The values in the table are compiled by the INL Laboratory Directed Research and Development (LDRD) office using Web of Science and Scopus, and include journal articles, books, and book chapters. This process to compile publication metrics is difficult, and MFC would benefit from a compilation that could be used consistently across divisions, and that would reflect other indicators of research activity (conference papers, notable reports). Other metrics reported in the past include numbers of post-docs and interns hosted, numbers of external users supported, and numbers of proposals submitted.

Table 1. Publication rates for MFC authors and co-authors.

	2017	**2018**	**2019**	**2020**
MFC/ % of INL	27/10%	53/18%	49/18%	
INL	262	288	275	

3.3.1.2 Research Integrity

No notable incidents related to research or scientific integrity have been raised at MFC in recent years, although anecdotally it appears that some research staff are not familiar with INL research integrity standards or processes. INL's 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 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. INL qualifications for R&D Principal Researcher (QNRDPRIN), are documented by Form 361.A61, "Science & Technology Principal Researcher (PR) Qualification Checklist," and for Hands On Researcher (QNCONRES), by Form 361.A60, "Science & Technology Hands-on Researcher Qualification Checklist." A review of the form checklists indicates that the qualifications address work control, integrated safety management, and ES&H topics, and research integrity is not explicitly addressed.

3.3.1.3 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.

3.3.1.4 Research and Data Quality

Much of the work at MFC is performed to collect data and generate information, initially for investigation but increasingly to support design and safety bases. INL provides two procedures to control such activities: LWP-10107, "Engineering Test Control," governs "non-research tests or test procedures that may be used as qualification testing… or for other testing of engineered design," and MCP-1380, "Research and Development Test Control," governs testing "used to verify compliance with selected R&D requirements or to collect data/information for selected R&D work activities." Surprisingly, it is MCP-1380 that is to be used when collecting data for fuel qualification and design, which would apply to much of the testing and data collection at MFC. MCP-1380 directs the performer to address quality assurance requirements for data collection and control, including reference to NQA-1 Part 1. Other than a vague direction to consult with a quality engineer, no specifics are provided. Quality requirements for specific programs are typically implemented to MFC work through the INL program managers, which has been mostly successful, as evidenced by the recent U.S. Nuclear Regulatory Commission (NRC) approval of the Tristructural isotropic (TRISO) fuel qualification Licensing Topical Report submitted by the Electric Power Research Institute (EPRI) and compiled by INL and other contributors. However, other anecdotal evidence suggests that research data quality requirements should be made clearer to MFC staff and managers. Quality requirements in this context touch on the engineering process as applied to equipment to be used in data collection; data collection, measurement techniques, and quality measures; and data storage and control.

3.3.2 People

The MFC Chief Scientist leads efforts to measure and improve the MFC research culture. The new MFC Chief Scientist will transition into this responsibility during the Fall of 2020. 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.

3.3.3 Process

3.3.3.1 Research Metrics

The process for assessing MFC research performance can be improved, in part by establishing a consistent and practical method for compiling metrics.

3.3.3.2 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 whether and how best to ensure personnel are familiar with research integrity expectations and PDD-221.

3.3.3.3 Mission Work Planning

The process used to plan mission work for an upcoming fiscal year can be improved, primarily with the appropriate ALDs (MFC, NS&T, N&HS) establishing expectations, and program managers and directors collaborating to enter into the Integrated Resource Planning Tool (IRPT) the best available data at the appropriate time in the planning process and updating that data as DOE plans become clear.

3.3.3.4 Research and Data Quality

As mentioned in Subsection 3.3.1, control and research and engineering testing and measurements at INL is governed by LWP-10107 and MCP-1380 (particularly MCP-1380), which do not provide explicit guidance on data quality for testing that is not engineering verification. MFC and INL programs will benefit from a guide issued to address this need. Also, R&D staff question whether the INL engineering process is implemented appropriately for research equipment that does not have safety function.

3.3.4 Equipment/Tools

3.3.4.1 Research Metrics

In terms of useful tools for research metrics, such as publication counts, the Characterization and Advanced PIE Division has recently found success in using Scopus as an online tool for staff to list their publications, with validation of publication. It may be possible to put forward a scheme or process for using Scopus for all publishing MFC staff.

3.3.4.2 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.

3.3.4.3 Research and Data Quality

Other than a process or guide useful for MFC staff and managers, no other tools are envisioned at this time.

3.3.5 Actions FY-21

- Research Metrics (Abdul Dulloo, July 30, 2021)
  - MFC Chief Scientist and MFC directors identify key research metrics to be tracked as a performance indication
  - MFC Chief Scientist define and implement a scheme or process for identifying research metrics to be tracked and reviewed annually
- Mission Work Planning (Tiffany Leavitt, July 30, 2021)
  - ALDs clarify and communicate their expectations for annual workforce planning, with a practical and manageable process to be agreed upon
  - MFC directors establish and keep to a FY-22 planning schedule
- Research and Data Quality
  - MFC directors commission drafting of an MFC testing and measurement quality guide to be used in accordance with LWP-10107 and MCP-1380; FY-21 work will identify scope, approach, and develop the outline for the guide (Abdul Dulloo, September 30, 2021)
  - MFC mission directors commission drafting of objectives and requirements for the engineering of research equipment and for data storage and control (Abdul Dulloo, September 30, 2021)
  - MFC Chief Scientist resumes the MFC Science Talk series, starting with a presentation on the TREAT Facility (Abdul Dulloo, March 31, 2021).

3.3.6 Looking Forward (FY-22 and Beyond)

- Research Metrics
  - Show year-over-year improvement and sustained performance on key indicators
- Mission Work Planning
  - MFC directors 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. See the forthcoming MFC administrative document for IRPT.
  - MFC ALD 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
- Research and Data Quality
  - Issue Revision 0 of the MFC testing and measurement quality guide in FY-22 (action owner to be determined)
  - MFC directors determine and execute best approaches to achieve objectives for engineering of research equipment and for data storage and control.

3.4 Mentoring

3.4.1 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 INLs Employee Development Network and Assessment Center. INLs Learning and Organizational Development division offers and facilitates many programs and courses. Therefore, mentoring may be considered a part of employee development.

There is presently no formal mentoring program in effect at MFC, making it difficult to provide a detailed 5-year look back. However, it should be noted that mentoring at MFC still occurs – and has been occurring - on an informal basis. Furthermore, it has been reported that, due to attrition within the ranks of senior research staff, there has been a decline in the number of mentors available to guide new researchers in some areas.

3.4.2 People

The hiring process identifies good candidates and brings them to INL; then on-boarding 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 MFCs 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 through 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.

3.4.3 Process

MFC leaders and managers will support, encourage, and facilitate mentoring relationships. 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.

3.4.4 Equipment/Tools

Currently, mentoring occurs mostly informally and organically (employees develop relationships, and activities are not tracked). A more-structured program would provide more training for employees, mentors, and managers, with examples to help participants develop mentoring activity ideas. A tracking system would allow participants to record activities, tips, and suggestions.

3.4.5 Actions FY-21

- Develop an MFC Mentor/Mentee program that focuses on personnel in science research roles (Abdul, Dulloo, September 30, 2021).

3.4.6 Looking Forward (FY-22 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.
- Make mentoring accessible to everyone and expected of MFC leaders and managers. This will result in improved employee development and retention.

3.5 University Partnerships

3.5.1 Look Back

University engagement has steadily improved as awareness of the strategic importance of university partnerships to MFC recruiting and research collaborations has increased. As indicators of university engagement, Figure 2 shows that the number of student interns increased steadily from 8 interns in FY-15 to a peak of 63 interns in FY-19,[1] and Figure 3 shows the increasing number of postdoctoral researchers, graduate fellows, and university joint appointments over the same period of time.

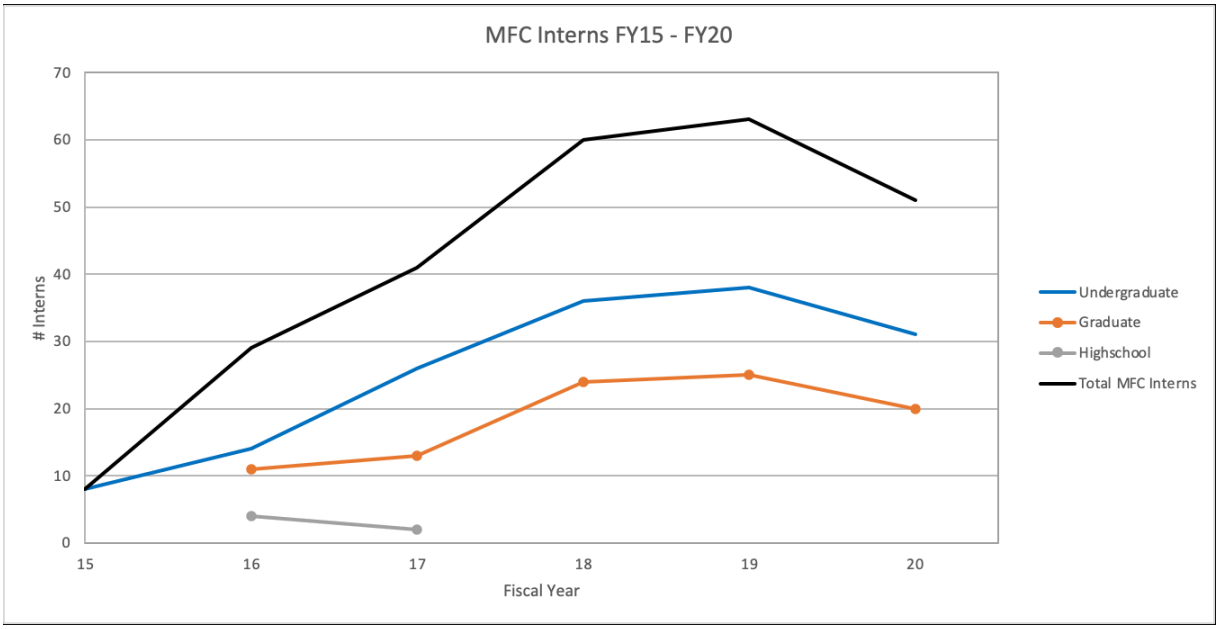

Figure 2. Number of MFC interns from FY-15 to FY-20.[a]

1. A decision was made to limit the number of interns at MFC during the COVID-19 pandemic in FY-20.

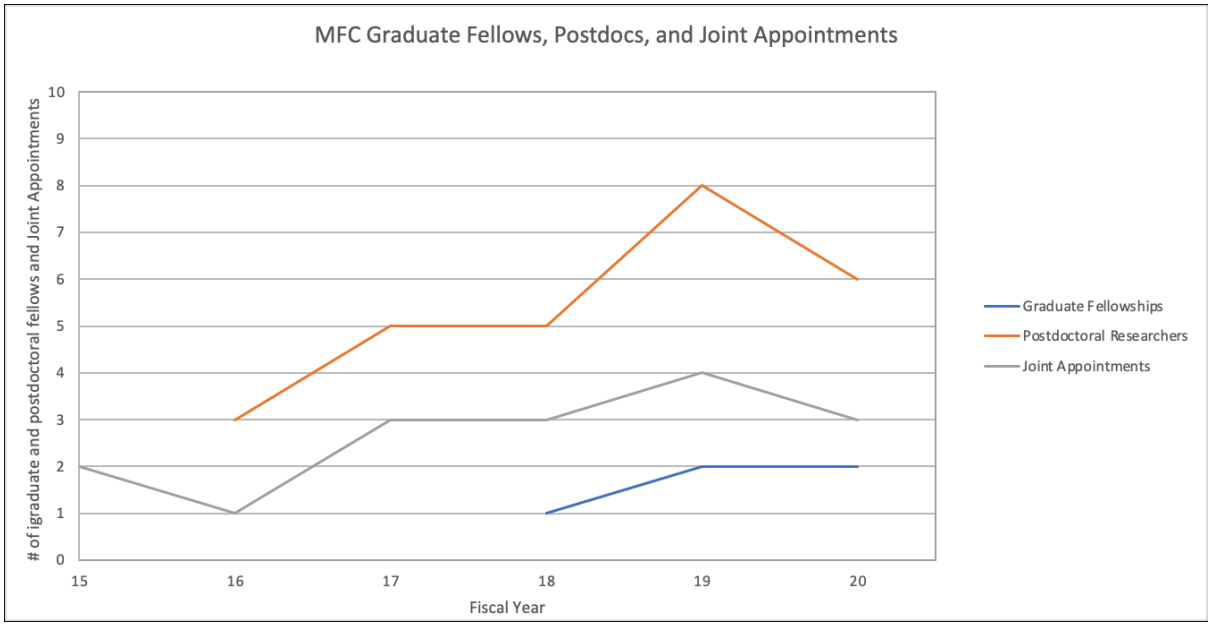

Figure 3. Number of graduate fellows, postdoctoral researchers, and joint appointments at MFC from FY-15 to FY-20.

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. Some MFC support organizations would likely benefit from an increased focus on internships as a method to recruit and retain high quality personnel.

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. As the research culture at INL matures and external funding opportunities have shifted toward the nuclear industry, these sources of research funding have become more competitive. To improve the quality of INL nuclear energy-related proposals, the NS&T directorate implemented a process to prescreen proposals before submission.

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. Executing these fellowships is difficult at MFC because most funding is controlled by other INL organizations, making it difficult to guarantee funding.

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 six postdoctoral fellows, including two distinguished postdoctoral fellows.

Joint Appointments (JA) 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. Three MFC personnel currently hold joint appointments. 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.

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.

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.

3.5.2 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.

3.5.3 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.

3.5.4 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 that allow tracking and identify specific areas of improvement for university engagement at MFC are not defined. The University Partnership program tracks many parameters that could be accessed

for use.

3.5.5 Actions FY-21

- Each research division will develop a strategy for engagement of universities in their division 5-year plan (Abdul Dulloo, March 30, 2021)
    - The strategy should clearly indicate goals for engagement and indicators of success
    - Specific universities and funding strategies should be identified; this is particularly true for the graduate fellowship program
    - The strategy should clearly indicate goals for engagement and indicators of success
- Each support and operations-focused division will develop a strategy for engagement of vocational/technical schools (universities as appropriate) (Eric Papaioannou, March 30, 2021)
    - The strategy should clearly indicate goals for engagement and indicators of success

3.5.6 Looking Forward (FY-22 and Beyond)

- Execute division engagement strategies
- Leverage INL's University Partnerships program to provide data for indicators of university. engagement
- 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.

4. STRATEGIC PLANNING

4.1 5-Year Mission Plan

4.1.1 Look Back

In 2016, MFC issued its first Five-Year Science Strategy and its first Five-Year Investment Strategy. 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 NSUF. Currently the document serves as a helpful reference for mission and science objectives but is of limited strategic value. As such, the scope of the document will change to better focus on strategy and associated actions.

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. The new MFC Chief Scientist will transition into this responsibility during Fall 2020, bringing a fresh look and strategic planning experience to the task. 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 Laboratory objectives as communicated through the INL Laboratory Agenda, INL Laboratory Plan, NS&T strategy, and N&HS strategies. 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 also be included in the MFC Five-Year Mission Strategy.

4.1.4 Equipment/Tools

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

4.1.5 Actions FY-21

The MFC Leadership Team intends to rewrite the MFC Five-Year Mission Strategy to present a forward look at mission objectives, and the strategies and actions required to obtain these objectives. Written in this way, the Mission Strategy will drive the development of both the Five-Year Funding Strategy and the Operations Improvement Strategy to meet mission needs.

- The MFC Chief Scientist will revise the scope and outline for the Five-Year Mission Strategy, with input from the MFC directors and ALD (Abdul Dulloo, January 30, 2021).
- The MFC Chief Scientist will lead preparation of and issue the Five-Year Mission Strategy update, in accordance with the new scope and outline, with input provided by MFC divisions, through their directors, and appropriate NS&T and N&HS leaders (Abdul Dulloo, January 30, 2021).

4.1.6 Looking Forward (FY-22 and Beyond)

- The timeline for issuance of the Five-Year Mission Strategy will be moved forward, so that the Mission Strategy drives the development of the Investment Strategy and the Operations Management Improvement Strategy
- 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 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 the 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 – FY-20 provided additional funding to specifically address items identified in the MFC Five-Year Investment Strategy (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 $106 million in funding has been directed to support 5YS investments.

4.2.2 People

MFC established a Director of Projects to oversee 5YS projects. 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 5YS 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 is not staffed to support the large increase in 5YS projects. Engineering resources, in particular, 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 Project Management, are also reducing staffing impacts.

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. Lack of adequate advanced planning has resulted in 5YS estimates that are generally significantly less than actual costs and take considerably more time than estimated. This is a result of poor up-front scope definition and risks inherent in executing work in aging facilities. These deficiencies create downstream financial risks and undermines recent successes (i.e., RHLLW Facility, RCB construction) that have increased federal sponsors' confidence in MFC's ability to execute this important work. Additional effort and engineering support are essential to reduce uncertainty in scope and costs. MFC has requested indirect investment in 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 outyear investment profiles. A Complex Health Committee (CHC) was formed with the objective to populate an integrated priority list (IPL) focused on facility reliability/plant health scope. The CHC process has not yet matured enough to generate and incorporate an IPL into the 5YS planning process. The Director of Engineering 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

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

4.2.5 Actions FY-21

- The MFC Projects division will initiate advanced planning with the funds granted through the IPL (Tiffany Leavitt, February 28, 2021 [annually])
- The MFC Engineering and Projects divisions will mature the CHC process (Tiffany Leavitt, February 28, 2021 [annually])
    - The CHC process will support the FYS investments.

4.2.6 Looking Forward (FY-22 and Beyond)

None.

4.3 DOE PEMP

4.3.1 A Look Back

The INL Performance Evaluation Management Plan (PEMP) establishes performance measures used by the Department of Energy (DOE) to evaluate the BEA management and operations (M&O) of Idaho National Laboratory (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 2 illustrates the FY-21 PEMP hierarchy and primary area of MFC involvement.

Table 2. FY-21 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 1.1A – Versatile Test Reactor.
		Notable Outcome 1.1.B – Advanced Fuel.
		Notable Outcome 1.1C – Fuel Cycle.
		Notable Outcome 1.1D – Microreactors.
	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).	None. Currently MFC has nothing leading up to CD-2.
	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 Experimental Breeder Reactor-II (EBR-II) driver spent nuclear fuel (SNF) receipts at MFC in support of the 2019 Supplemental Agreement milestone.
		Notable Outcome 2.3.C – Maximize EBR-II driver SNF processing and EBR-II blanket SNF treatment alternative research.
	Objective 2.4: Utilization of facility(ies) to provide impactful S&T Results and Benefits to Internal and External User Communities.	None specified.
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.
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. The 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 tri-annual 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 submitted to DOE-ID. DOE-ID reviews the report and responds with their own evaluation and grades. Close-out 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-21

- Report on PEMP progress on a trimester basis during the fiscal year (Tiffany Leavitt, September 30, 2021 [annually]).

4.3.6 Looking Forward (FY-22 and Beyond)

None.

4.4 INL Laboratory Planning

4.4.1 Look Back

For each of the fiscal years 2017 through 2020, INL issued an Annual Laboratory Plan and a Laboratory Agenda. DOE requires an annual Laboratory Plan, and the preparation and review of the annual laboratory plan provides a venue for INL engagement with DOE on strategic planning. The Laboratory Agenda is an internally facing document used by the Senior Leadership Team (SLT) to show strategic and tactical elements for implementing the INL mission and vision consistent with INL Values.

In the words of the Laboratory Director, the 2017 "Laboratory Plan highlights major priorities, provides a road map for our work, and specifies how we intend to accomplish our goals and objectives," while the 2020 "Laboratory Plan contains specifics about how we intend to accomplish [INL] objectives in service to our fellow citizens." The format for each of the Laboratory Plans has remained consistent, with sections addressing core capabilities; major initiatives of science and technology strategy; technology transfer and commercialization; partnerships; infrastructure human resources; and Laboratory budget. Year-by-year changes and evolutions are apparent in a comparison of sub-chapter headings for successive laboratory plans, although the main structure of the Plan remains constant. Each year the detailed Laboratory Plan is marked and controlled as BEA proprietary, however in FY-19 INL prepared a non-proprietary Laboratory Overview for public release. It is not clear whether a public overview of the FY-20 Laboratory Plan will be released. INL also prepares a presentation each year to use for disseminating the Laboratory Plan to DOE and others.

The Laboratory Agenda's purpose is to "[provide] a structured framework championed by the Senior Leadership Team and [identify] the strategic initiatives and near-term research, development, and demonstration (RD&D) and mission-support activities necessary to accomplish INL strategic objectives for the DOE…" The Laboratory Agenda is apparently controlled as BEA proprietary, though not always marked as such. The 2018 the Laboratory Agenda was available to INL employees in a condensed form. The content of the Laboratory Agenda is consistent with, but not identical to, the content of the Laboratory Plan, descending deeper to actions and desired outcomes.

It is desirable and satisfying for each year's MFC 5-Year Mission Strategy to show specifically its alignment with the Laboratory Plan, Laboratory Agenda, and other directorate strategies (the NS&T strategy, in particular). This is challenged partly by the disparate dates of issue for each year's Laboratory Plan and Laboratory Agenda but also by the structure of the Laboratory Agenda. In particular the structure of the 2020 Laboratory Agenda included many hierarchical layers of organization, including Strategic Objectives, Strategic Objectives (10-20 years), Pillars, Outcomes, 2-5 Year Efforts, near-term Tactical Actions, and numbering with as many as four levels of hierarchy.

4.4.2 People

The Laboratory Plan and Laboratory Agenda are issued each year by the Institute Planning and Programs organization, under the direction of the Deputy Laboratory Directors. Representatives from each of the directorates, as designated by the ALDs, are points of contact for the annual process. At MFC that has included, for example, the MFC Chief Scientist and/or the MFC Business Director, who solicit input from MFC divisions. In practice, engagement from the MFC Chief Scientist and mission directors has been selective and topical.

4.4.3 Process

4.4.3.1 Laboratory Plan

From December to January, Institutional Planning staff prepare for the upcoming revision, by identifying sections and emphases that will change. In February, DOE provides guidance and expectations for the upcoming laboratory plan, the document outline is prepared, and input is solicited

laboratory-wide from key contributors, which is reviewed during the process. MFC input and participation is welcomed and usually solicited through this writing and reviewing period. The plan document is formally reviewed and revised in March and April, reviewed by Laboratory leadership and BEA, and then sent to DOE as draft by the end of the month. The plan is presented to DOE in June, at which time DOE provides comments. The comments are responded to within 2 weeks and the final plan is submitted to DOE.

4.4.3.2 Laboratory Agenda

The laboratory agenda is modified twice each year from the previous version. A large update is made in November and December, when tactical actions for the fiscal year are entered. In June and July, contributors update the plan to reflect what will be accomplished by the end of the fiscal year. Institute Planning staff maintain the document along with a work-in progress document showing marked-up changes. The staff intend to transition the Laboratory Agenda during FY-21 to an online dashboard system, to facilitate updates and convenient access for those approved to see it.

4.4.4 Equipment/Tools

The tools used for annual updates to the Laboratory Plan and Laboratory Agenda consist primarily of collaboration tools, primarily email.

4.4.5 Actions FY-21

- The MFC Chief Scientist will ensure the Laboratory Plan is communicated to MFC staff (Abdul Dulloo, July 30, 2021 [annually]).

4.4.6 Looking Forward (FY-22 and Beyond)

- Under the lead of the MFC Chief Scientist, identify and act on opportunities to simplify MFC's use of the Laboratory Plan and Laboratory Agenda to include showing co-alignment with the MFC Mission Strategy.

4.5 Memorandum of Understanding

4.5.1 A Look Back

Over the last 5 years, there have been no formal Memoranda of Understanding between the Materials and Fuels Complex (MFC) and other entities. There are multiple, long-standing Tenant Use Agreements (TUA) that have been established between facility management and internal and external organizations performing work and/or occupying space in various facilities. In general, the TUAs outline the responsibilities and limitations of both parties and have worked well in supporting the mission at MFC.

The scheduling, performance, and prioritization of programmatic work at MFC has improved over the last 5 years, but much remains to be done to attain the efficiencies needed to perform at the levels required in the coming years. Prior to 2018, an Annual Mission Plan (AMP) was written each year; however, this document was often written mid-way through the fiscal year and did not clearly define successful mission outcomes. The AMP was of limited use and provided little insight as to the real accomplishments or risks encountered by the facilities.

MFC has three issues that contribute to the lack of a coordinated work project scheduling between MFC facilities and NS&T programs:

- Incomplete identification of needed resources – time and personnel
- Lack of coordination **between** NS&T programs
- Lack of a fully integrated schedule.

In an effort to alleviate these frustrations, in 2015 the MFC mission division directors from HFEF and ARL began meeting with NS&T division directors prior to the beginning of FY-16 to establish the scope of work in the facilities for the fiscal year. These efforts were the beginning of an extended effort to establish lines of communication between MFC facilities and NS&T programs regarding the conduct of work, the mitigation of conflicts, and the establishment of work priorities. In ensuing years, additional mission facilities have been added, and more NS&T programs are now involved in the effort.

The "MFC Nuclear Capabilities Chart" was developed and identified the capabilities available in the various MFC facilities. Templates that identified flow of work and average resources needed were also developed by the facilities and provided to schedulers. These tools were helpful in outlining flow of work and achieving more consistency in scheduling; however, they did not address multi-programmatic scheduling challenges or conflicts.

In 2018, MFC began development of the IRPT in an effort to identify resources needed for work activities at all MFC facilities and integrate them into a more coordinated manner. Through the IRPT, needed resources could be more easily identified and assigned to work activities, and more coordinated schedules could be developed that would lessen the likelihood of programmatic issues due to scheduling conflicts. Initial efforts for the IRPT focused on IFM-funded activities and served as a learning time for users of the tool.

4.5.2 People

Multiple facilities at MFC conduct programmatic work and maintain the personnel to perform the work. However, some personnel working in facilities may report directly to other organizations. In many instances, there is no TUA covering the performance of this work, and no clearly defined method for determining the prioritization of work as conflicts arise.

4.5.3 Process

Some facilities encountered minimal scheduling conflicts. Fabrication facilities utilize unique pieces of equipment for the fabrication of the various fuel types, so these facilities experience minimal local scheduling conflicts. HFEF was also very successful in working and communicating with the programs in mitigating conflicts that arose due to issues in the facility; however, schedule changes did not consider the global affect that could occur in downstream facilities. As well, NS&T schedulers were often not aware of changes in facilities that affected the schedule, and the schedule was not a reflection of the reality of the facility. Many programmatic schedulers were also unwilling to allow facilities to make changes to the schedule to reflect changes that had been made in the facility. As a result, some facilities utilized alternate means to schedule work in their facilities to ensure staff were able to stay current of programmatic work activities in the facilities.

Given the success HFEF encountered with communicating directly with programs, many facilities began directly coordinating with NS&T and MFC experimenters to ensure timely completion of work in facilities. Facilities, such as IMCL and ARL, have been successful with this approach.

When scheduling conflicts have arisen due to facility issues, they have generally been resolved by either changing milestone dates or missing milestone dates. In other cases, conflicts have been overcome by discussions with the Facility Director and the appropriate NS&T programs; however, in many cases, the experimental plan was either amended/changed or milestone dates moved by either one or both programs to accommodate needed schedule changes.

4.5.4 Equipment/Tools

In early 2020, several NS&T programs agreed to provide input into the IRPT. It is expected that the addition of the programmatic information will greatly enhance the usefulness of the tool.

The software Primavera P6 is used by NS&T schedulers for project planning. However, all aspects of

the software are not utilized which leads to limited utilization for MFC facilities. For instance, resource loading is not utilized and therefore, does not allow for the identification of needed resources in MFC facilities. In some instances, there is not a full understanding of the time needed to complete work, the number of people needed for the work, or the amount of support work needed. This makes it difficult for MFC management to appropriately manage resources, which in turn lead to frustration with programmatic customers.

4.5.5 Actions FY-21

- Incorporate the work acceptance process currently under discussion between Advanced Test Reactor (ATR), MFC, and NS&T (Ron Crone, September 30, 2021).
- Integrate all programmatic work into IRPT when the programs know what activities will be performed at MFC (Tiffany Leavitt, September 30, 2021).

4.5.6 Looking Forward (FY-22 and Beyond)

- Implement longer-range resource planning to ensure trained and qualified personnel are available to meet work demands
- Develop a mechanism to resolve priority conflicts that extend beyond resolution at the division director level, which could include leveraging Directorate priorities called out in the respective strategic plans of the Directorates.

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 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 Guide" in 2018 formalized INLs commitment to this philosophy and has guided the strategy to increase knowledge and integration of HPI philosophies and tools. GDE-863 identified the HPI Vision as; "Reduce Human Error, Enhance Human Ingenuity, and Create a Capacity for Resilience. Resilience is not the absence of mistakes, errors, or failures but the presence of defenses and controls." The guide also defined Risk Important Steps and introduced the use of the Resiliency Scale to be used when evaluating a critical step 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:

- Core HPI tools for all employees to learn and use
- The need for development of a single subject matter expert (SME) as an MFC HPI Lead
- Expectation that the MFC HPI Lead will work with staff in each MFC division to develop HPI Practitioners
- HPI Practitioners will help embed HPI tools and concepts with personnel in their divisions
- Defined 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 a 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 handbook
- By the end of March 2020, at least 80% of MFC employees had attended 0INL1757, "Human Performance Improvement (HPI) Introduction" course.

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 personnel have been identified to attend the 0INL1758, "HPI Tool Selection and Use" training.

MFC is also very fortunate to have a Procedure Professionals Association (PPA) Certified Instructor available on site. PPA is a writer certification program that is based on Human Performance Principles that are proven to improve human performance and reduce error by teaching 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 in their writing.

The PPA instructor 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 to 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.

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 reduces 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.

- 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 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-21

- Qualify at least one individual from each division as an HPI Practitioner (Shawn Hill, September 30, 2021).
- Identify individuals to attend and complete 0INL1759, "HPI for INL Leaders and Supervisors" course (Shawn Hill, September 30, 2021).
- Identify at least one individual to be the primary procedure coordinator for each facility (Tiffany Leavitt, February 28, 2021).
- Train and certify procedure developers and writers to teach personnel how to functionally incorporate human factored wiring into procedures (Tiffany Leavitt, September 30, 2021).
- Create additional DLAs to expand personnel knowledge and reinforce the use of HPI tools (Shawn Hill, September 30, 2021).

