August 2013

FESS/Engineering Project No. 6-10-23

MC Infrastructure

PP

Project Plan for the construction of the cooling water for the A-0 Compressors and for the construction of an addition to the MI-52 Service Building.

Submitted, Accepted, and Approved By:

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Thomas Lackowski *Date*
Fermilab Project Manager
Facilities Engineering Services Section

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Gerald Annala *Date*
Fermilab Project Director
Accelerator Division

____

Mary Convery *Date*
Fermilab Muon Campus Program Director
Accelerator Division

____

Randy Ortgiesen *Date*
Fermilab Section Head
Facilities Engineering Services Section

____

Jack Anderson *Date*
Chief Operating Officer
Fermilab Directorate

The Project Plan (PP) describes the management, control systems and procedures used by Fermi National Accelerator Laboratory (Fermilab) to meet the technical, cost, and schedule objectives of this project. The Project Plan is comprised of a Project Charter (PC), Conceptual Design Report (CDR) and Project Execution Plan (PEP). This controlling document establishes the basis for managing the project, throughout the projects life cycle including, initiating, planning, executing, monitoring/controlling and closing.

This project will be managed based on the guidance provided in DOE Manual 413.3b. This manual is not the sole source for all requirements and guidance that apply to the acquisition of capital assets. Other DOE Order and Manuals, especially regarding design, engineering, management reserve and indirect costs have been used to determine the basis for estimating costs and establishing baselines. This identification, implementation and compliance with other relevant Orders, Manuals and requirements are the responsibility of the Integrated Project Team.

This project will be managed by a certified Project Management Professional (PMP) certified by Project Management Institute (PMI) employing FESS/Engineering policies and procedures which adhere to the Project Management Institute's knowledge areas and process groups, tailored to conform to the relevant DOE orders, manuals and requirements.

The Project Plan is to be viewed as a "living document," and as such, will be revised when necessary. The Fermilab Project Manager is authorized to approve non-substantive changes to the Project Plan (e.g. name changes to the positions stated in the Project Plan), but will inform the DOE Federal Project Director via electronic mail of such changes. Baseline changes will require approval by the Department of Energy's (DOE) Fermi Site Office.

Section 1 – Project Charter (PC)
The Project Charter (PC) formally authorizes the project. The Project Charter incorporates the signed U.S. Department of Energy Construction Authorization as part of this document. The Project Charter states the project justification within the framework of the Fermilab's strategic goals. The Project Charter defines the roles and identifies the Fermilab Project Director and the Fermilab Project Manager as well as other key members of the Integrated Project Team.

Section 2 – Conceptual Design Report
The Conceptual Design Report (CDR) is intended to be a self-consistent basis for a project baseline scope, cost estimate and schedule. It is not a Title 1 report and has not answered every technical design question. The current level of contingency is believed to be consistent with the degree of technical confidence in the design at this stage. It is recognized that some basic construction concerns will be reviewed and optimized during the remaining stages of the project.

Section 3 – Project Execution Plan
The Project Execution Plan (PEP) defines the Enterprise Environmental Factors and Fermilab's Organizational Process Assets that provides project management the methodology which defines the process.

Author of this document:

Thomas Lackowski / FESS/Eng.
Ron Jedziniak / FESS/Eng.
Jim Niehoff / FESS/Eng.
Chuck Federowicz / FESS/Eng.
Emil Huedem / FESS/Eng.

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Project Charter

MC Infrastructure

FESS/Engineering Project No. 6-10-23

1.1 PROJECT JUSTIFICATION

Fermilab's Strategic Plan outlines a set of key research objectives that Fermilab plans to pursue into the future. One of these objectives, support of High Energy Physics, is a major driving force behind the Muon Campus program and the MC Infrastructure project that is the subject of this Project Plan.

New facilities at Fermilab, the nation's dedicated particle physics laboratory, would provide thousands of scientists from across the United States and around the world with world-class scientific opportunities. In collaboration with the Department of Energy and the particle physics community, Fermilab is pursuing a strategic plan that addresses fundamental questions about the physical laws that govern matter, energy, space and time. Fermilab is advancing plans for the best facilities in the world for the exploration of neutrinos and rare subatomic processes, far beyond current global capabilities.

Certain particle physics experiments require particle beams with incredibly large numbers of particles: the Intensity Frontier. Beginning in 2013, Fermilab's upgraded accelerator complex will create more intense particle beams for experiments such as MINOS, NOvA and MicroBooNE that will explore neutrino interactions. The updated complex will also enable the planned muon experiments, Muon g-2 and Mu2e, that will explore rare sub-atomic processes and make precision measurements.

To establish a base for these future muon experiments the Muon Campus is being developed to house these future experiments. The MC Infrastructure project supports the Cryogenics AIP and Beam Transport AIP in support of the Mu2e Experiment and the G-2 Experiment.

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Office of Science / U.S. Department of Energy / Managed by Fermi Research Alliance, LLC

Project Costs

The Total Estimated Cost (TEC) for this project is estimated to be $1M funded in mid-year FY15 dollars. Fiscal funding is $500,000 in FY 14 and $500,000 in FY15.

The TEC includes Construction, EDIA (Engineering, Design, Inspection and Administration), Management Reserve and Indirect Costs. The TEC has been escalated to fourth quarter FY14 dollars, the mid-point of construction.

Also included in the TEC are the Indirect Costs associated with this project, which is based on current published laboratory rates as of June 2013.

Schedule

Project Start	Month 1
Engineering Start	Month 6
Construction Start	Month 11
Construction Complete	Month 42
Engineering Complete	Month 46
Project Complete	Month 50

1.3.1 DOE MANAGEMENT

The U.S. Department of Energy (DOE) provides funding for this project to Fermilab.

The Site Manager of the FSO has been delegated the authority and responsibility for field oversight of the project. This includes line management authority, responsibility and accountability for overall project implementation and contract administration.

The FSO administers the Management and Operations (M&O) contract with Fermi Research Alliance (FRA) for the operations of Fermilab and exercises oversight of Fermilab. The FSO Manager has been delegated responsibility and authority for execution of the project. The specific responsibilities of the FSO manager are:

- Supervision of DOE Federal Project Director and Fermi Site Office staff;
- Review of and concurrence with this Project Plan;
- Review documents as required by federal regulations or departmental orders or notices;
- Approval of Fermilab subcontract actions, within the authority delegated to FSO;

The DOE-Chicago Integrated Support Center (ISC) can provide support to the FSO in the following areas as requested:

- Quality Assurance
- Implementation of ESH&Q
- Project Management Systems
- Design Review
- Legal

The FSO Manager has delegated authority and responsibility for management and direction of the project to the DOE Federal Project Director, Alan Harris. The specific responsibilities of the DOE Project Director include:

- Measurement of performance against established goals including technical performance, cost levels, and schedule milestones;
- Making any necessary changes or corrective actions within the appropriate thresholds established in this Project Plan;
- Overseeing Fermilab’s management of construction activities;
- Monitoring project progress via reports prepared by the Fermilab Project Manager;
- Coordinating the approval of the Project Plan by the FSO Manager.

1.3 PROJECT ORGANIZATIONAL STRUCTURE

The DOE has delegated the responsibility for design and construction of this project to Fermilab.

1.3.2 FERMILAB MANAGEMENT

The project management team structure shown in Figure 1 identifies the Organizational structure that will be responsible for design, procurement and construction of the project. The organization structure employed is a weak matrix as defined by the Project Management Institute.

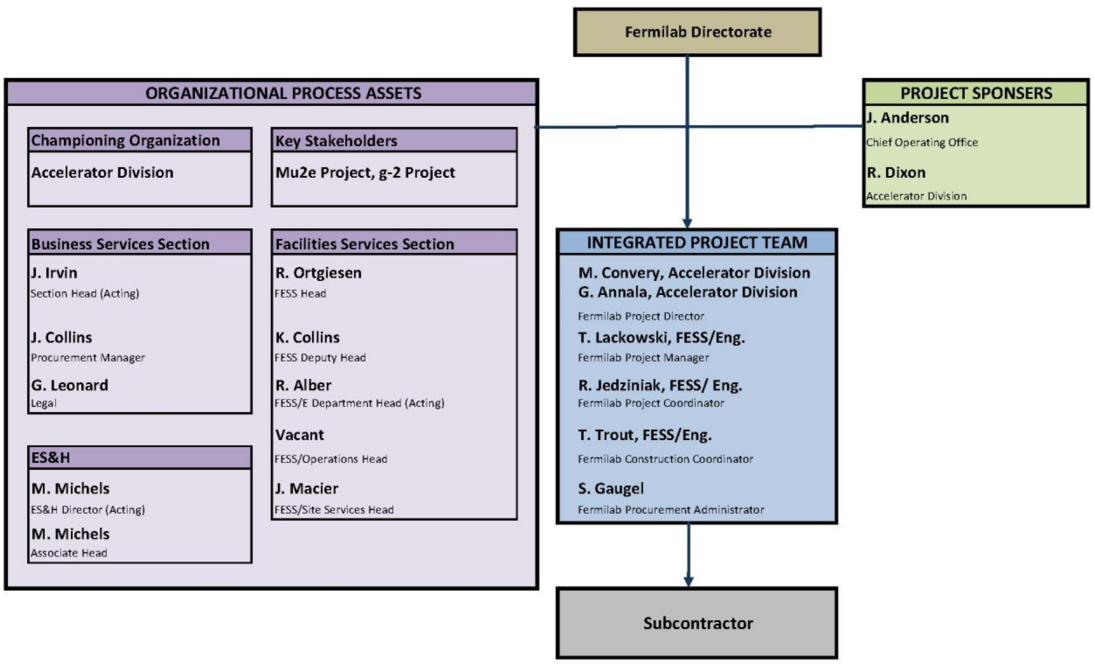


Figure 1 – Fermilab Project Management Team Structure

1.3.2.1 Directorate

As with all activities at Fermilab, the Fermilab Directorate is at the highest level of responsibility.

1.3.2.2 Project Sponsors

The Fermilab Chief Operating Officer (COO), Jack Anderson and Roger Dixon of the Accelerator Division are the Project Sponsors championing the project. The Project Sponsors establish and approve the mission need and allocate the funds from the Fermilab budget.

1.3.2.3 Integrated Project Team

The integrated project team is comprised of the Fermilab Project Director(s), Fermilab Project Manager, Project Engineer, Construction Manager, Fermilab Design Coordinator, Fermilab Construction Coordinator and the Fermilab Procurement Administrator.

1.3.2.3.1 Fermilab Project Director(s)

The Project Sponsors have designated Mary Convery and Gerry Annala of Accelerator Division as the Fermilab Project Directors. The Fermilab Project Directors are a key stakeholder that has accepted the scope of work as described within this project's Conceptual Design Report as being appropriate and complete. The Fermilab Project Directors initiate all scope changes and shall secure any additional funding authority as defined by the Fermilab Project Manager. A summary of the Fermilab Project Directors' functions and responsibilities is provided in the Integrated Project Team Responsibilities Matrix included in Appendix B.

1.3.2.3.2 Fermilab Project Manager

Project Management, design, construction management, cost and schedule for this project are the responsibility of the Facilities Engineering Services Section (FESS). FESS will manage the design and conventional construction activities associated with this project, as well as accept line management responsibility for safety. This effort will be accomplished using the resources of the FESS Engineering Department. The FESS/Engineering Manager shall assure proper attention to the coordination and timely completion of the project.

Fermilab has designated Tom Lackowski of FESS/Eng. as Fermilab Project Manager. The Fermilab Project Manager is certified by the Project Management Institute (PMI) as a Project Management Professional (PMP). The Fermilab Project Manager is committed to manage to a successful completion, the defined project scope for the cost stated within the allotted project schedule.

Based on the size and complexity of this project, the Fermilab Project Manager, will serve as Construction Manager. The Fermilab Project Manager will utilize the resources of the FESS/Engineering Department as appropriate for design, construction phase support, and construction coordination. Portions of the civil design may be subcontracted to an Architectural/Engineering firm. The Fermilab Project Manager/Construction Manager shall be the first line of contact with the Construction Subcontractor's organization. A summary showing the functions and responsibilities of the Fermilab Project Manager/Construction Manager is provided in the Integrated Project Team Responsibility Matrix contained in Appendix B.

1.3.2.3.3 Project Coordinator

Ronald Jedziniak of FESS/Eng. has been assigned as Project Coordinator for this project. The Project Coordinator will handle coordination of design team efforts in the execution of this project. A summary of the Project Coordinator functions and responsibilities is provided in the Integrated Project Team Responsibility Matrix contained in Appendix B.

1.3.2.3.4 Fermilab Construction Coordinator

Job coordination during construction phase activities will be accomplished through the Fermilab Construction Coordinator (FCC), a member of the FESS/Engineering department, who shall be responsible for daily monitoring of all work at the site, including the environment, safety and health (ESH&Q) program. The FCC reports to the Construction Manager for this project.

1.3.2.3.5 Fermilab Procurement Administrator

The Fermilab Procurement Administrator(s) (PA) is a member of the Business Services Section (BSS). Separate PA may be assigned for the procurement of the architectural/engineering services (A&E) and for the construction subcontract. Through the head of the BSS the Fermilab Procurement Administrators will execute all subcontracts. The details of the PA's functions and responsibilities are provided in the Integrated Project Team Responsibility Matrix contained in Appendix B.

1.3.3 ORGANIZATIONAL PROCESS ASSETS

Organizational process assets are those Fermilab processes that can be used to influence the project's success. These assets and organizations are described below.

1.3.3.1 Championing Organization

The championing organization provides support for the project throughout the project process by providing objectives for the eventual operational use of the project. Since the championing organization will be the primary beneficiary of the project, the input of the organization is vital to establishing the goals and objectives for the project.

1.3.3.2 Stakeholders

All project stakeholders are considered to be organizational project assets and are considered invaluable during the planning and execution of the project. The

Fermilab Project Director and Fermilab Project Manager will identify those key stakeholders and obtain the relative inputs critical to the project's success. Prospective users, landlord ESH&Q personnel and building managers are always key stakeholders that are included in the process.

1.3.3.3 Business Services Section

The Business Services Section (BSS) has the responsibility for subcontract administration, providing budget status and subcontract/requisition information. The details of the Fermilab Procurement Administrator's, a member of the Integrated Project Team, responsibilities have been identified and described in the Integrated Project Team Responsibility Matrix contained in Appendix B.

1.3.3.4 ESH&Q Management

The Environment, Safety, Health and Quality (ESH&Q) Section has the responsibility for providing safety coordination support and oversight of safety throughout the project. As with all Fermilab projects, attention to ESH&Q concerns will be part of project management and safety will be incorporated into all processes. Line management for safety on this project will be the responsibility of the Facilities Engineering Services Section.

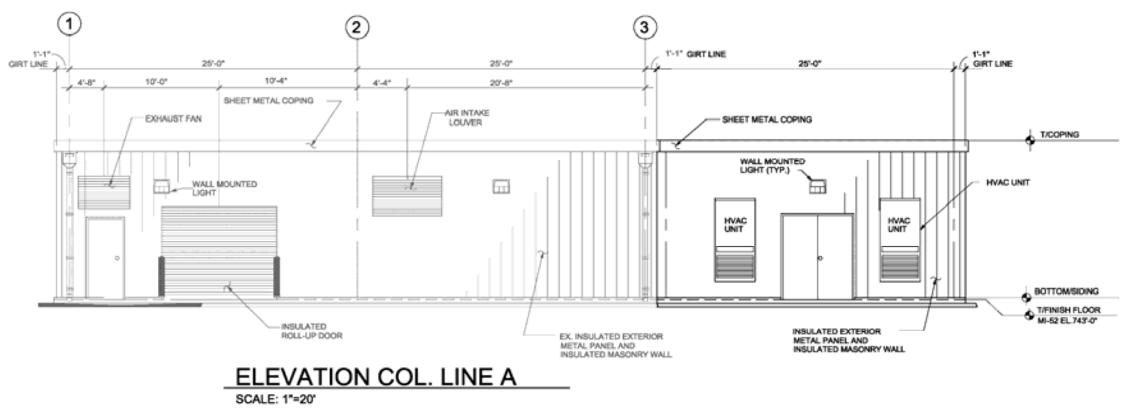
The ability to perform the construction work in a safe, environmentally acceptable manner will be designed into the project. Construction documents (drawings and specifications) will be reviewed as the documents are developed, by Fermilab engineering, construction, and safety professionals to ensure ESH&Q concerns are addressed. Project specific safety and health requirements for construction will be outlined in the construction documents.

The potential subcontractors will be qualified for bidding by submitting specific information about their safety and health program with the proposals. During construction the subcontractors will utilize Project Hazard Analyzes (PHA) to plan the work and mitigate hazards. The Fermilab Construction Coordinator will audit the subcontractor's compliance with the PHA's and with their overall Safety Plan. The Fermilab ESH&Q Section will augment the FCC with appropriate safety personnel during construction.

1.3.3.5 Facilities Engineering Services Section

The Facilities Engineering Services Section (FESS) has the responsibility of coordinating existing and proposed infrastructure, including sewer and water, power and communication systems, site roads and overall grounds. FESS will provide criteria and project reviews for systems and areas that they will maintain and service. The ability to safely maintain and service the project's deliverable will be designed into the project documents. Construction documents (drawings and specifications) will be reviewed as the documents are developed for appropriateness, ESH&Q concerns and life cycle value.

Conceptual Design Report



MC Infrastructure

FESS/Engineering Project No. 6-10-23

2.1 DETAILED DESCRIPTION MC Infrastructure

The MC Infrastructure scope of work provides a cooling water system for the A-0 Compressors and constructs an addition to the MI-52 Service Building to house new kicker power supplies.

A-0 Compressor Cooling

The g-2 and Mu2e projects both require cryogenics for the experiments. The refrigerators will be located in the MC-1 building but the compressors will be located in the A-0 Compressor Building. While the Tevatron was operating the pond system that is inscribed within the Main Ring Road functioned to provide primary cooling. Since the end of the TeVatron operations the pond system is no longer viable for several reasons but mainly since the ponds were designed to circulate the water around the ring and requires much of the aged pond infrastructure to continue to be operated in order to return the water to where it is needed. This is not only inefficient but also not maintainable considering the age of the equipment and current state of the ponds.

A six inch Industrial Cooling Water pipe (ICW) is located along the Main Ring Road and is connected to the system near the B-0 and F-0 Main Ring Stations. The ICW system original design and purpose was to provide the primary heat rejection to experiments and water for fire protection. Additionally the ICW is used as a supplement to maintain water levels in the Main Injector Ponds. The proposed A-0 Compressor cooling design uses the ICW as the primary cooling source and rejects the water and heat to the existing ponds at A-0. The A-0 pond will flow to the RF Pond and via an existing gravity line to the Main Injector Ponds. The ICW will supply the 800 GPM required for the compressors by installing a Tee into the existing 6” pipe and extend an 8” lateral to the A-0 Compressor Building. The 8” discharge pipe will be extended from the A-0 Compressor Building and terminate at the A-0 Pond via a gooseneck type structure. The ICW piping network has been analyzed for both water pressure and water flow. This analysis includes the ICW on the entire Fermilab site, all supply points and discharge points including the demands to address fire with hydrant flow and automatic sprinkler systems. The ICW Hydraulic Modeling Analysis results have been included at the end of Appendix B.

A number of options were evaluated and are summarized in Table 1. Backup design and cost information, including manufacturer’s quotes are filed in the project file. This comprehensive analysis clearly indicates that the chosen option to use ICW & Return to MR Pond, option #4, provides the best value to the government. During final design there will be continued evaluation of options that will add value to the project.

2.1 DETAILED DESCRIPTION

A-0 COMPRESSOR HEAT REJECTION OPTIONS (April 29 2013)

	1	2	3	4	5	6	7	8	9	10
OPTIONS	MR POND AS IS	PORTION OF OF MR POND	ICW & return to ICW system	ICW & return to MR pond	COOLING TOWER (OPEN-type)	COOLING TOWER (CLOSED-type)	GEOTHERMAL	DRYCOOLER (AIR TOWER)	CUB COOLING TOWER WATER (direct)	CUB CHILLED WATER (thru HX)
SHORT DESCRIPTION	Use existing system	Isolate approx 110ft of main ring pond	Use ICW and return to ICW system via fcc bubbler	Use ICW and return back to existing main ring pond	Use open-type coling tower with new accessories (pump, treatment, etc)	Use close-type coling tower with new accessories (pump, treatment, etc)	Use drilled geothermal similar to recent OTE project	Use of drytower (drycooler)	Use CUB tower	Use CUB chiller water via heat exchanger
POSSIBILITY	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO
ISSUES and CONSIDERATIONS	Recirculation of MR Pond issue; Old pipe/pumps	End-Of-Life equipment (pumps, piping) is an issue per Operations group and will have to be upgraded for this option	Aside from old ICW supply header, a means of returning the ICW to the Casey's system should be considered	New piping from the existing buried ICW and flow limited, depending on the ICW hydraulic modeling	Cooling tower accessories (Water Treatment, makeup water, tanks, softener, filtration, pump, etc) and spaces for these should be considered	Similar issue with Open-Type cooling tower except the make-up and blowdown is minimized, and the closed piping system will require glycol	This is considered a high first cost and the system will require glycol	This was listed for discussion purposes. Typical Process supply water from this system at peak season is greater than 120F and not feasible	This was listed for discussion purposes. Pipe routing and size is a major issue	This was listed for discussion purposes. Aside from major pipe routing issue, chilled water is considered a premium water
RELATIVE FIRST COST	N/A	*high*	*high*	lowest	medium	medium	*high*	N/A	N/A	N/A
Construction Cost Range w OHP	N/A			**< $160 K**	**< $ 340K**	**< $ 360K**		N/A	N/A	N/A
RELATIVE LIFE CYCLE COST	N/A		better	medium	low	low		N/A	N/A	N/A
OPERATIONAL COST										
Water treatment chemicals					X	X				
Salt					X					
Pond Water Treatment		X								
OPERATIONS ITEMS / CONCERN										
End of Life Equipment		X								
Old Pipes		X	X	X						
Operational		X								

Table 1 - Summary of A-0 Compressor Cooling Options

<u>MI-52 Building Addition</u>

The MI-52 Service Building is one of the Main Injector Kicker Service Buildings. A twenty-five foot by 30 foot addition is required for power supplies to support new kickers planned for the Energy Saver Recycler beam line. Utilities to the building such as LCW, ICW, electrical power and communications are all adequate to support the new power supplies. There are ample penetrations between the existing service building and the Main Injector enclosure for the additional cabling that is required.

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The performance requirements listed below describe the project specifics that exceed or are not addressed in the applicable building codes and standards requirements contained in Section 2.4, Quality Levels.

2.2.1 GENERAL PROJECT REQUIREMENTS

New space adjacent to the existing MI-52 kicker room thirty feet by twenty-five feet to house new kicker power supplies. Channel inserts will be installed in the concrete wall spaced at a maximum of 8 feet for the support of utilities in MI-52.

The compressors at A-0 require a maximum of 800 GPM of ICW for their primary heat rejection.

2.2.2 SITE AND UTILITIES

Open cut excavation trench techniques are anticipated for the construction of the A-0 Compressor cooling piping except for where the pipes cross the duct bank. At the duct bank we plan to employ pipe jacking method to install a 24” steel carrier pipe under the duct bank. HDPE water piping is planned for long service life. All paving and natural areas will be reestablished to at least their original condition. No new site utilities are required for MI-52.

2.2.3 ELECTRICAL SYSTEMS

No changes or electrical upgrades are needed for the A-0 Compressor Cooling.

Extension of the general lighting and convenience outlets will be required at MI-52. Electrical power distribution and cable tray to the kicker’s supplies will be installed by others.

2.2.4 FIRE PROTECTION SYSTEMS

There are no required changes to the fire protection system for the A-0 Compressor Cooling.

MI-52 egress shall be space so that travel distances are no greater than 300 feet where there are two paths of travel to an exit and no more than 50 feet where there is a single path of travel to a vertical exit. Sprinklers are required in the building and will be extended from the existing system. Manual pull stations and alarm notifications will be provided. The building’s smoke detectors system will be extended into the new space. In addition, fire extinguishers will be provided in accordance with FESHM Chapter series 6000. The existing fire alarm control panel is adequate.

2.2.5 MECHANICAL SYSTEMS

Additional wall HVAC units will be installed and two of the existing units will be relocated and supply air ducted to the existing kicker space at Mi-52.

2.3.1 SAFEGUARDS AND SECURITY

Direction for security issues related to the design of this project is taken from the current operating procedures of the Fermilab activities.

Access to any radiological areas, areas within 50 feet of existing beam lines, are controlled by the Accelerator Division Radiation Safety and will require coordination of work efforts and beam line operations.

2.3.2 ENERGY CONSERVATION

In accordance with Section 0110-12 "Energy Conservation" of DOE Order 6430.1A - General Design Requirements, all elements of this project will be reviewed for energy conservation features that can be effectively incorporated into the design. Energy conservation techniques and high efficiency equipment will be utilized wherever appropriate to minimize the total energy consumption.

2.3.3 HEALTH AND SAFETY

All aspects of the project will be evaluated to ensure that the adequate health and safety precautions are incorporated in the design and construction of this project.

2.3.4 ENVIRONMENTAL PROTECTION

The overall environmental impact of this project will be evaluated and reviewed as required to conform to all applicable portions of the National Environmental Policy Act (NEPA).

2.3.5 DECONTAMINATION AND DECOMMISSIONING

Decontamination and decommissioning procedures are an important part of Fermilab environment, safety and health policies. These policies are described in Chapter 8070 of the Fermilab Environment, Safety and Health Manual. Appropriate decontamination and decommissioning procedures will be instituted for this project.

2.3.6 TELECOMMUNICATIONS

Phone will be extended from the existing MI-52 building.

2.3.7 COMPUTER EQUIPMENT

No computer equipment will be installed as part of this project.

2.3.8 HANDICAPPED PROVISIONS

The building will not be accessible to handicapped personnel.

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2.3.9 EMERGENCY SHELTER PROVISIONS

Site specific emergency shelter provisions will be incorporated into this project.

2.3.10 SPACE MANAGEMENT REQUIREMENTS

In 2009, a space offset request was approved by DOE HQ for this facility.

2.4 QUALITY LEVELS

The design of this project will be in accordance with recognized engineering practices and design standards and will comply with the applicable portions of the U.S. Department of Energy and the State of Illinois codes, orders and regulations as incorporated into contract No. DE-AC02-07CH11359 between the U.S. Department of Energy and Fermi Research Alliance, LLC. A URL link to the contract is included in Appendix B of this document.

Fermilab has adopted the Necessary and Sufficient Process (NSP) for determining the Work Smart Set (WSS) of Standards which are used to determine the appropriate environment, safety and health standards used to ensure the safe and environmentally responsible operations of the Laboratory. The Work Smart Set in effect for this project is included in Appendix B of this Project Plan. Where no edition or "latest edition" is noted on the Work Smart Set, it is assumed that the edition in effect at the time of the acceptance of this Project Plan will be used.

2.5 COST ESTIMATE

The Baseline Project Costs contained in Section 3.2.2 assumes that the improvements will be done as part of the General Plant Project (GPP) program and includes the costs associated with Engineering, Design, Inspection and Administration (EDIA), Contingency and Indirect Costs.

The estimated construction costs are based on cost data taken from Means Cost Estimating Guides, historical data and recent construction history at Fermilab. While the suggested project budget can provide input for the feasibility of the project, further design refinement will affect the final cost of the project.

Engineering Design and Inspection (ED&I) activities are included in the suggested project budgets. ED&I activities include the engineering and design activities in Preliminary and Final Design, the inspection activities associated with Construction Phase Support. The descriptions are based on DOE Directive G413.3-21, Chapter 6. Past historical data and DOE Directive G413.3-21, Section 5.4.3 indicates that 15%-25% of the construction cost is an appropriate range. Non-traditional, first of a kind projects may be higher, while simple construction such as buildings will be lower than this range (on the order of 6%); the more safety and regulatory intervention is involved, the higher the percentage.

Administration activities include those defined by DOE Directive G413.3-21, Section 5.4.3 as Project Management (PM) and Construction Management (CM). Project management costs range from 5%-15% of the other estimated project costs for most DOE projects, depending on the nature of the project and the scope of what is covered under project management.

DOE Directive G413.3-21, Section 6.4.5 was used as guidance in estimating the appropriate Contingency for this project.

Indirect costs are costs incurred by an organization for common or joint objectives and which cannot be identified specifically with a particular activity or project. The multipliers used in this document are based on current Fermilab rates.

The costs contained in the estimates listed above are based on FY2014 dollars. Adjustment to the escalation will need to be applied should this assumption change.

DOE Guide 413.3-21, *Cost Estimating Guide* classifies cost estimates into one (1) of five (5) categories. These classifications are listed below in Figure 2:

Cost Estimate Classification	Primary Characteristics	
	Level of Definition (% of Complete Definition)	Cost Estimating Description (Techniques)
Class 5, Concept Screening	0% to 2%	Stochastic, most parametric, judgment (parametric, specific analogy, expert opinion, trend analysis)
Class 4, Study or Feasibility	1% to 15%	Various, more parametric (parametric, specific analogy, expert opinion, trend analysis)
Class 3, Preliminary, Budget Authorization	10% to 40%	Various, including combinations (detailed, unit-cost, or activity-based; parametric; specific analogy; expert opinion; trend analysis)
Class 2, Control or Bid/Tender	30% to 70%	Various, more definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)
Class 1, Check Estimate or Bid/Tender	50% to 100%	Deterministic, most definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)

Figure 2 - Cost Estimate Classifications

These classifications are based on the Association for the Advanced of Cost Engineering (AACE) Recommended Practice No. 18R-97. These classifications help ensure that the quality of the cost estimate is appropriately considered when applying escalation and contingency.

The level of detail and accuracy of the budget becomes more definitive as the project's scope is refined. In a project's earliest phases, the Initiation, or Pre-Conceptual Phase (before Critical Decision [CD] -0, an Order-of-Magnitude (or Parametric) Estimate is usually required. When a capital asset acquisition project has completed the Conceptual Design Phase, a Preliminary Budget Range is required to establish the Budget Baseline at CD-1. Budget refinements shall be based on a Definitive Estimate for every element in the WBS and is required for CD-2.

The classification for the cost estimates contained in this project definition report is considered a Class 3 (Preliminary) based on the preliminary nature and level of definition of the programmatic requirements.

Conceptual Design Report

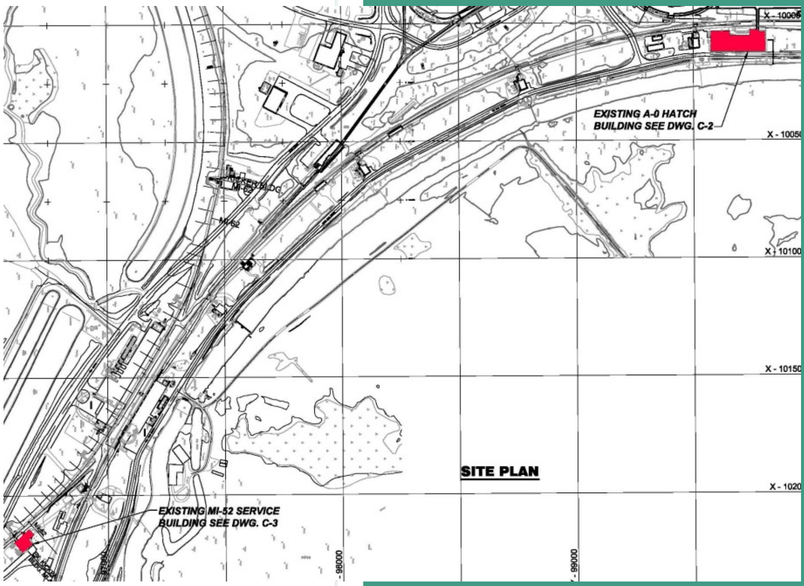
		FERMILAB FESS COST ESTIMATE					
		A-0 Compressor Building Cooling Water		Project No.	Status:	Date:	Rev Date
				6-10-23	PP	5/19/13	
		DESCRIPTION OF WORK:		QUANTITY	UNITS	UNIT COST	AMOUNT
		Expected cost of proposal					**$159,000**
		Escalation					$7,000
		Subtotal					$152,000
		Overhead and Profit					$30,250
		Subcontract Division Cost					$121,000
01		**SITE CONSTRUCTION**	**$111,110**				
		Mobilize		1	LS	$2,000.00	$2,000.00
		Traffic Control Barricades		1	LS	$1,500.00	$1,500.00
		Utility Locates		1	LS	$1,400.00	$1,400.00
		Pot Holing for Utilities		1	LS	$3,500.00	$3,500.00
		Sawcut Pavement		160	LF	$5.00	$800.00
		Demo Asphalt Pavement		145	SY	$15.00	$2,200.00
		Demo Existing CMP		1	LS	$500.00	$500.00
		Remove 8" D.I. S&R Pipe		180	LF	$50.00	$9,000.00
		Remove 8" D.I. Fittings		1	LS	$1,000.00	$1,000.00
		Misc. Protect Utilities		1	LS	$1,500.00	$1,500.00
		New 8" PVC S&R Pipe		255	LS	$45.00	$11,500.00
		PIV		3	EA	$1,800.00	$5,400.00
		Discharge structure		1	Lot	$1,000.00	$1,000.00
		Jacking pipe pits and excavation		1	ea	$30,000.00	$30,000.00
		Testing		1	Lot	$4,500.00	$4,500.00
		Misc. D.I. Fittings		1	LS	$8,100.00	$8,100.00
		Joint Restraint & Thrust Blocking		8	EA	$250.00	$2,000.00
		New 6" Gate Valves		3	EA	$1,000.00	$3,000.00
		Install New 15" Dia. CMP w/ end sects.		25	LF	$30.00	$800.00
		Pipe Bedding		255	LF	$7.00	$1,800.00
		Compacted Aggregate Backfill		100	CY	$75.00	$7,500.00
		2" Asphalt Pavement Patch		145	SY	$45.00	$6,500.00
		FinishGrade/Seed and Blanket		1	LS	$2,500.00	$2,500.00
		Building mods	**$9,000.00**				
		Demo Block Wall at excavtion in building		1	LS	$1,000.00	$1,000.00
		Rebuild Block Wall at excavtion in building		1	LS	$3,000.00	$3,000.00
		Sawcut Slab		1	LS	$1,000.00	$1,000.00
		Hand dig in building		1	LS	$4,000.00	$4,000.00
		Flowable fill		1	LS	$3,000.00	$3,000.00

FERMILAB FESS COST ESTIMATE						
MI-52 Addition		Project No.	Status:	Date:	Rev Date	
		6-10-23	PP	5/19/13		
DESCRIPTION OF WORK:		*QUANTITY*	*UNITS*	*UNIT COST*	*AMOUNT*	
Expected cost of proposal					**$328,000**	
Escalation					$25,000	
Subtotal					$303,000	
Overhead and Profit					$61,000	
Subcontract Division Cost					$242,000	
Div. 1 General	**$9,000**					
Bid and Award						
Obtain permits						
Complete Punchlist						
Mobilization		1	Lot	$9,000	$9,000	
Beneficial Occupancy						
Issue Final Acceptance						
Div 02 Site Construction	**$13,685**					
				$0	$0	
Soil and Erosion Control		300	LF	$9	$2,700	
Excavate for Footings		62	CY	$26	$1,637	
Clear and Grub		1	Lot	$6,000	$6,000	
Haul and stockpile excess excavated materials		25	CY	$7	$180	
Backfill at foundation		32	CY	$24	$768	
Seeding and Landscaping				$0	$0	
Seeding		1200	sf	$1	$720	
Topsoil under seed - 6"		25	cy	$36	$900	
Grading Topsoil, assume cut and fill		25	cy	$7	$180	
Landscape Allowance		1	ea	$600	$600	
				$0	$0	
Div 03 Concrete	**$26,897**					
FBP Footings		21	CY	$360	$7,560	
Pour Slab on Grade				$0	$0	
Granular Fill at Slab on Grade - 4"		9	cy	$34	$302	
2" Extruded Polystyrene Insulation Under Slab		750	sf	$1	$1,080	
15 Mil Vapor Barrier Under Slab		750	sf	$0	$270	
5" Concrete Slab w 6x6 WWF		750	sf	$6	$4,455	
FBP Foundation Walls		33	CY	$390	$12,870	
FBP Walks and aprons		1	CY	$360	$360	
Div 04 Masonry	**$9,000**					
Demo Existing		1	Lot	9000	$9,000	
Div 05 Metals	**$21,123**					
Erect Steel Frame		3810	lbs	$5	$18,288	
Erect Metal Deck		750	SF	$4	$2,835	
Div 06 Wood & Plastics						
Div 07 Thermo & Moisture Protection	**$51,872**					
Install Built-Up Roofing				$0	$0	
2 Layers 1 1/2" Insulation, 1/2" Fiberboard,	4 F	750	sf	$17	$13,050	
Tapered Insulation		120	sf	$3	$360	
Install Aluminum Coping		77	lf	$19	$1,478	
Install Insulated steel wall panels		670	SF	$55	$36,984	
Div 08 Doors & Windows	**$12,940**					
Install Skylights		2	EA	$3,500	$7,000	
Install Overhead roll up door				$0	$0	

		Install Exterior Man Doors		1	EA	$4,500	$4,500
		Install Interior man doors		1	EA	$1,440	$1,440
		Div 09 Finishes	**$3,376**			$0	$0
		Paint Walls		1,340	sf	$1	$1,126
		Paint Exposed Ceiling		750	sf	$3	$2,250
		Div 10 Specialties					
		Div 14 Cranes & Elevators					
		Div 15 Mechanical	**$40,850**				
		Install HVAC (allowance for)		1	LOT	$35,000	$35,000
		Ductwork		750	SF	$8	$5,850
		Div 16 Electrical	**$52,732**			$0	$0
		Install Ground Rods		2	EA	$828	$1,656
		Install Building Ground Wire		80	LF	$22	$1,728
						$0	$0
		Install 120/208 VAC Receptacles		9	EA	$287	$2,581
						$0	$0
		Install Disconnect Switches		4	EA	$648	$2,592
		Connect Other mechanical Equipment		2	EA	$1,080	$2,160
		Install Unit Heaters		2	EA	$1,200	$2,400
						$0	$0
		Install 4' Fluorescents		750	SF	$16	$11,700
		Extend Emergency Lighting (UPS)		1	LS	$5,400	$5,400
		Install Exit Lights		2	EA	$720	$1,440
		Install Exterior Wall Packs		2	EA	$787	$1,574
						$0	$0
		Extend Fire Detection		1	LS	$1,500	$1,500
		Devices wiring and conduit		750	SF	$18	$13,500
		Re-Program Panel		1	Lot	$4,500	$4,500

Figure 3 – Summary of Engineer's Estimate

Project Execution Plan



MC Infrastructure

FESS/Engineering Project No. 6-10-23

3.1 RESOURCE REQUIREMENT **MC Infrastructure**

The following resource requirements have been identified for this project.

3.1.1 FUNDING

This project is a General Plant Project (GPP) with a Total Estimated Cost (TEC) of $1M.

3.1.2 HUMAN RESOURCES

Divisions/Sections/Research Centers (D/S/C) will be responsible for assigning the responsibilities of individuals within the design and construction organization as indicated in Figure 1 of the Project Charter.

Design reviews will occur at varying levels throughout Final Design. All Divisions/Sections/Research Centers are aware of the design review process and will assign appropriate personnel to complete the reviews for conformance and compliance with D/S/C requirements.

Divisions/Sections/Research Centers will provide required personnel to coordinate construction phase activities that directly affect their operations. For example, the Facilities Engineering Services Section (FESS) will provide personnel to coordinate related activities with the Fermilab Construction Coordinator.

FESS/Engineering will provide licensed professional architects, professional engineers and structural engineers for the design and coordination of the project. Project management will be by certified project manager professionals. Where required, FESS/Engineering will retain the professional services of consulting architects and/or engineers for final design and construction oversight.

If appropriate, the development of construction documents and bid packages may be accomplished by use of an Architectural-Engineering (A/E) firm in conjunction with the Integrated Project Team during Final Design. The selection of the A/E firm will be based on qualifications and past performance on similar FESS/Engineering projects. Existing professional services contract will be used to accomplish this work.

The A/E may be retained during construction phase activities for engineering support of the following:

- Bid Period Information Requests;
- Amendment/Addendum Development;
- Shop Drawing/Submittal Review;

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- Assistance in estimating and negotiating changes to the subcontracted work;
- Responding to subcontractor request for information including developing sketches/revisions to the subcontract documents
- Periodic site visits;
- Punchlist development.

The FESS/Engineering department will provide the construction management for the project, coordinating the subcontractor's construction subcontract. Field inspection, environment, safety and health, and quality control of construction activity will be the responsibility of the subcontractor. FESS/Engineering will provide quality and safety assurance during construction phase activities.

3.3 ACQUISITION EXECUTION PLAN MC Infrastructure

The Project Baseline identifies the basis for evaluating project performance. The components are the Work Breakdown Structure, which identifies each component of the project, the Baseline Costs, Escalation Rates, and Baseline Schedule and Milestones.

3.2.1 WORK BREAKDOWN STRUCTURE (WBS) DICTIONARY

Listed below is the breakdown of the WBS for this project. Further breakdown of the above listed structure may be applied as required for accounting purposes. Items covered under Other Project Costs are noted as such.

Level 1 – MC Infrastructure Enclosure

1.0 Engineering, Design and Inspection (ED&I)

ED&I activities include the engineering and design activities in Preliminary Design and Final Design, the inspection activities associated with Construction Management. The descriptions are based on DOE Directive G413.3-21, Chapter 6. In addition, DOE Directive G413.3-21, Section 5.4.3 was used as guidance in estimating the ED&I cost for this project. This DOE Directive can be found at the DOE website. Appendix B of this document contains the URL link to this chapter.

Listed below is a further breakdown of this WBS

1.1 This WBS item will be used for Preliminary Design ED&I
1.2 This WBS item will be used for Final Design ED&I
1.3 This WBS item will be used for Construction Management ED&I

2.0 Administration

Administration activities include those defined by DOE Directive G413.3-21, Section 5.4.3 as Project Management (PM) and Construction Management (CM). This DOE Directive can be found at the DOE website. Appendix B of this document contains the URL link to this chapter.

Listed below is a further breakdown of this WBS

2.1 This WBS item will be used for Preliminary Design Administration
2.2 This WBS item will be used for Final Design Administration
2.3 This WBS item will be used for Construction Management Administration

3.0 Construction

3.1 This is fixed-price construction portion of the project;

3.2 This is Time and Materials construction orders for this project;
3.3 This WBS item will be used for advanced procured materials.

For accounting purposes, the management reserve of the above listed WBS items will be included in the WBS costs. DOE Directive G413.3-21, Section 6.4 was used as guidance in estimating the appropriate management reserve for this project. This DOE Directive can be found at the DOE website. Appendix B of this document contains the URL link to this chapter.

For accounting purposes, the indirect costs of the above listed WBS items will be included in the WBS items. The multipliers used in this document are based on current Fermilab rates. Appendix B of this document contains the URL link to the Fermilab Indirect Cost rates. While Indirect Costs have been estimated and included in the Total Project Cost, the Finance Section will confirm that the allocated funds are adequate. The Indirect Costs are not considered as part of the managed baseline.

3.2.2 BASELINE PROJECT COSTS

Listed below are the baseline project costs for this project.

		Base Cost	Management Reserve	Indirect Costs	Subtotal
1.1	Title 1 ED&I				$0
1.2	Title 2 ED&I	$44,000	$12,000	$19,000	$75,000
1.3	Title 3 ED&I	$48,000	$12,000	$20,000	$80,000
2.1	Title 1 Administration				$0
2.2	Title 2 Administration	$19,000	$4,000	$8,000	$31,000
2.3	Title 3 Administration	$20,000	$5,000	$9,000	$34,000
3.1	Fixed Price Construction	$487,000	$147,000	$146,000	$780.000
3.2	Tim and Materials Const.	$	$	$	$
3.3	Pre-procurement	$	$	$	$
	TOTALS	$618,000	$180,000	$202,000	$1,000,000

3.2.3 SCOPE CONTINGENCY

In order to provide a well-balanced, manageable project, several items of scope contingency have been identified. These items will be identified on the final construction documents as “alternate deducts” during the competitive procurement activities. During the source evaluation process, the project team will review the alternate deducts and determine which ones should be excluded from the scope of work, if necessary.

3.2.4 ESCALATION

The baseline project and associated cost estimate assumes that the midpoint of construction will be the 4th quarter of fiscal year 2014 (FY14). DOE Directive G413.3-21, Section 6.4.4 was used as guidance in estimating the appropriate escalation for this project. This DOE Directive can be found at the DOE website. Appendix B of this document contains the URL link to this chapter.

3.2.5 BASELINE PROJECT SCHEDULE AND MILESTONES

The baseline schedule listed below sets forth the major activities and milestones essential for the completion of the project. The milestones are defined as:

MILESTONE	DEFINITION	BASELINE
Project Start	Directive signed	Month 1
Engineering Start	Engineering work for the project starts when a task is entered into the Task Database	Month 6
Construction Start	Notice To Proceed/Purchase Order Issued	Month11
Construction Complete	Final acceptance of all work	Month 42
Engineering Complete	Completion of Close-out Documents	Month 46
Project Complete	Project Closed	Month 50

3.2.6 FUNDING PROFILE

Listed below are the anticipated total costs by fiscal year for this project as contained in the Fermilab Project Request Form.

	FY14	FY15	TOTAL
Construction	$200,000	$287,000	$487,000
EDIA	$80,000	$84,000	$164,000
Management Reserve	$140,000	$40,000	$180,000
Subtotal	$420,000	$411,000	$831,000
Indirect Costs	$80,000	$89,000	$169,000
TOTAL	**$500,000**	**$500,000**	**$1,000,000**

The Project Management, Construction Management, design, construction and inspection for this project will be performed in compliance with the applicable DOE Orders and Fermilab Policy and Procedures and in accordance with the Work Breakdown Structure.

3.3.1 DESIGN

If appropriate, the development of construction documents and bid packages may be accomplished by use of an Architectural-Engineering (A/E) firm in conjunction with the FESS/Engineering Project Team during Final Design. The selection of the A/E firm will be based on qualifications and past performance on similar FESS/Engineering projects. Existing professional services contract will be used to accomplish this work.

Architectural and Engineering (A/E) services procurement will conform to the Business Services Section (BSS) A/E selection procedures. Consulting firms will be selected based on the firms strengths of subject area expertise required for the project. Consultants will normally be selected from the firms that have been prequalified and that are under a master contract. Where specific individuals or area of expertise are required for the success of the project and this expertise is not available with the pre-selected firms then sole source justification will be written. A/E's will conform to the current version of the FESS Engineering A&E Handbook in force at the start of the project.

3.3.2 CONSTRUCTION

The majority of the construction work for this project will be accomplished by means of one or more construction packages. The Conventional Construction packages will be a competitively bid, lump sum contract. A Time and Materials (T&M) task may be used for preparatory work that is specialized and difficult to include in the competitive procurement process.

3.3.2.1 Possible Sources for the Conventional Construction Subcontractors

Fermilab has access to several Subcontractors that have sufficient qualifications to execute this Subcontract. Subcontractors are selected in response to a Request for Proposal and must meet specific safety and quality requirements. When applicable, there will be a close-out meeting to formally assess the performance of subcontractors in accordance with FESHM Chapter 7010.

3.3.2.2 Performance Based Incentive Process

The subcontractor will be paid only for work completed. In addition, retention may be reduced from 10% to as little as 2% during the subcontract if the subcontractor maintains a safe environment and meets subcontract milestones.

3.3.2.3 Methods of Completion

The Request for Proposal (RFP) process will be used to solicit proposals from area Subcontractors with the appropriate safety records and experience to accomplish this work.

3.3.2.4 Source Selection Process

A Source Evaluation Team (SET) will be established which will include the Fermi Project Director, Fermi Project Manager, Fermi Project Coordinator, and Fermi Procurement Officer to evaluate and select a Subcontractor for the Conventional Construction Package. Evaluation criteria will be included in the Request For Proposal (RFP) documents as a basis for the SET evaluation of proposals.

3.3.2.5 Justification for Non-competitive Acquisitions

Anticipated non-competitive acquisitions may include Time and Material (T&M) tasks and advanced-procured items requiring longer than tolerated fabrication or delivery time. These items will be identified during the Final Design phase.

3.3.2.6 Milestones for Acquisition

Construction milestones will be established for inclusion into the subcontract documents.

3.4 MONITORING AND CONTROLS

3.4.1 COST CONTROL

A separate cost account will be maintained for the following elements listed in the project Work Breakdown Schedule (WBS): Engineering Design and Inspection (ED&I), Administration, and Construction. The baseline budget for each element will be shown on all reports. Costs charged to these accounts will be reported monthly on a report available on the Business Services Section (BSS) website. The Fermilab Project Manager will review the report as needed in order to verify the validity of all cost charges during the reporting period, that commitments are correct, and that projections of costs can be covered by the baseline budget for each work element.

The Fermilab Project Manager has the responsibility for the use and commitment of project funds. Any costs or commitments that are made without his signed approval or that of higher Laboratory management may be rejected. Progress payments to the Architect/Engineer, suppliers, and subcontractors will be made upon receipt and approval of acceptable invoices, nominally on a monthly basis.

The Fermilab Project Manager, within authorized limits, will be responsible for the administration of the project's management reserve funds.

The Funding Profile, depicted in Section 3.2.6, is based on the current DOE funding profile. This plan reflects the best estimate of funding levels and the baseline schedule. The Funding Profile establishes the planned rate of accrued costs for the life of the project. The Fermilab Project Manager is responsible for updating, as needed, the project Estimate at Completion (EAC) for each work element to reflect changes in design and construction, and for overall project fiscal management.

3.4.2 SCHEDULE CONTROL

The Baseline Schedule, shown in Section 3.2.5 of this project plan, depicts the milestones and their expected achievement dates. As the project develops, the schedule may be further refined. The Fermilab Project Manager shall have the responsibility to monitor and control these tasks within the baseline. The baseline may be revised with DOE Fermi Site Office concurrence.

The Integrated Project Team will review work progress with the subcontractor at regular intervals. Any identified difficulties will require the subcontractor to provide a plan for their resolution. Significant schedule slippage will be cause for expediting actions by BSS at the request of the Fermilab Project Manager.

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3.4.3 CHANGE CONTROL PROCEDURES AND AUTHORITIES

Changes to the project's internal baseline can occur to the scope, cost, or schedule aspects of the project. Changes at WBS Level 1 and below will be made with the approval of the Fermilab Project Manager for cost changes up to $75,000 and schedule changes up to 3 months. Cost and schedule changes above these amounts and changes to the scope of the project as outlined in the CDR will require the approvals of the Change Control Board. Any change to the Total Project Cost will require the approval of the Change Control Board and DOE Fermi Area Office. Project change control will be accomplished in accordance with practices listed below.

Change Control Procedures		
Change	**Approval Required**	**Change Request Form**
Normal Field Changes no added cost or time	Fermilab Project Manager	None
In scope <u><</u>$75k or <u><</u>3 mos. schedule change	Fermilab Project Manager	None
In scope >$75k or >3 mos. schedule change	Control Board	Required
Total Project Cost	Control Board DOE Fermilab Directorate	Required
Non-Emergency Required for ESH&Q regulations	Control Board	Required
Change to Project Scope or Schedule	Control Board DOE Fermilab Sponsors	Required

The Change Control Board (Control Board) will be comprised of the following named individuals or the designees:

DOE Fermi Site Office	A. Harris (non-voting)
Sponsor - Chief Operating Officer	J. Anderson
Sponsor – Accelerator	R. Dixon
Project Director	M. Convery
Project Director	G. Annala
Project Manager	T. Lackowski (Chair)

The Fermilab Project Manager will act as Chair to the Control Board. The Control Board will consider the change requests promptly and, in cases not requiring additional information or discussion, will respond within two (2) weeks.

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3.5.1 INTEGRATED SAFETY MANAGEMENT (ISM)

Fermilab subscribes to the philosophy of Integrated Safety Management (ISM), in accordance with Department of Energy Order 413.3 "Program and Project Management for the Acquisition of Capital Assets." Appendix B of this document contains a URL link to the DOE order. Fermilab requires its subcontractors and sub-tier subcontractors to do the same. ISM is a system for performing work safely and in an environmentally responsible manner. The term "integrated" is used to indicate that the Environment, Safety & Health (ESH&Q) management systems are normal and natural elements of doing work. The intent is to integrate the management of ESH&Q with the management of the other primary elements of construction: quality, cost, and schedule.

The subcontractor(s) shall submit proof of an effective integrated safety management program. The program must be described in the terms listed below.

- Line Management Responsibility for Safety;
- Clear Roles and Responsibilities;
- Competence Commensurate with Responsibility;
- Balanced Priorities;
- Identification of Safety Standards and Requirements;
- Hazard Controls Tailored to Work Being Performed;
- Operations Authorization.

3.5.2 QUALITY ASSURANCE

All aspects of this project will be periodically reviewed with regard to Quality Assurance issues from Conceptual Design through Close-out. This review process will be completed in accordance with the applicable portions of the Fermilab Director's Policy Manual, Section 10. Appendix B of this document contains a URL link to the Fermilab Director's Policies. The following elements will be included in the design and construction effort:

- An identification of staff assigned to this project with clear definition of responsibility levels and limit of authority as well as delineated lines of communication for exchange of information;
- Requirements for control of design criteria and criteria changes and recording of standards and codes used in the development of the criteria;
- Periodic review of design process, drawings and specification to insure compliance with accepted design criteria;
- Identification of underground utilities and facility interface points prior to the commencement of any construction in affected areas;

- Conformance to procedures regarding project updating and compliance with the approved construction schedule;
- Conformance to procedures regarding the review and approval of shop drawings, samples test results and other required submittals;
- Conformance to procedures for site inspection by Fermilab personnel to record construction progress and adherence to the approved contract documents;
- Verification of project completion, satisfactory system start-up and final project acceptance.

3.5.3 HIGH PERFORMANCE BUILDING DESIGN

Refer to Appendix B for High Performance Building Design.

3.5.4 RELIABILITY AND MAINTAINABILITY

Both reliability and future maintenance are considered in the design of all components of Fermilab site. Materials and construction techniques are selected during the design process to provide adequate design life, accessibility, and minimal maintenance.

When completed, the facility resulting from this project will become the formal responsibility of the Fermilab Particle Physics Division. The completed project, and the utilities and systems that support it, will be added to the overall laboratory maintenance and building inspection program of the Facilities Engineering Services Section. The Facilities Engineering Services Section and Business Services Section will coordinate the preventative maintenance, normal service and emergency repairs for the building.

The Building Research Board National Research Council states that if a building receives an adequate level of maintenance and repair funding, a steady-state situation should exist wherein the inventory would remain in a service condition that would neither decline nor improve and a maintenance and repair backlog would not develop. Maintenance is defined as the day-to-day work necessary to sustain property in order to realize the originally anticipated useful life of a fixed asset. Maintenance includes periodic inspection, adjustment, lubrication, and cleaning (non-janitorial) of equipment, replacement of parts etc. to assure continuing service and to prevent breakdown. Repair is defined as the work required to restore damaged or worn-out property to a normal operating condition. In general, repairs are curative and maintenance is preventive.

Operations are the activities related to a building's normal performance of the function for which it is used. The cost of utilities, janitorial services, window cleaning, rodent control and waste management are generally included within the scope of operations and are not maintenance.

The following preliminary maintenance and repair costs forecast is based on information contained in the Whitestone Building and Repair Cost Reference 2011 and indexed for the Chicago, Illinois area. The Building M&R Cost Profile is based on the General Laboratory model. While not an exact match, the functions and basic material selections are considered similar in nature to provide a preliminary forecast of maintenance and repair costs for this project.

Cost (FY2011)	Annual Cost Per Square Foot	Annual Cost as % of Replac. Cost
PM and Minor Repair	$2.47	0.66%
Unscheduled Maintenance	$2.01	0.49%
Renewal and Replacement	$5.41	1.38%
Total M&R Costs	**$9.89**	**2.53%**

If requested, a detailed maintenance and repair forecast for this project will be developed after the completion of construction. A copy of the referenced Whitestone Building and Repair Cost Reference data is included in the Appendix B of this project plan.

3.5.5 VALUE MANAGEMENT

It is not anticipated that a separate value management exercise will be required for this project. However, internal reviews of designs at various levels of completion will be performed by the most experienced individuals at Fermilab with the goal to identify cost effective design solutions. These internal reviews will focus on understanding the impact of the technical requirements on the overall project including optimization to reduce the life cycle costs.

3.5.6 RISK MANAGEMENT

The majority of the risk management on this project involves the coordinated activities affecting ongoing Fermilab operations. Sufficient schedule float is currently anticipated for the activities related to constructing project to accommodate minor potential disruptions.

3.5.7 DESIGN REVIEWS

Design reviews are accomplished in accordance with FESS/Engineering Standard Operating Procedure 8.3.5.1, "Document Reviews." Designs are reviewed for conformance to project requirements and for appropriateness of the proposed systems, impacts on existing systems and operations, specific technical requirements to be incorporated into the design and compliance with best and required practices of authority having jurisdiction.

The objective of the reporting and review activity is to provide the assemblage and integration of project related cost data, schedule status and performance progress into reports for the monitoring and management of the project.

Per Fermilab's engineering policy, an Engineering Risk Assessment has been performed and determined that the project is Low Risk therefore the project will follow standard FESS Engineering procedures. See Appendix B for the Engineering Risk Assessment Worksheet.

3.6.1 REPORTING

Daily – If appropriate, construction logs may be prepared by the Fermilab Construction Coordinator that document the ongoing progress, quality assurance, safety and change issues. When required, the Subcontractor prepares daily quality control reports documenting their efforts on field activities. The Fermilab Project Manager and Fermilab Construction Manager are provided these reports on the following workday.

Weekly – The Subcontractor submits a summary report of quality control activities for the previous week at the weekly construction meeting. These reports will include a "look ahead" schedule that details the expected progress in the coming weeks.

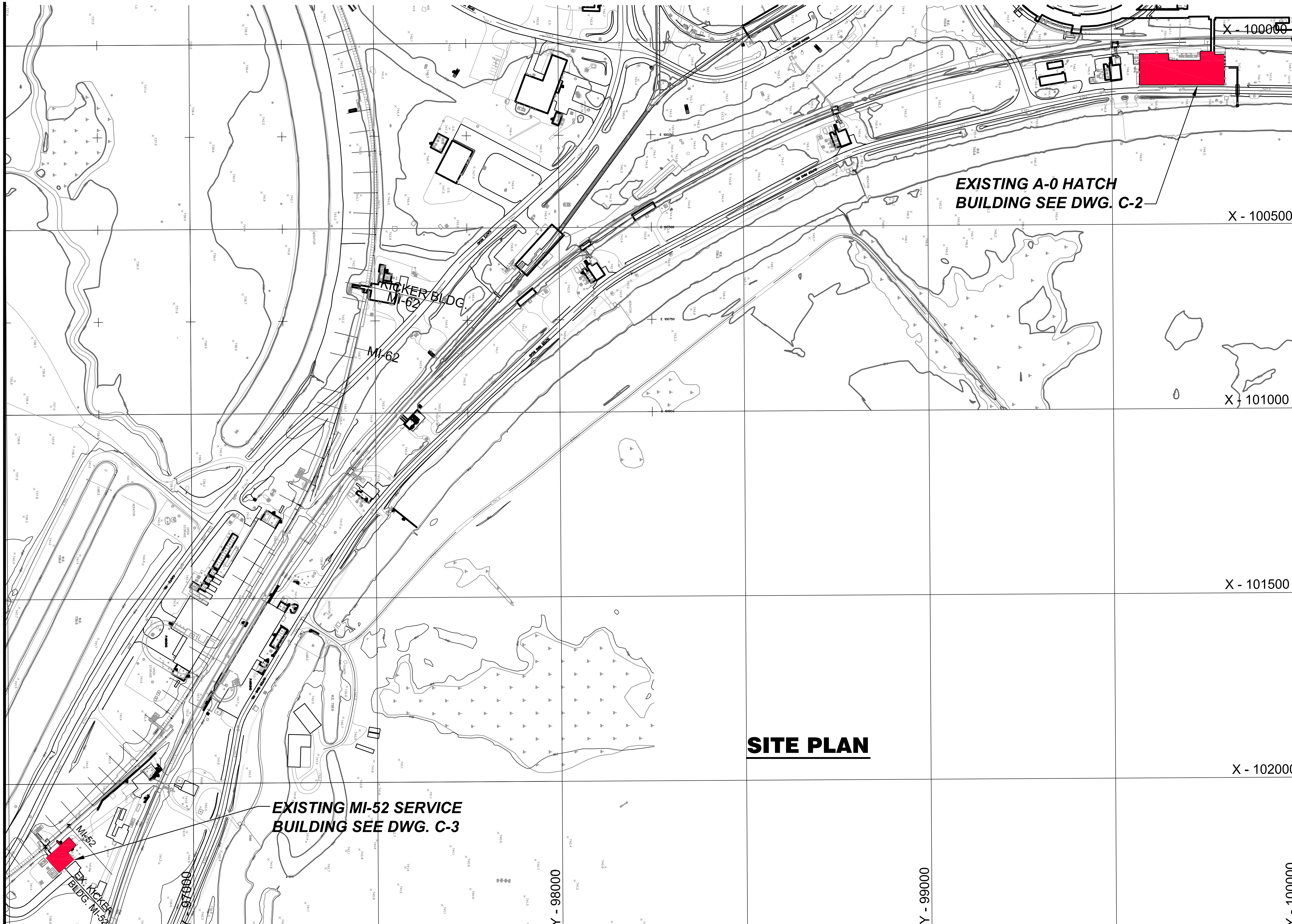
Quarterly - The Fermilab Project Manager will review construction progress, changes, Subcontractor payouts and general project progress in order to prepare a Quarterly General Plant Project (GPP) report.

3.6.2 REVIEWS

Directorate Level Review – If appropriate and requested, the project team will meet with the Directorate to review the project related cost data, schedule status and performance progress.

Multi-Organization Construction Site Safety Walkthrough – These walkthroughs will occur periodically as determined by the Fermilab Project Manager. The walkthroughs will be completed in accordance with Section 7010 of the Fermilab Environment Safety and Health Manual (FESHM). A copy of the procedure is included in Appendix B of this Project Plan.