5.6 Looking Forward (FY-22 and Beyond)

- Develop an HPI refresher course for MFC personnel
- Evaluate the progress of FY-21 actions and adjust these actions to provide continued improvements.

6. CONDUCT OF OPERATIONS

6.1 Procedure Scope and Usage

6.1.1 A Look Back

The productivity and output demand of the MFC Document Management (DM) organization has increased on a yearly basis over the past 4 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.

DM significant improvements since FY-16 include the following:

- Updated DM's processes to MFC's required standards from the Procedure Professional Association's (PPA's) PPA AP-907-005, "Procedure Writer's Manual," and incorporated those standards in MFC-ADM-0001, "MFC Normal Operating Procedure Writing"
- Trained employees to the new processes
- Initiated re-writing MFC operation procedures.

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 improvements since FY-16 include:

- Training on procedure usage for new employees
- Conduct of Operations Procedure use simulators (HuPerT)
- Continued training for employees to reinforce procedure compliance requirements
- Updated MCP-9600, "Conduct of Operations for Materials and Fuels Complex Facility Operations," for clarity.

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.

DM has experienced very little increase in staff. Although head count has remained fairly constant, turnover has been, and will continue to be, an issue. Twenty-five percent of the DM staff have worked at MFC 2 years or less and another 25% are retirement age.

The changes to the procedure process require re-writing 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 re-write initiative. The workload has noticeably increased over the last 4 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.

DM's workload is expected to continue to increase due to the 5-year plan re-write 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

DM processes and procedures are continually improving, striving for safe and accurate work performance. DM and the 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.

6.1.4 Equipment/Tools

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

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

6.1.5 Actions FY-21

- Issue administrative procedures to address the following by the end of FY-21 (Tiffany Leavitt, September 30, 2021):
  - Procedure Writer's Guide
  - Procedure Use Guide
  - Procedure Change Guide.
- Work with facility NFMs to identify procedures to have updated to the new format (Tiffany Leavitt, September 30, 2021).
- Strengthen employees' understanding of human factored writing to build consistency within MFC's procedures by improving the writing instructions for Laboratory Instructions (LIs), Normal Operating Procedures (NOPs), Maintenance Procedures (MPs), Abnormal Operating Procedures (AOPs), and Alarm Response Procedures (ARPs) (ongoing through the management observation programs (MOP), coaching, and mentoring) (Tiffany Leavitt, September 30, 2021).

6.1.6 Looking Forward (FY-22 and Beyond)

- Logic tie associated work documents (forms, logs, checklists, etc.) on EDMS required to perform a specific task/evolution
- Develop HPI tools for reviewing document changes and periodic reviews
- Update/revise training to continually improve and reinforce procedure adherence
- Train 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.
- Evaluate replacing Use Type 1, 2, and 4 with General Use and Direct Use procedure types.

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 MCP-9600. Administrative control of log keeping practices at MFC in recent years has undergone substantial changes, notably a major revision to MCP-9600 in 2014 which added Appendix K for detailed logkeeping instructions. Further analysis of individual facility log keeping 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:

- MCP-9600, Rev 21 was issued on June 19, 2014 and added Appendix K, Log Keeping. The appendix greatly expanded the "how" and provided numerous examples.
- Between 2018 and 2019, logs were collected on three separate occasions and sent to all 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.

6.2.2 People

Shift Supervisors each day must prioritize the day's activities and subsequently log keeping in some facilities seems to be regularly moved to the bottom of the priority list.

6.2.3 Process

Many different areas have been identified as findings for improvement during the logkeeping process. Through facility log inspections, interviews with end users and facility supervision the following areas for improvement have been identified. Various comments from the respective facilities included:

- Log keeping sometimes is a low priority, operations personnel assume the watch, perform work throughout the day, many times away from the operations base where the Logbook is kept, then when securing the watch at the end of shift try to catch up the log entries.
- Many times, logkeeping is not discussed when assignments are made.
- In some facilities ownership of the facility logkeeping and expectations are not fully understood.
- In some facilities required periodic reviews by first line supervision are sporadic at best.
- The determination for which logs are required needs to be revisited in each facility.
- The required details of logkeeping entries to enable the re-creation of the day's events are not fully understood or implemented in many cases. Facilities are still struggling to capture sufficient logkeeping details.
- When required, logkeeping is seldom discussed as part of the job assignment and adequate log keeping time is not factored in.

6.2.4 Equipment/Tools

Several facilities are piloting the use of electronic logs (eSOMS). This system will be rolled out to all MFC facilities in 2021.

6.2.5 Actions for FY-21

Major factors in log keeping discrepancies have been determined to be the lack of ownership of log keeping and subsequent log keeping issues. Once first line supervision takes ownership of the expected log keeping practices, makes specific log keeping assignments, performs periodic reviews, and has open discussions with end users on Log entries, while coaching, mentoring, and training staff, it will create an atmosphere of accountability and ownership.

- The Cognizant Operations Manager/Operations Supervisor/Shift Supervisor will ensure, per LWP-9600, Subsection 4.11.4, that Supervisory Reviews are formalized, and written directions shall be captured in the appropriate facility administrative documents (e.g., SPs, SDs) (Shawn Hill, June 30, 2021)
- During log keeping reviews, supervision will coach, mentor, and provide training regarding log keeping expectations and content (Shawn Hill, September 30, 2021 [ongoing])
- First line supervision shall ensure that all tasks that require logkeeping will include a specific log keeping assignment, and adequate time will be built into operations to allow formal log keeping duties to be correctly carried out (Shawn Hill, September 30, 2021 [ongoing])
- When a documented brief is performed, Form 434.14, "INL Briefings," Section 6 shall include log keeping assignment(s) (Shawn Hill, September 30, 2021 [ongoing])
- Use MFC training to improve understanding of and performance in logkeeping (Shawn Hill, September 30, 2021)
    - MFC training will work with operations to provide logkeeping training with an emphasis on reviews and content to supervision, especially SS/Foreman, or equivalent
    - MFC training will work with operations to develop a DLA focusing on content in facility logbooks for all end users.

6.2.6 Looking Forward (FY-22 and Beyond)

- Each Facility will accept the use of electronic logs (eSOMS when the system is made available).
- Each facility will accept the use of electronic logs (eSOMS when the system is made available).

6.3 Turnover

6.3.1 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 has increased. One of the key elements in communicating a turnover and assumption of responsibilities is the narrative logs. MFC has been working on a continuous improvement agenda to train, coach, and improve the detail of the narrative logs to assist in a proper turnover. The use of management observations as a tool in 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 3. Also, a key focus at MFC is 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 3. Recent MFC Turnover Improvements.

MFC Turnover Improvements	
Procedures/Process Improvements • MCP-9600 "Conduct of Operations for Materials and Fuels Complex Facility Operations" • LWP-9600 "Conduct of Operations for the Idaho National Lab" • DOE O 422.1, "Conduct of Operations" • DOE O 422.1 "Conduct of Operations," Chg 3 • DOE-HDBK-1226-2019 "Conduct of Operations Implementation"	**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 managements observations (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 changes and future changes that are being discussed along with active progression plans will help to 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 MCP-9600 and LWP-9600 is descriptive and detailed. The detail 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. Reviewing how the different facilities at MFC execute this process differs in how it is implemented, but the key aspects lined out in MCP-9600 and LWP-9600 are being used consistently. 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 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. The use of eSOMS for tracking, trending, and efficiency is being evaluated. Also, continuous improvement of facility logs, updated information, training, and HPI efficiencies aides in the progression of turnover processes.

6.3.5 Actions FY-21

- Complete a pilot of eSOMS at an MFC facility (Shawn Hill, September 30, 2021).
- Improve MFC personnel proficiency, awareness, attitudes, and training regarding turnovers and assumption of responsibility
  - Continue to utilize management observations as a tool to identify issues and coach, as necessary. Continue to use management observations as a tool to coach and strengthen consistency and knowledge base (Shawn Hill, September 30, 2021 [ongoing]).
  - Continue to develop individuals through training and progression plans (Shawn Hill, September 30, 2021 [ongoing]).
  - Use observations from throughout MFC as a lesson learned to improve all facilities (Shawn Hill, September 30, 2021 [ongoing]).

6.3.6 Looking Forward (FY-22 and Beyond)

None.

6.4 Operational Configuration Management and Status Control

6.4.1 Looking 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 laboratory-wide procedure LWP-9600 and management controlled procedure MCP-9600.

Facility NFMs and Shift Supervisors 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).

Recent incidents at MFC have either come directly from or have been complicated by shortcomings in the practice of operational configuration management and status control. Hot cell over-pressurizations at FCF and HFEF are examples where robust status control and operational configuration management could have helped prevent or mitigate these events.

In the cell over-pressurization event, the FCF supervisor relied on verbal directions to operators and operator manipulated equipment without any written instruction. If FCF had utilized the tools available for status control, specifically SP-96.8.1 and FRM-1387, to control abnormal system alignments, the tools may have prevented the operator from mistakenly securing equipment which resulted in cell over-pressurization. Furthermore, the use of approved written instructions for attempting to reestablish a negative cell pressure could have prevented the subsequent cell low pressure received during the operator's recovery actions.

Operational configuration management at HFEF failed to recognize that an upgrade to the facility pressure control system, while functional, was not yet released by engineering as it had not been fully tested and the engineering job (EJ) had not been closed out. Using the new, untested automatic pressure control system, as well as making assumptions on the operational characteristics of this system, resulted in cell over-pressurization when power was secured to the system and the (untested) transfer switch failed to transfer to a backup power supply.

Looking even further back than the last 5 years, a lack of status control on multiple independent components required for the function of an Argon-West hood system at the Zero Power Physics Reactor (ZPPR) exacerbated the consequences of a plutonium release from a damaged fuel plate, and ultimately resulted in a plutonium uptake by MFC staff members.

Operational configuration management and status control at MFC is occurring effectively in most cases across all facilities, but as past incidents show, every facility could benefit from a critical evaluation and improvements.

6.4.2 People

6.4.2.1 Roles/Responsibilities & Accountabilities

DOE O 422.1, Paragraph 2, H dictates that DOE Contractors establish a Control of Equipment and Status portion of the Conduct of Operations program. The details of these requirements are further discussed in DOE-STD-1039-93, "Guide to Good Practices for Control of Equipment and Status Control." The DOE Standard and DOE Order require that DOE Contractors meet the following criteria within the Control of Equipment and Status Control programs:

- The operations supervisor maintains proper facility configuration, including authorizing changes to equipment and system status.
- A system is in place to ensure and document proper alignment of equipment and systems prior to placing them in service.
- A lockout/tagout program is in place to provide protection to personnel and equipment, and to aid in the control of equipment and system status (covered by DOE-STD-1030-96, "Guide to Good Practices for Lockouts and Tagouts").
- Administrative controls are established to document compliance with operational limits.
- Operating personnel receive accurate information reflecting the status of control panel and local panel alarms.
- A system is in place to document equipment deficiencies.
- All activities, including maintenance, on equipment that are important to safety, that affect operations, or that change control indications or alarms, are properly analyzed, documented, and authorized.
- Operational testing is performed following maintenance to demonstrate that equipment and systems can perform their intended function.

- A system is in place to control temporary modifications to facility equipment or systems.
- A document control system is in place to ensure operating personnel have the latest revision to documents necessary for proper control of equipment and systems.

To implement the requirements of the DOE Order and Standard, INL has incorporated the required elements into LWP-9600, "Conduct of Operations for the Idaho National Laboratory" and again locally into MCP-9600, "Conduct of Operations for Materials and Fuels Complex Facility Operations" and MCP-3955, "Conduct of Operations for the Transient Reactor Test (TREAT) Facility." Supplemental tools available at MFC include SP-96.8.1, and FRM-1387 "Miscellaneous System/Equipment Alignment" which both MFC and TREAT use.

The basic structure of these documents mandates that NFMs determine which facility systems are important to the safety and the safe operation of the facility, and therefore, require configuration management and status control. NFMs should also work with supervisors to determine ways to incorporate these status and configuration systems into facility operating practices. Facility Operators have the responsibility to keep supervisors informed of equipment status changes and deficiencies. All other responsibilities become the responsibility of the Operations Supervisors (Shift Supervisors/Foremen).

6.4.2.2 Recruitment

Recruiting operations managers and supervisors that understand the importance of status control and configuration management is important to the overall conduct of operations mission at MFC. Hiring managers should include these topics during initial candidate interviews.

6.4.2.3 Training & Qualification

Conduct of Operations is an integral part of MFC operator, supervisor, and management training; however, little training is available specifically for status control and operational configuration management. Most training associated with these topics is covered by required readings of LWP-9600 and MCP-9600. A classroom version of training is available for SP-96.8.1 (non-repeating), and up until 2016 there was an annual conduct of operations written exam. A new training needs to be developed, further described in the "Actions" section.

6.4.2.4 Decision Making

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. Most of the decision-making responsibilities lie with the supervisors as they are responsible for maintaining an overall view of the facility's systems and are responsible for directing operators in response to abnormal conditions. Poor configuration management and status control decisions by supervisors in each of the cases mentioned earlier either contributed to causing the issues or complicated them.

6.4.2.5 Conflict Resolution

Conflicts between individual facilities and the MFC operations group over what was perceived to be an onerous administrative requirement concerning operational configuration management and status control have arisen in the past. The two MFC-wide computer systems used to track status and

configuration of systems at MFC in the past have either been abandoned (MFC Facility Status Workbook) or transferred to RadCon (Facility Equipment Status Board, now the RadCon Instrumentation Status Board). This shows that an MFC-wide equipment status tracking program will not add value to the individual facilities. Additionally, some facilities interviewed were reluctant to use the existing Status Control binders, which incorporated the use of SP-96.8.1 and FRM-1387, as use of the Status Control binder was viewed as an unnecessary administrative task. Other facilities viewed SP-96.8.1 and FRM-1387 as a requirement to be performed on all systems, regardless of the operating tempo and existing operating instructions.

The answer to this conflict is somewhere in the middle; a few of the facilities use these tools as intended. Using the tools available with a graded approach could alleviate the stigma of undue administrative burden. In some cases, the tools may make operation of these systems more efficient. For example, if a procedure is paused mid-work for any kind of reason, and the operations supervisor determines that a piece of equipment that was secured per the procedure needs to be restarted until work on the procedure can continue, the operations supervisor can use FRM-1387 to give written instruction to the operators to start the equipment, while tracking this action so that when the procedure is resumed the supervisor is able to ensure that operators will re-secure the equipment before proceeding with the procedure. If these steps had been taken in the FCF over-pressurization incident, there is a much smaller chance that the over-pressurization would have happened at all.

On the other hand, continuously performing configuration checklists on systems that are routinely operated using approved written instructions could lead to confusion between the procedural system alignment and the anticipated lineup per the checklist as the system may have been operated since the creation of the checklist. Additionally, repeated performance of configuration checklists on benign systems or systems that rarely change configuration, may lead to complacency. Determining the right time (i.e., after major maintenance, deviations from operating instructions, or if the system has not been checked in a long time) could aid in operations staff viewing the configuration checklists as a useful tool instead of an undue administrative burden.

6.4.3 Process

6.4.3.1 Contract Requirements

BEA is contractually required to adhere to all applicable DOE Orders and Standards. This includes Conduct of Operations requirements and, therefore, Operational Configuration Management and Status Control.

6.4.3.2 Compliance performance

While DOE O 422.1 states that the Control of Equipment and Status Control program must adhere to items (a) through (j), 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, MCP-9600, MCP-3955 (TREAT), SP-96.8.1, and FRM-1387. Additionally, when an incident regarding status control or configuration management has occurred, it has been considered by management and DOE oversight that the issue is a procedural non-compliance failure, rather than a Control of Equipment and Status Control program failure.

6.4.3.3 Efficiency

Increased use of configuration management and status control would result in an increase in facility efficiency. The gain in efficiency would be realized not necessarily from performing status control checklists, but from preventing lost time that could result from system misalignments, fact findings, damaged equipment, etc.

6.4.3.4 Innovation

An opportunity is available to use technology innovation to assist operations supervisors in maintaining status control and configuration management, discussed below in Subsection 6.4.4, Equipment/Tools.

6.4.3.5 Human Performance Improvement

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, "Materials and Fuels Complex Human Performance and Nuclear Safety Culture Pocket Guide."

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

6.4.4.1 Tools Needed

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. For all facilities, a reminder on what tools

are available and how to employ the tools, is needed. 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.

All facilities should investigate improvements to their current system. For example, a facility that only uses logbook turnover for the status of systems, equipment, and components may explore using a manual status board. Facilities that use a manual status board may try to incorporate an electronic monitoring system after the next equipment upgrade. Facilities that have an electronic monitoring system may review the current system to ensure that the information displayed is vital or to determine if other vital information is missing from the current system.

6.4.4.2 Computer Systems & Information Management Upgrades

For facilities that do not have an electronic monitoring system, equipment upgrades should be chosen that have remote monitoring capabilities. A corresponding computer system for displaying this information would then be installed after an adequate number of system components have this capability. Facilities that already have an electronic monitoring system may need to update/upgrade the existing systems to prevent obsolescence issues or displaying incomplete/inaccurate information.

6.4.4.3 Automation Potential

Electronic monitoring systems remove the human error of remembering to update manual status boards and logbook entries. The use of these types of systems should be used to the maximum extent possible where complexity and importance warrant their use.

6.4.5 Actions FY-21

- NFM's and operations supervisors shall assess and critically evaluate the facilities current method of status control/operational configuration management and look for improvement (Shawn Hill, September 30, 2021)
    - Facilities that do not use a status board may evaluate if the use of one would help, facilities that use a manual status board may explore an electronic one, and facilities that have an electronic monitoring system may determine if the information provided by it is useful and if other important information is missing.

6.4.6 Looking Forward (FY-22 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

MFC had a rash of Lockout/Tagout (LO/TO) issues in 2012. Several performance issues were identified which led to the implementation of several improvements, including learning seminars, procedure improvements, planning (roundtable) requirements, clarification of exclusion control both for cord-and-plug and for gas cylinders. Unfortunately, the learning seminars lost priority and were quickly discontinued. There were also several actions that were suggested but never implemented. The actions are now included in this improvement agenda. Recently, MFC has developed and implemented a complex specific LO/TO procedure and has taken great strides to improve the vast Multiwire Branch Circuit (Edison Circuit) issues that existed. Personnel have performed a significant number of LO/TOs in the last 5 years, with an incredibly high percentage of the LO/TOs resulting in successful task completion, with no issues. Unfortunately, the LO/TOs completed in the last 5 years have not been 100% successful in mitigating hazards to personnel, thus leaving room for needed improvements in the LO/TO procedure. A review of LO/TO events that have occurred within the last 5 years revealed that the overwhelming majority are electrical hazard related. Therefore, a special emphasis on electrical issues is needed to confront this challenge.

Regarding specific lessons learned over the last 5 years at MFC, 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. As noted above, MFC uses a facility specific LO/TO procedure. When the procedure is executed properly, employees can adequately perform lockouts/tagouts 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 lockouts/tagouts could provide opportunities to improve personnel performance at MFC for LO/TO work.

In addition to proper procedure use and adherence, other lockout/tagout 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 lockouts/tagouts at MFC. Table 4 lists additional ways MFC can improve the LO/TO process.

Table 4. Recent MFC LO/TO improvements.

LO/TO Improvements		
Drawing development Improvement • Adequate/accurate drawings for LO/TO	**LO/TO Tools Improvements** • Modify facilities to minimize complicated LO/TO requirements.	**Training/Qualification Improvements** • Update LO/TO qualification tools used for practical

preparers. • Electronic Database Maneuverability and ease of access to online drawings.	Utilize highest quality isolation devices. • Simplify the LO/TO process for qualified personnel.	testing. • Increase testing rigor to include covering CFR requirements. • Update scenarios that require personnel to think through each phase of the LO/TO. • Review/add the EFCOG best practices into the SP-94.0.0 to ensure personnel have the most current information to base decision making on. • Involve personnel that have had past LO/TO issues be involved in the seminar demonstrations to share their insight and though process.
Technology Improvements • Development of ASs, or other software program, for LO/TO preparation.	**Procedure/Process Improvements** • SP-94.0.0 MFC LO/TO Process. • LO/TO checklist development that mirrors the LO/TO process as an HPI tool. • Checklist covers: Preparation, Installation, Zero Energy, and acceptance. • Need to re-evaluate for Temporary/Partial removals or areas for improvement to minimize the probability for missed steps. • Procedurally require a proximity check after the zero has been completed, but prior to work groups signing onto the LO/TO. Adds a second layer of defense to hazardous energy identification before accepting the LO/TO.	**Personnel Improvements** • Utilize outside resources and lessons learned to develop qualified personnel's respect for the LO/TO program. • Utilize personnel accountability for non-compliance to LO/TO program expectations more effectively, while still adhering to the just culture principles. • Develop a LO/TO advisory group that consists of a variety of individuals and backgrounds to review issues, trends, and improvement items to strengthen the LO/TO process.

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, 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 creation of a MFC LO/TO advisory group, populated with personnel from all levels not just management, will work to correct LO/TO issues. The advisory group will remain cognizant of LO/TO issues and will be given the authority and responsibility to correct these issues. The group will look at trends, perform periodic observations, and crosscut throughout different facilities to collect positives and negatives. The group will be charged with developing activities to keep correct LO/TO actions 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 (like now), the advisory group will work to decrease LO/TO incidents. Additionally, the LO/TO advisory group will be 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.

NOTE: *All scenarios conducted are not intended to be graded and testable. These need to be practical, helpful, and interactive. The intent is to improve skills, proficiency, awareness, and incorporation of HPI tools into LO/TO.*

Develop more rigorous LO/TO seminars/Dynamic Learning Activities for all AE/FAS:

- Create complicated/tricky scenarios which would require personnel to really look at the drawings to determine all sources of energy.
- Demonstrate practical scenarios for the use of Temporary and Partial removals, to improve proficiency.
- Improve hazard identification skills.
- Valve position indication techniques.
- Review and discussion of EFCOG Best Practice bulletins.
- Share consequences of failures of actual events in industry (there are plenty) and personal experiences.
- Engage personnel involved in previous LO/TO errors to be involved in seminar demonstration and to help share insight.

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 maintain 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.

A LO/TO checklist should be created to focus on items to help with preparation, zero energy, and installation. The areas of focus for a checklist cover the majority of MFC's LO/TO problem areas. A checklist should be simple and be kept to a single page.

6.5.4 Equipment/Tools

Tools and equipment for lockout/tagout 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 lockout/tagout plans developed using Asset Suite 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-21

- Streamline LO/TO preparation documentation by using Human Factored Documentation (Shawn Hill, June 30, 2021)
  - Redevelop SP-94.0.0, "MFC Lockout and Tagouts Supplement to LWP-9400," to include a checklist for LO/TO steps, thus minimizing the administrative procedure to either be in hand all the time, or to create a pocket guide which would be small enough for the user to carry on person, similar to HBK-104. The checklist would be part of the documentation added to the work package, along with the LO/TO record sheet, to establish a record of the work completed.
  - Simplify the process of finding adequate drawings for LO/TO preparation and round-table reviews.
- Improve MFC personnel proficiency, awareness, attitude, and training regarding the LO/TO program (Shawn Hill, June 30, 2021)
  - 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).
- Improve MFC LO/TO program capabilities
  - Focused Engineering support for drawing identification, LO/TO preparation, and round-table reviews (Shawn Hill, September 30, 2021 [ongoing]).
  - Creating a LO/TO Advisory Group and have an approved Charter (Shawn Hill, June 30, 2021).

6.5.6 Looking Forward (FY-22 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

MFC is undergoing a process improvement phase. Part of that improvement is in the development and implementation of surveillances and overall application of SAR controls prescribed in TSR documents.

This chapter describes the past and present state of SAR/TSR implementation at MFC and provides suggestions for continued improvement.

A review of how MFC is implementing Safety Basis documents, Safety Analysis Reports (SAR) and Technical Safety Requirements (TSR), 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, three weak areas were identified. Those areas, and a summary of suggested corrective actions are as follows:

- Training – Training needs to improve and increase in facility specific safety basis documents and the INL SAR/TSR-400 document, including evaluation, and diagnostic skills.
- Current TSR Controls – Facilities should identify and compare their hazard analysis to the Evaluation Guidelines to see where restrictions can be reduced.
- TSR/SAR Implementation Tracking – Facilities should assess and improve SAR/TSR implementation, as necessary.

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 5 below.

Table 5. 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 6.

Table 6. 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

All facilities identified had safety basis documents prepared as required by DOE per 10 CFR 830, "Nuclear Safety Management - Quality Assurance Requirements," however, the facilities did not necessarily follow the format and guidelines of DOE standards. 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. 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 LCO and Surveillance applications, and other common areas such as siting, INL wide programs, and emergency response.

All facilities currently have SARs and TSRs based on a standardized format.

A review of recent Initial Notification Reports identified the following problems with respect to SAR/TSR implementation:

- On 6/01/2020, two Technical Safety Requirement Surveillance Requirements (SRs) were missed in the IMCL.
- On 7/30/2020, during review of an Experimental Safety Analysis (ESA) for an upcoming experiment, it was discovered that the ESA for the ongoing ATF-RIA-1 test series did not address the experiment reactivity effect of a burst disc rupture or blowdown mechanism for an experiment capsule filled with water.
- On 9/28/2020, TREAT management was informed that the Swagelok ball valve on the BUSTER irradiation assemblies were received as commercial grade even though nuclear grade was specified in the purchase order (PO 200535). The component was required to be nuclear grade because it must maintain integrity during all upset conditions to prevent a fission product release.
- On 5/16/2019, a review was performed of an HFEF Decon Cell (Air Cell) utility feedthrough cover plate in preparation for modification to support in-cell activities. This review led to the discovery of three feedthrough cover plates being declared inoperable.
- On 10/07/19 in the ZPPR Facility, operations were accessing material storage locations. At 1325, upon opening a storage location access door, a bin storage tube location door was found in the open position, with fissionable material located inside of the storage tube. Previously, three storage locations had been opened which meant a total of four storage locations were open at one time. The ZPPR Facility criticality control list, LST-392, "Zero Power Physics Reactor Criticality Control List," had the following requirements:
  - Bin storage tubes containing fissionable material must have a hinge door bolt-lock in the locked position with a hitch pin inserted.
  - The number of approved storage locations allowed to be open during fissionable material handling activities is limited to less than or equal to three.

This constituted a violation of SAC 5.412.3 in TSR-412, "Technical Safety Requirements for the Zero Power Physics Reactor Complex."

Along with these examples, in 2018 ONA performed a Technical Safety Requirements Implementation Review at MFC, TREAT, and 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.

A summary of the overall results included that:

- Most personnel were unfamiliar with general LCOs or SRs within the documents (TSR-400/TSR-facility specific).
- Several personnel did not know that surveillances were not required to be performed on inoperable equipment.

- Action time limits and specific caveats were missed (e.g., mode changes when not meeting a SR, time specified to initiate action to change modes when actions are not provided or not met).
- Personnel did not enter each associated action per LCO 3.0.2 (3.400.2).
- Personnel knew the defined term IMMEDIATELY but had varying answers when challenged with a scenario.

MFC specific comments indicated a need for improved training on INL SAR/TSR-400 and SAR/TSR in general. Those comments included:

- Some personnel were unfamiliar with what constituted a TSR violation.
- Some individuals did not recognize that failure to meet an SR resulted in failure to meet the LCO.
- Several personnel were unfamiliar with the requirements of LCO 3.400.3.
- The concept of mission time with regards to SSC operability was not understood by some individuals.
- When using TSR-400 to determine the requirements for a particular answer, several personnel applied the wrong motherhood LCO.
- General level of knowledge of the TSR requirements varied based on past work experience (e.g., commercial nuclear industry, other DOE complex facilities).
- Some were not familiar with an Evaluation of the Safety of the Situation or how it related to the safety basis.

ONA also conducted a review of four TSR violations at MFC, including two which happened in 2020:

- FCF Criticality Control (2020-0216)
- Missing SR during Material Transfer (IMCL MFC-1729 2020-0880)

Their review focused on four questions/areas:

1. Was the TSR necessary?
2. Is the TSR clear in its intent, is there any ambiguity, and can it be followed easily?
3. Verify/review implementation of the TSR. Is it implemented appropriately? Is it clean and workable?
4. Were the corrective actions to the TSR violation adequate?

One of the weaknesses noted in this review was that often TSR controls were based on very conservative interpretations of the hazard's analysis, leading to restrictions that impact the ability to conduct and accomplish work in safe but more efficient ways.

This is in line with recent MFC Management observations concerning the margin of safety used in the derivation of controls compared to the Evaluation Guidelines, as outlined in DOE-STD-3009 (1994 and 2014) and reiterated by NE-ID in a recent letter from the Idaho Operations Office (CCN 247290). In some instances, identified by MFC management, the controls put in place severely restrict operations compared to that allowed by the Evaluation Guidelines. This impacts work in a negative manner and can increase workload and stress to workers while complicating or even preventing accomplishing daily work processes.

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 5 above. The MFC Activities categorized hazard category 3 or above can be found in Table 6 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 documented safety analysis 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-21

- Improve adherence to the safety basis envelope for all of MFC facilities. MFC leadership, working with other INL organizations as appropriate, is implementing significant actions to improve our adherence to the safety basis envelope for all of MFC facilities. These actions are multi-faceted to (Shawn Hill, September 30, 2021):
  - Ensure TSRs and associated controls are clear and unambiguous to support successful execution
  - Ensure controls are developed with appropriate margins and reduce unintended cliff-edge effects
  - Ensure all aspects of TSRs are appropriately implemented.
- ONA will conduct a focused review of all Surveillance Requirements (SRs) at each MFC facility. ONA will be performing an in-depth evaluation of implementation methods for each SR to ensure adequacy and identify potential gaps. (Shawn Hill, September 30, 2021).

6.6.4 Looking Forward (FY-22 and Beyond)

This review, along with documented issues as seen in Labway reports, suggest there is a need to improve in three areas.

- Training – Training needs to improve and increase in facility specific safety basis documents and the INL SAR/TSR-400 document. This training should include evaluation and diagnostic skills for senior operators and management, those who implement and interpret SAR/TSR controls.
- Current TSR Controls – Each facility should review controls with the analysis and compare them to the Evaluation Guidelines to see where restrictions can be reduced while still maintaining a conservative margin of safety yet allow work processes to improve and move work forward. A two-way dialogue with MFC and DOE should be established to gauge the department's willingness to adhere to the NE-ID letter (CCN 247290).
- TSR/SAR Implementation Tracking – Several instances of tracking how SAR and TSR controls, whether materials, construction, inventory, or operator actions, were not adequate and led to problems. Each facility should be closely monitoring and tracking SSC pedigree, work performance, and how work control implementation meets the required controls. Periodic and independent assessments performed by the MFC Operations group should be scheduled to ensure that adequate

controls remain in place.