Conceptual Design Drawings



SCALE:

PROJECT NORTH

MC - INFRASTRUCTURE

SITE PLAN

CDR

Fermilab

U.S. DEPARTMENT OF ENERGY

DATE

20 MAY, 2013

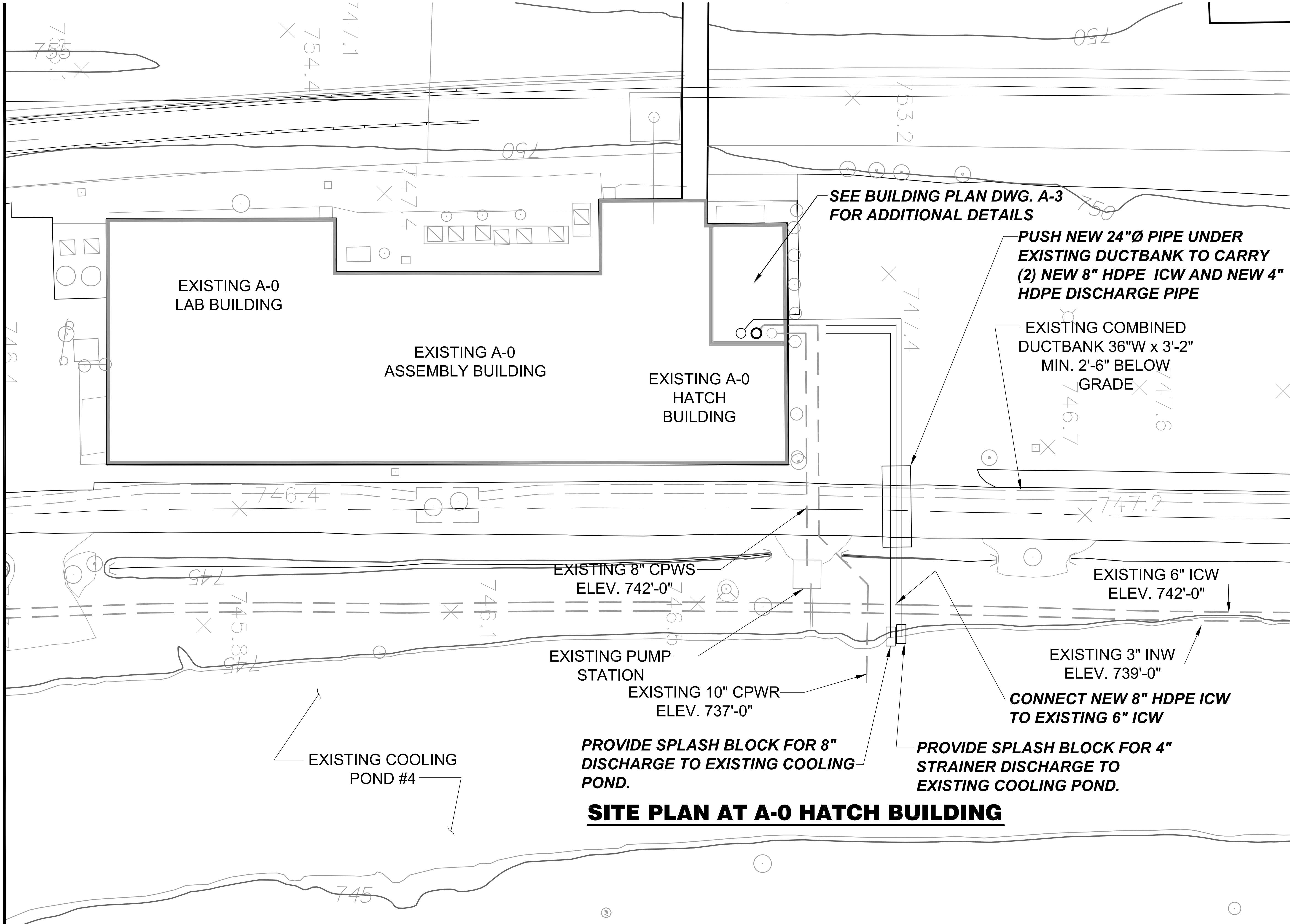
PROJECT NO.

6-10-23

DRAWING NO.

C-1

May 20, 2013 - 10:20am \\blue1\fess\FESS_ENG\Active Projects\6\10\23\2 - Conceptual Design\Drawings\C-1 - C-2_6-10-23.dwg



SITE PLAN AT A-0 HATCH BUILDING

SCALE:

PROJECT NORTH

MC - INFRASTRUCTURE

SITE PLAN AT A-0 HATCH BUILDING

CDR

Fermilab

U.S. DEPARTMENT OF ENERGY

DATE
20 MAY, 2013

PROJECT NO.
6-10-23

DRAWING NO.
C-2

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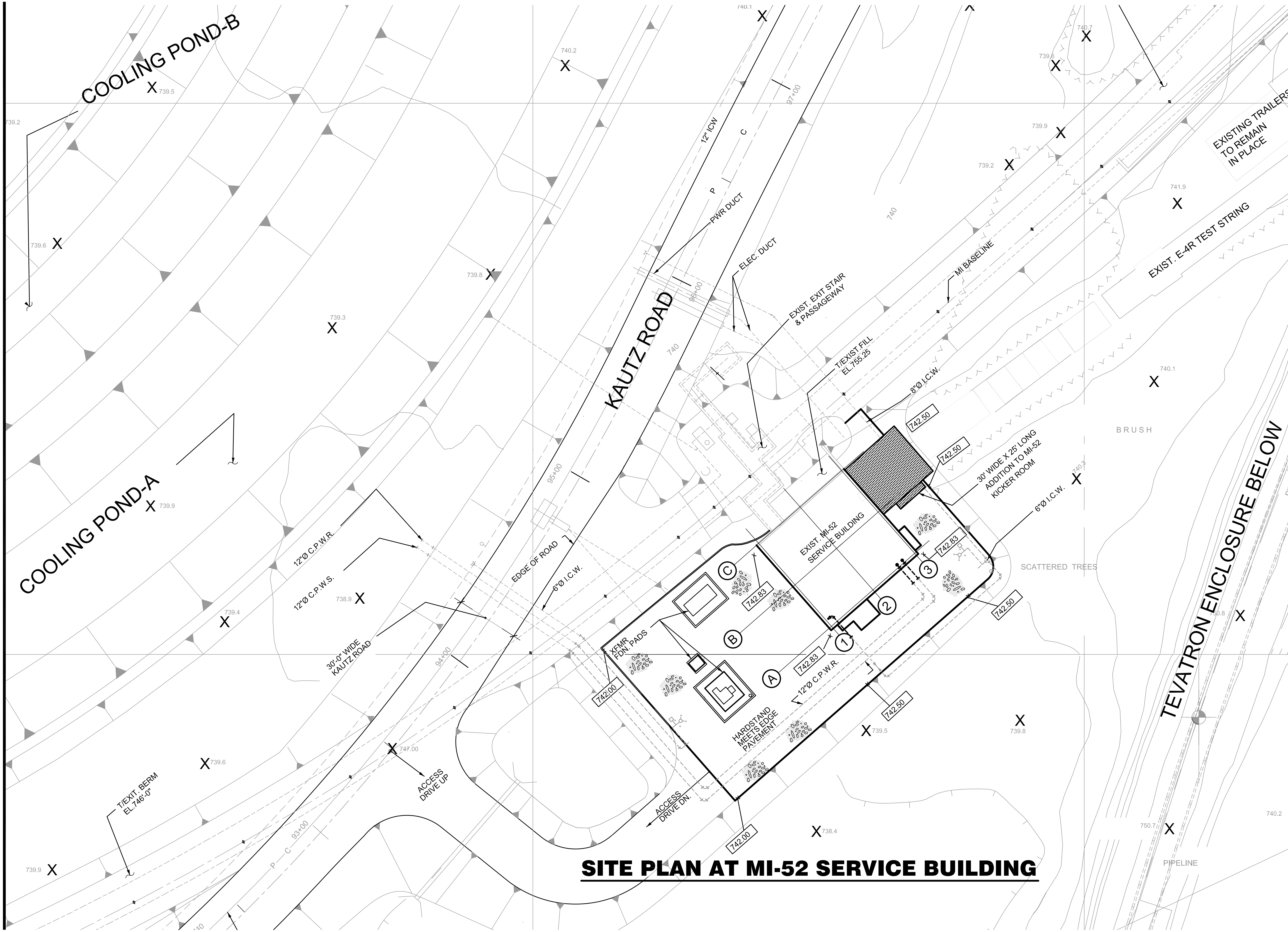


SITE PLAN AT MI-52 SERVICE BUILDING

SCALE: 1" = 40'-0"

PROJECT NORTH

CDR

Fermilab

U.S. DEPARTMENT OF ENERGY

MC - INFRASTRUCTURE

SITE PLAN AT MI-52 SERVICE BUILDING

DATE

20 MAY, 2013

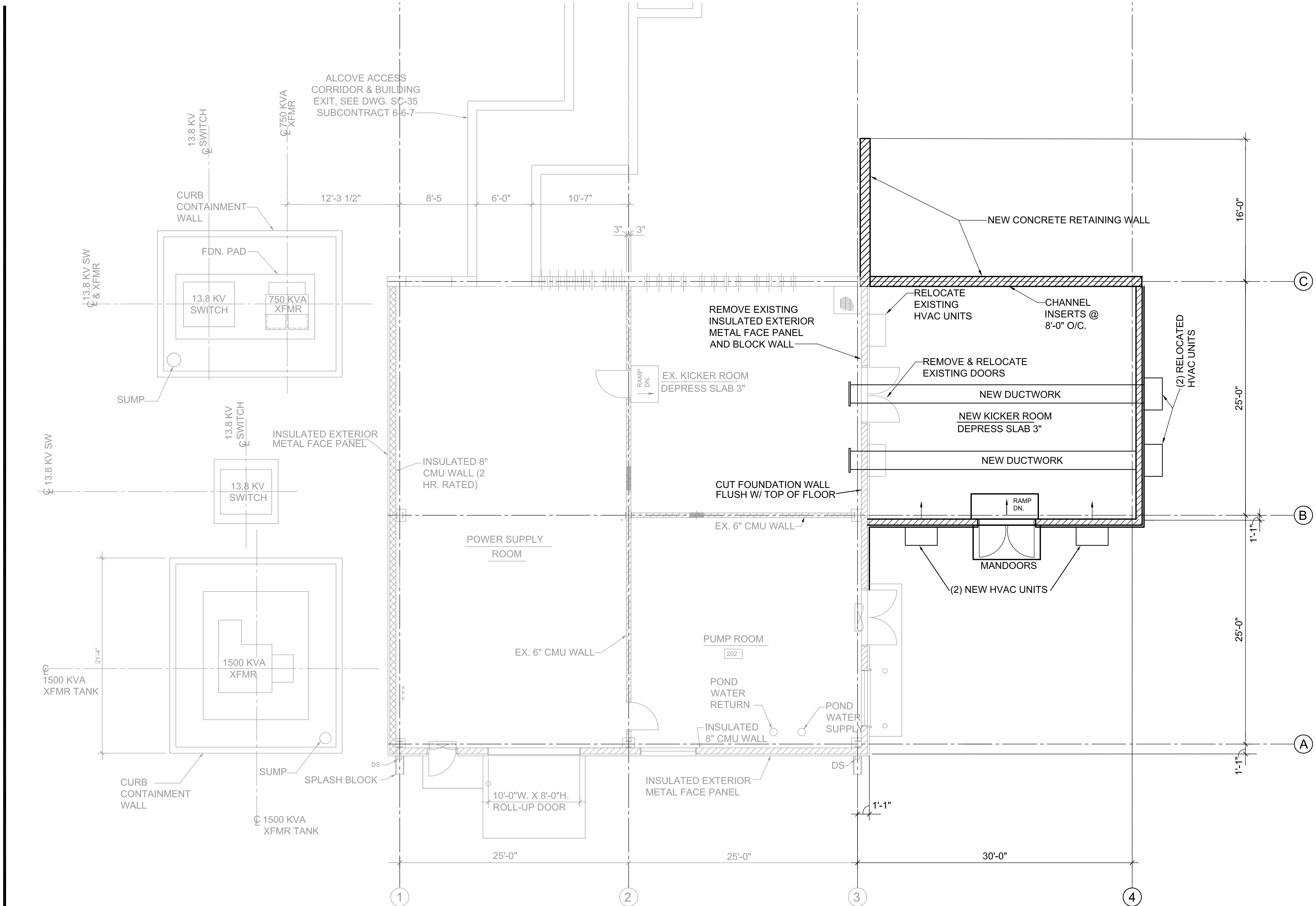
PROJECT NO.

6-10-1

DRAWING NO.

C-3

May 20, 2013 - 10:23am \\blue1\fess\FESS_ENG\Active Projects\6110232 - Conceptual Design\Drawings\C-3_6-10-23.dwg



FLOOR PLAN - MI-52 SERVICE BUILDING ADDITION

T/FLOOR ELEVATION = 743'

SCALE: 1" = 10'-0"

SCALE 10 0 10 20 FEET

PROJECT NORTH

MC - INFRASTRUCTURE

MI-52 SERVICE BUILDING ADDITION - FLOOR PLAN

CDR

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U.S. DEPARTMENT OF ENERGY

DATE

20 MAY, 2013

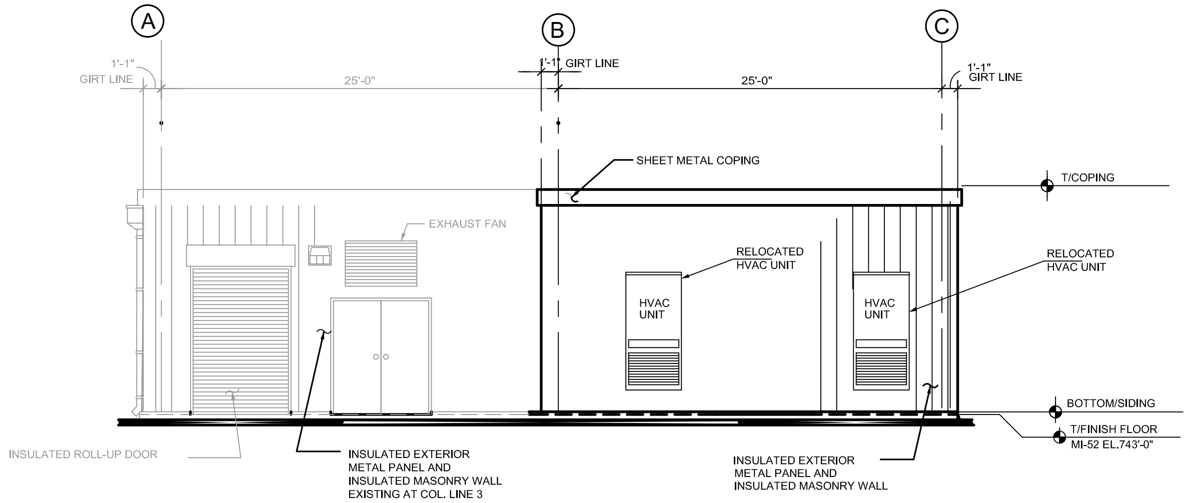
PROJECT NO.

6-10-23

DRAWING NO.

A-1

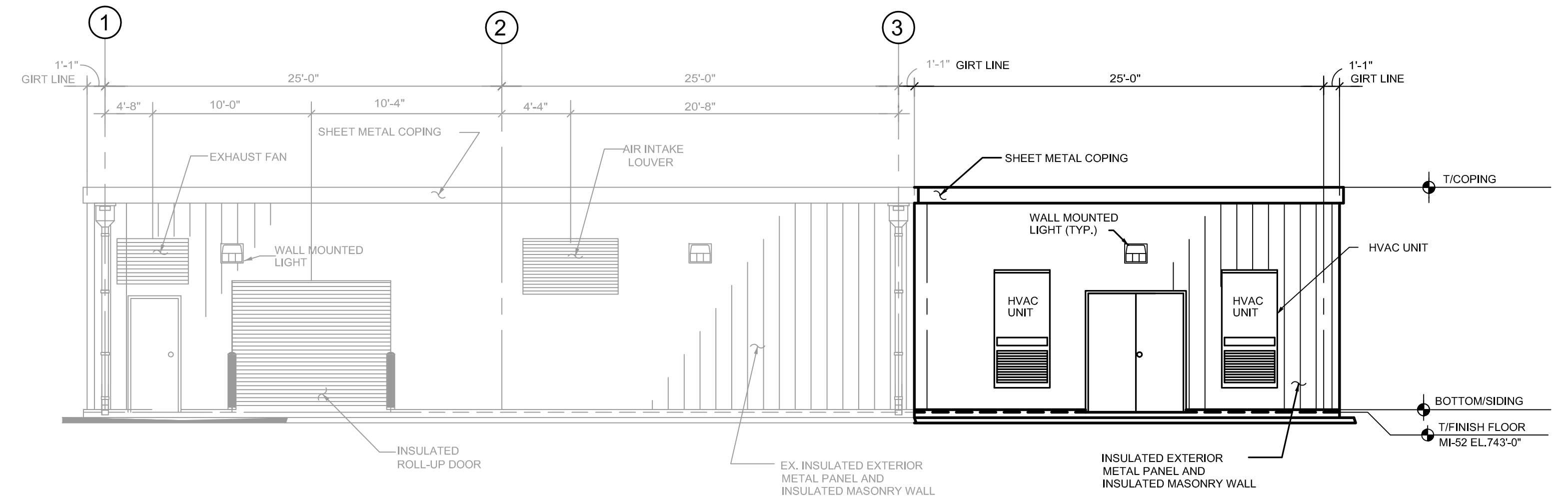
May 20, 2013 - 10:24am \\blue1\fess\FESS_ENG\Active Projects\6\10\23\2 - Conceptual Design\Drawings\A-1_6-10-23.dwg



ELEVATION COL. LINE 4

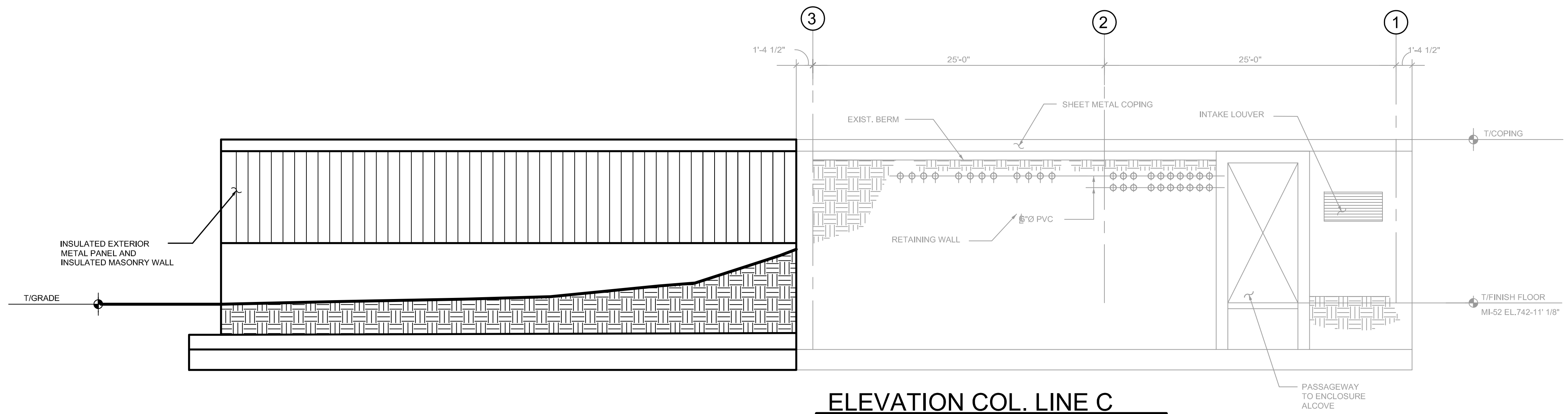
SERVICE BUILDING MI-52

SCALE: 1"=20'



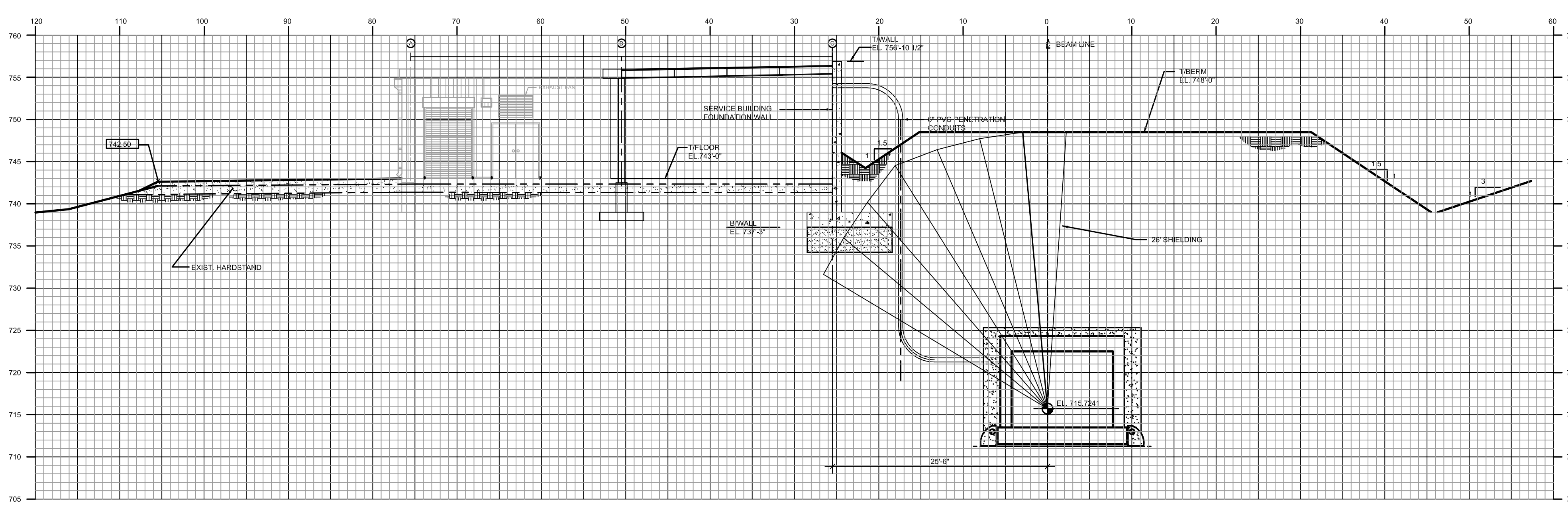
ELEVATION COL. LINE A

SCALE: 1"=20'



ELEVATION COL. LINE C

SCALE: 1"=20'



SECTION @ COL. LINE 3

SCALE: 1"=40'

SCALE:

MC INFRASTRUCTURE

MI-52 SERVICE BUILDING ADDITION - ELEVATIONS

CDR

Fermilab

U.S. DEPARTMENT OF ENERGY

DATE

20 MAY, 2013

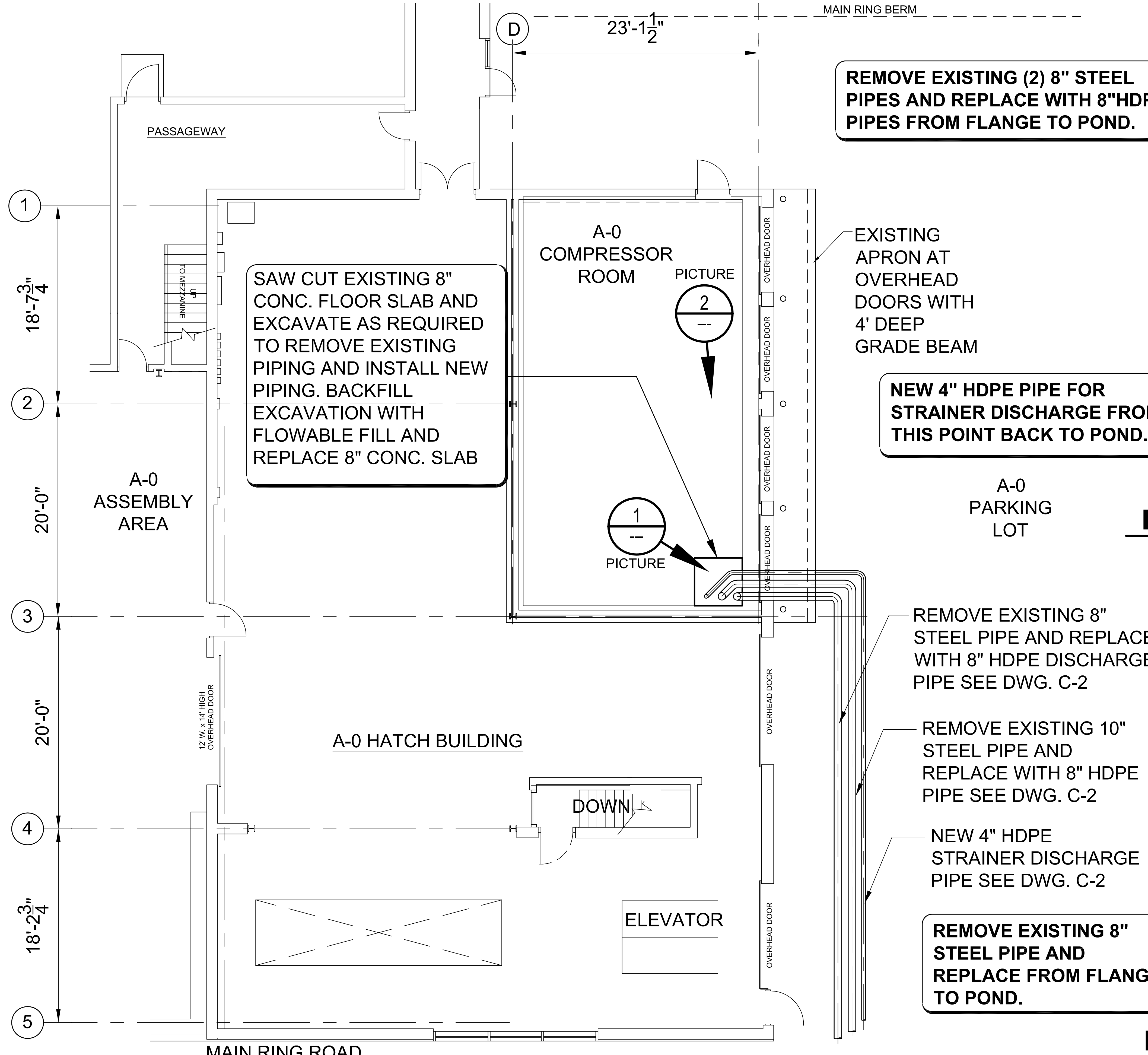
PROJECT NO.

6-10-23

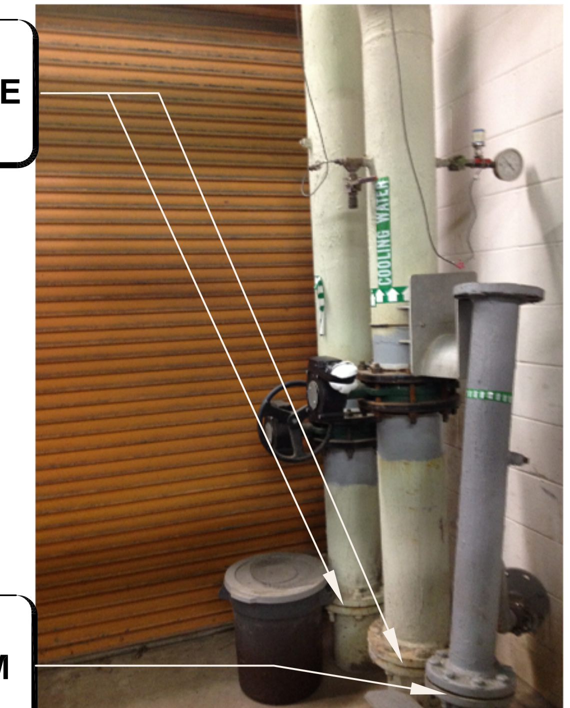
DRAWING NO.

A-2

May 20, 2013 - 10:25am \\blue1\fess\FESS_ENG\Active Projects\6\10\23\2 - Conceptual Design\Drawings\A-2_6-10-23.dwg



PLAN AT A-0 HATCH BUILDING



PICTURE 1

PICTURE 2

SCALE: 1" = 10'-0"

PROJECT NORTH

MC - INFRASTRUCTURE

A-0 SERVICE BUILDING - FLOOR PLAN

CDR

Fermilab

U.S. DEPARTMENT OF ENERGY

DATE

20 MAY, 2013

PROJECT NO.

6-10-23

DRAWING NO.

A-3

May 20, 2013 - 10:26am \\blue1\fess\FESS_ENG\Active Projects\6\10\23\2 - Conceptual Design\Drawings\A-3_6-10-23.DWG

URL List of referenced DOE Directives and Guides

- DOE Directive 413.3b
  http://www.directives.doe.gov/directives/current-directives/413.3-BOrder-b/view
- DOE Directive G413.3-21
  https://www.directives.doe.gov/directives/current-directives/413.3-EGuide-21/view

URL List of referenced Fermilab Policies, Procedures and Guidance

- DOE/Fermi Research Associates Contract DE-AC02-07CH11359
  http://fra-hq.org/pdfs/FRA_Contract.pdf
- Fermilab Director's Policy Manual
  http://www.fnal.gov/directorate/Policy_Manual.html
- Fermilab Environment Safety and Health Manual (FESHM)
  http://www-esh.fnal.gov/FESHM/7000/7010.htm
- Fermilab Engineering Manual
  http://www.fnal.gov/directorate/documents/FNAL_Engineering_Manual.pdf
- FESS/Engineering Policy Manual
  http://fess.fnal.gov/engineering/PolicyManual.pdf
- FESS/Engineering Procedure Manual
  http://fess.fnal.gov/engineering/FESSProcedureManual.pdf
- FESS Environmental Review Form Database
  http://fess-oracle-web.fnal.gov:8085/FessEnvironmentalReviewProj-war/home.seam
- Fermilab Indirect Burden Rates
  http://finance.fnal.gov/Accounting/index.html

Attachments Contained In This Appendix

- URL List of referenced DOE Directives and Guides
- URL List of referenced Fermilab Policies, Procedures and Guidance
- Integrated Project Team Responsibility Matrix
- Life Safety Analysis
- NEPA Documentation
- Sustainable Design/High Performance Building Review Memo
- LEED/Guiding Principles Checklist
- Engineering Risk Assessment
- Whitestone Building and Repair Cost Reference Information
- Fermilab Work Smart Set, Chapter 1070 of FESHM
- Multi-Organization Construction Site Safety Walkthrough Procedure
- ICW Analysis Results 5-1-13
- Stakeholder Input
  - Comment and Compliance Review Request
  - Stakeholder Comments

INTEGRATED PROJECT TEAM RESPONSIBILITY MATRIX

MC Infrastructure

WORK PHASE	PROJECT SPONSERS: Directorate, Chief Operating Officer, J. Anderson	PROJECT SPONSERS: Championing Organization, Accelerator Div. Head, R. Dixon	INTEGRATED PROJECT TEAM: D/S/C, Fermilab Project Directors, M. Convery/G. Annala	INTEGRATED PROJECT TEAM: FESS/Engineering, Fermilab Project Manager, T. Lackowski	INTEGRATED PROJECT TEAM: FESS/Engineering, Fermilab Design Coordinator, R. Jedziniak	INTEGRATED PROJECT TEAM: FESS/Engineering, Fermilab Construction Coordinator, TBD	INTEGRATED PROJECT TEAM: Business Services Section, Procurement, S. Gaugel	ORGANIZATIONAL PROCESS ASSETS: Directorate, Finance Section Budget Office, D. Keiner	ORGANIZATIONAL PROCESS ASSETS: Business Services Section, Legal, Department	ORGANIZATIONAL PROCESS ASSETS: Business Services Section, Accounting, Department	ORGANIZATIONAL PROCESS ASSETS: Facilities Engineering Services Section, Section Head, R. Ortgiesen	ORGANIZATIONAL PROCESS ASSETS: Facilities Engineering Services Section, FESS Engineering Department Head, R. Alber	ORGANIZATIONAL PROCESS ASSETS: Championing Organization, Accelerator Div. Safety Officer, J. Anderson	ORGANIZATIONAL PROCESS ASSETS: Championing Organization, Accelerator Div. Budget Officer, A. Nestander	ORGANIZATIONAL PROCESS ASSETS: Facilities Engineering Services Section, Environmental, R. Walton	ORGANIZATIONAL PROCESS ASSETS: ES&H Section, Safety and Health, J. Cassidy	ORGANIZATIONAL PROCESS ASSETS: Business Services Section, Security, B. Flaherty
Project Justification CD-0																	
establish mission need, identify funding	Approve mission need, place in GPP/AIP queue	Establish mission need; appoint Fermilab Project Director	Prepare/submit mission need									Provide Project Cost Range					
Preliminary Design CD-1																	
Establish FESS/Engineering task		Assess D/S/C resource availability	Define project scope	Establish project and task request for Operating Reserve Funds for devlopment of CDR	Develop design costs for each disciple							Determine Fermilab Project Manager					
				Coordinate engineering resources, selection, tasking													
				Review in-house and A/E human resource requirements													
	Issue Approval to Proceed on Operating Reserve task			Submit task request for Operating Reserve funding							Review engineering task request for Operating Reserve funds	Review, concur and forward task request for Operating Reerve funds to COO					
Human Resource Management				Determine need for in-house and A/E human resource requirements								Review workload assignments					
				Prepare A/E RFP Memo	Review A/E RFP		Issue A/E RFP										
				Review A/E proposal	Review A/E proposal		Forward A/E to FPM		Assist with contracting								
				Initiate requisition for A/E work			Establish tasking purchase order with A/E										
Prepare NEPA documentation				Enter FERF into tracking database	Develop information for FERF						Interface with ES&H Section				Review FERF and detemine if PIF is required.		
				Review PIF											Develop PIF, if needed		
				Submit PIF											Interface with ES&H Section to support PIF process		
Develop Project Plan	Preliminary acceptance of aesthetic concerns	Provide D/S/C Resources as required	Coordinate customer team	Establish project design team	Direct design teams effort						Provide FESS Resources as Required	Monitor, Review and Comment					
			Provide project requirements	Interface with customer	Interface w/ customer												
				Develop Project Plan Documents	Assist in Developing Project Plan Documents												
Lab-wide Comment and Compliance Review	Review and Comment	Review and Comment	Review and Comment	Issues CCR, comment resolution	Coordinate CCR, comment resolution		Review and Comment		Review and Comment		Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment
Fermilab Project Request Form	approve PRF	Approve Fermilab Project Request Form		Draft Fermilab Project Request Form										Review Submittal and Forward to Finance Section			
	Review Directive Request			Submit Fermilab Project Request Form				Create and Submit Directive Request to DOE									
Project Plan Approval			Accepts project scope	Accepts Project Baseline, Cost , Scope and sSchedule													
	Accept and Approve Project Plan	Accept and Approve Project Plan	Accept and Approve Project Plan	Submit Project Plan													
Project Plan Submittal to DOE for Construction Directive Authorization								Submit Construction Directive Authorization									
Project Filing			Monitor Filing	Establish Project File Requirements	Maintain Project Files							Monitor Project Filing					
Final Design CD-2																	
Establish Funding Codes				Request Work Package				Create Work Package						Create PCM for Task Numbers, submit request to Finance			
Human Resource Management				Determine need for in-house and A/E human resource requirements								Review workload assignments					
				Prepare A/E RFP Memo	Review A/E RFP		Issue A/E RFP										
				Review A/E proposal	Review A/E proposal		Forward A/E to FPM		Assist with Contracting								
				Initiate requisition for A/E work			Establish tasking purchase order with A/E										
Design Coordination Meetings			Participate in Meetings	Participate in Meetings	Coordinate and Lead Meetings												
Design Development				Approve change orders	Interface with Customer and Fermilab organizations		issue change orders										
					Lead Development of Construction Documents, Drawings, Exhibits												
Execute Project Plan Exhibit A and Exhibit B				assist in writing Exhibit A	coordinate writing of Exhibit A&B		assist in writing Exhibit A		provide counsel as requested								
Internal Cost Tracking and Control				Monitor Design Progress and Costs						provide timely cost data to PM							
				initiate Design Phase Change Orders (if required)	Review Design Phase Change Orders		Issue Design Phase Change Orders to A/E firms (if required)										
				Review and Approve A/E Invoices	Review and Approve A/E Invoices		Review and Approve A/E Invoices			pay invoices		approve A/E invoices					

LEGEND

(tan)	Indicates Initiator of Action
(blue)	Indicates Approval Action Required

LIST OF ACRONYMS

AP	Acquisition Plan
BO	Beneficial Occupancy
CCB	change control board
A/E	Architectural Engineering Consultant
PIF	Project Information Form (NEPA)
PEP	Project Execution Plan
CDR	Conceptual Design Report
FPM	Fermilab Project Manager
D/S/C	divisions/sections/research centers
PO	Purchase Order
RFP	Request for Proposal
FERF	FESS Environmental Review Form
COO	Chief Operating Officer
SET	Source Evaluation Team

INTEGRATED PROJECT TEAM RESPONSIBILITY MATRIX

MC Infrastructure

	PROJECT SPONSERS		INTEGRATED PROJECT TEAM					ORGANIZATIONAL PROCESS ASSETS									
	Directorate	Championing Organization	D/S/C	FESS/Engineering	FESS/Engineering	FESS/Engineering	Business Services Section	Directorate	Business Services Section	Business Services Section	Facilities Engineering Services Section	Facilities Engineering Services Section	Championing Organization	Championing Organization	Facilities Engineering Services Section	ES&H Section	Business Services Section
	Chief Operating Officer	*Accelerator Div. Head*	*Fermilab Project Directors*	*Fermilab Project Manager*	*Fermilab Design Coordinator*	*Fermilab Construction Coordinator*	*Procurement*	*Finance Section Budget Office*	*Legal*	*Accounting*	*Section Head*	*FESS Engineering Department Head*	*Accelerator Div. Safety Officer*	*Accelerator Div. Budget Officer*	*Environmental*	*Safety and Health*	*Security*
WORK PHASE	**J. Anderson**	**R. Dixon**	**M. Convery/G. Annala**	**T. Lackowski**	**R. Jedziniak**	**TBD**	**S. Gaugel**	**D. Keiner**	**Department**	**Department**	**R. Ortgiesen**	**R. Alber**	**J. Anderson**	**A. Nestander**	**R. Walton**	**J. Cassidy**	**B. Flaherty**
Change Control for Design	Secure Additional Funding	Secure Additional Funding	Initiate Changes to Design Performance Baseline	Establish CCB for Design Phase	Prepare Estimates of Cost and Schedule Impacts												
			Secure Additional Funding For Changes	Provide Cost and Schedule Impact of Proposed Changes to Fermilab Project Director													
Lab-wide Comment and Compliance Review			Review and Comment	Issues CCR, comment resolution	Coordinate CCR, comment resolution		Review and Comment		Review and Comment		Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment	Review and Comment
Monitoring and Controlling			Monitor Design Progress	Coordinate Engineering Resources, Selection, Tasking, Invoices													
				Monitor Design Progress													
			Monitor Project Costs	Monitor Project Costs													
				Review and Approve A/E Invoices	Review and Approve A/E Invoices		Review and Approve A/E Invoices			Pay A/E Invoices		Review and Approve A/E Invoices					
Value Management (tailored)			Participate in Value Management	Coordinate and Lead Value Management Exercises	Participate in Value Management	Participate in Value Management											
Develop Design Phase Cost and Schedule Estimate				Lead Development of Design Phase Cost and Schedule Estimate	Assist in Development of Design Phase Cost and Schedule Estimate												
Independent Cost Estimate			Concur with Need for Independent Cost Estimate	Determine need for Independent Cost Estimate	Provide Input for Need for Independent Cost Estimate												
				Prepare A/E RFP Memo	Review A/E RFP		Issue A/E RFP										
				Review A/E proposal	Review A/E proposal		Forward A/E to FPM		Assist with Contracting								
				Initiate requisition for A/E work			Establish tasking purchase order with A/E										
Design Phase Submittals				Prepare Signature Sheet for Release of Design Phase Documents													
			Approve Release of Design Phase Documents	Approve Release of Design Phase Documents	Approve Release of Design Phase Documents						Approve Release of Design Phase Documents	Approve Release of Design Phase Documents					
Request For Proposal			Review Request For Proposal Documents	Review Request For Proposal Documents			Develop Request For Proposal Documents										
Regulatory Permits									Provide Counsel as Requested				Identify Required Permits		Identify Required Permits		
				Provide Permit Information	Provide Permit Information						Approve Permit Submittal				Prepare Permit Application		
			Approval Permit Submittal	Approval Permit Submittal											Submit Application to ES&H Section		
				Monitor Permitting Process													
Update Project Plan			Identify Changes to Project Plan	Identify Changes to Project Plan	Identify Changes to Project Plan						Identify Changes to Project Plan	Identify Changes to Project Plan			Identify Changes to Project Plan		
				Update Project Plan													
			Approve Changes to Project Plan	Approve Changes to Project Plan													
Project Reporting				Monitor Design Progress and Costs				Initiate Request for Quarterly GPP Reports									
				Prepare Quarterly GPP Reports						Provide Timely Cost Data to FPM							
			Review Quarterly GPP Reports									Review Quarterly GPP Reports		Review Quarterly GPP Reports			
	Review Quarterly GPP Reports							Review Quarterly GPP Reports						Forward Quarterly GPP Reports to Finance Section			
								Submit Quarterly GPP Reports to DOE									
Directive Modifications		Review and Approve Directive Modification Request Form	Review Directive Modification Request Form	Prepare Directive Modification Request Form										Review and Approve Directive Modification Request Form			
														Submit Directive Modification Request Form to Finance Section			
								Review Directive Modification Request Form									
	Review and Approve Directive Modification Request Form																
								Forward Directive Modification Form to DOE									
Project Filing			Monitor Filing	Establish Project File Requirements	Maintain Project Files							Monitor Project Filing					
Procurement CD-3																	
Issue Request For Proposal				Initiate Construction Requisition													
	Approve Requisition	Approve Requisition									Approve Requisition	Approve Requisition		Approve Requisition			
							Issue Request For Proposal										
Pre-Proposal Meeting (if required)				Determine Necessity for Pre-Proposal Meeting													
							Coordinate and Chair Pre-Proposal Meeting										

LEGEND

(tan)	Indicates Initiator of Action
(blue)	Indicates Approval Action Required

LIST OF ACRONYMS

AP	Acquisition Plan
BO	Beneficial Occupancy
CCB	change control board
A/E	Architectural Engineering Consultant
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D/S/C	divisions/sections/research centers
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RFP	Request for Proposal
FERF	FESS Environmental Review Form
COO	Chief Operating Officer
SET	Source Evaluation Team

INTEGRATED PROJECT TEAM RESPONSIBILITY MATRIX

MC Infrastructure

	PROJECT SPONSERS		INTEGRATED PROJECT TEAM					ORGANIZATIONAL PROCESS ASSETS									
	Directorate	Championing Organization	D/S/C	FESS/Engineering	FESS/Engineering	FESS/Engineering	Business Services Section	Directorate	Business Services Section	Business Services Section	Facilities Engineering Services Section	Facilities Engineering Services Section	Championing Organization	Championing Organization	Facilities Engineering Services Section	ES&H Section	Business Services Section
	Chief Operating Officer	*Accelerator Div. Head*	*Fermilab Project Directors*	*Fermilab Project Manager*	*Fermilab Design Coordinator*	*Fermilab Construction Coordinator*	*Procurement*	*Finance Section Budget Office*	*Legal*	*Accounting*	*Section Head*	*FESS Engineering Department Head*	*Accelerator Div. Safety Officer*	*Accelerator Div. Budget Officer*	*Environmental*	*Safety and Health*	*Security*
WORK PHASE	**J. Anderson**	**R. Dixon**	**M. Convery/G. Annala**	**T. Lackowski**	**R. Jedziniak**	**TBD**	**S. Gaugel**	**D. Keiner**	**Department**	**Department**	**R. Ortgiesen**	**R. Alber**	**J. Anderson**	**A. Nestander**	**R. Walton**	**J. Cassidy**	**B. Flaherty**
			Participate in Pre-Proposal Meeting	Participate in Pre-Proposal Meeting	Participate in Pre-Proposal Meeting											Participate in Pre-Proposal Meeting	
Requests For Information					Coordinates RFIs												
			Monitors RFI Process	Concurs with Replies for RFIs	Prepares Replies For RFIs							Monitors RFI Process					
Amendments				Concurs with Need for Amendment to RFP			Determines Need for Amendment to RFP										
			Monitors Amendment Process		Assemble Amendment Documentation							Monitors Amendment Process					
							Issues Amendment to RFP										
Proposal Evaluations				Chair Source Evaluation Team			Source Selection Officer									evaluate safety submittals	
			Participate in Source Evaluation Team	Evaluate Corporate Quality Control Plan	Participate in Source Evaluation Team		Participate in Source Evaluation Team		Provide Counsel as Requested			Monitor Source Evaluation Team Process					
				Evaluate Schedule Submittal			Review Proposals for Business Related Issues										
				Forward Recommendation to Source Selection Officer													
Negotiations				Assist in Negoiations			Conduct Negotiations		Provide Counsel as Requested								
Subcontract Award				Initate Recommendation To Award												Review and Accept Safety Documentation	
			Approve Award	Approve Award			Award Subcontract		Provide Counsel as Requested								
Update Project Plan For Construction Phase			Identify Changes to Project Plan	Identify Changes to Project Plan	Identify Changes to Project Plan						Identify Changes to Project Plan	Identify Changes to Project Plan			Identify Changes to Project Plan		
				Update Project Plan													
			Approve Changes to Project Plan	Approve Changes to Project Plan													
Project Filing			Monitor Filing	Establish Project File Requirements	Maintain Project Files							Monitor Project Filing					
Construction																	
Pre-Construction Meeting				Determine Necessity for Pre-Construction Meeting													
							Coordinate and Chair Pre-Construction Meeting										
			Participate in Pre-Construction Meeting	Participate in Pre-Construction Meeting	Participate in Pre-Construction Meeting	Participate in Pre-Construction Meeting							Participate in Pre-Construction Meeting			Participate in Pre-Construction Meeting	Participate in Pre-Construction Meeting
Subcontractor Corporate Safety Plan				Review Submittals		Review Submittals										Review/Approve Safety and Health Submittals	
				Accept Subcontractor Corporate Safety Plan													
Subcontractor Quality Control Plan				Review Subcontractor Plan	Review Subcontractor Plan	Review Subcontractor Plan											
				Accept Subcontractor Quality Control Plan													
Storm Water Erosion Control Plan				Review Plan	Review Plan	Review Plan									Review/Approve Environmental Submittals		
				Accept Storm Water Erosion Control Plan													
Hazard Analysis						Review and Accept Hazard Analysis						Monitor Process				Assist Review as Requested	
Fermilab Permits				Monitor Process	Monitor Process	Obtain and Maintain Currency						Monitor Process			Provide Oversite and Support of Process		
Notice To Proceed				Monitor Process		Assure Predessocors are in Place	Issue Notice To Proceed					Monitor Process					
Cost Loaded Schedule (CLS)				Review CLS	Review CLS	Review and Comment on CLS											
				Accept CLS													
Submittal List				Review Submittal List	Review Submittal List	Review Submittal List											
					Approve Submittal List												
A/E Support For Construction Phase				Determine need for in-house and A/E human resource requirements								Review workload assignments					
				Prepare A/E RFP Memo	Review A/E RFP		Issue A/E RFP										
				Review A/E proposal	Review A/E proposal		Forward A/E to FPM		Assist with Contracting								
				Initiate requisition for A/E work			Establish tasking purchase order with A/E										
Execute Construction Phase				Monitors Process		Fermilab Competent Person											
						First Line Contact with Subcontractor											
						Coordinate Fermilab Interfaces (services, outages, etc.)											
Inspections and Reports				Monitor QA program		QA Inspections for Technical and Safety Plan Compliance					Support as Requested	Support as Requested	Support as Requested			Support as Requested	
				Monitor Progress and Trends		Daily Construction Report to FPM					Monitor Progress and Trends	Monitor Progress and Trends					
Labor Reporting						Obtain Man-hour Reports from Subcontractor	Review Davis-Bacon Payroll Submittals										
Deficiency Log				Monitor Deficiency Log	Monitor Deficiency Log	Maintain Deficiency Log											
Submittals				Monitor Submittal Review Process	Coordinate Submittal Review	Participate in Submittal Review Process											

LEGEND	
(tan)	Indicates Initiator of Action
(blue)	Indicates Approval Action Required

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INTEGRATED PROJECT TEAM RESPONSIBILITY MATRIX

MC Infrastructure

WORK PHASE	PROJECT SPONSERS		INTEGRATED PROJECT TEAM					ORGANIZATIONAL PROCESS ASSETS									
	Directorate	Championing Organization	D/S/C	FESS/Engineering	FESS/Engineering	FESS/Engineering	Business Services Section	Directorate	Business Services Section	Business Services Section	Facilities Engineering Services Section	Facilities Engineering Services Section	Championing Organization	Championing Organization	Facilities Engineering Services Section	ES&H Section	Business Services Section
	Chief Operating Officer	*Accelerator Div. Head*	*Fermilab Project Directors*	*Fermilab Project Manager*	*Fermilab Design Coordinator*	*Fermilab Construction Coordinator*	*Procurement*	*Finance Section Budget Office*	*Legal*	*Accounting*	*Section Head*	*FESS Engineering Department Head*	*Accelerator Div. Safety Officer*	*Accelerator Div. Budget Officer*	*Environmental*	*Safety and Health*	*Security*
	J. Anderson	R. Dixon	M. Convery/G. Annala	T. Lackowski	R. Jedziniak	TBD	S. Gaugel	D. Keiner	Department	Department	R. Ortgiesen	R. Alber	J. Anderson	A. Nestander	R. Walton	J. Cassidy	B. Flaherty
				Issue and Approve Actions													
					Maintain Submittal Log												
Engineering Changes				Initiate Engineering Change Request													
					Develop Documentation for Engineering Changes												
				Concur with Engineering Change Request	Issue Engineering Change Request												
							Issue Engineering Change Request to Subcontractor										
							Forward Engineering Change Request Information from Subcontractor to Project Team				review / approve						
				Review Subcontractor Engineering Change Request Submittal	Review Subcontractor Engineering Change Request Submittal	Review Subcontractor Engineering Change Request Submittal											
				Initiate Requisition													
	Approve Requsition	Approve Requsition									Approve Requsition	Approve Requsition		Approve Requsition			
							Issue Supplemental Agreement										
				Maintain Engineeeing Change Log													
Claim Review and Negotiations				Lead Review and Negotiations	Assist Review	Assist Review	Assist Review and Negotiation		provide counsel as requested		assist review						
				Approve Settlements			Determine Settlements										
Supplemental Agreements				Approve Supplemental Agreements			Issue Supplemental Agreements										
Non-compliance Notifications						Draft Non-compliance Notification	Provide Counsel as Requested		provide counsel as requested								
				Issue Non-compliance Notification			Concur with Non-compliance Notification										
				Monitor Non-compliance Notifications													
Construction Meeting				Participate in Meetings	Patricipate in Meetings	Chair Meeting	Patricipate in Meetings						Attend as Requested		Attend as Requested	Attend as Requested	
Weekly Project Team Meeting			Participate in Meetings	Participate in Meetings	Chair Meeting	Participate in Meetings	Participate in Meetings									Participate in Meetings	
Project Management Group Meeting	Participate in Meetings	Participate in Meetings	Participate in Meetings	Lead Presentation		Participate in Meetings	Participate in Meetings	Participate in Meetings								Participate in Meetings	
Project Reporting				Monitor Design Progress and Costs				Initiate Request for Quarterly GPP Reports									
				Prepare Quarterly GPP Reports						Provide Timely Cost Data to FPM							
			Review Quarterly GPP Reports									Review Quarterly GPP Reports		Review Quarterly GPP Reports			
	Review Quarterly GPP Reports							Review Quarterly GPP Reports						Forward Quarterly GPP Reports to Finance Section			
								Submit Quarterly GPP Reports to DOE									
Cost Tracking and Control				Monitor Construction Progress	Monitor Construction Progress	Monitor Construction Progress	Monitor Construction Progress			Provide Timely Cost Data to FPM		Track A/E invoices and FESS Engineering Costs					
				Monitor EDIA Costs													
				Monitor Project Costs													
Subcontractor Progress Updates				Review and Comment on Subcontractor Update Submittals	Review and Comment on Subcontractor Update Submittals	Conduct Progress Updates with Subcontractor	Review and Comment on Subcontractor Update Submittals										
Invoice Approvals				Review Invoices	Review Invoices	assure invoice checklist is complete											
				Approve Invoices	Approve A/E and Subcontractor Invoices	Approve Subcontractor Invoices	Approve Invoices										
Punch List				Determine Punchlist Start													
			Participate in Walkthroughs	Coordinate Customer Walkthroughs	Coordinate Engineering Portion of Walkthroughs	Coordinate Punch List Walkthroughs	Monitor Punch List Activity										
					Transmit Punch List to Subcontractor	Assemble Lab Punch lList											
						Monitor Completion of Punch List Items											
Beneficial Occupancy			Accept Customer D/S/C Responsibilities	Coordinate Customer D/S/C Responsibilities		Coordinate Walkthroughs											
			Approve Beneficial Occupancy	Approve Beneficial Occupancy	Transmit Beneficial Occupancy to Sucbontractor	Initiate Beneficial Occupancy Form	Approve Beneficial Occupancy				Approve Beneficial Occupancy	Approve Beneficial Occupancy					
Final Acceptance			Approve Final Acceptance	Approve Final Acceptance	Transmit Final Acceptance to Subcontractor	Initiate Final Acceptance Form	Approve Final Acceptance				Approve Final Acceptance	Approve Final Acceptance					
Update Project Plan			Identify Changes to Project Plan	Identify Changes to Project Plan	Identify Changes to Project Plan						Identify Changes to Project Plan	Identify Changes to Project Plan			Identify Changes to Project Plan		
				Update Project Plan													
			Approve Changes to Project Plan	Approve Changes to Project Plan													
Incident Investigations						Initiate Call Tree					Assist as Required	Assist as Required	Assist as Required	Assist as Required	Assist as Required	Assist as Required	Assist as Required
						Obtain Incident Report from Subcontractor										monitor process	monitor process
			Monitor Incident Repsonse	Issue Incident Report, Monitor Response		Prepare Incident Report for FPM					Monitor Incident Repsonse	Monitor Incident Repsonse	Monitor Incident Repsonse	Monitor Incident Repsonse	Monitor Incident Repsonse	Monitor Incident Repsonse	Monitor Incident Repsonse

LEGEND	
(tan)	Indicates Initiator of Action
(blue)	Indicates Approval Action Required

LIST OF ACRONYMS	
AP	Acquisition Plan
BO	Beneficial Occupancy
CCB	change control board
A/E	Architectural Engineering Consultant
PIF	Project Information Form (NEPA)
PEP	Project Execution Plan
CDR	Conceptual Design Report
FPM	Fermilab Project Manager
D/S/C	divisions/sections/research centers
PO	Purchase Order
RFP	Request for Proposal
FERF	FESS Environmental Review Form
COO	Chief Operating Officer
SET	Source Evaluation Team

INTEGRATED PROJECT TEAM RESPONSIBILITY MATRIX
MC Infrastructure

WORK PHASE	PROJECT SPONSERS		INTEGRATED PROJECT TEAM					ORGANIZATIONAL PROCESS ASSETS									
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WORK PHASE	J. Anderson	R. Dixon	M. Convery/G. Annala	T. Lackowski	R. Jedziniak	TBD	S. Gaugel	D. Keiner	Department	Department	R. Ortgiesen	R. Alber	J. Anderson	A. Nestander	R. Walton	J. Cassidy	B. Flaherty
Lessons Learned				Assist as Required	Assist as Required	Assist as Required						Develop Lessons Learned					
Environment, Safety and Heath Compliance	Monitor Compliance	Monitor Compliance	Monitor Compliance	Monitor Compliance		Monitor Compliance	Monitor Compliance				Monitor Compliance	Monitor Compliance	assist on technical issues		Monitor Compliance	Monitor Compliance	
				Interface with Subcontractor	Assist as Requested	Assure Subcontractor Compliance										Assist as Requested	
As-Built Documentation					Assist as Requested	Assure As-builts Kept Current and Accurate											
Directive Modifications		Review and Approve Directive Modification Request Form	Review and Approve Directive Modification Request Form	Prepare Directive Modification Request Form										Review and Approve Directive Modification Request Form			
														Submit Directive Modification Request Form to Finance Section			
								Review Directive Modification Request Form									
	Review and Approve Directive Modification Request Form																
								Forward Directive Modification Form to DOE									
Project Filing			Monitor Filing	Establish Project File Requirements	Maintain Project Files							Monitor Project Filing					
Close-out CD-4																	
Subcontractor Performance Review			Participate in Review	Participate in Review		Participate in Review	Coordinate and Lead Review									Participate in Review	
Final Payment and Renetention Release						Assure Invoice Checklist is Complete											
				Review and Approve Subcontractor Invoices	Review and Approve Subcontractor Invoices	Review and Approve Subcontractor Invoices	Review and Approve Subcontractor Invoices										
				Assist as Required	Assist as Required	Assist as Required	Move Outstanding Issues to Warranty										
Level1 Budget Close	Approve Budget Close	Approve Budget Close		Determine Close Date				Activate Level 1 Budget Close		Assure All Commitments in Place				Request Budget Close			
Notice of Project Closeout	Approve Closeout	Approve Closeout												Submit Project Closeout Request			
Final Budget Close								Activate Final Budget Close						Initiate Final Close			
Directive Modifications		Review and Approve Directive Modification Request Form	Review and Approve Directive Modification Request Form	Prepare Directive Modification Request Form										Review and Approve Directive Modification Request Form			
														Submit Directive Modification Request Form to Finance Section			
								Review Directive Modification Request Form									
	Review and Approve Directive Modification Request Form																
								Forward Directive Modification Form to DOE									
Project Filing			Monitor Filing	Establish Project File Requirements	Maintain Project Files							Monitor Project Filing					

LEGEND

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PO	Purchase Order
RFP	Request for Proposal
FERF	FESS Environmental Review Form
COO	Chief Operating Officer
SET	Source Evaluation Team

Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

JUN 12 2012

Dr. Bruce L. Chrisman
Chief Operating Officer
Fermilab
P.O. Box 500
Batavia, IL 60510

Dear Dr. Chrisman:

SUBJECT: NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) DETERMINATION AT FERMI NATIONAL ACCELERATOR LABORATORY (FERMILAB) – FERMILAB MUON CAMPUS, INCLUDING THE MUON TO ELECTRON CONVERSION (Mu2e) EXPERIMENT AND THE MC-1 BUILDING

Reference: Letter, from B. Chrisman to M. Weis, dated June 6, 2012, Subject: NEPA Environmental Evaluation Notification Form (EENF) for the Fermilab Muon Campus, including the Mu2e Experiment and the MC-1 Building

I have reviewed the Fermilab EENF for the Fermilab Muon Campus, including the Mu2e Experiment and the MC-1 Building. Based on the information provided in the EENF, I have approved the following categorical exclusion (CX):

Project Name	Approved	CX
Fermilab Muon Campus, including the Mu2e Experiment and the MC-1 Building	6/8/2012	B1.15, B3.10

I am returning a signed copy of the EENF for your records. No further NEPA review is required. This project falls under categorical exclusions provided in Title 10, *Code of Federal Regulations*, Part 1021, as amended in November 2011.

Sincerely,

Michael J. Weis
Site Manager

Enclosure:
As Stated

cc: P. Oddone, w/o encl.
Y.-K. Kim, w/o encl.
N. Grossman, w/encl.
T. Dykhuis, w/encl.

FERMILAB ENVIRONMENTAL EVALUATION NOTIFICATION FORM (EENF)

for documenting compliance with the National Environmental Policy Act (NEPA), DOE NEPA Implementing Regulations, and the DOE NEPA Compliance Program of DOE Order 451.1

Project/Activity Title: Establishment of a Fermilab Muon Campus (MC) Program, including the Muon to Electron Conversion (Mu2e) Experiment and the MC-1 Building

ES&H Tracking Number: 01090

I hereby verify, via my signature, the accuracy of information in the area of my contribution for this document and that every effort would be made throughout this action to comply with the commitments made in this document and to pursue cost-effective pollution prevention opportunities. Pollution prevention (source reduction and other practices that eliminate or reduce the creation of pollutants) is recognized as a good business practice which would enhance site operations thereby enabling Fermilab to accomplish its mission, achieve environmental compliance, reduce risks to health and the environment, and prevent or minimize future Department of Energy (DOE) legacy wastes.

Fermilab Associate Lab Director, Particle Physics Sector: Greg Bock 6/4/12

Fermilab Particle Physics Sector ES&H Manager: Eric McHugh 1374 6/7/12

Fermilab Associate Lab Director, Accelerator Sector: Stuart Henderson 6/4/12

Fermilab Accelerator Sector ES&H Manager: John Anderson 1 June 12

Fermilab Muon Department Head: Gerald Annala Gerald Annala 6/5/12

Fermilab MC-1 Building Project Director: Erik Gottschalk 6/6/12

Fermilab Mu2e Project Manager: Ronald Ray Ronald E Ray 6/5/12

Fermilab Mu2e ES&H Coordinator: Adrienne Dee Hahn 6/6/12

Fermilab Engineering and Services Section (FESS) Head: Randy Ortgiesen 6-1-12

Fermilab Engineering and Services Section Environmental Officer: Rodney Walton 6/5/12

Fermilab Environment, Safety and Health Director: Nancy L. Grossman 6-4-12

Fermilab Environment, Safety and Health Senior Safety Officer: John P. Cassidy 6/4/12

Fermilab Environment, Safety and Health Radiation Safety Officer: J. Donald Cossairt 6/4/12

Fermilab Environment, Safety and Health Environmental Officer: Eric Mieland Eric Mieland 6-4-12

Fermilab NEPA Program Manager: Teri L. Dykhuis Teri L Dykhuis 6/4/12

I. Description of the Purpose and Need for the Proposed Action; the Proposed Action; and Alternatives to the Proposed Action

Purpose and Need:

The purpose of the proposed action/project is to establish a Fermilab Muon Campus (see Figure 1 and 2 in Appendix A) Program that would be a base for future muon experiments. The Program currently includes the proposed construction and operation of the Muon to Electron Conversion (Mu2e) Experiment and the proposed construction of the Muon Campus (MC)-1 Building, that would be built in anticipation of the future Muon Gyromagnetic Ratio Measurement (g-2, pronounced g minus 2) Experiment. It is expected that the Muon Campus Program would maximize the synergy between the Mu2e Experiment and the g-2 Experiment and minimize the overall cost of developing them individually due to the ability to share utilities, consolidate infrastructure, and mobilize civil construction concurrently.

The purpose of creating the Mu2e Experiment is to enable scientists to make the most sensitive search ever made for the coherent conversion of muons into electrons in the field of a nucleus, which is an example of 'charged lepton flavor violation' (electrons are 1st generation and muons are 2nd generation leptons). The Mu2e Experiment would provide an advance in experimental sensitivity of four orders of magnitude (10,000 times more sensitive) than previous experiments and it is needed to shed light on the mechanism for generating the observed matter-antimatter asymmetry of the universe. Combined with neutrino program results, the Mu2e Experiment could also help point the way to a unification theory of the fundamental forces of nature. This leap in sensitivity could be achieved with a modest evolution of the existing Fermilab accelerator complex, to create the required intense low energy muon beam; a state-of-the art detector capable of precision measurements in the presence of high rates of conversions; and a new detector hall facility to house the experiment. A successful Mu2e Experiment could be the first step in a world-leading muon-decay program that would "advance fundamental knowledge in high energy physics that would result in a deeper understanding of matter, energy, space and time" which is consistent with the Department of Energy Secretarial Strategic Priority of Science, Discovery, and Innovation.

The purpose of the MC-1 Building is to initially house the anticipated g-2 Experiment that is needed to measure the gyromagnetic ratio "g" of the muon; this ratio is particularly sensitive to any new particles or interactions beyond the Standard Model, the current understanding of elementary particle physics. The building would potentially be repurposed for other future muon experiments that would be suited to an intense muon beam and benefit from the reuse of the existing accelerator system, specifically the recycler and antiproton facilities.

Proposed Action:

To fulfill the purpose and need for the Muon Campus Program, which currently includes the Mu2e Experiment and the MC-1 Building, the following activities are proposed.

Mu2e Experiment

To achieve the sensitivity goal described in the 'purpose and need' for the Mu2e Experiment, a high intensity low energy muon beam coupled with a detector capable of efficiently identifying 105 MeV electrons, while minimizing background from conventional processes, is necessary and the muon beam would be created at Fermilab by an 8 GeV pulsed beam of protons striking a production target.

The components necessary to execute the Mu2e Experiment include a Primary Proton Beam which would require modifications to the Fermilab Accelerator Complex that involve Recycler Ring Modifications, Antiproton Debuncher/Delivery Ring Upgrades, a new Muon Campus External Beamline and Beamline Enclosure; Superconducting Solenoids including the Production, Transport, and Detector Solenoids; a Mu2e Detector; Muon Campus Cryogenic Plant; and a Mu2e Facility comprised of an Underground Detector Hall and a Surface Building at grade level. Proposed activities needed to construct and enable operation of the Mu2e Experiment are as follows:

- **Prepare the Muon Campus Site**, which would include relocation of a portion of Kautz Road to the west to accommodate construction of the Mu2e Building. Additionally, a large portion of the Kautz Road stockpile would be relocated to provide for the realignment of the roadway and the existing high-pressure gas line that parallels the existing roadway would be relocated alongside the new roadway alignment. The roadway and gas line would be made functional prior to construction of the new Mu2e Facility.

To accommodate the future electrical loading requirements of the Muon Campus, an additional high-voltage electrical feeder would be extended to the campus footprint. A new extension of Feeder 24 would be constructed from the Master Substation to the F-3 service area and isolating 4-bay air switches would be installed at these locations to provide for configuration changes. The new feeder cables would be pulled through existing ductbank and no new ductbank construction is expected other than at the location of the new switches.

- **Modify the existing Fermilab Accelerator Complex** to facilitate the transfer of 8 GeV protons from the Fermilab Booster to the proposed Mu2e Detector while the 120 GeV neutrino program is operating (see Figure 3 in Appendix A). To accomplish this, the existing Recycler and Antiproton Debuncher/Delivery Ring (the Antiproton Debuncher Ring would be renamed Delivery Ring for the purposes of the Muon Campus so is referred to here as the Antiproton Debuncher/Delivery Ring) would be modified to re-bunch batches of protons from the Booster and then slow extract beam to the Mu2e Detector (see Figures 3 and 4 in Appendix A).

Primary Proton Beam – The Mu2e Experiment requires a high intensity pulsed proton beam to produce an intense beam of low energy muons with the time structure required by the experiment; Figure 3 illustrates the eventual Fermilab accelerator complex necessary to acquire protons for the Mu2e Experiment. The total number of protons to be delivered on target for the experiment is 1.2×10^{20} per year, corresponding to an average power of about 8 kW. As shown in Figure 4, batches of protons from the existing Booster would be transported to the Recycler Ring for re-bunching via a new Radio Frequency (RF) system and the re-bunched beam would be kicked out of the Recycler into existing transfer lines that would deliver protons to the Antiproton Debuncher/Delivery Ring. A resonant extraction system in the Antiproton Debuncher/Delivery Ring would then slow extract protons to the proposed Mu2e Detector through a new external beamline. The operating scenario and proposed modifications are as follows:

- **Recycler Ring Modifications -** The transport of protons from the Booster to the Recycler Ring would occur via a connection from the MI-8 line to the Recycler Ring. This connection does not currently exist but it, along with construction and installation of a kicker system to inject Booster batches into the Recycler Ring, are part of the *Neutrinos at the Main Injector (NuMI) Off-Axis Electron Nuetrino Appearance Experiment (NOvA)* project scope that would be completed in advance of the Mu2e Experiment. The scope of this work was included in the *NOvA Environmental Assessment/Finding of No Significant Impact.*

  In addition, the Mu2e Experiment would require the ability to re-bunch beam in the Recycler Ring; therefore, a new 2.5 MHz RF system would be installed to divide batches of protons from the Booster into four smaller bunches that would be transferred one-at-a-time to the existing P1 line. A new connection would be made from the Recycler Ring to the P1 line, which currently connects to the Main Injector. A new extraction kicker is also required.

- **Transfer Lines and Antiproton Debuncher/Delivery Ring Injection** - Proton bunches formed in the Recycler Ring would be kicked into the P1 line and transported to the Antiproton Debuncher/Delivery Ring through a series of existing transfer lines. For Mu2e running, protons would traverse the P2, AP1 and AP3 lines before being injected into the Antiproton Debuncher/Delivery Ring by a new injection kicker. The proton bunches would be captured in the Antiproton Debuncher/Delivery Ring by a new 2.4 MHz RF system consisting of RF modules that are identical to the RF modules needed for the Recycler Ring. Stochastic cooling tanks and other equipment used for antiproton production would be removed from the Antiproton Debuncher/Delivery Ring to open up the beam aperture as much as possible.

  The Antiproton Debuncher/Delivery Ring upgrade would improve the aperture of the beam transport line to the Antiproton Debuncher/Delivery Ring, as well as the Antiproton Debuncher/Delivery Ring itself to better serve multiple muon experiments. General improvements would be made to support the transport of 8 GeV protons with a large momentum spread and high repetition rate from the Recycler Ring to the AP0 target or to the Antiproton Debuncher/Delivery Ring. The aperture of the beam line would be increased by replacement of limiting magnets as well as modest improvements of the optics. These changes would minimize beam loss and allow better transmission efficiency. Small changes in the power systems and beamline enclosure would be required for some of these improvements. Instrumentation would be upgraded to allow operation with higher repetition rates and longer bunch structure.

In the Antiproton Debuncher/Delivery Ring, an injection kicker and septum magnet would be added to allow direct injection of 8 GeV protons, or 3.1 GeV muons from the new Muon Campus beamline. Collider equipment that is no longer necessary would be removed to maximize the aperture. An abort system would be installed that would serve as a standard proton abort for Mu2e, as well as provide the ability to remove unwanted protons from the muon beam circling the Antiproton Debuncher/Delivery Ring. Instrumentation would be upgraded to be compatible with the beam structure specified by future muon experiments. Various improvements would be made to allow for the higher radiation environment that would be present with the operation of the muon experiments, including replacement of magnet cooling hoses and tubing with more radiation resistant materials, and magnet shunts would be relocated to service buildings from their present tunnel locations. Within the scope of the Mu2e project, there would be the addition of local shielding and a Total Loss Monitor system which would be implemented to ensure that the radiation dose to the public is below 1 mrem/year while the muon program is in operation. Finally, upgrades to the electrical panels and service buildings would be implemented to better serve the future power supply systems needed for muon operation. There are some power supplies that would be upgraded as a result of their age and difficulty maintaining.

➢ **Antiproton Debuncher/Delivery Ring Modifications exclusive to Mu2e** - Mu2e requires slow extracted proton beam to be delivered to the Mu2e Detector. A new resonant extraction system is required that delivers narrow microbunches to the detector that are separated by the revolution period of the Debuncher Ring. The resonant extraction system consists of sextupole magnets, quadrupole magnets, an RF knockout device and an electrostatic extraction septum along with the controls and instrumentation necessary to operate and control the resonant extraction process. Internal shielding at loss points in the beamline tunnel and Debuncher Ring are also required for Mu2e operation.

- **Design and construct a new MC External Beamline and Beamline Enclosure from the Antiproton Debuncher/Delivery Ring to the Mu2e Detector** (see Figure 4 in Appendix A). The MC Beamline Enclosure would consist of the activities required for construction of a below-grade, cast-in-place and/or precast concrete enclosure to house the programmatic beamline components that would be required to transport the proton beam from the existing Antiproton Debuncher/Delivery Ring into the Mu2e Detector Enclosure and MC-1 Building. The MC Beamline Enclosure would be a 10 foot wide by 8 foot high concrete enclosure approximately 700 feet long, running from the existing Antiproton Debuncher/Delivery Ring enclosure to the Mu2e Detector Enclosure. A shortened stub up section would be constructed to transport beam from the Antiproton Debuncher/Delivery Ring enclosure to the MC-1 Building as well. The MC Beamline Enclosure would be designed to support 16 feet of earth and concrete shielding to grade.

  The MC Beamline Enclosure would be flanked with underdrain piping that would negate the hydraulic pressure on the walls and roof of the enclosure and the underdrains would be routed to a duplex sump that would discharge water onto grade and away from the enclosure. The walls and ceiling of the enclosure would be fitted with channel inserts to allow for support of cable trays, cooling water, electrical conduits and fire detection equipment. In addition, convenience outlets and welding outlets would be located along the enclosure, in addition to required emergency and exit lighting, as well as normal light fixtures. The enclosure would be ventilated with neutral dehumidified air and fire detection would be via air sampling and line type sensors.

  The majority of the construction of the MC Beamline Enclosure would utilize traditional 'open cut and cover' methods in which material is removed from the beamline location, the beamline is constructed and the completed enclosure is covered with the excavated material. This method has been used successfully at Fermilab for the construction of the majority of shielded enclosures on-site. For those areas located adjacent to existing utility crossings, an earth retention system would be used.

- **Design and construct the proposed Mu2e Superconducting Solenoid System** (see Figure 5 in Appendix A) consisting of a *Production Solenoid* that contains the target for the primary proton beam, an

S-shaped *Transport Solenoid* that serves as a magnetic channel for pions and muons of the correct charge and momentum range and a *Detector Solenoid* that would house the muon stopping target made from a series of thin foils and the detector elements.

Considerable infrastructure is required to support the operation of the solenoids. This includes power, quench protection, cryogens (liquid nitrogen and liquid helium), control and safety systems as well as mechanical supports to resist the substantial magnetic forces on the magnets.

- **Design and construct a proposed Mu2e Detector** (See Figure 5 in Appendix A) consisting of a tracker, a calorimeter, a stopping target monitor, a cosmic ray veto, an extinction monitor and the electronics, trigger and data acquisition required to read out, select and store the data. The tracker would accurately measure the trajectory of charged particles, the calorimeter would provide independent measurements of energy, position and time, the stopping target monitor would measure the characteristic X-ray spectrum from the formation of muonic atoms, the cosmic ray veto would identify cosmic ray muons traversing the detector region that can cause backgrounds and the extinction monitor would detect scattered protons from the stopping target to determine the fraction of out-of-time beam.

- **Design and construct a Muon Campus Cryoplant.** The Mu2e Experiment would require liquid helium to cool superconducting magnets and therefore a cryogenic facility would be constructed. Existing Tevatron compressors would drive compressed Helium from the Tevatron ring to a low bay attached to the proposed MC-1 Building. The low bay would contain 3 recycled Tevatron satellite refrigerators that could handle the dynamic load and cold lines would run from the refrigerators to the proposed Mu2e Detector Hall/Enclosure.

- **Design and construct a proposed facility (Mu2e Facility) to house the Mu2e Detector and the associated infrastructure** (see Figure 6 in Appendix A). This would include an underground enclosure to house the Mu2e Detector (Mu2e Detector Hall/Enclosure) and a surface building to house necessary equipment and infrastructure that can be accessed while beam is being delivered to the detector. Routing of utilities from nearby locations and installation of new transformers to power the facility would be conducted. The Mu2e Facility would be comprised of approximately 25,000 square feet of new construction space.

MC-1 Building

The proposed MC-1 Building (See Figure 7 in Appendix A) would be a general purpose facility for the study of muon detectors and the internal outfitting would be designed and constructed in order to accommodate the future Muon g-2 Experiment. It would be located within the new Muon Campus, northeast of the existing Antiproton Facility (Antiproton Debuncher/Delivery Ring) and the south side of the facility would be constructed to support the berm required to shield the future beamline for the Mu2e Experiment.

The general building would be comprised of a 13,500 gross square feet facility and the experimental area would consist of an 80 feet by 80 feet high-bay facility with overhead bridge crane and one-story basement area designed to support large loads from accelerator equipment. Equipment access would be from a grade-level loading dock. A one and two story Service Building would include areas for the installation of computing facilities; power supplies; control/counting room; storage space and building support equipment. A one-story 40 feet by 40 feet Refrigeration Room would be included to house refrigeration equipment in support of installed experiments as well as toilet and janitorial services and general space for shop equipment.

Utilities would be tapped from nearby feeders and piping in existing utility corridors, including: electrical, communications, natural gas, industrial cooling water, sanitary sewer, domestic water and chilled water. The facility would be constructed in consideration of potential future Muon Campus construction, including beamline enclosures, refrigeration utilities and the future Mu2e Experiment.

Alternatives:

Alternative Sites

The Brookhaven National Laboratory (BNL) Alternating Gradient Synchrotron (AGS), if suitably upgraded, could be used to provide proton beam for a muon conversion experiment. However, the BNL Muon to Electron Conversion (MECO) proposal that was initiated as a National Science Foundation (NSF) project was cancelled due to the cost of the upgrades and therefore this alternative is not viable.

The Los Alamos National Laboratory (LANL) 800 MeV proton line could be used to produce a secondary beam of muons for a muon conversion experiment. The duty factor of the beam, however, is less than 10 percent which would result in substantially higher instantaneous rates that would require more sophisticated, costly and risky detector technologies so this alternative is not viable.

Conversely, the existing Fermilab accelerator complex could be easily and cost effectively adapted to provide a high intensity proton beam necessary for a muon conversion experiment. In fact, Mu2e is ideally suited to the Fermilab complex because the existing antiproton source (Debuncher/Delivery Ring) could be repurposed since the Tevatron collider run has concluded. Furthermore, the Mu2e Experiment requires high intensity pulses of protons that are separated by roughly twice the muon lifetime in aluminum of 864 nanoseconds and the circumference of the antiproton source is 1,694 nanoseconds, which means that as the protons are traversing the antiproton rings they can be appropriately bunched and prepared for slow-extraction to the detector in a straightforward manner. Additionally, the Fermilab scheme that has been developed would result in a high enough duty factor for the delivery of the proton beam, thus reducing instantaneous rates in the detector and minimizing backgrounds to the signal, which makes it superior from a scientific perspective to the above mentioned alternatives.

A short beamline from the antiproton source to the Mu2e Detector and a new Detector Hall/Enclosure would have to be constructed; however, modifications to the existing Fermilab accelerator complex, to accommodate the Mu2e Experiment, would be modest and would capitalize on the existing DOE investment. Additionally, most, if not all, of the magnets required for the new beamline could be recycled from decommissioned transfer lines associated with the Tevatron collider, thereby making efficient use of existing equipment.

In addition, a second anticipated muon experiment, g-2, proposes to use the Fermilab accelerator complex in a similar way to Mu2e and the substantial overlap between the two experiments would allow for a world class Muon Program at Fermilab that would cost considerably less than that of executing the two experiments independently.

In conclusion, Fermilab's scientific and technical expertise, an existing accelerator facility capable of delivering beam that is essential for the desired science, the cost savings realized from the efficient reuse of equipment and infrastructure, and the synergy with the g-2 experiment preclude an alternative site for the Muon Campus and the Mu2e Experiment in particular.

Alternative Locations on the Fermilab Site

The location of the Mu2e facility just north of the Antiproton source near Kautz Road is dictated by the required length of the external beamline and the location of an existing beamline stub that connects to the Antiproton source. No alternate location on the Fermilab site was therefore viable.

The 'No Action' alternative would not meet the above stated purpose and need.

II. Description of the Affected Environment

The proposed location on the Fermilab site of the Muon Campus (see Figure 1 and 2 in Appendix A) was selected due to the needs of the Mu2e Experiment and the anticipated future g-2 Experiment. The Fermilab location for the Mu2e Experiment was dictated by the programmatic requirement for extraction of a proton beam from the existing Antiproton Facility (Antiproton Debuncher/Delivery Ring for Muon Experiments). The proposed Muon Campus area would occur southwest of Wilson Hall/Enclosure and would be bounded by the Antiproton Facility, Giese Road, Indian Creek, and South Booster Road and bisected by Kautz Road, which would need to be rerouted. The area is previously disturbed upland comprised of gravel parking area, upland fields, and woodland. No regulated wetlands would be impacted by the proposed action and the small, degraded wetlands that would be impacted have minimal wetland function and value. Potential indirect impacts to adjacent regulated wetlands from erosion and sedimentation would be mitigated through the development and implementation during construction of a detailed Storm Water Pollution Prevention Plan and an Erosion Control Plan. There would be no construction in the 100-year floodplain.

The Muon Campus proposed MC Beamline Enclosure (also referred to as the Mu2e External Beamline) would be a 10 foot wide by 8 foot high concrete enclosure approximately 700 feet long, running underground from the existing Antiproton Debuncher/Delivery Ring Enclosure to a proposed Mu2e Detector Enclosure that would be a below grade concrete structure of approximately 15,000 square feet that would be 25 feet deep.

Construction of the Mu2e Detector Hall/Enclosure would involve excavation of previously disturbed land to provide an underground enclosure to house the Mu2e Detector. An estimated 30,000 cubic yards of soil would be excavated for the Mu2e Detector Enclosure and 20,000 cubic yards for the External Beamline. Spoils from excavation would be placed in a temporary pile at the construction site until the construction is complete and then used for backfill, soil shielding, and piled along the length of the underground Mu2e External Beamline enclosure to provide a 16 foot berm for the beamline. Any remaining spoils would be placed on one of the onsite stockpiles or disposed off-site. The placement of the new facilities would necessitate relocation of approximately 1000 feet of the existing Kautz Road to the west by a maximum of approximately 250 feet. Diversion of Kautz Road would involve excavation of approximately 36,000 cubic yards and surface grading in an area of previously disturbed land. A building would also be constructed on the surface directly above the enclosure and utilities would be routed from nearby locations to the new Detector Hall/Enclosure. All construction and debris waste would be disposed of by Fermilab and appropriate material would be sent to a recycling vendor.

Utilities would be run from several locations through previously disturbed soil as follows:

- 13.8 kV power would be run approximately 500 feet to the Mu2e Detector Hall/Enclosure from the MC-1 Building area. Power to the Muon Campus would be extended from the loop that currently circles the Antiproton Area (Debuncher/Delivery Ring).
- Low Conductivity Water (LCW), Chilled Water (CW) and Sanitary Sewer (SS) would be run approximately 600 feet to the Mu2e Detector Hall/Enclosure from the Central Utility Building. Some of the Low Conductivity piping corridor between the Central Utility Building (CUB) and the Antiproton Area would be replaced. LCW to the MC-1 Building and the Mu2e Facility would be through the new beamline enclosure. The existing lift station at the Antiproton Area (Debuncher/Delivery Ring) would be removed and connecting piping to the existing tie-ins would be reconnected to a new sanitary lift station installed at the MC-1 Building. The Mu2e Facility would tie into this new lift station.
- Industrial Cooling Water (ICW), Drinking Water System (DWS), and natural gas (NG) would be run approximately 150 feet each from the existing corridor along relocated Kautz Road. The relocation of Kautz Road would also repositions the ICW, DWS and NG.

Construction of the Mu2e Detector would take place at various locations around Fermilab, at collaborating institutions and in industry in the US and possibly abroad. Final assembly and installation of the detector would take place at Fermilab but would not involve any digging, trenching, demolishing or conventional construction.

The Mu2e beam intensity in the Antiproton Facility (Debuncher/Delivery Ring) would increase from that of the previous Tevatron collider program in which between 4E12 and 5E12 antiprotons passed through the Antiproton complex every day. For Mu2e operations there would be approximately 4E12 protons contained in every Booster batch and approximately 130,000 Booster batches would pass through the Antiproton complex every day, which corresponds to a beam power of about 8 kW. In comparison, the total beam power out of the Booster is 70 kW and the *NuMI* beam power in the *NOvA* era would be 700 kW (see *NovA Environmental Assessment/Finding of No Significant Impact* for more information).

Three service buildings, known as AP-10, AP-30 and AP-50, sit above the Antiproton Facility beamline enclosure (See Figure 2 in Appendix A). The shielding between the top of the beamline enclosure and the floor of the service buildings was sufficient during Tevatron collider operations; however, the shielding in the three service buildings would need to be upgraded for Mu2e operations at a beam power of 8 kW. The deployment of a network of Total Loss Monitors (TLMs) would minimize beam losses and local shielding of known loss points in the beamline enclosure would be implemented. Additionally, the beam current can also be turned down until the losses fall well below the DOE regulatory limits. This is similar to the strategy currently employed in the Fermilab Booster, a more complex machine that runs at substantially higher beam currents.

The 8 GeV proton beam would strike a production target located inside the Production Solenoid. This area would be similar to a target vault for a typical fixed target experiment at Fermilab. The layout in this area is shown in Figure 5 of Appendix A. A map of the residual activation levels in this area that results from the interaction of the proton beam with the production target is shown in Figure 8 of Appendix A. The activation level at the outside surface of the iron yoke surrounding the Production Solenoid is a few mSv/hour. Simulations of Mu2e beamline operations indicate that ground water activation would be a factor of 10 to 100 times below the regulatory limits and therefore in a range typical to Fermilab experiments. Tritium and other short-lived radionuclides are produced as a normal by-product of beamline operations. The airborne radionuclides produced by the Mu2e beam would be released into the atmosphere through a vent stack to the surface; however, these emissions would be limited by minimizing the ventilation of the area during beam operations. Ventilation would be maximized for personnel access, but only after allowing sufficient time for decay of radionuclides after beam shutdown. The air from the ventilation system would be monitored for radionuclide emissions. The expected dose rate at the site boundary due to Mu2e operations would be an order of magnitude lower than the dose rate due to operation of the NuMI facility for NOvA, which is well below the regulatory limit.

The heat shield that would protect the Production Solenoid from particles produced in the production target would be cooled by a closed loop water system. The water would become radioactive over time. Tritium, 7Be and activated corrosion products are the only radioisotopes that would survive for any substantial duration as the others would decay away on the timescale of a few hours. Most of the 7Be would be trapped in de-ionization bottles. The water would be monitored and replaced at appropriate intervals.

Residual magnetic fields would be present in the detector enclosure when the superconducting solenoids are powered. The magnetic field immediately outside the Transport Solenoid is estimated to be about 5 kG, falling off to about 1 kG at a distance of 100 centimeter. Access would be restricted within a few meters of the solenoids when they are powered and warnings would be posted for people with pacemakers.

Components of the Mu2e Detector would be procured, fabricated and tested at existing facilities at Fermilab, other collaborating institutions and in industry. The main component of the detector is a series of large superconducting solenoids operating at liquid helium temperatures. Particle physics detectors, including drift chambers, scintillating crystals and plastic scintillator would be installed inside and around the outside of one of the solenoids. Liquid helium and liquid nitrogen would be used to maintain the operating temperature of the solenoids. In their natural state, helium and nitrogen are gasses that can displace oxygen and would pose an oxygen deficiency hazard and a freezing hazard in the event of a major leak in the detector hall/enclosure. However, Fermilab has extensive experience with similar systems and appropriate safety measures, based on that experience, would be incorporated into the design and planning of this new experiment.

MC-1 Building
The proposed site has been examined and is not in any wetlands, defined flood plain or other protected area. It would involve excavation that would create temporary spoils to be stored adjacent to the project site; spoils not used as backfill would be disposed on site and erosion control measures would be implemented during construction. All construction waste and debris would be properly managed by Fermilab and appropriate materials would be sent to a recycling vendor.

III. Potential Environmental Effects (Comments/clarification provided for each checked item in Section IV.)

A. Sensitive Resources: Would the proposed action result in changes and/or disturbances to any of the following resources?

- ☐ Threatened or endangered species
- ☐ Other protected species
- ☒ Wetland/Floodplains
- ☐ Archaeological or historical resources
- ☐ Non-attainment areas for Ambient Air Quality Standards

B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated substances or activities?

- ☒ Clearing or Excavation
- ☒ Demolition or decommissioning
- ☐ Asbestos removal
- ☐ PCBs
- ☐ Chemical use or storage

- ☐ Pesticides
- ☒ Air emissions
- ☒ Liquid effluents
- ☐ Underground storage tanks
- ☒ Hazardous or other regulated waste (including radioactive or mixed)
- ☒ Radioactive exposures or radioactive emissions
- ☐ Radioactivation of soil or groundwater

C. Other relevant Disclosures

- ☐ Threatened violation of ES&H permit requirements
- ☐ Siting/construction/major modification of waste recovery or TSD facilities
- ☐ Disturbance of pre-existing contamination
- ☒ New or modified permits
- ☐ Public controversy
- ☐ Action/involvement of another federal agency
- ☐ Public utilities/services
- ☐ Depletion of a non-renewable resource

IV. Comments on checked items in section III.

Wetland/Floodplains
No regulated wetlands would be impacted under the proposed action and the small area of degraded wetlands, which would be impacted, has minimal wetland function or value. Potential indirect impacts to adjacent regulated wetlands from erosion and sedimentation would be mitigated through the implementation during construction activities of a detailed Storm Water Pollution Prevention Plan and an Erosion Control Plan. There would be no construction in the 100-year floodplain.

Planning Resources Inc. performed a delineation of wetlands for the area of the proposed Muon Campus site. The wetland delineation was conducted in accordance with the 'Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (COE 2008)' and the wetland delineation and reporting guidance provided by the Chicago District Corps of Engineers on April 13, 2010. The Corps of Engineers reviewed the results of the wetlands study and determined that these low quality wetlands are exempt from their permit program; therefore, a Department of the Army permit under Section 404 of the Clean Water Act is not required and impacts would not constitute an extraordinary circumstance.

Clearing and Excavation
Clearing and excavation would be necessary for this project. It is anticipated that there would be approximately 36,000 cubic yards excavated for the diversion of Kautz Road; 30,000 cubic yards of soil excavated for the Mu2e Detector Hall/Enclosure; 20,000 cubic yards for the External Beamline; and 9000 cubic yards for the MC-1 Building. About 34,000 cubic yards of the excess soil would be stockpiled on the Fermilab site or disposed off-site and the remainder would be used for backfill and soil shielding for the beamline.

Demolition or Decommissioning
Concrete demolition of the antiproton ring would be required at the interface with the new external beamline; this interface would be approximately 10 feet by 8 feet and the waste would be placed in the soil backfill near the source.

After the useful life of the project has ended, there would be a need for Decommissioning and Dismantling. To the extent possible, components would be reused and materials would be evaluated for reuse and recycle. Resultant waste materials would be managed appropriately and according to all applicable rules and regulations for packaging, transporting, disposal, records management, and reporting.

Air Emissions
During excavation and construction of the Mu2e Detector Hall/Enclosure, the operation of construction equipment and vehicles would be expected to introduce SO_2, NO_x, particulates and other criteria pollutants to the atmosphere, typical of similar sized construction projects. These are mobile sources and therefore do not require a permit, nor would they affect the site wide operating permit. Particulates (dust) generated during earthmoving

activities and vehicle movement over unpaved areas would be minimized by watering or other dust-control measures.

Airborne radionuclides would also be produced by the Mu2e beam during operation of the experiment and would be released into the atmosphere through a vent stack to the surface. Air emissions would be limited by minimizing the ventilation of the area during beam operations. Ventilation would be maximized for personnel access, but only after allowing sufficient time for decay after beam shutdown. Air from the ventilation system would be monitored for radionuclide emissions. The dose rate at the site boundary due to Mu2e operations would be an order of magnitude lower than the dose rate due to operation of the NuMI facility or NOvA, which is well below the regulatory limit. Any necessary modifications to the Fermilab Lifetime Operating Permit (issued by the IEPA Air Bureau) would be obtained prior to beginning work.

Liquid Effluents
Liquid effluents would result from pumping groundwater that seeps into the underground portions of the Mu2e external beamline and experimental hall/enclosure to the surface ponds at Fermilab. The ponds may discharge to streams that flow offsite. The resulting concentration of radionuclides would be a factor of 500-1000 times below the regulatory limits.

Roof and parking lot drains would empty into storm water drainage systems and all other liquid effluents would be discharged to the sanitary sewer system. Work planning, experimental review, and safety inspections are the three methods for ensuring that hazardous effluents do not enter the sanitary waste stream.

Hazardous or other regulated waste (including radioactive or mixed)
Beamline elements and detector components may become activated during operation of the Mu2e experiment. A cool down period would be required before decommissioning could begin. All commonly reused valuable equipment such as magnets would be stored. Small amounts of lead, in the form of thin sheets, may be used as part of the calorimeter system and these sheets may become mildly activated and would have to be disposed of as mixed waste.

Radioactive Exposures or Emissions
Airborne radionuclides would be produced by the Mu2e beam and would be released into the atmosphere through a vent stack to the surface. Emissions would be limited by minimizing the ventilation of the area during beam operations. Ventilation is maximized for personnel access, but only after allowing sufficient time for decay after beam shutdown. Air from the ventilation system would be monitored for radionuclide emissions. The dose rate at the site boundary due to Mu2e operations would be an order of magnitude lower than the dose rate due to operation of the NuMI facility for NOvA, which is well below the regulatory limit. This may require modification of existing permits.

The 8 GeV proton beam would strike a production target located inside one of the superconducting solenoids. This area would be similar to a target vault for a typical fixed target experiment at Fermilab. The layout in this area is shown in Figure 5 of Appendix A. A map of the residual activation levels in this area that results from the interaction of the proton beam with the production target is shown in Figure 8 of Appendix A. The activation level at the outside surface of the concrete shielding surrounding the Production Solenoid is a few mSv/hour. Simulations of Mu2e beamline operations indicate that ground water activation would be a factor of 10 to 100 times below the regulatory limits and therefore in a range typical to Fermilab experiments.

A safety assessment document (SAD) module would be developed that would address radiation exposures to workers and members of the public due to the operation of Mu2e. The SAD would also address the potential radioactive emissions due to the proposed project. Personnel and public exposures would remain well below regulatory limits (Fermilab designs facilities for potential exposures of 10 mrem per year, while the regulatory limit is 100 mrem per year to the public per DOE Orders 458.1) and within guidelines of the Fermilab Radiological Control Manual including the control of occupational radiation exposures during maintenance activities. Radionuclide emissions would be monitored and reported in accordance with existing practices and regulatory requirements. Cumulative air emissions are expected to remain substantially below the National Emission Standards for Hazardous Air Pollutants (NESHAPs) threshold for continuous monitoring and far below the regulatory limit for effective dose to members of the public.

New or Modified Permits

All work activities would be evaluated to determine the necessity of permits and these would be obtained prior to construction. Specifically, expected radionuclide emissions would be evaluated to determine the necessity of a change to the site wide air operating permit.

Additional Information
The proposed Muon Campus is not in the vicinity of any cultural resources previously identified in the Fermilab Cultural Resources Management Plan. If any unexpected potential archaeological/historical/cultural resources are encountered, work would be stopped and the resource would be evaluated as per legal requirement.

The project would incorporate sustainable design principles into all phases of planning, design, and construction and follow Leadership in Energy and Environmental Design (LEED) guiding principles, however, because the facilities would not be occupied on a regular basis, LEED-Gold certification is not appropriate and would not be pursued.

V. NEPA Recommendation

Fermilab staff have reviewed this proposed action and concluded that the appropriate level of NEPA determination is a Categorical Exclusion. The conclusion is based on the proposed action meeting the categorical exclusion descriptions found in DOE's NEPA Implementation Procedures, 10 CFR 1021, Subpart D, Appendix B1.15 and B3.10, and that no extraordinary circumstances are anticipated.

B1.15 states the following: Siting, construction or modification, and operation of support buildings and support structures (including, but not limited to, trailers and prefabricated and modular buildings) within or contiguous to an already developed area (where active utilities and currently used roads are readily accessible). Covered support buildings and structures include, but are not limited to, those for office purposes; parking; cafeteria services; education and training; visitor reception; computer and data processing services; health services or recreation activities; routine maintenance activities; storage of supplies and equipment for administrative services and routine maintenance activities; security (such as security posts); fire protection; small-scale fabrication (such as machine shop activities), assembly, and testing of non-nuclear equipment or components; and similar support purposes, but exclude facilities for nuclear weapons activities and waste storage activities, such as activities covered in B1.10, B1.29, B1.35, B2.6, B6.2, B6.4, B6.5, B6.6, and B6.10 of this appendix.

B3.10 states the following: Siting, construction, modification, operation, and decommissioning of particle accelerators, including electron beam accelerators, with primary beam energy less than approximately 100 million electron volts (MeV) and average beam power less than approximately 250 kilowatts (kW), and associated beamlines, storage rings, colliders, and detectors, for research and medical purposes (such as proton therapy), and isotope production, within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible), or internal modification of any accelerator facility regardless of energy, that does not increase primary beam energy or current. In cases where the beam energy exceeds 100 MeV, the average beam power must be less than 250 kW, so as not to exceed an average current of 2.5 milliamperes (mA).

VI. DOE/CH-FSO NEPA Coordinator Review

Concurrence with the recommendation for determination:

U.S. DOE Fermi Site Office (FSO) Manager: Michael J. Weis

Signature [signature]

Date 6/12/2012

U.S. DOE FSO NEPA Coordinator Reviewer: Rick Hersemann

Signature Rick Hersemann

Date 6/7/12

APPENDIX A – Figures

Figure 1 The proposed Muon Campus is included in the red circle, superimposed on the Fermilab site.

Figure 2 The Fermilab Muon Campus including the Mu2e Facility, the MC-1 Building, the Muon Campus Beamline berm, and the former Antiproton Facility Buildings (AP-30, AP-10, and AP-50)

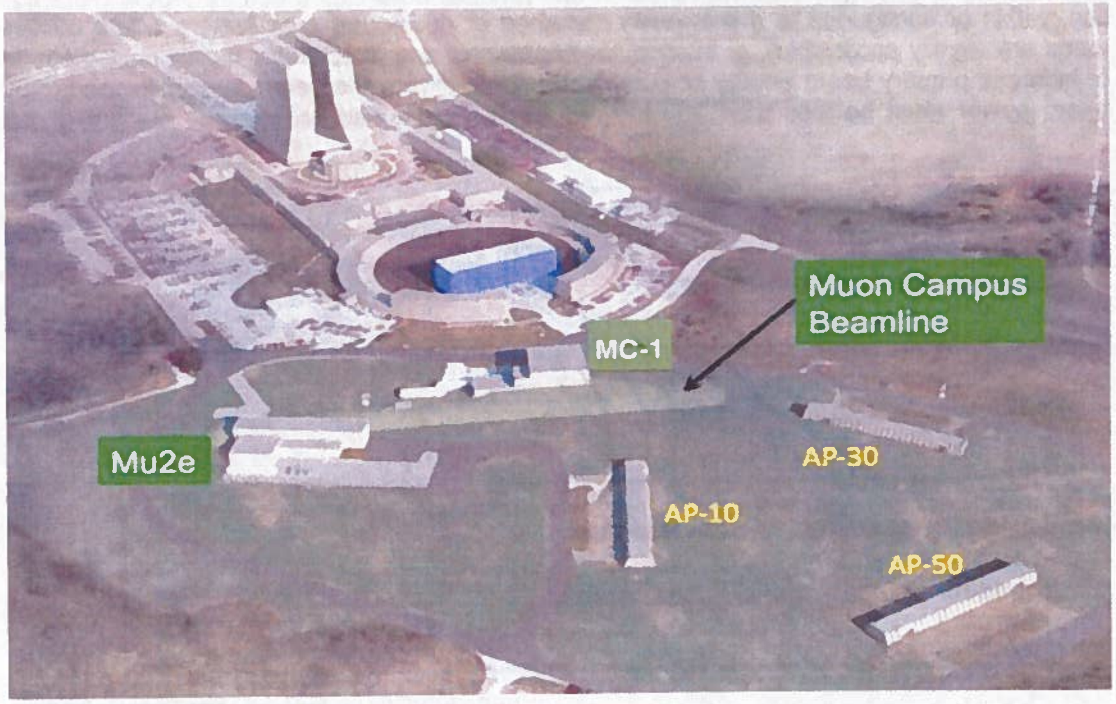


Figure 3 The components of the Fermilab accelerator complex that would be used to acquire protons for the Mu2e experiment. The proton beam path from Booster to Recycler is shown in yellow; the beam path in the Recycler is in red; the beam path from Recycler to Delivery Ring (otherwise called the Antiproton Debuncher Ring) is in blue; and the beam path from Delivery Ring to Mu2e target is in green.

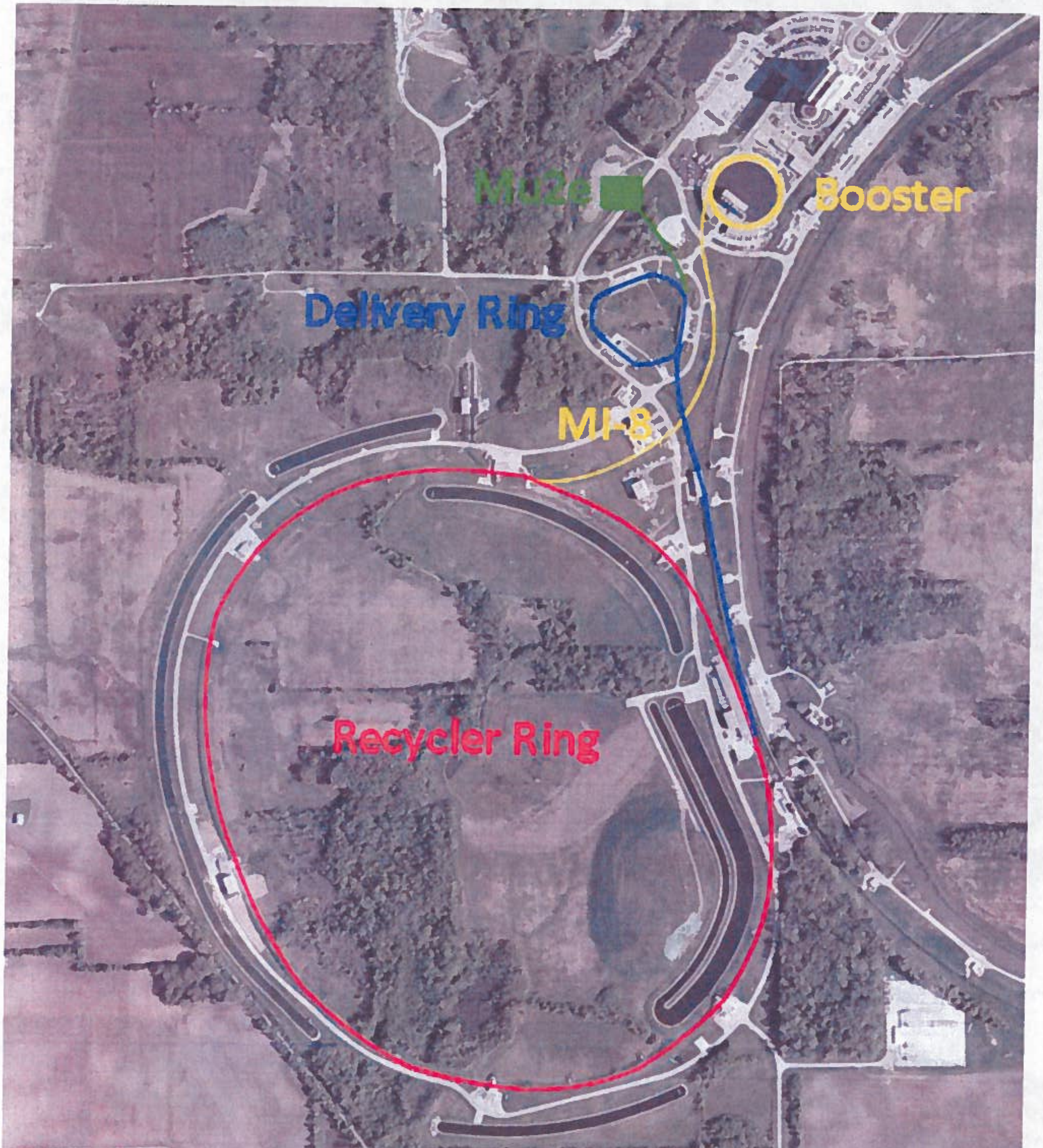


Figure 4 The path of protons from the Fermilab Booster (round figure at the forefront of the photo) to the Mu2e Detector

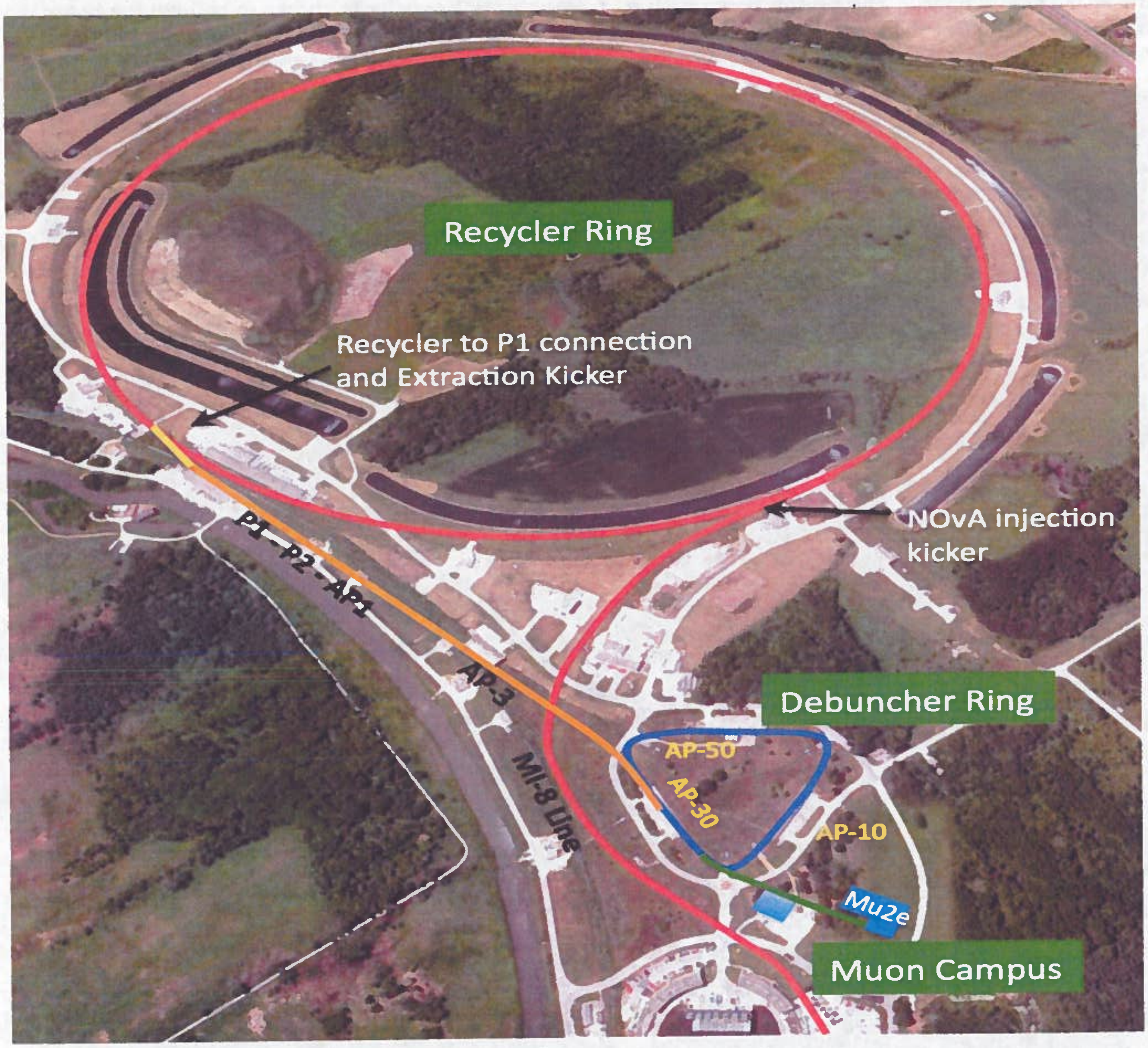


Figure 5 Depiction of the Mu2e Experiment Solenoids

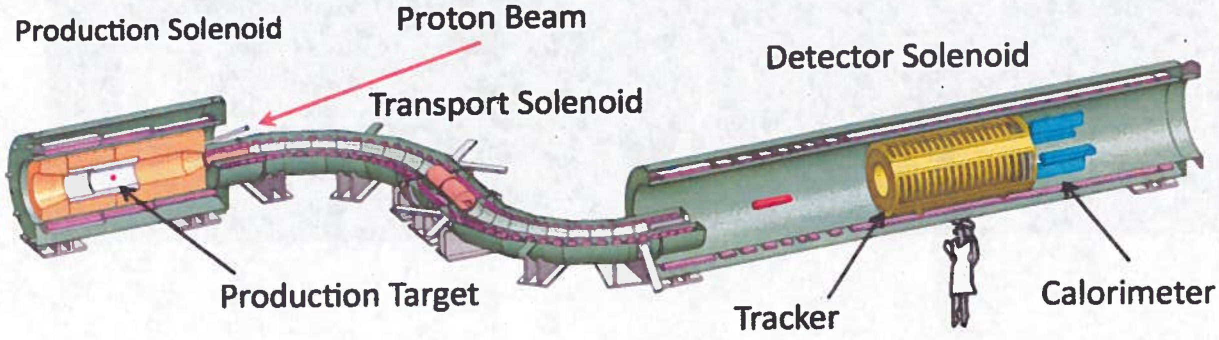


Figure 6 Depiction of the above-grade portion of the Mu2e Facility

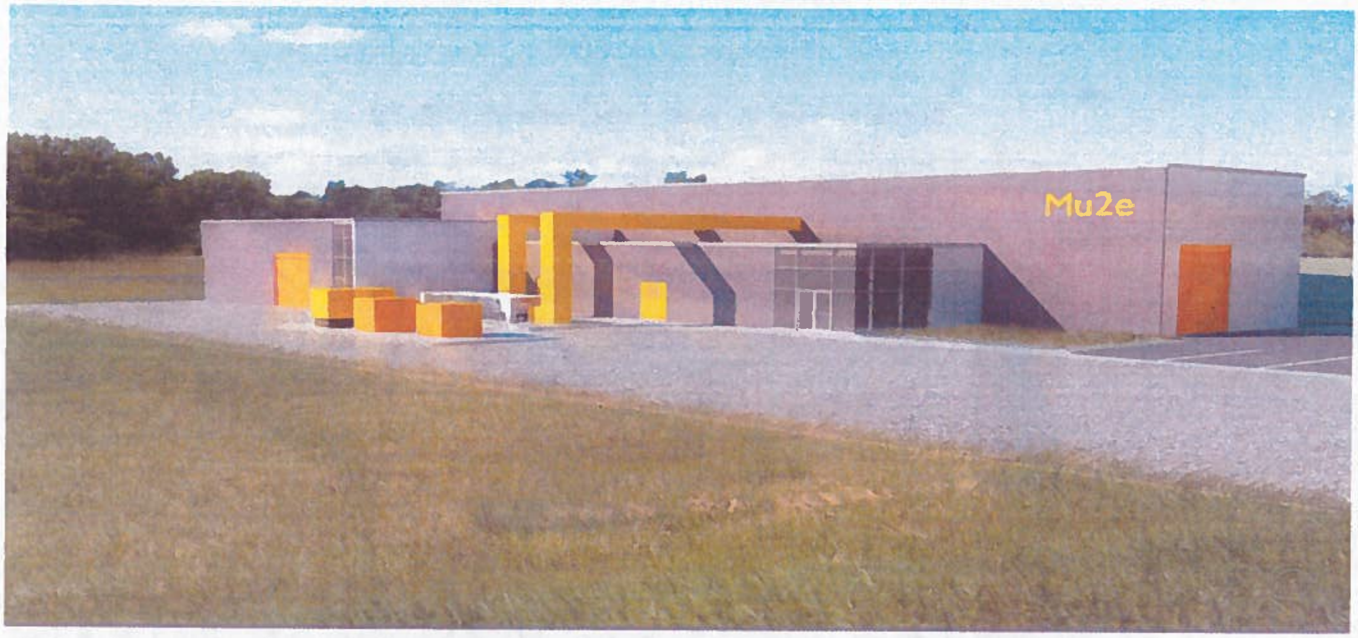
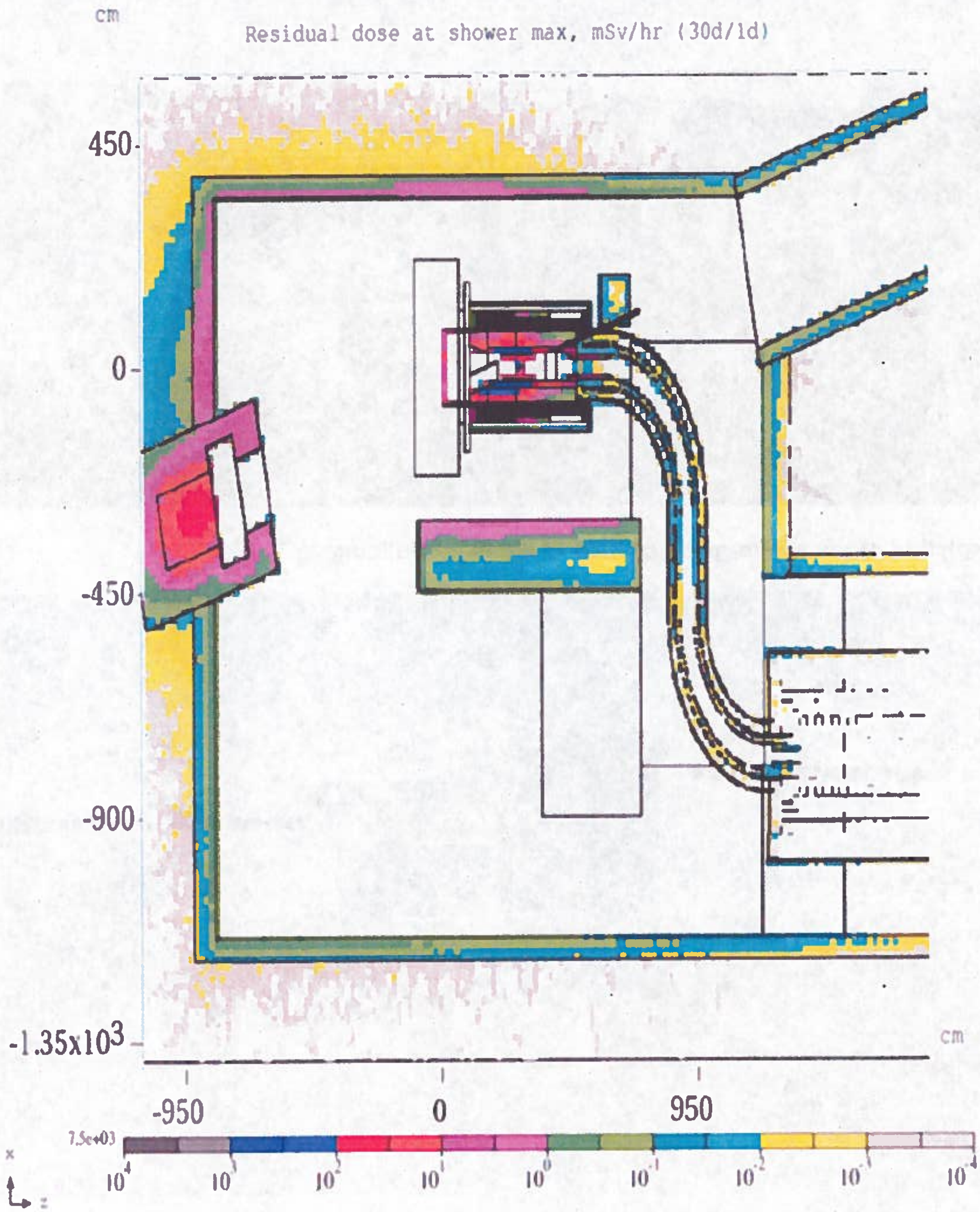


Figure 7 Depiction of the above-grade portion of the MC-1 Building

Figure 8 Residual activation expected in the area around the Mu2e Production Solenoid. At the surface of the surrounding walls and the peak residual activation is a few mSv/hour



High Performance Sustainable Buildings
Compliance Summary Checklist for New Construction

Building Name: AO COMPRESSOR COOLING

Federal Real Property ID:

This field will populate as the Guiding Principles are marked complete and documented. ------------->

% Guiding Principles Complete

100.0%

* For a detailed explanation of each Guiding Principle and required actions please refer to the corresponding Compliance Tab.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
1. Employ Integrated Design Principles					
Integrated design	Use a collaborative, integrated planning and design process that:				
	Initiates and maintains an integrated project team as described on the Whole Building Design Guide in all stages of a project's planning and delivery, http://www.wbdg.org/design/engage_process.php		Complete the Building Information Tab or equivalent document, e.g., a team roster. Follow the DOE. O. 430.2B and 450 1A.	☑	Team Roster list to be identified by Project Manager.
	Integrates the use of OMB's A-11, Section 7, Exhibit 300: Capital Asset Plan and Business Case Summary		Provide documentation and use this checklist or equivalent (USGBC LEED) to demonstrate incorporation. The establishment of 413.3A, 430.2B and 450.1A meet the goal setting requirement.	☑	DOE 413.3A
	Establishes performance goals for siting, energy, water, materials and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building		The establishment of 430.2B and 450.1A meet the goal setting requirement. Use this checklist or equivalent (USGBC LEED) to demonstrate incorporation.	☑	Goals and schedules are set forth in the DOE SSPP and the Fermilab Annual SSP
	Considers all stages of the building's lifecycle, including deconstruction.		The establishment of 430.2B and 450.1A meet the goal setting requirement. Use this checklist or equivalent (USGBC LEED) to demonstrate incorporation.	☑	DOE Order 413.3A

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Commissioning	Employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.		Provide a commissioning plan. In-house experienced personnel or team acceptable. (may provide compliance for GP IV. Enhance Indoor Environmental Quality: Moisture Control.)	☑	Not Applicable
2. Optimize Energy Performance					
Energy Efficiency	Establish a whole building performance target that takes into account the intended use, occupancy, operations, plug loads, other energy demands, and design to earn the ENERGY STAR® targets for new construction and major renovation where applicable. For new construction, reduce the energy use by 30 percent compared to the baseline building performance rating per the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential. For major renovations, reduce the energy use by 20 percent below pre-renovations 2003 baseline. Laboratory spaces may use the Labs21 Laboratory Modeling Guidelines.		Have a licensed engineer or architect provide documents that identify that the energy use targets were achieved or provide USGBC LEED submittal documentation also stating that the goals were achieved.	☑	Not Applicable
	Use ENERGY STAR® and FEMP-designated Energy Efficient Products, where available?		Provide standard purchasing policy/policies, constructions specifications, or retain proof of purchase.	☑	Not applicable

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
On-Site Renewable Energy	Per the Energy Independence and Security Act (EISA) Section 523, meet at least 30% of the hot water demand through the installation of solar hot water heaters, when lifecycle cost effective.		Implement on-site solar hot water heating and retain design specs, statement of work, or photos, etc. If not lifecycle cost effective provide justification.	☑	Not applicable
	Per Executive Order 13423, implement renewable energy generation projects on agency property for agency use, when lifecycle cost effective.		Any of the following or equivalent: design specs, statement of work, photos, etc. If not lifecycle cost effective provide justification.	☑	Not applicable
Measurement and Verification	Per the Energy Policy Act of 2005 (EPAct) Section 103, install building level electricity meters in new major construction and renovation projects to track and continuously optimize performance.		Retain statement of work, billing records, photos, etc and/or provide ENERGY STAR® label certification if applicable.	☑	Not applicable
	Per EISA Section 434, include equivalent meters for natural gas and steam, where natural gas and steam are used.		Retain statement of work, billing records, photos, etc and/or provide ENERGY STAR® label certification if applicable.	☑	Not applicable
Benchmarking	Compare actual performance data from the first year of operation with the energy design target, preferably by using ENERGY STAR® Portfolio Manager for building and space types covered by ENERGY STAR®. Verify that the building performance meets or exceeds the design target, or that actual energy use is within 10% of the design energy budget for all other building types. For other building and space types, use an equivalent benchmarking tool such as the Labs21 benchmarking tool for laboratory buildings.		Use ENERGY STAR's Portfolio Manager or Labs 21 database to enter annual performance data and print out the Statement of Energy Performance on an annual basis to track performance over time.	☑	NOt applicable
3. Protect and Conserve Water					

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Indoor Water	Employ strategies that in aggregate use a minimum of 20 percent less potable water than the indoor water use baseline calculated for the building, after meeting the EPAct 1992, Uniform Plumbing Codes 2006, and the International Plumbing Codes 2006 fixture performance requirements.		Use Watergy, the LEED® water calculator, or equivalent modeling to establish baseline usage and calculated savings or provide documentation based on metering/bills.	☑	Not applicable
	The installation of water meters is encouraged to allow for the management of water use during occupancy.		Install water meter(s) and provide documentation.	☑	Not applicable
	The use of harvested rainwater, treated wastewater, and air conditioner condensate should also be considered and used where feasible for nonpotable use and potable use where allowed.		Document use of harvested rainwater, treated wastewater, and air conditioner condensate as applicable.	☑	ICW water is used for non-potable applications and it is primarily "harvested" rainwater anyway. Documented via FESS Operations Procedure for Surface Water Management 5410.0
Outdoor Water	Use water efficient landscape and irrigation strategies, such as water reuse, recycling, and the use of harvested rainwater, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities).		Retain documentation from design tools, such as the LEED® water calculator or other water tools to provide a statement on how water usage was reduced and calculated, or document minimal use of irrigation water due to nominal or no landscape. Choose irrigation contractors who are certified through a WaterSense labeled program and document outdoor potable water consumption reduction. (May provide compliance for GP III. Protect and Conserve Water: Water-Efficient Products)	☑	Not Applicable
	The installation of water meters for locations with significant outdoor water use is encouraged.		Document Installation and use of outdoor water meters.	☑	Not applicable since we use no potable water.
	Employ design and construction strategies that reduce storm water runoff and discharges of polluted water offsite. Per EISA Section 438, to the maximum extent technically feasible, maintain or restore the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow using site planning, design, construction, and maintenance strategies.		Provide documents that demonstrate strategy implemented to reduce storm water runoff and maintain or restore predevelopment hydrology of the site.	☑	Based on Option 1 in the U.S. EPA Technical Guidance for EISA section 438, we can show that we meet the goal of this element.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Process Water	Per the Energy Policy Act of 2005 Section 109, when potable water is used to improve a building's energy efficiency, deploy lifecycle cost effective water conservation measures.		Document water conservation strategy in process systems. Documentation may be provided by licensed engineer, water utility or through an energy service provider. Guiding principle is met if no potable water is used.	☑	This is not applicable to this project
Water Efficient Products	Specify EPA's WaterSense-labeled products or other water conserving products, where available.		Any of the following or equivalent: purchasing or design specifications, statement of work, receipts, etc.	☑	There are no bathroom fixtures in this project so N/A
	Choose irrigation contractors who are certified through a WaterSense labeled program.			☑	Not Applicable
4. Enhance Indoor Environmental Quality					
Ventilation and Thermal Comfort	Meet ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, including continuous humidity control within established ranges per climate zone AND		Document compliance with ASHRAE Standards by licensed architect or engineer or achieve an ENERGY STAR Label Certification	☑	NA since there are no occupants
	ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.			☑	NA since there are no occupants
Moisture Control	Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.		Document inspection-driven moisture prevention strategy that is part of building commissioning plan that specifies maintenance of the roof drainage and the foundation system, or document that your building does not have a moisture problem.	☑	Not Applicable
Daylighting	Achieve a minimum daylight factor of 2 percent (excluding all direct sunlight penetration) in 75 percent of all space occupied for critical visual tasks.		Document through computer simulation or by light measurement.	☑	NA since there are no occupants
	Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control.		Document that individual lighting control is available for the occupants by schematic of floor layout, showing locations of manual lighting controls (such as task lighting) or statement based upon visual audit.	☑	NA since there are no occupants

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Low-Emitting Materials	Specify materials and products with low pollutant emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings.		Establish contract(s), design specifications, purchasing specifications or solicitations with specific language for the purchase of low emitting materials, durable goods, consumables and for green cleaning.	☑	Not Applicable
Protect Indoor Air Quality during Construction	Follow the recommended approach of the Sheet Metal and Air Conditioning Contractor's National Association Indoor Air Quality Guidelines for Occupied Buildings under Construction, 2007. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials. After construction and prior to occupancy, conduct a minimum 72-hour flush-out with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials.		Before major renovations, develop and implement an indoor air quality management plan, specification or guidelines. May use USGBC LEED reference documentation.	☑	Not Applicable
Tobacco Smoke Control	Implement a policy indicating that smoking is prohibited within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes during building occupancy. Post signage indicating that smoking is prohibited within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes during building occupancy.		Establish environmental tobacco smoke control policy or equivalent. Policy may be for entire site, PSO or for Agency.	☑	Director's policy #25

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
5. Reduce Environmental Impact of Materials					
Recycled Content	Per Section 6002 of the Resource Conservation and Recovery Act (RCRA), for EPA-designated products, specify products meeting or exceeding EPA's recycled content recommendations. For other products, specify materials with recycled content when practicable. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building. EPA's recycled content product designations and recycled content recommendations are available on EPA's Comprehensive Procurement Guideline web site at <www.epa.gov/cpg>.		Incorporate the FAR requirements for the purchase of EPA-designated products into contracts, bid solicitations and purchasing specifications and use products meeting or exceeding EPA's recycled content recommendations. Provide construction, purchasing or bid specifications, and/or affirmative procurement report.	☑	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well.
Biobased Content	Per Section 6002 of the Resource Conservation and Recovery Act (RCRA), for EPA-designated products, specify products meeting or exceeding EPA's recycled content recommendations. For other products, specify materials with recycled content when practicable. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building. EPA's recycled content product designations and recycled content recommendations are available on EPA's Comprehensive Procurement Guideline web site at <www.epa.gov/cpg>.		Incorporate the FAR requirements for the purchase of USDA-designated products into contracts and use products meeting or exceeding USDA's biobased content recommendations. In addition, use biobased products made from rapidly renewable resources and certified sustainable wood products. Provide construction, purchasing or bid specifications, and/or affirmative procurement report.	☑	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Environmentally Preferable Products	Use products that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose. A number of standards and ecolabels are available in the marketplace to assist specifiers in making environmentally preferable decisions. For recommendations, consult the Federal Green Construction Guide for Specifiers at <www.wbdg.org/design/greenspec.php>.		Establish purchasing contracts, bids construction documents with specification language for the purchase of environmentally preferable materials, durable goods, cleaning supplies, and consumables. Ensure that language is explicit and clear regarding such considerations as VOC limits and Green Seal requirements.	☑	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well.
Waste and Materials Management	Incorporate adequate space, equipment, and transport accommodations for recycling in the building design. During a project's planning stage, identify local recycling and salvage operations that could process site-related construction and demolition materials. During construction, recycle or salvage at least 50 percent of the non-hazardous construction, demolition and land clearing materials, excluding soil, where markets or onsite recycling opportunities exist. Provide salvage, reuse and recycling services for waste generated from major renovations, where markets or onsite recycling opportunities exist.		Documentation may be in the form of receipts, agreements or contracts with local recycling and product reclaiming services. Documentation may include contract specifications with vendors, for example, outlining carpet recycling programs through the manufacturer/distributer or may include photos, or polices that illustrate recycling initiatives for batteries, computers, and beverage containers. Building or site recycling program documentation except able.	☑	Not Applicable
Ozone Depleting Compounds	Eliminate the use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account lifecycle impacts.		Document zero use of CFC-refrigerants (policy, equipment specification, procurement specification or contract) unless a third party audit shows that a replacement or conversion is not economically feasible - in which case show that a phase out plan is in place. Do not use halons in fire suppression. Use all alternatives consistent with EPA's Significant New Alternatives Policy (SNAP) regulatory requirements.	☑	This is already our policy. Or spec items

High Performance Sustainable Buildings
Compliance Summary Checklist for New Construction

Building Name: MI52 Addition

Federal Real Property ID: not yet assigned

This field will populate as the Guiding Principles are marked complete and documented. ------------->

% Guiding Principles Complete

67.6%

* For a detailed explanation of each Guiding Principle and required actions please refer to the corresponding Compliance Tab.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
1. Employ Integrated Design Principles					
Integrated design	Use a collaborative, integrated planning and design process that:				
	Initiates and maintains an integrated project team as described on the Whole Building Design Guide in all stages of a project's planning and delivery, http://www.wbdg.org/design/engage_process.php		Complete the Building Information Tab or equivalent document, e.g., a team roster. Follow the DOE. O. 430.2B and 450 1A.	☑	Team Roster list to be identified by Project Manager.
	Integrates the use of OMB's A-11, Section 7, Exhibit 300: Capital Asset Plan and Business Case Summary		Provide documentation and use this checklist or equivalent (USGBC LEED) to demonstrate incorporation. The establishment of 413.3A, 430.2B and 450.1A meet the goal setting requirement.	☑	DOE 413.3A
	Establishes performance goals for siting, energy, water, materials and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building		The establishment of 430.2B and 450.1A meet the goal setting requirement. Use this checklist or equivalent (USGBC LEED) to demonstrate incorporation.	☑	Goals and schedules are set forth in the DOE SSPP and the Fermilab Annual SSP
	Considers all stages of the building's lifecycle, including deconstruction.		The establishment of 430.2B and 450.1A meet the goal setting requirement. Use this checklist or equivalent (USGBC LEED) to demonstrate incorporation.	☑	DOE Order 413.3A

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Commissioning	Employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.		Provide a commissioning plan. In-house experienced personnel or team acceptable. (may provide compliance for GP IV. Enhance Indoor Environmental Quality: Moisture Control.)	☐	This is to be evaluated in the design stage. At a minimum, building-energy-related items (HVAC, lighting control) will be go thru the fundamental commissioning
2. Optimize Energy Performance					
Energy Efficiency	Establish a whole building performance target that takes into account the intended use, occupancy, operations, plug loads, other energy demands, and design to earn the ENERGY STAR® targets for new construction and major renovation where applicable. For new construction, reduce the energy use by 30 percent compared to the baseline building performance rating per the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential. For major renovations, reduce the energy use by 20 percent below pre-renovations 2003 baseline. Laboratory spaces may use the Labs21 Laboratory Modeling Guidelines.		Have a licensed engineer or architect provide documents that identify that the energy use targets were achieved or provide USGBC LEED submittal documentation also stating that the goals were achieved.	☐	Due to the nature of the project an Energy model may not be appropriate for this type of project .
	Use ENERGY STAR® and FEMP-designated Energy Efficient Products, where available?		Provide standard purchasing policy/policies, constructions specifications, or retain proof of purchase.	☐	Required by FL-1 and other FL's. The Project manager and the design coordinator will ensure that this language will be incorporated into specifications to get the requirements to those actually doing the work.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
On-Site Renewable Energy	Per the Energy Independence and Security Act (EISA) Section 523, meet at least 30% of the hot water demand through the installation of solar hot water heaters, when lifecycle cost effective.		Implement on-site solar hot water heating and retain design specs, statement of work, or photos, etc. If not lifecycle cost effective provide justification.	☑	Based on calculations done for the CMTF project, Solar water heating option is at least twice as expensive on a LCC basis than the gas alternative.
	Per Executive Order 13423, implement renewable energy generation projects on agency property for agency use, when lifecycle cost effective.		Any of the following or equivalent: design specs, statement of work, photos, etc. If not lifecycle cost effective provide justification.	☑	Fermilab has installed several PV generating sources in remote locations where supplying conventional power would be very expensive. A study done in 2008 by NREL suggests that larger PV and/or wind generating projects are not cost effective for Fermilab where conventional power is available due to insufficient available resources (wind, sun) coupled with low electrical energy prices.
Measurement and Verification	Per the Energy Policy Act of 2005 (EPAct) Section 103, install building level electricity meters in new major construction and renovation projects to track and continuously optimize performance.		Retain statement of work, billing records, photos, etc and/or provide ENERGY STAR® label certification if applicable.	☐	Where applicable. electric meter(s) will be installed and connected via Metasys or other tracking means. The project manager and design coordinator will explore this during
	Per EISA Section 434, include equivalent meters for natural gas and steam, where natural gas and steam are used.		Retain statement of work, billing records, photos, etc and/or provide ENERGY STAR® label certification if applicable.	☑	There are no natural gas usage in this project
Benchmarking	Compare actual performance data from the first year of operation with the energy design target, preferably by using ENERGY STAR® Portfolio Manager for building and space types covered by ENERGY STAR®. Verify that the building performance meets or exceeds the design target, or that actual energy use is within 10% of the design energy budget for all other building types. For other building and space types, use an equivalent benchmarking tool such as the Labs21 benchmarking tool for laboratory buildings.		Use ENERGY STAR's Portfolio Manager or Labs 21 database to enter annual performance data and print out the Statement of Energy Performance on an annual basis to track performance over time.	☑	After building construction, Fermilab representative (TBD) will enter relevant data into Energy Star Portfolio Manager, including data from all meters.
3. Protect and Conserve Water					

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Indoor Water	Employ strategies that in aggregate use a minimum of 20 percent less potable water than the indoor water use baseline calculated for the building, after meeting the EPAct 1992, Uniform Plumbing Codes 2006, and the International Plumbing Codes 2006 fixture performance requirements.		Use Watergy, the LEED® water calculator, or equivalent modeling to establish baseline usage and calculated savings or provide documentation based on metering/bills.	☑	There are no bathroom fixtures in this project so N/A
	The installation of water meters is encouraged to allow for the management of water use during occupancy.		Install water meter(s) and provide documentation.	☑	There are no bathroom fixtures in this project so N/A
	The use of harvested rainwater, treated wastewater, and air conditioner condensate should also be considered and used where feasible for nonpotable use and potable use where allowed.		Document use of harvested rainwater, treated wastewater, and air conditioner condensate as applicable.	☑	ICW water is used for non-potable applications and it is primarily "harvested" rainwater anyway. Documented via FESS Operations Procedure for Surface Water Management 5410.0
Outdoor Water	Use water efficient landscape and irrigation strategies, such as water reuse, recycling, and the use of harvested rainwater, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities).		Retain documentation from design tools, such as the LEED® water calculator or other water tools to provide a statement on how water usage was reduced and calculated, or document minimal use of irrigation water due to nominal or no landscape. Choose irrigation contractors who are certified through a WaterSense labeled program and document outdoor potable water consumption reduction. (May provide compliance for GP III. Protect and Conserve Water: Water-Efficient Products)	☑	Recent memo from FESS Head to Roads and Grounds established the policy of not using any potable water for these uses. Also can cite extensive use of native vegetation to conserve water for landscaping use.
	The installation of water meters for locations with significant outdoor water use is encouraged.		Document Installation and use of outdoor water meters.	☑	Not applicable since we use no potable water.
	Employ design and construction strategies that reduce storm water runoff and discharges of polluted water offsite. Per EISA Section 438, to the maximum extent technically feasible, maintain or restore the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow using site planning, design, construction, and maintenance strategies.		Provide documents that demonstrate strategy implemented to reduce storm water runoff and maintain or restore predevelopment hydrology of the site.	☑	Based on Option 1 in the U.S. EPA Technical Guidance for EISA section 438, we can show that we meet the goal of this element.