RADIOLOGICAL PROTECTION

6.7 A Look Back

Radiological Controls (RadCon) performance at MFC is strong. Radiological Work (RadWork) has increased nearly 50% and Radiological Issues (RadIssues) have been reduced by 4 times over the course of the last 5 years. Technology upgrades have allowed 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-15 many improvements have been made to the MFC RadCon organization. The more significant improvements include the following improvements in Table 7.

Table 7. MFC RadCon significant improvements from FY-15 to FY-20.

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.	**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	**Training/Qualification Improvements** • Key Radiological Aspect courses rolled into GDE-880, "Key Radiological Aspects for MFC Facilities" • Eliminated classroom trainings • Streamlined the qualification process • Created field office qualifications.	**Radiological Control Improvements** • Increased contamination control device capabilities • Reduced RadCon coverage requirements • Reduced routine survey requirements • Streamlined radiation work permits • Soil Handling defined and refined • Evaluation/implementation of new gloves and gauntlets for Manipulator Repair Group gloveboxes.

Device/Source Database.		
Facility Characterization Improvements • Characterized and defined source term for nearly all facilities • Underground Radioactive Material Area Map updated • Underground Radioactive Material Area Controls defined • Glovebox classifications.	**Procedure/Process Improvements** • MCP-139, "Radiological Surveys" • MCP-187, "Radiological Control Posting and Labeling" • MCP-9, "Radiological Control Log Keeping" • LI-15002, "Radiological Control Activities and Norm Determination at MFC" • EPI-56 • LWP-15017, "Radiological Release Surveys" • ALARA Goal Changes.	**Personnel Improvements** • Key personnel development • Key strategic hires • Hiring strategy refined • Succession planning • Multiple certifications obtained • Multiple degrees obtained.

6.8 People

RadCon staff are engaged, knowledgeable, and service oriented, as evidenced by the significant increase in RadWork over the last 5 years, despite little increase in staff. RadWork at MFC has increased by more than 50% and RadCon staff has increased by 4%. Although head count has not increased much, turnover has been, and will continue to be, an issue. 75% of Health Physics Technicians (HPTs) have worked at MFC 5 years or less. 70% of Radiological Engineers have worked at MFC 5 years or less. The RadCon management team is also young, having significantly changed in FY-20. 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.

Through the last 5 years, RadCon and RadWorker training has been acceptable to maintain qualifications but needs significant improvement 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 Radiochemistry Laboratory contamination event in August of FY-19, when 2 personnel contamination events at IMCL within weeks of each other, 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.

6.9 Process

RadCon processes and procedures are acceptable, but additional improvements are needed to make them strong. RadCon program managers diligently work to streamline procedures and processes. In FY-20 that included changes to dozens of procedures and processes. Significant improvements have been made to the Radiation Work Permit (RWP) approval process, access control stations and SENTINEL, the air sampling process, and the RadCon count room. While efficiency improvements, as noted in Table 7, have been significant and varied, there is more work to be done.

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 striving for continuous improvement in the program is needed. Of great importance to MFC is the addition and implementation of volume contaminated and activated material release limits to the RadCon Program which has yet to occur. To assist with the process and procedures improvements, a prioritized list of procedure changes has been developed for INL and will be worked continuously. Assisting the RadCon home organization in the development and implementation of volume contaminated and activated material limits, procedures, and processes has also been added to the MFC RadCon Improvement Agenda for FY-21.

6.10 Equipment/Tools

Tools and equipment for RadCon are strong. With few exceptions across MFC, obsolete equipment has been replaced and technology improvements are ongoing. All MFC facilities have the radiological equipment and tools that are needed to fulfill mission goals safely and successfully. However, some facilities are lacking upgraded instrumentation or are lacking enough instruments to be truly efficient. Where facilities are lacking in radiological equipment and tools, the MFC RadCon Organization is working with Facility Management to increase, and standardize, radiation detection equipment. To increase HPI efficiency, RadCon equipment is being networked together 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.

Further equipment and tools that will increase efficiency and human performance include software upgrades in the RadCon count room, 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 (which should include the addition of an MFC RadCon Network Specialist).

6.11 Actions FY-21

- Streamline Radiological Controls Documentation (Alan Carvo, September 30, 2021)
  - Combine MCP-139 and MCP-9 to eliminate confusion, redundancy, and multiplicity of requirements.
  - Assist the RadCon home organization in the development of a new documentation software system including procedure changes, training, and development of a user's guide.
- Progress the Development and Implementation of Activated/Volume Contaminated Material Release Process as Release Limits are Approved through/by DOE (Alan Carvo, March 30, 2021)
  - Assist the RadCon home organization in development of technical basis documents and RadCon procedures.
- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training Regarding

Radiological Controls (Alan Carvo, September 30, 2021)

- Develop, and begin implementation of, a plan for training improvement that includes MFC specific topics for RadCon personnel as well as RadWorkers and their line management.
- Evaluate and provide suggestions to the INL training department for improvement of RadWorker training as well as RadCon continuing training.

- Improve MFC Radiation Detection Capabilities (Alan Carvo, September 30, 2021)
  - Develop a cost estimate to procure handheld alpha spectroscopy units and provide the cost estimate to MFC divisions to plan for procurement. Handheld alpha spectroscopy may help in isotopic identification in-field.
  - Provide a cost estimate for full implementation of HORIZON to MFC divisions to determine funding path forward. HORIZON will allow instruments to be viewed from any networked computer allowing quicker response times to abnormal events and potentially reducing routine survey requirements across MFC.
  - Evaluate, select, and provide a cost estimate for a new gamma spectroscopy system for activated/volume contaminated material release measurements. Activated/Volume contaminated material release will require gamma spectroscopy measurement prior to release.
  - Post, and fill, a position for a Radiological Controls Network Specialist to support the instrument network, RadCon application and database maintenance, and technology/innovation improvements.
  - Develop a cost estimate for procurement of remaining equipment needed to replace obsolete equipment across MFC. Deliver that cost estimate to MFC divisions for funding determination.
  - Install PCM-12s in Key Locations across MFC. The PCMs have been purchased, are being entered in the PM/EJ system, and will be tracked to completion.

6.12 Looking Forward (FY-22 and Beyond)

- Streamline Radiological Controls Documentation
  - Continue support of the RadCon home organization in development of a new documentation software system including procedure changes, training, and development of a user's guide.
  - Train RadCon personnel and implement new documentation system.
- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training Regarding Radiological Controls
  - Implement and continue with the plans developed in FY-21.
  - Annually evaluate the impact the plans are having and adjust the plans as necessary for continued improvement.
- Improve Radiological Controls Processes and Procedures
  - Develop and implement electronic forms to replace dosimetry forms, RWP request form, RWP peer review form, and instrument check sheets.
  - Develop and implement a barcode system for instrument checks that ties into the Radiological Controls Documentation System.

7. ENVIRONMENTAL

7.1 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 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, 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., light detection and ranging (LIDAR) imaging for cultural resources documentation, electronic inspection forms, tracking environmental requirements database, and radio-frequency identification (RFID) to fulfill inventory tracking). Stack monitor upgrades and improved methods for calculating air effluent source terms have improved MFC's compliance posture related to Clean Air Act (CAA) requirements. 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. Continuing areas of weakness exist within the National Environmental Policy Act (NEPA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). 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-16 many improvements have been made in the MFC Environmental organization. The most significant improvements are shown in Table 8.

Table 8. Recent MFC Environmental Improvements.

<table>
<tr><th colspan="3">MFC Environmental Organization Improvements</th></tr>
<tr>
<td>Wastewater and Potable Water
Closed old sanitary sewer lagoons under State and CERCLA regulations.
Renewed reuse permit for longer duration (10 years vs. initial 5 years) and reduced the number of monitored contaminants and implemented new requirements.
Completed the connection of the two industrial wastewater system pipelines with one monitoring location as part of the West Campus Utility Corridor (WCUC) project and implemented new operation and maintenance (O&M)</td>
<td>Waste Management
Total amount of waste shipped off site in cubic feet and total number of shipments sent off site per year:
FY-16 19,911 ft^3 42
FY-17 18,647 ft^3 55
FY-18 34,100 ft^3 50
FY-19 17,867 ft^3 58
FY-20 34,428 ft^3 66
Performed baseline monitoring of stored waste in Sodium Storage Building.</td>
<td>Resource Conservation and Recovery Act (RCRA)
Implemented the Hazardous Waste Generator Improvements rule.
Completed and implemented multiple permit modifications for the continual improvement of RCRA permitted TSDFs.
Developed and implemented Accountable Nuclear Materials program for the management and tracking of accountable nuclear material that will become mixed waste.</td>
</tr>
</table>

• Closed Industrial Waste Ditch reuse unit. • Implemented remote monitoring/recording of industrial wastewater flow. • Completed new pumphouse and second water main to TREAT Facility and implemented new O&M procedures. procedures		
Technology • Initiated upgrade to RFID for the management of mixed waste inventory. • Used LIDAR for the documentation of cultural resources. • Developed electronic RCRA inspection forms. • Developed requirements tracking database. • Used new electronic spill notification tool. • Identified remote monitoring needs for stored waste.	**Training/Qualification** • Developed Environmental Qualification process; staff completed general and media-specific quals. • Attended vendor provided sodium/sodium potassium alloy handling training. • Created and presented training to familiarize technicians, planners, and maintenance managers with extensive revisions to ozone depleting substances (ODS) regulations; fulfill RCRA training requirements; and provide general training to engineering and utilities and infrastructure support personnel regarding a variety of regulatory requirements. • Supported qualifications for PIs and PRs.	**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 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. • Used regulatory analysis and computational fluid dynamics study to bring the HFEF stack into compliance with NESHAPs. • Prioritized and completed stack upgrades. • Developed dose calculator tool for new projects. • Developed/revised INL Permit to Construct (PTC) facility IPs. • Completed INL PTC MFC record management surveillance and corrective actions.

NEPA	CERCLA	Personnel Improvements/ Key Personnel Development
• New NEPA/Environmental Review Process is the method used to evaluate a new project, proposal, procurement, decision, or activity for potential environmental impacts.	• Worked with home organization, F&SS, and MFC operations to identify CERCLA improvement agenda. • Closed old sanitary sewer lagoons as a CERCLA site. • Home organization added a CERCLA lead position.	• Cross-trained backups for various environmental media. • Succession planning. • Presented at conferences. • Hired and mentored summer interns annually (starting in FY-15).

7.2 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 coming 3-8 years. A 10-year resource management plan has been developed to counter that challenge. Environmental staff established and is 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 in various environmental disciplines. In addition, the MFC Program Environmental Lead position was changed to an Environmental Manager to recognize the level of staff, risk, and liability management overseen by this position. 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 participates 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: Chain of Custody, General Waste Generator, Radioactive Waste Inventory Sheet for Low Level Waste, TSD RCRA Inspector, Waste Generator Services Temporary Accumulation Areas, RCRA Contingency Plan for MFC Emergency Action Managers (EAMs), and New ODS Regulations.

7.3 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 some work planning walkdowns.

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 TSD 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 Fuel Conditioning Facility (FCF), Fuel Manufacturing Facility (FMF), HFEF, and Analytical Lab. The industrial wastewater plan of operation was revised as required by the new reuse permit. MFC Environmental staff ensured facility

procedures, forms, and manuals were revised to implement operation and maintenance of the new industrial wastewater and sanitary sewer lift stations, and changes resulting from the new industrial wastewater pipeline connection (all installed per the WCUC project). MFC Environmental staff developed or revised INL PTC IPs 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.

As a result of large-scale construction projects at MFC over the past couple years, a weakness related to knowledge and documentation of CERCLA requirements has been identified. Efforts to strengthen the CERCLA program in collaboration with project, Facilities and Site Services, MFC operations, and environmental home organization personnel are ongoing and must continue over the new few years to rebuild internal expertise in this area.

7.4 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.

A new water tank, pumphouse, and mainline to TREAT were installed in the potable water system, which enhanced the resiliency of the system. The industrial wastewater system was upgraded to combine discharge lines to eliminate a regulated unit, and flow meter equipment was upgraded to record and remotely monitor flow data. Additional upgrades to the industrial wastewater system are needed to optimize performance.

7.5 Actions FY-21

- Pursue DOE concurrence to use double check instead of reduced pressure type backflow assemblies in radiological area fire sprinkler lines (Alan Carvo, Action Complete)
- Develop a strategy for old paint potentially containing polychlorinated biphenyls (Alan Carvo, September 30, 2021)
- Complete implementation of NEPA transformation processes at MFC by ensuring all environmental staff have a thorough understanding of the revised process, educating researchers on the new process, and continuing to identify additional opportunities to improve the process (Alan Carvo, September 30, 2021)
- Implement the CERCLA Improvement Strategy and revise appropriate facility procedures and processes to ensure CERCLA is adequately evaluated when planning work, and appropriate responses to common scenarios are understood and documented (Alan Carvo, September 30, 2021)
- Support Environmental Support and Services in developing a high-level waste (HLW) program (Alan Carvo, September 30, 2021).
- Complete RCRA permit modifications: Class 1 Permit Modification Notification to update training plan and EAMs; Class 2 Permit Modification Request (PMR) to remove the solidification unit, repackaging tent and revise the secondary containment within Sodium Components Maintenance Shop (SCMS) (RCRA closure will be required for the removal of the solidification unit prior to submittal of the Class 2 PMR) (Alan Carvo, September 30, 2021)
- Dispose of legacy waste/materials at MFC (Alan Carvo, September 30, 2021)
- Develop RFID capability for tracking mixed and hazardous waste containers (Alan Carvo,

September 30, 2021)

- Install new flow meter and composite sampler for industrial wastewater system (Alan Carvo, September 30, 2021)
- Complete MFC Health and Safety Plan for working in CERCLA Institutional Control areas (Alan Carvo, January 30, 2021)
- Implement monitoring instrumentation for stored waste as funding allows (Alan Carvo, September 30, 2021).

7.6 Looking Forward (FY-22 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 Air Permitting Applicability Determinations (APADs) 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
- Technology:
    - Develop RFID for chemical management
    - Develop and implement additional electronic forms (e.g., Temporary Accumulation Areas, Satellite Accumulation Areas)
- Support the ES&S home organization to develop and implement an HLW program.

8. SAFETY & HEALTH

8.1 A Look Back

The MFC Occupational Safety and Health Group has experienced dynamic change in the last 5-years Organizational challenges and a steady influx of new personnel have enriched the safety and health program, demonstrating resilience in fulfilling the group's mission. Any measure of safety and health program performance must start with effectiveness in preventing injuries. Since FY-16, the MFC Total Recordable Injury Rate has improved, with an approximate 25% reduction. This has been achieved through leadership's commitment to safety, adherence to fundamental hazard control programs, and pursuit of an effective safety culture. Despite as impressive as this improvement has been, MFC still lags other similar laboratory environments in injury prevention. Continued improvement is necessary.

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
  - Fire Barrier Improvement Project – Including Fire Barrier and FireStop Training
  - Machine Guarding Improvements
  - Fall Protection Assessment and Inventory
  - Confined Space Evaluations and Inventory
  - AED Deployment Improvement
  - Crane Descender Training
  - Flooding Electrical Safety Contingency Development
  - Asbestos Abatement and Inventory Program
  - Specialized Ventilation System Assessments
  - Severe Weather Response Improvement
  - Foot Protection Assessment
  - Walking/Working Surface Assessment.
- Resource Management Improvements
  - Key Personnel Hires
  - Functional Realignments Leveraging Personnel Skills
  - Team Engagement in Recruitment and Selection
  - University Outreach to Support Diversity and Inclusion.
- Procedure/Process Improvements
  - PRD-14101, "Fall Protection for General Industry Activities"/PRD-14102, "Fall Protection for Construction Activities"
  - PRD-14410, "INL Fire Barrier Program"
  - LRD-14003, "Accident Prevention Signs, Tags, Barricades, and Color Codes"
  - LRD-14004, "Requirements for the Voluntary Protection Program STAR Process at the INL"
  - LRD-14118, "Personal Protective Equipment"
  - LRD-14303, "Handling and Use of Compressed Gases."

8.2 People

The professionals who make up the MFC Safety and Health organization are consistently identified as a strength within the MFC community. Feedback from the MFC workforce routinely praise the thorough and thoughtful nature of services provided to protect personnel from hazards. The diversity of skills is exceptional. All personnel are degreed in either occupational safety and health, health science, fire protection, engineering, or industrial hygiene. And 45% of MFC Safety and Health employees have earned graduate degrees in one or more of those fields. In addition, the majority of personnel in the organization have achieved one or more professional certifications in chosen disciplines.

The Safety and Health group has evolved quickly to meet MFC's mission. Most of the staff (72%) have been hired since 2016, including the Safety and Health Manager. Including veteran MFC employees, the experience range across industry is impressive. Many employees come from other nuclear industry sectors, while others have had successful prior careers in chemical and materials processing, aerospace, and construction, each offering valuable insights into MFC's unique research pursuits. Reflecting the organization's experience and credibility, many MFC Safety and Health personnel have been delegated authority for many INL programs, as Technical Points of Contact for programs such as Respiratory Protection, Laser Safety, and Hazardous Waste Operations.

While recruitment and succession have been successful, the fast pace of MFC's growth, and expansion of its mission, promise even greater resource challenges. Past recruitment and succession opportunities have been reactive. 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. Also, personnel will be challenged 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.

8.3 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 oxygen deficient environments, complex fire protection systems, 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 efforts, such as fire barrier improvements, oxygen deficient environment assessment and remediation, and walking/working surface improvements 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 ESHQ 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 ESHQ 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 team dynamics and resource planning. 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 ESHQ Home Organization that may be beneficial to MFC operations.

8.4 Equipment/Tools

Tools and equipment for Safety and Health programs are strong. With few exceptions, industrial hygiene 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.

Work venues will continue to diversify. Telecommuting technology will be called upon to ensure greater engagement through a variety of circumstances. Similarly, the Safety and Health group must be open to opportunities to apply intelligent process technologies (such as automated hazard measurement monitoring, hazard identification, mapping, and controls verification) data management, and effective communication to improve work efficiency.

8.5 Actions FY-21

- Hazard Mitigation for Hands-on Work – Among the most vulnerable MFC employees to occupational hazard have been those engaged in hands-on activities. Activities such as manual material handling, craft-related manufacturing, mechanical and electrical maintenance, and common laborer tasks have prompted significant hazard potential, resulting in injury. The general goal is to achieve reduction in injuries associated with hands-on work by the end of FY-21. This action is focused on improving injury prevention efforts, including awareness and intervention strategies to address (Alan Carvo, September 30, 2021):
  - Ergonomics, particularly related to remote manipulator use but also including other industrial ergonomic hazards in the fabrication and machine shops.
  - Provide hand and power tool selection and hazard mitigation techniques to users of this equipment at MFC.
  - Identification of appropriate cut and puncture resistant gloves for areas that have experienced hand lacerations over the past 5 years. In addition, MFC work areas will be assessed to remove inappropriate tools that pose significant cut hazards.
  - Provide education to targeted audiences on methods to improve situational awareness in the performance of common work tasks.
- Optimize OS&H Team Dynamics – Develop, cultivate, and implement common team dynamics, including behavioral norms, collaborative skills, priority setting, and clarified roles and responsibilities. This action may be facilitated by INL Learning and Organizational Development (Alan Carvo, September 30, 2021).
- Continue Long-Term Hazard Control Program Improvements – Sponsor and assure progress of long-term improvement efforts associated with the following programs (Alan Carvo, September 30, 2021):
  - MFC Fire Barrier Project - ensure all fire barrier deficiencies are identified, mitigations have been implemented, and FY-21 budgeted repairs have been completed.

- Oxygen Deficient Hazards Assessment - complete all necessary assessments (including an assessment on cryogen use at MFC), roll out revised off-nominal oxygen alarm response protocols, and initiate INL-wide Oxygen Deficient Hazard Program considerations.
- CERCLA Health and Safety Plan (HASP) Development - issue a generic HASP for typical, largely Utilities and Infrastructure Support, activities at MFC that occur within identified CERCLA areas.
- Walking/Working Surface - ensure all Walking/Working Surface deficiencies are identified, mitigations have been implemented, and necessary repair planning has been initiated.
- Fire Extinguisher and Suppression Head Inventories - develop and implement a process and necessary tools to inventory this fire protection equipment.

- Improve H150 Intraorganizational Communication – Assure effective and productive communication and collaboration with MFC and ESHQ organization representatives by planning and conducting frequent interaction with key stakeholders. Also explore professional collaboration venues for industry and government safety, health, and fire protection professionals, such as OSHA's Alliance Program, the NASA Safety and Health Learning Alliance, programmatic relationships with the American Industrial Hygiene Association, Society of Fire Protection Engineers, and the American Society of Safety Professionals (Alan Carvo, September 30, 2021).

8.6 Looking Forward (FY-22 and Beyond)

- Complete Long-Term Hazard Control Program Improvements – It is anticipated that some of the Long-Term Hazard Control Program Improvements (noted above) associated with MFC infrastructure will require sustained effort beyond FY-21 to resolve.

- Improve Resource Planning – Explore and formulate processes to forecast resource needs, establish succession development programs, and determine the needs of operational counterparts. This will include 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, and greater alignment of ESHQ Home Organization efforts and initiatives with deployed MFC Safety and Health objectives.

9. CONTRACTOR ASSURANCE

9.1 A Look Back

Prior to 2016, the performance analyst function was carried out by staff specialists embedded in each division as an ancillary duty. The performance analyst (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 one year until a department manager was put in place with contractor assurance 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 contractor assurance along with increased experience contributed to further improvements in PA performance. PAs were ultimately assigned two divisions each and provided those divisions with contractor assurance 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 contractor assurance. In addition, the manager rotated PAs through different assignments, which led to further knowledge, proficiency and efficiency gains, and better overall implementation of contractor assurance (CAS) processes.

The current department manager recently rotated to an operations line position for further development. A new department manager was identified and will rotate into the vacated position in January 2021. The new manager brings to MFC a background in operations, management, administration, and process improvement that will aid in further contractor assurance enhancements. The new manager is highly capable and motivated to develop and implement an improved model of contractor assurance. The new 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 new manager will work closely with the MFC COO, and the Business and Operations division directors to improve MFC performance analysis.

A new COO joined MFC in September 2019. The new Chief Operating Officer (COO) has an extensive background in Conduct of Operations and Performance Evaluation and Assessment developed over a 25-year career that spans Naval and commercial nuclear power, and 15 years in various leadership roles at both the Institute of Nuclear Power Operations and the World Association of Nuclear Operators. The COO has made significant improvements in the following areas: CARB engagement and intrusiveness which has contributed to more timely closure of corrective actions and a reduction in the number of open conditions and NTS actions; more immediate sharing of lessons learned from consequential events and development of actions and response to repeat or recurring events; and better focus on the identification and correction of undesired worker behaviors through more effective implementation of the management observation program (MOP). The COO is also focused on improving causal analysis quality, and timely and effective corrective action implementation. The COO continues to monitor the improvements, tracks progress, and when trends are evident, identifies additional areas of focus for MFC.

9.2 People

Contractor Assurance staff are engaged and service oriented. Staff has decreased from seven to six personnel. Turnover in the group has been an issue. Contractor Assurance currently has two relatively new personnel. Previous administrative tasks have been scaled back or eliminated to allow for the decrease in full-time equivalent positions to handle administrative aspects of Contractor Assurance. There is a need for more analytical expertise to address growing needs with implementing proactive measures such as trend analysis and effectiveness reviews. Additional technical knowledge and expertise is needed for reactive situations (event response) with cause analysis, fact findings, critiques, and HPI investigations.

9.3 Process

MFC management uses assessments to review, evaluate, inspect, test, check, survey, or audit, in order 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 or performance-related issues to develop appropriate corrective actions. Understanding which assessments are required and development of risk-based assessments is an area that needs focus and improvement.

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 when necessary. This is an analysis of facts and conditions surrounding an issue or event to identify causes. A causal analysis provides a basis for understanding the complex factors involved in an event 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.

9.4 Equipment/Tools

Multiple tools are used by Contractor Assurance 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 management review meetings. The reactive tools are cause analysis, event investigations, and HPI investigations.

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

OPEXSHARE is the software tool that facilitates the lessons learned process.

9.5 Actions FY-21

- Continue improvements in CARB performance by achieving the following goals at MFC (Dave Coates, September 30, 2021):
  - A 50% reduction in the number of conditions open greater than 180 days based on the number of open conditions as of December 17, 2020.
  - A 50% reduction in open corrective actions for conditions open greater than 180 days based on the number of open actions as of December 17, 2020.
  - A 50% reduction in the number of open NTS actions based on the number of open NTS actions as of December 17, 2020.
  - No more than 2 corrective action extensions for any corrective action associated with a root cause evaluation, apparent cause evaluation, or NTS action.
  - Timely completion of all root and apparent cause evaluations with no revisions required following CARB approval.
- Continue improvements at MFC through the use of Immediate Lessons Learned, Significant Lessons Learned, and the lab-wide Lessons Learned and Operating Experience Program by achieving the following goals (Dave Coates, September 30, 2021):
  - An 80% reduction in MFC-specific repeat events when comparing FY-21 performance to FY-20 performance.
- Continue improvements in MFC implementation of the MOP by achieving the following goals (Dave Coates, September 30, 2021):
  - 100% completion of the required number of observations for each month, when adjusted for approved absences.
  - 95% of completed observations rated "meets expectations" or higher.
- Develop and implement comprehensive Contractor Assurance KPIs. As a minimum, the indicators will track and trend CARB, Lessons Learned, MOPs, Assessment, and Benchmarking performance (Tiffany Leavitt, April 30, 2021).
- Establish a Performance Improvement Working Group represented by an appropriate cross-section of MFC directors and managers. The working group will provide oversight of all performance improvement efforts including CARB, MOPs, Lessons Learned, Self-assessments, and Benchmarking. The working group will provide input and feedback on performance improvement efforts to enhance MFC continual improvement efforts (Tiffany Leavitt, April 30, 2021).

9.6 Looking Forward (FY-22 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.

10. PERSONNEL DEVELOPMENT

10.1 Personnel Selection

10.1.1 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" and defines the processes used over the last 5-years. (pages 35-42). MFC has been consistent using the criteria outlined in the "Materials and Fuels Complex Management Plan" book. 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. 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.

10.1.2 People

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

10.1.2.1 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.

10.1.2.2 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 and the candidates will decide if they want to be part of the department's team.

10.1.2.3 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. It 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.

10.1.3 Process

During the selection process, there are many hand-offs that create an error-likely situation, which is 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 these 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 managers 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 managers 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 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 will be critical to ensure INL is staying relevant in the market.

10.1.3.1 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 is contributing 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 are:

- Offer contingencies are taking about 6-8 weeks to complete
- On boarding 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 on-boarding experience. There is a need for better communication as candidates prepare for the new employee on-boarding. During COVID-19, there are 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 On-boarding with the increase in teleworking arrangements. Content for future classes should be reviewed annually to ensure continued relevance.

10.1.3.2 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. A better method for completing this step needs to be identified.

10.1.4 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 which will track where candidates are throughout the entire process.

10.1.5 Actions for FY-21

- Establish interview scheduling protocol with HR to enable MFC organizations to schedule candidate interviews while ensuring appropriate vetting through HR processes (Scott Wallin, February 28, 2021).

- Implement an enhanced recruiter-provided review matrix of applicants for MFC positions that clearly identify candidate eligibility and provide efficient access to applicant materials (Scott Wallin, Action Complete).

- Train managers and their administrative assistants on the features and full capability of Taleo (HR Talent Acquisition training) (Scott Wallin, September 30, 2021)

Establish memorandums of understanding with other organizations that define expectations and involvement of MFC management in the selection and placement of personnel supporting MFC (Scott Wallin, September 30, 2021).

10.1.6 Looking Forward (FY-22 and Beyond)

- Begin gaining access to the information needed to develop a dashboard so managers can follow selected candidates throughout the onboarding process

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

- Continue to explore Taleo capability with feedback from users in the field to ensure the system provides confidence in the applicant tracking process and provide efficiency to the process

- Gain access to the information needed to develop a dashboard so managers can follow selected candidates throughout the onboarding process.

10.2 Professional Development

10.2.1 A Look Back

For the last ten 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 18-24 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 Survey's 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 ~$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 lab 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 Human Resources (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.

10.2.2 People

MFC has always been mindful of roles and skill sets that are of 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 getting developed. 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 their leadership and management skills. A yearly schedule will be developed with the seminar.

There must be a balanced approach to the staff role. Currently, processes are cumbersome and time consuming. Until processes become more streamlined, it will take staff to support work. It is suggested 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 as any other staff support would charge. This employee should gain experiences in conduct of operations, contractor assurance, training, human resources, 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 lab, 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.

10.2.3 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 on-going conversations and never be closed until the end of the calendar year.

10.2.4 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 week-long 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.

10.2.5 Actions FY-21

- While working remotely, develop a different way to continue collecting data for the PPP, as outlined by L&OD (Scott Wallin, March 30, 2021)
- MFC engagement and roll out of Mind Tools while working remotely (Scott Wallin, March 30, 2021)

10.2.6 Looking Forward (FY-22 and Beyond)

- Complete succession planning to include SS, NFM, Department Managers, and key research PIs
- Implement qualification programs for manager and supervisor positions
- 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)
- Develop a knowledge transfer and retention program

- 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
- Explore ways to display the data captured in the PPP
- Work to establish a cross organizational weeklong immersion leadership development program similar to the "Thinking Expeditions" conducted in the past.

10.3 Inclusion and Diversity

10.3.1 A Look Back

Inclusion and diversity (I&D) are critical to laboratory outcomes and is 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 Historically Black Colleges and Universities (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.

Improvement has been made in some areas; 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 inclusion and diversity 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 WDC's 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 an 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.

10.3.2 People

MFC will continue to partner with HR in obtaining data useful in making decisions. The recruiting section of this document 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 MFCs commitment to improving work performance through inclusion and diversity. MFC must also actively and appropriately identify, recognize, and reward worker participation and championing of inclusion, including identifying personnel for award nominations as appropriate.

10.3.3 Process

The process for obtaining MFC labor statistics as they pertain to inclusion and diversity 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 where it 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.