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Process Water	Per the Energy Policy Act of 2005 Section 109, when potable water is used to improve a building's energy efficiency, deploy lifecycle cost effective water conservation measures.		Document water conservation strategy in process systems. Documentation may be provided by licensed engineer, water utility or through an energy service provider. Guiding principle is met if no potable water is used.	☑	This is not applicable to this project
Water Efficient Products	Specify EPA's WaterSense-labeled products or other water conserving products, where available.		Any of the following or equivalent: purchasing or design specifications, statement of work, receipts, etc.	☑	There are no bathroom fixtures in this project so N/A
	Choose irrigation contractors who are certified through a WaterSense labeled program.			☑	NA
4. Enhance Indoor Environmental Quality					
Ventilation and Thermal Comfort	Meet ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, including continuous humidity control within established ranges per climate zone AND		Document compliance with ASHRAE Standards by licensed architect or engineer or achieve an ENERGY STAR Label Certification	☑	NA since there are no occupants
	ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.			☑	NA since there are no occupants
Moisture Control	Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.		Document inspection-driven moisture prevention strategy that is part of building commissioning plan that specifies maintenance of the roof drainage and the foundation system, or document that your building does not have a moisture problem.	☐	Project will evaluate this during design (this is one of the item that still is unclear)
Daylighting	Achieve a minimum daylight factor of 2 percent (excluding all direct sunlight penetration) in 75 percent of all space occupied for critical visual tasks.		Document through computer simulation or by light measurement.	☑	NA since there are no occupants
	Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control.		Document that individual lighting control is available for the occupants by schematic of floor layout, showing locations of manual lighting controls (such as task lighting) or statement based upon visual audit.	☑	NA since there are no occupants

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Low-Emitting Materials	Specify materials and products with low pollutant emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings.		Establish contract(s), design specifications, purchasing specifications or solicitations with specific language for the purchase of low emitting materials, durable goods, consumables and for green cleaning.	☐	The project will evalute this requirement, may need to include this in the specs
Protect Indoor Air Quality during Construction	Follow the recommended approach of the Sheet Metal and Air Conditioning Contractor's National Association Indoor Air Quality Guidelines for Occupied Buildings under Construction, 2007. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials. After construction and prior to occupancy, conduct a minimum 72-hour flush-out with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials.		Before major renovations, develop and implement an indoor air quality management plan, specification or guidelines. May use USGBC LEED reference documentation.	☐	Include in the spec as part of Division 1 spec. We will require the contractor to submit their IAQ plan with flushout
Tobacco Smoke Control	Implement a policy indicating that smoking is prohibited within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes during building occupancy. Post signage indicating that smoking is prohibited within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes during building occupancy.		Establish environmental tobacco smoke control policy or equivalent. Policy may be for entire site, PSO or for Agency.	☑	Director's policy #25

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
5. Reduce Environmental Impact of Materials					
Recycled Content	Per Section 6002 of the Resource Conservation and Recovery Act (RCRA), for EPA-designated products, specify products meeting or exceeding EPA's recycled content recommendations. For other products, specify materials with recycled content when practicable. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building. EPA's recycled content product designations and recycled content recommendations are available on EPA's Comprehensive Procurement Guideline web site at <www.epa.gov/cpg>.		Incorporate the FAR requirements for the purchase of EPA-designated products into contracts, bid solicitations and purchasing specifications and use products meeting or exceeding EPA's recycled content recommendations. Provide construction, purchasing or bid specifications, and/or affirmative procurement report.	☐	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well. It is unclear if this is applicable to this project, the project will evaluate this further during design
Biobased Content	Per Section 6002 of the Resource Conservation and Recovery Act (RCRA), for EPA-designated products, specify products meeting or exceeding EPA's recycled content recommendations. For other products, specify materials with recycled content when practicable. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building. EPA's recycled content product designations and recycled content recommendations are available on EPA's Comprehensive Procurement Guideline web site at <www.epa.gov/cpg>.		Incorporate the FAR requirements for the purchase of USDA-designated products into contracts and use products meeting or exceeding USDA's biobased content recommendations. In addition, use biobased products made from rapidly renewable resources and certified sustainable wood products. Provide construction, purchasing or bid specifications, and/or affirmative procurement report.	☐	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well. It is unclear if this is applicable to this project, the project will evaluate this further during design

Guiding Principle	Action Required	Yes/No	Suggested Compliance Verification Documents	On File?	Notes
Environmentally Preferable Products	Use products that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose. A number of standards and ecolabels are available in the marketplace to assist specifiers in making environmentally preferable decisions. For recommendations, consult the Federal Green Construction Guide for Specifiers at <www.wbdg.org/design/greenspec.php>.		Establish purchasing contracts, bids construction documents with specification language for the purchase of environmentally preferable materials, durable goods, cleaning supplies, and consumables. Ensure that language is explicit and clear regarding such considerations as VOC limits and Green Seal requirements.	☐	We would cite FESHM 5011 on "Sustainable Acquisition", and this language would also be included in Exhibit A in the bid documents. A new FL-300 that would address it as well. It is unclear if this is applicable to this project, the project will evaluate this further during design
Waste and Materials Management	Incorporate adequate space, equipment, and transport accommodations for recycling in the building design. During a project's planning stage, identify local recycling and salvage operations that could process site-related construction and demolition materials. During construction, recycle or salvage at least 50 percent of the non-hazardous construction, demolition and land clearing materials, excluding soil, where markets or onsite recycling opportunities exist. Provide salvage, reuse and recycling services for waste generated from major renovations, where markets or onsite recycling opportunities exist.		Documentation may be in the form of receipts, agreements or contracts with local recycling and product reclaiming services. Documentation may include contract specifications with vendors, for example, outlining carpet recycling programs through the manufacturer/distributer or may include photos, or polices that illustrate recycling initiatives for batteries, computers, and beverage containers. Building or site recycling program documentation except able.	☐	The project will include division 1 specification to have the contractor develop, submit & implement their waste management plan to compy with this requirement
Ozone Depleting Compounds	Eliminate the use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account lifecycle impacts.		Document zero use of CFC-refrigerants (policy, equipment specification, procurement specification or contract) unless a third party audit shows that a replacement or conversion is not economically feasible - in which case show that a phase out plan is in place. Do not use halons in fire suppression. Use all alternatives consistent with EPA's Significant New Alternatives Policy (SNAP) regulatory requirements.	☑	This is already our policy. Or spec items

Engineering Risk Assessment

Interpreting the Graded Approach Worksheet

The purpose of this chapter is to define a risk-based graded approach for use in engineering projects. This process helps the lead engineer and department head evaluate project risks and determine the appropriate level of documentation and review a project needs. The project manager may add additional requirements, as defined in **Chapter 1: Requirements and Specifications**.

The lead engineer and department head complete the graded approach worksheet as part of the specification process. Completion of the graded approach worksheet is a way to quantify project risk early in a project. If a project carries a high level of risk, the engineer needs to complete further risk analysis based on guidelines from other governing organizations.

Definitions

Graded Approach: *A graded approach uses a list of factors to establish the appropriate level of formality a project requires.*
Risk-Based Graded Approach: *A risk-based graded approach evaluates the level of risk in various risk elements in order to establish the appropriate level of controls a project requires.*
Risk Element: *A risk element is an aspect of a project that could prevent its successful completion, without appropriate control measures.*

Risk Assessment

The Engineering Policy Manual Team has identified 15 potential risk elements to evaluate for each project.
The department head and lead engineer determine the level of risk for each element and document it using the graded approach worksheet. The department head and lead engineer can use the guidelines in this chapter to determine the overall level of risk and to highlight high-risk categories. This risk assessment applies to the engineering subproject at hand, not the overall project. A subproject is a self-contained engineering task, component or system that generally falls under the responsibility of a single department. Subprojects do not take on the risk level of the larger project.

The engineer should record, in Tables 1 and 2 below, risk assessment integer values between 1 and 5, as follows:
1 low risk
2 low to medium risk
3 medium risk
4 medium to high risk
5 high risk
Definitions of the risk levels are given below with criteria for risk levels 1, 3 and 5. Levels 2 and 4 are implied to fall between those provided.

Interpreting the Graded Approach Worksheet

The lead engineer fills out an engineering and project risk element table for his or her project or subproject. If the project or subproject has a risk score of 5 in any engineering risk element (A - G), it requires formal control as described within the Engineering Manual chapters indicated in the table below. If the subtotal of the risk scores for the elements related to one chapter is higher than the high risk score indicated in the table below, the topic covered in that chapter requires formal control. If the project or subproject has a risk score of 5 in any project risk element (A - O), or the project management risk (H - O) subtotal is 25, notify the project manager. The project manager may choose to elevate formal control requirements to address elevated project management risk (H - O).

Engineering Risk Assessment

Project: MC Infrastructure
Lead Engineer: T. Lackowski
Department: FESS/Engineering
Date: July 31, 2013

Score	
1 - Low Risk	1

Technology

This defines the degree of technical complexity the Lead Engineer or engineering team will face in executing the project.

1 The project will use off-the-shelf technology.
3 Engineers will purchase and modify off-the-shelf technology.
5 The project will require the development of new technology.

Environmental Impact

2 - Low to Medium Risk	2

This defines the potential level of environmental impact.

1 There will be no environmental impact.
3 The project may have some environmental impact but will not require an environmental assessment, as determined by FESHM.
5 The project will require an environmental impact statement.

Vendor Issues

2 - Low to Medium Risk	2

This defines the degree of complexity to be expected with vendors. Complicating factors may include long-lead-time items and issues with vendor qualification and reliability.

1 Vendors could cause minor issues.
3 Vendors could cause manageable complications.
5 Vendor issues could result in significant schedule delays or cost overruns or could otherwise jeopardize the successful completion of the project.

Resource Availability

2 - Low to Medium Risk	2

This defines the availability of internal and external resources to plan and execute the project.

1 Resources will be readily available.
3 Resources could be somewhat restricted.
5 The difficulty of obtaining resources puts the project schedule at high risk.

Quality Requirements

1 - Low Risk	1

This determines the effort required to achieve the quality level the customer assigns to the final product.

1 The quality requirements can be met easily with existing infrastructure.
3 The quality requirements are challenging but can be met with existing infrastructure.
5 The quality requirements are beyond the capability of existing infrastructure.

Safety

2 - Low to Medium Risk	2

This defines the safety issues the project team will encounter while completing the project.

1 The project will require standard safety considerations.

3 The project will require increased diligence due to its location, the configuration of the product or the type of work required. This includes work requiring review according to FESHM.

5 The project will require very restrictive safety considerations. This includes work requiring review and personnel safety systems.

Manufacturing Complexity

1 - Low Risk	1

This defines the degree of complexity to be expected when combining the elements of technology, operations and schedule in product manufacturing.

1 The manufacturing processes will be routine.

3 The project will require an existing technology that the manufacturer has not previously used.

5 The project will require new or complex manufacturing methods.

Schedule

3 - Medium Risk	3

This defines how much time the Lead Engineer or engineering team will have to complete the schedule.

1 Time will be unlimited.

3 The schedule will be somewhat constrained.

5 The subproject will be on the overall project critical path and has no schedule contingency.

Interfaces

2 - Low to Medium Risk	2

This defines the risk associated with the complexity of integrating multiple subprojects.

1 One department at Fermilab will be involved with a standalone project.

3 Project success depends upon contributions from multiple departments at Fermilab.

5 Project success depends upon contributions from multiple institutions.

Experience/Capability

3 - Medium Risk	3

This defines the level of experience and capability project team members will have.

1 Only experts will participate.

3 A blend of experts and inexperienced personnel will participate.

5 Only inexperienced personnel will participate.

Regulatory Requirements

2 - Low to Medium Risk	2

This identifies the degree to which oversight by governmental or other regulatory agencies will impact the project.

1 Regulatory agencies will have minor to no involvement.

3 The Department of Energy, DOE, will have direct regulatory involvement.

5 DOE, as well as state or federal government, will have regulatory involvement.

Project Funding

1 - Low Risk	1

This defines the availability and approval status of project planning and execution funds.

1 A single source within Fermilab will fund the project.

3 A source outside of Fermilab will fund the project.

5 Multiple sources outside of Fermilab will fund the project.

Project Reporting Requirements

5 - High Risk	5

This indicates the level of reporting to the senior management the project requires.

1 Reports to senior management about the project will not be required.

3 The project will require quarterly performance reports.

5 The project will be highly visible. Top management or outside agencies will schedule visits and issue monthly performance reports.

Public Impact

1 - Low Risk	1

This indicates how much the project will affect the public or public opinion.

1 The public will not be affected.

3 The public may be somewhat affected and should be informed with news releases.

5 The project may have an impact on the public. The public should be involved through public forums and may participate in advisory councils.

Project Cost

5 - High Risk	5

This defines how much the project is projected to cost.

1 The project will be within the department operating budget.

3 The project will require divisional budget planning.

5 The project will require laboratory or DOE budget tracking and reporting.

Engineering Risk Assessment

Project: MC Infrastructure
Lead Engineer: T. Lackowski
Department: FESS/Engineering
Date: July 31, 2013

	Chapter	Engineering Risk Element							High Risk	Subtotal	Assessment
		A	B	C	D	E	F	G			
1	Requirements and Specifications	1	2				2		≥ 10	5	Standard Risk
3	Requirements and Specification Review	1	2		2	1	2		≥ 16	8	Standard Risk
4	System Design	1	2	2		1	2	1	≥ 19	9	Standard Risk
5	Engineering Design Review	1	2	2		1	2	1	≥ 19	9	Standard Risk
6	Procurement and Implementation		2		2	1	2	1	≥ 16	8	Standard Risk
7	Testing and Validation	1				1	2	1	≥ 13	5	Standard Risk
8	Release to Operations						2		≥ 4	2	Standard Risk
9	Final Documentation		2				2		≥ 7	4	Standard Risk

Project Risk Element								High Risk	Subtotal	Assessment
H	I	J	K	L	M	N	O			
3	2	3	2	1	5	1	5	≥ 25	22	High Risk

Engineering Risk Elements	
A	Technology
B	Environmental Impact
C	Vendor Issues
D	Resource Availability
E	Safety
F	Quality Requirements
G	Manufacturing Complexity

Project Risk Elements	
H	Schedule
I	Interfaces
J	Experience / Capability
K	Regulatory Requirements
L	Project Funding
M	Project Reporting Requirements
N	Public Impact
O	Project Cost

2. M&R Cost Profiles

This chapter presents estimates of 50-year maintenance cost profiles for 74 models. Each two-page profile includes a description of the model, a list of major components, and forecasts of maintenance and repair (M&R) costs at various levels of aggregation. The profile estimates were made with the Whitestone MARS Facility Cost Forecast System, calibrated for the Washington, D.C. area. The profiles can be adjusted for other areas using the Local Maintenance Cost Index shown in Chapter 3, and modified to include different components shown in Chapter 5.

Table 2-1
Summary of M&R Cost Profiles

Model	GSFT	PRV	Annual M&R Cost per GSFT*	Annual M&R Cost as % of Repl. Value
Electrical Power, Backup	240	$781,790	$86.52	2.66%
Guard House	100	41,604	69.46	16.70
Central Plant, Boiler	1,100	703,471	40.61	6.35
Electrical Power, Substation	220	320,019	24.25	1.67
Data Center, Tier III	25,000	48,811,977	23.27	1.19
Central Plant, Chilled Water	9,175	7,048,429	20.60	2.68
Pump House	195	124,706	19.07	2.98
Central Plant, Steam	43,500	44,701,494	14.90	1.45
Laboratory, Agricultural	27,000	10,153,418	12.52	3.33
Restaurant, Fast Food	4,000	1,267,243	12.24	3.86
Laboratory, Electronics	30,200	10,237,918	10.71	3.16
Laboratory, Life Science	27,400	10,939,320	10.36	2.59
Car Wash	800	245,033	10.03	3.28
Apartments, 1-3 Story	22,500	4,691,880	9.91	4.75
Garage, Service Station	1,400	379,001	9.54	3.52
Natatorium	10,280	2,375,584	9.06	3.92
Restaurant	10,000	3,121,190	8.52	2.73
Laboratory, General	56,000	18,814,700	8.49	2.53
Apartments, 4-7 Story	60,000	12,121,945	8.34	4.13
Bank, Branch	4,100	1,059,447	8.27	3.20
Public Restroom	500	137,788	7.79	2.83
Motel, 40 Units	18,000	3,673,374	7.38	3.61
Fire Station	6,000	1,535,268	7.36	2.88
Laundry, Self-Service	3,000	655,482	7.25	3.32
Greenhouse, Research	2,100	454,647	7.21	3.33
Motel, 18 Units	8,000	1,747,953	6.97	3.19
Warehouse, HAZMAT	3,680	798,695	6.96	3.21
Clubhouse, Golf	6,000	1,663,465	6.74	2.43
Cafeteria	21,500	7,035,709	6.55	2.00
College Dormitory, 50 Room	25,000	6,547,845	6.33	2.42
Store, Convenience	4,000	826,087	5.73	2.78
Religious Education	10,000	2,726,217	5.67	2.08
Telecom Central Office	5,000	1,436,673	5.60	1.95
Hospital, Research	540,200	176,328,254	5.46	1.67
Hospital, General	125,000	48,607,650	5.45	1.40
College Student Union	25,000	5,387,525	5.38	2.49
Movie Theater	10,000	2,129,316	5.36	2.52
Visitor Center	20,700	4,915,035	5.22	2.20
Medical Clinic	13,000	4,078,007	5.13	1.64
Religious Assembly	17,000	4,327,530	4.99	1.96
Community Center	10,000	2,613,597	4.86	1.86
Store, Retail	8,000	1,652,174	4.79	2.32
Passenger Terminal	12,000	2,633,901	4.77	2.17
Apartments, 24 Story	220,000	44,426,778	4.71	2.33
College Auditorium	24,000	4,286,076	4.70	2.63
Court House	30,000	8,235,749	4.47	1.63
Municipal Building	11,000	2,908,266	4.42	1.67
Health Club w/Gymnasium	40,000	8,655,961	4.40	2.03
Mortuary	10,000	2,384,479	4.34	1.82
Post Office	13,000	1,919,555	4.18	2.83
Club, Social	22,000	5,185,803	4.09	1.74
Skating Rink	30,000	5,174,917	3.87	2.24
Day Care Center	12,000	2,941,441	3.85	1.57
Bowling Center	20,000	4,928,588	3.84	1.56
Manufacturing Plant, Process	50,700	12,091,083	3.82	1.60
Public Library, 3 Story	60,000	13,787,273	3.80	1.66
Jail, County	318,455	64,602,477	3.62	1.78
Maintenance Shop	12,100	2,574,282	3.56	1.67
Outdoor Pool	10,280	2,375,584	3.54	1.53
College Lecture Classrooms	90,000	18,321,957	3.48	1.71
Warehouse, Temperature Controlled	8,200	1,180,707	3.46	2.40
Elementary School	47,000	9,888,099	3.43	1.63
Warehouse, Self-storage	24,000	2,809,848	3.28	2.80
Office Building, 2 Story	83,000	16,561,720	3.16	1.58
Auto Salesroom	21,000	3,331,286	3.00	1.89
Manufacturing Plant, Light	45,000	10,896,218	3.00	1.24
Aircraft Hangar	32,000	9,332,007	2.97	1.02
Supermarket	96,000	16,391,086	2.85	1.67
Office Building, 15 Story	250,000	49,793,402	2.84	1.43
Manufacturing Plant, Machinery	384,000	84,626,798	2.80	1.27
Office Park	65,000	13,023,487	2.80	1.40
Store, Department	94,000	15,400,653	2.71	1.65
Warehouse, Dry	80,000	8,454,513	2.33	2.20
Garage, Parking	110,800	11,658,816	1.06	1.00

*Average costs over 50-year lifetime, Washington, D.C. area

From the cost analyst's perspective, the most useful information in these profiles is the year-by-year total shown under the "Cost per GSFT by System" section. A projection of M&R costs is required in the financial evaluation of virtually all large construction or renovation projects. Often this trend is estimated with a simple approximation (typically two to four percent of replacement value). This simplification obscures the oscillations in M&R requirements, and misstates costs when expressed in terms of present value. In comparison, Whitestone estimates are based on component life-cycles that provide a more realistic and defensible projection of M&R costs.

For the purposes of the facility manager, average values for M&R costs may be more useful than detailed year-to-year estimates. Conversations about facility funding and budgeting usually dwell on average costs per square foot, or average costs as a percentage of replacement value. Among our models, the highest average cost per gross square foot is for the Electrical Power, Backup ($86.52), while the Parking Garage had the lowest average cost ($1.06).

The reader may note the rankings in order of cost are different when expressed in terms of replacement value. The highest average M&R cost from this perspective was for the Guard House —17 percent of replacement value. A complete list of replacement costs is shown in Table A-1 in the Appendix. In general, we are wary of costs expressed in terms of replacement values because of the great variation in new construction costs and the difficulty of determining replacement costs for older assets. Replacement values have been completely revised based on a Whitestone survey of actual federal construction projects.

Profile estimates are sensitive to a variety of factors such as unscheduled maintenance rates, in-house shop rates, and facility utilization. These sensitivities are discussed in Chapter 6, Definitions and Methods.

Laboratory, General

Gross Square Feet:	56,000
Height in Ft:	25
Exterior:	Clay Brick
Floor coverings:	Carpet, Ceramic Tile, Finished Concrete
HVAC:	Chilled Water, Heat Exchanger, Single Zone
Capacity:	N/A
Occupancy:	500
Replacement Cost:	$18,814,700

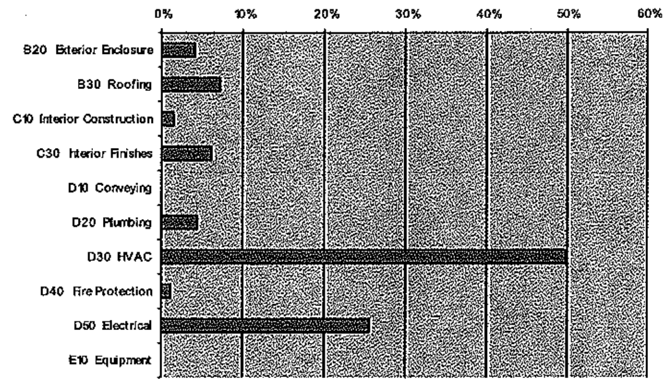
Components

Uniformat / Component	Quantity	Units
B20 Exterior Enclosure		
Aluminum Louver, 1st Floor	5	Each
Clay Brick, Exterior, 1st Floor	11000	Sq Ft
Concrete Block, Exterior, 1st Floor	12800	Sq Ft
Steel Single 12'x12', Painted, Roll-up Door	1	Each
Steel, Painted, Exterior Door	7	Each
B30 Roofing		
Single-Ply Thermoset Roof	56000	Sq Ft
C10 Interior Construction		
Movable Partitions, Office, Fabric, 6'	100	Ln Ft
Toilet Partitions, Painted Metal, Overhead Braced	16	Each
Steel, Painted, Interior Door	114	Each
C30 Interior Finishes		
Ceramic Tile, 4"x4", Interior Wall Finish	2500	Sq Ft
Gypsum Board, Interior Wall Finish	42700	Sq Ft
Carpet, Nylon 20 oz., High Traffic	13800	Sq Ft
Ceramic Tile Flooring	17000	Sq Ft
Concrete, Painted Flooring	25200	Sq Ft
Acoustical Tile, Dropped Ceiling	54400	Sq Ft
Gypsum Board, Finished Ceiling	1600	Sq Ft
D10 Conveying		
Hoist Electric, Overhead, Chain, 3 Ton	1	Each
D20 Plumbing		
Drinking Fountain, Refrigerated	2	Each
Lavatory, Vitreous China	27	Each
Service Sink, Iron, Enamel	2	Each
Sink, Stainless Steel	2	Each
Tankless Water Closet	16	Each
Urinal, Vitreous China	9	Each
Circulator Pump, 1/2 HP, Hot Water	1	Each
Circulator Pump, 1 HP, Cold Water	2	Each
Circulator Pump, 3 HP, Cold Water	3	Each
Pipe & Fittings, 3/4" Copper, Cold Water	1.7	K Ln Ft
Pipe & Fittings, 3/4" Copper, Hot Water	0.88	K Ln Ft
Pipe & Fittings, 2" Copper, Cold Water	0.8	K Ln Ft
Pipe & Fittings, 4" Copper, Cold Water	0.4	K Ln Ft
Pipe & Fittings, 4" Steel	1.5	K Ln Ft
Pipe & Fittings, 12" Steel	1.3	K Ln Ft
Pipe Insulation, Fiberglass, Cold Water	4	K Ln Ft
Pipe Insulation, Fiberglass, Hot Water	1.2	K Ln Ft
Water Heater, Gas/Oil, 275 Gph	1	Each
Backflow Preventer, 4"	2	Each
Floor Drain	4	Each
Pipe & Fittings, 4" Cast Iron	1.6	K Ln Ft
Pipe & Fittings, 6" Cast Iron	1.3	K Ln Ft
Pipe & Fittings, 4" PVC	0.777	K Ln Ft
Roof Drain, 4-6"	16	Each
Sump Pump, 1/2 HP	2	Each
Air Compressor, 25 HP	2	Each
Compressed Air Dryer	2	Each
Gas Compressor, 7 1/2 HP	2	Each
D30 HVAC		
Chemical Feed System	1	Each
Condensate Receiver Station, 10-15 Gal.	1	Each
Expansion Tank, 100 Gal.	2	Each
Expansion Tank, 400 Gal.	1	Each
Heat Exchanger, Steam-to-Water, 40 Gpm	1	Each
Steam Trap, F&T, 2"	6	Each
Valve, Non-Drain, 2"	430	Each
Valve, Non-Drain, 4"	50	Each
Chiller, Reciprocal Water-Cooled Hermetic, 100 Ton	1	Each
Circulation Pump, 5 HP, Chiller & Condenser Water	4	Each
Circulation Pump, 25 HP, Chiller & Condenser Water	2	Each
Cooling Tower, 100 Ton	2	Each
Evaporative Cooler, Indirect, 2,000 Scfm	12	Each
Evaporative Cooler, Indirect, 5,000 Scfm	1	Each
Pipe & Fittings, 2" Copper	0.5	K Ln Ft
Pipe & Fittings, 2" Steel	1.6	K Ln Ft
Pipe & Fittings, 3" Steel	1.8	K Ln Ft
Pipe & Fittings, 6" Steel	1.3	K Ln Ft
Pipe & Fittings, 8" Steel	0.3	K Ln Ft
Air Handler, Single Zone, 6,500 Cfm	2	Each
Air Handler, Single Zone, 10,000 Cfm	25	Each
Duct Insulation, Fiberglass Blanket	18200	Sq Ft
Ductwork	26000	Lbs

50-Year M&R Cost Summary

Task Type	50 Year Total Cost	Annual Cost per GSFT	Annual Cost as % of Replacement
PM & Minor Repair	$6,185,971	$2.21	0.66%
Unscheduled Maintenance	$4,635,141	$1.66	0.49%
Renewal & Replacement	$12,953,025	$4.63	1.38%
Total	**$23,774,137**	**$8.49**	**2.53%**

Distribution of M&R Costs



Thirty Most Costly M&R Tasks

M&R Task	Task Cost*	Pct.**
Replace MV Switchgear, >1,200 Amp.	46.57	13.6%
Replace Air Handler, Single Zone, 10,000 Cfm	29.58	8.7%
Maintain Air Handler, Single Zone, 10,000 Cfm	22.44	6.6%
Lubricate, Repack Gland, Valve, Non Drain, 2"	21.64	6.3%
Replace Membrane, Single-Ply Thermoset Roof	19.28	5.6%
Replace Valve, Non-Drain, 2"	15.84	4.6%
Replace Carpet, Nylon 20 oz., High Traffic	8.54	2.5%
Refinish Gypsum Board, Interior Wall Finish	7.66	2.2%
Replace Ceramic Tile Flooring	6.25	1.8%
Maintain Power Panel Board, 208 Y/120 V, 200 Amp.	6.15	1.8%
Maintain Evaporative Cooler, Indirect, 2,000 Scfm	5.87	1.7%
Replace Power Panel Board, 208 Y/120 V, 200 Amp.	5.81	1.7%
Replace Evaporative Cooler, Indirect, 2,000 Scfm	5.32	1.6%
Maintain Single-Ply Thermoset Roof	5.26	1.5%
Maintain Direct Digital Controls, System Points	5.06	1.5%
Replace Circuit Breaker, Main, MV, 600 V, 1,600 Amp.	4.60	1.3%
Replace Direct Digital Controls, System Points	4.52	1.3%
Replace Transfer Switch, HV, Auto, 600 V	4.02	1.2%
Replace Valve, Non-Drain, 4"	3.54	1.0%
Maintain Chemical Feed System	3.33	1.0%
Clean & Seal Concrete Block, Exterior, 1st Floor	3.14	0.9%
Replace Steel, Painted, Interior Door Locks	3.07	0.9%
Replace Chiller, Reciprocal Water-Cooled Hermetic, 100 Ton	2.97	0.9%
Clean & Reseal Clay Brick, Exterior, 1st Floor	2.71	0.8%
Repair Air Handler, Single Zone, 10,000 Cfm	2.67	0.8%
Lubricate, Repack Gland, Valve, Non Drain, 4"	2.52	0.7%
Maintain Cooling Tower, 100 Ton	2.44	0.7%
Replace Batteries & Check Operation, Smoke Detector	2.17	0.6%
Replace Cooling Tower, 100 Ton	1.99	0.6%
Maintain Chiller, Reciprocal Water-Cooled Hermetic, 100 Ton	1.96	0.6%

**Task cost ($2010) per GSFT over 50 years.*

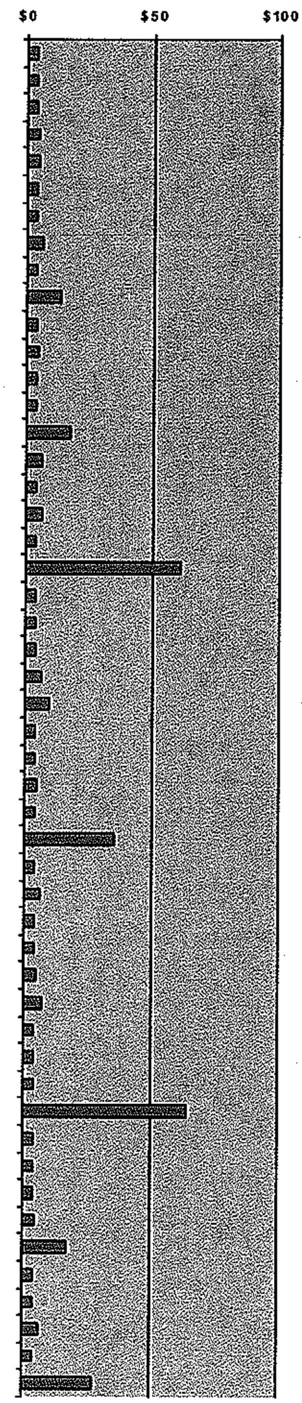
***Percent of total M&R costs.*

Note: For a complete list of components see Chapter 2.2. For alternative locations use the Local Indexes shown in Chapter 3.

Cost per GSFT by System

Asset Age	Exterior Closure	Roofing	Interior Constrution	Stairways	Interior Finishes	Conveying Systems	Plumbing	HVAC Systems	Fire Protection	Electrical	Equipment	Special Construction	Site Improvements	Total per GSFT
1		.20				.00	.15	2.65	.05	.58	.00			3.64
2		.20			.03	.00	.22	2.65	.05	.61	.00			3.77
3		.20				.00	.15	2.70	.05	.58	.00			3.69
4		.20	.05		.70	.00	.28	2.65	.05	.61	.00			4.56
5	.01	.33	.19			.00	.23	2.70	.08	.75	.00			4.31
6		.20			.03	.00	.22	2.70	.05	.61	.00			3.82
7		.20				.00	.19	2.66	.05	.58	.00			3.69
8		.20	.05		2.09	.00	.29	2.65	.05	.61	.00			5.96
9		.20			.06	.00	.15	2.70	.05	.58	.00			3.75
10	2.85	.53	.81		.35	.00	.60	5.71	.25	2.34	.03			13.47
11		.20				.00	.15	2.65	.05	.58	.00			3.64
12		.20	.05		.70	.00	.49	2.69	.15	.61	.00			4.89
13		.20				.00	.15	2.69	.05	.58	.00			3.68
14		.20			.03	.00	.26	2.66	.05	.61	.00			3.82
15	.03	.33	.19		.20	.00	.34	14.48	.11	1.12	.00			16.83
16		.20	.05		2.09	.00	.29	2.69	.05	.61	.00			6.00
17		.20				.00	.16	2.65	.08	.58	.00			3.68
18		.20			.09	.00	.22	2.66	.05	3.17	.00			6.39
19		.20				.00	.15	2.69	.05	.58	.00			3.68
20	2.85	9.64	1.08		1.07	.00	1.30	18.41	.22	26.38	.03			60.99
21		.20				.00	.19	2.67	.05	.58	.00			3.70
22		.20			.03	.00	.23	2.65	.08	.61	.00			3.80
23		.20				.00	.15	2.69	.05	.61	.00			3.71
24		.20	.05		2.09	.00	.49	2.69	.15	.61	.00			6.29
25	1.61	.33	.23		.00	.08	1.95	4.25	.06	.94	.00			9.46
26		.20			.03	.00	.22	2.69	.05	.61	.00			3.81
27		.20			.06	.00	.15	2.66	.05	.58	.00			3.71
28		.20	.05		.70	.00	.26	2.66	.05	.64	.00			4.57
29		.20				.00	.23	2.69	.08	.58	.00			3.79
30	2.88	.53	.81		.55	.00	.74	17.41	.28	11.61	.03			34.83
31		.20				.00	.15	2.65	.05	.58	.00			3.64
32		.20	.05		2.09	.00	.22	2.65	.05	.61	.00			5.89
33		.20				.00	.22	2.70	.05	.61	.00			3.79
34		.20			.03	.00	.23	2.65	.08	.61	.00			3.80
35	.06	.33	.19			.00	.82	2.71	.06	.73	.00			4.91
36		.20	.05		.76	.00	.36	2.73	.15	3.17	.00			7.43
37		.20				.00	.28	2.66	.05	.58	.00			3.78
38		.20			.03	.00	.16	2.65	.05	.61	.00			3.71
39		.20				.00	.21	2.70	.05	.58	.00			3.75
40	2.84	9.64	1.08		2.46	.00	1.22	19.79	.22	26.59	.03			63.88
41		.20				.00	.29	2.65	.08	.61	.00			3.83
42		.20			.03	.00	.20	2.66	.05	.61	.00			3.76
43		.20				.00	.21	2.69	.05	.58	.00			3.75
44		.20	.05		.70	.00	.16	2.66	.05	.61	.00			4.44
45	.05	.33	.19		.26	.00	.60	14.49	.11	1.09	.00			17.14
46		.20			.03	.00	.17	2.69	.08	.64	.00			3.81
47		.20				.00	.21	2.65	.05	.58	.00			3.70
48		.20	.05		2.09	.00	.36	2.69	.15	.61	.00			6.16
49		.20				.00	.32	2.69	.05	.58	.00			3.86
50	4.44	.53	.85		6.61	.08	2.06	4.76	.32	7.91	.03			27.58
Total	**17.62**	**30.39**	**6.15**		**25.98**	**.36**	**19.02**	**211.65**	**4.42**	**108.63**	**.31**			**424.54**

50-Year Total M&R Cost Profile per GSFT



A value of ".00" means a cost of more than $.000 but less than $.005 per GSFT.

Note: For a complete list of components see Chapter 2.2. For alternative locations use the Local Indexes shown in Chapter 3.

3. Local M&R Costs

The statistics in this chapter focus on local maintenance costs for 255 major North American and International areas. Three types of measures are presented:

> **Section 3.1: Local maintenance cost indexes** measure M&R costs across areas.
>
> **Section 3.2: In-house shop rates** for trades and supervisory positions common to facility staff.
>
> **Section 3.3: Contract labor rates** for trades common in M&R construction.

The local maintenance cost index is based on the M&R costs of the 2 Story Office Building (shown in Chapter 2) standardized to the Washington, D.C. area. The range of the index is considerable, as Table 3-1 indicates. Costs in New York, NY are an estimated 29% higher than those in Washington, D.C. for the same asset. In the other direction, M&R costs in Beijing, CHN are an estimated 76% lower than the Washington, D.C. value. This index can be used for simple comparisons among areas, and also used to adjust the cost profiles in Chapter 2 for areas other than Washington, D.C. For a listing of international contract labor and in-house shop rates; see tables A-5 and A-6 in Appendix 1.

Table 3-1
Comparison of M&R Costs by Area

Area	Local Maintenance Cost Index*	Area	Local Maintenance Cost Index*	Area	Local Maintenance Cost Index*	Area	Local Maintenance Cost Index*	Area	Local Maintenance Cost Index*
New York, NY	128.5	Albany, NY	97.7	Atlanta, GA	90.4	Little Rock, AR	83.9	**International Cities+**	
Yonkers, NY	128.5	Annapolis, MD	97.5	Manchester, NH	90.3	Boise, ID	83.9		
San Francisco, CA	125.2	Baltimore, MD	97.5	Dover, DE	89.7	Montgomery, AL	83.8	Zurich, CHE	105.5
Philadelphia, PA	121.4	Indianapolis, IN	97.5	Cedar Rapids, IA	89.7	Cheyenne, WY	83.6	Berlin, DEU	87.5
New Brunswick, NJ	121.4	Madison, WI	97.5	Denver, CO	89.7	Tucson, AZ	83.6	Paris, FRA	78.5
Trenton, NJ	121.4	Terre Haute, IN	97.4	Beaumont, TX	89.6	Beaufort, SC	83.5	Sydney, AUS	75.2
Jersey City, NJ	120.7	Worcester, MA	97.4	Altus, OK	89.0	Charleston, SC	83.5	Tokyo, JPN	64.5
Morristown, NJ	120.7	Sacramento, CA	97.4	Louisville, KY	88.9	Dallas, TX	83.4	London, GBR	63.6
Newark, NJ	120.7	Duluth, MN	97.4	Toledo, OH	88.8	Orlando, FL	83.3	Sao Paulo, BRA	55.2
Camden, NJ	120.5	Moline, IL	97.3	Baton Rouge, LA	88.7	Amarillo, TX	83.2	Seoul, KOR	49.4
Chicago, IL	118.1	Akron, OH	97.3	Great Falls, MT	88.6	Huntsville, AL	83.2	Istanbul, TUR	45.8
Oakland, CA	115.3	Salem, OR	97.3	Grand Rapids, MI	88.5	Columbia, SC	83.2	Abu Dhabi, UAE	38.1
San Jose, CA	113.9	Evansville, IN	97.1	Phoenix, AZ	88.5	Las Cruces, NM	83.2	Buenos Aires, ARG	37.7
Springfield, IL	113.0	Springfield, MA	97.0	Utica, NY	88.3	Fort Worth, TX	82.5	Riadh, SAU	36.2
Hilo, HI	112.7	Rochester, MN	96.8	Savannah, GA	88.1	Oklahoma City, OK	82.5	Johannesburg, ZAF	31.9
Honolulu, HI	112.7	Santa Barbara, CA	96.5	Lewiston, ME	87.6	Springfield, MO	82.1	Mexico City, MEX	30.7
Ann Arbor, MI	111.1	Youngstown, OH	96.4	Mobile, AL	87.5	Roanoke, VA	82.0	Moscow, RUS	30.6
Rockford, IL	108.2	San Diego, CA	95.9	Biloxi, MS	87.4	Bowling Green, KY	81.8	St. Petersburg, RUS	30.3
Minneapolis, MN	107.8	Lowell, MA	95.9	Spokane, WA	87.4	Raleigh-Durham, NC	81.8	Cairo, EGY	29.6
St. Paul, MN	107.8	Providence, RI	95.9	Chattanooga, TN	87.4	Knoxville, TN	81.7	Shanghai, CHN	29.4
St. Louis, MO	107.6	Anacortes, WA	95.8	Wichita Falls, TX	87.3	Nashville, TN	81.0	Karachi, PAK	28.5
Kansas City, MO	107.5	Brockton, MA	95.7	St. George, UT	87.2	Fayetteville, AR	80.9	Mumbai, IND	26.3
Las Vegas, NV	107.3	Jefferson City, MO	95.6	Lincoln, NE	87.0	Macon, GA	80.9	Beijing, CHN	24.1
Atlantic City, NJ	106.9	Buffalo, NY	95.4	Sioux City, IA	87.0	Charlotte, NC	80.8		
Peoria, IL	106.6	Riverside, CA	95.4	Shreveport, LA	87.0	Pierre, SD	80.4		
Detroit, MI	105.9	Reno, NV	95.3	Richmond, VA	86.9	Rapid City, SD	80.4		
Boston, MA	105.8	Oxnard, CA	95.2	Houston, TX	86.8	Bismarck, ND	80.2		
Norwalk, CT	105.5	Cincinnati, OH	94.9	Colorado Springs, CO	86.8	Daytona Beach, FL	80.1		
Stamford, CT	105.5	Flint, MI	94.9	Jacksonville, FL	86.7	Columbus, GA	80.0		
New Haven, CT	104.6	Olympia, WA	94.9	Hampton, VA	86.7	Fort Smith, AR	80.0		
Gary, IN	103.7	Davenport, IA	94.7	Newport News, VA	86.7	Greensboro, NC	79.7		
Seattle, WA	103.4	Cumberland, MD	94.5	Norfolk, VA	86.7	Sioux Falls, SD	79.1		
Portland, OR	103.3	Fresno, CA	94.3	Virginia Beach, VA	86.7	Winston-Salem, NC	78.9		
Waterbury, CT	103.2	Harrisburg, PA	94.0	Waco, TX	86.6	Tallahassee, FL	78.8		
Danbury, CT	103.2	Pueblo, CO	94.0	Miami, FL	86.6	Fargo, ND	78.5		
Springfield, OH	103.1	Saginaw, MI	93.3	Wichita, KS	86.5	Lubbock, TX	78.3		
Lansing, MI	103.0	Columbus, OH	93.2	Fort Lauderdale, FL	86.4	Alamogordo, NM	77.7		
Pittsburgh, PA	102.9	Syracuse, NY	93.1	Albuquerque, NM	86.0	El Paso, TX	77.1		
Juneau, AK	101.9	Watertown, NY	93.1	Frankfort, KY	85.8	Hagatna, GU	75.9		
Milwaukee, WI	101.8	Dayton, OH	92.9	Lexington, KY	85.8	San Juan, PR	69.6		
Anchorage, AK	101.3	Rochester, NY	92.8	Sante Fe, NM	85.6				
Kokomo, IN	101.2	South Bend, IN	92.7	Austin, TX	85.5	**Canadian Cities+**			
Hartford, CT	101.1	Stockton, CA	92.6	Pocatello, ID	85.5				
Anaheim, CA	101.0	Green Bay, WI	92.6	Birmingham, AL	85.3	Calgary, AB	97.8		
Los Angeles, CA	101.0	Muncie, IN	92.5	Portland, ME	85.2	Toronto, ON	97.6		
Norwich, CT	100.8	New Orleans, LA	92.3	Jackson, MS	85.1	Ottawa, ON	96.6		
Cleveland, OH	100.3	Concord, NH	92.3	Memphis, TN	85.1	Hamilton, ON	96.4		
Charleston, WV	100.1	Topeka, KS	92.2	Corpus Christi, TX	85.0	London, ON	96.4		
Washington, D.C.	100.0	Erie, PA	92.1	Ogden, UT	84.8	Vancouver, BC	96.3		
Tacoma, WA	99.9	Fall River, MA	92.0	Salt Lake City, UT	84.8	Edmonton, AB	96.2		
Parkersburg, WV	99.6	Medford, OR	92.0	Key West, FL	84.8	Victoria, BC	95.3		
Carson City, NV	99.5	Des Moines, IA	91.8	Tulsa, OK	84.7	Halifax, NS	94.1		
Fairbanks, AK	99.4	Battle Creek, MI	91.6	San Antonio, TX	84.4	Montreal, QC	93.0		
Bakersfield, CA	99.4	Kalamazoo, MI	91.6	Owensboro, KY	84.4	Quebec City, QC	90.5		
Richland, WA	99.2	Lawton, OK	91.3	Tuscaloosa, AL	84.2	St. John's, NL	88.3		
Wilmington, DE	99.0	Omaha, NE	91.0	Augusta, ME	84.1	Regina, SK	85.9		
Marquette, MI	99.0	Helena, MT	90.9	Tampa, FL	84.1	Winnipeg, MB	84.7		
Scranton, PA	98.6	Billings, MT	90.8	Burlington, VT	84.1				
Reading, PA	98.5	Boulder, CO	90.6	Montpelier, VT	84.1				
Eugene, OR	97.9	Eau Claire, WI	90.6	Rutland, VT	84.0				

*Total average cost, Washington D.C.=100
+Adjusted using 5/14/10 exchange rate from Reuters.com

3.1 Local Maintenance Cost Indexes, Selected North American Areas

Area	Cost per GSFT *	Local Index	255 Area Ranking	Area	Cost per GSFT *	Local Index	255 Area Ranking
Charleston, WV				Columbus, GA			
PM & Minor Repair	$.61	96.4	56	PM & Minor Repair	$.44	68.6	227
Unscheduled Maintenance	$.46	96.3	50	Unscheduled Maintenance	$.29	60.2	229
Renewal & Replacement	$2.08	102.1	44	Renewal & Replacement	$1.79	88.2	206
Total Average Cost	$3.15	100.1	48	Total Average Cost	$2.52	80.0	223
Charlotte, NC				Columbus, OH			
PM & Minor Repair	$.45	70.8	220	PM & Minor Repair	$.53	82.5	150
Unscheduled Maintenance	$.30	63.6	218	Unscheduled Maintenance	$.38	79.3	143
Renewal & Replacement	$1.79	87.9	210	Renewal & Replacement	$2.03	99.9	62
Total Average Cost	$2.54	80.8	218	Total Average Cost	$2.93	93.2	106
Chattanooga, TN				Concord, NH			
PM & Minor Repair	$.54	84.9	136	PM & Minor Repair	$.55	85.7	130
Unscheduled Maintenance	$.38	80.0	138	Unscheduled Maintenance	$.38	79.9	140
Renewal & Replacement	$1.83	89.9	186	Renewal & Replacement	$1.98	97.2	94
Total Average Cost	$2.75	87.4	152	Total Average Cost	$2.90	92.3	117
Cheyenne, WY				Corpus Christi, TX			
PM & Minor Repair	$.52	81.6	153	PM & Minor Repair	$.47	74.2	199
Unscheduled Maintenance	$.37	77.3	153	Unscheduled Maintenance	$.32	68.1	200
Renewal & Replacement	$1.74	85.8	222	Renewal & Replacement	$1.88	92.4	156
Total Average Cost	$2.63	83.6	198	Total Average Cost	$2.68	85.0	181
Chicago, IL				Cumberland, MD			
PM & Minor Repair	$.76	119.6	13	PM & Minor Repair	$.56	87.4	119
Unscheduled Maintenance	$.58	121.0	13	Unscheduled Maintenance	$.41	85.4	111
Renewal & Replacement	$2.38	116.9	3	Renewal & Replacement	$2.01	98.8	74
Total Average Cost	$3.72	118.1	11	Total Average Cost	$2.97	94.5	100
Cincinnati, OH				Dallas, TX			
PM & Minor Repair	$.55	86.9	121	PM & Minor Repair	$.49	76.6	183
Unscheduled Maintenance	$.40	83.1	122	Unscheduled Maintenance	$.34	70.7	179
Renewal & Replacement	$2.04	100.2	59	Renewal & Replacement	$1.80	88.5	202
Total Average Cost	$2.99	94.9	96	Total Average Cost	$2.62	83.4	202
Cleveland, OH				Danbury, CT			
PM & Minor Repair	$.65	101.3	38	PM & Minor Repair	$.61	95.7	64
Unscheduled Maintenance	$.48	100.9	39	Unscheduled Maintenance	$.44	92.1	76
Renewal & Replacement	$2.03	99.8	63	Renewal & Replacement	$2.20	108.1	24
Total Average Cost	$3.16	100.3	47	Total Average Cost	$3.25	103.2	35
Colorado Springs, CO				Davenport, IA			
PM & Minor Repair	$.51	80.3	160	PM & Minor Repair	$.59	92.0	91
Unscheduled Maintenance	$.36	74.9	161	Unscheduled Maintenance	$.43	90.6	86
Renewal & Replacement	$1.86	91.5	169	Renewal & Replacement	$1.96	96.5	104
Total Average Cost	$2.73	86.8	160	Total Average Cost	$2.98	94.7	99
Columbia, SC				Dayton, OH			
PM & Minor Repair	$.46	71.5	216	PM & Minor Repair	$.53	83.8	143
Unscheduled Maintenance	$.30	63.8	217	Unscheduled Maintenance	$.38	79.4	142
Renewal & Replacement	$1.86	91.4	172	Renewal & Replacement	$2.01	99.0	70
Total Average Cost	$2.62	83.2	206	Total Average Cost	$2.93	92.9	110

*Annual average costs, over a 50 year service life, of maintaining the 2 Story Office Building shown in Chapter 2.
Note: Local Indexes are standardized (equal 100) for the Washington D.C. area.

Fermilab Work Smart Set

INTRODUCTION

Fermilab has adopted the Necessary and Sufficient (N&S) Process for determining the Work Smart Set of Standards (WSS) to determine the appropriate ES&H standards to ensure the safe and environmentally responsible operations of the laboratory. Fermilab, in conjunction with participation from, the DOE FSO, the Chicago Operations Office (CH) and the Office of Science (SC), conducted the first site-wide application of the Departmental N&S Closure Process. The result was a set of significant hazard aspects and impacts that were used to establish a Work Smart Set of Standards (WSS). The WSS were incorporated into the prime contract with DOE. These standards, if properly implemented, provide adequate assurance that the public, workers, and environment are protected from adverse consequences. Fermilab's work activities, the hazards associated with the work, and the standards are reviewed on an annual basis, and revised as needed. Additionally, new standards promulgated by DOE or national standards-making bodies (e.g. National Fire Protection Association) are evaluated and incorporated into the WSS as appropriate.

RESPONSIBILITIES

The Chief Operating Officer is responsible for assuring that suggested changes to Fermilab's WSS are incorporated into the FRA contract with DOE.

The ESH Section Head is responsible for

- Conducting annual review of WSS and recommending to Fermilab management changes to the set.
- Distributing copies of the revised WSS to the Library.

The Laboratory Services, Information Resources Department Manager is responsible for assuring that all WSS are available through the library system.

PROGRAM DESCRIPTION

The WSS shall be reviewed on an annual basis. The ESH Section Head will transmit to the Chief Operating Officer recommendations of changes to the WSS. Once the set has been accepted by DOE-FSO and incorporated into the contract with FRA, copies shall be distributed to the Library and the FESHM chapter.

Appendix A
Fermilab Work Smart Set of Standards

10 CFR 1021 (DOE NEPA rules)
10 CFR 1022 (Compliance with Floodplain/Wetlands environmental review requirements)
10 CFR 1046 Subpart B, App. A, Chapter X, par. H through I inclusive. (Physical protection of security interests, protective force personnel)
10 CFR 835 (Occupational radiation protection - applicable and enforceable portions)
10 CFR 850 (Chronic Beryllium Disease Prevention Program)
10 CFR 851 (Worker Safety and Health Program)
10 CFR 860 (Trespass to land owned & leased by the U.S. Government)
17 IAC 525 and permit pursuant (Nuisance animal trapping permits)
17 IAC 3702 (Construction and Maintenance of Dams)
18 U.S. Code Sections 841-848 (Use, or threat of use, of explosives; includes civil disorders)
28 CFR 36 (Section 302(b)(2) of the Americans with Disabilities Act and Section 4.1.3(9) of the ADAAG -- accommodations and accessibility)
29 CFR 1903.13 (Imminent danger)
29 CFR 1903.2 (Posting of notice...)
29 CFR 1904 (Recordkeeping and reporting occupational injuries and illnesses)
29 CFR 1910 (OSHA general industry standards - applicable and enforceable portions)
29 CFR 1926 (OSHA construction industry standards - applicable and enforceable portions)
29 CFR 1928 Subpart C (Roll-over protective structures - applicable and enforceable portions)
29 CFR 1928 Subpart D (Safety for agricultural equipment - applicable and enforceable portions)
29 CFR 1977.12 (Exercise of any right afforded by the Act)
29 CFR 1977.4 (Persons prohibited from discriminating)
29 IAC Chapter 1, Subchapter f (Emergency services, disasters, and civil defense /ESDA/ chemical safety)
33 CFR 320-323, 328-330 (Army Corp of Engineers wetlands regs)
35 IAC (State of IL environmental regs - applicable and enforceable portions)
36 CFR 60, 63, 65 (National historic landmark program)
36 CFR 78-79 (NHPA waiver and collection curation regs)
36 CFR 800 (Protection of historic and cultural properties)
40 CFR (Federal environmental regs - applicable and federally-enforceable portions)
41 IAC 100 (Fire prevention and safety)
41 IAC 120 (Boiler and pressure vessels)
41 IAC 140 (Policy and procedures manual for fire protection personnel)
41 IAC 160 (Storage, transportation, sale and use of gasoline and volatile oils: rules relating to general storage)
41 IAC 170 (Storage, transportation, sale and use of petroleum and other regulated substances)
41 IAC 180 (Storage, transportation, sale and use of volatile oils)
43 CFR 7 (Archaeological collections)
49 CFR (Offsite) Parts 100-177 (Applicable Parts) Parts 178-199 (Applicable Parts) Parts 382-399 (Applicable Parts)
49 CFR (Onsite) Parts 382-399 (Applicable Parts) 177.848 (Segregation Table for Hazardous Materials)
50 CFR 17 (Endangered species rules)
71 IAC 400 (Illinois accessibility code, Subparts C-F)

77 IAC 830 (Structural pest control code)
77 IAC 855 (Rules for Asbestos Abatement for Public & Private Schools and Commercial & Public Buildings in Illinois)
77 IAC 890 (Plumbing code)
77 IAC 900 (Drinking water systems requirements)
77 IAC 905 (Private Sewage Disposal Code)
77 IAC 920 (Water well construction code)
77 IAC 925 (Well pump installation)
92 IAC 700 and all permits pursuant (Construction in water course permit application)
92 IAC 704 and all permits pursuant (Regulation of public waters)
92 IAC 708 and all permits pursuant (Floodway construction permit application)
105 ILCS 105 (Asbestos Abatement Act)
225 ILCS 207 (Commercial and Public Building Asbestos Abatement Act)
ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 2005
ANSI A 17.1 (Elevator Construction)
ANSI A 17.3 (Elevator Maintenance)
ANSI A 39 (Window Washing)
ANSI B11 series (Metalworking - applicable portions)
ANSI B15.1 (Power transmission apparatus)
ANSI O1.1 (Woodworking machinery)
ANSI Z88.2 (Respiratory Protection) 1992
ANSI Z136.1 (Lasers), 2000
AWS (American Welding Standard) Z 49.1 (Cutting, Welding and Hot Work Activities) 1999 version
ANSI/ASHRAE 15 (Mechanical refrigeration)
ANSI/ASME B30.10 (Hooks) 2005
ANSI/ASME B30.11 (Monorails and Underhung Cranes) 2004
ANSI/ASME B30.16 (Overhead Hoists (Underhung)) 2003
ANSI/ASME B30.17 (Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)) 2003
ANSI/ASME B30.2 (Overhead and gantry cranes) 2005
ANSI/ASME B30.20 (Below the hook lifting devices) 2006
ANSI/ASME B30.21 (Manually Lever Operated Hoists) 2005
ANSI/ASME B30.22 (Articulating Boom Cranes) 2002
ANSI/ASME B30.5 (Mobile and locomotive truck cranes) 2004
ANSI/ASME B30.9 (Slings) 2003
ANSI/ASME B31.1 (Power piping) 2001, B31.1a 2002, Addenda to b 31.1 2001
ANSI/ASME B31.3 (Process Piping) 2004
ANSI/ASME B31.5 (Refrigeration piping) 2001
ANSI/ASME B31.8 (Gas transmission and piping systems) 2003
ANSI/ASME B31.9 (Building Services Piping) 1996
Archaeological and Historic Preservation Act of 1974 (P.L. 93-291)
Archaeological Resources Protection Act of 1979 [amended], 16 USC 470aa et seq.
ASME Pressure Vessel Code - Section VIII
ASME B20.1-1996 (Safety Standard for Conveyors & Related Equipment)
Atomic Energy Act of 1954 [amended], 42 USC 2011 et seq.
ANSI N323A-1997 (Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments)
ANSI N323D-2002 (American National Standard for Installed Radiation Protection Instrumentation)

Batavia Code of Regulations, City Ordinance, Section 8-3-10-3
International Building Code Fire Prevention Code (latest edition)
International Building Code (latest edition)
Boiler & Pressure Vessels of the Illinois Office of the State Fire Marshall - applies to CUB Boilers Only
CERCLA/SARA, 42 USC 9601 et seq.
City Code of Warrenville, IL Title 7, Chapter 4, sewer/sewerage ordinance
Clean Air Act Amendments 1990, 42 USC 7401 et seq., and Illinois State Implementation Plan, 40 CFR 52 Subpart O
Clean Water Act, 33 USC 1251 et seq.
DOE Order 420.1A Fire Protection (Section 4.2)
DOE Order 5400.5 Derived Concentration Guide Table and dose limits to the public (Chapter 2, Section 1; Chapter 3)
DOE Manual 231.1A (Environment, Safety and Health Reporting Manual), as it applies to injury recordkeeping only, September 9, 2004
DuPage County Health Department Private Water Supply Ordinance (Chapter 18, Article 18-4, DuPage County Code)
E.O. 11988 (Floodplain Management)
E.O. 11990 (Protection of Wetlands)
E.O. 12580 (Implementation of superfund)
E.O. 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition)
E.O. 13058 (Protecting Federal Employees and the Public from Exposure to Tobacco Smoke in the Federal Work Place)
E.O. 13148 (Greening the Government through Leadership in Environmental Management)
E.O. 13149 (Greening the Government through Federal Fleet and Transportation Efficiency)
Endangered Species Act, 16 USC 1531 et seq.
Federal Facility Compliance Act, 42 USC 6961
Fermilab ES&H Section SQIP RPS.8 (Control and accountability of nuclear materials)
FESHM 2010 (Planning and review of accelerator facilities and their operations)
FESHM 3010 (Significant and Reportable Occurrences) (formerly, Occurrence reporting)
FESHM 5031 (Pressure vessels)
FESHM 5031.1 (Pressure piping systems)
FESHM 5032 (Cryogenic system review)
FESHM 5032.1 (Liquid nitrogen dewar installation rules)
FESHM 5032.2 (Guidelines For the Design, Fabrication, Testing, Installation, and Operation of LH2 Targets)
FESHM 5032.3 (Transporting gases in building elevators)
FESHM 5033 (Vacuum vessel safety)
FESHM 5033.1 (Vacuum window safety)
FESHM 5035 (Mechanical refrigeration systems)
FESHM 5040 (Fermilab electrical safety program)
FESHM 5041 (Electrical utilization equipment safety)
FESHM 5042 (AC electrical power distribution safety)
FESHM 5043 (Management and use of cable tray systems)
FESHM 5044 (Protection against exposed electrical bus)
FESHM 5046 (Low voltage, high current power distribution systems)
FESHM 5064 (Oxygen deficiency hazards)
FESHM 5084 (Ergonomics Program)
FESHM 6020.3 (Installation of flammable gas lines in or near cable trays)

FESHM 9030 (Aviation safety)
FIFRA, 7 USC 136 et seq.
FRCM Article 362 (X-Ray Generating Devices & Radiography Sources)
FRCM Article 411 (Radioactive Material Identification, Storage and Control - Definitions)
Handbook for Sampling & Sample Preservation of Water and Wastewater, EPA-600/4-82-029
IEC 61511, Functional Safety, Safety Instrumented Systems for the Process Industry Sector
Illinois Chemical Safety Act, 430 ILCS 45/1 et seq.
Illinois Compiled Statutes (ILCS) Chapter 625 (State vehicle code -- Applicable Portions)
Illinois Department of Public Health, DuPage County Dept. Public Health. CDC December 7,1990
Illinois Endangered Species Protection Act, 520 ILCS 10/1 et seq.
Illinois Ground Water Protection Act, 415 ILCS 55/1 et seq.
Illinois Health and Safety Act, 820 ILCS 225/1 et seq.
Illinois Pesticide Act, 415 ILCS 60/1 et seq.
Illinois Structural Pesticide Act, 225 ILCS 235/1 et seq.
Kane County Health Department Ordinance 04-199/05-141 Water Well Code
National Fire Protection Association Codes and Standards (NFPA Standards - applicable portions)
NFPA (National Electric Code), 2005
NFPA 70E (Standard for Electrical Safety in the Workplace), 2004
National Historic Preservation Act of 1966 [amended], 16 USC 470 et seq.
Native American Graves Protection and Repatriation Act of 1990, 25 USC 3001 et seq.
NEPA, 42 USC 4321 et seq.
OSH Act, 29 USC 654(a)(1) -- General duty clause.
Privacy Act of 1974, 5 USC 552a
RCRA Part B Permit (Illinois Log #131), including Emergency Contingency plan
RCRA, 42 USC 6901 et seq.
Recommended standards for Water Works, Great Lakes Upper Mississippi R. Bd. of State Public Health & Environmental Managers (1992)
Safe Drinking Water Act, 42 USC 300f et seq.
Standard Methods for the Examination of Water and Wastewater, 18th Ed., APHA (1992)
Standards and Specifications for Soil Erosion and Sediment Control, 10/87, IEPA 87-102
TSCA, 15 USC 2601 et seq.
UL Listing
Uniform Federal Accessibility Standards, Chapter 4, Accessible Elements and Spaces: Scope and Technical Requirements
Energy Solutions LLC Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria

Rather than attempt a precise analysis of all necessary standard citations to exclude non-applicable parts, inclusive citations were made qualified by the phrase "applicable and enforceable parts thereof."