10.3.4 Equipment/Tools

HR has provided some tools to support managers as they work to increase their inclusion and diversity 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 9 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 9. 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.

10.3.5 Actions FY-21

- Discuss, explain, and publicly promote the importance of an inclusive and diverse environment during Extended Leadership Quarterly meetings. Share tools such as the Culture Wizard Tool, Mind Gym tidbits, other I&D best practices (Scott Wallin, September 30, 2021).
- Share best practices with the entire MFC population during Quarterly Safety Meetings. Help people make the connection to feeling valued in the organization and how that will contribute to safety (Scott Wallin, September 30, 2021).
- Designated leaders complete current I&D course, "Strategies for Inclusive Hiring" (Scott Wallin, September 30, 2021).

- All managers must attend at least one I&D course offered by HR&D per year (contact I&D) (Scott Wallin, September 30, 2021).
- Continue active participation in I&D councils and affinity groups (Scott Wallin, September 30, 2021).

10.3.6 Looking Forward (FY-22 and Beyond)

- All employees must attend at least one I&D course offered by HR&D by the end of FY-22 (contact I&D).
- 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.
- Ensure regular training and forums for appropriate education and discussion of inclusion-related topics amongst MFC leadership and staff.
- 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.
- Establish a relationship with at least one Historically Black College or University (HBCU) or Minority Serving Institution (MSI), chosen for strategic impact for INL and the university, evidenced by a meeting of selected MFC and university leaders and at least one professor/MFC PI relationship to collaborate on a research proposal.
- Actively solicit applications from HBCUs/MSIs for three entry-level MFC positions.
- Incorporate the values for employee inclusivity and for addressing employee disabilities into MFC policies and practices (Tiffany Leavitt, May 30, 2021).

10.4 Recruiting

10.4.1 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 recognized 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 another chapter (Subsection 11.8). This will assist HR in understanding the hiring needs across the nuclear platform to source talent in advance of openings.

10.4.2 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.

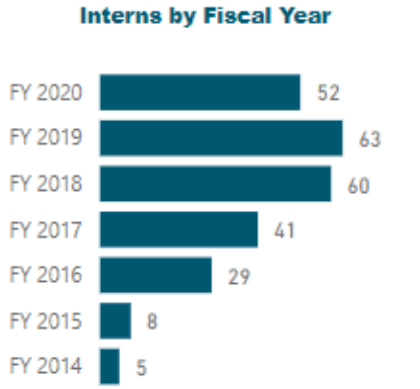

Figure 4. Number of Interns by fiscal year.

Figure 5. Number of Post-docs by fiscal year.

Recently University Partnerships conducted an assessment matching the skill sets needed at the laboratory with the best universities that matched MFC skills. This information should be provided to managers as a foundation 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 about 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, to establish relationships, and then mentor these students during the fellowship application process. It is suggested that indirect funding is provided at the lab level to support this professional endeavor.

Post-docs are an important part of the nuclear pipeline strategy. It is generally expected that post-docs will remain in a post-doc role for at least one 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.

10.4.3 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. However, 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 (PD) until after that call. The staffing consultant should join the call or review the PD 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 making sure 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 lab 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.

10.4.4 Equipment/Tools

Since this 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. This dashboard could contain information which should be provided to managers during the process. Information as to where the candidate pool reached and attracted candidates would 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.

10.4.5 Actions FY-21

- Implement enhanced recruiter/HR intake meeting process to equip the HR team with all context needed to facilitate an agile and efficient recruitment for specific positions (Scott Wallin, March 30, 2021)
- Develop community and INL informational packages and implement process to distribute to external candidates interviewed for MFC positions (Scott Wallin, June 30, 2021)
- Establish FY-22 division goals for intern and/or postdoc headcount (Scott Walling, September 30, 2021)
- Post FY-22 summer intern positions by end of FY-21 (Scott Wallin, September 30, 2021).

10.4.6 Looking Forward (FY-22 and Beyond)

- Implement and enable a continuously improving recruiting and hiring function that proactively and inclusively identifies, attracts, and onboards targeted talent for current and future mission needs. Ensure the processes and tools are efficient, agile, and responsive to candidate and market needs.
- Establish division goals for intern and/or postdoc headcount by the beginning of each fiscal year.
- Develop a variety of recruitment-focused media to communicate benefits of working at MFC facilities.
- Explore funding for spousal/significant other with the goal of having travel to interview.

10.5 Personnel Training and Qualification

10.5.1 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, 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 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 MSAs and RHs 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.

10.5.2 People

Refer to Subsection 11.7.

10.5.3 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. Overall, these lab-wide procedures and processes are acceptable for MFC except in the area of "Continuing Training" and "Training Program Evaluation." MFC's training staff needs more guidance on 1) how to implement consistent and effective continuing training programs for each nuclear facility and 2) how to implement a consistent and effective training evaluation program that identifies training strengths and weaknesses.

10.5.4 Equipment/Tools

MFC has access to two acceptable classrooms in building MFC-172 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 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 equipment is not available.

10.5.5 Actions FY-21

- Improve the qualification program of nuclear support managers at MFC to strengthen their knowledge of and application of MFC's Management Plan, Science Culture, Nuclear Safety Culture, HPI Culture and Conduct of Operations Culture. (Tiffany Leavitt, January 30, 2021)
- Develop additional facility systems training to strengthen operations knowledge (Tiffany Leavitt, September 30, 2021)
- Identify acceptable classroom and lab space for MFC employees to receive training on Rad Worker training, LO/TO training, Respirator training, First Aid training, and other ES&H hands-on courses (Tiffany Leavitt, January 30, 2021)
- Develop and implement additional DLAs (Dynamic Learning Activities) to support the mastery of HPI and Conduct of Operations Skills. (Tiffany Leavitt, September 30, 2021 [on-going])
- Continue updates to Facility Operator/SS exam banks to increase the number of higher-level thinking questions (Tiffany Leavitt, September 30, 2021 [on-going]).
- Develop an LXR User Guide to help training staff updated and revise qualification exam banks and exam profile (Tiffany Leavitt, September 30, 2021)
- Revitalize the "Basic Operator School" to create test-out options and to incorporate more hands-on learning techniques (Tiffany Leavitt, September 30, 2021 [on-going])
- Finalize the implementation of the new MFC System Engineer program (Tiffany Leavitt, September 30, 2021)
- Analyze the need for MFC Specific Technical Staff (not including engineers) qualification programs (Tiffany Leavitt, September 30, 2021)
- Update Exam Banks (Tiffany Leavitt, September 30, 2021)
    - Review two facility exam banks for relevancy and validity.

10.5.6 Looking Forward (FY-22 and Beyond)

- Improve the quantity and quality of operational drills to better prepare Facility Staff to respond to upsets, abnormalities, and emergencies. This would include the recruitment and hiring of a drill coordinator.
- Improve the quality of formal OJT at MFC by involving line managers in the occasional observation and feedback of checkouts.
- Improve the shift supervisor 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 implement an MFC administrative procedure that clearly specifies how MFC implements a consistent and effective training evaluation program that identifies training strengths and weaknesses.
- 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 hoisting and rigging 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 hoisting and rigging 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 Shift Supervisors attendance at the INPO First Line Supervisor Academy.

10.6 Continuing Training

10.6.1 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, "MFC Nuclear and Radiological Facility Training Program," 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 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.

10.6.2 People

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

10.6.3 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 Waste Examination Operators, will be required to complete 4 hours/year of job-specific, 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." This continuing training is determined, developed, and implemented per PDD-1073, "Radiological Control Training and Qualification Program."

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, MAR Coordinator, and Facility Disposition Specialist (FDS) will be required to attend a minimum of 4 hours/year of job-specific, 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, Criticality Safety Officers, 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 (eCRs), and DSA upgrade checklists.

10.6.4 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.

10.6.5 Actions FY-21

- Codify the continuing training process for MFC (Tiffany Leavitt, March 30, 2021)
  - Develop an administrative procedure to document how continuing training is conducted at MFC
  - Obtain manager buy-in and implement across MFC.

10.6.6 Looking Forward (FY-22 and Beyond)

- NFM requalification
  - Develop continuing training for NFMs that includes oral boards every 2 years
  - Develop continuing training for SSs.

10.7 Training Staff

10.7.1 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 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 the issues of training material being constantly out of date. Over the last two 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.

10.7.2 People

Training staff consists of a training manager, 10 instructional analysts/developers, and three training coordinators. They support 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. 70% of the instructional staff have worked at MFC two years or less. 100% of the training coordinators have been in the position for less than a year. Attrition, due to retirement/age, will pose a significant challenge to MFC Training over the next 5 years, with at least one senior instructor set to retire within 18 months. 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.

10.7.3 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 Technical Safety Requirements (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.

10.7.4 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.

10.7.5 Actions FY-21

- Review MFC Training Processes to find efficiencies (Tiffany Leavitt, September 30, 2021)
  - Design/Develop and implement a more effective MFC-specific training request/needs analysis form
  - Design/Develop and implement a more effective MFC-specific training job analysis task listing form
- Develop training staff and increase their capabilities (Tiffany Leavitt, September 30, 2021)
  - Develop a 1-year continuing instructor training schedule
  - Develop plans with individual instructors to allow them time to gain facility-specific knowledge
  - Develop an LXR User Guide
- Oral Board Training Aid (Tiffany Leavitt, September 30, 2021)
  - Create a training job aid for MFC Oral Boards and provide to all MFC NFMs and MFC Oral Board Chairs
  - Develop training on “Boardsmanship” for operations personnel.

10.7.6 Looking Forward (FY22 and Beyond)

- Revise PDD-147
  - Revise PDD-147 to simplify the format
- Incorporate Augmented Reality in Training Modules
  - Develop and pilot augmented reality training for operators or maintenance personnel

- Training Effectiveness Evaluation Program
  - Develop and implement a "MFC Training Effectiveness Evaluation Program" procedure that establishes site-specific guidance for the systematic evaluation of training programs that meets the intent of Objective 8 of DOE-STD-1070
- Develop Nuclear Facility Manager Book of Knowledge (NFMBOK)
  - Create an NFMBOK to assist to NFM candidates through the qualification process

10.8 MFC Staffing Plan

10.8.1 A Look Back

Every year, Human Resources (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 decision 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 lab 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 in 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.

10.8.2 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.

10.8.3 Process

10.8.3.1 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.

10.8.3.2 INL Nuclear Executive 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 this 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.

Executive Board meetings should include:

- 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
- 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.

10.8.3.3 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.

10.8.4 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.

10.8.5 Actions FY-21

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

- Establish MFC's process for annual updating of the staffing plan (Tiffany Leavitt, September 30, 2021)
- Develop succession plans deeper into the organization (people planning process actions are included in the professional development section [Subsection 11.2] of this publication) (Tiffany Leavitt, September 30, 2021)

- Continue close coordination with NRIC to establish future staffing needs (Tiffany Leavitt, September 30, 2021 [on-going]).

10.8.6 Looking Forward (FY-22 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:
  - Establish the lead and future chairman
  - Write a charter and submit to INL Laboratory Directory for approval
  - 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 (people planning process actions are included in the professional development section (Subsection 11.2) 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:
  - 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
  - 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
- Continued refinement of dashboard
- 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.

11. FUNDING/BUDGET CONTROLS

11.1 Integrated Resource Planning Tool

11.1.1 A Look Back

For years, INL senior leadership has asked how much it costs 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 was not an easy method to find out where discrepancies were.

Over the past 5 years, MFC has made great strides in the development and implementation of the Integrated Resource Planning Tool (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 outyears 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 if they will use the data from the tool to decide if it adds value to their work planning process.

11.1.2 People

Management and division control account managers (CAMs) 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.

11.1.3 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 tool 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 tool is used to make hiring decisions and continued development to better demonstrate those gaps are on-going.
- Disciplined structured monthly review meetings are key, reviewing base 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 tool, a strategic approach to future development should take place. A strategic advisory group should be formed so changes to the tool that benefit all BEA directorates can be approved. Looking at the tool 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 tool will help to understand resources needed to perform work if funding is awarded.
- Integrating the Nuclear Staffing Plan into the tool.

11.1.4 Equipment/Tools

The tool has developed significantly since is its conception

- A lab-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.

11.1.5 Actions FY-21

- Update and issue the IRPT administrative document (Tiffany Leavitt, September 30, 2021)
  - Define and use Priorities 1, 2, and 3
- Develop dashboards (Tiffany Leavitt, September 30, 2021)
  - Outline and prioritize basic information for the dashboard.
- Collaborate with NS&T on the data entered this year to better understand what improvements are needed to meet their needs (Tiffany Leavitt, September 30, 2021)
  - Enter activities in the division in which the tasks will be performed
- Improve interfaces (import or export) from IRPT into the business systems (Tiffany Leavitt, September 30, 2021).

11.1.6 Looking Forward (FY-22 and Beyond)

- Explore future capabilities following NS&T's testing
- Develop and refine dashboards
- Use Priorities 1, 2, and 3 in a meaningful way
- Use the tool as the parking lot of IPL items
- Refine the tool so PFCs can use it to perform analysis instead of having to use other tools
- Explore how to identify and track milestones in the tool for visibility and reporting purposes.

12. WORK PLANNING AND CONTROL

12.1 MFC Maintenance Planning Improvement Strategy

12.1.1 A Look Back

Five years ago, MFC Planning was a very reactive organization with high planner turnover (>50%). This high turnover rate was caused by multiple factors. MFC is a complex directorate with multiple missions and competing priorities, making it challenging to foster ownership and proficiency in the planning group. The planning department is a very lean organization compared to other areas on the INL site. MFC has more than 2,000 model work orders (MWOs) and 16 planners, compared to ATR's 700 MWOs and 20 planners. When coupled with the identified challenges, this created a stressful work environment and poor morale.

From 2015 through 2020 the following improvements were implemented:

- Aligned planning to MFC mission centers with dedicated planners (PF, PIE, R&S, and U&IS).
- Developed tools to enable planners to efficiently manage workloads proactively (i.e., SharePoint dashboards, EQ slicer, and a Planning Wikipedia page).
- Updated MFC Nuclear planner qualification card and individual training plans by streamlining the qualification process.
- Updated work order template to revision 8. This revision improved Sections 8, 11, and 12 based on feedback from crafts.
- Certified all planners to PPAAP-907-005, "Professional Procedure Association (PPA) writing standards." Additionally, qualified one planner as a PPA instructor.
- Updated all work orders to current PPA format, integrating HPI tools thus improving the quality and usability of work orders.
    - PPA is human factor writing. It is the international standard method for incorporating HPI tools and principles into documents.
    - PPAAP-907-005 is the current DOE writing standard.
- Reduced hours per document from 6.65 hr/item in 2014, to 4.3 hr/item in 2018 (by increasing planner efficiency).
- Identified barriers to success and challenged planning to implement innovative solutions to resolve these challenges. This enabled innovation within the planning group that increased consistency, efficiency, and productivity. Examples of the innovative solutions planning implemented are:
    - SP-20.2.6, "MFC Supplement to LWP-6200 and GDE-6200" – This SP standardized planning expectations and implemented Professional Procedure Association standards into MFC planning work orders.
    - Minor Maintenance PMs – These are Preventative Maintenance work orders that follow the criteria of Minor Maintenance work orders. Resulting in a significant time savings due to the simplified planning process.
    - M-LIs, PMIs – These are MFC specific documents in EDMS that standardize maintenance instructions and simplify the planning process on common equipment or activities.
- Reduced planning backlog from a historical high of greater than 250 to approximately 150 work orders by increasing planner efficiency.

- Completed the predictive maintenance workorder pilot. Developed more than 100 predictive maintenance work orders.
- Completed the mobile work package pilot. The Mobile work platform is up and running approximately 5% implemented.
- Developed a rotational planner advancement path that enables opportunities for MFC crafts personnel to become planners. This benefits MFC by shortening the learning curve for planners and retains critical facility and process knowledge.
- Completed a paradigm shift within the expeditor role that significantly improved the quality and compliance of minor maintenance work orders.
- Transitioned to Asset Suite 9 (AS9).

MFC Planning improvements had the following impacts:

- Reduced stress, improved proficiency, productivity, efficiency, ownership, morale, and engagement.
- Reduced overall planner turnover rate to less than 20%. This included a 3-year period with zero turnover. Although planning turnover is currently acceptable, MFC planning continues to lose key employees to other areas on site. The main cause of this turnover is the HR hiring and promotion process. Planning personnel are incentivized to move across the INL for increased pay, rather than staying with an organization and receiving a pay increase with experience.
- Improved work order quality and readability.
- Transitioned from a reactive group to a proactive/highly responsive group.

12.1.2 People

MFC Planning's staff are engaged, knowledgeable, and have a great service attitude. MFC Planning increased productivity by 35% while staff decreased by 25% over the last 5 years. Additionally, 31% of MFC planners are in the initial qualification process, 56% have less than 5 years' planning experience, and 50% of planners were promoted from within MFC crafts. It takes at least three years for a planner to fully develop and begin to gain significant benefit from experience. The current pay grades and progression plans make retention of planners, that have reached fully proficient status, difficult. One success for retaining a highly talented individual within the maintenance organization was accomplished by moving the individual into a Rotational Staff position that better fit the individual's skill set. Half of the MFC planning group is nearing retirement age and steps will need to be taken to ensure staff is hired in advance of those losses.

Although planner training is acceptable to maintain qualifications, there are recognized vulnerabilities in planner specialized training associated with maintaining Asbestos M&O project designer, and ASME Certified pressure vessel qualified planners. Additionally, all qualified MFC planners are PPA certified.

All qualified MFC Planners demonstrate acceptable decision making and conflict resolution skills, approximately 25% of the group is considered highly skilled in this area. These are the most experienced planners within the group. Conflict resolution and decision-making skills are a key component of planner's daily job function and demonstrating proficiency in this area is key to qualification and advancement.

12.1.3 Process

The current INL Planning processes and procedures are acceptable; however, they contain multiple error traps and conflicting or confusing information. When fully implemented the new Maintenance Work Control System developed by the MSTI program resolves almost all of these issues. Specific areas of

confusion in the current process are understanding and proper application of "Skill of the Craft," consistent handling of general hazards, and clear guidance for the threshold for documenting hazards and corresponding mitigations.

The AS9 roll out created issues that have had a significant impact on planning's productivity. MFC Planning is currently eight weeks into the roll out and is still having significant issues with AS (i.e., Time out causing data loss and rework, inability to save Word documents, security profile errors preventing normal access to fields in AS9). A database of all AS9 issues from across INL has been created and shared with key employees involved with AS9 implementation and issue resolution. These issues are being worked, but still affect day to day productivity.

MFC Planning has incorporated multiple innovations into the planning process, many of which have been adopted by INL and integrated into the MSTI Work Management process. One example is M-LI-118, "MFC Preventative Maintenance for Emergency Eyewash/Shower Stations," which standardizes eyewash maintenance and simplifies the planning process.

MFC Planning has fully embraced human performance tools and integrated these tools within work orders using PPA.

12.1.4 Equipment and Tools

MFC Planning equipment and tools are strong. However, utilization of some tools needs improvement including:

- Most of the equipment panels in AS which are not fully utilized.
- Currently the MFC planning group is working with the equipment reliability group to fully utilize these panels, however this is a significant project and ultimately outside the control of planning.

MFC Planning has developed tools to enable planners to efficiently manage their workload proactively. The tools that have been developed have included SharePoint dashboards, EQ slicer, and a Planning Wiki page.

There have been numerous changes in Planning from moving to a new building and transitioning to a telecommuting status. With these changes, new technology is an important piece of maintaining a high level of productivity and communication, and has required the following equipment to work efficiently:

- All planners have new desktop computers updated to Windows 10.
- All planners have new laptops and RSA tokens to work remotely.
- In the process of obtaining hardware to implement tele-meeting capabilities at on-site office locations.
- Working to automate reporting.

MFC Planning is fully prepared to implement mobile work package, an electronic work order platform, which will be phased in over the next year. The mobile work package will aide Planning by offering the following advancements:

- Improve work order efficiency
- Eliminate lost work packages
- Simplify record retention compliance
- Speed up signatures and approvals
- Simplify place keeping as it is an integral part of the system
- Allow for close to real time work order status updates.

12.1.5 Actions FY-21

- Make immediate improvement in the area of maintenance field execution through comprehensive actions designed to focus maintenance management, line supervision, planners, and crafts on the fundamentals of conduct of operations/maintenance. These sweeping actions will include (Eric Papaioannou, September 30, 2021):
  - Reinforcement of supervisory standards through INPO 05-004 (Guidelines for the Conduct of Maintenance during weekly 1st line supervisor staff meetings.
  - Enhancing standards through implementation of robust MFC Leadman qualification by qualifying two leads per shop who will stand in for foremen in their absence.
  - Ensuring thorough work package preparation by requiring that all planners certify PPA and reinforcing the expectation that nothing is scheduled at risk when supporting permits, lift plans, return to service tests, material requests, or other supporting documentation, is incomplete.
  - Performance of department wide tailgate sessions, and continuous in-the-field reinforcement, of procedure use and compliance rules, including place-keeping expectations, as they apply to work control documents.
  - Department wide reinforcement of HPI tools and their use with emphasis on resiliency discussion at critical steps, both in pre-job briefings and at the critical point of work.
  - Implement a Return to Service Checklist for equipment installed or affected by engineering modifications to be utilized in all planned work orders executing plant modifications.
  - Conduct regularly scheduled Quality Review Team reviews of work packages for consistency, accuracy, and compliance with standards.
  - 2-year Continuing Training Plan created with craft and foremen input with focus on HPI, procedural adherence, and conduct operations/maintenance.
- Resolve AS9 implementation issues (Eric Papaioannou, September 30, 2021)
  - Multiple AS9 issues have been identified and tracked. These issues are significantly affecting planning efficiency and productivity.
  - Working with INL AS9 implementation team to identify and resolve issues.
  - Identifying and implementing strategies to continue work as effectively as possible while issues are being addressed.
- Roll out new MSTI Work Management process (Eric Papaioannou, September 30, 2021)
  - Implement MSTI Work Management process.
  - MFC Planning leads will provide training on the MSTI process to MFC affected personnel.
- Evaluate and track work order feedback (Eric Papaioannou, September 30, 2021)
  - Identified a deficiency in recording feedback in AS. The deficiency was corrected immediately.
  - Develop a metric for tracking feedback.
  - Develop a standardized method for tracking and resolving feedback that allows automatic retrieval.
- Track and reduce “hold for approval” times (Eric Papaioannou, September 30, 2021)
  - Current work order average hold for approval times are 32 days.
  - Develop metrics to track work order hold for approval times.
  - Define acceptable times.
  - Assess and identify the fundamental causes of long “hold for approval” times and take action

to correct.

- Complete transition of reports from Asset Suite 7 to 9 (Eric Papaioannou, September 30, 2021)
  - The transition to AS9 caused multiple reports to no longer function.
  - This is a combined effort with MFC and INL level IT professionals.

12.1.6 Looking Forward (FY-22 and Beyond)

- Restart mobile work package implementation in the field.
  - Target groups have been identified and a draft IP is in place. This was disrupted by the COVID-19 shutdown but is ready to roll out.
  - Implementation of the mobile work package will be phased and is expected to take one to two years depending on available resources.
- Improve work order labor estimates.
  - Standardize estimate expectations by working with scheduling and foreman.
  - Train Planning on expectations.
  - Update current model work orders and implement going forward.
- Correct issues that cause work order close out to fluctuate outside standard deviation.
  - The work order process flow is plan, hold for approval, ready, working, finish, and complete. All the trends that have been tracked have shown a normal standard deviation for the process, except for setting work orders to complete. Work order close out shows significant fluctuations outside standard deviation.
  - Evaluate causes of wild fluctuations and implement process improvements that level out throughput.
- Fully implement mobile work package process.
- Implementation of work order tasking in AS as a scheduling tool.
  - Planning develops tasks in AS9 and sequences them to cover all tasks associated with the performance of the work order. Typical activities that would be tracked with tasking are: LO/TO, outage requests, material staging, post maintenance testing, facility mode changes, etc.
  - This was piloted for LO/TO and was very successful.
  - This process can be expanded to any task that scheduling needs to track and simplifies the scheduling process.
  - Coupled with the widespread use of mobile work packages, this action will provide almost real time, work status tracking and overall coordination.
- Implement worksite staging of material
  - This was piloted and was very successful, however, there are some challenges with controlled quality material that need to be resolved.

12.2 Work Scheduling

12.2.1 A Look Back

MFC Facility Scheduling performance is acceptable. MFC Scheduling organization structure has changed significantly in the last 5 years. Schedulers now report to maintenance management. Production coordinators and work week managers were reorganized to the facilities they support, and the scheduling manager position was dissolved. Despite the vast changes to organization structure, the Facility Scheduling workload and productivity has increased significantly in the last 5 years. Automation

technology upgrades have been instituted, such as Asset Suite 7 to P6, and Asset Suite 9 to P8. This interface between the computer maintenance management system (CMMS) and the scheduling software Primavera has provided more capability and efficiency by eliminating hand input of maintenance activities into the schedule software and allowing for integration of operation and project schedules with maintenance. This has resulted in efficient, and dependable scheduling to support the INL and MFC missions. With few exceptions throughout the last 5 years, performance has improved, and data reliability issues have decreased.

Since FY-15, process improvements have been made within MFC Facility Scheduling. The significant improvements are listed in Table 10 below.

Table 10. Improvements made within MFC Facility Scheduling.

MFC Facility Scheduling Improvements		
• Asset Suite to P6 Interface	• Specialized Facility Support	• Two Week POW Schedule
• Work Week Critique	• Simplified Performance Metrics	• Integrated QA Scheduling
• Integrated Mockup Scheduling	• Integrated Project Scheduling	• Integrated Waste Scheduling

12.2.2 People

Facility Scheduling staff are matrixed to MFC from the Scheduling organization. Staff are engaged, knowledgeable, and service oriented, as evidenced by the integration of operation and project schedules with maintenance. Facility Scheduling staff roles and responsibilities, and Accountabilities/Authorities are defined in LWP-6202, "Facility Scheduling and Resource Forecasting" and LST-7310, "Project Management Definitions and Acronyms"." A Scheduler is responsible for developing, integrating, and maintaining detailed resource-loaded schedules based on facility operational requirements. The facility scheduler develops the plan-of-the week/plan-of-the-day (POW/POD) schedules to satisfy facility authorization requirements. The facility scheduler provides scheduling interface between projects, maintenance, and operations. The late delivery of operation and research schedules continues to effect schedule integration. The operation and research schedules are still in flux up to the final draft meeting one hour before the performance week effecting planning, foreman, procurement, and other facilities. The ability of Facility Scheduling staff to deliver a POW in this constant state of flux demonstrates their strong abilities in decision making, and conflict resolution skills. This is accomplished even though there is no process for prioritization of work at MFC. Recruitment retention and training qualification are handled by scheduling's home organization in collaboration with MFC Management. The increase of facilities, such as 1729 (IMCL),784 (AFF), and new gloveboxes in 797 (FASB), over the past 5 years has increased the amount of scheduling activities to integrate into the POW. Despite the increase of activities, Facility Scheduling staff has not increased. Turnover will become a future staffing issue due to retirement/age of the current staff, therefore, a five-year staffing plan needs to be developed to counter this challenge. Currently 50% of Facility Scheduling staff have worked at MFC for 5 years or less.

12.2.3 Process

The process for planning, scheduling, coordination, and control of maintenance activities is adequate and emphasizes equipment availability. Compliance with LWP-6202 is adequate. This procedure defines the administrative process for the scheduling of work and resources at INL. Scheduling issues a draft POW on Wednesday and a final POW on Thursday every other week to authorize activities in accordance with LWP-9500, "Laboratory Excellence Program Organization and Administration."

Schedulers have identified short falls with required work week critique's and metrics. Scheduling restarted the work week critique and have defined metrics that will be tracked on a SharePoint metric dashboard and reported to management. Facility Scheduling is working to streamline procedures and processes, to improve performance, and improve Human Performance in schedule pressure allowing maintenance craft the ability to plan daily and weekly activities in advance. This process is being performed in the facility meetings, in order to set priorities and schedule dates for maintenance activities weeks in advance; however, the lack of a MFC priority list effects coordination.

12.2.4 Equipment/Tools

Current tools and equipment for Facility Scheduling are strong. Scheduling has updated computers and software, and all Schedulers have tablets or laptops allowing for telecommuting. However, when new software is installed the staff needs to ensure the interfaces are incorporated.

The new AS9 upgrade has caused issues with the P6 to AS9 interface. MFC Maintenance created a database of all AS9 issues from across INL and shared it with key employees involved with AS9 implementation and issue resolution.

Scheduling has encountered numerous changes including moving to a new building and transitioning to a telecommuting status. With these changes, new technology is an important piece of maintaining a high level of productivity and communication, and has required the following advancements:

- All schedulers have new desktop computers updated to Windows 10.
- All schedulers have laptops/tablets and RSA tokens to work remotely.
- In the process of obtaining hardware to implement tele-meeting capabilities at on-site office locations.
- Working to automate reporting of metrics.

12.2.5 Actions FY-21

- Implement a balanced rolling schedule with input/feedback from all the facilities and support organizations at MFC (Eric Papaioannou, September 30, 2021).
    - Five-week schedule
        - Week one, performance week
        - Week two, next performance
        - Week three through five, activities moving forward to the performance week.
    - Drive operation integration through facility meetings
    - Develop improved scheduling reports
    - Re-establish MFC wide Work Week Critique.
- Hire a Work Control Manager position to lead the Planning, Scheduling, and Work Control Groups (Eric Papaioannou, September 30, 2021).
- Schedule Quality Baselines and Maintenance metric dashboard (Eric Papaioannou, September 30, 2021)
    - Schedule Adherence
    - Break-in and Emergent Work.
- Modify process approval timeline (Eric Papaioannou, September 30, 2021)
    - POW approvals will move from Thursday to Wednesday—allowing maintenance a much-needed day of preparation before the performance week.

- Resolve AS9 implementation issues (Eric Papaioannou, September 30, 2021)
  - Multiple AS9 issues that significantly affect planning efficiency and productivity have been identified and tracked.
  - Working with INL AS9 implementation team to identify and resolve issues.
  - Identifying and implementing strategies to continue work as effectively as possible while issues are being addressed.