To the extent these standards apply to DOE and not the contractor, the contractor will assist DOE in complying with them.

This Set does not change any existing Federal, State or local enforcement authority.

For standards not applicable as a matter of law (other than FESHM provisions), the applicable version shall be the revision in effect on July 14, 1995, unless otherwise indicated. For FESHM provisions, the applicable version shall be the most recent version established through the procedures set forth in Appendix I.

Fermilab
ESH Section

Multi-Organization Construction Site Safety Walkthrough

1.0 Background and Purpose

Background: The vast majority of incidents happen when barriers are bypassed, procedures are not followed or there are departures by workers from safe behaviors. Unsafe conditions have historically been a small percentage of the causes of accidents whereas behaviors or unsafe acts are the bulk of the causes. In order to eliminate these incidents from the workplace we must concentrate our efforts to those actions that will have the biggest return on "investment" such as the elimination of unsafe behaviors and the evaluation of work processes and barriers to determine conformance with accepted practices.

Purpose: To establish a process for conducting formal safety program evaluations and field assessments through site safety walkthroughs for construction activities. These walk-throughs should consider management systems, employee behaviors, conformance to the subcontractor safety plan, and performance to Fermilab requirements as expressed in contractual documents, pre-bid and pre-construction meetings.

2.0 Scope

This procedure applies to all active construction activities that require a multi-organizational scrutiny as designated by the Chief Operating Officer.

3.0 Responsibilities

3.1 Construction Manager

3.1.1 Determine the frequency of walkthroughs based upon input received from the Chief Operating Officer and the Project Manager. Frequency should be identified in the Project Execution Plan (PEP).

3.1.2 Identify walk-through team members. The team should be kept to a reasonable size and may include the Construction Manager, Construction Coordinator, Subcontractor Superintendent, a representative from the Fermilab ESH Section, a representative from the Department of Energy Fermi Site Office if requested, and a Project ESH Coordinator, if one is assigned.

3.1.3 Conduct a closeout meeting as described below.

3.2 Construction Coordinator

3.2.1 Assist the Construction Manager in the walkthrough process as requested. Such requests may include:

3.2.1.1 Transmit all concerns to the Sub-Contractor for resolution and provide copies to all team members.

3.2.1.2 Review corrective action responses from the Sub-Contractor and provide feedback to the Construction Manager and the Project ES&H Coordinator.

3.2.1.3 Track responses to action items (in a formal database, daily/weekly logs or construction meeting minutes).

3.2.1.4 Document & distribute closeout-meeting minutes.

3.3 ES&H Section Representative

3.3.1 Provide technical support relative to safety issues.

3.4 Project ES&H Coordinator

3.4.1 Participate in walkthroughs keeping an eye especially toward safety issues that would impact installation and operational activities that will follow construction.

3.4.2 Provide feedback from walkthroughs and closeout meetings directly to the Project Manager.

4.0 Procedure

4.1 The Construction Manager (CM) will identify the time and frequency of the walkthrough.

4.2 The CM will develop an agenda for the walk-through and identify any specific areas to focus on. Appendix A should be used as guidance. Trying to cover a broad spectrum of programs or activities may result in specifics being missed. This is especially true for a larger project, or one covering more than one work site. Interviews with subcontractor employees are encouraged.

Field observations from one visit may give rise to focused assessments at a future date or provide justification for a formal audit.

4.3 CM will complete a closeout meeting with all participating organizations to discuss results of the walkthrough and to discuss suggestions for possible corrective actions.

4.4 Document walkthrough results through meeting minutes that will be distributed to all participating organizations.

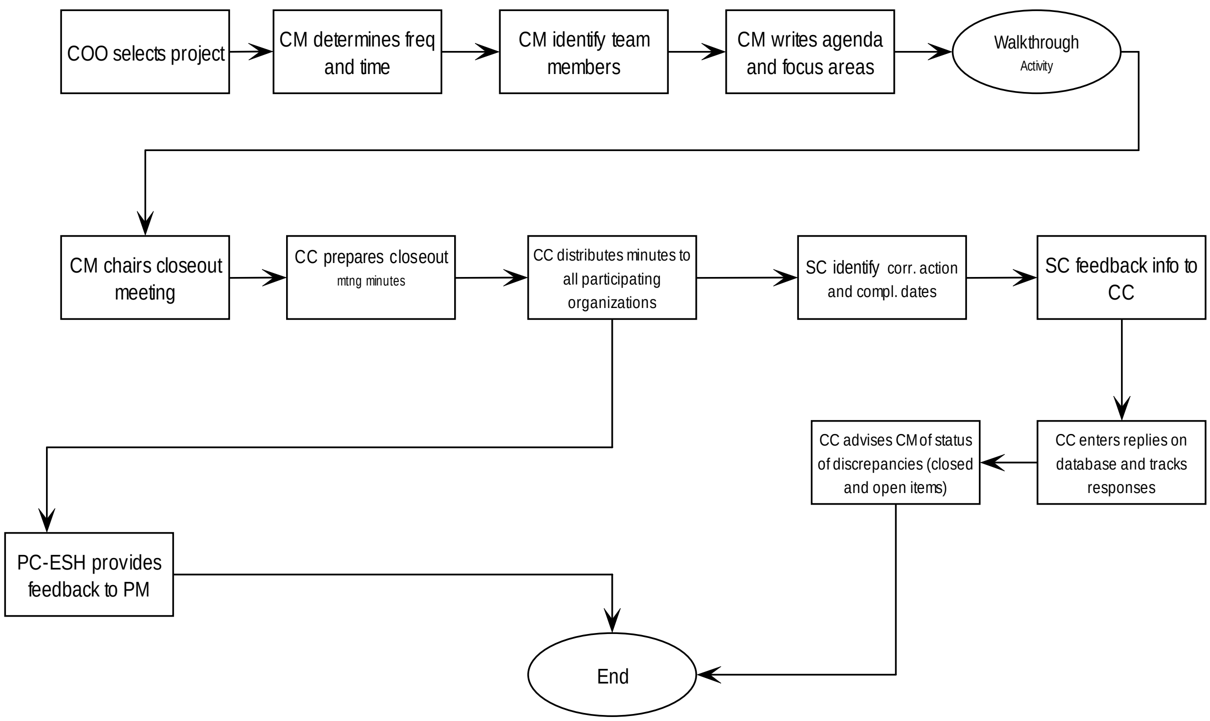
4.5 Enter concerns and corrective actions into a database created for the specific project.

5.0 Corrective Actions

5.1 The walkthrough report shall be provided to the subcontractor for action.

5.2 The subcontractor shall identify corrective actions and completion dates. Corrective actions shall be completed as quickly as possible.

Construction Project
Multi-Organizational Safety Walkthrough



Abbreviations:

COO	Chief Operating Officer
CM	Construction Manager
CC	Construction Coordinator
PC-ESH	Project ES&H Coordinator
PM	Project Manager

Appendix

ESH Assessment Guidance- Areas of Inquiry

1. Injuries or Illnesses

2. General
   - Housekeeping
   - Garbage Containers
   - Emergency Phone #s Posted
   - Emergency Communication
   - Fence Condition
   - Gates
   - Signage on Fences and Gates
   - Whip Checks
   - Electrical Cords
   - GFCI’s
   - Gas Test Log
   - Machine/Equipment Guards
   - Lighting
   - Ladders
   - Explosive Storage
   - Oxy/Acetylene Storage
   - Scaffolding

2. Traffic Control
   - Barricades
   - Traffic Signs
   - Flag Person
   - Vests
   - Flag

3. Shafts & Tunnels
   - Hand held lights/Miners Lights
   - Lighting
   - Communication
   - Ventilation
   - Self Rescuers Present

- Housekeeping
- Air/Noise Testing
- Signage
- Barricades

4. Emergency Equipment
   - Fire Extinguishers
   - First Aid Kits
   - Oxygen
   - Blankets
   - Eye Wash
   - Infection Control
   - Medical Emergency Teams
   - Rescue Teams

5. Personal Protective Equipment
   - Hard Hats
   - Eye Protection
   - Hearing Protection
   - Foot Protection
   - Respiratory Protection
   - Hand Protection
   - Fall Protection Harness/Lanyard
   - Face Protection
   - Barrier Cream

6. Cranes
   - Inspections
   - Certifications
   - Anti-Two Blocks
   - Hook Latches
   - Perimeter Barricades
   - Glass
   - Horn
   - Fire Extinguisher
   - Rigging Equipment

7. Equipment
   - Daily Inspections
   - Glass

- Back-Up Alarm
- Fire Extinguishers
- Hydraulic Oil Leaks

8. Work Planning
   - H/A for Tasks Performed
   - Dail Huddles
   - Tool Box Meetings
   - Monthly ESH Meetings
   - Records/Log Reviews
   - LOTO

FERMILAB
ICW Analysis

Model Demands
5/1/2013

Junction Node	Description	Peak Summer 2006 Demand	Theoretical Summer 2012 Demand*	Observed Summer 2012 Demand**	Assumed Peak Summer 2013 Demand***
J-1030	WIDE BAND COUNT LAB	-	-	-	-
J-1090	EAO CENTER	102	102	114	114
J-1180	MESON SERVICE 3	-	-	-	-
J-1200	NS-2/NW-4	-	-	-	-
J-1290	PROTON SERVICE 4	-	-	-	-
J-1330	PROTON PAGODA/PS3	-	-	-	-
J-1364	PROTON SERVICE 6	-	-	-	-
J-1420	MS7 SERVICE BLDG.	-	-	-	-
J-1440	POLARIZED PROTON LAB	91	91	102	102
J-1520	MESON CTG/AD CROY.	-	-	-	-
J-1530	MESON WEST LAB	170	170	191	191
J-1570	MESON SERVICE 6	400	400	449	449
J-170	MUON LAB	680	680	763	763
J-1730	MESON DETECTOR BLDG.	220	220	247	247
J-1732	MESON ASSBLY. BLDG.	-	-	-	-
J-1770	MESON SERVICE 4	30	30	34	34
J-1786	MESON CENTRAL CRYO	618	500	561	561
J-1820	FACILITY MGMT. BLDG.	-	-	-	-
J-1870	RDS AND GRND MAIN BLDG.	-	-	-	-
J-1930	RECEIVING WRHS. 2	-	-	-	-
J-2000	RECEIVING WRHS. 1	-	-	-	-
J-2040	SITE 38 VEH. MAINT.	-	-	-	-
J-2110	SITE 38 FIRE STN.	-	-	-	-
J-2150	MESON SERVICE 1	-	-	-	-
J-2290	NS1 SERVICE BLDG.	-	-	-	-
J-230	NEUTRINO LAB D	-	-	-	-
J-2350	MESON SERVICE 2	-	-	-	-
J-2460	INDUSTRIAL COMPRESS. BLDG.	-	150	168	168
J-2530	PS1 E SERVICE BLDG.	-	-	-	-
J-2570	INDUSTR. BLDG. 2	40	40	45	45
J-2610	INDUSTR. BLDG. 3	123	123	138	138
J-2630	INDUSTR. CENTER BLDG.	-	-	-	-
J-2660	INDUSTR. CENTER BLDG.	225	225	252	252
J-2690	INDUSTR. BLDG. 4	60	60	67	67
J-2730	INDUSTR. BLDG. 1	60	60	67	67
J-2770	CDF PORTAKAMPS	-	-	-	-
J-2790	COLLIDER DETECTOR BLDG.	-	-	-	-
J-2850	CENTRAL HE LIQUEFIER	464	300	337	447
J-2900	FCC	1,596	990	1,111	821
J-2980	SWITCHYARD/G1	-	-	-	-
J-310	NEUTRINO LAB G	43	43	48	48
J-3100	LINAC NORTH ANNEX	58	58	65	65
J-3120	WILSON HALL FIRE	-	-	-	-
J-3140	WILSON HALL	-	-	-	-
J-3200	WILSON AUDITORIUM	-	-	-	-
J-3220	LINAC LOWER LEVEL	-	-	-	-
J-3250	CROSS GALLERY	-	-	-	-
J-3290	SW CROSS GALRY ADDITION	-	-	-	-
J-3354	TRANSFER GALLERY	-	-	-	-
J-3358	TRANSFER GALRY NW AREA	-	-	-	-
J-3460	SCI. EDUC. CNTR.	-	-	-	-
J-350	NEUTRINO LAB F	-	-	-	-
J-3508	MUCOOL	250	250	281	281
J-3550	SW BOOSTER TOWER	-	-	-	-
J-3600	CENTRAL UTILITY BUILDING	150	150	168	168
J-3640	SE BOOSTER TOWER	-	-	-	-
J-3680	AP 30 SERVICE BLDG.	-	-	-	-
J-3720	AP 10 SERVICE BLDG.	-	-	-	-
J-3750	AP 50 SERVICE BLDG.	-	-	-	-
J-3770	TARGET HALL/AP-0	-	-	-	-
J-38	MINOS SERV. BLDG.	-	-	-	-
J-3960	B-0 MAIN RING	-	-	-	-
J-400	NEUTRINO LAB E	24	24	27	27
J-4124	A-0 LAB	-	-	-	-
J-4287	R.F. BLDG.	-	-	-	-
J-450	NEUTRINO LAB B	-	50	56	56
J-460	LAB B	410	410	460	460
J-490	NEUTRINO LAB A	64	64	72	72
J-51	KTEV	-	-	-	-
J-5142	D-0	-	-	-	-
J-5243	CMTF	-	-	-	800
J-5242	CMTF	-	-	-	800
J-530	NEUTRINO LAB C	39	39	44	44
J-670	NWA	85	85	95	95
J-74	MINI BOONE DETECTOR	-	-	-	-
J-810	HIGH INTENSITY LAB	160	160	180	180
J-834	PROTON SERVICE 5	-	-	-	-
J-880	PROTON ASBLY. BLDG.	8	8	9	9
J-940	MAGNET STRG. BLDG.	-	-	-	-
J-960	TAGGED PHOTON LAB	-	-	-	-
J-995	PB6/PB7 WIDE BAND LAB	-	-	-	-
		6,170	**5,482**	**6,151**	**7,571**

*Based on data from ICW users
**Sustained (4-day average) peak flow of 6,151 gpm observed July 4th to July 7th. Multiplier of 1.122 applied to theoretical demands to match observed flows.
***Assumes Observed Summer 2012 Demand plus any demand modifications with the multiplier

Demand Modifications for 2013 Analysis

FERMILAB ICW ANALYSIS
DEMAND SUMMARY
5/1/2013

Junction Node	Description	Demand (gpm)	2013 Max Day	2013 Max Day with Mu2E & A-0	2013 Max Day with Mu2E, A-0 & IARC
2013 Maximum Day Demand (adjusted per observed July 2012 demands)		7,572	7,572	7,572	7,572
H-36	Mu2E	30	--	30	30
J-2790	IARC	300	--	--	300
J-4124	A-0	600	--	600	600
Total Demand (gpm)			**7,572**	**8,202**	**8,502**

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-27	745.1	932.5	81.1	913.6	72.9	913.6	72.9	81.1	72.9	8.2
H-28	743.9	934.1	82.3	915.8	74.4	915.8	74.4	82.3	74.4	7.9
H-29	740.9	916.1	75.8	877.4	59.1	877.4	59.1	75.8	59.1	16.7
H-30	740.9	916.1	75.8	877.4	59.1	877.4	59.1	75.8	59.1	16.7
H-33	741.2	916.1	75.6	877.4	58.9	877.4	58.9	75.6	58.9	16.7
H-34	744.6	916	74.2	875.8	56.8	875.8	56.8	74.2	56.8	17.4
H-35	745.5	916.4	73.9	858.9	49.1	858.9	49.1	73.9	49.1	24.8
H-36	746.6	916.6	73.5	854.1	46.5	854.1	46.5	73.5	46.5	27
H-37	745.9	917.2	74.1	863.3	50.8	863.3	50.8	74.1	50.8	23.3
H-38	746.5	917.9	74.2	874.5	55.4	874.5	55.4	74.2	55.4	18.8
H-39	746.2	918.5	74.6	884.4	59.8	884.4	59.8	74.6	59.8	14.8
H-40	744.4	919	75.5	892	63.8	892	63.8	75.5	63.8	11.7
H-41	744.7	919	75.4	892	63.7	892	63.7	75.4	63.7	11.7
H-42	745	919	75.3	893.6	64.3	893.6	64.3	75.3	64.3	11
H-44	746.2	927.2	78.3	906.3	69.3	906.3	69.3	78.3	69.3	9
H-45	743.8	928.5	79.9	908.2	71.1	908.2	71.1	79.9	71.1	8.8
H-46	742.1	928.5	80.6	908.2	71.9	908.2	71.9	80.6	71.9	8.7
H-49	742.3	935.7	83.7	918.2	76.1	918.2	76.1	83.7	76.1	7.6
H-50	740.1	932.3	83.2	914	75.2	914	75.2	83.2	75.2	8
H-51	749.2	925.8	76.4	904.1	67	904.1	67	76.4	67	9.4
H-52	741	926.8	80.4	905.5	71.2	905.5	71.2	80.4	71.2	9.2
H-53	747.4	931.7	79.8	913.2	71.7	913.2	71.7	79.8	71.7	8.1
H-55	745.7	932.5	80.8	914.4	73	914.4	73	80.8	73	7.8
H-57	742.8	925.9	79.2	909.1	72	909.1	72	79.2	72	7.2
H-58	742.9	929.9	80.9	913.1	73.6	913.1	73.6	80.9	73.6	7.3
H-59	747.1	932.2	80.1	913.9	72.2	913.9	72.2	80.1	72.2	7.9
H-60	747.1	932.2	80.1	913.9	72.2	913.9	72.2	80.1	72.2	7.9
H-61	747.3	931.8	79.8	913.3	71.9	913.3	71.9	79.8	71.9	7.9
H-62	744.5	918.6	75.3	893.4	64.4	893.4	64.4	75.3	64.4	10.9

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-63	743.4	918.1	75.6	893.4	64.9	893.4	64.9	75.6	64.9	10.7
H-64	743.1	919	76.1	894.3	65.4	894.3	65.4	76.1	65.4	10.7
H-65	746.4	920	75.1	895.3	64.4	895.3	64.4	75.1	64.4	10.7
H-66	746	917.2	74.1	891.8	63.1	891.8	63.1	74.1	63.1	11
H-67	744.6	915	73.8	889.9	62.9	889.9	62.9	73.8	62.9	10.9
H-68	748.2	920.5	74.6	896.1	64	896.1	64	74.6	64	10.6
H-72	744.6	927.1	78.9	905.7	69.7	905.7	69.7	78.9	69.7	9.2
H-73	743	928.2	80.1	907.3	71.1	907.3	71.1	80.1	71.1	9
H-74	743.9	930.1	80.6	910.2	72	910.2	72	80.6	72	8.6
H-75	741.1	932	82.6	913.5	74.6	913.5	74.6	82.6	74.6	8
H-76	740.7	932.3	82.9	913.9	75	913.9	75	82.9	75	7.9
H-77	741.6	932.4	82.5	914.1	74.6	914.1	74.6	82.5	74.6	7.9
H-78	741.3	932.3	82.6	914.1	74.7	914.1	74.7	82.6	74.7	7.9
H-79	743	937.7	84.2	920.6	76.8	920.6	76.8	84.2	76.8	7.4
H-80	741	934	83.5	916.2	75.8	916.2	75.8	83.5	75.8	7.7
H-82	746.7	930.9	79.7	912.2	71.6	912.2	71.6	79.7	71.6	8.1
H-83	741.5	938.3	85.1	921.4	77.8	921.4	77.8	85.1	77.8	7.3
H-84	742.1	935.8	83.8	918.5	76.3	918.5	76.3	83.8	76.3	7.5
H-85	747.1	938.1	82.7	921.3	75.4	921.3	75.4	82.7	75.4	7.3
H-86	742.2	938.5	84.9	921.6	77.6	921.6	77.6	84.9	77.6	7.3
H-87	742	952.3	91	938	84.8	938	84.8	91	84.8	6.2
H-88	741.7	940	85.8	923.8	78.8	923.8	78.8	85.8	78.8	7
H-89	741.4	940.5	86.2	924.3	79.1	924.3	79.1	86.2	79.1	7.1
H-90	740.8	940.3	86.3	923.9	79.2	923.9	79.2	86.3	79.2	7.1
H-91	741.7	940	85.8	923.5	78.6	923.5	78.6	85.8	78.6	7.2
H-92	744.8	924.8	77.9	902.3	68.1	902.3	68.1	77.9	68.1	9.8
H-95	747.2	920	74.7	894.1	63.6	894.1	63.6	74.7	63.6	11.1
H-97	743.2	919.1	76.1	891.5	64.2	891.5	64.2	76.1	64.2	11.9
H-98	743.5	919.2	76	891.9	64.2	891.9	64.2	76	64.2	11.8

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-99	744.7	919.4	75.6	892.9	64.1	892.9	64.1	75.6	64.1	11.5
H-100	743.3	919.1	76.1	891.6	64.2	891.6	64.2	76.1	64.2	11.9
H-101	743.1	919.1	76.2	891.6	64.3	891.6	64.3	76.2	64.3	11.9
H-103	745	916.6	74.2	881	58.8	881	58.8	74.2	58.8	15.4
H-105	744	915.5	74.2	875.7	57	875.7	57	74.2	57	17.2
H-107	742.7	916.1	75	877.6	58.3	877.6	58.3	75	58.3	16.7
H-108	742.5	940.6	85.7	924.4	78.7	924.4	78.7	85.7	78.7	7
H-109	742.6	916	75	875.7	57.6	875.7	57.6	75	57.6	17.4
H-111	746.5	916.1	73.4	877.4	56.6	877.4	56.6	73.4	56.6	16.8
H-112	742.1	929	80.9	908.5	72	908.5	72	80.9	72	8.9
H-113	748.1	919.6	74.2	893.6	63	893.6	63	74.2	63	11.2
H-114	741.7	939.6	85.6	923.3	78.6	923.3	78.6	85.6	78.6	7
H-115	742.1	937.5	84.5	921	77.4	921	77.4	84.5	77.4	7.1
H-116	742.4	936.5	84	920	76.8	920	76.8	84	76.8	7.2
H-117	741.2	937.7	85	921.2	77.9	921.2	77.9	85	77.9	7.1
H-119	768.6	927.5	68.8	906.8	59.8	906.8	59.8	68.8	59.8	9
H-121	766.1	925.8	69.1	904.1	59.7	904.1	59.7	69.1	59.7	9.4
H-122	766.5	926	69	904.4	59.7	904.4	59.7	69	59.7	9.3
H-123	750	919.1	73.2	891.6	61.3	891.6	61.3	73.2	61.3	11.9
H-123	770.9	926.4	67.3	905	58	905	58	67.3	58	9.3
H-124	770.6	926.7	67.6	905.5	58.4	905.5	58.4	67.6	58.4	9.2
H-126	767.8	927.5	69.1	906.8	60.1	906.8	60.1	69.1	60.1	9
H-127	768	927	68.8	906	59.7	906	59.7	68.8	59.7	9.1
H-128	768.5	927.4	68.7	906.6	59.7	906.6	59.7	68.7	59.7	9
H-130	764.7	928.1	70.7	907.8	61.9	907.8	61.9	70.7	61.9	8.8
H-131	766.4	926.3	69.2	904.8	59.9	904.8	59.9	69.2	59.9	9.3
H-132	746.8	919.1	74.5	891.6	62.6	891.6	62.6	74.5	62.6	11.9
H-138	743	916.1	74.9	877.4	58.2	877.4	58.2	74.9	58.2	16.7
H-141	745.8	916.1	73.7	877.4	57	877.4	57	73.7	57	16.7

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-142	748.1	916.1	72.7	877.4	56	877.4	56	72.7	56	16.7
H-146	741.5	916.1	75.5	877.4	58.8	877.4	58.8	75.5	58.8	16.7
H-150	740.3	916.1	76	877.4	59.3	877.4	59.3	76	59.3	16.7
H-153	741.5	916.1	75.5	877.4	58.8	877.4	58.8	75.5	58.8	16.7
H-155	741.5	916.1	75.5	877.4	58.8	877.4	58.8	75.5	58.8	16.7
H-158	741.7	916.1	75.4	877.4	58.7	877.4	58.7	75.4	58.7	16.7
H-159	742.4	916.1	75.1	877.4	58.4	877.4	58.4	75.1	58.4	16.7
H-168	745.4	916.1	73.8	877.4	57.1	877.4	57.1	73.8	57.1	16.7
H-179	766	926.9	69.6	905.8	60.5	905.8	60.5	69.6	60.5	9.1
H-190	748.5	930.7	78.8	911.9	70.7	911.9	70.7	78.8	70.7	8.1
H-200	740.3	916.1	76	877.4	59.3	877.4	59.3	76	59.3	16.7
H-205	744	916.1	74.4	877.4	57.7	877.4	57.7	74.4	57.7	16.7
H-209	743.9	919.1	75.8	891.6	63.9	891.6	63.9	75.8	63.9	11.9
H-230	736	919	79.2	893.6	68.2	893.6	68.2	79.2	68.2	11
H-231	740	919	77.5	893.6	66.5	893.6	66.5	77.5	66.5	11
J-10	737.5	953.3	93.4	939.2	87.2	939.2	87.2	93.4	87.2	6.2
J-20	737.5	952.2	92.9	937.8	86.7	937.8	86.7	92.9	86.7	6.2
J-38	750	919.1	73.2	891.6	61.3	891.6	61.3	73.2	61.3	11.9
J-39	748	919.1	74	891.6	62.1	891.6	62.1	74	62.1	11.9
J-40	737.5	953.3	93.4	939.2	87.2	939.2	87.2	93.4	87.2	6.2
J-41	737.5	953.3	93.4	939.2	87.2	939.2	87.2	93.4	87.2	6.2
J-42	737.5	953.3	93.4	939.2	87.2	939.2	87.2	93.4	87.2	6.2
J-43	737.5	961.1	96.7	948.3	91.2	948.3	91.2	96.7	91.2	5.5
J-44	737.5	961.3	96.8	948.5	91.3	948.5	91.3	96.8	91.3	5.5
J-45	737.5	953.3	93.4	939.2	87.2	939.2	87.2	93.4	87.2	6.2
J-46	737.5	959.9	96.2	946.8	90.6	946.8	90.6	96.2	90.6	5.6
J-48	750	919.1	73.2	891.6	61.3	891.6	61.3	73.2	61.3	11.9
J-49	748	919.1	74	891.6	62.1	891.6	62.1	74	62.1	11.9
J-50	738.1	946.9	90.3	931.6	83.7	931.6	83.7	90.3	83.7	6.6

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-51	751	927.2	76.2	906.2	67.1	906.2	67.1	76.2	67.1	9.1
J-53	737.5	954.9	94.1	941	88.1	941	88.1	94.1	88.1	6
J-54	738	947	90.5	931.8	83.9	931.8	83.9	90.5	83.9	6.6
J-55	742	919	76.6	893.6	65.6	893.6	65.6	76.6	65.6	11
J-57	745	919.1	75.3	891.6	63.4	891.6	63.4	75.3	63.4	11.9
J-58	745.2	919.1	75.2	891.6	63.3	891.6	63.3	75.2	63.3	11.9
J-59	745	916.1	74	879.1	58	879.1	58	74	58	16
J-60	737.5	945.9	90.2	930.5	83.5	930.5	83.5	90.2	83.5	6.7
J-65	737.5	946.8	90.6	931.6	84	931.6	84	90.6	84	6.6
J-67(Ptrans)	729.8	953	96.6	938.9	90.5	938.9	90.5	96.6	90.5	6.1
J-68	736.6	952.7	93.5	938.5	87.4	938.5	87.4	93.5	87.4	6.1
J-69	740.2	916.1	76.1	877.4	59.4	877.4	59.4	76.1	59.4	16.7
J-70	732	952.3	95.3	938	89.1	938	89.1	95.3	89.1	6.2
J-71	741.6	916.1	75.5	877.4	58.8	877.4	58.8	75.5	58.8	16.7
J-73	744	919	75.7	892	64	892	64	75.7	64	11.7
J-74	743.9	919.1	75.8	891.6	63.9	891.6	63.9	75.8	63.9	11.9
J-80	737.5	953.1	93.3	938.9	87.1	938.9	87.1	93.3	87.1	6.2
J-90	739.8	944.7	88.7	929.2	81.9	929.2	81.9	88.7	81.9	6.8
J-100	740.6	944.7	88.3	929.2	81.6	929.2	81.6	88.3	81.6	6.7
J-110	742.5	935.3	83.4	918.6	76.2	918.6	76.2	83.4	76.2	7.2
J-120	742.5	934.4	83	917.5	75.7	917.5	75.7	83	75.7	7.3
J-130	743.7	932.3	81.6	915.4	74.3	915.4	74.3	81.6	74.3	7.3
J-140	743.7	929.9	80.5	913.1	73.3	913.1	73.3	80.5	73.3	7.2
J-160	743.8	925.9	78.8	909.1	71.5	909.1	71.5	78.8	71.5	7.3
J-170	743.8	922.8	77.5	906.1	70.2	906.1	70.2	77.5	70.2	7.3
J-190	742	936.5	84.1	919.9	77	919.9	77	84.1	77	7.1
J-210	741.8	942.2	86.7	926	79.7	926	79.7	86.7	79.7	7
J-220	728.5	937.4	90.4	920.9	83.2	920.9	83.2	90.4	83.2	7.2
J-230	743	937.4	84.1	920.9	77	920.9	77	84.1	77	7.1

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-260	741.3	938.4	85.3	922	78.2	922	78.2	85.3	78.2	7.1
J-290	741.4	939.1	85.5	922.8	78.5	922.8	78.5	85.5	78.5	7
J-300	740.9	939.5	85.9	923.2	78.9	923.2	78.9	85.9	78.9	7
J-310	740.9	939.4	85.9	923.2	78.9	923.2	78.9	85.9	78.9	7
J-340	742.3	940.3	85.7	924.1	78.6	924.1	78.6	85.7	78.6	7.1
J-350	742.3	940.3	85.7	924.1	78.6	924.1	78.6	85.7	78.6	7.1
J-350	745	919.1	75.3	891.6	63.4	891.6	63.4	75.3	63.4	11.9
J-360	741.7	940.5	86	924.3	79	924.3	79	86	79	7
J-370	741.7	940	85.8	923.8	78.8	923.8	78.8	85.8	78.8	7
J-400	742.2	940	85.6	923.7	78.5	923.7	78.5	85.6	78.5	7.1
J-420	741	939.6	85.9	923.4	78.9	923.4	78.9	85.9	78.9	7
J-430	741	939.6	85.9	923.4	78.9	923.4	78.9	85.9	78.9	7
J-450	742.7	939.6	85.2	923.3	78.2	923.3	78.2	85.2	78.2	7
J-460	741.9	939.4	85.4	923.2	78.4	923.2	78.4	85.4	78.4	7
J-480	742	938.1	84.8	921.7	77.8	921.7	77.8	84.8	77.8	7
J-490	742	938.1	84.8	921.7	77.7	921.7	77.7	84.8	77.7	7.1
J-520	742.6	937	84.1	920.5	77	920.5	77	84.1	77	7.1
J-530	742.3	936.9	84.2	920.4	77.1	920.4	77.1	84.2	77.1	7.1
J-550	742.3	940.7	85.8	924.5	78.8	924.5	78.8	85.8	78.8	7
J-590	741.5	940.5	86.1	924.3	79.1	924.3	79.1	86.1	79.1	7
J-610	740.5	940.3	86.4	923.9	79.3	923.9	79.3	86.4	79.3	7.1
J-630	741	940	86.1	923.5	79	923.5	79	86.1	79	7.1
J-650	741.2	940	86	923.4	78.8	923.4	78.8	86	78.8	7.2
J-660	743.1	938.8	84.7	921.9	77.4	921.9	77.4	84.7	77.4	7.3
J-670	743.1	938.5	84.5	921.6	77.2	921.6	77.2	84.5	77.2	7.3
J-710	742.8	936.7	83.9	919.4	76.4	919.4	76.4	83.9	76.4	7.5
J-720	742.8	936.7	83.9	919.4	76.4	919.4	76.4	83.9	76.4	7.5
J-730	742.3	935.7	83.7	918.2	76.1	918.2	76.1	83.7	76.1	7.6
J-750	742.3	935.5	83.6	917.9	76	917.9	76	83.6	76	7.6

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:
B/C Schopp/Lt. Williams

Project Number
6-10-23

UIP ECP (If applicable)

Project Phase:
Comment and Compliance

Comment Date:
June 18, 2013

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COMMENT

Drawing Reference:

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

Fire Department is concern with the amount of water being used from the ICW system. We understand there is a study taking place to make sure the ICW system can handle the amount of water needed for this project and still have plenty of water for fire protection.

RESPONSE

Project Contact Response:

Response Incomplete, Additional Information to Follow

Comment:

James Niehoff spoke with Lt. C. Williams and they are fully aware of the on-going ICW system study. Once the study is complete and if the determination is upgrades are needed to the ICW system. In communications with the Fire Department, once the ICW Study and Casey's pump house study is complete, he will present the findings to the Fire Department.

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:
FESS Ops

Project Number: **6-10-23**

UIP ECP (If applicable):

Project Phase:

Comment Date:
June 28, 2013

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COMMENT

Drawing Reference:

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

General:
1. Isolation valves on ICW need to be replaced
. On the ICW modeling, there was no use stated for the Switchyard compressor and RF
3. The ICW water that is currently used for make-up in MI Ponds is through a hydrant from the ICW system. This surface water has been treated with chlorine and therefore has no zebra mussels. The proposed method for providing make-up water to the MI ponds utilizing the one-time pass-thru of ICW from this project will send "un-treated" surface water to the MI Ponds, which will promote zebra mussel infestation to them (where there are little signs of them now)

RESPONSE

Project Contact Response:

Agree and will incorporate comments

Comment:

We will consider your comments and apply appropriately.

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:
David Baird

Project Number
6-10-23

UIP ECP (If applicable)

Project Phase:
Comment and Compliance

Comment Date:
June 25, 2013

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COMMENT

Drawing Reference:

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

I have no comments regarding this project at this time.

In addition, I have signed the ESH&Q Project Design Traveler.

RESPONSE

Project Contact Response:

Thank You for Reviewing this Project

Comment:

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:

Erik Gottschalk

Project Number

No. 6-10-23

UIP ECP (If applicable)

Project Phase:

Comment Date:

May 30, 2013

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COMMENT

Drawing Reference:

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

No comment

RESPONSE

Project Contact Response:

Thank You for Reviewing this Project

Comment:

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:

Mary Convery

Project Number

6-10-23

UIP ECP (If applicable)

Project Phase:

Comment and Compliance

Comment Date:

June 27, 2013

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COMMENT

Drawing Reference:

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

-We have in the org charts Randy Ortgiesen as Project Director instead of Jerry Annala. Jerry is listed on the signoff page, on p32, and in the Responsibility Matrix in appendix B.
(If you want it to be Jerry, we can discuss...)
-p1 Sec 1.1 last line "Mu2e Detector Hall..." -> CrAgree and will incorporate commentsyogenics AIP and Beam Transport AIP.
-p10 Sec 2.1 3rd para Insert "pipe" after "(ICW)"
-Sec 2.1 Energy Saver -> Recycler
-p17 Sec 2.5 FY11 dollars -> FY13?

RESPONSE

Project Contact Response:

Thank You for Reviewing this Project

Comment:

This project plan determines the Project Director

Fermilab

Please ensure that your review included a review of the project for appropriateness of the proposed systems, impacts on existing systems and operations and specific technical requirements to be incorporated into the design

PLEASE ENTER THE FOLLOWING INFORMATION

Reviewer:
Gary Lauten

Project Number
6-10-23

UIP ECP (If applicable)

Project Phase:
Comment and Compliance

Comment Date:
June 3, 2013

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COMMENT

Drawing Reference:
A-2

START WITH PAGE NUMBER FIRST FOLLOWED BY SECTION OR DETAIL REFERENCE. Example: A-1, Detail 4

Specification Reference:

PROVIDE SPECIFICATION SECTION AND PARAGRAPH IF APPLICABLE. Example: 02070 1.5.D.2 (Page 02070-2)

Comment:

The MI-52 addition construction appears to impact the berm, which will impact beam operations. What will be the extent of the excavation and how deep will the excavation need to be? Is the penetration conduit(s) already present, or will excavating be down to the enclosure to install penetrations? What is the "B'Wall structure between the new building addition and enclosure? How long will the berm be excavated, thus impacting beam operations?

RESPONSE

Project Contact Response:

Thank You for Reviewing this Project

Comment:

A one month shutdown of the Main Injector is required to construct the foundations. All penetrations for cabling is existing. The drawings include where the shielding shrtfalls atre present.

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-760	742.5	935.5	83.5	917.9	75.9	917.9	75.9	83.5	75.9	7.6
J-770	740.5	933.1	83.3	915	75.5	915	75.5	83.3	75.5	7.8
J-780	741.3	932.7	82.8	914.6	75	914.6	75	82.8	75	7.8
J-790	741.3	932.7	82.8	914.6	75	914.6	75	82.8	75	7.8
J-800	740.9	932.5	82.9	914.4	75.1	914.4	75.1	82.9	75.1	7.8
J-810	741.8	932.4	82.4	914.3	74.6	914.3	74.6	82.4	74.6	7.8
J-830	740.5	933	83.3	914.8	75.4	914.8	75.4	83.3	75.4	7.9
J-832	743.2	933	82.1	914.8	74.2	914.8	74.2	82.1	74.2	7.9
J-834	742.9	933	82.2	914.8	74.4	914.8	74.4	82.2	74.4	7.8
J-836	745.2	933	81.2	914.8	73.4	914.8	73.4	81.2	73.4	7.8
J-840	740.1	932.3	83.2	914	75.2	914	75.2	83.2	75.2	8
J-860	742.4	931.5	81.8	912.8	73.7	912.8	73.7	81.8	73.7	8.1
J-870	742.9	931.4	81.5	912.7	73.4	912.7	73.4	81.5	73.4	8.1
J-880	745.1	931.4	80.6	912.7	72.5	912.7	72.5	80.6	72.5	8.1
J-910	740.7	931.8	82.7	913.3	74.7	913.3	74.7	82.7	74.7	8
J-940	745.7	931.8	80.5	913.3	72.5	913.3	72.5	80.5	72.5	8
J-950	741.7	932	82.3	913.6	74.4	913.6	74.4	82.3	74.4	7.9
J-960	740	932	83.1	913.6	75.1	913.6	75.1	83.1	75.1	8
J-970	744	932.2	81.4	913.9	73.5	913.9	73.5	81.4	73.5	7.9
J-980	741	932.2	82.7	913.9	74.8	913.9	74.8	82.7	74.8	7.9
J-990	741.3	932.2	82.6	913.9	74.7	913.9	74.7	82.6	74.7	7.9
J-995	741.3	932.2	82.6	913.9	74.7	913.9	74.7	82.6	74.7	7.9
J-1010	741.6	932.2	82.4	913.9	74.5	913.9	74.5	82.4	74.5	7.9
J-1030	743.7	932.2	81.5	913.9	73.6	913.9	73.6	81.5	73.6	7.9
J-1060	743.9	934.1	82.3	915.8	74.4	915.8	74.4	82.3	74.4	7.9
J-1090	744.5	933.9	81.9	915.6	74	915.6	74	81.9	74	7.9
J-1120	744.5	932.8	81.5	914.1	73.4	914.1	73.4	81.5	73.4	8.1
J-1130	741.7	932.5	82.5	913.6	74.4	913.6	74.4	82.5	74.4	8.1
J-1150	740.7	930.1	82	910.2	73.3	910.2	73.3	82	73.3	8.7

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1180	742.7	930.1	81.1	910.2	72.5	910.2	72.5	81.1	72.5	8.6
J-1190	742.8	929.1	80.6	908.8	71.8	908.8	71.8	80.6	71.8	8.8
J-1210	742.8	929.1	80.6	908.7	71.8	908.7	71.8	80.6	71.8	8.8
J-1220	742.8	929	80.5	908.5	71.7	908.5	71.7	80.5	71.7	8.8
J-1227	744.2	927.6	79.4	906.8	70.4	906.8	70.4	79.4	70.4	9
J-1240	745.2	927.4	78.8	906.5	69.8	906.5	69.8	78.8	69.8	9
J-1250	742.8	928.5	80.3	908.2	71.5	908.2	71.5	80.3	71.5	8.8
J-1260	742.1	928.5	80.6	908.2	71.9	908.2	71.9	80.6	71.9	8.7
J-1280	743.9	928.5	79.9	908.2	71.1	908.2	71.1	79.9	71.1	8.8
J-1290	743	928.5	80.2	908.2	71.5	908.2	71.5	80.2	71.5	8.7
J-1300	746	928.5	79	908.2	70.2	908.2	70.2	79	70.2	8.8
J-1310	746.2	928.5	78.9	908.2	70.1	908.2	70.1	78.9	70.1	8.8
J-1320	745.9	928.5	79	908.2	70.2	908.2	70.2	79	70.2	8.8
J-1330	746.2	928.5	78.9	908.2	70.1	908.2	70.1	78.9	70.1	8.8
J-1350	740.4	929.4	81.8	909.5	73.2	909.5	73.2	81.8	73.2	8.6
J-1360	745.3	929.4	79.6	909.5	71.1	909.5	71.1	79.6	71.1	8.5
J-1362	740.4	930.5	82.2	911.3	73.9	911.3	73.9	82.2	73.9	8.3
J-1364	741.4	930.5	81.8	911.3	73.5	911.3	73.5	81.8	73.5	8.3
J-1370	740.9	930.6	82.1	911.5	73.8	911.5	73.8	82.1	73.8	8.3
J-1380	746	930.6	79.9	911.5	71.6	911.5	71.6	79.9	71.6	8.3
J-1390	740.1	938.6	85.9	921.8	78.6	921.8	78.6	85.9	78.6	7.3
J-1400	746	938.5	83.3	921.6	76	921.6	76	83.3	76	7.3
J-1420	746	938.3	83.2	921.5	75.9	921.5	75.9	83.2	75.9	7.3
J-1440	746	938	83.1	921.2	75.8	921.2	75.8	83.1	75.8	7.3
J-1450	746	938.1	83.1	921.3	75.8	921.3	75.8	83.1	75.8	7.3
J-1470	740	938.3	85.8	921.4	78.5	921.4	78.5	85.8	78.5	7.3
J-1490	738.3	936	85.5	918.6	78	918.6	78	85.5	78	7.5
J-1495	739.4	936	85.1	918.6	77.5	918.6	77.5	85.1	77.5	7.6
J-1510	744	935.6	82.9	918.3	75.4	918.3	75.4	82.9	75.4	7.5

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1520	744	935.6	82.9	918.3	75.4	918.3	75.4	82.9	75.4	7.5
J-1530	744	934.3	82.3	916.9	74.8	916.9	74.8	82.3	74.8	7.5
J-1540	740	934.7	84.2	917	76.6	917	76.6	84.2	76.6	7.6
J-1560	739.5	932.8	83.6	914.8	75.9	914.8	75.9	83.6	75.9	7.7
J-1570	739.5	929	82	911	74.2	911	74.2	82	74.2	7.8
J-1580	741	932.4	82.8	914.2	74.9	914.2	74.9	82.8	74.9	7.9
J-1630	740.7	932.3	82.9	913.9	74.9	913.9	74.9	82.9	74.9	8
J-1670	741.4	932.3	82.6	913.9	74.6	913.9	74.6	82.6	74.6	8
J-1690	741.4	932.3	82.6	913.9	74.6	913.9	74.6	82.6	74.6	8
J-1700	742.3	932.2	82.2	913.7	74.2	913.7	74.2	82.2	74.2	8
J-1710	741	932	82.6	913.5	74.6	913.5	74.6	82.6	74.6	8
J-1730	742	931.3	81.9	912.8	73.9	912.8	73.9	81.9	73.9	8
J-1731	740	934.4	84.1	916.7	76.4	916.7	76.4	84.1	76.4	7.7
J-1732	740	934.4	84.1	916.7	76.4	916.7	76.4	84.1	76.4	7.7
J-1738	742	932.3	82.3	914	74.4	914	74.4	82.3	74.4	7.9
J-1760	742.7	932.3	82	914.1	74.1	914.1	74.1	82	74.1	7.9
J-1770	743	932.3	81.9	914.1	74	914.1	74	81.9	74	7.9
J-1780	744	930.9	80.9	912.2	72.8	912.2	72.8	80.9	72.8	8.1
J-1784	746	930.9	80	912.3	71.9	912.3	71.9	80	71.9	8.1
J-1786	747	930.8	79.5	912.1	71.5	912.1	71.5	79.5	71.5	8
J-1790	753.5	928.1	75.6	907.8	66.8	907.8	66.8	75.6	66.8	8.8
J-1792	748.1	930.7	79	911.9	70.9	911.9	70.9	79	70.9	8.1
J-1795	764.9	927.9	70.5	907.4	61.7	907.4	61.7	70.5	61.7	8.8
J-1796	747.3	930.3	79.2	911.3	71	911.3	71	79.2	71	8.2
J-1798	748	930.3	78.9	911.3	70.7	911.3	70.7	78.9	70.7	8.2
J-1800	752.9	928.1	75.8	907.8	67	907.8	67	75.8	67	8.8
J-1820	753.5	928.1	75.6	907.8	66.8	907.8	66.8	75.6	66.8	8.8
J-1830	760.6	927.5	72.2	906.8	63.3	906.8	63.3	72.2	63.3	8.9
J-1840	759.6	927.5	72.7	906.8	63.7	906.8	63.7	72.7	63.7	9

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1850	767.8	927.5	69.1	906.8	60.1	906.8	60.1	69.1	60.1	9
J-1870	759	927.5	72.9	906.8	64	906.8	64	72.9	64	8.9
J-1890	759.5	927.4	72.6	906.6	63.6	906.6	63.6	72.6	63.6	9
J-1920	761.4	927.1	71.7	906.1	62.6	906.1	62.6	71.7	62.6	9.1
J-1930	761.4	927.1	71.7	906.1	62.6	906.1	62.6	71.7	62.6	9.1
J-1940	761.5	927	71.6	906	62.5	906	62.5	71.6	62.5	9.1
J-1980	763.9	926.4	70.3	905	61	905	61	70.3	61	9.3
J-1990	763.9	926.4	70.3	905	61	905	61	70.3	61	9.3
J-2000	762.9	926.4	70.7	905	61.5	905	61.5	70.7	61.5	9.2
J-2040	762.6	926.2	70.8	904.7	61.5	904.7	61.5	70.8	61.5	9.3
J-2060	763.3	926	70.4	904.4	61	904.4	61	70.4	61	9.4
J-2100	758.1	925.6	72.5	903.7	63	903.7	63	72.5	63	9.5
J-2110	761	925.6	71.2	903.7	61.7	903.7	61.7	71.2	61.7	9.5
J-2120	758.1	925.6	72.5	903.7	63	903.7	63	72.5	63	9.5
J-2130	758.2	926.3	72.7	904.8	63.4	904.8	63.4	72.7	63.4	9.3
J-2140	760.1	926.9	72.2	905.8	63	905.8	63	72.2	63	9.2
J-2145	766	926.9	69.6	905.8	60.5	905.8	60.5	69.6	60.5	9.1
J-2150	744.6	927.1	78.9	905.7	69.7	905.7	69.7	78.9	69.7	9.2
J-2160	753.3	924.3	74	901.6	64.2	901.6	64.2	74	64.2	9.8
J-2180	751.3	923.6	74.5	900.5	64.6	900.5	64.6	74.5	64.6	9.9
J-2220	745	923.2	77.1	899.8	67	899.8	67	77.1	67	10.1
J-2240	744.5	922.8	77.1	899.2	66.9	899.2	66.9	77.1	66.9	10.2
J-2250	743	922.8	77.8	899.2	67.6	899.2	67.6	77.8	67.6	10.2
J-2260	745	924.8	77.8	902.3	68.1	902.3	68.1	77.8	68.1	9.7
J-2280	745	924.9	77.8	902.5	68.1	902.5	68.1	77.8	68.1	9.7
J-2290	745	924.9	77.8	902.5	68.1	902.5	68.1	77.8	68.1	9.7
J-2300	743.8	927.1	79.3	905.7	70	905.7	70	79.3	70	9.3
J-2320	744.3	928.2	79.6	907.3	70.5	907.3	70.5	79.6	70.5	9.1
J-2350	745.2	928.2	79.2	907.3	70.1	907.3	70.1	79.2	70.1	9.1

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Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-2360	746.2	927.2	78.3	906.3	69.3	906.3	69.3	78.3	69.3	9
J-2380	749.2	925.8	76.4	904.1	67	904.1	67	76.4	67	9.4
J-2400	750.5	925	75.5	903	66	903	66	75.5	66	9.5
J-2412	751	927.2	76.2	906.2	67.1	906.2	67.1	76.2	67.1	9.1
J-2420	742	923	78.3	900	68.4	900	68.4	78.3	68.4	9.9
J-2430	743	921.8	77.3	898.1	67.1	898.1	67.1	77.3	67.1	10.2
J-2440	746	921	75.7	897.4	65.5	897.4	65.5	75.7	65.5	10.2
J-2460	746	920.9	75.7	897.2	65.4	897.2	65.4	75.7	65.4	10.3
J-2470	748	920.9	74.8	896.7	64.3	896.7	64.3	74.8	64.3	10.5
J-2480	746.3	922.1	76.1	898.4	65.8	898.4	65.8	76.1	65.8	10.3
J-2490	742	922.1	77.9	898.4	67.7	898.4	67.7	77.9	67.7	10.2
J-2530	743.8	922.1	77.2	898.4	66.9	898.4	66.9	77.2	66.9	10.3
J-2540	744	919	75.7	894.4	65.1	894.4	65.1	75.7	65.1	10.6
J-2570	743	918.9	76.1	894.3	65.4	894.3	65.4	76.1	65.4	10.7
J-2580	742	919	76.6	894.3	65.9	894.3	65.9	76.6	65.9	10.7
J-2610	745	917.7	74.7	893	64	893	64	74.7	64	10.7
J-2620	743	918.8	76	893.8	65.3	893.8	65.3	76	65.3	10.7
J-2630	743	918.8	76	893.8	65.3	893.8	65.3	76	65.3	10.7
J-2640	744	918.5	75.5	893.4	64.6	893.4	64.6	75.5	64.6	10.9
J-2650	746	915.1	73.1	889.9	62.3	889.9	62.3	73.1	62.3	10.8
J-2660	746	913.8	72.6	888.7	61.7	888.7	61.7	72.6	61.7	10.9
J-2670	746	915	73.1	889.9	62.3	889.9	62.3	73.1	62.3	10.8
J-2690	746	915	73.1	889.8	62.2	889.8	62.2	73.1	62.2	10.9
J-2700	743	918.7	76	893.4	65.1	893.4	65.1	76	65.1	10.9
J-2730	744	918.5	75.5	893.3	64.6	893.3	64.6	75.5	64.6	10.9
J-2740	745	919	75.3	893.6	64.3	893.6	64.3	75.3	64.3	11
J-2750	743	919	76.2	893.6	65.2	893.6	65.2	76.2	65.2	11
J-2770	741.2	919	76.9	893.6	65.9	893.6	65.9	76.9	65.9	11
J-2780	746	919.1	74.9	893.6	63.9	893.6	63.9	74.9	63.9	11

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Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-2790	744	919.1	75.7	893.6	64.7	893.6	64.7	75.7	64.7	11
J-2790add.	744	919.1	75.7	893.6	64.7	893.6	64.7	75.7	64.7	11
J-2790add2	743	919.1	76.2	893.6	65.2	893.6	65.2	76.2	65.2	11
J-2820	744	919.1	75.8	893.6	64.7	893.6	64.7	75.8	64.7	11.1
J-2830	744	917.2	75	891.8	63.9	891.8	63.9	75	63.9	11.1
J-2850	746	913.9	72.6	888.4	61.6	888.4	61.6	72.6	61.6	11
J-2860	740.2	919.5	77.6	894.1	66.6	894.1	66.6	77.6	66.6	11
J-2870	748	920	74.4	895.3	63.7	895.3	63.7	74.4	63.7	10.7
J-2890	748	920.1	74.4	895.4	63.8	895.4	63.8	74.4	63.8	10.6
J-2900 (alt. p trans)	753	918.3	71.5	893.7	60.9	893.7	60.9	71.5	60.9	10.6
J-2900vsp	744.7	918.3	75.1	893.7	64.5	893.7	64.5	75.1	64.5	10.6
J-2930	750	922.5	74.6	898.7	64.3	898.7	64.3	74.6	64.3	10.3
J-2940	746	922.5	76.4	898.7	66	898.7	66	76.4	66	10.4
J-2950	740.4	921.3	78.3	896.6	67.6	896.6	67.6	78.3	67.6	10.7
J-2960	744.7	921.3	76.4	896.6	65.7	896.6	65.7	76.4	65.7	10.7
J-2970	745	921.3	76.3	896.6	65.6	896.6	65.6	76.3	65.6	10.7
J-2980	740.6	921.3	78.2	896.6	67.5	896.6	67.5	78.2	67.5	10.7
J-2990	741.5	920	77.2	894.2	66	894.2	66	77.2	66	11.2
J-3020	741.8	919.6	76.9	894	65.8	894	65.8	76.9	65.8	11.1
J-3030	740.4	919.5	77.5	894.1	66.5	894.1	66.5	77.5	66.5	11
J-3040	743.1	919.5	76.3	894.1	65.3	894.1	65.3	76.3	65.3	11
J-3050	744.1	918.8	75.6	890.3	63.2	890.3	63.2	75.6	63.2	12.4
J-3060	745	918.8	75.2	890.4	62.9	890.4	62.9	75.2	62.9	12.3
J-3070	743.8	918.8	75.7	890.4	63.4	890.4	63.4	75.7	63.4	12.3
J-3075	744.2	918.8	75.6	890.5	63.3	890.5	63.3	75.6	63.3	12.3
J-3080	744	918.8	75.6	890.4	63.3	890.4	63.3	75.6	63.3	12.3
J-3100	744	918.7	75.6	890.4	63.3	890.4	63.3	75.6	63.3	12.3
J-3110	744.2	918.9	75.6	890.5	63.3	890.5	63.3	75.6	63.3	12.3
J-3120	744	918.9	75.7	890.5	63.4	890.5	63.4	75.7	63.4	12.3

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Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-3130	744.2	918.9	75.6	890.6	63.3	890.6	63.3	75.6	63.3	12.3
J-3140	744	918.9	75.7	890.6	63.4	890.6	63.4	75.7	63.4	12.3
J-3190	744.2	918.9	75.6	890.7	63.4	890.7	63.4	75.6	63.4	12.2
J-3200	744.2	918.9	75.6	890.7	63.4	890.7	63.4	75.6	63.4	12.2
J-3210	744	919	75.7	891.2	63.7	891.2	63.7	75.7	63.7	12
J-3220	744.8	919	75.4	891.2	63.3	891.2	63.3	75.4	63.3	12.1
J-3225	744	919.1	75.7	891.5	63.8	891.5	63.8	75.7	63.8	11.9
J-3240	744	919.1	75.7	891.5	63.8	891.5	63.8	75.7	63.8	11.9
J-3250	743.5	919.1	76	891.5	64	891.5	64	76	64	12
J-3260	743.5	919.1	76	891.6	64.1	891.6	64.1	76	64.1	11.9
J-3270	743	919.1	76.2	891.6	64.3	891.6	64.3	76.2	64.3	11.9
J-3280	742.8	919.1	76.3	891.6	64.4	891.6	64.4	76.3	64.4	11.9
J-3290	742.8	919.1	76.3	891.6	64.4	891.6	64.4	76.3	64.4	11.9
J-3320	743.5	919.1	76	891.6	64.1	891.6	64.1	76	64.1	11.9
J-3340	745.4	919.2	75.2	891.9	63.4	891.9	63.4	75.2	63.4	11.8
J-3352	740.1	919.3	77.5	892.4	65.9	892.4	65.9	77.5	65.9	11.6
J-3354	740.1	919.3	77.5	892.4	65.9	892.4	65.9	77.5	65.9	11.6
J-3356	740.1	919.3	77.5	892.6	66	892.6	66	77.5	66	11.5
J-3358	740.1	919.3	77.5	892.6	66	892.6	66	77.5	66	11.5
J-3380	741.8	919.4	76.8	893	65.4	893	65.4	76.8	65.4	11.4
J-3390	740.5	919.4	77.4	893	66	893	66	77.4	66	11.4
J-3400	741.8	919.6	76.9	893.6	65.7	893.6	65.7	76.9	65.7	11.2
J-3420	744	918.2	75.4	887.7	62.2	887.7	62.2	75.4	62.2	13.2
J-3427	750	919.1	73.2	891.6	61.3	891.6	61.3	73.2	61.3	11.9
J-3450	747	919.1	74.5	891.6	62.5	891.6	62.5	74.5	62.5	12
J-3460	747	919.1	74.5	891.6	62.5	891.6	62.5	74.5	62.5	12
J-3480	743.6	917.8	75.4	885.9	61.6	885.9	61.6	75.4	61.6	13.8
J-3490	743.9	917.8	75.2	885.9	61.5	885.9	61.5	75.2	61.5	13.7
J-3500	743.4	916.6	74.9	881	59.5	881	59.5	74.9	59.5	15.4

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With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-3508	745	915.9	73.9	878.9	57.9	878.9	57.9	73.9	57.9	16
J-3515	745	916.4	74.1	880.1	58.5	880.1	58.5	74.1	58.5	15.6
J-3520	745.3	916.1	73.9	878.5	57.6	878.5	57.6	73.9	57.6	16.3
J-3530	742	916.1	75.3	878.5	59	878.5	59	75.3	59	16.3
J-3540	742.3	916.1	75.2	878.5	58.9	878.5	58.9	75.2	58.9	16.3
J-3550	738.9	916.1	76.7	878.5	60.4	878.5	60.4	76.7	60.4	16.3
J-3560	744.5	916.1	74.2	877.6	57.6	877.6	57.6	74.2	57.6	16.6
J-3570	745.2	916	73.9	876.2	56.7	876.2	56.7	73.9	56.7	17.2
J-3600	742.6	915.4	74.8	875.6	57.5	875.6	57.5	74.8	57.5	17.3
J-3610	741.9	916	75.3	875.8	57.9	875.8	57.9	75.3	57.9	17.4
J-3620	744.4	916	74.2	875.8	56.8	875.8	56.8	74.2	56.8	17.4
J-3640	744.1	916	74.4	875.8	57	875.8	57	74.4	57	17.4
J-3650	741.9	916	75.3	875.7	57.9	875.7	57.9	75.3	57.9	17.4
J-3680	743	916	74.8	875.7	57.4	875.7	57.4	74.8	57.4	17.4
J-3690	742	916.1	75.3	877.6	58.7	877.6	58.7	75.3	58.7	16.6
J-3720	743	916.1	74.9	877.6	58.2	877.6	58.2	74.9	58.2	16.7
J-3730	743	916.1	74.9	877.5	58.2	877.5	58.2	74.9	58.2	16.7
J-3740	740.5	916.1	76	877.5	59.3	877.5	59.3	76	59.3	16.7
J-3750	743	916.1	74.9	877.5	58.2	877.5	58.2	74.9	58.2	16.7
J-3755	743	916.1	74.9	877.4	58.2	877.4	58.2	74.9	58.2	16.7
J-3760	743.8	916.1	74.5	877.4	57.8	877.4	57.8	74.5	57.8	16.7
J-3770	740.5	916.1	76	877.4	59.2	877.4	59.2	76	59.2	16.8
J-3920	743	919	76.1	892	64.4	892	64.4	76.1	64.4	11.7
J-3930	744	919	75.7	892	64	892	64	75.7	64	11.7
J-3940	743	919	76.1	892	64.4	892	64.4	76.1	64.4	11.7
J-3950	743	919	76.1	892	64.4	892	64.4	76.1	64.4	11.7
J-3960	744	919	75.7	892	64	892	64	75.7	64	11.7
J-4122	743.7	916.5	74.8	852.7	47.2	852.7	47.2	74.8	47.2	27.6
J-4124	743.7	916.5	74.8	847.3	44.9	847.3	44.9	74.8	44.9	29.9

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With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-4140	743.9	916	74.5	875.2	56.8	875.2	56.8	74.5	56.8	17.7
J-4170	742.8	916	75	877.1	58.1	877.1	58.1	75	58.1	16.9
J-4180	744.9	916	74	877.1	57.2	877.1	57.2	74	57.2	16.8
J-4190	742.7	916	75	877.2	58.2	877.2	58.2	75	58.2	16.8
J-4200	744.9	916	74	877.2	57.2	877.2	57.2	74	57.2	16.8
J-4210	741.9	916.1	75.3	877.4	58.6	877.4	58.6	75.3	58.6	16.7
J-4240	740.7	916.1	75.9	877.4	59.1	877.4	59.1	75.9	59.1	16.8
J-4280	741.1	916.1	75.7	877.4	59	877.4	59	75.7	59	16.7
J-4287	741.1	916.1	75.7	877.4	59	877.4	59	75.7	59	16.7
J-4410 (P-Trans)	737.5	959.1	95.9	946	90.2	946	90.2	95.9	90.2	5.7
J-5005	743.6	916.1	74.6	877.4	57.9	877.4	57.9	74.6	57.9	16.7
J-5015	743.2	916.1	74.8	877.4	58.1	877.4	58.1	74.8	58.1	16.7
J-5020	742.1	916.1	75.3	877.4	58.5	877.4	58.5	75.3	58.5	16.8
J-5025	745	916.1	74	877.4	57.3	877.4	57.3	74	57.3	16.7
J-5030	744.8	916.1	74.1	877.4	57.4	877.4	57.4	74.1	57.4	16.7
J-5040	742	916.1	75.3	877.4	58.6	877.4	58.6	75.3	58.6	16.7
J-5070	743.3	916.1	74.8	877.4	58.1	877.4	58.1	74.8	58.1	16.7
J-5075	744	916.1	74.4	877.4	57.7	877.4	57.7	74.4	57.7	16.7
J-5100	745	919	75.3	893.6	64.3	893.6	64.3	75.3	64.3	11
J-5105	744.5	919	75.5	893.6	64.5	893.6	64.5	75.5	64.5	11
J-5125	742	919	76.6	893.6	65.6	893.6	65.6	76.6	65.6	11
J-5130	741	919	77	893.6	66	893.6	66	77	66	11
J-5135	741	919	77	893.6	66	893.6	66	77	66	11
J-5140	741	919	77	893.6	66	893.6	66	77	66	11
J-5142	744	919	75.7	893.6	64.7	893.6	64.7	75.7	64.7	11
J-5145	742	919	76.6	893.6	65.6	893.6	65.6	76.6	65.6	11
J-5150	742	919	76.6	893.6	65.6	893.6	65.6	76.6	65.6	11
J-5155	744.5	919	75.5	893.6	64.5	893.6	64.5	75.5	64.5	11
J-5165	742	919	76.6	893.6	65.6	893.6	65.6	76.6	65.6	11

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5167	746	921	75.7	897.3	65.5	897.3	65.5	75.7	65.5	10.2
J-5171	745.1	916.1	73.9	877.4	57.2	877.4	57.2	73.9	57.2	16.7
J-5177	747	919.1	74.5	891.6	62.5	891.6	62.5	74.5	62.5	12
J-5178	743	916.1	74.9	879.1	58.9	879.1	58.9	74.9	58.9	16
J-5179	743	916.1	74.9	879.1	58.9	879.1	58.9	74.9	58.9	16
J-5188	744	918.5	75.5	893.3	64.6	893.3	64.6	75.5	64.6	10.9
J-5189	746	915	73.1	889.8	62.2	889.8	62.2	73.1	62.2	10.9
J-5194	743.1	938.6	84.6	921.7	77.3	921.7	77.3	84.6	77.3	7.3
J-5196	745.3	916.1	73.9	877.4	57.2	877.4	57.2	73.9	57.2	16.7
J-5197	740	916.1	76.2	877.4	59.5	877.4	59.5	76.2	59.5	16.7
J-5198	741.3	916.1	75.6	877.4	58.9	877.4	58.9	75.6	58.9	16.7
J-5199	747.5	916.1	72.9	877.4	56.2	877.4	56.2	72.9	56.2	16.7
J-5200	747	916.1	73.1	877.4	56.4	877.4	56.4	73.1	56.4	16.7
J-5201	739	916.1	76.6	877.4	59.9	877.4	59.9	76.6	59.9	16.7
J-5202	739	916.1	76.6	877.4	59.9	877.4	59.9	76.6	59.9	16.7
J-5203	739	916.1	76.6	877.4	59.9	877.4	59.9	76.6	59.9	16.7
J-5204	739	916.1	76.6	877.4	59.9	877.4	59.9	76.6	59.9	16.7
J-5205	740.3	916.1	76	877.4	59.3	877.4	59.3	76	59.3	16.7
J-5206	740.3	916.1	76	877.4	59.3	877.4	59.3	76	59.3	16.7
J-5207	739.5	916.1	76.4	877.4	59.7	877.4	59.7	76.4	59.7	16.7
J-5208	738.5	916.1	76.8	877.4	60.1	877.4	60.1	76.8	60.1	16.7
J-5209	739.5	916.1	76.4	877.4	59.7	877.4	59.7	76.4	59.7	16.7
J-5210	739.5	916.1	76.4	877.4	59.7	877.4	59.7	76.4	59.7	16.7
J-5214	742.5	916.1	75.1	877.4	58.4	877.4	58.4	75.1	58.4	16.7
J-5217	746	916.1	73.6	877.4	56.9	877.4	56.9	73.6	56.9	16.7
J-5217	745.5	916.1	73.8	877.4	57.1	877.4	57.1	73.8	57.1	16.7
J-5218	742	916.1	75.3	877.4	58.6	877.4	58.6	75.3	58.6	16.7
J-5219	746	916.1	73.6	877.4	56.9	877.4	56.9	73.6	56.9	16.7
J-5221	742	916.1	75.3	877.4	58.6	877.4	58.6	75.3	58.6	16.7

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With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5223	741	916.1	75.7	877.4	59	877.4	59	75.7	59	16.7
J-5223	743	919	76.1	894.3	65.5	894.3	65.5	76.1	65.5	10.6
J-5224	743	919	76.1	894.3	65.5	894.3	65.5	76.1	65.5	10.6
J-5225	741.5	919	76.8	893.6	65.8	893.6	65.8	76.8	65.8	11
J-5226	741.5	919	76.8	893.6	65.8	893.6	65.8	76.8	65.8	11
J-5227	741.5	919	76.8	893.6	65.8	893.6	65.8	76.8	65.8	11
J-5228	741	919	77	893.6	66	893.6	66	77	66	11
J-5230	738.5	916.1	76.8	877.4	60.1	877.4	60.1	76.8	60.1	16.7
J-5231	739	916.1	76.6	877.4	59.9	877.4	59.9	76.6	59.9	16.7
J-5232	743	916.1	74.9	877.4	58.2	877.4	58.2	74.9	58.2	16.7
J-5233	743	916.1	74.9	877.4	58.2	877.4	58.2	74.9	58.2	16.7
J-5234	744	928.9	80	908.4	71.1	908.4	71.1	80	71.1	8.9
J-5234	743	916.1	74.9	877.4	58.2	877.4	58.2	74.9	58.2	16.7
J-5235	746	916.1	73.6	877.4	56.9	877.4	56.9	73.6	56.9	16.7
J-5237	743	919.1	76.2	891.6	64.3	891.6	64.3	76.2	64.3	11.9
J-5238	743	919.1	76.2	891.6	64.3	891.6	64.3	76.2	64.3	11.9
J-5239	743	919.1	76.2	891.6	64.3	891.6	64.3	76.2	64.3	11.9
J-5240	743.9	932.6	81.6	915.7	74.3	915.7	74.3	81.6	74.3	7.3
J-5241	739.8	937.4	85.5	921.1	78.4	921.1	78.4	85.5	78.4	7.1
J-5242	738	925.2	81	908.5	73.8	908.5	73.8	81	73.8	7.2
J-5243	736	925.9	82.2	909.3	75	909.3	75	82.2	75	7.2
J-5244	745.4	918.6	75	893.4	64.1	893.4	64.1	75	64.1	10.9
J-5246	744.8	916	74.1	877.1	57.2	877.1	57.2	74.1	57.2	16.9
J-5247	746.6	916	73.3	875.9	55.9	875.9	55.9	73.3	55.9	17.4
J-5257	737.1	945.7	90.2	930.2	83.5	930.2	83.5	90.2	83.5	6.7
J-5258	738.3	946.4	90	931.1	83.4	931.1	83.4	90	83.4	6.6
J-5260	742	940.4	85.8	924	78.8	924	78.8	85.8	78.8	7
J-5261	744.4	932.7	81.5	914.7	73.7	914.7	73.7	81.5	73.7	7.8
J-5262	741.4	931	82	911.4	73.6	911.4	73.6	82	73.6	8.4

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With Casey's pumps on only:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5263	753	922.8	73.5	899.2	63.3	899.2	63.3	73.5	63.3	10.2
J-5264	740.7	945.1	88.5	929.6	81.7	929.6	81.7	88.5	81.7	6.8
J-5266	742.2	939.8	85.5	923.5	78.5	923.5	78.5	85.5	78.5	7
J-5271	740.3	944.7	88.4	929.1	81.7	929.1	81.7	88.4	81.7	6.7
J-5276	743.6	932.9	81.9	915.1	74.2	915.1	74.2	81.9	74.2	7.7
J-5281	739.9	916.1	76.2	877.4	59.5	877.4	59.5	76.2	59.5	16.7
J-5282	743.1	916.1	74.8	877.4	58.1	877.4	58.1	74.8	58.1	16.7
J-5284	746	916.1	73.6	877.6	56.9	877.6	56.9	73.6	56.9	16.7
J-5291	748	932.2	79.7	913.9	71.8	913.9	71.8	79.7	71.8	7.9
J-5296	746	917.3	74.1	864.8	51.4	864.8	51.4	74.1	51.4	22.7
J-5301	745	919.1	75.3	891.6	63.4	891.6	63.4	75.3	63.4	11.9
J-5302	745	919.1	75.3	891.6	63.4	891.6	63.4	75.3	63.4	11.9
J-5303	746.2	919.1	74.8	891.6	62.9	891.6	62.9	74.8	62.9	11.9
J-5306	746	919.1	74.9	893.6	63.9	893.6	63.9	74.9	63.9	11.0
J-5307	746	919.1	74.9	893.6	63.9	893.6	63.9	74.9	63.9	11.0
J-5308	746	919.1	74.9	893.6	63.9	893.6	63.9	74.9	63.9	11.0
J-5309	745	919.1	75.3	893.6	64.3	893.6	64.3	75.3	64.3	11.0
J-5310	747	919.1	74.4	893.6	63.4	893.6	63.4	74.4	63.4	11.0
J-5311	746.5	919.1	74.7	893.6	63.7	893.6	63.7	74.7	63.7	11.0
J-5313	745	917.8	74.7	893.1	64.1	893.1	64.1	74.7	64.1	10.6
J-5314	743.7	916.5	74.8	849	45.6	849	45.6	74.8	45.6	29.2
J-5315	742.6	919.1	76.4	891.6	64.5	891.6	64.5	76.4	64.5	11.9

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With Casey's pumps on only:

			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
H-27	1,000	20	TRUE	2,333	20	TRUE	2,097	20	TRUE	1,939	21.7	2,333	1,939	394
H-28	1,000	20	TRUE	3,309	20	TRUE	2,391	35.8	TRUE	2,004	40.9	3,309	2,004	1305
H-29	1,000	20	FALSE	939	20	FALSE	712	20	FALSE	650	20.1	939	650	289
H-30	1,000	20	TRUE	1,105	20	FALSE	812	20	FALSE	738	20.1	1,105	738	367
H-33	1,000	20	TRUE	1,461	20	FALSE	956	23.7	FALSE	812	26.1	1,461	812	649
H-34	1,000	20	TRUE	1,301	20	FALSE	893	20	FALSE	774	21.8	1,301	774	527
H-35	1,000	20	TRUE	1,186	20	FALSE	536	22.7	FALSE	459	22.9	1,186	459	727
H-36	1,000	20	TRUE	1,076	20	FALSE	483	20.8	FALSE	413	20.9	1,076	413	663
H-37	1,000	20	FALSE	981	20	FALSE	530	20.4	FALSE	455	21.1	981	455	526
H-38	1,000	20	FALSE	999	20	FALSE	621	20	FALSE	538	20.9	999	538	461
H-39	1,000	20	TRUE	1,174	20	FALSE	801	20.7	FALSE	700	21.3	1,174	700	474
H-40	1,000	20	TRUE	1,325	20	TRUE	1,059	20.1	FALSE	967	20.1	1,325	967	358
H-41	1,000	20	FALSE	825	20	FALSE	703	20	FALSE	649	20.1	825	649	176
H-42	1,000	20	TRUE	1,328	20	TRUE	1,154	20	TRUE	1,055	20	1,328	1,055	273
H-44	1,000	20	TRUE	2,877	20	TRUE	2,066	32.4	TRUE	1,727	36.3	2,877	1,727	1150
H-45	1,000	20	TRUE	1,905	20	TRUE	1,696	20	TRUE	1,591	20	1,905	1,591	314
H-46	1,000	20	TRUE	2,618	20	TRUE	2,122	26.3	TRUE	1,776	32.7	2,618	1,776	842
H-49	1,000	20	TRUE	2,608	20	TRUE	2,370	20	TRUE	2,061	27.6	2,608	2,061	547
H-50	1,000	20	TRUE	2,412	20	TRUE	2,180	20	TRUE	1,978	23.8	2,412	1,978	434
H-51	1,000	20	TRUE	1,829	20	TRUE	1,605	20	TRUE	1,490	20	1,829	1,490	339
H-52	1,000	20	TRUE	2,462	20	TRUE	2,042	24.5	TRUE	1,696	31.6	2,462	1,696	766
H-53	1,000	20	TRUE	3,828	22	TRUE	2,318	41.8	TRUE	1,948	43.9	3,828	1,948	1880
H-55	1,000	20	TRUE	1,760	20	TRUE	1,604	20	TRUE	1,524	20	1,760	1,524	236
H-57	1,000	20	TRUE	1,816	20	TRUE	1,663	20	TRUE	1,586	20	1,816	1,586	230
H-58	1,000	20	TRUE	2,174	20	TRUE	1,984	20	TRUE	1,889	20	2,174	1,889	285
H-59	1,000	20	TRUE	1,913	20	TRUE	1,731	20	TRUE	1,638	20	1,913	1,638	275
H-60	1,000	20	TRUE	2,035	20	TRUE	1,835	20	TRUE	1,735	20	2,035	1,735	300
H-61	1,000	20	TRUE	1,789	20	TRUE	1,620	20	TRUE	1,534	20	1,789	1,534	255
H-62	1,000	20	TRUE	2,054	20	TRUE	1,730	20	TRUE	1,442	24.7	2,054	1,442	612
H-63	1,000	20	TRUE	1,370	21	TRUE	1,184	20.9	TRUE	1,082	20.9	1,370	1,082	288
H-64	1,000	20	TRUE	1,785	20	TRUE	1,534	20	TRUE	1,398	20	1,785	1,398	387
H-65	1,000	20	TRUE	1,639	20	TRUE	1,415	20	TRUE	1,297	20	1,639	1,297	342
H-66	1,000	20	TRUE	1,705	20	TRUE	1,442	20	TRUE	1,300	20	1,705	1,300	405
H-67	1,000	20	TRUE	1,227	20	TRUE	1,055	20	FALSE	959	20	1,227	959	268
H-68	1,000	20	TRUE	3,056	23	TRUE	1,803	38.4	TRUE	1,494	38.7	3,056	1,494	1562

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With Casey's pumps on only:

			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
H-72	1,000	20	TRUE	1,582	20	TRUE	1,411	20	TRUE	1,323	20	1,582	1,323	259
H-73	1,000	20	TRUE	1,544	21	TRUE	1,386	21	TRUE	1,304	21	1,544	1,304	240
H-74	1,000	20	TRUE	1,359	20	TRUE	1,236	20	TRUE	1,172	20	1,359	1,172	187
H-75	1,000	20	TRUE	2,715	20	TRUE	2,393	21.6	TRUE	1,999	30.6	2,715	1,999	716
H-76	1,000	20	TRUE	3,221	20	TRUE	2,411	33.7	TRUE	2,015	39.6	3,221	2,015	1206
H-77	1,000	20	TRUE	3,514	20	TRUE	2,422	38	TRUE	2,027	42.7	3,514	2,027	1487
H-78	1,000	20	TRUE	3,635	21	TRUE	2,403	40.2	TRUE	2,017	44	3,635	2,017	1618
H-79	1,000	20	TRUE	4,094	33	TRUE	2,555	49.8	TRUE	2,142	52	4,094	2,142	1952
H-80	1,000	20	TRUE	3,742	27	TRUE	2,465	43.3	TRUE	2,067	46.6	3,742	2,067	1675
H-82	1,000	20	TRUE	2,055	20	TRUE	1,837	20	TRUE	1,731	20	2,055	1,731	324
H-83	1,000	20	TRUE	3,787	20	TRUE	2,595	40.6	TRUE	2,176	45.7	3,787	2,176	1611
H-84	1,000	20	TRUE	3,392	22	TRUE	2,523	35.2	TRUE	2,117	40.9	3,392	2,117	1275
H-85	1,000	20	TRUE	1,571	20	TRUE	1,452	20	TRUE	1,391	20	1,571	1,391	180
H-86	1,000	20	TRUE	1,736	20	TRUE	1,608	20	TRUE	1,543	20	1,736	1,543	193
H-87	1,000	20	TRUE	1,790	20	TRUE	1,692	20	TRUE	1,642	20	1,790	1,642	148
H-88	1,000	20	TRUE	3,347	20	TRUE	2,710	31.2	TRUE	2,270	39.6	3,347	2,270	1077
H-89	1,000	20	TRUE	2,553	20	TRUE	2,358	20	TRUE	2,260	20	2,553	2,260	293
H-90	1,000	20	TRUE	2,594	20	TRUE	2,393	20	TRUE	2,246	22	2,594	2,246	348
H-91	1,000	20	TRUE	3,030	20	TRUE	2,660	24.2	TRUE	2,229	34.6	3,030	2,229	801
H-92	1,000	20	TRUE	2,420	20	TRUE	1,928	25.8	TRUE	1,606	31.2	2,420	1,606	814
H-95	1,000	20	TRUE	2,848	20	TRUE	1,657	37	TRUE	1,379	37.6	2,848	1,379	1469
H-97	1,000	20	TRUE	1,806	20	TRUE	1,480	20	TRUE	1,240	25.4	1,806	1,240	566
H-98	1,000	20	TRUE	1,906	20	TRUE	1,501	22.9	TRUE	1,254	27.6	1,906	1,254	652
H-99	1,000	20	TRUE	2,491	20	TRUE	1,546	34.7	TRUE	1,290	35.9	2,491	1,290	1201
H-100	1,000	20	TRUE	1,595	20	TRUE	1,323	20	TRUE	1,211	20	1,595	1,211	384
H-101	1,000	20	TRUE	1,264	20	TRUE	1,069	20	FALSE	985	20	1,264	985	279
H-103	1,000	20	TRUE	1,626	20	TRUE	1,085	24.2	FALSE	919	26.5	1,626	919	707
H-105	1,000	20	TRUE	1,417	20	FALSE	930	21.2	FALSE	792	23.4	1,417	792	625
H-107	1,000	20	TRUE	1,335	20	FALSE	944	20.1	FALSE	824	21.9	1,335	824	511
H-108	1,000	20	TRUE	4,332	34	TRUE	2,714	51.7	TRUE	2,272	54.4	4,332	2,272	2060
H-109	1,000	20	TRUE	1,014	20	FALSE	730	20.2	FALSE	662	20.2	1,014	662	352
H-111	1,000	20	TRUE	1,444	20	FALSE	958	21.8	FALSE	814	24.1	1,444	814	630
H-112	1,000	20	TRUE	2,399	20	TRUE	2,126	20	TRUE	1,784	28.4	2,399	1,784	615
H-113	1,000	20	TRUE	2,332	20	TRUE	1,607	30.2	TRUE	1,343	32.3	2,332	1,343	989
H-114	1,000	20	TRUE	4,334	26	TRUE	2,706	48.2	TRUE	2,266	51.6	4,334	2,266	2068

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Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
H-115	1,000	20	TRUE	3,529	20	TRUE	2,673	34.8	TRUE	2,242	41.5	3,529	2,242	1287
H-116	1,000	20	TRUE	4,189	20	TRUE	2,645	43.8	TRUE	2,221	47.7	4,189	2,221	1968
H-117	1,000	20	TRUE	3,592	20	TRUE	2,667	36.3	TRUE	2,238	42.7	3,592	2,238	1354
H-119	1,000	20	TRUE	2,510	20	TRUE	2,027	22.6	TRUE	1,688	26.5	2,510	1,688	822
H-121	1,000	20	TRUE	2,806	20	TRUE	1,959	29.6	TRUE	1,627	31.5	2,806	1,627	1179
H-122	1,000	20	TRUE	1,917	20	TRUE	1,643	20	TRUE	1,501	20	1,917	1,501	416
H-123	1000	20	FALSE	509	20	FALSE	463	20.1	FALSE	432	20	509	432	77
H-123	1,000	20	TRUE	1,524	20	TRUE	1,317	20	TRUE	1,207	20	1,524	1,207	317
H-124	1,000	20	TRUE	2,663	20	TRUE	1,996	26	TRUE	1,657	28.7	2,663	1,657	1006
H-126	1,000	20	TRUE	1,937	20	TRUE	1,670	20	TRUE	1,530	20	1,937	1,530	407
H-127	1,000	20	TRUE	2,027	20	TRUE	1,739	20	TRUE	1,588	20	2,027	1,588	439
H-128	1,000	20	TRUE	2,711	20	TRUE	2,022	26.6	TRUE	1,682	29.5	2,711	1,682	1029
H-130	1,000	20	TRUE	1,827	20	TRUE	1,589	20	TRUE	1,460	20	1,827	1,460	367
H-131	665	35.1	TRUE	1,037	35	TRUE	865	35.1	TRUE	774	35.1	1,037	774	263
H-132	1,000	20	FALSE	610	20	FALSE	549	20.1	FALSE	511	20	610	511	99
H-138	1,000	20	TRUE	1,435	22	FALSE	959	23.1	FALSE	815	25.4	1,435	815	620
H-141	1,000	20	TRUE	1,397	21	FALSE	958	21	FALSE	815	23.5	1,397	815	582
H-142	1,000	20	TRUE	1,392	20	FALSE	955	20	FALSE	815	22.4	1,392	815	577
H-146	1,000	20	TRUE	1,412	20	FALSE	959	22	FALSE	815	24.8	1,412	815	597
H-150	1,000	20	TRUE	1,407	21	FALSE	959	22.4	FALSE	815	25.2	1,407	815	592
H-153	1,000	20	TRUE	1,419	20	FALSE	959	22.2	FALSE	815	24.9	1,419	815	604
H-155	1,000	20	TRUE	1,419	20	FALSE	959	22.2	FALSE	815	25	1,419	815	604
H-158	1,000	20	TRUE	1,183	20	FALSE	859	20	FALSE	778	20	1,183	778	405
H-159	1,000	20	TRUE	1,294	20	FALSE	921	20	FALSE	814	21.2	1,294	814	480
H-168	1,000	20	TRUE	1,444	20	FALSE	960	22	FALSE	815	24.4	1,444	815	629
H-179	1,000	20	TRUE	1,815	20	TRUE	1,570	20.1	TRUE	1,442	20	1,815	1,442	373
H-190	1,000	20	TRUE	1,600	20	TRUE	1,445	20	TRUE	1,368	20	1,600	1,368	232
H-200	1,000	20	TRUE	1,093	20	FALSE	807	20	FALSE	733	20.1	1,093	733	360
H-205	1,000	20	TRUE	1,390	20	FALSE	959	20.6	FALSE	815	23.5	1,390	815	575
H-209	1,000	20	FALSE	599	23	FALSE	538	22.6	FALSE	500	22.6	599	500	99
H-230	1,000	20	TRUE	1,726	24	TRUE	1,475	23.9	TRUE	1,334	23.9	1,726	1,334	392
H-231	1,000	20	TRUE	1,652	22	TRUE	1,415	22.2	TRUE	1,283	22.2	1,652	1,283	369
J-10	1,000	20	TRUE	5,287	38	TRUE	4,277	44.2	TRUE	3,807	46.8	5,287	3,807	1480
J-20	1,000	20	TRUE	5,256	39	TRUE	4,252	44.2	TRUE	3,783	46.8	5,256	3,783	1473
J-38	479	45	FALSE	362	45	FALSE	309	45.4	FALSE	272	45.3	362	272	90

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J-39	1000	20	FALSE	517	20	FALSE	471	20	FALSE	439	20	517	439	78
J-40	1,000	20	TRUE	5,288	34.8	TRUE	4,277	42	TRUE	3,807	45.1	5,288	3,807	1481
J-41	1,000	20	TRUE	5,288	34	TRUE	4,277	41.4	TRUE	3,807	44.6	5,288	3,807	1481
J-42	1,000	20	TRUE	5,288	36	TRUE	4,277	42.6	TRUE	3,807	45.6	5,288	3,807	1481
J-43	1,000	20	TRUE	5,760	43	TRUE	4,675	49.1	TRUE	4,166	51.9	5,760	4,166	1594
J-44	1,000	20	TRUE	5,773	43	TRUE	4,686	49.1	TRUE	4,177	52	5,773	4,177	1596
J-45	1,000	20	TRUE	5,288	33	TRUE	4,277	40.8	TRUE	3,807	44.1	5,288	3,807	1481
J-46	1,000	20	TRUE	5,685	42	TRUE	4,611	48.4	TRUE	4,109	51.2	5,685	4,109	1576
J-48	1,000	20	FALSE	521	20	FALSE	473	20.1	FALSE	441	20	521	441	80
J-49	1,000	20	FALSE	518	20	FALSE	471	20	FALSE	439	20	518	439	79
J-50	1,000	20	TRUE	4,572	43	TRUE	2,888	58.8	TRUE	2,423	61.2	4,572	2,423	2149
J-51	545	57	TRUE	1,243	57	TRUE	903	57.4	TRUE	719	57.4	1,243	719	524
J-53	1000	20	TRUE	5,338	38	TRUE	4,322	44.2	TRUE	3,850	46.8	5,338	3,850	1488
J-54	1,000	20	TRUE	4,582	43	TRUE	2,894	59	TRUE	2,428	61.4	4,582	2,428	2154
J-55	761	30	TRUE	1,363	30	TRUE	1,148	30.3	TRUE	1,026	30.3	1,363	1,026	337
J-57	1000	20	FALSE	967	22	FALSE	826	22.2	FALSE	762	22.2	967	762	205
J-58	1,000	20	TRUE	1,310	22	TRUE	1,093	22.1	TRUE	1,001	22.1	1,310	1,001	309
J-59	1,000	20	TRUE	1,790	21	TRUE	1,035	28.9	FALSE	879	29.6	1,790	879	911
J-60	1,000	20	TRUE	4,932	35	TRUE	3,980	40.7	TRUE	3,538	43.1	4,932	3,538	1394
J-65	1,000	20	TRUE	4,994	36	TRUE	4,031	41.7	TRUE	3,583	44	4,994	3,583	1411
J-67(Ptrans)	1,000	20	TRUE	5,280	42	TRUE	4,271	47.5	TRUE	3,801	50.1	5,280	3,801	1479
J-68	1,000	20	TRUE	5,272	39	TRUE	4,265	44.6	TRUE	3,795	47.2	5,272	3,795	1477
J-69	1,000	20	TRUE	1,442	22	FALSE	958	24	FALSE	814	26.4	1,442	814	628
J-70	1,000	20	TRUE	5,261	41	TRUE	4,255	46.6	TRUE	3,786	49.2	5,261	3,786	1475
J-71	1,000	20	TRUE	1,408	20	FALSE	958	21.8	FALSE	814	24.6	1,408	814	594
J-73	1,000	20	TRUE	1,865	20	TRUE	1,318	25.3	TRUE	1,125	27.5	1,865	1,125	740
J-74	698	32	FALSE	519	32	FALSE	462	32.2	FALSE	422	32.2	519	422	97
J-80	1000	20	TRUE	5,305	39.1	TRUE	4,293	44.9	TRUE	3,820	47.4	5,305	3,820	1485
J-90	1,000	20	TRUE	4,501	40	TRUE	2,838	56.3	TRUE	2,382	58.7	4,501	2,382	2119
J-100	1,000	20	TRUE	4,498	40	TRUE	2,838	55.9	TRUE	2,381	58.4	4,498	2,381	2117
J-110	1,000	20	TRUE	4,205	28	TRUE	2,616	46.8	TRUE	2,201	49.4	4,205	2,201	2004
J-120	1,000	20	TRUE	4,175	27	TRUE	2,588	46.2	TRUE	2,178	48.7	4,175	2,178	1997
J-130	1,000	20	TRUE	3,967	22	TRUE	2,603	40	TRUE	2,191	43.5	3,967	2,191	1776
J-140	1,000	20	TRUE	3,654	21	TRUE	2,616	34.9	TRUE	2,201	39.3	3,654	2,201	1453
J-160	1,000	20	TRUE	3,317	21	TRUE	2,631	28.5	TRUE	2,212	33.9	3,317	2,212	1105

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J-170	312	39	TRUE	1,934	39	TRUE	1,657	38.6	TRUE	1,520	38.6	1,934	1,520	414
J-190	1000	20	TRUE	4,245	21	TRUE	2,643	44.8	TRUE	2,220	48.4	4,245	2,220	2025
J-210	1,000	20	TRUE	4,303	39	TRUE	2,727	54	TRUE	2,287	56.3	4,303	2,287	2016
J-220	1,000	20	TRUE	3,645	26	TRUE	2,662	43.1	TRUE	2,234	49.1	3,645	2,234	1411
J-230	1,137	64	TRUE	1,628	64	TRUE	1,300	63.6	FALSE	1,130	63.6	1,628	1,130	498
J-260	1,000	20	TRUE	3,561	20	TRUE	2,677	35.7	TRUE	2,245	42.4	3,561	2,245	1316
J-290	1,000	20	TRUE	3,704	20	TRUE	2,687	38.1	TRUE	2,252	44.3	3,704	2,252	1452
J-300	1,000	20	TRUE	3,877	20	TRUE	2,693	40.8	TRUE	2,256	46.4	3,877	2,256	1621
J-310	325	65	TRUE	1,857	65	TRUE	1,465	65	TRUE	1,265	65	1,857	1,265	592
J-340	1000	20	TRUE	4,334	26	TRUE	2,707	48.5	TRUE	2,267	51.9	4,334	2,267	2067
J-350	850	20	TRUE	2,537	20	TRUE	2,340	20	TRUE	2,240	20	2,537	2,240	297
J-350	1000	20	FALSE	683	22	FALSE	607	22.2	FALSE	563	22.2	683	563	120
J-360	1,000	20	TRUE	4,339	34	TRUE	2,716	51.8	TRUE	2,275	54.4	4,339	2,275	2064
J-370	1,000	20	TRUE	4,336	30	TRUE	2,710	49.9	TRUE	2,270	52.9	4,336	2,270	2066
J-400	525	20	TRUE	2,148	20	TRUE	1,990	20	TRUE	1,910	20	2,148	1,910	238
J-420	1000	20	TRUE	4,335	27	TRUE	2,707	48.9	TRUE	2,267	52.2	4,335	2,267	2068
J-430	1,000	20	TRUE	4,335	27	TRUE	2,707	48.8	TRUE	2,267	52.1	4,335	2,267	2068
J-450	100	20	TRUE	2,803	20	TRUE	2,572	20	TRUE	2,268	27.1	2,803	2,268	535
J-460	645	43.2	TRUE	3,249	43	TRUE	2,707	44.9	TRUE	2,268	49.1	3,249	2,268	981
J-480	1000	20	TRUE	3,611	20	TRUE	2,683	36.2	TRUE	2,250	42.6	3,611	2,250	1361
J-490	476	62	TRUE	1,659	62	TRUE	1,351	62	TRUE	1,191	62	1,659	1,191	468
J-520	1000	20	TRUE	3,591	20	TRUE	2,665	35.9	TRUE	2,236	42.1	3,591	2,236	1355
J-530	850	20	TRUE	1,703	20	TRUE	1,580	20	TRUE	1,517	20	1,703	1,517	186
J-550	1000	20	TRUE	4,342	35	TRUE	2,718	52	TRUE	2,277	54.6	4,342	2,277	2065
J-590	1,000	20	TRUE	4,314	34	TRUE	2,703	51.9	TRUE	2,263	54.6	4,314	2,263	2051
J-610	1,000	20	TRUE	4,278	34	TRUE	2,683	52.1	TRUE	2,246	54.8	4,278	2,246	2032
J-630	1,000	20	TRUE	4,231	36	TRUE	2,660	52.4	TRUE	2,229	54.7	4,231	2,229	2002
J-650	1,000	20	TRUE	4,221	36	TRUE	2,656	52.4	TRUE	2,226	54.7	4,221	2,226	1995
J-660	1,000	20	TRUE	4,151	34	TRUE	2,602	50.5	TRUE	2,181	52.8	4,151	2,181	1970
J-670	512	61	TRUE	1,316	61	TRUE	1,086	61.1	TRUE	966	61.2	1,316	966	350
J-710	1000	20	TRUE	3,907	20	TRUE	2,498	43.1	TRUE	2,089	46.9	3,907	2,089	1818
J-720	1,000	20	TRUE	2,515	20	TRUE	2,292	20	TRUE	2,088	23.9	2,515	2,088	427
J-730	1,000	20	TRUE	3,562	20	TRUE	2,467	38.9	TRUE	2,061	43.9	3,562	2,061	1501
J-750	1,000	20	TRUE	3,510	20	TRUE	2,462	38.2	TRUE	2,056	43.4	3,510	2,056	1454
J-760	1,000	20	FALSE	342	20	FALSE	336	20	FALSE	325	20	342	325	17

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			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-770	1,000	20	TRUE	3,171	23	TRUE	2,408	34.6	TRUE	2,011	40.5	3,171	2,011	1160
J-780	1,000	20	TRUE	2,310	22	TRUE	2,083	22	TRUE	1,968	22	2,310	1,968	342
J-790	1,000	20	TRUE	1,933	20	TRUE	1,763	20	TRUE	1,676	20	1,933	1,676	257
J-800	1,000	20	TRUE	2,124	22	TRUE	1,920	22.1	TRUE	1,817	22.1	2,124	1,817	307
J-810	850	20	TRUE	2,038	20	TRUE	1,850	20	TRUE	1,755	20	2,038	1,755	283
J-830	1000	20	TRUE	3,187	22	TRUE	2,401	34.7	TRUE	2,006	40.5	3,187	2,006	1181
J-832	1,000	20	TRUE	1,090	21	TRUE	1,007	20.9	FALSE	964	20.9	1,090	964	126
J-834	100	20	TRUE	1,069	20	TRUE	990	20	TRUE	948	20	1,069	948	121
J-836	1000	20	TRUE	1,036	20	FALSE	958	20	FALSE	917	20	1,036	917	119
J-840	1,000	20	TRUE	3,359	20	TRUE	2,365	37.1	TRUE	1,979	42	3,359	1,979	1380
J-860	1,000	20	TRUE	3,801	25	TRUE	2,303	43.9	TRUE	1,936	45.9	3,801	1,936	1865
J-870	1,000	20	TRUE	3,789	24	TRUE	2,296	43.6	TRUE	1,929	45.6	3,789	1,929	1860
J-880	850	20	TRUE	1,580	20	TRUE	1,437	20	TRUE	1,364	20	1,580	1,364	216
J-910	1000	20	TRUE	3,840	25	TRUE	2,324	44.7	TRUE	1,954	46.8	3,840	1,954	1886
J-940	596	36	TRUE	1,333	36	TRUE	1,184	35.6	TRUE	1,107	35.6	1,333	1,107	226
J-950	1000	20	TRUE	3,859	24	TRUE	2,335	44.3	TRUE	1,963	46.4	3,859	1,963	1896
J-960	850	20	TRUE	1,592	20	TRUE	1,456	20	TRUE	1,387	20	1,592	1,387	205
J-970	1000	20	TRUE	3,885	23	TRUE	2,349	43.4	TRUE	1,975	45.5	3,885	1,975	1910
J-980	1,000	20	TRUE	2,587	23	TRUE	2,300	23	TRUE	1,975	29.8	2,587	1,975	612
J-990	1,000	20	TRUE	2,115	23	TRUE	1,904	22.5	TRUE	1,797	22.5	2,115	1,797	318
J-995	525	60	TRUE	1,182	60	TRUE	952	60	TRUE	831	60	1,182	831	351
J-1010	1000	20	TRUE	2,338	22	TRUE	2,094	22.4	TRUE	1,972	22.4	2,338	1,972	366
J-1030	503	51	TRUE	1,487	51	TRUE	1,242	51	TRUE	1,117	51	1,487	1,117	370
J-1060	1000	20	TRUE	3,869	29	TRUE	2,391	46.6	TRUE	2,004	48.6	3,869	2,004	1865
J-1090	255	47	TRUE	1,777	47	TRUE	1,507	46.7	TRUE	1,369	46.7	1,777	1,369	408
J-1120	1000	20	TRUE	3,806	28	TRUE	2,340	45.8	TRUE	1,958	47.7	3,806	1,958	1848
J-1130	1,000	20	TRUE	3,780	29	TRUE	2,317	46.7	TRUE	1,939	48.6	3,780	1,939	1841
J-1150	1,000	20	TRUE	3,650	28	TRUE	2,192	45.9	TRUE	1,830	47.6	3,650	1,830	1820
J-1180	100	20	TRUE	464	20	TRUE	448	20	TRUE	429	20	464	429	35
J-1190	1000	20	TRUE	3,605	26.3	TRUE	2,147	44.7	TRUE	1,791	46.2	3,605	1,791	1814
J-1210	1,000	20	TRUE	3,602	26	TRUE	2,144	44.7	TRUE	1,788	46.2	3,602	1,788	1814
J-1220	1,000	20	TRUE	3,616	21	TRUE	2,139	43.1	TRUE	1,784	45.1	3,616	1,784	1832
J-1227	1,000	20	TRUE	3,206	21	TRUE	2,087	38.8	TRUE	1,737	41.5	3,206	1,737	1469
J-1240	1,000	20	TRUE	3,461	24	TRUE	2,074	41.5	TRUE	1,733	42.9	3,461	1,733	1728
J-1250	1,000	20	TRUE	3,534	24	TRUE	2,122	42.7	TRUE	1,777	44.2	3,534	1,777	1757

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			Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)			
J-1260	1,000	20	TRUE	3,483	22	TRUE	2,122	41.4	TRUE	1,777	43.3	3,483	1,777	1706
J-1280	1,000	20	TRUE	3,314	21	TRUE	2,122	38.8	TRUE	1,777	41.3	3,314	1,777	1537
J-1290	100	20	TRUE	2,946	20	TRUE	2,121	33.1	TRUE	1,777	37.3	2,946	1,777	1169
J-1300	1000	20	TRUE	2,843	20	TRUE	2,122	30.7	TRUE	1,776	35.2	2,843	1,776	1067
J-1310	1,000	20	TRUE	2,525	20	TRUE	2,122	23.1	TRUE	1,776	29.7	2,525	1,776	749
J-1320	1,000	20	TRUE	2,759	20	TRUE	2,122	29	TRUE	1,776	34	2,759	1,776	983
J-1330	850	20	TRUE	2,459	20	TRUE	2,122	21.1	TRUE	1,777	28.3	2,459	1,777	682
J-1350	1000	20	TRUE	3,600	25	TRUE	2,167	43.9	TRUE	1,817	45.5	3,600	1,817	1783
J-1360	1,000	20	TRUE	2,056	20	TRUE	1,828	20	TRUE	1,714	20	2,056	1,714	342
J-1362	1,000	20	TRUE	3,696	25	TRUE	2,232	44.3	TRUE	1,875	46.1	3,696	1,875	1821
J-1364	100	20	TRUE	685	20	TRUE	650	20.1	TRUE	624	20	685	624	61
J-1370	1000	20	TRUE	3,711	25.1	TRUE	2,243	44.1	TRUE	1,883	45.9	3,711	1,883	1828
J-1380	1,000	20	TRUE	2,473	20	TRUE	2,187	20	TRUE	1,883	26.4	2,473	1,883	590
J-1390	1,000	20	TRUE	4,016	35	TRUE	2,605	50	TRUE	2,185	52.7	4,016	2,185	1831
J-1400	1,000	20	TRUE	2,698	21	TRUE	2,451	20.6	TRUE	2,185	26	2,698	2,185	513
J-1420	100	20	TRUE	2,201	21	TRUE	2,015	20.5	TRUE	1,922	20.5	2,201	1,922	279
J-1440	966	45	TRUE	1,290	45	TRUE	1,141	45	TRUE	1,063	45	1,290	1,063	227
J-1450	1000	20	TRUE	1,806	21	TRUE	1,663	20.5	TRUE	1,590	20.5	1,806	1,590	216
J-1470	1,000	20	TRUE	3,992	35	TRUE	2,595	49.7	TRUE	2,176	52.4	3,992	2,176	1816
J-1490	1,000	20	TRUE	3,835	34	TRUE	2,523	48.4	TRUE	2,116	51.1	3,835	2,116	1719
J-1495	1,000	20	TRUE	3,836	30	TRUE	2,523	46.3	TRUE	2,117	49.4	3,836	2,117	1719
J-1510	1,000	20	TRUE	2,908	21	TRUE	2,523	23.6	TRUE	2,117	32.1	2,908	2,117	791
J-1520	500	60	TRUE	1,393	60	TRUE	1,128	60	TRUE	991	60	1,393	991	402
J-1530	501	63.4	TRUE	869	63	TRUE	714	63.4	TRUE	615	63.4	869	615	254
J-1540	1000	20	TRUE	3,752	33	TRUE	2,480	46.7	TRUE	2,081	49.3	3,752	2,081	1671
J-1560	1,000	20	TRUE	3,694	22	TRUE	2,453	40.7	TRUE	2,055	44.8	3,694	2,055	1639
J-1570	100	20	TRUE	2,016	20	TRUE	1,822	20	TRUE	1,726	20	2,016	1,726	290
J-1580	1000	20	TRUE	3,707	21	TRUE	2,425	40.7	TRUE	2,030	44.6	3,707	2,030	1677
J-1630	1,000	20	TRUE	3,198	20	TRUE	2,410	33.5	TRUE	2,014	39.5	3,198	2,014	1184
J-1670	1,000	20	TRUE	2,400	20	TRUE	2,172	20	TRUE	2,014	21.9	2,400	2,014	386
J-1690	1,000	20	TRUE	2,370	20	TRUE	2,146	20	TRUE	2,014	20.9	2,370	2,014	356
J-1700	1,000	20	TRUE	3,161	20	TRUE	2,392	32.7	TRUE	1,999	38.5	3,161	1,999	1162
J-1710	1,000	20	TRUE	2,815	21	TRUE	2,393	25	TRUE	1,999	33	2,815	1,999	816
J-1730	850	20	TRUE	2,237	20	TRUE	2,017	20	TRUE	1,906	20	2,237	1,906	331
J-1731	1000	20	TRUE	3,718	33	TRUE	2,467	46.3	TRUE	2,071	48.9	3,718	2,071	1647

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J-1732	540	50	TRUE	2,073	50	TRUE	1,742	50	TRUE	1,577	50	2,073	1,577	496
J-1738	1000	20	TRUE	3,561	31	TRUE	2,378	43.8	TRUE	2,002	46.1	3,561	2,002	1559
J-1760	1,000	20	TRUE	3,615	20	TRUE	2,410	39	TRUE	2,021	43	3,615	2,021	1594
J-1770	850	20	TRUE	2,478	20	TRUE	2,232	20	TRUE	2,021	23.7	2,478	2,021	457
J-1780	1000	20	TRUE	3,417	29	TRUE	2,288	41.9	TRUE	1,936	43.6	3,417	1,936	1481
J-1784	1,000	20	TRUE	3,434	29	TRUE	2,299	41.1	TRUE	1,944	42.9	3,434	1,944	1490
J-1786	100	20	TRUE	3,433	26	TRUE	2,298	39.5	TRUE	1,943	41.5	3,433	1,943	1490
J-1790	1000	20	TRUE	2,974	26	TRUE	2,054	36.3	TRUE	1,718	37.9	2,974	1,718	1256
J-1792	1,000	20	TRUE	3,379	27	TRUE	2,263	40.1	TRUE	1,918	41.6	3,379	1,918	1461
J-1795	1,000	20	TRUE	2,945	21	TRUE	2,041	31.3	TRUE	1,706	33	2,945	1,706	1239
J-1796	1,000	20	TRUE	3,303	28	TRUE	2,215	40.3	TRUE	1,880	41.5	3,303	1,880	1423
J-1798	656	50	TRUE	1,255	50	TRUE	1,032	50.3	TRUE	919	50.3	1,255	919	336
J-1800	1000	20	TRUE	2,151	25	TRUE	1,853	25.1	TRUE	1,695	25.1	2,151	1,695	456
J-1820	668	60	TRUE	802	60	FALSE	610	60	FALSE	483	60	802	483	319
J-1830	1000	20	TRUE	2,791	23.4	TRUE	2,027	31.2	TRUE	1,689	33.6	2,791	1,689	1102
J-1840	1,000	20	TRUE	2,765	24	TRUE	2,027	31.2	TRUE	1,689	33.8	2,765	1,689	1076
J-1850	1,000	20	TRUE	2,193	20	TRUE	1,871	20	TRUE	1,689	20.6	2,193	1,689	504
J-1870	498	50	TRUE	1,027	50	TRUE	788	50	TRUE	665	50	1,027	665	362
J-1890	1000	20	TRUE	2,755	24	TRUE	2,021	31.3	TRUE	1,682	33.9	2,755	1,682	1073
J-1920	1,000	20	TRUE	2,721	23	TRUE	2,009	30	TRUE	1,670	32.7	2,721	1,670	1051
J-1930	1,560	42	TRUE	1,899	42	FALSE	1,454	42.3	FALSE	1,220	42.3	1,899	1,220	679
J-1940	1,000	20	TRUE	2,714	23	TRUE	2,007	29.9	TRUE	1,669	32.7	2,714	1,669	1045
J-1980	1,000	20	TRUE	2,667	23	TRUE	1,981	29.2	TRUE	1,645	31.8	2,667	1,645	1022
J-1990	1,000	20	TRUE	2,650	23	TRUE	1,981	29	TRUE	1,645	31.6	2,650	1,645	1005
J-2000	1,560	42	TRUE	1,748	42	FALSE	1,335	42.3	FALSE	1,116	42.3	1,748	1,116	632
J-2040	250	20	TRUE	2,703	23	TRUE	1,976	30	TRUE	1,641	32.5	2,703	1,641	1062
J-2060	1000	20	TRUE	2,767	22	TRUE	1,966	30.3	TRUE	1,633	32.5	2,767	1,633	1134
J-2100	1,000	20	TRUE	2,894	23	TRUE	1,948	33.9	TRUE	1,619	35.5	2,894	1,619	1275
J-2110	525	55	TRUE	759	55	TRUE	579	54.6	FALSE	454	54.6	759	454	305
J-2120	1000	20	TRUE	2,908	22.7	TRUE	1,946	34	TRUE	1,617	35.6	2,908	1,617	1291
J-2130	1,000	20	TRUE	2,525	24	TRUE	1,984	27.8	TRUE	1,647	31.6	2,525	1,647	878
J-2140	1,000	20	TRUE	2,493	23	TRUE	2,009	25.6	TRUE	1,669	29.9	2,493	1,669	824
J-2145	569	38	TRUE	598	38	FALSE	535	38.4	FALSE	481	38.4	598	481	117
J-2150	415	60	TRUE	768	60	TRUE	616	60	TRUE	509	60	768	509	259
J-2160	1000	20	TRUE	3,062	21.2	TRUE	1,905	36.5	TRUE	1,581	37.7	3,062	1,581	1481

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J-2180	1,000	20	TRUE	3,153	21	TRUE	1,884	37.7	TRUE	1,564	38.6	3,153	1,564	1589
J-2220	1,000	20	TRUE	3,214	23	TRUE	1,872	40.7	TRUE	1,554	41.4	3,214	1,554	1660
J-2240	1,000	20	TRUE	3,210	24	TRUE	1,862	41.1	TRUE	1,546	41.7	3,210	1,546	1664
J-2250	1,000	20	TRUE	3,202	25	TRUE	1,865	42	TRUE	1,548	42.6	3,202	1,548	1654
J-2260	1,000	20	TRUE	3,293	24	TRUE	1,928	41.3	TRUE	1,606	42	3,293	1,606	1687
J-2280	1,000	20	TRUE	3,299	24	TRUE	1,932	41.3	TRUE	1,610	42	3,299	1,610	1689
J-2290	100	20	TRUE	2,697	20	TRUE	1,931	32	TRUE	1,610	35.5	2,697	1,610	1087
J-2300	1000	20	TRUE	3,425	25	TRUE	2,025	42.4	TRUE	1,691	43.5	3,425	1,691	1734
J-2320	1,000	20	TRUE	3,513	25	TRUE	2,085	42.9	TRUE	1,740	44.3	3,513	1,740	1773
J-2350	100	20	TRUE	384	20	TRUE	371	20	TRUE	355	20.1	384	355	29
J-2360	1000	20	TRUE	3,451	23.4	TRUE	2,067	41	TRUE	1,727	42.3	3,451	1,727	1724
J-2380	1,000	20	TRUE	3,354	22	TRUE	1,997	39.2	TRUE	1,667	40.2	3,354	1,667	1687
J-2400	1,000	20	TRUE	3,312	21	TRUE	1,967	38.5	TRUE	1,640	39.4	3,312	1,640	1672
J-2412	1,000	20	TRUE	2,575	20	TRUE	2,060	25.8	TRUE	1,712	31.4	2,575	1,712	863
J-2420	1,000	20	TRUE	3,211	25	TRUE	1,891	41.7	TRUE	1,573	42.3	3,211	1,573	1638
J-2430	1,000	20	TRUE	3,146	24	TRUE	1,848	41	TRUE	1,535	41.4	3,146	1,535	1611
J-2440	1,000	20	TRUE	1,853	20	TRUE	1,589	20.1	TRUE	1,452	20.1	1,853	1,452	401
J-2460	100	20	TRUE	1,743	20	TRUE	1,500	20	TRUE	1,374	20	1,743	1,374	369
J-2470	1000	20	TRUE	3,087	23	TRUE	1,818	38.7	TRUE	1,507	39.1	3,087	1,507	1580
J-2480	1,000	20	TRUE	3,153	24	TRUE	1,848	40	TRUE	1,533	40.5	3,153	1,533	1620
J-2490	1,000	20	TRUE	1,988	21	TRUE	1,715	20.8	TRUE	1,532	22.8	1,988	1,532	456
J-2530	100	20	TRUE	1,772	20	TRUE	1,540	20	TRUE	1,421	20	1,772	1,421	351
J-2540	1000	20	TRUE	2,377	21	TRUE	1,789	27.7	TRUE	1,473	31.2	2,377	1,473	904
J-2570	850	20	TRUE	1,493	20	TRUE	1,297	20	TRUE	1,189	20	1,493	1,189	304
J-2580	1000	20	TRUE	2,369	22	TRUE	1,787	28.5	TRUE	1,473	32	2,369	1,473	896
J-2610	544	51	TRUE	741	51	TRUE	585	50.9	FALSE	469	50.9	741	469	272
J-2620	1000	20	TRUE	2,438	20	TRUE	1,774	29	TRUE	1,461	32	2,438	1,461	977
J-2630	592	64	TRUE	887	64	FALSE	529	64.2	FALSE	297	64.2	887	297	590
J-2640	1000	20	TRUE	2,431	23	TRUE	1,758	30.4	TRUE	1,449	32.6	2,431	1,449	982
J-2650	1,000	20	TRUE	1,377	21	TRUE	1,169	20.5	TRUE	1,054	20.5	1,377	1,054	323
J-2660	100	20	TRUE	1,168	20	TRUE	998	20	TRUE	903	20	1,168	903	265
J-2670	1000	20	TRUE	1,356	20	TRUE	1,154	20.1	TRUE	1,042	20.1	1,356	1,042	314
J-2690	516	59	TRUE	535	59	FALSE	390	58.9	FALSE	252	58.9	535	252	283
J-2700	1000	20	TRUE	2,571	22.8	TRUE	1,747	33.4	TRUE	1,442	34.8	2,571	1,442	1129
J-2730	850	20	TRUE	1,674	20	TRUE	1,432	20	TRUE	1,299	20	1,674	1,299	375

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			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-2740	1000	20	TRUE	2,831	22	TRUE	1,729	36.7	TRUE	1,428	36.9	2,831	1,428	1403
J-2750	1,000	20	TRUE	1,705	20	TRUE	1,462	20	TRUE	1,326	20	1,705	1,326	379
J-2770	759	54	TRUE	793	54	FALSE	621	53.5	FALSE	498	53.5	793	498	295
J-2780	1000	20	TRUE	2,852	20	TRUE	1,726	36	TRUE	1,426	36	2,852	1,426	1426
J-2790	891	63	TRUE	1,133	63	FALSE	626	63	FALSE	326	63	1,133	326	807
J-2790add.	927	48	TRUE	1,670	48	TRUE	1,195	48	FALSE	895	48	1,670	895	775
J-2790add2	282	70	TRUE	822	70	TRUE	319	70	FALSE	18	70	822	18	804
J-2820	1000	20	TRUE	2,907	23	TRUE	1,722	38.5	TRUE	1,422	38.5	2,907	1,422	1485
J-2830	1000	20	TRUE	2,117	22	TRUE	1,722	22.9	TRUE	1,422	26.7	2,117	1,422	695
J-2850	501	53	TRUE	856	53	TRUE	598	52.6	FALSE	437	52.6	856	437	419
J-2860	1,000	20	TRUE	2,986	25	TRUE	1,733	41.1	TRUE	1,432	41.1	2,986	1,432	1554
J-2870	1,000	20	TRUE	3,028	23	TRUE	1,781	38.1	TRUE	1,475	38.3	3,028	1,475	1553
J-2890	1000	20	TRUE	3,024	23	TRUE	1,786	38.2	TRUE	1,480	38.4	3,024	1,480	1544
J-2900 (alt. p trans)	893	66	FALSE	754	66	FALSE	286	65.9	FALSE	48	65.9	754	48	706
J-2900vsp	100	20	TRUE	2,721	20	TRUE	2,225	20	TRUE	1,980	20	2,721	1,980	741
J-2930	1,000	20	TRUE	3,148	20	TRUE	1,827	37.9	TRUE	1,520	38.5	3,148	1,520	1628
J-2940	1000	20	TRUE	2,379	20	TRUE	1,827	26.8	TRUE	1,519	31.2	2,379	1,519	860
J-2950	1000	20	TRUE	2,971	24	TRUE	1,730	40.7	TRUE	1,442	41.3	2,971	1,442	1529
J-2960	1,000	20	TRUE	2,408	20	TRUE	1,729	29.8	TRUE	1,441	33	2,408	1,441	967
J-2970	1,000	20	TRUE	1,993	20	TRUE	1,685	20	TRUE	1,442	24.5	1,993	1,442	551
J-2980	850	20	TRUE	1,156	20	TRUE	1,016	20	TRUE	947	20	1,156	947	209
J-2990	1,000	20	TRUE	2,835	24	TRUE	1,655	39.7	TRUE	1,378	40.2	2,835	1,378	1457
J-3020	1,000	20	TRUE	2,842	23	TRUE	1,661	39.1	TRUE	1,383	39.6	2,842	1,383	1459
J-3030	1000	20	TRUE	2,997	22	TRUE	1,708	40.3	TRUE	1,415	40.6	2,997	1,415	1582
J-3040	1,000	20	TRUE	1,044	20	FALSE	917	20	FALSE	850	20	1,044	850	194
J-3050	1,000	20	TRUE	2,432	22	TRUE	1,434	35.6	TRUE	1,203	36.2	2,432	1,203	1229
J-3060	1,000	20	TRUE	2,449	20	TRUE	1,441	34.8	TRUE	1,208	35.6	2,449	1,208	1241
J-3070	1,000	20	TRUE	1,684	20	TRUE	1,370	20	TRUE	1,208	22.2	1,684	1,208	476
J-3075	1,000	20	TRUE	2,438	20	TRUE	1,445	34.8	TRUE	1,212	35.7	2,438	1,212	1226
J-3080	1,000	20	TRUE	2,073	20	TRUE	1,446	28.3	TRUE	1,211	31.1	2,073	1,211	862
J-3100	850	20	TRUE	1,718	20	TRUE	1,393	20	TRUE	1,212	22.9	1,718	1,212	506
J-3110	1,000	20	TRUE	2,432	20	TRUE	1,447	34.8	TRUE	1,213	35.7	2,432	1,213	1219
J-3120	1,250	47	TRUE	1,536	47	FALSE	1,019	47	FALSE	821	47	1,536	821	715
J-3130	1000	20	TRUE	2,425	20	TRUE	1,449	34.7	TRUE	1,215	35.7	2,425	1,215	1210
J-3140	100	20	TRUE	1,431	20	TRUE	1,187	20	TRUE	1,089	20	1,431	1,089	342

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			Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)			
J-3190	1,000	20	TRUE	2,408	20	TRUE	1,456	34.4	TRUE	1,219	35.5	2,408	1,219	1189
J-3200	100	20	TRUE	1,525	20	TRUE	1,258	20	TRUE	1,151	20	1,525	1,151	374
J-3210	1000	20	TRUE	2,379	20	TRUE	1,471	34.1	TRUE	1,231	35.4	2,379	1,231	1148
J-3220	850	20	TRUE	1,938	20	TRUE	1,471	24.3	TRUE	1,230	28.4	1,938	1,230	708
J-3225	1000	20	TRUE	2,330	22	TRUE	1,483	34	TRUE	1,240	35.3	2,330	1,240	1090
J-3240	1,000	20	TRUE	2,327	22	TRUE	1,484	34	TRUE	1,241	35.3	2,327	1,241	1086
J-3250	850	20	TRUE	1,735	20	TRUE	1,427	20	TRUE	1,240	23.2	1,735	1,240	495
J-3260	1,000	20	TRUE	2,316	23	TRUE	1,486	34.2	TRUE	1,243	35.6	2,316	1,243	1073
J-3270	1,000	20	TRUE	2,125	23	TRUE	1,486	30.8	TRUE	1,242	33.2	2,125	1,242	883
J-3280	1000	20	TRUE	1,970	20	TRUE	1,486	25.3	TRUE	1,242	29.4	1,970	1,242	728
J-3290	850	20	TRUE	1,645	20	TRUE	1,363	20	TRUE	1,243	20.2	1,645	1,243	402
J-3320	1,000	20	TRUE	2,323	23	TRUE	1,488	34.2	TRUE	1,244	35.6	2,323	1,244	1079
J-3340	1,000	20	TRUE	2,373	20	TRUE	1,501	33.4	TRUE	1,254	34.8	2,373	1,254	1119
J-3352	1000	20	TRUE	2,441	21	TRUE	1,519	35.9	TRUE	1,269	37.4	2,441	1,269	1172
J-3354	850	20	TRUE	2,218	20	TRUE	1,519	31.5	TRUE	1,268	34.2	2,218	1,268	950
J-3356	1,000	20	TRUE	2,474	21	TRUE	1,528	36.2	TRUE	1,276	37.5	2,474	1,276	1198
J-3358	850	20	TRUE	2,124	20	TRUE	1,528	29.1	TRUE	1,276	32.6	2,124	1,276	848
J-3380	1000	20	TRUE	2,523	21	TRUE	1,553	36.2	TRUE	1,296	37.3	2,523	1,296	1227
J-3390	1,000	20	TRUE	1,585	20	TRUE	1,339	20	TRUE	1,231	20	1,585	1,231	354
J-3400	1000	20	TRUE	2,659	23	TRUE	1,607	37.8	TRUE	1,344	38.4	2,659	1,344	1315
J-3420	1,000	20	TRUE	2,221	22	TRUE	1,310	33.9	TRUE	1,104	34.6	2,221	1,104	1117
J-3427	1,000	20	FALSE	521	20	FALSE	473	20.1	FALSE	440	20	521	440	81
J-3450	1,000	20	FALSE	626	20	FALSE	562	20.1	FALSE	524	20	626	524	102
J-3460	586	54	FALSE	371	54	FALSE	298	53.5	FALSE	248	53.6	371	248	123
J-3480	1,000	20	TRUE	2,106	22	TRUE	1,239	33	TRUE	1,047	33.7	2,106	1,047	1059
J-3490	1,000	20	TRUE	1,625	20	TRUE	1,240	20.4	TRUE	1,047	24.6	1,625	1,047	578
J-3500	1,000	20	TRUE	1,864	22	TRUE	1,084	30.5	FALSE	919	31.2	1,864	919	945
J-3508	412	22	TRUE	1,692	22	TRUE	1,036	27	TRUE	879	28.2	1,692	879	813
J-3515	1,000	20	TRUE	1,829	21	TRUE	1,061	29.4	FALSE	900	30.1	1,829	900	929
J-3520	1,000	20	TRUE	1,754	21	TRUE	1,010	28.4	FALSE	858	29.2	1,754	858	896
J-3530	1000	20	TRUE	1,319	20	FALSE	954	20.1	FALSE	858	20.4	1,319	858	461
J-3540	1,000	20	TRUE	1,290	20	FALSE	937	20	FALSE	848	20	1,290	848	442
J-3550	537	55	TRUE	686	55	FALSE	382	55	FALSE	271	55	686	271	415
J-3560	1,000	20	TRUE	1,712	22	FALSE	980	28.4	FALSE	833	29.2	1,712	833	879
J-3570	1,000	20	TRUE	1,652	20.4	FALSE	930	27.3	FALSE	792	28.1	1,652	792	860