12.2.6 Looking Forward (FY-22 and Beyond)

- Ensure an adequate staffing plan is in place through collaboration with the home and work organizations
  - Attrition
  - Facility growth.
- Continue collaboration with all MFC facilities to ensure most efficient and effective schedule is available.
- Fully implement mobile work package process allowing real time updates.
- Implementation of work order tasking in AS as a scheduling tool
  - Planning develops tasks in AS9 and sequences them to cover all tasks associated with the performance of the work order. Typical activities that would be tracked with tasking are: LO/TO, outage requests, material staging, post maintenance testing, facility mode changes, etc.
  - This was piloted for LO/TO and was very successful.
  - The process can be expanded to any task that scheduling needs to track and simplifies the scheduling process.
  - Coupled with mobile work package this will significantly enhance, close to real time, work status tracking and coordination.

12.3 Preventive Maintenance

12.3.1 A Look Back 2015 to FY 2020

12.3.1.1 Preventive Maintenance

The INL-wide maintenance control procedure, MCP-6201, "Preventive/Predictive Maintenance Program," did not capture the needs of multiple facilities across MFC. The following was enacted for MFC:

- MFC developed a supplemental facility specific procedure, SP-20.2.5, "MFC Preventive/Predictive Maintenance Program – Supplement to MCP-6201," to clarify grey areas within MCP-6201 and to identify how preventative maintenances (PMs) would be addressed at MFC.
- The action request panel of AS is being utilized for PM justifications. This created a single point for retrieval, conveyed PM basis, and provided details of maintenance strategy. The history will be retained in CMMS for retrieval using facility specific forms, FRM-1833, "MFC PM/PdM Deferral Iteration Cancel Form," FRM-1835, "MFC Preventive Maintenance Justification (PMJ) for Work Control," and FRM-2638, "MFC Preventative/Predictive Maintenance Equipment List Change."

- Between 240 and 340 PMs were generated monthly
  - Incomplete Preventative Maintenance (PM) (either in grace or not addressed correctly/on

time, with some resulting in out-of-service equipment)

- Prior to June 2017 the PM backlog averaged 50

- Progress was made by the PM coordinator to address/remove the backlog (BL) by collaborating with engineering and operations on lingering maintenance that was not at the forefront:
  - June 2017 – BL of 8 PMs
  - December 2018 – BL of 8 PMs
  - Increase in backlog was evidenced March 2019 to December 2019 – Average BL of 16 PMs
  - January to March 2020 – Average BL of 20 PMs

NOTE: *COVID-19 Effect (not enough available personnel to complete "normal" volume of PMs).*

- April to September 2020 – Average BL of 55 PMs
  - 181 PMs were addressed as *'Cancel'* during the time of COVID-19. Going forward, real time management of resource loading and maintenance throughput has been affected.

Table 11. Recent MFC Preventive Maintenance Improvements.

Improvements made to Preventive Maintenance	
Maintenance Strategy Conveyance Form Improvements • Created FRM-2638 • Revised FRM-1835	**Equipment History Improvements** • Overreaching PMJ's applied to – Electrical equipment lists for 36M/72M – Vibration monitoring – Thermography – Fire Barrier /Door maintenance per M-LI-120 – Fixed ladders – CAMS.
Process Improvements • Streamlining of mobile equipment maintenance work control. • Mobile Work Platform maintenance pilot finished. • Eyewashes and safety showers maintained by M-LI-118. This brought consistency to eyewash maintenance into a single LI for all, instead of individualized WOs. • Asbestos is maintained by M-LI-114, "Class I/II/III Removal/Repair of Asbestos Containing or Presumed Asbestos Containing Materials." The Asbestos LI allowed asbestos spill situations to be cleaned up without waiting for a qualified asbestos planner to plan a work control document. • Operations surveillances for RCRA and TSRs was added to CMMS (Asset Suite), eliminating individual facility databases across MFC.	

12.3.2 People

PM coordinator is actively engaged to assist Engineering, Scheduling, and Operations with maintenance requirements and history retention/retrieval in the CMMS database. This function supports day-to-day business through continual problem-solving via solid collaboration.

Currently PM coordination is not staffed with a backup. Administrative assistance is available only when staff is not performing work control functions.

PM coordinating needs to be staffed with a backup coordinator and administrative support for day-to-day business. This structure will allow for assistance to Engineering and Operations by providing input,

thus realizing process improvements. Problem-solving and continual communication is a must for PM coordination.

The PM coordinator is a Single Point of Contact (SPOC) for PM Technical Requirements (basis) from cradle to grave, functioning as a Subject Matter Expert (SME) in the preventative program for MFC assets, and as a Technical point of contact for MFC. The PM Coordinator advises internal and external customers with CMMS history and compliance questions. PM coordinating utilizes highly specialized operational and technical knowledge and experience to develop and implement DOE Order and a company compliant Systematic Approach to MFC PMs.

Special attributes of the PM Coordination position include:

- Processing PMJs to support new maintenance and changes to current maintenance strategies (PMJs)
- Updating and maintaining the CMMS for configuration management and accuracy
- Uploading as found Reports that are retrievable for tracking and trending
- Coordinating feedback for preventive maintenance optimization (PMO)
- Assisting in scheduling to resolve scheduling conflicts
- Creating PMs to fulfill regulatory requirements for current and new facilities.

Maintenance throughput, (e.g., schedule adherence and facility availability and readiness to support required maintenance) needs improvement. Reliability of an asset is maintained with a well thought out maintenance strategy with buy-in of all stake holders to meet the expectations. Significant improvement is needed to address the future of reliability-centered maintenance at MFC. Behavior and buy-in will require training, awareness, attitude, and proficiency to achieve total productive maintenance (TPM).

12.3.3 Process

All stakeholders (facility management, workers, and crafts) need to understand asset reliability strategies, to not only meet requirements, but to improve predictive trending. Such improvements would allow MFC to avoid undesirable impacts, such as equipment unavailability and process disruption from reactive maintenance. Improvements in efficiency, schedule adherence (both Operations and Maintenance), facility availability, and meeting commitments to our customers would be realized by effective predictive maintenance indicators. An example would be to trend identified degradation indictors from predictive technologies allowing repair, or replacement **before** catastrophic failure. Through solid human performance, communication, and feedback, all MFC facilities can align with the maintenance strategies for continuous improvement.

Compliance to required maintenance has been affected as a response to COVID-19. Innovative thinking is needed to adjust maintenance throughput, during these times, to adapt planned maintenance to craft resource and facility availability. Due to isolation efforts at INL, facilities at MFC were staffed and operated at Min Safe. Maintenance was cancelled or deferred. Deferred maintenance was tracked on the Incomplete PM backlog to ensure the maintenance was scheduled or addressed otherwise with justification.

12.3.4 Equipment/Tools

Tools and equipment for PM tracking and trending have been enhanced. These improvements assist system engineering in determining system/equipment health and support development of a maintenance strategy that considers reliability to support equipment replacement or rebuild decisions.

Asset Suite 9.6 provides enhanced information retention abilities and broadens interface opportunities for Engineering and Operations with Maintenance. These improved communication and information-

sharing capabilities will minimize rework and rescheduling, and better both asset reliability and regulatory compliance. With respect to HPI errors, enhanced tools, improved communication, and less frustration will reduce performance errors.

Automation in conveying information for database and work control changes in AS 9 is available. This can improve efficiency with signature approval authority currently being captured on FORMS with the proper training and proficiency of users.

12.3.5 Actions FY-21

- Streamline Preventive maintenance information conveyance (Eric Papaioannou, September 30, 2021):
  - Develop a process flow for justification approval(s) and changing maintenance strategies. This will support PMO trending to predict failures and to achieve TPM.
  - Correct maintenance disruption caused by in-field modifications made without consideration of effect to current developed PMs. Utilize engineering change module when available in AS.
  - Through collaboration with RadCon Management, establish that radiological control engineers will own the PM program for radiological instruments throughout MFC facilities.
  - Collaborate with the MFC Procurement group to improve just-in-time procurement to better support scheduled maintenance.
  - Create metrics that illustrate scheduling adherence deviation to drive improvement in on-time maintenance performance.
  - Rebalance the PM load throughout the year and make necessary schedule adjustments to reduce impact to facilities, as well as improve schedule compliance. (This will be particularly impactful for electrical maintenance.)

12.3.6 Looking Forward (FY-22 and Beyond)

- Continue building Maintenance Department
  - Procedure changes, training, and development of User's Guides
  - Train System Engineering to use AS change module, to be proficient in history retrieval, and to consider modification affect to maintenance work control documents prior to in-field modifications to improve PM efficiency.
- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training
  - Continue with the plans developed in FY-21
  - Annually, evaluate the impact the plans are having and adjust the plans as necessary for continued improvement (Critical equipment available as scheduled)
  - Increase AS usage by Engineering and Operations for equipment strategy alignment with Maintenance
  - Develop and implement electronic forms
  - Begin implementing training to include a Reliability Centered Maintenance mind-set.
- Continue to drive HPIs and conduct of Maintenance/Operations for work control to meet ESH&Q commitments
  - Maintenance up-front engagement with new facilities, for example SPL, to compile information such as end-of-life expectancy of equipment, and to develop maintenance strategies during construction. This engagement would remove rush and, perhaps, errors when facilities come on-line
  - Continued feedback from the deck plate, striving for continuous improvement in maintenance

execution is needed from all stakeholders

- Implement the new processes and procedures.

12.4 Corrective Maintenance

12.4.1 A Look Back

MFC Crafts personnel are engaged, knowledgeable, and highly service oriented. MFC has one of the most productive and proficient craft groups at the INL, with an excellent work ethic. Craft turnover rates are acceptable, but there are areas that need improvement. Maintenance crafts have a strong understanding of facilities and equipment they support, procedural requirements, and conduct of operations. However, MFC has experienced issues in the past due to challenges with processes and procedures that contain multiple error traps, and conflicting or confusing information. Crafts continues to experience work execution delays, which are tracked in a metric database—but once work is released to perform, the crafts are highly effective at execution.

Past Improvements:

- Developed maintenance specific LIs, M-LIs, PMIs, and general hazard documents that improved efficiency through reusable procedures versus creation of work orders for routine corrective maintenance
- Converted 90% of MRG Maintenance Instructions from LI format to work packages which improved efficiency and useability
- Purchased equipment and tools that increased MFC Maintenance capabilities (see Equipment and Tools section for details)
- Improved shop utilization and layout by adding cabinets, shelving, and worktables (Weld shop update, Mechanic shop 788, carpenter/painter shop 753, MRG shop 706, HEO/EO shop, I&C shop 791)
- Obtained specialized training that increased shop capabilities (see training section for details)
- Setup QA material staging areas in buildings 788, 791, and 753 (designated work locations for weld fabrication)
- Completed several plant modifications projects under the Site Stabilization Agreement (SSA) allowance for covered work done in house (see Process section for details).

12.4.2 People

MFC Craft productivity, skill, and proficiency is among the highest at the INL.

- MFC craft perform approximately 40% of all maintenance work at the INL with significantly higher output than similar directorates
- For example, in 2019 MFC's 100 crafts completed 5,769 work orders compared to ATR's 74 crafts completing 1,570 work orders.

Maintenance crafts turnover overall is not alarming, but there are some crafts that have a turnover rate that has influenced production from time to time. Maintenance crafts has lost HVAC technicians, electricians, and system mechanics to promotions into the MFC Planning group, positions at other INL directorates, and personnel leaving the Laboratory entirely. These losses have usually been the result of personal choice, but competitive wages in the building and trades have also had an effect. Wages were modified during the recent union negotiations (late FY-20) and should have an immediate positive affect on retention.

Maintenance crafts have a strong understanding of facilities and equipment they support, procedural requirements, and conduct of operations. However, crafts have experienced issues in the past due to processes and procedures that contain multiple error traps, and conflicting or confusing information. The MSTI work control process changes, which will be implemented in FY-21, will correct these issues.

MFC maintenance has had significant management turnover in the last 5 years, which has led to confusing standards and expectations. Identified areas for improvement are work execution, procedural compliance/understanding, and clarifying expectations.

Roles/Responsibilities and Accountabilities/Authorities are clearly defined and communicated.

- MFC's maintenance organization is mainly comprised of highly skilled journeyman level technicians, with substantial knowledge of their fields and are able to support performing On-The-Job Training for the small percentage of technicians with less experience.
- Craft foremen and the general foreman understand their R2A2s. The maintenance organization was restructured so the foreman all directly report to one manager which has improved clarity and understanding of expectations.
- 60% of Foremen have >5 years' experience, while 40% of Forman have <5 years.
- 78% of Craft have >5 years' experience, while 22% of Craft have <5 years.

12.4.3 Training and Qualification

The Maintenance Training Program is up to date and acceptable:

- Maintenance craft foremen and lead qualifications have been rewritten to ensure stronger HPI and well-rounded qualified personnel
- Craft training opportunities have steadily increased over the last few years
- The training budget for FY-21 increased by 55%
    - This will increase training opportunities, expand capabilities, and benefit MFC by providing a skilled, competent, flexible workforce proficient with current technology to support cutting edge nuclear research
        - For example: PLCs, new master-slave manipulators (MSMs) (redesigned CRL models and new Walischmiller models), new types of Mechanical Material Handling (MMH) equipment, new electrical testing equipment, upgraded HVAC equipment/tools, recently purchased tent making equipment, and a waterjet cutting tool
- MFC crafts receive periodic training on work control and facility systems
    - This provides crafts with the knowledge needed to make decisions regarding work in the field. This is an on-going process related to continuous improvement
- Current focus on HPI tools and principles to increase resiliency.

MFC's mission is expanding and requires a larger maintenance workforce. Recruitment for the maintenance craft group has experienced the following in the past few years:

- Increased the maintenance craft group by 33% in the last 5 years.
- Success in in hiring skilled journeymen in the HVAC, equipment operators, and electrician fields.
- The Instrumentation and Control (I&C) area has been a challenge mainly due to a large number of opportunities in the country within this area.
- Some of these employees took longer than normal to locate and hire.

- Involvement with the Energy Systems Technical Education Center (ESTEC) has improved the ability to recruit locally.
- Finding experienced industrial mechanics has proven too been difficult at times, however, recruitment has been possible in this area as well.

Maintenance crafts turnover overall is not alarming; however, some crafts have a turnover rate that has influenced production from time to time. Therefore, personnel retention is an area of improvement.

- During recent union negotiations multiple adjustments to wages, lead pay, etc. were agreed upon to keep pay competitive.
- Monitoring of wages in the area for non-represented personnel will ensure MFC Crafts wages remain competitive–enabling crafts to retain the current workforce.
- Knowledge retention remains a challenge. The increase in number of technicians has made it possible to perform the current workload but has resulted in limited time available for good area specific training, with some exceptions of work assignments.
- Attrition due to retirement is a concern for the Maintenance Department
    - 20% of crafts/foreman are eligible for retirement within the next 5 years
        - Six employees are eligible and at retirement age
        - Two employees are expected to leave within less than a year
        - Two employees are expected to leave within the next two years
        - Three foremen and six technicians are expected to leave within next 5 years.

12.4.4 Process

The management structure applies sufficient resources (e.g., oversight and independent assessment, management involvement, funding, assignment of personnel roles, and responsibilities, facilities, tools, and equipment) necessary to support the requirements described in DOE O 433.1B, "Maintenance Management Program for DOE Nuclear Facilities," and ensures integration with other programs.

MFC craft compliance and understanding of contract requirements as delineated in Laboratory Instructions and Work orders is acceptable. Attention needs to be given to the compliance process and procedural performance:

- During the COVID-19 shut down a downward trend was identified.
- This resulted in some procedural violations and near misses.
- Management implemented actions to reverse the trend including:
    - Significantly increased coaching and mentoring on procedure compliance, place keeping, stop work authority, conduct of operations, appropriate rigor, conservative bias, and HPI principles.

MFC maintenance work control process is acceptable, however efficiency in terms of elimination/replacement is an area requiring improvement.

- Some procedures contain multiple error traps, and conflicting or confusing information.
- MSTI Work Management Process will improve the process by simplifying requirements, removing confusing and conflicting information, and allowing for tailoring to MFC needs.
- Low Risk Simple Activity (LRSA) list will clarify thresholds for work control rigor and improve compliance.
- Increased scope and complexity of project type work due to changes in the SSA.

- SSA work was originally limited to $2,000. It was raised to $10,000 total cost limit and then modified to $5,000 for labor, with no limit on material. Currently, it has been modified to 400 hours of wrench time labor.
- These improvements allow MFC Crafts to take on the additional work, while maintaining the current workload of CM and PM's. Therefore, giving crafts an opportunity to develop new and expanded proficiencies and increasing morale.
  - Examples of additional work include the removal of legacy Perchloric duct work from 752 AL, 752 AL supply fans replacement, 704 HVAC units upgrade, 752 AL hot cell window replacements, and 784 AFF upgrades.
- In most cases these improvements provide significant cost and time savings for MFC, as well as, providing additional skill use for the MFC crafts.

Work Execution is an area needing improvement. There are multiple issues that delay the start of work, however, once work is started crafts are effective.

- The main barriers to effective work execution are:
  - Facility availability to perform scheduled work. The facilities schedule work that they are not prepared to support.
  - Final POW approval is less than 1 working hour before the start of the next workday. Foremen do not have a chance to review and prepare for the upcoming week.
  - Outages are not ready when work is scheduled. The Outage Coordinator is not notified in time to process the necessary outage.
  - Work orders that are lost, not ready, or missing.
  - LO/TO not ready.
  - Material not available, not correct, missing, or assumed in stock but not verified.
  - Support group limitations including personnel availability, training conflicts, paperwork issues, and facility delays.

A list of innovations from the craft improvement agendas included new and upgraded equipment, shop layout, qual card improvements, procedure updates, craft input to planning and scheduling, craft re-write of SP-94.0.0 and improved craft ownership of the task at hand.

The maintenance crafts group focus on HPI has had the following impacts:

- Increased focus on HPI tool use, resilience, understanding, and remaining within the bounds of scope statements
- Increased emphasis on technician input for planning, scheduling, and work execution
  - Created a more interactive environment for the group
  - Increased ownership through involvement
  - Improved quality of final product.

12.4.5 Equipment and Tools

MFC Crafts equipment and tools are acceptable. A recent significant effort to update tools and equipment was implemented. This effort is still in process and is ~80% complete. The following is a list of recent accomplishments in this area:

- Purchased tables, storage racks, curtains, and assembly tooling for the weld shop.
- Enhanced craft maintenance's ability to perform safe and effective MMH through the purchase of multiple special application MMH tools and equipment.

- Replaced large power tools in the carpenter shop and purchased additional shapers, planers, and jointers. This has increased productivity and quality of the final product.
- Purchased heavy-duty industrial cabinets and benches for the carpenter and mobile mechanic shops.
- Purchased 40-foot manlift and an electric scissor lift, to support any area under MFC control.
- Replaced aging equipment for the equipment operator group, increasing capabilities to support item movement and transfers.
- Repaired electric mobile crane. This is needed for large item placement in IMCL and has also benefitted other MFC areas where fossil fueled vehicle use is restricted.
- Purchased an 8-ton rough terrain forklift, a new semi-tractor, and a pin trailer for transporting RSU's, slings, shackles, and tie down equipment.
- Purchased load test beam for testing fabricated tooling prior to placing into service. MFC is the only BEA area at INL with this capability.
- Purchased a small rough terrain forklift, a new transport trailer, a spider crane, a tracked equipment transport unit with the capability of transposing the load from horizontal to vertical positions and vice-versa.
- Purchased a yard dog tractor to allow safer and more efficient trailer movement with the focus of cask trailer placement into HFEF and FCF.
- Replaced equipment in the paint shop with current models.
- Electricians equipment improvements:
  - Measuring instruments
  - Upgraded personnel safety gear
  - Purchased a Hipotronics unit enabling us to test 13.8 KV breakers
  - Purchased a very low frequency (VLF) tester
  - Purchased a Wire tugger which allows for replacement of large underground cables
  - Purchased a power quality recorder which is beneficial in troubleshooting and monitoring power feeds
  - In the process of establishing a designated area for breaker testing and are currently in the remodeling phase for this.
- Completed INL's mobile work package test implementation with 20% of the current staff trained on mobile work package use.

12.4.6 Actions FY-21

- Perform detailed resource forecasting for each craft area, and hire in advance of attrition at least two I&C technicians in FY-21 (Eric Papaioannou, September 30, 2021)
- Complete Solidworks training for effective utilization of the newly acquired water jet cutter and tent making capability at MFC (Eric Papaioannou, September 30, 2021).

12.4.7 Looking Forward (FY-22 and Beyond)

- Evaluate current state of heavy equipment and formulate a detailed plan for replacement
  - For example, purchase a new snowplow/sand application truck for winter use
- Evaluate trends in technology and adjust craft training programs, and equipment on hand, to keep

up with current technological capabilities

- Add infrastructure and complete mobile work package implementation across MFC.

13. SECURITY

13.1 Emergency Preparedness

13.1.1 A Look Back

Since FY-16 many improvements have been made to the MFC Emergency Preparedness organization. The more significant improvements include the following:

- FY 2016

  - Completion of the 3-year $185,000 Emergency Control Center (ECC) upgrade project. This upgraded all the information management systems, including placement of multiple monitors on the walls for display of information, graphics, and event status. Video connectivity with other ECCs and the Emergency Operations Center (EOC) in Idaho Falls was upgraded and proceduralized. All 11 computer desktops were replaced as well as all desks and cabinetry. These upgrades increased the speed and accuracy with which decisions can be made and transmitted in an emergency.

  - Significant INL Emergency Management resources were put into the new hazard's assessment Emergency Action Levels (EALs) and documents that were developed for the TREAT project.

  - Completion of an Emergency Management-wide Job Task Analysis for 52 different Emergency Management professional and emergency response organization (ERO) positions. This included analyzing the applicability of 1,350 tasks to those positions and then constructing matrices to record difficulty, importance/consequence, and frequency (DIF) of each of those tasks by each of those 52 positions. This included all MFC ERO positions.

- FY 2017

  - As part of the readiness review process for the start-up of TREAT Facility, two drills were successfully conducted, effectively demonstrating our readiness to respond to events at the TREAT Facility.

- FY 2018

  - Eleven vacancies were identified on the four MFC ERO teams. All vacancies plus other personnel turnover positions were filled with qualified individuals by the end of the fiscal year. This required running ten different functional drills. By February 2019, 100% of all MFC ERO team positions were filled.

  - An initiative was started by Emergency Management to standardize implementation of the Incident Command System (ICS) method of managing emergency events across INL in the Emergency Management, Security, Fire Department, and RadCon organizations. This national standard will be implemented in a multi-year phase-in effort.

  - Increased the ability to remotely monitor Rad sensors with the addition of another CPU for the Rad Technical Specialist in the ECC. This CPU is on the Alpha Client network unique to MFC and enables ECC to monitor continuous air monitors (CAMs) in FMF, Analytical Lab, EML, and ZPPR. (This is in addition to the capability to remotely monitor sensors in FCF and HFEF that previously existed.)

  - Coordinated remote programming of all MFC handheld radios to enable switching between high and low power transmission settings and had them default set to high power transmission rate to further decrease instances of dead spots/scratchy radio transmissions.

  - Finished the training/qualifying of plant managers in charge of non-nuclear facilities (not

under the supervision of Shift Supervisors) in concert with their assignment to respond to facility emergencies as Building Emergency Directors (BEDs).

- FY 2019

  - The MFC ERO was activated for five successive, 12-hour periods in conjunction with the wildland Sheep Fire. This activation validated the training, effective qualification, and professionalism of the MFC ERO teams.

  - Emergency Management hazard analysts revised and issued hazard assessment EHA-70, "Emergency Planning Hazards Assessment for Materials and Fuels Complex," for the proposed use of the HFEF-14 Cask for transporting EBR-II Fuel from INTEC to RSWF.

  - The number of drills with radiological scenarios and RadCon involvement was increased over previous years.

- FY 2020

  - Several MFC personnel supported Emergency Management and the Continuity of Operations Program (COOP) to maintain the COVID-19 Continuity Emergency Response Group (CERG). The COVID-19 CERG was fully activated on March 26, 2020 and provided the command structure for mitigative efforts as it pertained to INL COVID-19 response efforts. Those staff provided daily reporting to Senior BEA Leadership and DOE/ID. Reports consisted of status of the MFC Facility, number of teleworking employees, local case numbers, INL related case numbers, and the status of employees on travel.

  - Completion of walk-through of all MFC buildings to update the EHS-70 Hazard Survey for MFC.

  - The communications resiliency of the ERO teams has been tested by running drills that forced the ERO team to leave the ECC temporarily.

Overall effectiveness assessment: The MFC ERO is a tested, highly capable group of volunteers that are ready to respond to worst case scenarios. Both personnel and equipment are routinely evaluated to ensure this ready state is always the standard. No issues exist today that would place doubt in ERO readiness.

13.1.2 People

Activation for the 2019 Sheep Fire and successful completions of all drills are solid testaments of the reliability of the ERO personnel and their dedication to their voluntary contribution above and beyond their regular-assigned operational duties.

The following are total MFC personnel dedicated to assisting in keeping fellow employees safe in emergency events:

- The 41 ERO personnel are organized into four, 10-person teams and five Emergency Action Managers (EAMs). Each team is on-call for a week at a time and required to respond within 90 minutes of notification.

- The 67 Area Wardens and four Area Warden Coordinators are dedicated to evacuation of each building and the MFC Facility in general.

- At MFC 37 Shift Supervisors have the additional assignment as BEDs as a qualification requirement to be a shift supervisor. These BEDs have the responsibility to report via radio the details of the incident to the EAM on call.

All ERO positions are voluntary.

- The main advantage to this is that personnel already have an internal motivation to seek an extra

commitment. This helps guarantee active training, drilling, and response in time of need.

- The disadvantage is the somewhat unpredictable character of longevity. Operational promotions, transfers, retirement, etc., are examples of the many factors affecting assignment to position. Training is almost always being conducted on at least a weekly basis to maintain team strength.

Areas needing improvement include:

- Recommend that the expectation be expressed to all Operations personnel that ERO participation is desired by MFC management.
    - This could be extended to being a desirable assignment for professional development purposes.
- Anticipating position vacancies.
    - Individual ERO personnel are good at providing notice of a professional change that makes ERO assignment no longer possible.
    - Improvements for the notification of that eventuality could be improved by supervisors giving notice as far ahead as possible to the MFC emergency planner so replacements can be recruited, trained, and qualified.
    - More weighty expectations like recommended above would facilitate more effective advance planning on the part of the MFC emergency planner.
        - MFC RadCon is a great example of this expressed expectation, especially of RadCon supervisors.
- Drill participation is always a challenge because it necessitates absence from the regular operational assignment for 1-2 hours.
    - The need to cover operational requirements, sometimes unanticipated prior to drill day, has, on occasion, led to decreased value of the drill. There is no organizational pattern to this other than the desire of the RadCon to drill more despite the need to be present at the location of operational processes.
    - Improvements can be made in terms of the drill planning phase, and in communicating with managers when an employee has agreed to support a drill so operational assignments can be adjusted, when possible.

13.1.3 Process

During this last year, Emergency Management and the RadCon organizations have reviewed and revised procedures that define emergency response of the two organizations. This has served to eliminate duplication of reporting and associated division of attention.

As first responders, the Fire Department, Security, and RadCon organizations continue to respond to events in concert with Emergency Management ERO event response management. Rough on-scene coordination happens. Although adequate in the past it could be much smoother with more principled application (see paragraph 3 next).

The ICS Implementation plan is an area of Emergency Management which needs improvement. By DOE order, the Emergency Management organization has the overall responsibility to manage emergencies. As such an IP is in effect with the assignment to standardize application of the national standard of the ICS under the authority of the presidential directives that established the National Incident Management System (NIMS). Emergency Management, Security, and the Fire Department have their own versions of ICS that operate together, but still are not efficient in association with each other. The RadCon organization has first responders, similar to the Security and the Fire Department, but have not trained within the principles of ICS. This is the first innovation of its kind in the DOE complex.

13.1.4 Equipment and Tools

ECC equipment and decision-making tools are state of the art, including the incident management database software – the same used to manage response to wildland fires, tornadoes, and hurricanes elsewhere.

The following are areas in which Emergency Management has strong or acceptable equipment and tools in place:

- Upgrading or replacing computer equipment owned by Emergency Management in the ECC is prompt and timely.
- The TRAIN-based qualifications system is acceptable. The TRAIN-based qualification system in the lab communicates electronically with the RPIS database that holds ERO team structures and is readily accessible electronically.

The following are areas of Emergency Management needing improvement:

- Occasionally, when passing though security access control points, Emergency Management and ERO personnel are not recognized for their specific assignments in responding to emergencies. Emergency Management is investigating ways of credentialling (i.e., a separate card or other identification issued by the proper Laboratory authorities) ERO members in a physical way to alleviate periodic scene access control issues.
- Faster replacement of wall screens owned by MFC in the ECC when needed before they fail.

13.1.5 Actions FY-21

- Integrate the process of notifying managers of ERO personnel involvement in a drill as routine planning sequence leading up to drill day (Eric Papaioannou, September 30, 2021).
- Expressed expectation by MFC management to all operations personnel the need to project movement of personnel out of ERO positions whenever possible as evidence of career planning that includes ERO service and awareness (Eric Papaioannou, September 30, 2021).

13.1.6 Looking Forward (FY-22 and Beyond)

- FY-21 through FY-22: Implement credentialing of ERO personnel. This is an Emergency Management lab-wide initiative that is still being researched.
- FY-22 through FY-23: Complete implementation of the ICS concept at MFC to function seamlessly with Emergency Management, Security, Fire Department and 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 lab's emergency response organizations.

13.2 Personnel Security

13.2.1 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, Human Reliability Program (HRP), and Foreign Visitors and Appointments (FV&A).

Personnel Security (PERSEC) is an element in the overall protection strategy of the Laboratory Protection Division at INL. This element 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.

Personnel Security 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"
- LWP-11105, "Classified Visits Involving Foreign Nationals"
- 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 FV&A process, and the process for determining access to documents that personnel need to perform their job functions is difficult and cumbersome. Initial clearance paperwork, and that required for recertification, 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.

13.2.2 Process

The process of hiring for any position within a national laboratory is lengthy and cumbersome. This process is made more difficult for any position requiring a DOE "L" or "Q" clearance. 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. 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 personnel security. 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.

Because of the nature of security concerns and/or incidents these experiences are not allowed or able to be shared in a light that could benefit others.

13.2.3 Actions FY-21

- Evaluate and determine whether the required training for clearance holders is adequate or should be adjusted (Eric Papaioannou, September 30, 2021).
- Evaluate and determine whether the required training for hosts of foreign national employees is adequate or should be adjusted (Eric Papaioannou, September 30, 2021).
- Determine how security Lessons Learned could be more openly shared and discussed with staff (Eric Papaioannou, September 30, 2021).
- Provide direct feedback/comments to the document owner(s) of implementing security procedures for improvements based on MFC experience/lessons learned (Eric Papaioannou, September 30, 2021).

13.2.4 Looking Forward (FY-22 and Beyond)

- Provide a POC for clearance paperwork and related concerns at MFC to help staff with this process.
- Provide a POC for personnel security much like our POC for physical security.
- Improve accessibility to documents for foreign national employees.
- Streamline the clearance paperwork process.
- Streamline FV&A process.

13.3 Human Reliability Program

13.3.1 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 for 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.

Within the past several years the Safeguards and Security Directorate has undergone a significant reorganization and hired many new personnel. Despite the reorganization and growth of this directorate, very little has been done to improve HRP documents to 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 inconsistent management of this program and its requirements.

13.3.2 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
- Ensure 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
- Must report **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
- Update job task analysis form each year for HRP employees
- Receive and issue requests for drug and alcohol testing of HRP employees
- Removes 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
- Reports the removal of an HRP employee from HRP duties to the HRP management official.

HRP certifying officials are responsible for the following actions:

- Receives notice from the HRP management official if an HRP employee is temporarily removed from HRP
- Maintains authority to approve employee reinstatement to HRP
- Ensures DOE personnel security office reviews certification documents.

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.*

- Receives 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
- Notifies HRP supervisor of temporary removal of an HRP employee from HRP
- Notifies the HRP certifying official of removal or reinstatement of HRP employees
- Evaluates all individuals for initial or re-certification to HRP communicates concerns to HRP certifying official and DOE-ID personnel security
- Provides initial training for HRP participants and HRP supervisors
- Provide 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:

- Perform annual medical assessment of HRP employees
- Recommend temporary removal of HRP employees from the program
- Impose restrictions on HRP employees
- Approve the use of regulated medications including narcotics (This is noted in the employee medical file and not HRP file)
- Provide written return to work recommendations for HRP employees to the HRP management official
- Conducts rehabilitation evaluations and subsequent recommendation to HRP management official
- Determines frequency of drug/alcohol testing for HRP employees that are reinstated to HRP
- Ensures training of medical staff to fulfill HRP duties
- Makes medical based decisions and recommendations based on testing results.

The INL designated psychologist is responsible for the following actions:

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

13.3.3 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 obstinance 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. There are numerous inconsistencies in how the requirements of HRP have been interpreted and implemented. 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.

13.3.4 Equipment/Tools

Medical facilities and staffing on site at MFC are required to implement the HRP effectively.

13.3.5 Actions FY-21

- Provide direct feedback/comments to LWP-11104 and PLN-11101 document owner for improvements based on MFC experience/lessons learned (Tim Hyde, September 30, 2021)

13.3.6 Looking Forward (FY-22 and Beyond)

- Evaluate and determine if the required training for HRP is adequate or should be adjusted based on position/decision authority
- Request better defined guidance for positive breathalyzer and prescription drug testing
- Develop a User Guide to help HRP employees with decisions (Improve HRP webpage/interface)
- Develop a Decision Tree to help HRP supervisors 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 mechanism for HRP supervisors to have access to individuals HRP files in the event of personnel actions
- Evaluate pay differential for HRP employees

- Improve MFC Medical Facility and incorporate EAP for increased availability
- 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 and decision trees.

14. SUBCONTRACTOR WORK MANAGEMENT

14.1 Subcontracted Construction and Modification Performance

14.1.1 A Look Back

In the last 5 years the amount of construction work and subcontracted plant modifications has increased significantly. The INL processes for subcontracted work require collaboration between Facilities and Site Services (F&SS) personnel, MFC personnel, and subcontractor representatives. The day-to-day responsibility for most pre-construction processes, bidding walkdowns, mobilization preparation, and construction/modification execution is the responsibility of the Utilities and Infrastructure (U&IS) Department. At times, MFC nuclear and radiological Facility Managers are also heavily involved in the process.

Looking back at 2015 and early 2016, performance in this area was suspect and events happened frequently. Scope would creep beyond what was briefed and expected to be executed during a given shift, multiple times heavy equipment encroached on nuclear facilities and caused work to be outside of the Unresolved Safety Question (USQ) process, informed decision making was lacking as subcontractor superintendents did not know who the points of contact were, and Construction Field Representatives (CFRs) were too few in number to keep eyes on critical work and did not feel as though they were a part of the MFC team.

To correct these and other repetitive issues, collaboration with F&SS Construction personnel was necessary to ensure U&IS department personnel understood the roles and responsibilities and could effectively work together to navigate processes and successfully execute contracts. Tactically, several changes to process were introduced. These included implementations of daily work release forms with key USQ responsibilities and triggers embedded, pre-mobilization meetings became standard to ensure personnel were introduced to one another (NFM, FM, SS, CFR Superintendent, and key support staff), and NFMs and Facility Managers (FMs) routinely established authority over subcontract work and the standards for which work will be performed in their facilities. Additionally, more CFRs have been hired to ensure eyes on work in the field would be the standard.

14.1.2 People

Recent unforeseen retirements have the U&IS Department understaffed by two Facility Managers. Hiring is in progress, but it will take time to qualify new personnel. FMs are key to daily work release for all subcontracted work occurring outside nuclear and radiological facilities which constitutes most of the subcontracted construction and modifications being executed across MFC. This shortage stresses the qualified staff and affects projects as staff is physically unable to be where they need to be in order to efficiently start work each day. The FM role faces competition from other areas of the Laboratory that are non-nuclear (i.e., REC), and yet, have a higher salary grade attached to the role. This will need to be corrected in order to attract and retain the best candidates for this vital position.

F&SS has hired additional CFRs to ensure that field oversight is able to be provided for every critical activity being performed. Despite this, CFRs are still stretched thin and not always able to meet that expectation.

14.1.3 Process

Construction processes, subcontracted modification processes, and project management processes have yet to be revised by the Management Systems Transformation Initiative (MSTI). These processes have the same common gaps and issues associated with all INL management systems and are navigated by knowing who to call for help. Until these are streamlined, and the gaps removed, there will be inefficiencies and problems in planning, preparation, and execution that must be overcome. Additionally, these issues typically land on the CFR to resolve and detract from their ability to be in the field.

14.1.4 Actions FY-21

- Develop a project "look ahead" process to ensure FM and Project Manager staff are assigned to proposed projects early in the process to ensure complete alignment (Eric Papaioannou, September 30, 2021).

14.1.5 Looking Forward (FY-22 and Beyond)

- Develop a Facility Manager guide to project planning, subcontracting, and execution to assist FMs with subcontract work responsibilities and processes
- Move CFRs from the F&SS Home Organization to the MFC line
- Push INL Construction, Project Management, and Subcontract Procurement processes through the MSTI process.

15. EQUIPMENT RELIABILITY

15.1 A Look Back

Prior to 2016, MFC had no specific equipment reliability program (ERP) or processes beyond standard preventative maintenance. 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 in Table 12 below.

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

Table 12. Equipment Reliability Program's workstreams of primary focus.

Equipment Reliability Program Improvements		
Predictive Maintenance Improvements (PdM) • Vibration Analysis – As of September 2020 - 92 pieces of rotating equipment monitored – Motion amplification for in-depth diagnoses. • Thermography Analysis – As of September 2020 – 1,122 pieces of electrical and rotating equipment monitored. • Tribology Analysis – As of September 2020 - 155 pieces of rotating and electrical equipment monitored – Ultrasonics used for bearing lubrication.	**Preventative Maintenance Optimization (PMO)** • Developed process to review facility equipment and current preventative maintenance (PM) strategies. • Reviewed and updated maintenance strategies for top 20% of equipment within Analytical Labs. • Currently reviewing making updates to IMCL equipment. • Created templates for MFC specific equipment (i.e., hot cells, gloveboxes, fume hoods, manipulators).	**System Equipment Reliability Prioritization (SERP)** • Performed System Value Rankings (SVRs) of 586 systems at MFC according to established criteria. • Performed Component Value Rankings (CVRs) on over 6,000 pieces of equipment in IMCL, UIS, SSPSF, FMF, and Analytical Lab. • Developed streamlined methodology for determining equipment criticality using feedback and lessons learned from SERP process – Used results to feed PMO process.

Root Cause Analysis Process (RCA)	Equipment Reliability (ER) Suite	Personnel Development
• Developed working procedure for performance of equipment-based RCAs at MFC. • Performed RCA on the following equipment: – STL cam follower in FCF in 2019 – RPZ backflow preventer in RCL in 2020 – MFC -768 Facility Air Compressors PA-CP-001, PA-CP-002.	• Completed Training of ER suite package with System Engineers. • Loaded current system health reports into SystemIQ. • Loaded PdM equipment into PlantIQ for predictive tracking moving forward • Developed MFC-ADM-0005 (still in review at the time of OMI issuance) Updated PRD-394.	• PdM Vibration/ Tribology Analyst – Level 1&2 Vibration, Level 1 Thermography, Level 1 Lubrication, Level 1 Motion Amplification, Level 1 Ultrasound. • PdM Thermography Analyst – Level 1 Thermography, Level 1 Vibration. • Mechanical Reliability Engineer – Level 1&2 Vibration, Level 1 Thermography, Level 1 Lubrication, Level 1 Motion Amplification, Level 1 Ultrasound.

15.2 People

The MFC Equipment Reliability Team consists of two Reliability Engineers (one Mechanical, and one Electrical), and two Predictive Maintenance (PdM) Analysts (one Thermography, one Vibration/Tribology). The PdM Analysts possess highly specialized skillsets for in-depth analysis of equipment health using PdM technologies. The team, shown in Figure 6, is cross trained to be able to support each other, while each team member has become a SME in their own respective areas.

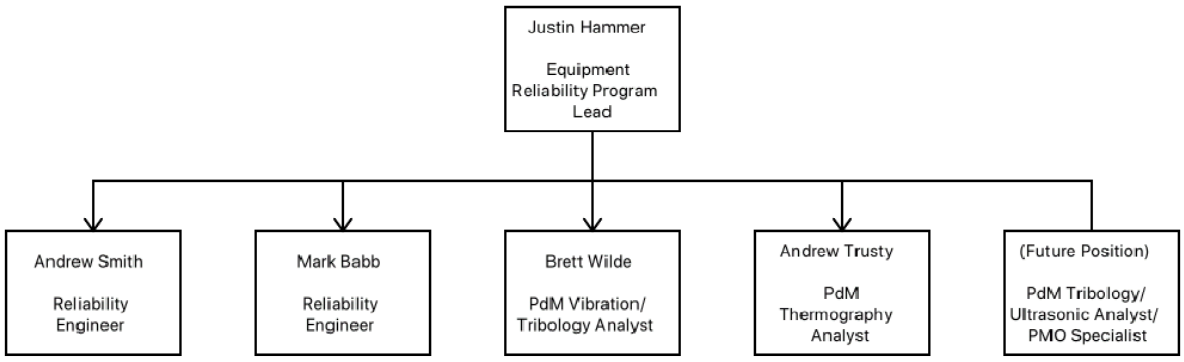

Figure 6. The MFC Equipment Reliability Team.

As the PdM program is relatively new at MFC, the personnel retention rate has been near 100%. Initially, the program struggled to acquire a dedicated Lead; however, the position was filled in February 2020. As the program continues to grow, a goal of MFC Equipment Reliability leadership is to incorporate PdM positions into a career path for personnel continuing to seek professional development. The group will look to add a position that will own Tribology/lubrication and Ultrasonic testing for MFC facilities. This position will also be responsible for supporting the Preventative Maintenance Optimization (PMO) process. This position will fill the gap identified in a 2019 assessment of the MFC lubrication program, which called out a need for improvements in procurement, quality control, storage, handling, application, sampling, training, and analysis.

Each of the PdM analysts will obtain at least a level 3 certification in their primary technologies (as applicable) and the Reliability Engineers will obtain at least a level 2 in the technologies associated with their engineering disciplines. A 5-year ERP training plan will be developed to ensure that the organization

stays current with changes in technologies and processes associated with Equipment Reliability. As the PMO process continues to strengthen, the primary responsibility and ownership of the work stream will shift from ERP personnel to System/Facility Engineers. However, ERP personnel will still support and provide subject matter recommendations. Another responsibility of the ERP will be to track equipment failures and ensure correct engineering resources are identified to correct equipment failures.

15.3 Process

Currently, within the Equipment Reliability group, there are several processes that will help to complete the MFC/INL vision and support other work groups. The PdM work management process has been significantly streamlined in most MFC facilities. Previously, existing legacy PdM tasks lacked consistency and rigor – and were often part of packages for other preventative activities with little thought given to optimal monitoring frequency or task alignment. In 2018, PdM personnel worked closely with MFC Planning to update and improve these tasks and packages, as necessary. Today, data acquisition packages are easy and safe to perform by Maintenance personnel with a high level of consistency. PdM will enable MFC increasingly to replace time-based PM's with condition based PdM's, which will be more effective at preventing failures and reduce the hours facilities spend in maintenance and repair. Equipment Reliability continues to support other work groups by performing equipment RCA, which helps to proliferate understanding of failure modes and how to prevent failures from reoccurring. RCAs are currently performed by the Reliability Engineers at the request of MFC Management with assistance from various SMEs as required. Findings and technical recommendations from RCAs are reported to System/Facility Engineers and Managers using Technical Evaluations (TEVs) and Engineering Calculation and Analysis Reports (ECARs). The group has also been heavily involved in the implementation of ER Suites - which will track equipment health and support system health reports, Long-term Planning, and store analysis reports from Predictive Monitoring.

There are still processes that need to be developed and implemented within the organization. One of these processes is the Reliability, Availability, and Maintainability (RAM) standard. This process will be owned by the Reliability Engineers and the Reliability Lead and will be the main process in which Reliability will be incorporated into the design of new systems and equipment at MFC. The criteria and processes for RAM will be integrated into the Engineering Job (EJ) process for facility modification and subcontracted design with the intention of specifying and capturing Reliability-focused elements upfront – including design recommendations, PM/PdM recommendations, and acceptance criteria. Another process pending development and implementation is evaluation of equipment life-cycle management. This would include an obsolescence review of current equipment to determine which equipment needs to be added into long-term planning. This review will be informed by national standards, such as ANS 3.14, "Aging for Non-Reactor Nuclear Facilities." This will also require System Engineers to determine mitigation strategies for critical equipment. This information will be tracked within the ER suites Long Term Asset Manager (LTAM) module.

Reliability will be an integral part of the lifecycle of new and existing equipment and systems. Criticality will be defined and documented upfront. Engineering, Maintenance, and Operations personnel will work together to identify how existing and new equipment should be designed, maintained, and operated. As part of the RAM process, design recommendations will be implemented to ensure that critical equipment and systems can perform reliably and consistently and can be maintained with minimum complexity. PMs and PdMs will be specified to attack specific failure modes and forcing functions at frequencies that will maximize system availability at optimal cost while eliminating non-value PM activities. The goal is to move the MFC ERP from a dependent model to an independent model – and to permeate reliability principles and practices throughout the organization until the principles and practices become "business as usual".

15.4 Equipment/Tools

MFC PdM program currently utilizes the following suite of different tools and software to track and trend equipment health:

- Vibration – MFC utilizes vibration analysis to monitor rotating equipment such as pumps and fans using the SKF Vibration tool (CMXA 80), and SKF @ptitude analysis software.
- Thermography – MFC utilizes thermography analysis to monitor mechanical equipment and electrical equipment such as panels and breakers using FLIR infrared imaging hardware (E8, E85, T620 Cameras), and FLIR software for analysis.
- Tribology – MFC utilizes Bureau Veritas for mechanical oil analysis and SDMyers for transformer oil analysis.
- Ultrasonic – MFC utilizes a Ludeca SDT270 ultrasonic module to diagnosis rotating equipment, leak detection, electrical faults and to perform proper bearing lubrication.
- Motion Amplification – MFC utilizes RDI motion amplification hardware and software for in-depth vibration fault diagnosis.
- PdM Database – The MFC PdM team has developed an in-house database that stores PdM monitoring activities. With the implementation of ER suites, the PdM group will be using PlantIQ to continue to track the equipment.

The various PdM technologies will continue to monitor equipment health and report to System/Facility Engineers as well as Facility Managers as anomalies arise. Currently, "as-found" reports are authored and sent to System/Facility Engineers and Managers as anomalies are found. System/Facility Engineers are expected to work with Facility Managers and PdM personnel to determine corrective actions as required. Health for all equipment is also reported monthly to System/Facility Engineers and Facility Management. With the implementation of ER Suite, all reporting will be integrated into PlantIQ for System/Facility Engineers to view in real-time. Vibration monitoring will continue for existing rotating equipment and will also be incorporated into new equipment as an element of the MFC RAM process. Thermography and Tribology monitoring will continue to be streamlined as equipment criticality is evaluated. Ultrasonics will continue to be incorporated into new and existing bearing lubrication PMs and will be deployed for airborne and electrical survey applications as required. Proper execution of the PdM program will minimize unplanned facility/system downtime and move the maintenance culture from a Reactive/Preventative model to a Preventative/Predictive model and, ultimately, towards a Predictive/Proactive model.

15.5 Actions FY-21

- Continue PM Optimization process goal to complete top 20% of critical systems within MFC (Stuart Jensen, September 30, 2021 [on-going])
  - Continue to grow PdM monitoring through PM Optimization process.
- FY-21 training plan for PdM group (Stuart Jensen, September 30, 2021)
  - Train and certify (at least) two Mechanics to Vibration Level 1 and Ultrasonics Level 1
  - Train and certify (at least) one Electrician to Thermography Level 1
  - Train and certify PdM Thermography Analyst to Thermography Level 2 and Ultrasonics Level 1
  - Train and certify (at least) the Vibration/Tribology Analyst to Vibration Level 3
  - Train and certify the ERP Lead to Vibration Level 1, Thermography Level 1 and complete CRL course and certificate

- Train and certify PdM personnel in lubricated transformer Oil Analysis.

- Support full implementation of ER Suites (Stuart Jensen, June 30, 2021)
  - Continue to develop and grow System Health reporting through SystemIQ
    - Promote System Engineering ownership of the System Health reporting process.
  - Utilize PlantIQ to report PdM equipment monitoring
  - Utilize LTAM for long term planning.
- Create a RAM standard (Stuart Jensen, May 30, 2021)
  - Finalize criteria for RAM standard
  - Integrate standard into engineering design and facility modification process.

15.6 Looking Forward (FY-22 and Beyond)

- Develop life cycle management process and procedure
  - Develop Long Term planning process and procedure
    - Migrate forward-looking equipment issues into LTAM
    - Train in and implement the use of LTAM risk ranking to support the Facility and Complex Health committees
  - Create obsolescence review standard
- Transfer ownership of PM Optimization to System Engineers (with training) for updating and documenting equipment PM strategies
- FY-22/beyond training plan for 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 dedicated Tribology Analyst (Lubrication Champion) for MFC PdM Program
  - Implement Lubrication Improvement Strategies at MFC
  - Consolidate and standardize lubricant usage at MFC
    - Develop a centralized source of information for lubricant types, application, and compatibilities at MFC
  - Upgrade all PM activities for bearing lubrication at MFC to include usage of Ultrasonics where applicable.
- Develop new metrics for PdM Program – including Cost Benefit Analyses (CBAs) and Overall Program Effectiveness
- Grow and develop Ultrasonic Predictive technology application across MFC
- Train and implement the Life Cycle Management process across MFC
  - Integrate RAM process as part of standard Engineering Design and Project Management
  - Train System Engineers in complete obsolescence review of equipment
  - Strengthen long term planning process.
- Develop and Implement Spare Part Process and Program.

16. ENGINEERING/CONFIGURATION MANAGEMENT

16.1 Design Standards

16.1.1 A Look Back

MFC has had several issues with code implementation for 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.

Another major improvement in the use of standards was to introduce an evaluation section to the engineering job 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.

MFC has been creating a standard specification for glovebox procurement. Gloveboxes are a common engineered item that have a standard set of criteria to meet the AGS guidelines for glovebox design. This standard provides the contractors with a clear set of standards and test criteria that apply to a wide range of radiation containment enclosures. The results have saved time and resources for engineering, procurement, and inspection activities. These standards need to become a documented standard for use by the rest of the INL.

16.1.2 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.

16.1.3 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 Master Equipment List. This will create efficiency in not only the conduct of engineering process but in engineering excellence at the INL.

16.1.4 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.

16.1.5 Actions FY-21

- Issue standard for electrical on-line drawings (Stuart Jensen, September 30, 2021)
- Continue to hire engineers proficient in key disciplines (Stuart Jensen, September 30, 2021)
- Identify where lack of guidance indicates need for MFC standards (Stuart Jensen, September 30, 2021).

16.1.6 Looking Forward (FY-22 and Beyond)

The design standards for the Laboratory 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. Following are some examples of design standards that will need to be developed:

- Reliability, Availability, and Maintainability in design
- One-line electrical drawing standard for detail and completeness
- Standard fabrication package format and contents.

16.2 Configuration Management

16.2.1 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. The Analytical Laboratory and some minor facilities remain and are expected to complete by the end of 2020.

16.2.2 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 configuration management 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 location of equipment is known. The equipment coordinator is working through the MEL to verify its data against the reality in the facilities.

In addition, another equipment coordinator is being hired in October of 2020. This important position will be the expert on equipment coordination and modifications during and after the implementation of AS. 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 useable 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. This configuration management specialist will help ensure the engineers get the additional data tied to the equipment in the MEL. This will make all equipment information available to all personnel by looking up the equipment in the AS data base.

16.2.3 Process

The current process for configuration management requires a plan to be written for each system. The implementation of this process has been slow and creates a document that is not easy to find for personnel outside the engineering organization. The plans are entered into EDMS but are currently not stored in AS. The AS data base is the current and future data base for Configuration Management. With the implementation of version 9 of Asset Suite, 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 be retrieved after the modification is complete.

With the full implementation of the MEL data base 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. This will help in LO/TO. When preparing LO/TO, operations will have access to the drawings and information to prepare the LO/TO, this will help eliminate not only the time it takes to find drawings but will also help 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 engineering change. 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 to search 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.

16.2.4 Equipment Tools

The use of a single engineering tool to standardize and organize the engineering, maintenance and operational information is essential for the success of configuration management. AS 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.

16.2.5 Actions FY-21

- Write system design descriptions (SDDs) for all newly installed systems (Stuart Jensen, September 30, 2021).
- Have a staff of Configuration Management Engineer and coordinators adequate to support transition to AS equipment-based processes (Stuart Jensen, Action Complete).
- Develop a process for identification of safety class/safety significant items and critical characteristics in design output documents. This will aid in the procurement by clearly identifying which items support the safety function. This identification will be clearly defined in AS (Stuart Jensen, April 30, 2021).
- Continue with updating essential drawings for the facilities identified (Stuart Jensen, September 30, 2021).
- Implement the new facility modification process to add critical information into the data base (Stuart Jensen, April 30, 2021).

16.2.6 Looking forward (FY-22 and Beyond)

- Create system design descriptions (SDD) for systems; at present in general these only exist for active safety systems, as required by DOE O 420.1c, “Facility Safety.”
    - SDDs will proceed in order of importance as defined in the SERP process, also completed this year.
    - Assigned system engineers will write SDDs and include lists of safety-related and defense in depth equipment/components.

- The new AS will build configuration management into its workflows and data structures and will begin to populate those structures with CM documentation as it is developed.

- Upgrade to AS9, which will include integration of EDMS with AS.
  - Configuration management information will be directly tied to the over 50,000 pieces of equipment, including: tracking maintenance justifications, modification information, all drawings, SDDs, engineering specifications, operating procedures, and manufacturer information which can be organized with each individual piece of equipment.
  - The upgrade will save time and resources in engineering, operations, and maintenance.
- 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.
- Additional initiatives that must take place during the AS upgrade include:
  - System design descriptions for the systems will be created; at present in general these only exist for active safety systems, as required by DOE O 420.1c.
  - The new AS will build configuration management into its workflows and data structures and will begin to populate those structures with CM documentation as the data base is populated.

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 evaluated to provide justifiable level of system engineering rigor.

16.3 Modification Process

16.3.1 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.

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. Table 13 is a summary of the evaluation.

Table 13. Summary of the 2018 evaluation of the weaknesses and threats of the Engineering Division.

Area of Need	EFF FASB ZPPR FMF	HFEF	FCF RSWF RLWTF	EML IMCL	AL	UIS	Steady State	Mod Capacity	Total Need	Current Staff	Deficit
Research Equipment (instrument and NRAD).	1	11	4	1	1		18	4	22	14	8
Glovebox, Fume Hoods and Enclosure.	2	0.25	1	0.5	1		4.75	2	6	6	0
Hot Cell boundary, manipulators, atmosphere controls, and feedthroughs.	0.2	2	2	0.5	0.5		5.2	2	7	4	3
Confinement ventilation, chillers, piping, and building HVAC.	1	1	1	0.5	0.5	1	5	1	6	1	5
Software, Network, and servers.	0.5	1.5	1.5	0.5	0.5	2.5	7	2	9	9	0
I&C.	0.5	2	1	0.25	0.25	0.5	4.5	2	6	6	0
Cranes, structures, and seismic.	0.5	1	0.5	0.25	0.25	1	3.5	1	4	1	3
Casks, trailers, and containers.	1	1	1	0.25	0.2		3.45	0	3	1	2

The evaluation identified the need to hire an additional 16 personnel in the MFC Engineering Directorate. There was major emphasis placed in FY-18 on new roles and higher standards in areas of equipment reliability, configuration management, and quality assurance. Beginning in late 2018 and continuing through 2019 in to 2020, additional engineering positions were approved per the staffing plan evaluation and new hires were added to the Facility and System Engineering and the Design and Drafting Departments. The following Table 14 identifies new hires to date.

Table 14. MFC Engineering Directorate new hires.

Department	Full Time Position Hire	Hired
U710 Facility and System Engineering	FCF Process Engr	1

	HFEF System Engr	1
	Equipment Reliability Lead	1
	SPL System Engr	1
	Hoisting & Rigging and MMH	1
	Mech Design Engr	1
	HVAC Sys Engr	1
	Equipment Reliability Support	1
	Mech Design Engr	5
U720 Design Engineering and Drafting	Drafter	3
	Equipment Coordinator (Configuration Management)	2

16.3.2 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-21 MFC Engineering is short of staffing in the following positions:

- 1 Cask/Container Engineer
- 2 Mechanical System Engineer
- 2 Mechanical Design Engineer
- 1 Electrical Engineer
- 1 I&C Engineer
- 1 Drafter.

16.3.3 Process

The modification process performed by engineering is currently well defined at MFC. A major process improvement will be the implementation of Engineering Change within AS. With this new change to the facility modification process, MFC will have a managed system that will allow an outside organization to request engineering effort in a straightforward process to allow the engineering organization to assign the correct system engineers to 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 is investing time and attention to defining

and refining the ASengineering process workflow that will be implemented during the implementation of 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 Engineering Change (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 EC 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 will allow the engineer to load documents, drawings, and records against the proper equipment and/or Master Equipment and Activities List (MEAAL) system. Once facility documentation has been loaded against equipment and/or MEAAL system, the engineer will no longer have to spend days determining what documentation will require revisions because prior to initiation of a facility modification, i.e., the documentation will be readily available in AS.

16.3.4 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 will provide 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 will dramatically change the facility modification process at MFC. AS will not only be a tool used for both controlling and tracking the change but will 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.

16.3.5 Actions FY-21

- Implement the new modification process using AS, including training engineering personnel (Stuart Jensen, April 30, 2021)
- Continue to address staffing needs to broaden existing disciplines and fill needed discipline in the areas of HVAC, Cask Handling, Gloveboxes and Enclosures, and Civil/Structural (Stuart Jensen, September 30, 2021)

- Draft an indirect funding proposal for staffing to address legacy configuration management deficiencies (Stuart Jensen, September 30, 2021)
- Develop a modification process suitable for non-facility research equipment (Stuart Jensen, September 30, 2021)
- Develop a process for scalable and repeatable engineering rigor for facility modifications (Stuart Jensen, April 30, 2021)
- 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, April 30, 2021)
- Implement DOE STD-1189, "Integration of Safety into the Design Process," Major Modification screening questions formally into the facility modification process (Stuart Jensen, April 30, 2021).

16.3.6 Looking Forward (FY-22 and Beyond)

- The new facility modification based in AS will solve several systemic issues with the current facility modification process. The modifications will allow outside organizations a simple process to get engineering services, allow for a process that is rigorous and is electronic eliminating the time necessary to route paper packages for individual approval.
- The new approach, which will be fully integrated with configuration management, will have an impact to keeping 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 engineering change process.

16.4 Quality Assurance (Design)

16.4.1 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 was combined into the engineering organization. This change has facilitated collaboration in the design process and has created a culture where quality and how to verify the quality is considered early 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 are found below:

- Altered the engineering job 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 re-write of LWP-10109, "Commercial Grade Dedication" to be a clear and efficient process which also included comprehensive classroom training given by the SME.

16.4.2 People

The number of items being procured has increased from $11,200,000 in 2016 to $22,100,000 in 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. However, with the implementation of engineering change and procurement engineering, more quality engineers are needed for the creation of Bills of Materials (BOMs), and in performing procurement engineering evaluations to document design basis information. One additional quality engineer has been hired and an additional quality engineer will be needed within the second quarter of FY-21. Staff such as engineering and planning will need to be trained on BOMs to ensure an efficient and accurate process.

16.4.3 Process

New processes for engineering in AS will be deployed early in FY-21. The new processes are engineering change and procurement engineering. With the engineering process completely housed in AS, engineering decisions will be 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. 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 will be a part of the category ID 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.

16.4.4 Equipment Tools

The AS implementation of engineering change and procurement engineering modules will improve the quality of engineering deliverables by containing the design information as well as the history of design changes in one location. AS will drive quality assurance by being able to link important documents such as drawings, specifications, and others to the equipment. A clear link between requirements and outputs will be established within AS.

16.4.5 Actions FY-21

- Establish BOM within AS (Stuart Jensen, April 30, 2021)
  - A process will be established for building BOMs
  - Involvement of Cognizant Safety Engineer (CSE) in the review and approval of BOMs and Catalog IDs.
- Develop a process for identification of safety class/safety significant items and critical characteristics in design output documents (Stuart Jensen, April 30, 2021).
- Continue creating standard specifications for items like containers, lead crucibles, rad-con equipment, anchors, and others as appropriate (Stuart Jensen, September 30, 2021).
- Communicate to the engineering department on best practices for Drawings, SPC, and SOWs. Clarify when specifications should be used and when statement of works are appropriate (Stuart Jensen, September 30, 2021).