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Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-3600	1000	20	TRUE	1,366	20	FALSE	926	20	FALSE	792	22.4	1,366	792	574
J-3610	1,000	20	TRUE	1,637	21	FALSE	909	28.7	FALSE	775	29.3	1,637	775	862
J-3620	1,000	20	TRUE	1,352	20	FALSE	910	20.2	FALSE	775	22.8	1,352	775	577
J-3640	537	55	TRUE	679	55	FALSE	298	54.7	FALSE	198	54.7	679	198	481
J-3650	1,000	20	TRUE	1,639	21	FALSE	906	28.6	FALSE	772	29.3	1,639	772	867
J-3680	500	20	TRUE	983	20	TRUE	713	20	TRUE	648	20	983	648	335
J-3690	1000	20	TRUE	1,608	22	FALSE	968	27.8	FALSE	823	29	1,608	823	785
J-3720	500	20	TRUE	1,284	20	TRUE	916	20	TRUE	824	20.2	1,284	824	460
J-3730	1000	20	TRUE	1,529	22	FALSE	962	25.7	FALSE	818	27.3	1,529	818	711
J-3740	1,000	20	TRUE	1,416	20	FALSE	963	22.2	FALSE	819	25	1,416	819	597
J-3750	850	20	TRUE	1,483	20	TRUE	963	23.7	FALSE	818	25.9	1,483	818	665
J-3755	1,000	20	TRUE	1,476	22	FALSE	959	24.5	FALSE	815	26.5	1,476	815	661
J-3760	1,000	20	TRUE	1,462	21	FALSE	958	23.5	FALSE	813	25.6	1,462	813	649
J-3770	500	20	TRUE	1,286	20	TRUE	921	20	TRUE	814	21.4	1,286	814	472
J-3920	1,000	20	FALSE	893	20.5	FALSE	753	20.5	FALSE	695	20.4	893	695	198
J-3930	1,000	20	FALSE	840	20	FALSE	715	20	FALSE	661	20	840	661	179
J-3940	1,000	20	FALSE	900	20.8	FALSE	757	20.7	FALSE	699	20.7	900	699	201
J-3950	1,000	20	FALSE	839	20.8	FALSE	714	20.7	FALSE	659	20.7	839	659	180
J-3960	887	50	FALSE	534	50	FALSE	423	50	FALSE	351	50.1	534	351	183
J-4122	1,000	20	TRUE	1,130	20	FALSE	476	22.3	FALSE	407	22.3	1,130	407	723
J-4124	561	53	TRUE	632	53	FALSE	6	52.7	FALSE	0	50.3	632	0	632
J-4140	1,000	20	TRUE	1,617	20	FALSE	884	27.7	FALSE	754	28.3	1,617	754	863
J-4170	1,000	20	TRUE	1,352	21	FALSE	940	20.9	FALSE	805	23.5	1,352	805	547
J-4180	1,000	20	TRUE	1,087	20	FALSE	789	20.1	FALSE	715	20.1	1,087	715	372
J-4190	1,000	20	TRUE	1,362	21	FALSE	946	21	FALSE	805	23.7	1,362	805	557
J-4200	1,000	20	TRUE	1,093	20	FALSE	793	20.1	FALSE	718	20.1	1,093	718	375
J-4210	1,000	20	TRUE	1,468	20	FALSE	956	23.9	FALSE	812	26.1	1,468	812	656
J-4240	1,000	20	TRUE	1,174	20	FALSE	854	20	FALSE	774	20	1,174	774	400
J-4280	1,000	20	TRUE	1,160	20	FALSE	845	20.1	FALSE	766	20	1,160	766	394
J-4287	481	46	TRUE	762	46	FALSE	471	46.2	FALSE	377	46.2	762	377	385
J-4410 (P-Trans)	1,000	20	TRUE	5,640	42	TRUE	4,574	47.9	TRUE	4,075	50.7	5,640	4,075	1565
J-5005	1,000	20	TRUE	1,447	20.5	FALSE	958	22.8	FALSE	814	25.2	1,447	814	633
J-5015	1000	20	TRUE	1,449	20	FALSE	958	22.9	FALSE	814	25.3	1,449	814	635
J-5020	1,000	20	TRUE	1,438	21	FALSE	958	23	FALSE	814	25.5	1,438	814	624
J-5025	1,000	20	TRUE	1,411	20	FALSE	959	21.1	FALSE	814	23.7	1,411	814	597

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			Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)			
J-5030	1,000	20	TRUE	1,410	20	FALSE	959	21.1	FALSE	814	23.8	1,410	814	596
J-5040	1,000	20	TRUE	1,418	20	FALSE	959	22	FALSE	815	24.7	1,418	815	603
J-5070	1,000	20	TRUE	1,464	22	FALSE	959	24	FALSE	815	26	1,464	815	649
J-5075	1,000	20	TRUE	1,468	22	FALSE	959	23.8	FALSE	815	25.8	1,468	815	653
J-5100	1,000	20	TRUE	2,648	20	TRUE	1,728	33.6	TRUE	1,428	34.7	2,648	1,428	1220
J-5105	1,000	20	TRUE	1,974	20	TRUE	1,668	20.2	TRUE	1,428	23.4	1,974	1,428	546
J-5125	1,000	20	TRUE	1,643	21	TRUE	1,408	21.3	TRUE	1,277	21.3	1,643	1,277	366
J-5130	1,000	20	TRUE	1,485	22	TRUE	1,282	21.7	TRUE	1,167	21.7	1,485	1,167	318
J-5135	1,000	20	TRUE	1,470	22	TRUE	1,269	21.7	TRUE	1,156	21.7	1,470	1,156	314
J-5140	1,000	20	TRUE	1,446	21	TRUE	1,251	21.3	TRUE	1,141	21.3	1,446	1,141	305
J-5142	930	50	TRUE	935	50	FALSE	721	50	FALSE	587	50	935	587	348
J-5145	850	20	TRUE	1,421	20	TRUE	1,234	20	TRUE	1,129	20	1,421	1,129	292
J-5150	1,000	20	TRUE	1,569	21	TRUE	1,350	21.1	TRUE	1,227	21.1	1,569	1,227	342
J-5155	450	48	TRUE	989	48	TRUE	765	48	TRUE	632	48	989	632	357
J-5165	1,000	20	TRUE	1,413	20	TRUE	1,228	20	TRUE	1,123	20	1,413	1,123	290
J-5167	1000	20	TRUE	1,817	20.1	TRUE	1,560	20.1	TRUE	1,427	20.1	1,817	1,427	390
J-5171	1000	20	TRUE	1,399	21	FALSE	959	21.2	FALSE	815	23.8	1,399	815	584
J-5177	1,000	20	FALSE	571	21	FALSE	515	21.3	FALSE	479	21.3	571	479	92
J-5178	1,000	20	TRUE	1,790	21	TRUE	1,035	29.3	FALSE	879	30.1	1,790	879	911
J-5179	1,000	20	TRUE	1,712	20	TRUE	1,035	27.4	FALSE	879	28.7	1,712	879	833
J-5188	671	58	TRUE	926	58	FALSE	636	57.5	FALSE	455	57.5	926	455	471
J-5189	850	20	TRUE	1,214	20	TRUE	1,040	20	TRUE	943	20	1,214	943	271
J-5194	334	63.9	TRUE	1,363	64	TRUE	1,098	63.9	TRUE	959	63.9	1,363	959	404
J-5196	987	37	TRUE	1,133	37	FALSE	690	37	FALSE	579	37	1,133	579	554
J-5197	1000	20	TRUE	1,436	23	FALSE	959	24.5	FALSE	815	26.7	1,436	815	621
J-5198	987	41	TRUE	989	41	FALSE	607	41	FALSE	505	41	989	505	484
J-5199	1000	20	TRUE	1,392	20	FALSE	956	20.3	FALSE	815	22.6	1,392	815	577
J-5200	987	41	FALSE	922	41	FALSE	557	41	FALSE	455	41	922	455	467
J-5201	1000	20	TRUE	1,412	21	FALSE	959	23.1	FALSE	815	25.9	1,412	815	597
J-5202	987	41	FALSE	949	41	FALSE	600	41	FALSE	505	41	949	505	444
J-5203	1000	20	TRUE	1,371	20	FALSE	959	20.9	FALSE	815	24.3	1,371	815	556
J-5204	987	41	TRUE	1,043	41	FALSE	638	41	FALSE	533	41	1,043	533	510
J-5205	1000	20	TRUE	1,407	21	FALSE	959	22.4	FALSE	815	25.2	1,407	815	592
J-5206	987	41	TRUE	1,055	41	FALSE	637	41	FALSE	530	41	1,055	530	525
J-5207	1000	20	TRUE	1,419	21	FALSE	959	23.1	FALSE	815	25.8	1,419	815	604

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J-5208	987	41	FALSE	975	41	FALSE	612	41	FALSE	515	41	975	515	460
J-5209	987	41	TRUE	1,001	41	FALSE	618	41	FALSE	517	41	1,001	517	484
J-5210	987	41	TRUE	1,075	41	FALSE	649	41	FALSE	540	41	1,075	540	535
J-5214	987	41	TRUE	1,046	41	FALSE	623	41	FALSE	514	41	1,046	514	532
J-5217	1000	20	TRUE	1,452	20	FALSE	958	22.3	FALSE	814	24.5	1,452	814	638
J-5217	558	51.4	TRUE	818	51	FALSE	407	51.4	FALSE	282	51.4	818	282	536
J-5218	1000	20	TRUE	1,429	21	FALSE	958	22.8	FALSE	814	25.3	1,429	814	615
J-5219	613	37	TRUE	1,094	37	TRUE	668	37.1	FALSE	560	37.2	1,094	560	534
J-5221	723	60	FALSE	491	60	FALSE	190	60	FALSE	113	60	491	113	378
J-5223	1,000	20	TRUE	1,150	21	FALSE	837	20.4	FALSE	759	20.4	1,150	759	391
J-5223	1000	20	TRUE	1,634	20.1	TRUE	1,412	20.1	TRUE	1,290	20	1,634	1,290	344
J-5224	508	50	TRUE	1,050	50	TRUE	798	50	TRUE	653	50	1,050	653	397
J-5225	1,000	20	TRUE	1,496	22	TRUE	1,290	21.5	TRUE	1,175	21.5	1,496	1,175	321
J-5226	343	33.3	TRUE	1,261	33	TRUE	1,055	33.3	TRUE	939	33.2	1,261	939	322
J-5227	1000	20	TRUE	1,536	22	TRUE	1,323	21.5	TRUE	1,203	21.5	1,536	1,203	333
J-5228	318	59.8	TRUE	798	60	TRUE	572	59.8	TRUE	410	59.8	798	410	388
J-5230	1000	20	TRUE	1,430	24	FALSE	960	24.9	FALSE	815	27.2	1,430	815	615
J-5231	360	36.4	TRUE	1,008	36.4	TRUE	663	36.4	TRUE	572	36.4	1,008	572	436
J-5232	1000	20	TRUE	1,403	20	FALSE	959	21.2	FALSE	815	24	1,403	815	588
J-5233	360	39	TRUE	1,060	39	TRUE	648	39	TRUE	542	39	1,060	542	518
J-5234	1000	20	TRUE	3,546	20	TRUE	2,134	41.8	TRUE	1,780	43.9	3,546	1,780	1766
J-5234	1,000	20	TRUE	1,403	20	FALSE	959	21.2	FALSE	815	24	1,403	815	588
J-5235	1000	20	TRUE	1,432	20	FALSE	959	21.7	FALSE	815	24.1	1,432	815	617
J-5237	850	20	TRUE	1,898	23	TRUE	1,486	24.9	TRUE	1,242	29.1	1,898	1,242	656
J-5238	1,000	20	TRUE	2,232	23	TRUE	1,486	32.9	TRUE	1,243	34.7	2,232	1,243	989
J-5239	850	20	TRUE	2,168	20	TRUE	1,486	30.2	TRUE	1,242	32.8	2,168	1,242	926
J-5240	1000	20	TRUE	4,017	22	TRUE	2,601	40.7	TRUE	2,189	44.1	4,017	2,189	1828
J-5241	850	20	TRUE	4,285	31	TRUE	2,685	49.3	TRUE	2,257	52	4,285	2,257	2028
J-5242	321	66	TRUE	1,433	66	TRUE	1,031	66	TRUE	835	66	1,433	835	598
J-5243	321	66	TRUE	1,519	66	TRUE	1,109	66	TRUE	908	66	1,519	908	611
J-5244	1000	20	TRUE	2,516	22	TRUE	1,751	31.4	TRUE	1,445	33.1	2,516	1,445	1071
J-5246	1000	20	TRUE	1,694	21	FALSE	959	27.9	FALSE	816	28.7	1,694	816	878
J-5247	1,000	20	TRUE	1,633	20	FALSE	917	26.6	FALSE	781	27.3	1,633	781	852
J-5257	1,000	20	TRUE	4,488	42.3	TRUE	2,840	58.2	TRUE	2,382	60.6	4,488	2,382	2106
J-5258	1,000	20	TRUE	4,545	41.5	TRUE	2,872	57.7	TRUE	2,410	60.2	4,545	2,410	2135

FERMILAB ICW ANALYSIS
FIREFLOW REPORT
5/1/2013

With Casey's pumps on only:

			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-5260	1,000	20	TRUE	4,290	33	TRUE	2,690	51.5	TRUE	2,252	54.2	4,290	2,252	2038
J-5261	1,000	20	TRUE	3,949	22.8	TRUE	2,390	43.5	TRUE	2,012	45.7	3,949	2,012	1937
J-5262	1,000	20	TRUE	3,692	28	TRUE	2,233	46	TRUE	1,866	47.8	3,692	1,866	1826
J-5263	1,000	20	TRUE	3,206	21	TRUE	1,864	37.6	TRUE	1,547	38.1	3,206	1,547	1659
J-5264	1,000	20	TRUE	4,457	40	TRUE	2,822	56.2	TRUE	2,367	58.6	4,457	2,367	2090
J-5266	1,000	20	TRUE	4,336	28	TRUE	2,708	48.9	TRUE	2,268	52.1	4,336	2,268	2068
J-5271	1,000	20	TRUE	4,432	40	TRUE	2,807	56.1	TRUE	2,354	58.5	4,432	2,354	2078
J-5276	1,000	20	TRUE	3,973	23.3	TRUE	2,410	44	TRUE	2,030	46.2	3,973	2,030	1943
J-5281	1,000	20	TRUE	1,450	21.5	FALSE	958	24.3	FALSE	814	26.6	1,450	814	636
J-5282	1,000	20	TRUE	1,459	21.9	FALSE	959	23.9	FALSE	815	26	1,459	815	644
J-5284	1,000	20	TRUE	1,686	21	FALSE	977	27.3	FALSE	831	28.1	1,686	831	855
J-5291	1,000	20	TRUE	2,261	20	TRUE	2,026	20	TRUE	1,909	20	2,261	1,909	352
J-5295	1,000	20	TRUE	2,852	22.4	TRUE	1,664	39	TRUE	1,385	39.5	2,852	1,385	1467
J-5296	1000	20	FALSE	975	20	FALSE	540	20.2	FALSE	464	21	975	464	511
J-5298	1,000	20	TRUE	3,332	20	TRUE	2,633	27.7	TRUE	2,213	33.3	3,332	2,213	1119
J-5301	1,000	20	TRUE	332	56	TRUE	264	56	TRUE	218	56	332	218	114
J-5302	190	56	TRUE	338	56	TRUE	268	56	TRUE	221	56	338	221	117
J-5303	196	56	FALSE	580	21.7	FALSE	523	21.7	FALSE	486	21.6	580	486	94
J-5306	1,000	20	TRUE	2,910	21.8	TRUE	1,723	37.4	TRUE	1,423	37.4	2,910	1,423	1487
J-5307	1,000	20	TRUE	2,892	21.7	TRUE	1,725	37.1	TRUE	1,425	37.1	2,892	1,425	1467
J-5308	1,000	20	TRUE	2,874	21.7	TRUE	1,726	36.9	TRUE	1,426	36.9	2,874	1,426	1448
J-5309	1,000	20	TRUE	2,865	22.1	TRUE	1,726	37.2	TRUE	1,426	37.2	2,865	1,426	1439
J-5310	1,000	20	TRUE	2,865	21	TRUE	1,726	36.3	TRUE	1,426	36.3	2,865	1,426	1439
J-5311	1,000	20	TRUE	2,818	20	TRUE	1,726	35.5	TRUE	1,426	35.8	2,818	1,426	1392
J-5313	1,000	20	TRUE	896	43.3	TRUE	725	43.3	FALSE	617	43.3	896	617	279
J-5314	618	43.3	TRUE	872	37.3	FALSE	245	37.4	FALSE	191	37.3	872	191	681
J-5315	499	37.3	TRUE	1,517	23.2	TRUE	1,251	23.2	TRUE	1,139	23.2	1,517	1,139	378

Number of Junction Nodes that do not meet Fire Flow Goal	30	128	149


FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - Existing System
(2 Pumps on at Casey's Pump House)


FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - with Mu2E (30 gpm) & A-0 (600 gpm)
(2 Pumps on at Casey's Pump House)


FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - with Mu2E (30 gpm), A-0 (600 gpm), &
IARC (300 gpm)
(2 Pumps on at Casey's Pump House)

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-27	745.1	948.3	87.9	944.4	86.2	942.4	85.4	87.9	85.4	2.5
H-28	743.9	949	88.7	945.4	87.2	943.6	86.4	88.7	86.4	2.3
H-29	740.9	941.2	86.6	921.1	77.9	917.4	76.4	86.6	76.4	10.2
H-30	740.9	941.2	86.6	921.1	77.9	917.4	76.4	86.6	76.4	10.2
H-33	741.2	941.2	86.5	921	77.8	917.3	76.2	86.5	76.2	10.3
H-34	744.6	941.2	85	919.5	75.7	915.8	74.1	85	74.1	10.9
H-35	745.5	941.6	84.8	902.6	68	898.9	66.4	84.8	66.4	18.4
H-36	746.6	941.8	84.5	897.9	65.4	894.1	63.8	84.5	63.8	20.7
H-37	745.9	942.5	85.1	907.2	69.8	903.3	68.1	85.1	68.1	17
H-38	746.5	943.4	85.2	918.5	74.4	914.6	72.7	85.2	72.7	12.5
H-39	746.2	944.1	85.6	928.5	78.9	924.6	77.2	85.6	77.2	8.4
H-40	744.4	944.7	86.6	936.1	82.9	932.1	81.2	86.6	81.2	5.4
H-41	744.7	944.7	86.5	936.1	82.8	932.1	81.1	86.5	81.1	5.4
H-42	745	1,004.30	112.2	1,000.70	110.6	998.5	109.7	112.2	109.7	2.5
H-44	746.2	946.3	86.6	941.3	84.4	938.7	83.3	86.6	83.3	3.3
H-45	743.8	946.5	87.7	941.9	85.7	939.4	84.6	87.7	84.6	3.1
H-46	742.1	946.5	88.4	941.9	86.5	939.4	85.4	88.4	85.4	3
H-49	742.3	949.6	89.7	946.4	88.3	944.8	87.6	89.7	87.6	2.1
H-50	740.1	947.5	89.7	943.9	88.2	942	87.3	89.7	87.3	2.4
H-51	749.2	945.9	85.1	940.6	82.8	937.7	81.5	85.1	81.5	3.6
H-52	741	946.2	88.8	941.2	86.6	938.4	85.4	88.8	85.4	3.4
H-53	747.4	947.1	86.4	943.4	84.8	941.5	84	86.4	84	2.4
H-55	745.7	947.2	87.2	943.7	85.7	941.9	84.9	87.2	84.9	2.3
H-57	742.8	938.6	84.7	935.8	83.5	934.4	82.9	84.7	82.9	1.8
H-58	742.9	942.8	86.5	939.9	85.2	938.5	84.6	86.5	84.6	1.9
H-59	747.1	947.2	86.6	943.6	85	941.7	84.2	86.6	84.2	2.4
H-60	747.1	947.2	86.6	943.6	85	941.7	84.2	86.6	84.2	2.4
H-61	747.3	947.1	86.5	943.5	84.9	941.5	84.1	86.5	84.1	2.4
H-62	744.5	944.6	86.6	938	83.7	933.9	82	86.6	82	4.6

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-63	743.4	943.2	86.5	936.7	83.7	932.8	81.9	86.5	81.9	4.6
H-64	743.1	944.1	87	937.6	84.2	933.7	82.5	87	82.5	4.5
H-65	746.4	944.6	85.8	937.8	82.8	934	81.1	85.8	81.1	4.7
H-66	746	942.9	85.2	936	82.2	932	80.5	85.2	80.5	4.7
H-67	744.6	940.6	84.8	934.1	82	930.1	80.3	84.8	80.3	4.5
H-68	748.2	944.7	85	938	82.1	934.3	80.5	85	80.5	4.5
H-72	744.6	946.6	87.4	941.4	85.1	938.6	83.9	87.4	83.9	3.5
H-73	743	946.9	88.2	942	86.1	939.4	85	88.2	85	3.2
H-74	743.9	947.5	88.1	943.1	86.2	940.7	85.2	88.1	85.2	2.9
H-75	741.1	947.1	89.1	943.5	87.5	941.6	86.7	89.1	86.7	2.4
H-76	740.7	947.4	89.4	943.7	87.8	941.8	87	89.4	87	2.4
H-77	741.6	947.4	89	943.7	87.5	941.9	86.7	89	86.7	2.3
H-78	741.3	947.4	89.1	943.7	87.6	941.8	86.7	89.1	86.7	2.4
H-79	743	950.9	89.9	948	88.7	946.5	88	89.9	88	1.9
H-80	741	948.2	89.6	944.9	88.2	943.2	87.5	89.6	87.5	2.1
H-82	746.7	946.6	86.5	942.7	84.8	940.7	83.9	86.5	83.9	2.6
H-83	741.5	951	90.6	948.2	89.4	946.9	88.8	90.6	88.8	1.8
H-84	742.1	949.3	89.7	946.3	88.3	944.7	87.7	89.7	87.7	2
H-85	747.1	950.7	88.1	948	86.9	946.6	86.3	88.1	86.3	1.8
H-86	742.2	951	90.3	948.3	89.2	947	88.6	90.3	88.6	1.7
H-87	742	960.3	94.4	959.4	94.1	959	93.9	94.4	93.9	0.5
H-88	741.7	951.6	90.8	949.3	89.8	948.1	89.3	90.8	89.3	1.5
H-89	741.4	952.2	91.2	949.9	90.2	948.7	89.7	91.2	89.7	1.5
H-90	740.8	952.2	91.5	949.7	90.4	948.5	89.9	91.5	89.9	1.6
H-91	741.7	952.1	91	949.6	89.9	948.4	89.4	91	89.4	1.6
H-92	744.8	945.9	87	940.1	84.5	937	83.2	87	83.2	3.8
H-95	747.2	944.7	85.4	937	82.1	933.3	80.5	85.4	80.5	4.9
H-97	743.2	944.5	87.1	935.8	83.3	932.1	81.8	87.1	81.8	5.3
H-98	743.5	944.5	87	936.1	83.3	932.4	81.8	87	81.8	5.2

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-99	744.7	944.6	86.5	936.5	83	932.8	81.4	86.5	81.4	5.1
H-100	743.3	944.6	87.1	936	83.4	932.4	81.8	87.1	81.8	5.3
H-101	743.1	944.6	87.2	936	83.5	932.4	81.9	87.2	81.9	5.3
H-103	745	941.7	85.1	924.7	77.7	921	76.1	85.1	76.1	9
H-105	744	940.6	85.1	919.4	75.9	915.7	74.3	85.1	74.3	10.8
H-107	742.7	941.2	85.9	921.2	77.2	917.5	75.6	85.9	75.6	10.3
H-108	742.5	952.2	90.7	949.9	89.7	948.8	89.2	90.7	89.2	1.5
H-109	742.6	941.1	85.9	919.4	76.5	915.7	74.9	85.9	74.9	11
H-111	746.5	941.2	84.2	921.1	75.5	917.4	73.9	84.2	73.9	10.3
H-112	742.1	947.1	88.7	942.4	86.7	939.9	85.6	88.7	85.6	3.1
H-113	748.1	944.6	85	936.9	81.7	933.2	80.1	85	80.1	4.9
H-114	741.7	951.2	90.7	948.9	89.7	947.7	89.2	90.7	89.2	1.5
H-115	742.1	949.6	89.8	947.1	88.7	945.8	88.1	89.8	88.1	1.7
H-116	742.4	949	89.4	946.3	88.2	945	87.6	89.4	87.6	1.8
H-117	741.2	949.9	90.3	947.3	89.2	946	88.6	90.3	88.6	1.7
H-119	768.6	946.1	76.8	941.1	74.7	938.6	73.6	76.8	73.6	3.2
H-121	766.1	945.8	77.8	940.4	75.4	937.5	74.2	77.8	74.2	3.6
H-122	766.5	945.8	77.6	940.4	75.3	937.6	74	77.6	74	3.6
H-123	750	953.1	87.9	949.2	86.2	947.4	85.4	87.9	85.4	2.5
H-123	770.9	945.9	75.7	940.6	73.4	937.8	72.2	75.7	72.2	3.5
H-124	770.6	945.9	75.9	940.8	73.6	938.1	72.5	75.9	72.5	3.4
H-126	767.8	946.1	77.1	941.1	75	938.6	73.9	77.1	73.9	3.2
H-127	768	946	77	940.9	74.8	938.2	73.6	77	73.6	3.4
H-128	768.5	946.1	76.8	941.1	74.7	938.5	73.5	76.8	73.5	3.3
H-130	764.7	946.2	78.5	941.4	76.4	938.9	75.4	78.5	75.4	3.1
H-131	766.4	945.9	77.6	940.5	75.3	937.8	74.1	77.6	74.1	3.5
H-132	746.8	949.5	87.7	943.6	85.1	941	84	87.7	84	3.7
H-138	743	941.2	85.8	921.1	77.1	917.4	75.5	85.8	75.5	10.3
H-141	745.8	941.2	84.5	921.1	75.8	917.4	74.3	84.5	74.3	10.2

FERMILAB ICW ANALYSIS
PRESSURE REPORT
5/1/2013

With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
H-142	748.1	941.2	83.5	921.1	74.8	917.4	73.2	83.5	73.2	10.3
H-146	741.5	941.2	86.4	921.1	77.7	917.4	76.1	86.4	76.1	10.3
H-150	740.3	941.2	86.9	921.1	78.2	917.4	76.6	86.9	76.6	10.3
H-153	741.5	941.2	86.4	921.1	77.7	917.4	76.1	86.4	76.1	10.3
H-155	741.5	941.2	86.4	921.1	77.7	917.4	76.1	86.4	76.1	10.3
H-158	741.7	941.2	86.3	921.1	77.6	917.4	76	86.3	76	10.3
H-159	742.4	941.2	86	921.1	77.3	917.4	75.7	86	75.7	10.3
H-168	745.4	941.2	84.7	921.1	76	917.4	74.4	84.7	74.4	10.3
H-179	766	946	77.9	940.8	75.7	938.2	74.5	77.9	74.5	3.4
H-190	748.5	946.6	85.7	942.6	84	940.6	83.1	85.7	83.1	2.6
H-200	740.3	941.2	86.9	921.1	78.2	917.4	76.6	86.9	76.6	10.3
H-205	744	941.2	85.3	921.1	76.6	917.4	75	85.3	75	10.3
H-209	743.9	951	89.6	945.9	87.4	943.7	86.4	89.6	86.4	3.2
H-230	736	982	106.4	977.2	104.4	974.2	103.1	106.4	103.1	3.3
H-231	740	987.4	107	982.9	105.1	980.1	103.9	107	103.9	3.1
J-10	737.5	961	96.7	960.2	96.4	959.9	96.2	96.7	96.2	0.5
J-20	737.5	960.2	96.3	959.3	96	958.9	95.8	96.3	95.8	0.5
J-38	750	953.1	87.9	949.2	86.2	947.4	85.4	87.9	85.4	2.5
J-39	748	953.4	88.9	949.5	87.2	947.8	86.4	88.9	86.4	2.5
J-40	737.5	961	96.7	960.2	96.4	959.9	96.2	96.7	96.2	0.5
J-41	737.5	961	96.7	960.2	96.4	959.9	96.2	96.7	96.2	0.5
J-42	737.5	961	96.7	960.2	96.4	959.9	96.2	96.7	96.2	0.5
J-43	737.5	966.3	99	966.6	99.1	966.7	99.2	99.2	99	0.2
J-44	737.5	966.5	99.1	966.8	99.2	966.9	99.2	99.2	99.1	0.1
J-45	737.5	961	96.7	960.2	96.4	959.9	96.2	96.7	96.2	0.5
J-46	737.5	965.5	98.6	965.6	98.7	965.6	98.7	98.7	98.6	0.1
J-48	750	953.1	87.9	949.1	86.2	947.3	85.4	87.9	85.4	2.5
J-49	748	953.1	88.7	949.1	87	947.3	86.2	88.7	86.2	2.5
J-50	738.1	956.6	94.5	955	93.8	954.2	93.5	94.5	93.5	1

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-51	751	946.4	84.5	941.4	82.4	938.7	81.2	84.5	81.2	3.3
J-53	737.5	962.1	97.2	961.5	96.9	961.3	96.8	97.2	96.8	0.4
J-54	738	956.7	94.6	955.2	94	954.4	93.6	94.6	93.6	1
J-55	742	988.1	106.5	983.6	104.5	980.9	103.3	106.5	103.3	3.2
J-57	745	946.8	87.3	939.5	84.2	936.4	82.8	87.3	82.8	4.5
J-58	745.2	945.6	86.7	937.5	83.2	934.1	81.7	86.7	81.7	5
J-59	745	941.2	84.9	922.8	76.9	919.1	75.3	84.9	75.3	9.6
J-60	737.5	956	94.5	954.3	93.8	953.4	93.4	94.5	93.4	1.1
J-65	737.5	956.5	94.8	955	94.1	954.2	93.8	94.8	93.8	1
J-67(Ptrans)	729.8	960.8	99.9	960	99.6	959.6	99.4	99.9	99.4	0.5
J-68	736.6	960.6	96.9	959.8	96.6	959.4	96.4	96.9	96.4	0.5
J-69	740.2	941.2	87	921.1	78.3	917.4	76.7	87	76.7	10.3
J-70	732	960.3	98.8	959.4	98.4	959	98.2	98.8	98.2	0.6
J-71	741.6	941.2	86.3	921.1	77.6	917.4	76	86.3	76	10.3
J-73	744	944.7	86.8	936.1	83.1	932.1	81.4	86.8	81.4	5.4
J-74	743.9	951	89.6	945.9	87.4	943.7	86.4	89.6	86.4	3.2
J-80	737.5	960.8	96.6	960	96.3	959.7	96.1	96.6	96.1	0.5
J-90	739.8	955	93.1	953.2	92.3	952.3	91.9	93.1	91.9	1.2
J-100	740.6	955	92.8	953.2	92	952.3	91.6	92.8	91.6	1.2
J-110	742.5	948.1	88.9	945.3	87.7	943.9	87.1	88.9	87.1	1.8
J-120	742.5	947.5	88.7	944.5	87.4	943.1	86.8	88.7	86.8	1.9
J-130	743.7	945.3	87.2	942.4	86	940.9	85.3	87.2	85.3	1.9
J-140	743.7	942.8	86.1	939.9	84.9	938.5	84.3	86.1	84.3	1.8
J-160	743.8	938.6	84.3	935.8	83.1	934.4	82.5	84.3	82.5	1.8
J-170	743.8	935.5	83	932.8	81.8	931.4	81.2	83	81.2	1.8
J-190	742	948.9	89.5	946.3	88.4	944.9	87.8	89.5	87.8	1.7
J-210	741.8	953.5	91.6	951.3	90.7	950.2	90.2	91.6	90.2	1.4
J-220	728.5	949.6	95.7	947	94.5	945.7	94	95.7	94	1.7
J-230	743	949.6	89.4	947	88.3	945.7	87.7	89.4	87.7	1.7

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-260	741.3	950.4	90.5	947.9	89.4	946.7	88.9	90.5	88.9	1.6
J-290	741.4	951	90.7	948.5	89.6	947.3	89.1	90.7	89.1	1.6
J-300	740.9	951.2	91	948.8	90	947.6	89.4	91	89.4	1.6
J-310	740.9	951.2	91	948.8	90	947.6	89.4	91	89.4	1.6
J-340	742.3	951.9	90.7	949.6	89.7	948.4	89.2	90.7	89.2	1.5
J-350	742.3	951.9	90.7	949.6	89.7	948.4	89.2	90.7	89.2	1.5
J-350	745	949.5	88.5	943.6	85.9	941	84.8	88.5	84.8	3.7
J-360	741.7	952	91	949.7	90	948.6	89.5	91	89.5	1.5
J-370	741.7	951.6	90.8	949.3	89.8	948.1	89.3	90.8	89.3	1.5
J-400	742.2	951.6	90.6	949.2	89.6	948.1	89.1	90.6	89.1	1.5
J-420	741	951.3	91	948.9	90	947.8	89.5	91	89.5	1.5
J-430	741	951.3	91	948.9	90	947.7	89.4	91	89.4	1.6
J-450	742.7	951.2	90.2	948.9	89.2	947.7	88.7	90.2	88.7	1.5
J-460	741.9	951.1	90.5	948.7	89.5	947.5	89	90.5	89	1.5
J-480	742	950.1	90	947.6	89	946.4	88.4	90	88.4	1.6
J-490	742	950	90	947.6	88.9	946.3	88.4	90	88.4	1.6
J-520	742.6	949.3	89.5	946.7	88.3	945.4	87.8	89.5	87.8	1.7
J-530	742.3	949.2	89.5	946.6	88.4	945.3	87.8	89.5	87.8	1.7
J-550	742.3	952.2	90.8	949.9	89.8	948.8	89.3	90.8	89.3	1.5
J-590	741.5	952.2	91.2	949.9	90.1	948.7	89.6	91.2	89.6	1.6
J-610	740.5	952.2	91.6	949.7	90.5	948.5	90	91.6	90	1.6
J-630	741	952.1	91.3	949.6	90.3	948.4	89.7	91.3	89.7	1.6
J-650	741.2	952.1	91.2	949.6	90.2	948.3	89.6	91.2	89.6	1.6
J-660	743.1	951.4	90.1	948.7	89	947.4	88.4	90.1	88.4	1.7
J-670	743.1	951.2	90	948.5	88.8	947.1	88.3	90	88.3	1.7
J-710	742.8	950.2	89.7	947.2	88.4	945.7	87.8	89.7	87.8	1.9
J-720	742.8	950.2	89.7	947.2	88.4	945.7	87.8	89.7	87.8	1.9
J-730	742.3	949.6	89.7	946.4	88.3	944.8	87.6	89.7	87.6	2.1
J-750	742.3	949.4	89.6	946.3	88.2	944.6	87.5	89.6	87.5	2.1

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-760	742.5	949.4	89.5	946.3	88.2	944.6	87.5	89.5	87.5	2
J-770	740.5	947.8	89.7	944.4	88.2	942.5	87.4	89.7	87.4	2.3
J-780	741.3	947.4	89.2	943.9	87.7	942.1	86.9	89.2	86.9	2.3
J-790	741.3	947.4	89.2	943.9	87.7	942.1	86.9	89.2	86.9	2.3
J-800	740.9	947.2	89.3	943.7	87.8	941.9	87	89.3	87	2.3
J-810	741.8	947.1	88.8	943.6	87.3	941.8	86.5	88.8	86.5	2.3
J-830	740.5	947.8	89.7	944.3	88.2	942.4	87.4	89.7	87.4	2.3
J-832	743.2	947.8	88.5	944.3	87	942.4	86.2	88.5	86.2	2.3
J-834	742.9	947.8	88.6	944.3	87.1	942.4	86.3	88.6	86.3	2.3
J-836	745.2	947.8	87.6	944.3	86.1	942.4	85.3	87.6	85.3	2.3
J-840	740.1	947.5	89.7	943.9	88.2	942	87.3	89.7	87.3	2.4
J-860	742.4	947.1	88.6	943.3	86.9	941.3	86.1	88.6	86.1	2.5
J-870	742.9	947.1	88.3	943.3	86.7	941.3	85.8	88.3	85.8	2.5
J-880	745.1	947.1	87.4	943.3	85.7	941.3	84.9	87.4	84.9	2.5
J-910	740.7	947.1	89.3	943.5	87.7	941.5	86.9	89.3	86.9	2.4
J-940	745.7	947.1	87.2	943.5	85.6	941.5	84.7	87.2	84.7	2.5
J-950	741.7	947.2	88.9	943.5	87.3	941.6	86.5	88.9	86.5	2.4
J-960	740	947.2	89.6	943.5	88.1	941.6	87.2	89.6	87.2	2.4
J-970	744	947.2	87.9	943.6	86.4	941.7	85.6	87.9	85.6	2.3
J-980	741	947.2	89.2	943.6	87.7	941.7	86.9	89.2	86.9	2.3
J-990	741.3	947.2	89.1	943.6	87.5	941.7	86.7	89.1	86.7	2.4
J-995	741.3	947.2	89.1	943.6	87.5	941.7	86.7	89.1	86.7	2.4
J-1010	741.6	947.2	88.9	943.6	87.4	941.7	86.6	88.9	86.6	2.3
J-1030	743.7	947.2	88	943.6	86.5	941.7	85.7	88	85.7	2.3
J-1060	743.9	949	88.8	945.5	87.2	943.6	86.4	88.8	86.4	2.4
J-1090	744.5	948.8	88.4	945.2	86.9	943.4	86.1	88.4	86.1	2.3
J-1120	744.5	948.4	88.2	944.6	86.6	942.6	85.7	88.2	85.7	2.5
J-1130	741.7	948.3	89.4	944.4	87.7	942.4	86.8	89.4	86.8	2.6
J-1150	740.7	947.5	89.5	943.1	87.6	940.7	86.5	89.5	86.5	3

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1180	742.7	947.5	88.6	943.1	86.7	940.7	85.7	88.6	85.7	2.9
J-1190	742.8	947.2	88.4	942.5	86.4	940	85.3	88.4	85.3	3.1
J-1210	742.8	947.2	88.4	942.5	86.4	940	85.3	88.4	85.3	3.1
J-1220	742.8	947.1	88.4	942.4	86.4	939.9	85.3	88.4	85.3	3.1
J-1227	744.2	946.5	87.5	941.6	85.4	938.9	84.3	87.5	84.3	3.2
J-1240	745.2	946.3	87	941.4	84.9	938.7	83.7	87	83.7	3.3
J-1250	742.8	946.5	88.1	941.9	86.2	939.4	85.1	88.1	85.1	3
J-1260	742.1	946.5	88.4	941.9	86.5	939.4	85.4	88.4	85.4	3
J-1280	743.9	946.5	87.7	941.9	85.7	939.4	84.6	87.7	84.6	3.1
J-1290	743	946.5	88	941.9	86.1	939.4	85	88	85	3
J-1300	746	946.5	86.8	941.9	84.8	939.4	83.7	86.8	83.7	3.1
J-1310	746.2	946.5	86.7	941.9	84.7	939.4	83.6	86.7	83.6	3.1
J-1320	745.9	946.5	86.8	941.9	84.8	939.4	83.7	86.8	83.7	3.1
J-1330	746.2	946.5	86.7	941.9	84.7	939.4	83.6	86.7	83.6	3.1
J-1350	740.4	946.7	89.2	942.3	87.4	940	86.4	89.2	86.4	2.8
J-1360	745.3	946.7	87.1	942.3	85.2	940	84.2	87.1	84.2	2.9
J-1362	740.4	946.9	89.3	942.9	87.6	940.7	86.7	89.3	86.7	2.6
J-1364	741.4	946.9	88.9	942.9	87.2	940.7	86.2	88.9	86.2	2.7
J-1370	740.9	946.9	89.1	942.9	87.4	940.8	86.5	89.1	86.5	2.6
J-1380	746	946.9	86.9	942.9	85.2	940.8	84.3	86.9	84.3	2.6
J-1390	740.1	951.2	91.3	948.5	90.2	947.1	89.6	91.3	89.6	1.7
J-1400	746	951	88.7	948.3	87.5	947	86.9	88.7	86.9	1.8
J-1420	746	950.9	88.6	948.2	87.5	946.8	86.9	88.6	86.9	1.7
J-1440	746	950.6	88.5	947.9	87.4	946.6	86.8	88.5	86.8	1.7
J-1450	746	950.7	88.6	948	87.4	946.6	86.8	88.6	86.8	1.8
J-1470	740	951	91.3	948.2	90.1	946.9	89.5	91.3	89.5	1.8
J-1490	738.3	949.5	91.4	946.4	90.1	944.9	89.4	91.4	89.4	2
J-1495	739.4	949.5	90.9	946.4	89.6	944.9	88.9	90.9	88.9	2
J-1510	744	949.1	88.8	946.1	87.4	944.5	86.8	88.8	86.8	2

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1520	744	949.1	88.8	946.1	87.4	944.5	86.8	88.8	86.8	2
J-1530	744	947.8	88.2	944.7	86.8	943.2	86.2	88.2	86.2	2
J-1540	740	948.7	90.3	945.4	88.9	943.8	88.2	90.3	88.2	2.1
J-1560	739.5	947.4	90	943.9	88.4	942.1	87.7	90	87.7	2.3
J-1570	739.5	943.6	88.3	940.1	86.8	938.3	86	88.3	86	2.3
J-1580	741	947.4	89.3	943.7	87.7	941.9	86.9	89.3	86.9	2.4
J-1630	740.7	947.4	89.4	943.7	87.8	941.8	87	89.4	87	2.4
J-1670	741.4	947.4	89.1	943.7	87.5	941.8	86.7	89.1	86.7	2.4
J-1690	741.4	947.4	89.1	943.7	87.5	941.8	86.7	89.1	86.7	2.4
J-1700	742.3	947.4	88.7	943.7	87.1	941.8	86.3	88.7	86.3	2.4
J-1710	741	947.1	89.2	943.5	87.6	941.6	86.8	89.2	86.8	2.4
J-1730	742	946.5	88.5	942.8	86.9	940.9	86.1	88.5	86.1	2.4
J-1731	740	948.6	90.2	945.2	88.8	943.6	88.1	90.2	88.1	2.1
J-1732	740	948.6	90.2	945.2	88.8	943.6	88.1	90.2	88.1	2.1
J-1738	742	947.4	88.9	943.7	87.3	941.8	86.5	88.9	86.5	2.4
J-1760	742.7	947.4	88.5	943.7	87	941.8	86.2	88.5	86.2	2.3
J-1770	743	947.3	88.4	943.7	86.8	941.8	86	88.4	86	2.4
J-1780	744	946.6	87.7	942.7	86	940.7	85.1	87.7	85.1	2.6
J-1784	746	946.7	86.8	942.7	85.1	940.7	84.2	86.8	84.2	2.6
J-1786	747	946.5	86.3	942.6	84.6	940.6	83.8	86.3	83.8	2.5
J-1790	753.5	946.2	83.4	941.4	81.3	938.9	80.2	83.4	80.2	3.2
J-1792	748.1	946.6	85.9	942.6	84.2	940.6	83.3	85.9	83.3	2.6
J-1795	764.9	946.1	78.4	941.3	76.3	938.8	75.3	78.4	75.3	3.1
J-1796	747.3	946.6	86.2	942.4	84.4	940.3	83.5	86.2	83.5	2.7
J-1798	748	946.6	85.9	942.4	84.1	940.3	83.2	85.9	83.2	2.7
J-1800	752.9	946.2	83.6	941.4	81.6	938.9	80.5	83.6	80.5	3.1
J-1820	753.5	946.2	83.4	941.4	81.3	938.9	80.2	83.4	80.2	3.2
J-1830	760.6	946.1	80.2	941.1	78.1	938.6	77	80.2	77	3.2
J-1840	759.6	946.1	80.7	941.1	78.5	938.6	77.4	80.7	77.4	3.3

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-1850	767.8	946.1	77.1	941.1	75	938.6	73.9	77.1	73.9	3.2
J-1870	759	946.1	80.9	941.1	78.8	938.6	77.7	80.9	77.7	3.2
J-1890	759.5	946.1	80.7	941.1	78.6	938.5	77.4	80.7	77.4	3.3
J-1920	761.4	946	79.9	940.9	77.7	938.3	76.5	79.9	76.5	3.4
J-1930	761.4	946	79.9	940.9	77.7	938.3	76.5	79.9	76.5	3.4
J-1940	761.5	946	79.8	940.9	77.6	938.2	76.5	79.8	76.5	3.3
J-1980	763.9	945.9	78.7	940.6	76.5	937.8	75.3	78.7	75.3	3.4
J-1990	763.9	945.9	78.7	940.6	76.5	937.8	75.3	78.7	75.3	3.4
J-2000	762.9	945.9	79.2	940.6	76.9	937.8	75.7	79.2	75.7	3.5
J-2040	762.6	945.9	79.3	940.5	77	937.7	75.8	79.3	75.8	3.5
J-2060	763.3	945.8	79	940.4	76.6	937.6	75.4	79	75.4	3.6
J-2100	758.1	945.8	81.2	940.2	78.8	937.3	77.5	81.2	77.5	3.7
J-2110	761	945.8	79.9	940.2	77.6	937.3	76.3	79.9	76.3	3.6
J-2120	758.1	945.7	81.2	940.2	78.8	937.3	77.5	81.2	77.5	3.7
J-2130	758.2	945.9	81.2	940.5	78.9	937.8	77.7	81.2	77.7	3.5
J-2140	760.1	946	80.4	940.8	78.2	938.2	77	80.4	77	3.4
J-2145	766	946	77.9	940.8	75.6	938.2	74.5	77.9	74.5	3.4
J-2150	744.6	946.6	87.4	941.4	85.1	938.6	83.9	87.4	83.9	3.5
J-2160	753.3	945.5	83.2	939.6	80.6	936.5	79.3	83.2	79.3	3.9
J-2180	751.3	945.4	84	939.3	81.3	936.1	79.9	84	79.9	4.1
J-2220	745	945.3	86.7	939.1	84	935.8	82.5	86.7	82.5	4.2
J-2240	744.5	945.3	86.9	939	84.1	935.6	82.7	86.9	82.7	4.2
J-2250	743	945.3	87.5	939	84.8	935.6	83.3	87.5	83.3	4.2
J-2260	745	945.9	86.9	940.1	84.4	937	83.1	86.9	83.1	3.8
J-2280	745	945.9	86.9	940.2	84.4	937.1	83.1	86.9	83.1	3.8
J-2290	745	945.9	86.9	940.2	84.4	937.1	83.1	86.9	83.1	3.8
J-2300	743.8	946.6	87.7	941.4	85.5	938.6	84.3	87.7	84.3	3.4
J-2320	744.3	946.9	87.7	942	85.5	939.4	84.4	87.7	84.4	3.3
J-2350	745.2	946.9	87.3	942	85.1	939.4	84	87.3	84	3.3

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-2360	746.2	946.3	86.6	941.3	84.4	938.7	83.3	86.6	83.3	3.3
J-2380	749.2	945.9	85.1	940.6	82.8	937.7	81.6	85.1	81.6	3.5
J-2400	750.5	945.7	84.5	940.2	82.1	937.2	80.8	84.5	80.8	3.7
J-2412	751	946.4	84.5	941.4	82.4	938.7	81.2	84.5	81.2	3.3
J-2420	742	945.2	87.9	939.2	85.3	935.9	83.9	87.9	83.9	4
J-2430	743	944.9	87.4	938.6	84.6	935	83.1	87.4	83.1	4.3
J-2440	746	944.1	85.7	937.8	83	934.3	81.5	85.7	81.5	4.2
J-2460	746	944	85.7	937.7	82.9	934.1	81.4	85.7	81.4	4.3
J-2470	748	944.8	85.1	938.2	82.3	934.5	80.7	85.1	80.7	4.4
J-2480	746.3	945.1	86	938.7	83.2	935.2	81.7	86	81.7	4.3
J-2490	742	945.1	87.9	938.7	85.1	935.2	83.6	87.9	83.6	4.3
J-2530	743.8	945.1	87.1	938.7	84.3	935.2	82.8	87.1	82.8	4.3
J-2540	744	944.1	86.6	937.7	83.8	933.7	82.1	86.6	82.1	4.5
J-2570	743	944	87	937.6	84.2	933.6	82.5	87	82.5	4.5
J-2580	742	944.1	87.4	937.6	84.6	933.7	82.9	87.4	82.9	4.5
J-2610	745	942.8	85.6	936.4	82.8	932.4	81.1	85.6	81.1	4.5
J-2620	743	944.1	87	937.6	84.2	933.7	82.5	87	82.5	4.5
J-2630	743	944.1	87	937.6	84.2	933.7	82.5	87	82.5	4.5
J-2640	744	944.1	86.6	937.6	83.8	933.6	82	86.6	82	4.6
J-2650	746	940.7	84.2	934.2	81.4	930.2	79.7	84.2	79.7	4.5
J-2660	746	939.4	83.7	932.9	80.9	928.9	79.1	83.7	79.1	4.6
J-2670	746	940.6	84.2	934.1	81.4	930.1	79.7	84.2	79.7	4.5
J-2690	746	940.6	84.2	934	81.4	930	79.6	84.2	79.6	4.6
J-2700	743	944.7	87.3	938.1	84.4	934	82.6	87.3	82.6	4.7
J-2730	744	944.5	86.8	937.9	83.9	933.8	82.1	86.8	82.1	4.7
J-2740	745	945.6	86.8	938.8	83.9	934.6	82	86.8	82	4.8
J-2750	743	949.1	89.2	942.6	86.3	938.4	84.6	89.2	84.6	4.6
J-2770	741.2	949.1	90	942.6	87.1	938.4	85.3	90	85.3	4.7
J-2780	746	945.3	86.2	938.5	83.3	934.1	81.4	86.2	81.4	4.8

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-2790	744	945.3	87.1	938.5	84.1	933.7	82.1	87.1	82.1	5
J-2790add.	744	945.3	87.1	938.5	84.1	933.7	82.1	87.1	82.1	5
J-2790add2	743	945.3	87.5	938.5	84.6	933.9	82.6	87.5	82.6	4.9
J-2820	744	944.8	86.9	937.9	83.9	933.8	82.1	86.9	82.1	4.8
J-2830	744	942.9	86.1	936	83.1	932	81.3	86.1	81.3	4.8
J-2850	746	939.5	83.7	932.6	80.7	928.6	79	83.7	79	4.7
J-2860	740.2	944.7	88.5	937.8	85.5	933.8	83.8	88.5	83.8	4.7
J-2870	748	944.6	85.1	937.8	82.1	934	80.5	85.1	80.5	4.6
J-2890	748	944.6	85.1	937.8	82.1	934	80.5	85.1	80.5	4.6
J-2900 (alt. p trans)	753	942.9	82.2	936.1	79.2	932.2	77.5	82.2	77.5	4.7
J-2900vsp	744.7	942.9	85.7	936.1	82.8	932.2	81.1	85.7	81.1	4.6
J-2930	750	945.2	84.5	938.7	81.7	935.3	80.2	84.5	80.2	4.3
J-2940	746	945.2	86.2	938.7	83.4	935.3	81.9	86.2	81.9	4.3
J-2950	740.4	944.9	88.5	937.9	85.5	934.4	83.9	88.5	83.9	4.6
J-2960	744.7	944.9	86.6	937.9	83.6	934.4	82.1	86.6	82.1	4.5
J-2970	745	944.9	86.5	937.9	83.5	934.4	81.9	86.5	81.9	4.6
J-2980	740.6	944.9	88.4	937.9	85.4	934.4	83.8	88.4	83.8	4.6
J-2990	741.5	944.7	87.9	937	84.6	933.3	83	87.9	83	4.9
J-3020	741.8	944.7	87.8	937.1	84.5	933.3	82.9	87.8	82.9	4.9
J-3030	740.4	944.7	88.4	937.6	85.3	933.7	83.6	88.4	83.6	4.8
J-3040	743.1	944.7	87.2	937.6	84.1	933.7	82.5	87.2	82.5	4.7
J-3050	744.1	943.9	86.4	933.9	82.1	930.2	80.5	86.4	80.5	5.9
J-3060	745	943.9	86.1	934.1	81.8	930.4	80.2	86.1	80.2	5.9
J-3070	743.8	943.9	86.6	934.1	82.3	930.4	80.7	86.6	80.7	5.9
J-3075	744.2	944	86.4	934.2	82.2	930.5	80.6	86.4	80.6	5.8
J-3080	744	943.9	86.5	934.2	82.3	930.5	80.7	86.5	80.7	5.8
J-3100	744	943.9	86.5	934.1	82.3	930.4	80.7	86.5	80.7	5.8
J-3110	744.2	944	86.4	934.3	82.2	930.6	80.7	86.4	80.7	5.7
J-3120	744	944	86.5	934.3	82.3	930.6	80.7	86.5	80.7	5.8

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-3130	744.2	944	86.4	934.4	82.3	930.7	80.7	86.4	80.7	5.7
J-3140	744	944	86.5	934.4	82.4	930.7	80.8	86.5	80.8	5.7
J-3190	744.2	944.1	86.5	934.6	82.4	931	80.8	86.5	80.8	5.7
J-3200	744.2	944.1	86.5	934.6	82.4	931	80.8	86.5	80.8	5.7
J-3210	744	944.3	86.7	935.3	82.8	931.6	81.2	86.7	81.2	5.5
J-3220	744.8	944.3	86.3	935.3	82.4	931.6	80.8	86.3	80.8	5.5
J-3225	744	944.5	86.7	935.8	83	932.1	81.4	86.7	81.4	5.3
J-3240	744	944.5	86.7	935.8	83	932.2	81.4	86.7	81.4	5.3
J-3250	743.5	944.5	86.9	935.8	83.2	932.2	81.6	86.9	81.6	5.3
J-3260	743.5	944.5	87	935.9	83.2	932.3	81.7	87	81.7	5.3
J-3270	743	944.6	87.2	936	83.5	932.4	81.9	87.2	81.9	5.3
J-3280	742.8	944.6	87.3	936	83.6	932.4	82	87.3	82	5.3
J-3290	742.8	944.6	87.3	936	83.6	932.4	82	87.3	82	5.3
J-3320	743.5	944.5	87	935.9	83.3	932.3	81.7	87	81.7	5.3
J-3340	745.4	944.5	86.2	936.1	82.5	932.4	80.9	86.2	80.9	5.3
J-3352	740.1	944.5	88.5	936.3	84.9	932.6	83.3	88.5	83.3	5.2
J-3354	740.1	944.5	88.5	936.3	84.9	932.6	83.3	88.5	83.3	5.2
J-3356	740.1	944.6	88.5	936.4	84.9	932.7	83.3	88.5	83.3	5.2
J-3358	740.1	944.6	88.5	936.4	84.9	932.7	83.3	88.5	83.3	5.2
J-3380	741.8	944.6	87.7	936.6	84.3	932.9	82.7	87.7	82.7	5
J-3390	740.5	944.6	88.3	936.6	84.8	932.9	83.2	88.3	83.2	5.1
J-3400	741.8	944.6	87.8	936.9	84.4	933.2	82.8	87.8	82.8	5
J-3420	744	943.3	86.2	931.3	81.1	927.7	79.5	86.2	79.5	6.7
J-3427	750	953.1	87.9	949.2	86.2	947.4	85.4	87.9	85.4	2.5
J-3450	747	949.5	87.6	943.6	85.1	941	83.9	87.6	83.9	3.7
J-3460	747	949.5	87.6	943.6	85.1	941	83.9	87.6	83.9	3.7
J-3480	743.6	942.9	86.2	929.6	80.5	925.9	78.9	86.2	78.9	7.3
J-3490	743.9	942.9	86.1	929.6	80.3	925.9	78.7	86.1	78.7	7.4
J-3500	743.4	941.7	85.8	924.7	78.4	921	76.8	85.8	76.8	9

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-3508	745	941	84.8	922.5	76.8	918.9	75.2	84.8	75.2	9.6
J-3515	745	941.5	85	923.8	77.3	920.1	75.8	85	75.8	9.2
J-3520	745.3	941.2	84.8	922.1	76.5	918.4	74.9	84.8	74.9	9.9
J-3530	742	941.2	86.2	922.1	77.9	918.4	76.3	86.2	76.3	9.9
J-3540	742.3	941.2	86.1	922.1	77.8	918.4	76.2	86.1	76.2	9.9
J-3550	738.9	941.2	87.5	922.1	79.3	918.4	77.7	87.5	77.7	9.8
J-3560	744.5	941.2	85.1	921.3	76.5	917.6	74.9	85.1	74.9	10.2
J-3570	745.2	941.1	84.8	919.8	75.6	916.1	74	84.8	74	10.8
J-3600	742.6	940.5	85.6	919.2	76.4	915.6	74.8	85.6	74.8	10.8
J-3610	741.9	941.1	86.2	919.4	76.8	915.7	75.2	86.2	75.2	11
J-3620	744.4	941.1	85.1	919.4	75.7	915.7	74.1	85.1	74.1	11
J-3640	744.1	941.1	85.2	919.4	75.9	915.7	74.3	85.2	74.3	10.9
J-3650	741.9	941.1	86.2	919.4	76.8	915.7	75.2	86.2	75.2	11
J-3680	743	941.1	85.7	919.4	76.3	915.7	74.7	85.7	74.7	11
J-3690	742	941.2	86.2	921.2	77.5	917.5	75.9	86.2	75.9	10.3
J-3720	743	941.2	85.7	921.2	77.1	917.5	75.5	85.7	75.5	10.2
J-3730	743	941.2	85.7	921.2	77.1	917.5	75.5	85.7	75.5	10.2
J-3740	740.5	941.2	86.8	921.2	78.2	917.5	76.6	86.8	76.6	10.2
J-3750	743	941.2	85.7	921.2	77.1	917.5	75.5	85.7	75.5	10.2
J-3755	743	941.2	85.7	921.1	77.1	917.4	75.5	85.7	75.5	10.2
J-3760	743.8	941.2	85.4	921.1	76.7	917.4	75.1	85.4	75.1	10.3
J-3770	740.5	941.2	86.8	921.1	78.1	917.4	76.5	86.8	76.5	10.3
J-3920	743	944.7	87.2	936.1	83.6	932.1	81.8	87.2	81.8	5.4
J-3930	744	944.7	86.8	936.1	83.1	932.1	81.4	86.8	81.4	5.4
J-3940	743	944.7	87.2	936.1	83.6	932.1	81.8	87.2	81.8	5.4
J-3950	743	944.7	87.2	936.1	83.6	932.1	81.8	87.2	81.8	5.4
J-3960	744	944.7	86.8	936.1	83.1	932.1	81.4	86.8	81.4	5.4
J-4122	743.7	941.7	85.7	896.5	66.1	892.7	64.5	85.7	64.5	21.2
J-4124	743.7	941.7	85.7	891.1	63.8	887.4	62.2	85.7	62.2	23.5

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With Casey's, C-4, & Minos pumps on:

		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-4140	743.9	941.1	85.3	918.8	75.7	915.1	74.1	85.3	74.1	11.2
J-4170	742.8	941.2	85.8	920.8	77	917.1	75.4	85.8	75.4	10.4
J-4180	744.9	941.2	84.9	920.8	76.1	917.1	74.5	84.9	74.5	10.4
J-4190	742.7	941.2	85.9	920.8	77.1	917.1	75.5	85.9	75.5	10.4
J-4200	744.9	941.2	84.9	920.8	76.1	917.1	74.5	84.9	74.5	10.4
J-4210	741.9	941.2	86.2	921	77.5	917.3	75.9	86.2	75.9	10.3
J-4240	740.7	941.2	86.7	921.1	78	917.4	76.4	86.7	76.4	10.3
J-4280	741.1	941.2	86.6	921.1	77.9	917.4	76.3	86.6	76.3	10.3
J-4287	741.1	941.2	86.6	921.1	77.9	917.4	76.3	86.6	76.3	10.3
J-4410 (P-Trans)	737.5	965	98.4	965	98.4	965	98.4	98.4	98.4	0
J-5005	743.6	941.2	85.5	921.1	76.8	917.4	75.2	85.5	75.2	10.3
J-5015	743.2	941.2	85.7	921.1	77	917.4	75.4	85.7	75.4	10.3
J-5020	742.1	941.2	86.1	921.1	77.4	917.4	75.8	86.1	75.8	10.3
J-5025	745	941.2	84.9	921.1	76.2	917.4	74.6	84.9	74.6	10.3
J-5030	744.8	941.2	85	921.1	76.3	917.4	74.7	85	74.7	10.3
J-5040	742	941.2	86.2	921.1	77.5	917.4	75.9	86.2	75.9	10.3
J-5070	743.3	941.2	85.6	921.1	76.9	917.4	75.3	85.6	75.3	10.3
J-5075	744	941.2	85.3	921.1	76.6	917.4	75	85.3	75	10.3
J-5100	745	949.1	88.3	942.6	85.5	938.4	83.7	88.3	83.7	4.6
J-5105	744.5	968.3	96.8	962.8	94.4	959.3	92.9	96.8	92.9	3.9
J-5125	742	988.1	106.5	983.6	104.5	980.9	103.3	106.5	103.3	3.2
J-5130	741	1,002.60	113.2	998.9	111.6	996.6	110.6	113.2	110.6	2.6
J-5135	741	1,004.30	113.9	1,000.70	112.4	998.5	111.4	113.9	111.4	2.5
J-5140	741	1,007.70	115.4	1,004.30	113.9	1,002.20	113	115.4	113	2.4
J-5142	744	1,007.70	114.1	1,004.30	112.6	1,002.20	111.7	114.1	111.7	2.4
J-5145	742	1,012.10	116.8	1,008.90	115.5	1,006.90	114.6	116.8	114.6	2.2
J-5150	742	988.1	106.5	983.6	104.5	980.9	103.3	106.5	103.3	3.2
J-5155	744.5	988.1	105.4	983.6	103.5	980.9	102.3	105.4	102.3	3.1
J-5165	742	1,013.10	117.3	1,010.00	115.9	1,008.00	115.1	117.3	115.1	2.2

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5167	746	944.1	85.7	937.8	83	934.2	81.4	85.7	81.4	4.3
J-5171	745.1	941.2	84.8	921.1	76.1	917.4	74.5	84.8	74.5	10.3
J-5177	747	951.7	88.5	946.9	86.5	944.8	85.6	88.5	85.6	2.9
J-5178	743	941.2	85.7	922.7	77.7	919	76.2	85.7	76.2	9.5
J-5179	743	941.2	85.7	922.7	77.7	919	76.2	85.7	76.2	9.5
J-5188	744	944.5	86.8	937.9	83.9	933.8	82.1	86.8	82.1	4.7
J-5189	746	940.6	84.2	934.1	81.4	930	79.6	84.2	79.6	4.6
J-5194	743.1	951.2	90	948.5	88.9	947.2	88.3	90	88.3	1.7
J-5196	745.3	941.2	84.8	921.1	76.1	917.4	74.5	84.8	74.5	10.3
J-5197	740	941.2	87	921.1	78.4	917.4	76.8	87	76.8	10.2
J-5198	741.3	941.2	86.5	921.1	77.8	917.4	76.2	86.5	76.2	10.3
J-5199	747.5	941.2	83.8	921.1	75.1	917.4	73.5	83.8	73.5	10.3
J-5200	747	941.2	84	921.1	75.3	917.4	73.7	84	73.7	10.3
J-5201	739	941.2	87.5	921.1	78.8	917.4	77.2	87.5	77.2	10.3
J-5202	739	941.2	87.5	921.1	78.8	917.4	77.2	87.5	77.2	10.3
J-5203	739	941.2	87.5	921.1	78.8	917.4	77.2	87.5	77.2	10.3
J-5204	739	941.2	87.5	921.1	78.8	917.4	77.2	87.5	77.2	10.3
J-5205	740.3	941.2	86.9	921.1	78.2	917.4	76.6	86.9	76.6	10.3
J-5206	740.3	941.2	86.9	921.1	78.2	917.4	76.6	86.9	76.6	10.3
J-5207	739.5	941.2	87.3	921.1	78.6	917.4	77	87.3	77	10.3
J-5208	738.5	941.2	87.7	921.1	79	917.4	77.4	87.7	77.4	10.3
J-5209	739.5	941.2	87.3	921.1	78.6	917.4	77	87.3	77	10.3
J-5210	739.5	941.2	87.3	921.1	78.6	917.4	77	87.3	77	10.3
J-5214	742.5	941.2	86	921.1	77.3	917.4	75.7	86	75.7	10.3
J-5217	746	941.2	84.4	921.1	75.7	917.4	74.1	84.4	74.1	10.3
J-5217	745.5	941.2	84.7	921.1	76	917.4	74.4	84.7	74.4	10.3
J-5218	742	941.2	86.2	921.1	77.5	917.4	75.9	86.2	75.9	10.3
J-5219	746	941.2	84.4	921.1	75.7	917.4	74.1	84.4	74.1	10.3
J-5221	742	941.2	86.2	921	77.5	917.4	75.9	86.2	75.9	10.3