16.4.6 Looking Forward (FY-22 and Beyond)

As MFC Engineering moves forward, facility modifications will continue as MFC becomes the leader in reactor and fuel demonstration and testing. This will require an agile team that must be 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 becoming efficient in design quality.

- Reconcile INL drawings with fabricated red-line drawings.
- Create Cat ID's and common procurement strategies that span multiple facilities that aligns with the code or record (e.g., anchors, valves, PLCs, and other identified items).
- Determine how to design for manufacturing, constructability, and production processes for facility modifications.
- Establish reviews of design and look at improvements that can be made based on fabricator/construction feedback and change requests to original design.
- Develop a standard for model-based design definition and fabrication

16.5 Readiness

16.5.1 A Look Back

DOE O 425.1D, "Verification of Readiness to Startup or Restart Nuclear Facilities," was issued on April 16, 2010. This required a substantial change in the way NFMs prepared equipment, personnel, and processes following a change in the facility, operations, or activity. MCP-9902, "Verification of Readiness to Startup or Restart Nuclear Facilities," was issued on December 16, 2010 implementing the changes to the new Order. Revision 2 to MCP-9902 was issued on January 27, 2014 and added an appendix of criteria that, when satisfied, would not require a formal readiness review. This appendix had been revised several times since 2014 and has resulted in an effective tool for screening out minor changes from the readiness process.

The INL evaluates on average, 16 readiness activities each year. Of these, MFC activities support 13 per year, on average or 80%. Table 15 shows the readiness activities for INL-wide and MFC for the past 10 years. Once the screening criteria was added to MCP-9902, approximately half of the evaluated changes to equipment, operations, or activities do not require a formal readiness review.

Table 15. The number of readiness activities each year at INL and MFC.

Year	Number Eval	SNR	Exempt	MFC	MFC %	SNR %
2010	23	23	0	18	78%	
2011	23	23	0	15	65%	
2012	11	11	0	9	82%	
2013	11	9	2	8	73%	82%
2014	19	11	8	18	95%	58%
2015	17	7	10	13	76%	41%
2016	20	9	11	15	75%	45%
2017	10	3	7	10	100%	30%
2018	15	4	11	13	87%	27%
2019	7	4	3	7	100%	57%
2020	18	9	9	14	78%	50%

Average	15.8	10.3	5.5	12.7	82.6%	48.7%

Another substantial improvement was incorporating the readiness process into AssessmentWay in 2018. AssessmentWay has eliminated a significant amount of administrative burden for the operations team in preparing the required documentation necessary to conduct and document the results of a readiness review.

16.5.2 People

The primary challenge during years of heavy readiness review scope is having qualified team leaders that can lead the reviews. Three team leaders have retired or changed positions and therefore, are not available to support this activity. The DOE Order requires team leaders to be: 1) knowledgeable of the area assigned for evaluation, 2) knowledgeable of performance-based assessment processes and methods, and 3) knowledgeable of the facility, activity, or operation. Team members are generally easy to select and contributing to a readiness review provides a development opportunity for personnel.

16.5.3 Process

The primary purpose of the DOE Readiness Order is to provide the NFM with an independent review of a change to the facility, operation, or activity. The Readiness Order requires formal readiness activities that screen as an Operational Readiness Review (ORR) or a Readiness Assessment (RA) have two independent reviews, and a Contractor review followed by a DOE review. Each review takes approximately one month to complete and adds significantly to the project cost and schedule associated with the change.

The primary challenge with the process is performance of two independent reviews. The INL Readiness SME has been working with DOE-ID for the past 2-years to streamline this process. A key component of this improvement is strengthening the CM process. The EJ process is used to document changes to items managed under configuration management. A weakness noted in numerous readiness reviews is the lack of attention to detail when completing the EJ.

16.5.4 Equipment/Tools

The documentation required for a readiness review contains a significant amount of operational burden for the operations team. Once the equipment, operations, or activity change has been evaluated using TEM-9902-A, "Activity Description and Evaluation," each readiness activity requires preparation of a Plan of Action (POA), IP, and a readiness report. MCP-9902 allows three options for these documents: 1) AssessmentWay, 2) Use of forms (FRM-1469C, "Materials and Fuels Complex Contractor Readiness Assessment Plan of Action and Implementation Plan," and FRM-1469D, "Materials and Fuels Complex Contractor Readiness Assessment Report"), or 3) creating formal plans using TEM-9902-C, "Plan of Action Format" and TEM-9902-D, "Implementation Plan Format." The use of AssessmentWay has significantly streamlined this process but is not well understood by most users. It is also still somewhat "buggy." Creation of a user's-guide and additional development activities are required to improve this tool.

16.5.5 Actions FY-21

- Identify a total of five senior people who can serve as readiness activity team leaders (Shawn Hill, February 28, 2021).
- Train and mentor the identified team leaders such that they are proficient is performance of team lead functions (Shawn Hill, September 30, 2021).
- Create a User's-Guide for application of AssessmentWay to readiness reviews (Shawn Hill, March 30, 2021).

- Modify AssessmentWay to allow user friendly application to readiness reviews (Shawn Hill, June 30, 2021).

- Identify a new MFC Readiness SME to replace a pending retirement (Shawn Hill, January 30, 2021).

16.5.6 Looking Forward (FY-22 and Beyond)

- Revise MCP-9902 to eliminate DOE and Contractor readiness reviews. The current proposal is to perform a single contractor readiness review that DOE will shadow.

    - Materials and Services – Fish.

17. MATERIALS AND SERVICES

17.1 Procurement

17.1.1 A Look Back

In mid-2015 the Nuclear Material Acquisition Group was formed at MFC and has seen tremendous growth in recent years. As an example, in 2016 MFC purchased $11,200,000 in materials and in 2020 MFC purchased $22,100,000 in materials an increase of 97% in 4 years. The group was able to manage this large increase by incorporating process improvements and implementing a customer focused strategy that included more engagement with facilities and project individuals. The acquisition group was integrated within engineering and includes procurement (contracts and materials), material coordinators, commercial grade dedication, quality, warehousing, and receipt inspection.

NOTE: *This is not added headcount but rather assembling connected functions into one department with many positions being matrixed from home organizations, such as quality, to optimize teamwork.*

The current acquisition group focuses on customer service and being the path of least resistance for the programs at MFC. The group has embraced this culture and has 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 a complete re-write of LWP-10109. Accompanied with the re-write, was a new training program that included class time for CGD initiators and practitioners. Since re-write and implementation, an external audit has been conducted of the program with no findings. MFC continues to improve and analyze effectiveness.

MFC has increased capabilities for receipt inspection to include improved dimensioning capabilities as well as XRF (x-ray fluorescence) which allows MFC to perform dedication activities in house.

Improvements have been made to informal processes for tracking and staging of material, which has decreased the time to process as well as decreased errors. The acquisition group continues to hold meetings with facilities to provide up to date status on procurements and work to resolve issues. These meetings have been beneficial to Analytical lab, HFEF and specific projects such as MARVEL and MSTEC.

17.1.2 People

To create an effective cradle to grave procurement support organization at MFC it was imperative to identify key organizational positions and collate these existing functions within the organization was necessary. An effective method is matrixing individuals from functional organizations such as Quality Assurance (QA) into the Organization. The QA organization is fully matrixed within the Organization and consists of quality engineering and receipt inspection. Matrixing these individuals created a team environment where the team works together to solve problems that arise daily. Currently, procurement, including buyers and subcontract administrators, are co-located at MFC but are not directly matrixed to the organization.

To take the next step, matrixing these procurement individuals to MFC will be necessary. This effort will not only include matrixing buyers and subcontract administrators but will include construction contract administrators as well. All matrixed procurement individuals will be required to have a strong understanding of nuclear procurements a nuclear buyer/contract specialist qualification will be implemented. This qualification will ensure adherence to key nuclear facility quality and safety

requirements and could provide a financial incentive to those who are chosen to be part of the MFC Team. In the long term, BEA Acquisition and Contracts Management will assign a management level individual to lead the MFC team, who in turn will assign lead roles to competent and trustworthy individuals for materials purchasing, service contract management, and construction contract management.

The need also exists to transition MFC buyers from commodity-based purchasers (current BEA procurement structure) to facility-based buyers who will support only MFC specific needs. Additional dedicated procurement professionals will be needed to support all MFC facilities future purchasing and contracting needs.

17.1.3 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. A MFC online material request form has been beta tested 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 will provide efficiencies as items will contain all the needed information to facilitate efficient procurements. The changes include development of BOMs for equipment, containing design basis documentation, and reducing required reviews for procurement of items. This improvement will reduce the number of added hours engineers and planners spend looking for information and identifying the appropriate material or equipment to order.

17.1.4 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 larger staging area is necessary. Currently the staging is located on a mezzanine upstairs in Building 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.

17.1.5 Actions FY-21

- Addition of a Contract Specialist supporting MFC (Stuart Jensen, May 30, 2021)
- Implementation of procurement engineering within AS with the benefits of bill of materials, design basis documentation, and review by cognizant engineer (Stuart Jensen, April 30, 2021)
- Full deployment of MFC electronic acquisition form (Stuart Jensen, August 30, 2021)
- Reduction of reviews for material requests (Stuart Jensen, April 30, 2021)
- Development of procurement dashboard that is easy for all to use, track items by work order, requestor and be able to quickly see if the item is past due, in receipt inspection, has an OSD&D (over, short, damaged, and discrepant), or is fully received (Stuart Jensen, June 30, 2021)
- Use of website to incorporate procurement process from design to acceptance (Stuart Jensen, September 30, 2021).

17.1.6 Looking Forward (FY-22 and Beyond)

The demand for procurements at MFC is expected to grow in both volume and complexity. Efficient and transparent purchasing processes, paired with on demand acquisition status, will be vital to accomplish the needed modifications and improvements at MFC. The Nuclear Material Acquisitions Group at MFC is off to a great start but improvement must continue. 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 if customer oriented and technically competent individuals are in key procurement positions.

A summary of the recommended process improvements includes the following:

- Have a standard process for requesting engineered items that does not incorporate redundancies (e.g., Fab request, and material request)
- Nuclear Buyer and Nuclear Contract Specialist qualification/Designation and associated compensation incentives
- Enough buyers and contract specialists within the organization to handle all MFC acquisitions (change to commodity buying and centralized purchasing)
- Fully matrixed organization with a designated MFC Acquisitions Manager and procurement leads in key areas
- New warehouse for staging and storage of spares
- Staging improvement – scan and stage to location and implement a process to easily see location of staged items.

17.2 Commercial Grade Dedication

17.2.1 A Look Back

Five years ago, MFC embarked on a path to become “Best in Class” in CGD and procurement engineering. These changes included a new organization structure, new people, new procedures, and new training. These changes were brought about from a realization by MFC senior leadership of the need for improvement to attain excellence in the area of commercial grade dedication. An improved commercial grade dedication program is aligned with the projected growth at MFC which will require improved procurement effectiveness.

MFC has made significant investments in commercial grade dedication that have paid dividends in the past 2 years. MFC engineering took ownership of LWP-10109 in 2019 and completely re-wrote the procedure in collaboration with senior engineering, quality, and procurement lab-wide leadership (CGD Improvement Team). Additionally, the CGD Improvement Team (CGDIP) redesigned the CGD training program aimed at raising awareness of CGD across effected functions as well as provide focused practitioner training to those authoring CGD plans.

Since implementing the above noted improvements, MFC has employed its CGD program to create 25 CGD plans. The CGD program has been designed to react quickly to emergent operation’s needs, as well as being the primary procurement strategy for the SPL. MFCs program has enabled across the board improvements in nuclear use procurements and has proven effective when deployed for small procurements, as well as significant construction procurements such as SPL.

17.2.2 People

The CGDIP team has implemented a focused strategy to ensure those assigned as SE/CSE of safety SSCs receive CGD and AS training and support necessary to complete efficient, effective procurements. The team's strategy to ensure effective procurement engineering execution is through procedures, training, regular communication, and mentoring from a CGD SME.

Since rolling out the new CGD program in 2019, engineering has trained 24 engineers to be originators of CGD plans. Of those trained approximately half have been actively involved in the dedication process. As such, engineering has re-evaluated the population of those in need of training and identified an additional 14 engineers requiring training as CGD plan originators. This strategy is focused on ensuring that each HAZ-CAT 1, 2, or 3 facility has at least two trained engineers capable of originating/checking CGD plans. Employment of this strategy will focus on training and mentoring by the CGD SME, thereby expanding the knowledge and capability of MFC to sustain a best-in-class CGD program.

With regards to the AS9 roll out, the Procurement Engineering Module rollout team is developing MSTI process maps and corresponding training to ensure a seamless rollout.

17.2.2.1 Additional Salient Items

- The program is currently SME based
- Additional time and mentoring are required to raise the skill level of those needing this skill set

17.2.3 Process

17.2.3.1 Commercial Grade Dedication

Commercial Grade Dedication process improvements have significantly improved CGD performance across the lab. When the process was introduced in 2019, it aligned with the existing execution model of documenting processes in LWPs, completing work on standard templates and qualification to do that work via classroom training. As the process is transitioning to AS the procedure and process platform are changing significantly. CGD plan creation will be performed within AS in variable templates, while the procedure requirements will be housed in the MSTI process maps. Training will remain the same. This transition offers opportunities for efficiency gains that align with overall engineering configuration management improvements. Much of the data currently populated in CGD plans will exist within the AS panels therefore allowing for shortening of the CGD template.

Currently, CGD plans are created on an "as needed" basis and are very specific to the item and installed location. Going forward, the creation of bounding CGD plans for general commodities, that would be attached to the CAT-ID, will allow for items to be procured quickly and efficiently.

17.2.3.2 Asset Suite

The rollout of AS9 offers opportunities for engineering and procurement engineering to become more efficient and effective. In addition to incorporating CGD into Asset Suite, the process for creating CAT-IDs will be improved while the BOM module will be employed for the first time. Better integration of the above noted items is part of broader engineering process integration into AS. From a procurement engineering perspective, AS9 will ultimately result in more efficient, consistent procurement of QL-1, Ql-2, and QL-3 items. The primary drivers for this improvement will be the housing of technical and quality requirements within the item CAT-ID in addition to associating the item to the system via the BOM module.

17.2.4 Equipment/Tools

Completing the commercial grade dedication process can require special equipment. MFC inspection and test capability include X-Ray Fluorescence (material chemistry), metal hardness/strength testing, soft, good durometer testing as well as a variety of dimensional inspection instruments. MFC testing capability can be augmented via qualified testing suppliers. Additional testing and inspection capabilities would reduce reliance on third party dedicators as well as lower procurement costs and material lead times.

17.2.5 Actions FY-21

- Complete AS MSTI transition (Stuart Jensen, April 30, 2021)
  - Deploy CGD variable template into AS
  - Deploy non-standard RII into asset suite
  - Complete AS Procurement Engineering and BOM Module training
  - Complete and deploy MSTI process maps, step detail, R2A2's, training, and knowledge articles.
- Create bounding CGD plans and corresponding procurement specifications to lower procurement cost and lead time and enable ease of purchase for the following (Stuart Jensen, September 30, 2021):
  - Carbon and stainless-steel metal shapes
  - Fasteners
  - Electrical wire
- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training Regarding CGD (Stuart Jensen, September 30, 2021)
  - Complete CGD practitioner training at MFC
  - Issue regular Procurement Engineering bulletins to communicate lessons learned and best practices
  - MFC CGD user group practitioner capability needs to increase from six to ten in FY-21.
- AS9 Integration (Stuart Jensen, April 30, 2021)
  - Set all QL-1, QL-2, and QL-3 CAT-IDs to "Pending PE Eval" to require a PE review
  - Require a BOM evaluation for CAT-ID's requiring procurement.

17.2.6 Looking Forward (FY-22 and Beyond)

- Create Procurement Engineering Guidance
  - Create guidance on best practices for nuclear use build to print procurements
  - Create guidance on best practices for employment of CGD as the primary procurement strategy for EPC projects
  - Create guidance on nuclear use procurement strategy selection.
- Continued AS9 Integration
  - BOMs for all systems built in AS
  - CAT-IDs that have been through the PE Module can go directly to procurement.

17.3 Quality Assurance (Procurement)

17.3.1 A Look Back

In the last 5 years, MFC has driven significant organizational paradigm changes in procurement 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 quality assurance 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 (CGD Improvement Team).
- Implementation of the AS Procurement Engineering Module

Outcomes of improvements made have been quality focused, incremental progress. SPL is a prime example of 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.

MFC has been the laboratory trail blazer 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.

17.3.2 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 R2A2s must be aligned to ensure an integrated process.

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

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.

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.

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.

17.3.3 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.

17.3.4 Actions FY-21

The vision for FY-21 in terms of procurement quality improvement is focused on increased transparency, integration, and collaboration between 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:

- Adapt oversight to current exigent conditions where alternate supplier oversight techniques are employed, i.e., video teleconferencing and employing the EFCOG MSL to qualify suppliers (Stuart Jensen, September 30, 2021).
- Continue to mature the concept of directed procurements where INL specifies acceptance criteria/critical characteristics to reduce supplier risk and overall procurement costs (Stuart Jensen, September 30, 2021 [on-going]).
- Draft MFC guidance on best practices for developing large CAPEX procurement acceptance strategies (Stuart Jensen, September 30, 2021 [on-going]).
- Facilitate the retirement of LWP-13014, “Determining Quality Levels” by incorporating the quality level determination process into the AS Procurement Engineering module (Stuart Jensen, April 30, 2021).
- Develop process to define quality levels for procured services including construction (Stuart Jensen, September 30, 2021)
- Complete AS MSTI transition (Stuart Jensen, April 30, 2021)
    - Complete AS Procurement Engineering Module training
    - Complete and deploy MSTI process maps, step detail, R2A2s, training, and knowledge articles.

- Improve MFC Personnel Proficiency, Awareness, Attitudes, and Training Regarding Procurement Quality (Stuart Jensen, April 30, 2021)
    - Issue regular Procurement Engineering bulletins to communicate lessons learned and best practices
    - Improve communication and clarify roles regarding receipt inspection findings/outcomes such as OSD&Ds (over, short, damaged, and discrepant) and NCRs.
    - Ensure proper training and awareness of SP-20.6.5, "MFC Procurement Clause Requirements," by the MFC Engineering group.

17.3.5 Looking Forward (FY-22 and Beyond)

FY-22 and beyond will see MFC continuing to lead the way in procurement quality. The following are planned areas of improvement from FY-22 and beyond:

- Identify supply chain issues to help establish risk reduction approaches (e.g., welding, consistency of requirements for items such as ASME B31.3, "Process Piping").
- Establish a regular vendor forum to facility MFC/INL vendor improvements as well as allow vendors to offer suggestions on where MFC/INL can improve their procurement procurement/acceptance processes. (e.g., meeting with key suppliers on common performance health issues and needs, what issues vendors see with MFC/INL technical and quality specifications, etc.)
- Cross site-collaboration of resources for efficiencies (e.g., one DOE contractor audits a local vendor for a DOE contractor in another state to address travel restriction issues).
- 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.

18. NUCLEAR SAFETY

18.1 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 of the two new facilities within the department: Remote Handled Low-Level Waste (RHLLW), and Irradiated Material Characterization Laboratory (IMCL). Additionally, the department developed the preliminary documented safety analysis (PDSA) for the new SPL. The SPL PDSA was the first and precedent setting DSA following the newest revision of DOE-STD-3009.

The department has made improvements in the application of the USQ process and procedure, LWP-10801, "INL Unreviewed Safety Questions." MFC Nuclear Safety worked with the program office to define an additional Categorical Exclusion (CX) for the USQ process as outlined in LWP-10801. The new CX allows the exemption of procedures being suspended or canceled when they meet the requirements outlined by the CX. Additionally, MFC Nuclear Safety developed a streamlined process of including controlled drawings within the Engineering Process by allowing the drawings to forgo the normal USQ process and be included in the review of the associated EJ. This helped reduce additional reviews for the same EJ while providing for an overall, comprehensive review of modifications to a nuclear facility.

Over the past year, the MFC Nuclear Safety department has been working to identify and document a safety related equipment list (for all Safety Class and Safety Significant SSCs). This effort will identify all Safety Related systems for all facilities at MFC, as well as define the Critical Safety Functions of each. This is a specific request from the ALD for MFC. The goal of this list 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 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.

18.2 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 30 years' experience. This culminates in a department focused on mentoring younger staff while also being fully engaged in new developments and capable 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 bringing the department to full staffing as of the end of FY-20.

The employees hired in FY-20 will be fully qualified, contributing members of the department by spring 2021. The training and mentoring process used to fully qualify employees to be Nuclear Safety Analyst/Engineers fully meets the requirements for Technical Staff outlined in DOE directives.

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.

18.3 Process

Nuclear Safety processes and procedures are outlined in Laboratory-wide Manual Chapter 18, "Nuclear Safety." They 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 the Laboratory-wide. In FY-20 that included several changes to procedures and processes. Significant improvements have been made to the USQ process and analysis guidance documents. While efficiency has been gained, there is more work to be done.

18.4 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.

FY-20 has highlighted another tool for the MFC Nuclear Safety department. That is, 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.

18.5 Actions FY-21

- Safety Basis Development (Stuart Jensen, September 30, 2021)
  - Define the lower threshold for when Safety Significant shielding is required and revise program documents to include this guidance for future safety bases revisions.
  - Work with Operations to determine the best units for accounting Material at Risk (MAR) for each nuclear facility.
  - The Nuclear Safety Rule, 10 CFR 830 has been revised. Implement the changes to regulations at MFC once the revision to the code has been issued in the Federal Register.
  - Assist Transportation implement SAR-413, "Safety Analysis Report for Intra-INL Transportation and MFC Inter-Facility Transfers" following the conversion of Transport Plans into SAR-413.
- Safety Analysis (Stuart Jensen, September 30, 2021)
  - Use the development of Critical Safety Functions (CSF) outlined below to improve the Operability Review process. CSF development will assist in clearly defining the safety function of Safety Related SSCs to facilitate clearer Operability Reviews.
  - 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 violation

- Potential Inadequacy in the Safety Analysis (PISA)/USQ Process Implementation (Stuart Jensen, September 30, 2021)
  - Work with Engineering to develop a "Road Map" to help illustrate when the USQ process is required to be entered.
  - Work with NFMs to appropriately annotate when the PISA process is required to be entered. Part of this task will be to educate the NFMs on recent lessons learned across the DOE complex, the rest will be identifying on ramps to the PISA process from normal and abnormal occurrences within the facility.
- TSR Implementation (Stuart Jensen, September 30, 2021)
  - 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 to remove the impact of missed surveillances and the required actions associated with SAR-400.
- Critical Safety Functions (Stuart Jensen, September 30, 2021)
  - Complete the classification of each Safety SSC for all facilities at MFC and determine the appropriate format to present the information to both Engineering and Operations.
  - Work with Operations on understanding and implementing the different measures and limits for Criticality Safety terms, such as U5E.

18.6 Looking Forward (FY-22 and Beyond)

- Implement the 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.
- 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. (This effort was limited by COVID-19 in FY-20 but will remain a focus moving forward into FY-21 and beyond.)
- 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 Documented Safety Analyses and determine if an 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 facility 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 Material at Risk (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.”
- Critical Safety Functions
  - Build upon the system level CSFs to further define the system components, their functions, and better define the boundaries of Safety Related systems at all nuclear facilities at MFC.
  - Define CSF for equipment in the MEL database.

19. NUCLEAR MATERIAL MANAGEMENT

19.1 A Look Back

MFC manages a substantial inventory of contact-handled and remote-handled (primarily spent nuclear fuel [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 800 kg of contact-handled excess special nuclear material (plutonium and enriched uranium) and more than 115,000 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 sodium-bonded EBR-II/FFTF fuel. A custom vacuum distillation furnace system was developed and successfully used to separate the reactive sodium metal from between the cladding and the fuel slugs. the fuel slugs were then sheared and repackaged for shipment. The HEU was subsequently shipped to a BWXT Facility for recovery and subsequent re-use 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 special nuclear materials 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 multiple new advanced fuel manufacturing systems installed. These new systems have already proven to be key to supporting rapid manufacture of many unique test articles for TREAT and ATR irradiation.

Over the last 5 years, more than 660 kg of EBR-II SNF was also shipped from INTEC wet storage to MFC and 400 kilograms of EBR-II SNF was treated in FCF to eliminate the hazards associated with the reactive metallic sodium bond between the fuel slug and cladding. In addition, more than 700 kg of the recovered enriched uranium product was recast 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 30-40 kg HALEU through a stacked set of crucibles with the lower portion having interconnecting 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 intended to support glovebox-based fuel fabrication needs associated with advanced reactor concepts.

19.2 People

The Division staff working on the various nuclear material management efforts are highly trained and many require Q clearances and Human Reliability Program 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 Radiological Controls, Safeguards, Engineering, and Crafts support personnel are also routinely relied on outside of 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 $5 M, plus yearly escalation) and minimum perturbation of the staffing level. The current and outyear nuclear material management work scope priorities are planned around this consistent resource base. The majority of associated staff supporting the nuclear material management efforts are relatively young. Personnel attrition hires are made as needed, but there is little to no backup personnel capacity, so nuclear material management impacts can be expected if outyear staffing projections do not prove to be accurate, or if significant additional programmatic scope is added to the Division workload. The FFNMM staffing and succession planning efforts attempt to minimize the impact of such potential personnel shortfalls. However, FFNMM historically runs relatively ‘lean,’ and so mentoring and hiring of additional personnel is recommended to the extent funding permits, especially regarding positions associated with Nuclear Facility Management, Operations Support Professionals, and Fissile Material Handlers.

Production Facilities necessary staffing is more directly dictated by regulatory and legal commitment drivers associated with the Idaho Settlement Agreement, 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. The additional staff have included operational technicians, radiological control technicians, engineers, manipulator repair specialists, and a host of other administrative personnel necessary to support the fuel treatment and HALEU production requirements.

19.3 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 processes for disposition of excess legacy plutonium material has been initiated, but the approach will be dependent on whether near-term plutonium fuel fabrication efforts for the Versatile Test Reactor (VTR) or the Molten Chloride Reactor Experiment (MCRE) will occur.

FFNMM will continue to evaluate existing INL nuclear material inventories to determine what material 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 metal feedstock material. This includes installing a new casting furnace capability in FMF that can produce kilogram quantities of good, enriched uranium metal feedstock from legacy degraded metal pieces.

Production Facilities has continued to utilize the pyrometallurgical equipment originally deployed in FCF during the mid-90s as part of the Integral Fast Reactor (IFR) experiment. Upon cancellation 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 complete 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.

19.4 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:

- New 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. As a minimum, this will include new process equipment for casting scrap oxidation, mechanical disassembly, size reduction, blending, characterization, packaging, and disposal. If VTR or MCRE fuel fabrication do not occur in the near term, then the new indirect-funded general-purpose plutonium gloveboxes that are currently in development could house this processing equipment. If VTR or MCRE fuel fabrication does occur in the near term then another new glovebox may need to be developed to house this equipment, assuming new VTR or MCRE gloveboxes do not sufficiently incorporate usable legacy plutonium scrap disposition capabilities. If new plutonium fuel missions effectively fill-up space in FMF to the point of displacing the current HEU processing glovebox capabilities, a new smaller HEU breakout glovebox will still need to be installed in FMF, along with a larger glovebox system in ZPPR to maintain the capabilities currently provided in the existing FMF SNM Glovebox.

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 a new multi-function furnace to enhance the distillation and uranium casting capabilities. This new remotely operated furnace will increase the process reliability by alleviating the current single point failure 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 have also funded the establishment of an expanded fuel inspection workstation that will eliminate redundant element handling 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.

19.5 Actions FY-21

FFNMM contact-handled material management targets for FY-21 include the following:

- Meet defined program goals (Tim Hyde, September 30, 2021).
- Develop conceptual excess Pu scrap disposition process requirements and equipment to begin planning for those future efforts (Tim Hyde, September 30, 2021).
- Negotiate details and package additional ZPPR Pu fuel for the National Critical Experiments Research Center (NCERC) if their preliminary interest in additional high Pu-240 fuel becomes a firm material transfer request (Tim Hyde, September 30, 2021).
- Implement SNM program leadership succession plan (Tim Hyde, September 30, 2021).

19.6 Looking Forward (FY-22 and Beyond)

FFNMM contact-handled material management actions for several years beyond FY-21 include the following primary targets.

- Evaluate keeping NE owned HEU. 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 contract, facilitating reuse of this enriched uranium and freeing up vault storage space for RD&D missions.
- After completing EBR-II/FFTF casting scrap processing, restart decladding, stabilizing, and repackaging the remaining degraded ZPPR HEU fuel plates to make the metal fuel coupons available for reuse.
- Negotiate and perform multiple high-mass excess ZPPR HEU metal shipments to Y-12 to make this uranium available as feedstock for new research reactor fuel.
- If deemed viable, execute LLW disposal of the greater than 50 kg of impure UO_2 recovered from the Sandia sodium debris bed experiments, freeing up storage space for RD&D customers and retiring this long-standing DOE liability. (This is a full cost recovery effort for the NNSA material owner.)
- While processing legacy HEU casting scrap, simultaneously utilize the new casting furnace in the SNM Glovebox to efficiently fabricate kilogram quantities of HEU/HALEU feedstock/products for

RD&D customers.

- Package and ship additional ZPPR Pu fuel to NCERC if requested to support associated nuclear physics experiments.
- 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-21 include the following primary targets.

- Continuing with receipt 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.
- Implement a treatment method to address the inventory of non-candidate material.
- Support research into alternative methods for treatment of sodium bonded blanket elements.
- Support scale-up research into innovative pyrochemical separations concepts and development of related waste form associated with advanced fuel cycle concepts.
- Use electrorefiner salt to support investigations into molten chloride reactor compatibility.

20. RADIOLOGICAL WASTE MANAGEMENT

20.1 Legacy Waste Management

20.1.1 A Look Back

DOE-NE is responsible for the storage, management, and disposition of a number of legacy waste and spent nuclear fuel (SNF) inventories including irradiated sodium-bonded uranium-based material from the EBR-II reactor, sodium-contaminated CH and RH mixed transuranic waste (MTRU), RH mixed low-level waste (MLLW), CH-MLLW, EBR-II driver and blanket SNF and 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 Idaho Settlement Agreement 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, and HLW and the RCRA which establishes requirements for managing mixed waste (waste that is both hazardous and radioactive) and non-rad. 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 (Site Treatment Plan) 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 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 16 below details a summary of legacy waste reduction progress since 2015.

Table 16. Summary of legacy waste reduction progress since 2015.

Waste Stream	Facility Location	Treatment/ Disposal (m^3)*	Ending FY20 Inventory (m^3)	Inventory Dispositioned	Regulatory Driver
RH-LLW	RSWF, HFEF, and FCF	2.8	30.62	8%	DOE O 435.1
RH Mixed LLW	RSWF and SSB (RWDP Backlog)	0	39.32	0%	STP
CH Mixed LLW	SSB (SCMS Backlog)	8.03	14.66	35%	STP
RH-TRU Waste**	RSWF, HFEF, FCF, and AL	0.83	6.31	12%	DOE O 435.1
CH-TRU Waste***	FMF and AL	9.16	0	100%	DOE O 435.1
ZPPR Na Plates	AFF (formerly ZPPR Warehouse)	30,848 Na Plates	Est. 46,310 Na plates	40%	DOE O 435.1
Fermi Drums	Disposition of this	287.52	0	100%	DOE O 435.1

	inventory occurred in FY-18 and the liability has been eliminated				
Tin Bismuth (Na-cont.)	Disposition of this inventory occurred in FY-18 and the liability has been eliminated	1.8463	0	100%	STP
Lithium Hydride (Na-cont.)	Disposition of this inventory occurred in FY-19 and the liability has been eliminated	4.2383	0	100%	STP
ZPPR Calandria Tubes (Na-cont.)	Disposition of this inventory occurred in FY-19 and the liability has been eliminated	1,360 Tubes	0	100%	DOE O 435.1
*Actuals based on 2015-2020 OLELR deductions. **Ship to EM Contractor - INTEC for RH-TRU WIPP Certification ***Ship to EM Contractor - AMWTP for CH-TRU WIPP Certification					

20.1.2 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 been 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, Treatment, Storage, and Disposal Facilities (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 Waste Examination Operator (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 start-up of the RHLLW Disposal Facility, a Facility Disposition Specialist (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, Production Facilities Division has hired 6 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 such as VTR and NRIC are currently evaluating the use of Na and NaK and research activities in SCMS, FCF, and TREAT will be generating new quantities of Na and NaK.

20.1.3 Process

Legacy Waste Management processes are strong. This is due to a number of factors such as strong coordination between MFC waste generating facilities (Bi-weekly waste management meetings); implementing and reinforcing 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 program 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 one 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 Five Year Investment Strategy 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 down-stream waste handling and processing/disposition. The proof-of concept demonstration is scheduled to occur in FY-21 and will include 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 (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 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 (CH-TRU) waste due to downsizing operations to support plant closure. This is anticipated to occur in the 2024 timeframe.

20.1.4 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 currently being expanded to track 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 onsite 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, and 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.

20.1.5 Actions FY-21

- SCMS Backlog – Site Treatment Plan Milestone (Robert Miklos, September 30, 2021)
  - Treat 1.73m^3 of the SCMS Backlog to complete 3-year rolling milestone of treating 6m^3. Selected containers will be shipped off-site to Veolia and treated using GeoMelt.
- RWDP Backlog – Advanced Retrieval Project
  - Complete MSA/CRA readiness activities on the ARP prototype at RSWF (Robert Miklos, March 31, 2021)
  - Retrieve first RH-MLLW liner and ship off-site for treatment using GeoMelt (Robert Miklos, August 30, 2021)
  - Begin Phase II – Optimization of the ARP prototype to refine features to support future RH-MLLW retrieval operations (Robert Miklos, September 30, 2021).

- ZPPR Plates (Robert Miklos, September 30, 2021)
  - Package, ship, and treat at least one cargo container of ZPPR Na Plates.
- Legacy Cargo Containers (Robert Miklos, September 30, 2021)
  - Continue progress on sorting and segregating historical equipment and ancillary components located in cargo containers next to SCMS for identification of legacy waste, characterize and ship off-site for disposition.
- Transuranic Waste
  - Ship at least 2 RH-TRU/MTRU Interim Storage Containers (8 55-gal drums) to INTEC for storage pending WIPP certification by the EM contractor (Robert Miklos, May 30, 2021)
  - Continue efforts to characterize and package legacy RH-TRU waste from the HFEF and FCF Hot Cells (Robert Miklos, September 30, 2021)
  - Initiate preparations for a certified WIPP TRU waste program under CCP (Robert Miklos, Action Complete)
  - Procure Universal Drum Assay Scanning System (UDASS) which will be used as a screening tool and provide improved characterization methods to potentially reduce TRU waste container volumes and prepare the HFEF for equipment installation (Robert Miklos, September 30, 2021).
- Remote-Handled Low-Level Waste (Robert Miklos, September 30, 2021)
  - Retrieve and ship 14 RH-LLW liners from RSWF to the RHLLW Disposal Facility.
- High-Level Waste (Robert Miklos, September 30, 2021)
  - Support establishment of a High-Level Waste Program.

20.1.6 Looking Forward (FY-22 and Beyond)

Looking at FY-21 and beyond, MFC will also need to evaluate and support development of a HLW program for management of cladding hulls and metal waste forms associated with past and current EMT of EBR-II driver spent nuclear fuel 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.

Additional areas that will need focus in the future include:

- SCMS Backlog – Site Treatment Plan Milestone
  - Complete treatment of $6m^3$ by the end of 2024.
- RWDP Backlog – Advanced Retrieval Project
  - Complete Phase II ARP prototype optimization to support future RSWF RH-MLLW liner retrieval operations
  - Continue RWDP backlog reduction activities (retrieve, package, ship) for GeoMelt.
- ZPPR Plates
  - Complete shipment and treatment of remaining ZPPR Na Plates inventory by FY-22.
- Legacy Cargo Containers
  - Continue progress on sorting and segregating historical equipment and ancillary components located in cargo containers next to SCMS, determine waste applicability, characterize and ship off-site for disposition.

- Transuranic Waste
  - Continue leveraging EM contractor TRU certification capabilities
  - Continue efforts to characterize and package legacy RH-TRU waste from HFEF and FCF Hot Cells
  - Establish and mature MFC CCP TRU Waste Certification Program
  - Install UDASS and begin screening of existing and newly generated potential TRU containers.
- Remote-Handled Low-Level Waste
  - Retrieve and ship 14 RH-LLW liners from RSWF to the RHLLW Disposal Facility in FY-22 and continue to work off the RH-LLW backlog at RSWF FY-23 and beyond.
- High-Level Waste
  - Support applicability and implementation of a HLW Program.
- Establish a concentrated area within MFC that contains all the waste management functions.

20.2 Newly Generated Waste

20.2.1 A Look Back

MFC manages various newly generated radioactive waste streams as part of its nuclear energy research and development 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, Transuranic (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 waste programs have incorporated several improvements, specifically in the areas of cost recovery models, TRU program development which aligns with establishing an MFC WIPP certified program, and enhanced waste generator training. In addition, waste programs 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. In FY-20, MFC sent 68 semi-loads of hazardous, radioactive, and mixed waste to treatment and disposal facilities. This is a 113% increase over the 32 semi-loads sent in FY-16.

20.2.2 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, Remote-Handled Low-Level Waste (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 start-up 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. Additionally, a deficit was identified in knowledge/understanding

surrounding requirements related to radioactive material transfers which had created an error likely environment. A training needs analysis determined a qualification, subsequently titled the RMAC, was appropriate to fill this knowledge gap and strengthen MFC transfer procedures. The RMAC qualification will ensure qualified and knowledgeable individuals coordinate radioactive waste transfers. This qualification will be rolled out in FY-21.

Training and qualifications related to sodium (Na) and sodium-potassium (NaK) waste 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 waste treatment experience and expertise has been significantly reduced 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 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. Future programs such as the VTR and the NRIC are currently evaluating the use of Na and NaK. Research activities in SCMS, FCF, and TREAT will be generating new quantities of Na and NaK.

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 Waste Generator Services. 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.

20.2.3 Process

Newly Generated Waste Management processes are strong. This is due to a number of factors such as strong coordination between MFC waste generating facilities that include holding bi-weekly waste planning meetings, and implementing and reinforcing 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 two service centers that collect revenue from MFC programs and projects to pay waste disposition costs and programmatic elements. The INL Waste Generator Services 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 recently 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 Energy Facilities Contractors (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 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 2024 timeframe. VTR, primarily fuel fabrication activities, is currently estimated to generate more than 600 drums of TRU waste during start-up, and over 400 drums of TRU waste per year during operations. While these estimates are very conservative, the estimates dwarf the current MFC TRU waste generation rate of 20 drums per year.

Looking at FY-21 and beyond, MFC will also need to evaluate and support development of a High-Level Waste program for management of cladding hulls and metal waste forms associated with past and current EMT of EBR-II driver spent nuclear fuel 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.

20.2.4 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 used for a variety of waste tracking activities in addition to waste characterization, waste stream profiling, waste disposition, compliance with WAC for on and offsite 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 onsite 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 offsite 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 life-cycle cost savings, and current INL capabilities.

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, and 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. As discussed above, VTR fuel fabrication will increase MFC TRU waste generation from 20 drums per year to over 400 drums per year. VTR fuel fabrication will double the amount of LLW being shipped off-site each year. The facility is needed to accommodate these large increases in waste generation and support specialized characterization and loading capabilities for TRU waste shipments to WIPP.

MFC is currently evaluating a new thermal treatment pyrolysis system which will 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.

20.2.5 Actions FY-21

- R&D equipment within facilities (Robert Miklos, September 30, 2021)
  - Develop a method to ensure sufficient funding for equipment disposition is retained in the event of program termination.
- Transuranic Waste (Robert Miklos, September 30, 2021)
  - Initiate preparations for a certified WIPP TRU waste program under CCP
  - Procure UDASS which will be used as a screening tool and provide improved characterization methods to potentially reduce TRU waste container volumes and prepare the HFEF for equipment installation

- Continue evaluation of the InDrum thermal treatment pyrolysis system.

- High-Level Waste (Robert Miklos, September 30, 2021)
  - Support establishment of a High-Level Waste Program.

20.2.6 Looking Forward (FY-22 and Beyond)

- R&D equipment within facilities
  - Implement the developed method to ensure sufficient funding for equipment disposition is retained in the event of program termination.
- Transuranic Waste
  - Establish and mature MFC CCP TRU Waste Certification Program in coordination with EM ICP contractor TRU certification capability reductions
  - Install UDASS and begin screening of existing and newly generated potential TRU containers
  - Procure InDrum thermal treatment pyrolysis system and install in SCMS.
- High-Level Waste
  - Support applicability and strategic implementation of a HLW Program.
- Upgrade SCMS to a Hazard Category 2 Nuclear Facility
  - D&D legacy EBR-II support equipment
  - PDSA and SAR development, readiness activities, etc.

21. PROJECT MANAGEMENT

21.1 Project Planning

21.1.1 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, and a concerted effort to improve the management of projects at MFC. Similarly, RD&D activities at MFC have also increased significantly over the past 5 years adding additional demand to MFC's research infrastructure, facility operations, and research staffing. 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 at MFC. In order to establish core principles and process in the new division, the initial focus for the division was placed on construction projects. To that end, a monthly project reporting and review process was established for the major plant health projects, additional project management resources were obtained, and improvements have been made for the MFC Project Management division structure and integration with construction management.

21.1.2 People

INL and MFC continue to have a need for new project manager resources and personnel as demand increases and normal attrition occurs; however, with new hires and new project managers to 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. 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.

21.1.3 Process

The INL Project Management Office (PMO) has established the high-level management system/processes for capital asset project management, as required by DOE O 413.3B, "Program and Project Management for the Acquisition of Capital Assets." Project development and management is guided by INL procedures and guidelines that align with industry standards and practices. Tailoring project requirements to smaller projects exists; however, the tailoring process is still unclear for many project managers. 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. Project planning can be very dynamic for each set of circumstances depending on the scope, size, location, and complexity of the project or activity. This requires a project manager who is engaged to have a good base understanding of the requirements necessary to ensure all aspects of a project are covered during the planning phase and carried through execution.

21.1.4 Equipment/Tools/Training

While there is a suite of tools available to project managers during the planning phase there is still a need for improvement in this area. New tools and training have been identified as an area for improvement needed for project management staff to better aid the project planning process, provide clarity on requirements, and improve the current systems/tools that are utilized. A project planning checklist aid is currently being utilized that, if formalized, could help the planning process and areas for improved training relevant to MFC have also been identified by the MFC project management division. Additionally, 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 in order the establish realistic baseline scope, schedules, and estimated costs.

21.1.5 Actions FY-21

- Formalize the MFC Project Manager Subcontractor Work Checklist (Brady Orchard, March 30, 2021)
    - MFC Project Managers are using some version of an ad hoc checklist/spreadsheet to ensure all the necessary prerequisites are done before starting a new subcontract requisition which should be formalized. This takes a significant amount of time and coordination of several other resources to be able to start a requisition on time.
    - The checklist can also be used to ensure compliance and understanding of high-level requirements and could be used to incorporate lessons learned/corrective actions into the planning process.
- Strengthen in-field mentoring/on-the-job training for new and senior Project Managers (Brady Orchard, September 30, 2021)
    - Ensure all new project management staff are working with an assigned mentor
    - Ensure all project management staff understand their R2A2s. Where R2A2s may be adjusted based on a specific project/activity, R2A2s should be clearly established and documented with the program being supported.
    - Ensure Project Managers have a good understanding of the INL processes, tools, and procedure sets that are applicable to different types of work. (monthly learning sessions)
    - Consider development of an OJT checklist for Project Managers.
- Improve forecasting for projects throughout the year to include fiscal year reports, solicitations from divisions, procurement planning, etc. (Brady Orchard, September 30, 2021)
- Establish recurring MFC division staff meetings to share information and solicit lessons learned (Brady Orchard, March 30, 2021).
- Support development of National Reactor Innovation Center (NRIC) execution strategy that enables successful support of NRIC objectives and incorporates appropriate project management and cost accounting requirements/principles (Brady Orchard, March 30, 2021).
- Review existing Davis-Bacon process and ensure that the process appropriately reflects classification of science activities; enable revision(s), as necessary (Brady Orchard, June 30, 2021).

21.1.6 Looking Forward (FY-22 and Beyond)

- 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
- Active Project Manager engagement in advanced planning of critical work scope to ensure realistic scope, budget, and schedule expectations are established up-front 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

- Replace the vendor data system with a new management system that is integrated with AS/iBuy, EDMS, and others
    - The current vendor data system is awkward, outdated, and not user friendly. This antiquated system is only mastered by a few people, is difficult to access and navigate, and is extremely outdated
- Develop targeted training for MFC project management staff to address specific nuances of nuclear facilities, org structure, POCs, improving competency and certification of staff
- Coordinate with training department to formalize required reads, lessons learned, etc.
- Implement project forecasting for MFC
    - Increase the early visibility of projects in the pipeline to provide time for pre-award planning and staffing.

21.2 Project Execution

21.2.1 A Look Back

Implementation of project management principles has consistently evolved in a positive direction at MFC over the last several years. This positive trend is reflected in successful completion of INL's first line-item capital construction project, the Remote-Handled Low-Level Waste Disposal Project, initiation of the SPL line-item capital construction project, and 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 level. 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 in ensuring that 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.

21.2.2 People

The project management staff at MFC comprises people with strong work ethic and integrity. Project Manager experience ranges from newly hired to very seasoned individuals with very diverse experience. Each contributes significantly to project success across the MFC and INL. Project Managers work as a team to provide lessons learned and new ways to approach problems. Project Managers also work in close coordination with numerous work groups including engineering, environmental, safety, quality, researchers, management, crafts, and construction personnel. The relationship between the Project Manager and the Construction Field Representative (CFR) and the facility manger in the project execution phase is critical to success.

21.2.3 Process

A clearly defined scope is not always obvious for all projects/activities at MFC 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 recommended to ensure project is appropriately defined and to prevent scope creep from becoming a problem. 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. Additionally, the use of a Project Execution Plan (PEP) is not consistent or often utilized beyond formal capital asset projects. A checklist PEP could be helpful to ensure the technical aspects of project management are covered and considered, including identification of significant risks and mitigation strategies. Another area for improvement includes estimates and advertising of rough-order-of-magnitude (ROM) estimates before the scope is well

defined. Pre-planning to define scope, develop appropriate cost estimates, and ensure requirements are well understood could help better manage to a budget and not just managing to a funding amount. Development of a portfolio of appropriately planned MFC projects would enable leadership to balance resources across all activities, identify "peaks and valleys," aid in prioritizing activities, and support more effective internal (project staffing, engineering resources, support personnel, etc.) and external (union and subcontractor) communication of needs increasing the overall probability of successful execution.

21.2.4 Equipment/Tools/Training

The IRPT tool was established at MFC in recent years and while it helps better understand overall resource needs at MFC it is not well integrated with the other project management and Earned Value Management System (EVMS) processes required by the laboratory. Additional tools for traditional project execution could greatly improve the project management organization at MFC. There are several new resources and tools being explored and are also discussed in other chapter areas.

21.2.5 Actions FY-21

- Establish quarterly meetings to forecast upcoming projects including resource forecasting and potential conflict/issues resolution. Consider use of procurement portal for upcoming projects resulting from these meetings (Brady Orchard, September 30, 2021).
- Focused monthly meetings for lessons learned, shared experiences, forecasting, HPI tools, etc. (Brady Orchard, June 30, 2021).
- Establish a dedicated MFC Project Engineer and administrative support for the MFC Projects division (Brady Orchard, June 30, 2021).
- Establish formal Work Org relationship between Construction Management and MFC Projects Division (Brady Orchard, September 30,2021)
- Establish process for identification and prioritization of construction subcontractor Requests for Service between project management, construction management, and Utilities & Infrastructure Systems Division to ensure that MFC personnel are enabling successful execution of subcontracted work (Brady Orchard, March 30,2021)
- Establish formal interfaces and alignment between NRIC and MFC personnel (Brady Orchard, June 30,2021)
- Develop standardized PEP form to be utilized for low-risk projects (Brady Orchard, June 30, 2021)
- Establish formal interfaces with Facility and Site Services (F&SS) and Security projects (Brady Orchard, September 30, 2021).

21.2.6 Looking Forward (FY-22 and Beyond)

- Continue to improve integration of Project Management, Construction, Engineering, and Facility staff.
  - Co-locate Construction Management and Project Management Staff
  - 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 personnel at MFC performing a Project Manager function have formal line management relationship with MFC Projects Division to ensure consistency in application of processes and communication and improvement.

- Evaluate improving various tools used by Project Managers
  - The interface between IRPT and other EVMS reporting tools (P6, Cobra, etc.)
  - iBuy material tracking process
  - iBuy requisition status updates
  - Replacement of the Vendor Data System
  - Define requirements for use of formal PEP.
- 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 EVMS principles.
- Evaluate changes to the procurement process to address more contracts as best value and not just low bid by integrating contract specialist (CS), Project Manager, and CFR.
- Improve subcontractors short range schedule reporting – consider use of a standardized format.
- All key resources needed to successfully enable the MFC project portfolio are aligned and coordinated through the MFC projects division. Clear R2A2s established with support organizations and interfaces documented.
- External assessment of MFC Projects Division structure, processes, and performance.

21.3 Project Controls & Reporting

21.3.1 A Look Back

Improvements on reporting methodology to demonstrate work accomplishment; development of baselines that support effective resource management; and allocation of funding, compliance with established requirements, and the ability to support various reporting requests has been an important objective at MFC over the past several years. The MFC Projects Division was established in 2017 in part to place a greater focus on Plant Health investments and to establish a more consistent and standardized process for reporting. Over the past several years, project reporting has been better aligned to provide visibility into individual project performance. This alignment has considered INL's 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. 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.

21.3.2 People

Project controls support includes Planning and Financial Controls Specialists (PFCs) and PCAs. While Control Account Managers (CAMs) and Project Managers are not part of the project controls group, they are integral to the overall project management process. Project controls personnel support implementation of work scope to ensure compliance with applicable EVMS standards and principles, contractual requirements, lab procedures, DOE orders, and other driving regulations. Responsibilities include:

- Support of scope definition, development of the work breakdown structure, identification and mitigation of risks, support submittal of cost estimates and funding determinations, implementing scope, schedule, and budget for baselines
- Maintain proper change control through the formal Baseline Change Proposal (BCP) process, monitor performance, record status, monitor variances, trending, forecasting, and identifying corrective actions as necessary
- Collect and perform comprehensive analysis of project performance, variances, cost, and schedule and provide the analysis to management and stakeholders
- Provide analysis and guidance to Project Managers and CAMs regarding subcontracts, schedule of values, change orders, and other contracting provisions.

Based on the significant increase in workload and project complexity over the past 5 years, the project controls workforce 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 additional project controls personnel to meet the growing demands in support of the MFC mission.

There are numerous procedures and guides for performing the responsibilities of a PCA/PFCs. These documents provide expectations, regulations, requirements, and guidance for processing and implementing required actions; however, expansion of OTJ training and qualification represents an opportunity for improvement due to the magnitude of applicable requirements and the current/forecast work volume and staffing levels.

21.3.3 Processes

Sound application of project controls, particularly for capital asset projects, is required to maintain compliance with specific DOE orders, standards, procedures, and guides to ensure the lab maintains its EVMS certification. Processes and procedures have been developed to help ensure compliance to the specific orders and standards. The overall process is effective and efficient. Heightened awareness continues to expand regarding applicability of requirements and options, particularly associated with implementation of a tailored approach.

With several different requirements for different project sizes/types, Project Controls personnel, working closely with CAMs and Project Managers, have the opportunity to tailor project requirements to meet the needs and desires of the customer. Smaller projects are not required to provide the same level of rigor as larger capital asset projects. Accordingly, non-value added, and unnecessary work can be eliminated. While this is a benefit, there is room for improvement in consistent application. Most importantly, it is critical to ensure that any tailored requirement is approved and appropriately documented.

Due to the large array of responsibilities and methods within Project Controls, there are several different ways of performing the same task. This can prove difficult or result in confusion for CAMs and Project Managers who have several projects supported by different project controls personnel. Consistency and unified processes would be beneficial for some functions. A prime example and great opportunity for improvement would be associated with project folder setup and location as each

PCA/PFCs has a different idea of saving project files; they end up in several different locations, under several different file names. This creates difficulty when turning a project over to another PCA/PFCs or during an audit as project files are requested. Along these same lines, another opportunity for improvement would be associated with development of the Work Breakdown Structure (WBS). A consistent WBS for specific types of projects would result in an improved ability to utilize historical data in estimating new work scope.

The Project Controls group does an excellent job meeting the demands and requirements of 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, yet follow a less standardized process. While compliant, efficiency could be improved by implementing a unified business system approach for data collection in lieu of the labor intensive, manual collection process. Systematic data collection would also reduce errors associated with manual data collection.

21.3.4 Equipment and Tools

Project controls equipment and tools are sufficient and align with current industry standards. The primary tools used are Primavera P6 scheduling software, Deltek's Cobra pricing software, AS, the IRPT, Splash BI, the Business Decision Support Information System (BDSIS) Data Warehouse, Power BI, and SharePoint Dashboards. Development of the new Financial Model has been very successful in its testing stage and will significantly streamline the data collection, validation, and reporting process.

The Empower Analytics Software is currently being utilized in targeted areas of the Laboratory with great success. Expansion to all MFC projects would be another valuable opportunity for improvement as it would significantly streamline the monthly analysis and reporting process.

21.3.5 Actions FY-21

- Obtain/Hire Project Controls and PFC support as necessary to meet the demands of scope increase for MFC projects and O&M support (Brady Orchard, September 30, 2021)
    - No specific timeline required
    - Beneficial to maintain adequate support of projects, O&M, and other organizational needs. Stretched workforces struggle to maintain all requirements and expectations as the workload increases.
- Expand duration of OJT/mentoring for new hires or Project Controls personnel with minimal experience (Brady Orchard, September 30, 2021)
    - No specific timeline is required
    - Beneficial to properly prepare new employees or less experienced employees (job function change) and familiarize them with BEA processes, resources, points of contact, routine day-to-day operations, and risk/error avoidance.
- Create a standard file location, naming convention, and project folder setup for MFC projects (Brady Orchard, June 30, 2021)
    - Could be accomplished/transitioned over the next year
    - Necessary to standardize and appropriately house required documents for ease of access by Project Controls, Project Managers, CAMs, audits, and for day-to-day operations. This would also reduce transition time as projects are moved or assumed by new Project Managers or PCA/PFCSs.

21.3.6 Looking Forward (FY-22 and Beyond)

- Improve/standardize the process for documenting a tailored project management approach
  - Necessary to ensure projects are properly documented and compliant.
- Standardized WBS Structure on capital asset construction projects and other project types
  - Necessary to create consistency and efficiency. This will assist cost estimating, project controls, and project management to have more efficient upfront planning, standardization, categorized historical actuals to glean from, provide better alignment with capitalization of an asset post closeout of a project, and aligns with commercial standards.
- Upgrade Plant Health Performance Reporting tool to Empower or some other similar system
  - Necessary to reduce data collection time of PCA/PFCSs and allow for value-added analysis. This would help promote a standardized approach to EAC implementation and may allow for the utilization of Empower's variance analysis tool for CAMs and Project Managers in the future.
- Establish consistent reporting requirements/thresholds for MFC projects
  - To be accomplished over a phased implementation
  - Necessary to streamline the reporting process and provide visibility.

21.4 Construction Process

21.4.1 A Look Back

The value of awarded construction subcontracts at MFC has increased nearly 550% from 2016 ($12 M) to 2020 ($65.6 M) reflective of the increased investment in RD&D and supporting infrastructure. Correspondingly, the number of subcontracts has increased from 36 in 2016 to 59 in 2020, demonstrating that the size and complexity of construction activities has increased in addition to the number of projects. This growth is reflecting 1) the increased demand for RD&D capabilities which is putting pressure on the capacity of the current program, and 2) a predicted increase in longer-term demand because of new capital construction programs targeted for MFC (e.g., continued plant health investment, continued investment in supporting infrastructure, and expanding RD&D programs such as NRIC). Therefore, it is imperative MFC looks for ways to support and improve the current construction management team and provide the personnel and tools that will be needed in order to be successful.

21.4.2 People

Construction Management staff are engaged, knowledgeable, and service oriented, as evidenced by the significant increase in construction work over the last 5 years with minimal increase in staffing. Although head count has not increased, turnover has been, and will continue to be, an issue. Well over 80% of the construction staff (construction management, construction safety, construction quality) have worked at MFC 5-years or less. While retention of employees has been an issue in the past, it will remain a significant issue in the future due to other demands at the INL. Attrition, due to retirement/age, will also pose a significant challenge to construction management over the next 5 years and a 5-year staffing plan will need to be developed to counter said challenges. Understaffing of construction support (e.g., industrial hygiene, and safety) is a current issue which results in a demanding workload for the few individuals supporting multiple projects. A work/stress load like this will no doubt contribute to turnover issues at facilities across the INL.

21.4.3 Process

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.

BEA construction processes and procedures are acceptable but are considered archaic and should be brought up to current industry best practices. As the INL continues bringing in new subcontractors from outside the area to compete with local subcontractors, more standard methods/processes would be beneficial. Part of the reason local subcontractors have a head start is because they know the INL's processes, whereas new contractors' struggle. A more standardized process would allow more competition and perhaps a better value to projects and the laboratory.

21.4.4 Equipment/Tools/Training

New tools, equipment, and training need to be provided to the field construction staff to better define, provide access to, and/or in support of the following:

- Clear and concise R2A2s need to be developed for project managers and construction field representatives to support improved project execution
- Understanding the project depth; project team members need to understand and be able to complete others' tasks to keep work flowing (e.g., key personnel take PL, CFR covering too many jobs to process Subcontractor Field Problems (SFPs), etc.)
- Writing daily logs in the field
- View specifications and drawings in the field via mobile devices (i.e., phones, tablets, iPads)
- Implement a Request for Information (RFI) process distinguishable from that of the SFPs eliminating duplicative paperwork
- Streamline the SFP process to minimize the number of reviews, approvals, and signatures required
- Training to industry proven software for construction support
- Trending in order to establish trending of project metrics to evaluate what is driving the 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 [they underbid and expect to make up costs via change orders])
- Mentoring is a key item, currently MFC is mentoring new CFRs by having them shadow other CFRs for 6 months. The MFC construction management team is also developing a CFR checklist which will be a living document and revised, as needed.

21.4.5 Actions FY-21

- Review existing project execution metrics (e.g., construction change codes, risk realization) metrics and define improvements in process/reporting (Brady Orchard, June 30, 2021).
- Ensure completion of lessons learned from all projects and implement corrective actions to improve future work in pre-award planning, estimating, project management, and subcontractor proposal and management (Brady Orchard, September 30, 2021)
- Increase and develop staff resources in critical delivery areas (e.g., project management, construction field management, subcontracts, quality, industrial hygiene, and safety) (Brady Orchard, September 30, 2021 [on-going]).

- Evaluate permanent assignment of Project Managers to the MFC Projects Division (Brady Orchard, September 30, 2021)
- Formally establish reporting relationships for PMs supporting all work within MFC to the MFC Projects Division, regardless of fund source (Brady Orchard, September 30, 2021)
- Evaluate staffing workloads, including the number of projects supporting and location of such projects, to better support construction needs and increase MFC personnel field presence (Brady Orchard, September 30, 2021).
- Implement Best Value Contract Award (PM/CFR/SA) methodology versus the standard use of low-price, technically acceptable methodology to ensure that awarded construction subcontracts truly represent the best value to the government when considering technical capability, cost, and past performance (Brady Orchard, September 30, 2021).

21.4.6 Looking Forward (FY-22 and Beyond)

- 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. The following examples are some of the available tools for consideration:
        - Procore
        - P6
        - EMPOWER
        - Commodity use reports.
- Identify means of holding the subcontractors accountable for schedule and cost (need to look at the subcontractor's schedule and identify if they will or will not meet the schedule).
- Evaluate development of a standard 2-week look-a-head template for Subcontractors to use so all construction projects are consistent, making it easier for CFRs and Project Managers to cover for others when needed.
- 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).
- Implement early communication and planning of designs and bid packages to decrease downstream inefficiency and cost.
- Strengthen the project management program and function changes in the organization structure, increase training and competency building of key staff, and certification of the project managers.
- Increase the early visibility of MFC projects in the pipeline to provide time for pre-award planning and staffing.

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