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5223	741	941.2	86.6	921	77.9	917.4	76.3	86.6	76.3	10.3
J-5223	743	944.1	87	937.6	84.2	933.7	82.5	87	82.5	4.5
J-5224	743	944.1	87	937.6	84.2	933.7	82.5	87	82.5	4.5
J-5225	741.5	1,001.40	112.5	997.7	110.9	995.4	109.8	112.5	109.8	2.7
J-5226	741.5	1,001.40	112.5	997.7	110.9	995.4	109.8	112.5	109.8	2.7
J-5227	741.5	997.4	110.7	993.5	109	991	107.9	110.7	107.9	2.8
J-5228	741	997.4	110.9	993.5	109.2	991	108.2	110.9	108.2	2.7
J-5230	738.5	941.2	87.7	921.1	79	917.4	77.4	87.7	77.4	10.3
J-5231	739	941.2	87.5	921.1	78.8	917.4	77.2	87.5	77.2	10.3
J-5232	743	941.2	85.7	921.1	77	917.4	75.4	85.7	75.4	10.3
J-5233	743	941.2	85.7	921.1	77	917.4	75.4	85.7	75.4	10.3
J-5234	744	947.1	87.9	942.4	85.8	939.8	84.7	87.9	84.7	3.2
J-5234	743	941.2	85.7	921.1	77	917.4	75.4	85.7	75.4	10.3
J-5235	746	941.2	84.4	921.1	75.8	917.4	74.2	84.4	74.2	10.2
J-5237	743	944.7	87.3	936.2	83.6	932.6	82	87.3	82	5.3
J-5238	743	944.5	87.2	936	83.5	932.3	81.9	87.2	81.9	5.3
J-5239	743	944.5	87.2	936	83.5	932.3	81.9	87.2	81.9	5.3
J-5240	743.9	945.6	87.3	942.7	86	941.3	85.4	87.3	85.4	1.9
J-5241	739.8	949.4	90.7	946.9	89.6	945.7	89	90.7	89	1.7
J-5242	738	937.8	86.4	935	85.2	933.7	84.7	86.4	84.7	1.7
J-5243	736	938.4	87.6	935.7	86.4	934.3	85.8	87.6	85.8	1.8
J-5244	745.4	944.5	86.2	937.9	83.3	933.8	81.5	86.2	81.5	4.7
J-5246	744.8	941.1	85	920.7	76.1	917	74.5	85	74.5	10.5
J-5247	746.6	941.1	84.1	919.6	74.8	915.9	73.2	84.1	73.2	10.9
J-5258	738.3	956.2	94.3	954.6	93.6	953.8	93.2	94.3	93.2	1.1
J-5260	742	952.2	90.9	949.8	89.9	948.6	89.4	90.9	89.4	1.5
J-5261	744.4	947.3	87.8	943.8	86.3	942.1	85.5	87.8	85.5	2.3
J-5262	741.4	947.8	89.3	943.6	87.5	941.3	86.5	89.3	86.5	2.8
J-5263	753	945.3	83.2	939	80.5	935.6	79	83.2	79	4.2

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		2013 Max Day		2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)		2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)				
Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)	High	Low	Difference
J-5264	740.7	955.5	92.9	953.7	92.1	952.8	91.8	92.9	91.8	1.1
J-5266	742.2	951.4	90.5	949.1	89.5	947.9	89	90.5	89	1.5
J-5271	740.3	955.2	93	953.3	92.2	952.4	91.8	93	91.8	1.2
J-5276	743.6	947.3	88.1	943.9	86.7	942.2	85.9	88.1	85.9	2.2
J-5281	739.9	941.2	87.1	921.1	78.4	917.4	76.8	87.1	76.8	10.3
J-5282	743.1	941.2	85.7	921.1	77	917.4	75.4	85.7	75.4	10.3
J-5284	746	941.2	84.4	921.3	75.8	917.6	74.2	84.4	74.2	10.2
J-5291	748	947.2	86.2	943.6	84.6	941.7	83.8	86.2	83.8	2.4
J-5295	742	944.7	87.7	937.1	84.4	933.3	82.8	87.7	82.8	4.9
J-5296	746	942.6	85.1	908.7	70.4	904.9	68.7	85.1	68.7	16.4
J-5298	744	938.4	84.1	935.6	82.9	934.2	82.3	84.1	82.3	1.8
J-5301	745	951.7	89.4	946.9	87.4	944.8	86.4	89.4	86.4	3.0
J-5302	745	951.5	89.3	946.6	87.2	944.4	86.3	89.3	86.3	3.0
J-5303	746.2	951.5	88.8	946.6	86.7	944.4	85.8	88.8	85.8	3.0
J-5306	746	944.9	86.0	938	83.1	933.9	81.3	86.0	81.3	4.7
J-5307	746	945.1	86.1	938.2	83.2	934	81.4	86.1	81.4	4.7
J-5308	746	945.2	86.2	938.4	83.2	934.1	81.4	86.2	81.4	4.8
J-5309	745	945.3	86.7	938.5	83.7	934.2	81.8	86.7	81.8	4.9
J-5310	747	945.3	85.8	938.5	82.8	934.2	81.0	85.8	81.0	4.8
J-5311	746.5	945.3	86.0	938.5	83.1	934.2	81.2	86.0	81.2	4.8
J-5313	745	942.9	85.6	936.4	82.8	932.5	81.1	85.6	81.1	4.5
J-5314	743.7	941.7	85.7	892.8	64.5	889	62.9	85.7	62.9	22.8
J-5315	742.6	945.1	87.6	936.9	84.1	933.4	82.5	87.6	82.5	5.1

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With Casey's, C-4 & Minos pumps on:

			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
H-27	1,000	20	TRUE	2,856	20	TRUE	2,690	20	TRUE	2,607	20	2,856	2,607	249
H-28	1,000	20	TRUE	3,991	30	TRUE	3,305	40.4	TRUE	2,985	44.5	3,991	2,985	1006
H-29	1,000	20	TRUE	1,053	20	FALSE	887	20	FALSE	868	20	1,053	868	185
H-30	1,000	20	TRUE	1,264	20	TRUE	1,045	20	TRUE	1,021	20	1,264	1,021	243
H-33	1,000	20	TRUE	1,794	20	TRUE	1,410	20	TRUE	1,373	20	1,794	1,373	421
H-34	1,000	20	TRUE	1,553	20	TRUE	1,210	20	TRUE	1,179	20	1,553	1,179	374
H-35	1,000	20	TRUE	1,382	20	FALSE	736	22.3	FALSE	711	22.4	1,382	711	671
H-36	1,000	20	TRUE	1,230	20	FALSE	655	20.2	FALSE	632	20.3	1,230	632	598
H-37	1,000	20	TRUE	1,104	20	FALSE	699	20.1	FALSE	678	20	1,104	678	426
H-38	1,000	20	TRUE	1,125	20	FALSE	810	20	FALSE	787	20	1,125	787	338
H-39	1,000	20	TRUE	1,357	20	TRUE	1,079	20	TRUE	1,050	20	1,357	1,050	307
H-40	1,000	20	TRUE	1,566	20	TRUE	1,394	20.2	TRUE	1,360	20.2	1,566	1,360	206
H-41	1,000	20	FALSE	919	20	FALSE	845	20	FALSE	828	20	919	828	91
H-42	1,000	20	TRUE	2,896	20	TRUE	2,826	20	TRUE	2,760	20	2,896	2,760	136
H-44	1,000	20	TRUE	3,923	20	TRUE	3,298	30.4	TRUE	3,013	34.3	3,923	3,013	910
H-45	1,000	20	TRUE	2,305	20	TRUE	2,200	20	TRUE	2,130	20	2,305	2,130	175
H-46	1,000	20	TRUE	3,387	20	TRUE	3,170	20	TRUE	2,988	22.7	3,387	2,988	399
H-49	1,000	20	TRUE	3,137	20	TRUE	2,972	20	TRUE	2,889	20	3,137	2,889	248
H-50	1,000	20	TRUE	2,919	20	TRUE	2,763	20	TRUE	2,683	20	2,919	2,683	236
H-51	1,000	20	TRUE	2,250	20	TRUE	2,146	20	TRUE	2,072	20	2,250	2,072	178
H-52	1,000	20	TRUE	3,176	20	TRUE	2,968	20	TRUE	2,862	20	3,176	2,862	314
H-53	1,000	20	TRUE	4,153	49	TRUE	3,220	56	TRUE	2,867	57.6	4,153	2,867	1286
H-55	1,000	20	TRUE	2,010	20	TRUE	1,960	20	TRUE	1,907	20	2,010	1,907	103
H-57	1,000	20	TRUE	2,071	20	TRUE	2,013	20	TRUE	1,960	20	2,071	1,960	111
H-58	1,000	20	TRUE	2,570	20	TRUE	2,439	20	TRUE	2,373	20	2,570	2,373	197
H-59	1,000	20	TRUE	2,255	20	TRUE	2,164	20	TRUE	2,101	20	2,255	2,101	154
H-60	1,000	20	TRUE	2,443	20	TRUE	2,318	20	TRUE	2,250	20	2,443	2,250	193
H-61	1,000	20	TRUE	2,079	20	TRUE	2,015	20	TRUE	1,957	20	2,079	1,957	122
H-62	1,000	20	TRUE	2,854	20	TRUE	2,636	20	TRUE	2,519	20	2,854	2,519	335
H-63	1,000	20	TRUE	1,638	21	TRUE	1,573	20.9	TRUE	1,538	20.9	1,638	1,538	100
H-64	1,000	20	TRUE	2,283	20	TRUE	2,165	20	TRUE	2,081	20	2,283	2,081	202
H-65	1,000	20	TRUE	2,027	20	TRUE	1,943	20	TRUE	1,877	20	2,027	1,877	150

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			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
H-66	1,000	20	TRUE	2,220	20	TRUE	2,102	20	TRUE	2,012	20	2,220	2,012	208
H-67	1,000	20	TRUE	1,456	20	TRUE	1,396	20	TRUE	1,363	20	1,456	1,363	93
H-68	1,000	20	TRUE	3,973	46	TRUE	3,433	44.9	TRUE	3,136	45	3,973	3,136	837
H-72	1,000	20	TRUE	1,843	20	TRUE	1,786	20	TRUE	1,746	20	1,843	1,746	97
H-73	1,000	20	TRUE	1,775	21	TRUE	1,723	21	TRUE	1,691	21	1,775	1,691	84
H-74	1,000	20	TRUE	1,500	20	TRUE	1,465	20	TRUE	1,447	20	1,500	1,447	53
H-75	1,000	20	TRUE	3,370	20	TRUE	3,166	20	TRUE	2,939	24.8	3,370	2,939	431
H-76	1,000	20	TRUE	3,974	25	TRUE	3,277	37.2	TRUE	2,945	42.4	3,974	2,945	1029
H-77	1,000	20	TRUE	3,991	36	TRUE	3,288	45.3	TRUE	2,960	49	3,991	2,960	1031
H-78	1,000	20	TRUE	4,070	40	TRUE	3,274	49.6	TRUE	2,930	52.9	4,070	2,930	1140
H-79	1,000	20	TRUE	3,958	64	TRUE	3,352	64.2	TRUE	3,046	64.6	3,958	3,046	912
H-80	1,000	20	TRUE	3,974	50	TRUE	3,273	55.5	TRUE	2,968	57.2	3,974	2,968	1006
H-82	1,000	20	TRUE	2,465	20	TRUE	2,339	20	TRUE	2,273	20	2,465	2,273	192
H-83	1,000	20	TRUE	3,942	43	TRUE	3,350	49.4	TRUE	3,067	51.9	3,942	3,067	875
H-84	1,000	20	TRUE	3,962	33	TRUE	3,314	42.1	TRUE	3,013	45.8	3,962	3,013	949
H-85	1,000	20	TRUE	1,719	20	TRUE	1,694	20	TRUE	1,671	20	1,719	1,671	48
H-86	1,000	20	TRUE	1,925	20	TRUE	1,893	20	TRUE	1,850	20	1,925	1,850	75
H-87	1,000	20	TRUE	1,922	20	TRUE	1,903	20	TRUE	1,871	20	1,922	1,871	51
H-88	1,000	20	TRUE	3,908	25	TRUE	3,313	37	TRUE	3,033	41.9	3,908	3,033	875
H-89	1,000	20	TRUE	2,968	20	TRUE	2,833	20	TRUE	2,767	20	2,968	2,767	201
H-90	1,000	20	TRUE	3,025	20	TRUE	2,887	20	TRUE	2,818	20	3,025	2,818	207
H-91	1,000	20	TRUE	3,627	20	TRUE	3,325	24.5	TRUE	3,045	31.3	3,627	3,045	582
H-92	1,000	20	TRUE	3,206	20	TRUE	2,977	20	TRUE	2,863	20	3,206	2,863	343
H-95	1,000	20	TRUE	4,525	20	TRUE	3,424	32.7	TRUE	3,182	33.4	4,525	3,182	1343
H-97	1,000	20	TRUE	2,387	20	TRUE	2,184	20	TRUE	2,102	20	2,387	2,102	285
H-98	1,000	20	TRUE	2,574	20	TRUE	2,332	20	TRUE	2,243	20	2,574	2,243	331
H-99	1,000	20	TRUE	3,752	20	TRUE	3,202	23.4	TRUE	2,978	25.5	3,752	2,978	774
H-100	1,000	20	TRUE	2,044	20	TRUE	1,901	20	TRUE	1,851	20	2,044	1,851	193
H-101	1,000	20	TRUE	1,505	20	TRUE	1,414	20	TRUE	1,386	20	1,505	1,386	119
H-103	1,000	20	TRUE	2,079	20	TRUE	1,683	20	TRUE	1,638	20	2,079	1,638	441
H-105	1,000	20	TRUE	1,743	20	TRUE	1,328	20	TRUE	1,292	20	1,743	1,292	451
H-107	1,000	20	TRUE	1,599	20	TRUE	1,281	20.1	TRUE	1,249	20.1	1,599	1,249	350

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H-108	1,000	20	TRUE	3,901	67	TRUE	3,308	67.2	TRUE	3,030	67.5	3,901	3,030	871
H-109	1,000	20	TRUE	1,145	20	FALSE	928	20.2	FALSE	906	20.2	1,145	906	239
H-111	1,000	20	TRUE	1,783	20	TRUE	1,389	20	TRUE	1,352	20	1,783	1,352	431
H-112	1,000	20	TRUE	3,020	20	TRUE	2,831	20	TRUE	2,735	20	3,020	2,735	285
H-113	1,000	20	TRUE	3,342	20	TRUE	2,998	20	TRUE	2,864	20	3,342	2,864	478
H-114	1,000	20	TRUE	3,912	60	TRUE	3,317	61.9	TRUE	3,037	62.9	3,912	3,037	875
H-115	1,000	20	TRUE	3,926	33	TRUE	3,331	42.2	TRUE	3,049	45.9	3,926	3,049	877
H-116	1,000	20	TRUE	3,935	53	TRUE	3,341	56	TRUE	3,058	57.5	3,935	3,058	877
H-117	1,000	20	TRUE	3,928	36	TRUE	3,333	44	TRUE	3,051	47.6	3,928	3,051	877
H-119	1,000	20	TRUE	3,429	20	TRUE	3,156	20	TRUE	3,023	20	3,429	3,023	406
H-121	1,000	20	TRUE	4,033	21	TRUE	3,353	28.7	TRUE	3,048	31.8	4,033	3,048	985
H-122	1,000	20	TRUE	2,441	20	TRUE	2,288	20	TRUE	2,202	20	2,441	2,202	239
H-123	1000	20	FALSE	994	20	FALSE	964	20	FALSE	954	20	994	954	40
H-123	1,000	20	TRUE	1,812	20	TRUE	1,749	20	TRUE	1,710	20	1,812	1,710	102
H-124	1,000	20	TRUE	3,772	20	TRUE	3,336	23	TRUE	3,031	26.8	3,772	3,031	741
H-126	1,000	20	TRUE	2,449	20	TRUE	2,299	20	TRUE	2,215	20	2,449	2,215	234
H-127	1,000	20	TRUE	2,617	20	TRUE	2,433	20	TRUE	2,340	20	2,617	2,340	277
H-128	1,000	20	TRUE	3,817	20	TRUE	3,331	24.5	TRUE	3,023	28.3	3,817	3,023	794
H-130	1,000	20	TRUE	2,232	20	TRUE	2,131	20	TRUE	2,059	20	2,232	2,059	173
H-131	665	35.1	TRUE	1,182	35	TRUE	1,132	35.1	TRUE	1,106	35.1	1,182	1,106	76
H-132	1,000	20	FALSE	941	20	FALSE	908	20	FALSE	897	20	941	897	44
H-138	1,000	20	TRUE	1,776	22	TRUE	1,381	21.8	TRUE	1,343	21.8	1,776	1,343	433
H-141	1,000	20	TRUE	1,713	21	TRUE	1,340	20.9	TRUE	1,303	20.9	1,713	1,303	410
H-142	1,000	20	TRUE	1,705	20	TRUE	1,335	20	TRUE	1,299	20	1,705	1,299	406
H-146	1,000	20	TRUE	1,722	20	TRUE	1,356	20.4	TRUE	1,319	20.5	1,722	1,319	403
H-150	1,000	20	TRUE	1,712	21	TRUE	1,353	21	TRUE	1,318	21	1,712	1,318	394
H-153	1,000	20	TRUE	1,729	20	TRUE	1,366	20.1	TRUE	1,331	20.1	1,729	1,331	398
H-155	1,000	20	TRUE	1,729	20	TRUE	1,366	20.2	TRUE	1,330	20.3	1,729	1,330	399
H-158	1,000	20	TRUE	1,373	20	TRUE	1,123	20	TRUE	1,097	20	1,373	1,097	276
H-159	1,000	20	TRUE	1,537	20	TRUE	1,236	20	TRUE	1,206	20	1,537	1,206	331
H-168	1,000	20	TRUE	1,780	20	TRUE	1,391	20	TRUE	1,354	20	1,780	1,354	426
H-179	1,000	20	TRUE	2,248	20	TRUE	2,138	20	TRUE	2,061	20	2,248	2,061	187

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H-190	1,000	20	TRUE	1,817	20	TRUE	1,778	20	TRUE	1,743	20	1,817	1,743	74
H-200	1,000	20	TRUE	1,248	20	TRUE	1,034	20	TRUE	1,011	20	1,248	1,011	237
H-205	1,000	20	TRUE	1,687	20	TRUE	1,334	20	TRUE	1,300	20	1,687	1,300	387
H-209	1,000	20	TRUE	1,135	20	TRUE	1,098	20	TRUE	1,086	20	1,135	1,086	49
H-230	1,000	20	TRUE	4,276	20	TRUE	4,053	20	TRUE	3,926	20	4,276	3,926	350
H-231	1,000	20	TRUE	4,225	21	TRUE	4,013	20.8	TRUE	3,893	20.8	4,225	3,893	332
J-10	1,000	20	TRUE	3,131	87	TRUE	3,264	80.2	TRUE	2,893	81.2	3,264	2,893	371
J-20	1,000	20	TRUE	3,829	80	TRUE	3,249	80.2	TRUE	3,162	78.2	3,829	3,162	667
J-38	479	45	TRUE	787	45	TRUE	751	45.3	TRUE	739	45.3	787	739	48
J-39	1000	20	TRUE	1,054	20	TRUE	1,023	20	TRUE	1,013	20	1,054	1,013	41
J-40	1,000	20	TRUE	3,137	86.2	TRUE	3,265	78.9	TRUE	2,951	79.6	3,265	2,951	314
J-41	1,000	20	TRUE	3,139	86	TRUE	3,266	78.5	TRUE	2,951	79.3	3,266	2,951	315
J-42	1,000	20	TRUE	3,134	87	TRUE	3,265	79.3	TRUE	2,920	80.2	3,265	2,920	345
J-43	1,000	20	TRUE	2,975	94	TRUE	2,566	92.6	TRUE	2,552	90.3	2,975	2,552	423
J-44	1,000	20	TRUE	2,982	94	TRUE	2,569	92.7	TRUE	2,423	91.6	2,982	2,423	559
J-45	1,000	20	TRUE	3,141	86	TRUE	3,268	78.2	TRUE	2,968	78.8	3,268	2,968	300
J-46	1,000	20	TRUE	2,935	94	TRUE	2,538	92.1	TRUE	2,525	89.8	2,935	2,525	410
J-48	1,000	20	TRUE	1,053	20	TRUE	1,022	20	TRUE	1,011	20	1,053	1,011	42
J-49	1,000	20	TRUE	1,016	20	FALSE	986	20	FALSE	976	20	1,016	976	40
J-50	1,000	20	TRUE	3,853	76	TRUE	3,324	75.7	TRUE	2,991	76.3	3,853	2,991	862
J-51	545	57	TRUE	1,696	57	TRUE	1,571	57.4	TRUE	1,506	57.4	1,696	1,506	190
J-53	1000	20	TRUE	2,930	90	TRUE	3,287	80.3	TRUE	2,917	81.4	3,287	2,917	370
J-54	1,000	20	TRUE	3,852	77	TRUE	3,265	76.6	TRUE	2,994	76.5	3,852	2,994	858
J-55	761	30	TRUE	2,873	30	TRUE	2,754	30.3	TRUE	2,664	30.3	2,873	2,664	209
J-57	1000	20	TRUE	1,509	20	TRUE	1,438	20	TRUE	1,417	20	1,509	1,417	92
J-58	1,000	20	TRUE	1,954	20	TRUE	1,838	20	TRUE	1,804	20	1,954	1,804	150
J-59	1,000	20	TRUE	2,436	21	TRUE	1,728	26.1	TRUE	1,664	26.3	2,436	1,664	772
J-60	1,000	20	TRUE	3,862	75	TRUE	3,296	75.2	TRUE	2,999	75.4	3,862	2,999	863
J-65	1,000	20	TRUE	3,854	77	TRUE	3,324	75.9	TRUE	2,992	76.5	3,854	2,992	862
J-67(Ptrans)	1,000	20	TRUE	3,135	91	TRUE	3,260	83.5	TRUE	2,893	84.5	3,260	2,893	367
J-68	1,000	20	TRUE	3,819	81	TRUE	3,257	80.6	TRUE	3,169	78.6	3,819	3,169	650
J-69	1,000	20	TRUE	1,776	21	TRUE	1,389	21.6	TRUE	1,352	21.6	1,776	1,352	424

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J-70	1,000	20	TRUE	3,825	83	TRUE	3,249	82.6	TRUE	3,163	80.6	3,825	3,163	662
J-71	1,000	20	TRUE	1,710	20	TRUE	1,354	20	TRUE	1,319	20	1,710	1,319	391
J-73	1,000	20	TRUE	2,459	20	TRUE	2,138	20.3	TRUE	2,038	20.5	2,459	2,038	421
J-74	698	32	TRUE	946	32	TRUE	910	32.2	TRUE	898	32.2	946	898	48
J-80	1000	20	TRUE	3,230	86.9	TRUE	3,241	81	TRUE	3,157	79	3,241	3,157	84
J-90	1,000	20	TRUE	3,868	73	TRUE	3,280	73.4	TRUE	3,003	73.4	3,868	3,003	865
J-100	1,000	20	TRUE	3,868	73	TRUE	3,281	73	TRUE	3,004	73.1	3,868	3,004	864
J-110	1,000	20	TRUE	3,943	61	TRUE	3,350	61.6	TRUE	2,999	62.9	3,943	2,999	944
J-120	1,000	20	TRUE	3,950	59	TRUE	3,346	60.7	TRUE	2,965	62.5	3,950	2,965	985
J-130	1,000	20	TRUE	3,947	50	TRUE	3,355	52.4	TRUE	2,991	55	3,947	2,991	956
J-140	1,000	20	TRUE	3,945	42	TRUE	3,352	45.8	TRUE	3,012	48.7	3,945	3,012	933
J-160	1,000	20	TRUE	3,942	32	TRUE	3,349	37.7	TRUE	3,032	41.1	3,942	3,032	910
J-170	312	39	TRUE	2,524	39	TRUE	2,320	38.6	TRUE	2,217	38.6	2,524	2,217	307
J-190	1000	20	TRUE	3,935	55	TRUE	3,342	57.6	TRUE	3,057	58.8	3,935	3,057	878
J-210	1,000	20	TRUE	3,898	70	TRUE	3,306	70.1	TRUE	3,027	70.1	3,898	3,027	871
J-220	1,000	20	TRUE	3,929	44	TRUE	3,335	51.6	TRUE	3,052	54.8	3,929	3,052	877
J-230	1,137	64	TRUE	2,189	64	TRUE	2,035	63.6	TRUE	1,922	63.6	2,189	1,922	267
J-260	1,000	20	TRUE	3,924	34	TRUE	3,329	43.1	TRUE	3,046	46.9	3,924	3,046	878
J-290	1,000	20	TRUE	3,919	39	TRUE	3,324	46.8	TRUE	3,042	50.1	3,919	3,042	877
J-300	1,000	20	TRUE	3,916	44	TRUE	3,320	50.7	TRUE	3,039	53.5	3,916	3,039	877
J-310	325	65	TRUE	2,652	65	TRUE	2,373	65	TRUE	2,235	65	2,652	2,235	417
J-340	1000	20	TRUE	3,908	60	TRUE	3,314	62.3	TRUE	3,034	63.3	3,908	3,034	874
J-350	850	20	TRUE	2,956	20	TRUE	2,820	20	TRUE	2,753	20	2,956	2,753	203
J-350	1000	20	TRUE	1,201	21	TRUE	1,157	20.9	TRUE	1,143	20.9	1,201	1,143	58
J-360	1,000	20	TRUE	3,903	67	TRUE	3,310	67.3	TRUE	3,030	67.6	3,903	3,030	873
J-370	1,000	20	TRUE	3,907	63	TRUE	3,312	64.5	TRUE	3,032	65.1	3,907	3,032	875
J-400	525	20	TRUE	2,460	20	TRUE	2,354	20	TRUE	2,302	20	2,460	2,302	158
J-420	1000	20	TRUE	3,910	61	TRUE	3,315	62.9	TRUE	3,035	63.8	3,910	3,035	875
J-430	1,000	20	TRUE	3,911	61	TRUE	3,316	62.8	TRUE	3,036	63.7	3,911	3,036	875
J-450	100	20	TRUE	3,319	20	TRUE	3,155	20	TRUE	3,036	21.5	3,319	3,036	283
J-460	645	43.2	TRUE	3,912	54	TRUE	3,316	57.4	TRUE	3,037	59	3,912	3,037	875
J-480	1000	20	TRUE	3,922	36	TRUE	3,326	44.3	TRUE	3,044	47.8	3,922	3,044	878

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J-490	476	62	TRUE	2,177	62	TRUE	2,038	62	TRUE	1,933	62	2,177	1,933	244
J-520	1000	20	TRUE	3,929	36	TRUE	3,334	43.9	TRUE	3,051	47.3	3,929	3,051	878
J-530	850	20	TRUE	1,877	20	TRUE	1,853	20	TRUE	1,812	20	1,877	1,812	65
J-550	1000	20	TRUE	3,900	67	TRUE	3,307	67.7	TRUE	3,028	67.9	3,900	3,028	872
J-590	1,000	20	TRUE	3,904	66	TRUE	3,312	67	TRUE	3,033	67.4	3,904	3,033	871
J-610	1,000	20	TRUE	3,909	66	TRUE	3,317	67	TRUE	3,038	67.4	3,909	3,038	871
J-630	1,000	20	TRUE	3,919	67	TRUE	3,324	67.6	TRUE	3,044	67.7	3,919	3,044	875
J-650	1,000	20	TRUE	3,921	68	TRUE	3,326	67.8	TRUE	3,045	67.9	3,921	3,045	876
J-660	1,000	20	TRUE	3,940	65	TRUE	3,341	65.3	TRUE	3,051	65.6	3,940	3,051	889
J-670	512	61	TRUE	1,553	61	TRUE	1,503	61.1	TRUE	1,477	61.1	1,553	1,477	76
J-710	1000	20	TRUE	3,967	47	TRUE	3,335	52.1	TRUE	3,018	54.7	3,967	3,018	949
J-720	1,000	20	TRUE	2,995	20	TRUE	2,843	20	TRUE	2,767	20	2,995	2,767	228
J-730	1,000	20	TRUE	3,977	37	TRUE	3,323	45	TRUE	3,011	48.6	3,977	3,011	966
J-750	1,000	20	TRUE	3,811	39	TRUE	3,323	43.8	TRUE	3,008	47.6	3,811	3,008	803
J-760	1,000	20	FALSE	352	20.2	FALSE	349	20	FALSE	346	20	352	346	6
J-770	1,000	20	TRUE	4,030	24	TRUE	3,299	37.6	TRUE	2,961	42.9	4,030	2,961	1069
J-780	1,000	20	TRUE	2,802	22	TRUE	2,644	22	TRUE	2,565	22	2,802	2,565	237
J-790	1,000	20	TRUE	2,242	20	TRUE	2,158	20	TRUE	2,101	20	2,242	2,101	141
J-800	1,000	20	TRUE	2,548	22	TRUE	2,409	22.1	TRUE	2,339	22.1	2,548	2,339	209
J-810	850	20	TRUE	2,411	20	TRUE	2,295	20	TRUE	2,231	20	2,411	2,231	180
J-830	1000	20	TRUE	4,028	24	TRUE	3,285	38.1	TRUE	2,952	43.3	4,028	2,952	1076
J-832	1,000	20	TRUE	1,147	21	TRUE	1,128	20.9	TRUE	1,119	20.9	1,147	1,119	28
J-834	100	20	TRUE	1,123	20	TRUE	1,105	20	TRUE	1,096	20	1,123	1,096	27
J-836	1000	20	TRUE	1,085	20	TRUE	1,067	20	TRUE	1,058	20	1,085	1,058	27
J-840	1,000	20	TRUE	4,025	30	TRUE	3,223	43.7	TRUE	2,899	47.8	4,025	2,899	1126
J-860	1,000	20	TRUE	4,116	52	TRUE	3,220	58.1	TRUE	2,879	59.5	4,116	2,879	1237
J-870	1,000	20	TRUE	4,119	51	TRUE	3,220	57.7	TRUE	2,887	59	4,119	2,887	1232
J-880	850	20	TRUE	1,789	20	TRUE	1,747	20	TRUE	1,713	20	1,789	1,713	76
J-910	1000	20	TRUE	4,166	51	TRUE	3,222	58.8	TRUE	2,868	60.5	4,166	2,868	1298
J-940	596	36	TRUE	1,504	36	TRUE	1,461	35.6	TRUE	1,439	35.6	1,504	1,439	65
J-950	1000	20	TRUE	4,161	51	TRUE	3,227	58.3	TRUE	2,875	60	4,161	2,875	1286
J-960	850	20	TRUE	1,786	20	TRUE	1,748	20	TRUE	1,717	20	1,786	1,717	69

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J-970	1000	20	TRUE	4,164	50	TRUE	3,235	57.3	TRUE	2,885	58.9	4,164	2,885	1279
J-980	1,000	20	TRUE	3,243	23	TRUE	3,051	23	TRUE	2,886	25.5	3,243	2,886	357
J-990	1,000	20	TRUE	2,561	23	TRUE	2,420	22.5	TRUE	2,347	22.5	2,561	2,347	214
J-995	525	60	TRUE	1,421	60	TRUE	1,350	60	TRUE	1,314	60	1,421	1,314	107
J-1010	1000	20	TRUE	2,872	22	TRUE	2,710	22.4	TRUE	2,626	22.4	2,872	2,626	246
J-1030	503	51	TRUE	1,847	51	TRUE	1,771	51	TRUE	1,709	51	1,847	1,709	138
J-1060	1000	20	TRUE	3,990	59	TRUE	3,303	60.4	TRUE	2,984	60.9	3,990	2,984	1006
J-1090	255	47	TRUE	2,284	47	TRUE	2,135	46.7	TRUE	2,042	46.7	2,284	2,042	242
J-1120	1000	20	TRUE	3,964	58	TRUE	3,285	59.5	TRUE	2,972	59.9	3,964	2,972	992
J-1130	1,000	20	TRUE	3,955	59	TRUE	3,275	60.4	TRUE	2,966	60.8	3,955	2,966	989
J-1150	1,000	20	TRUE	3,987	56	TRUE	3,204	59.6	TRUE	2,910	59.8	3,987	2,910	1077
J-1180	100	20	TRUE	487	20	TRUE	478	20	TRUE	473	20	487	473	14
J-1190	1000	20	TRUE	4,002	54.2	TRUE	3,229	57.6	TRUE	2,895	58.4	4,002	2,895	1107
J-1210	1,000	20	TRUE	4,003	54	TRUE	3,233	57.5	TRUE	2,898	58.3	4,003	2,898	1105
J-1220	1,000	20	TRUE	4,007	48	TRUE	3,243	53.4	TRUE	2,909	54.9	4,007	2,909	1098
J-1227	1,000	20	TRUE	4,021	34	TRUE	3,247	43.7	TRUE	2,968	45.7	4,021	2,968	1053
J-1240	1,000	20	TRUE	4,031	49	TRUE	3,284	52.8	TRUE	2,998	53.2	4,031	2,998	1033
J-1250	1,000	20	TRUE	4,077	49	TRUE	3,256	54.6	TRUE	2,973	55	4,077	2,973	1104
J-1260	1,000	20	TRUE	4,079	44	TRUE	3,265	51.1	TRUE	2,981	52.1	4,079	2,981	1098
J-1280	1,000	20	TRUE	4,080	37	TRUE	3,273	45.9	TRUE	2,988	47.7	4,080	2,988	1092
J-1290	100	20	TRUE	3,968	20	TRUE	3,280	32.5	TRUE	2,996	36.3	3,968	2,996	972
J-1300	1000	20	TRUE	3,815	20	TRUE	3,281	28.5	TRUE	2,995	32.9	3,815	2,995	820
J-1310	1,000	20	TRUE	3,277	20	TRUE	3,062	20	TRUE	2,952	20	3,277	2,952	325
J-1320	1,000	20	TRUE	3,669	20	TRUE	3,288	24.4	TRUE	3,003	29.4	3,669	3,003	666
J-1330	850	20	TRUE	3,171	20	TRUE	2,966	20	TRUE	2,861	20	3,171	2,861	310
J-1350	1000	20	TRUE	4,136	50	TRUE	3,234	56.5	TRUE	2,951	57	4,136	2,951	1185
J-1360	1,000	20	TRUE	2,536	20	TRUE	2,389	20	TRUE	2,312	20	2,536	2,312	224
J-1362	1,000	20	TRUE	4,150	50	TRUE	3,209	57.9	TRUE	2,922	58.5	4,150	2,922	1228
J-1364	100	20	TRUE	720	20	TRUE	707	20	TRUE	700	20	720	700	20
J-1370	1000	20	TRUE	4,149	50.2	TRUE	3,212	57.8	TRUE	2,914	58.6	4,149	2,914	1235
J-1380	1,000	20	TRUE	3,115	20	TRUE	2,926	20	TRUE	2,830	20	3,115	2,830	285
J-1390	1,000	20	TRUE	3,936	64	TRUE	3,345	64.5	TRUE	3,062	64.8	3,936	3,062	874

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J-1400	1,000	20	TRUE	3,264	21	TRUE	3,086	20.6	TRUE	2,996	20.6	3,264	2,996	268
J-1420	100	20	TRUE	2,590	21	TRUE	2,459	20.6	TRUE	2,394	20.6	2,590	2,394	196
J-1440	966	45	TRUE	1,425	45	TRUE	1,394	45	TRUE	1,379	45	1,425	1,379	46
J-1450	1000	20	TRUE	2,037	21	TRUE	1,986	20.5	TRUE	1,938	20.5	2,037	1,938	99
J-1470	1,000	20	TRUE	3,941	63	TRUE	3,349	64	TRUE	3,066	64.4	3,941	3,066	875
J-1490	1,000	20	TRUE	3,960	61	TRUE	3,312	62.6	TRUE	3,010	63.4	3,960	3,010	950
J-1495	1,000	20	TRUE	3,961	56	TRUE	3,312	59.4	TRUE	3,011	60.6	3,961	3,011	950
J-1510	1,000	20	TRUE	3,625	21	TRUE	3,315	23.9	TRUE	3,013	30.3	3,625	3,013	612
J-1520	500	60	TRUE	1,736	60	TRUE	1,659	60	TRUE	1,615	60	1,736	1,615	121
J-1530	501	63.4	TRUE	982	63	TRUE	937	63.4	TRUE	915	63.4	982	915	67
J-1540	1000	20	TRUE	3,971	58	TRUE	3,280	60.9	TRUE	2,977	61.8	3,971	2,977	994
J-1560	1,000	20	TRUE	3,978	44	TRUE	3,276	50.7	TRUE	2,968	53.2	3,978	2,968	1010
J-1570	100	20	TRUE	2,409	20	TRUE	2,287	20	TRUE	2,219	20	2,409	2,219	190
J-1580	1000	20	TRUE	3,988	43	TRUE	3,277	50.3	TRUE	2,956	53.1	3,988	2,956	1032
J-1630	1,000	20	TRUE	3,972	24	TRUE	3,274	36.8	TRUE	2,948	41.9	3,972	2,948	1024
J-1670	1,000	20	TRUE	2,898	20	TRUE	2,739	20	TRUE	2,659	20	2,898	2,659	239
J-1690	1,000	20	TRUE	2,855	20	TRUE	2,700	20	TRUE	2,622	20	2,855	2,622	233
J-1700	1,000	20	TRUE	3,921	25	TRUE	3,249	36.3	TRUE	2,938	41	3,921	2,938	983
J-1710	1,000	20	TRUE	3,536	21	TRUE	3,251	22.9	TRUE	2,938	29.9	3,536	2,938	598
J-1730	850	20	TRUE	2,706	20	TRUE	2,553	20	TRUE	2,478	20	2,706	2,478	228
J-1731	1000	20	TRUE	3,975	57	TRUE	3,263	60.6	TRUE	2,967	61.4	3,975	2,967	1008
J-1732	540	50	TRUE	2,797	50	TRUE	2,564	50	TRUE	2,445	50	2,797	2,445	352
J-1738	1000	20	TRUE	4,074	50	TRUE	3,317	55.7	TRUE	2,901	58.9	4,074	2,901	1173
J-1760	1,000	20	TRUE	4,067	38	TRUE	3,256	48.4	TRUE	2,944	51.2	4,067	2,944	1123
J-1770	850	20	TRUE	3,014	20	TRUE	2,851	20	TRUE	2,769	20	3,014	2,769	245
J-1780	1000	20	TRUE	4,061	45	TRUE	3,352	50.8	TRUE	2,967	54	4,061	2,967	1094
J-1784	1,000	20	TRUE	4,063	45	TRUE	3,346	50.5	TRUE	2,961	53.6	4,063	2,961	1102
J-1786	100	20	TRUE	4,064	42	TRUE	3,347	47.8	TRUE	2,962	51.4	4,064	2,962	1102
J-1790	1000	20	TRUE	4,057	30	TRUE	3,314	39	TRUE	2,981	42.3	4,057	2,981	1076
J-1792	1,000	20	TRUE	4,059	43	TRUE	3,361	48.1	TRUE	2,978	51.4	4,059	2,978	1081
J-1795	1,000	20	TRUE	4,045	25	TRUE	3,305	34	TRUE	2,990	36.9	4,045	2,990	1055
J-1796	1,000	20	TRUE	4,058	41	TRUE	3,373	46.5	TRUE	2,991	50.1	4,058	2,991	1067

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Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-1798	656	50	TRUE	1,509	50	TRUE	1,446	50.3	TRUE	1,412	50.3	1,509	1,412	97
J-1800	1000	20	TRUE	2,757	25	TRUE	2,572	25.1	TRUE	2,478	25.1	2,757	2,478	279
J-1820	668	60	TRUE	1,018	60	TRUE	944	60	TRUE	903	60	1,018	903	115
J-1830	1000	20	TRUE	3,963	23.4	TRUE	3,315	31.4	TRUE	3,010	34.7	3,963	3,010	953
J-1840	1,000	20	TRUE	3,911	24	TRUE	3,323	30.6	TRUE	3,018	34.1	3,911	3,018	893
J-1850	1,000	20	TRUE	2,869	20	TRUE	2,663	20	TRUE	2,560	20	2,869	2,560	309
J-1870	498	50	TRUE	1,235	50	TRUE	1,163	50	TRUE	1,125	50	1,235	1,125	110
J-1890	1000	20	TRUE	3,905	24	TRUE	3,323	30.4	TRUE	3,017	33.9	3,905	3,017	888
J-1920	1,000	20	TRUE	3,848	23	TRUE	3,327	27.8	TRUE	3,005	32	3,848	3,005	843
J-1930	1,560	42	TRUE	2,846	42	TRUE	2,543	42.3	TRUE	2,391	42.3	2,846	2,391	455
J-1940	1,000	20	TRUE	3,833	23	TRUE	3,327	27.7	TRUE	3,018	31.5	3,833	3,018	815
J-1980	1,000	20	TRUE	3,802	23	TRUE	3,348	26.3	TRUE	3,042	30	3,802	3,042	760
J-1990	1,000	20	TRUE	3,769	23	TRUE	3,356	25.3	TRUE	3,050	29.2	3,769	3,050	719
J-2000	1,560	42	TRUE	2,580	42	TRUE	2,311	42.3	TRUE	2,176	42.3	2,580	2,176	404
J-2040	250	20	TRUE	3,875	22	TRUE	3,350	27.4	TRUE	3,043	31	3,875	3,043	832
J-2060	1000	20	TRUE	3,982	21	TRUE	3,352	28.6	TRUE	3,046	31.9	3,982	3,046	936
J-2100	1,000	20	TRUE	4,041	28	TRUE	3,355	35	TRUE	3,050	37.4	4,041	3,050	991
J-2110	525	55	TRUE	965	55	TRUE	894	54.6	TRUE	855	54.6	965	855	110
J-2120	1000	20	TRUE	4,042	29	TRUE	3,352	35.5	TRUE	3,049	37.9	4,042	3,049	993
J-2130	1,000	20	TRUE	3,469	24	TRUE	3,190	23.6	TRUE	3,013	24.8	3,469	3,013	456
J-2140	1,000	20	TRUE	3,394	23	TRUE	3,125	22.6	TRUE	2,985	22.8	3,394	2,985	409
J-2145	569	38	TRUE	673	38	TRUE	646	38.4	TRUE	631	38.4	673	631	42
J-2150	415	60	TRUE	934	60	TRUE	873	60	TRUE	841	60	934	841	93
J-2160	1000	20	TRUE	4,071	34.4	TRUE	3,374	39.4	TRUE	3,070	41.2	4,071	3,070	1001
J-2180	1,000	20	TRUE	4,089	38	TRUE	3,390	42	TRUE	3,083	43.3	4,089	3,083	1006
J-2220	1,000	20	TRUE	4,102	44	TRUE	3,399	46.2	TRUE	3,091	47.2	4,102	3,091	1011
J-2240	1,000	20	TRUE	3,870	51	TRUE	3,406	48	TRUE	3,097	48.5	3,870	3,097	773
J-2250	1,000	20	TRUE	3,926	51	TRUE	3,393	49.7	TRUE	3,093	50	3,926	3,093	833
J-2260	1,000	20	TRUE	4,079	46	TRUE	3,353	49.5	TRUE	3,058	50	4,079	3,058	1021
J-2280	1,000	20	TRUE	4,076	47	TRUE	3,349	49.6	TRUE	3,053	50.1	4,076	3,053	1023
J-2290	100	20	TRUE	3,701	20	TRUE	3,357	22	TRUE	3,061	27.1	3,701	3,061	640
J-2300	1000	20	TRUE	4,060	49	TRUE	3,305	52.6	TRUE	2,999	53.3	4,060	2,999	1061

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J-2320	1,000	20	TRUE	4,066	50	TRUE	3,276	54.4	TRUE	2,913	55.9	4,066	2,913	1153
J-2350	100	20	TRUE	406	20	TRUE	398	20	TRUE	393	20	406	393	13
J-2360	1000	20	TRUE	4,034	48.4	TRUE	3,291	52.1	TRUE	3,005	52.5	4,034	3,005	1029
J-2380	1,000	20	TRUE	4,059	45	TRUE	3,312	49.1	TRUE	3,034	49.3	4,059	3,034	1025
J-2400	1,000	20	TRUE	4,072	44	TRUE	3,331	47.9	TRUE	3,049	48.1	4,072	3,049	1023
J-2412	1,000	20	TRUE	3,419	20	TRUE	3,174	20	TRUE	2,990	22.1	3,419	2,990	429
J-2420	1,000	20	TRUE	4,102	46	TRUE	3,368	49.6	TRUE	3,062	50.2	4,102	3,062	1040
J-2430	1,000	20	TRUE	4,120	44	TRUE	3,395	47.4	TRUE	3,105	47.7	4,120	3,105	1015
J-2440	1,000	20	TRUE	2,379	20	TRUE	2,239	20.1	TRUE	2,151	20.1	2,379	2,151	228
J-2460	100	20	TRUE	2,191	20	TRUE	2,086	20	TRUE	2,006	20	2,191	2,006	185
J-2470	1000	20	TRUE	3,976	47	TRUE	3,417	45.7	TRUE	3,119	45.9	3,976	3,119	857
J-2480	1,000	20	TRUE	4,010	47	TRUE	3,399	47.2	TRUE	3,074	48	4,010	3,074	936
J-2490	1,000	20	TRUE	2,571	21	TRUE	2,397	20.8	TRUE	2,307	20.8	2,571	2,307	264
J-2530	100	20	TRUE	2,197	20	TRUE	2,095	20	TRUE	2,021	20	2,197	2,021	176
J-2540	1000	20	TRUE	3,433	20	TRUE	3,143	20.5	TRUE	2,992	20.6	3,433	2,992	441
J-2570	850	20	TRUE	1,805	20	TRUE	1,735	20	TRUE	1,697	20	1,805	1,697	108
J-2580	1000	20	TRUE	3,417	22	TRUE	3,129	21.9	TRUE	2,979	21.9	3,417	2,979	438
J-2610	544	51	TRUE	939	51	TRUE	875	50.9	TRUE	839	50.9	939	839	100
J-2620	1000	20	TRUE	3,563	20	TRUE	3,261	20	TRUE	3,103	20	3,563	3,103	460
J-2630	592	64	TRUE	1,407	64	TRUE	1,243	64.2	TRUE	1,151	64.2	1,407	1,151	256
J-2640	1000	20	TRUE	3,727	23	TRUE	3,381	22.9	TRUE	3,175	23.6	3,727	3,175	552
J-2650	1,000	20	TRUE	1,701	21	TRUE	1,625	20.5	TRUE	1,582	20.5	1,701	1,582	119
J-2660	100	20	TRUE	1,384	20	TRUE	1,325	20	TRUE	1,292	20	1,384	1,292	92
J-2670	1000	20	TRUE	1,662	20	TRUE	1,589	20.1	TRUE	1,548	20.1	1,662	1,548	114
J-2690	516	59	TRUE	778	59	TRUE	701	58.9	TRUE	656	58.9	778	656	122
J-2700	1000	20	TRUE	4,031	24.6	TRUE	3,479	28.7	TRUE	3,185	30.8	4,031	3,185	846
J-2730	850	20	TRUE	2,144	20	TRUE	2,047	20	TRUE	1,965	20	2,144	1,965	179
J-2740	1000	20	TRUE	4,162	40	TRUE	3,517	41.5	TRUE	3,218	41.6	4,162	3,218	944
J-2750	1,000	20	TRUE	2,288	20	TRUE	2,177	20	TRUE	2,090	20	2,288	2,090	198
J-2770	759	54	TRUE	1,042	54	TRUE	972	53.5	TRUE	933	53.5	1,042	933	109
J-2780	1000	20	TRUE	4,168	35.6	TRUE	3,527	38.1	TRUE	3,229	38	4,168	3,229	939
J-2790	891	63	TRUE	2,173	63	TRUE	1,879	63	TRUE	1,579	63	2,173	1,579	594

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J-2790add.	927	48	TRUE	2,890	48	TRUE	2,528	48	TRUE	2,228	48	2,890	2,228	662
J-2790add2	282	70	TRUE	1,999	70	TRUE	1,615	70	TRUE	1,315	70	1,999	1,315	684
J-2820	1000	20	TRUE	5,067	23	TRUE	3,495	43	TRUE	3,197	43	5,067	3,197	1870
J-2830	1000	20	TRUE	3,082	22	TRUE	2,806	22.3	TRUE	2,662	22.3	3,082	2,662	420
J-2850	501	53	TRUE	1,217	53	TRUE	1,099	52.6	TRUE	1,034	52.6	1,217	1,034	183
J-2860	1,000	20	TRUE	3,935	49	TRUE	3,471	46.1	TRUE	3,174	46.2	3,935	3,174	761
J-2870	1,000	20	TRUE	3,959	46	TRUE	3,453	43.9	TRUE	3,158	44	3,959	3,158	801
J-2890	1000	20	TRUE	3,970	45	TRUE	3,449	44.1	TRUE	3,151	44.3	3,970	3,151	819
J-2900 (alt. p trans)	893	66	TRUE	1,768	66	TRUE	1,399	65.9	TRUE	1,209	65.9	1,768	1,209	559
J-2900vsp	100	20	TRUE	3,971	26	TRUE	3,465	28.2	TRUE	3,168	30.5	3,971	3,168	803
J-2930	1,000	20	TRUE	5,135	20	TRUE	3,419	42.6	TRUE	3,122	43.3	5,135	3,122	2013
J-2940	1000	20	TRUE	3,258	20	TRUE	2,988	20	TRUE	2,863	20	3,258	2,863	395
J-2950	1000	20	TRUE	4,794	22	TRUE	3,594	36.5	TRUE	3,333	37.2	4,794	3,333	1461
J-2960	1,000	20	TRUE	3,362	20	TRUE	3,048	20.2	TRUE	2,916	20.1	3,362	2,916	446
J-2970	1,000	20	TRUE	2,615	20	TRUE	2,404	20	TRUE	2,312	20	2,615	2,312	303
J-2980	850	20	TRUE	1,301	20	TRUE	1,249	20	TRUE	1,227	20	1,301	1,227	74
J-2990	1,000	20	TRUE	4,586	22	TRUE	3,406	36.3	TRUE	3,167	36.8	4,586	3,167	1419
J-3020	1,000	20	TRUE	4,586	22	TRUE	3,461	35.6	TRUE	3,213	36.2	4,586	3,213	1373
J-3030	1000	20	TRUE	4,930	21	TRUE	3,675	36.9	TRUE	3,356	38.3	4,930	3,356	1574
J-3040	1,000	20	TRUE	1,171	20	TRUE	1,127	20	TRUE	1,106	20	1,171	1,106	65
J-3050	1,000	20	TRUE	3,727	22	TRUE	2,788	32.3	TRUE	2,608	32.8	3,727	2,608	1119
J-3060	1,000	20	TRUE	3,707	20	TRUE	2,820	30.2	TRUE	2,636	31	3,707	2,636	1071
J-3070	1,000	20	TRUE	2,139	20	TRUE	1,953	20	TRUE	1,889	20	2,139	1,889	250
J-3075	1,000	20	TRUE	3,681	20	TRUE	2,841	29.4	TRUE	2,656	30.4	3,681	2,656	1025
J-3080	1,000	20	TRUE	2,892	20	TRUE	2,533	20.1	TRUE	2,426	20.1	2,892	2,426	466
J-3100	850	20	TRUE	2,208	20	TRUE	2,014	20	TRUE	1,941	20	2,208	1,941	267
J-3110	1,000	20	TRUE	3,669	20	TRUE	2,850	29.1	TRUE	2,663	30.1	3,669	2,663	1006
J-3120	1,250	47	TRUE	2,455	47	TRUE	2,049	47	TRUE	1,911	47	2,455	1,911	544
J-3130	1000	20	TRUE	3,658	20	TRUE	2,859	28.7	TRUE	2,672	29.8	3,658	2,672	986
J-3140	100	20	TRUE	1,730	20	TRUE	1,601	20	TRUE	1,567	20	1,730	1,567	163
J-3190	1,000	20	TRUE	3,631	20	TRUE	2,889	27.5	TRUE	2,699	28.8	3,631	2,699	932
J-3200	100	20	TRUE	1,883	20	TRUE	1,738	20	TRUE	1,701	20	1,883	1,701	182

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			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-3210	1000	20	TRUE	3,600	20	TRUE	2,958	25.7	TRUE	2,760	27.4	3,600	2,760	840
J-3220	850	20	TRUE	2,655	20	TRUE	2,371	20	TRUE	2,277	20	2,655	2,277	378
J-3225	1000	20	TRUE	3,627	20	TRUE	3,015	24.9	TRUE	2,810	26.7	3,627	2,810	817
J-3240	1,000	20	TRUE	3,630	20	TRUE	3,019	24.9	TRUE	2,814	26.7	3,630	2,814	816
J-3250	850	20	TRUE	2,255	20	TRUE	2,082	20	TRUE	2,005	20	2,255	2,005	250
J-3260	1,000	20	TRUE	3,645	20	TRUE	3,031	25	TRUE	2,826	26.9	3,645	2,826	819
J-3270	1,000	20	TRUE	3,297	20	TRUE	2,914	20.1	TRUE	2,791	20.1	3,297	2,791	506
J-3280	1000	20	TRUE	2,806	20	TRUE	2,510	20.2	TRUE	2,411	20.2	2,806	2,411	395
J-3290	850	20	TRUE	2,130	20	TRUE	1,979	20	TRUE	1,919	20	2,130	1,919	211
J-3320	1,000	20	TRUE	3,640	20	TRUE	3,038	24.7	TRUE	2,831	26.7	3,640	2,831	809
J-3340	1,000	20	TRUE	3,603	20	TRUE	3,078	22.6	TRUE	2,867	24.7	3,603	2,867	736
J-3352	1000	20	TRUE	3,698	20	TRUE	3,130	24.3	TRUE	2,914	26.5	3,698	2,914	784
J-3354	850	20	TRUE	3,129	20	TRUE	2,801	20	TRUE	2,686	20	3,129	2,686	443
J-3356	1,000	20	TRUE	3,728	20	TRUE	3,155	24.5	TRUE	2,936	26.6	3,728	2,936	792
J-3358	850	20	TRUE	2,937	20	TRUE	2,643	20	TRUE	2,538	20	2,937	2,538	399
J-3380	1000	20	TRUE	3,821	20	TRUE	3,220	25.2	TRUE	2,995	27.2	3,821	2,995	826
J-3390	1,000	20	TRUE	1,950	20	TRUE	1,834	20	TRUE	1,790	20	1,950	1,790	160
J-3400	1000	20	TRUE	4,124	23	TRUE	3,344	30.5	TRUE	3,106	31.9	4,124	3,106	1018
J-3420	1,000	20	TRUE	3,269	22	TRUE	2,431	30.4	TRUE	2,283	30.9	3,269	2,283	986
J-3427	1,000	20	TRUE	1,053	20	TRUE	1,021	20	TRUE	1,011	20	1,053	1,011	42
J-3450	1,000	20	FALSE	989	20.1	FALSE	955	20	FALSE	943	20	989	943	46
J-3460	586	54	TRUE	668	54	TRUE	624	53.5	TRUE	608	53.5	668	608	60
J-3480	1,000	20	TRUE	3,039	22	TRUE	2,247	29.5	TRUE	2,112	30	3,039	2,112	927
J-3490	1,000	20	TRUE	2,052	20	TRUE	1,774	20	TRUE	1,731	20	2,052	1,731	321
J-3500	1,000	20	TRUE	2,584	22	TRUE	1,853	27.4	TRUE	1,775	27.8	2,584	1,775	809
J-3508	412	22	TRUE	2,252	22	TRUE	1,726	22	TRUE	1,664	22.4	2,252	1,664	588
J-3515	1,000	20	TRUE	2,512	21	TRUE	1,793	26.4	TRUE	1,724	26.7	2,512	1,724	788
J-3520	1,000	20	TRUE	2,362	21	TRUE	1,665	25.7	TRUE	1,602	26	2,362	1,602	760
J-3530	1000	20	TRUE	1,573	20	TRUE	1,284	20.1	TRUE	1,253	20.1	1,573	1,253	320
J-3540	1,000	20	TRUE	1,530	20	TRUE	1,254	20	TRUE	1,224	20	1,530	1,224	306
J-3550	537	55	TRUE	884	55	TRUE	631	55	TRUE	597	55	884	597	287
J-3560	1,000	20	TRUE	2,279	22	TRUE	1,592	25.8	TRUE	1,533	26.1	2,279	1,533	746

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J-3570	1,000	20	TRUE	2,157	20.3	TRUE	1,473	25	TRUE	1,420	25.2	2,157	1,420	737
J-3600	1000	20	TRUE	1,660	20	TRUE	1,278	20	TRUE	1,244	20	1,660	1,244	416
J-3610	1,000	20	TRUE	2,122	21	TRUE	1,427	26.3	TRUE	1,376	26.6	2,122	1,376	746
J-3620	1,000	20	TRUE	1,629	20	TRUE	1,250	20	TRUE	1,217	20	1,629	1,217	412
J-3640	537	55	TRUE	899	55	TRUE	565	54.7	FALSE	528	54.7	899	528	371
J-3650	1,000	20	TRUE	2,125	21	TRUE	1,420	26.3	TRUE	1,369	26.6	2,125	1,369	756
J-3680	500	20	TRUE	1,108	20	TRUE	901	20	TRUE	881	20	1,108	881	227
J-3690	1000	20	TRUE	2,079	22	TRUE	1,570	22.4	TRUE	1,513	22.9	2,079	1,513	566
J-3720	500	20	TRUE	1,523	20	TRUE	1,229	20	TRUE	1,198	20	1,523	1,198	325
J-3730	1000	20	TRUE	1,936	22	TRUE	1,482	22	TRUE	1,440	22	1,936	1,440	496
J-3740	1,000	20	TRUE	1,717	20	TRUE	1,366	20	TRUE	1,331	20	1,717	1,331	386
J-3750	850	20	TRUE	1,834	20	TRUE	1,436	20	TRUE	1,397	20	1,834	1,397	437
J-3755	1,000	20	TRUE	1,844	22	TRUE	1,424	22.2	TRUE	1,384	22.2	1,844	1,384	460
J-3760	1,000	20	TRUE	1,814	21	TRUE	1,409	21.1	TRUE	1,370	21.1	1,814	1,370	444
J-3770	500	20	TRUE	1,521	20	TRUE	1,229	20	TRUE	1,200	20	1,521	1,200	321
J-3920	1,000	20	FALSE	998	20.5	FALSE	914	20.5	FALSE	895	20.5	998	895	103
J-3930	1,000	20	FALSE	937	20	FALSE	861	20	FALSE	844	20	937	844	93
J-3940	1,000	20	TRUE	1,007	20.8	FALSE	922	20.7	FALSE	903	20.7	1,007	903	104
J-3950	1,000	20	FALSE	936	20.8	FALSE	860	20.8	FALSE	843	20.8	936	843	93
J-3960	887	50	FALSE	646	50	FALSE	569	50	FALSE	549	50	646	549	97
J-4122	1,000	20	TRUE	1,299	20	FALSE	643	22.3	FALSE	621	22.3	1,299	621	678
J-4124	561	53	TRUE	799	53	FALSE	174	52.7	FALSE	150	52.7	799	150	649
J-4140	1,000	20	TRUE	2,072	20	TRUE	1,373	25.4	TRUE	1,324	25.7	2,072	1,324	748
J-4170	1,000	20	TRUE	1,632	21	TRUE	1,289	20.9	TRUE	1,255	20.9	1,632	1,255	377
J-4180	1,000	20	TRUE	1,246	20	TRUE	1,022	20	FALSE	998	20	1,246	998	248
J-4190	1,000	20	TRUE	1,648	21	TRUE	1,300	21	TRUE	1,266	21	1,648	1,266	382
J-4200	1,000	20	TRUE	1,254	20	TRUE	1,028	20	TRUE	1,004	20	1,254	1,004	250
J-4210	1,000	20	TRUE	1,818	20	TRUE	1,415	20.5	TRUE	1,376	20.6	1,818	1,376	442
J-4240	1,000	20	TRUE	1,360	20	TRUE	1,114	20	TRUE	1,088	20	1,360	1,088	272
J-4280	1,000	20	TRUE	1,342	20	TRUE	1,100	20	TRUE	1,075	20	1,342	1,075	267
J-4287	481	46	TRUE	930	46	TRUE	695	46.2	TRUE	667	46.2	930	667	263
J-4410 (P-Trans)	1,000	20	TRUE	2,999	93	TRUE	3,118	86.2	TRUE	3,125	83.5	3,125	2,999	126

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J-5005	1,000	20	TRUE	1,789	20.2	TRUE	1,393	20.6	TRUE	1,355	20.6	1,789	1,355	434
J-5015	1000	20	TRUE	1,791	20	TRUE	1,395	20.5	TRUE	1,357	20.6	1,791	1,357	434
J-5020	1,000	20	TRUE	1,769	21	TRUE	1,384	20.8	TRUE	1,347	20.8	1,769	1,347	422
J-5025	1,000	20	TRUE	1,726	20	TRUE	1,356	20	TRUE	1,320	20	1,726	1,320	406
J-5030	1,000	20	TRUE	1,724	20	TRUE	1,355	20	TRUE	1,320	20	1,724	1,320	404
J-5040	1,000	20	TRUE	1,727	20	TRUE	1,365	20	TRUE	1,329	20	1,727	1,329	398
J-5070	1,000	20	TRUE	1,824	22	TRUE	1,411	21.9	TRUE	1,372	21.9	1,824	1,372	452
J-5075	1,000	20	TRUE	1,830	22	TRUE	1,415	21.6	TRUE	1,375	21.6	1,830	1,375	455
J-5100	1,000	20	TRUE	4,813	20	TRUE	3,913	30.5	TRUE	3,262	39.3	4,813	3,262	1551
J-5105	1,000	20	TRUE	4,240	20	TRUE	3,961	20	TRUE	3,805	20	4,240	3,805	435
J-5125	1,000	20	TRUE	4,196	21	TRUE	3,985	21.1	TRUE	3,865	21.1	4,196	3,865	331
J-5130	1,000	20	TRUE	4,451	20	TRUE	4,269	20	TRUE	4,166	20	4,451	4,166	285
J-5135	1,000	20	TRUE	4,442	22	TRUE	4,263	21.7	TRUE	4,161	21.7	4,442	4,161	281
J-5140	1,000	20	TRUE	4,561	21	TRUE	4,387	21.3	TRUE	4,288	21.3	4,561	4,288	273
J-5142	930	50	TRUE	2,855	50	TRUE	2,744	50	TRUE	2,657	50	2,855	2,657	198
J-5145	850	20	TRUE	4,753	20	TRUE	4,586	20	TRUE	4,491	20	4,753	4,491	262
J-5150	1,000	20	TRUE	3,541	21	TRUE	3,370	21.1	TRUE	3,272	21.1	3,541	3,272	269
J-5155	450	48	TRUE	2,016	48	TRUE	1,909	48	TRUE	1,841	48	2,016	1,841	175
J-5165	1,000	20	TRUE	4,807	20	TRUE	4,641	20	TRUE	4,547	20	4,807	4,547	260
J-5167	1000	20	TRUE	2,317	20.1	TRUE	2,189	20	TRUE	2,104	20	2,317	2,104	213
J-5171	1000	20	TRUE	1,716	21	TRUE	1,342	21.1	TRUE	1,305	21.2	1,716	1,305	411
J-5177	1,000	20	TRUE	1,100	20	TRUE	1,065	20	TRUE	1,054	20	1,100	1,054	46
J-5178	1,000	20	TRUE	2,423	21	TRUE	1,728	25.9	TRUE	1,664	26.3	2,423	1,664	759
J-5179	1,000	20	TRUE	2,243	20	TRUE	1,729	20.9	TRUE	1,664	21.6	2,243	1,664	579
J-5188	671	58	TRUE	1,311	58	TRUE	1,192	57.5	TRUE	1,125	57.5	1,311	1,125	186
J-5189	850	20	TRUE	1,442	20	TRUE	1,382	20	TRUE	1,348	20	1,442	1,348	94
J-5194	334	63.9	TRUE	1,668	64	TRUE	1,607	63.9	TRUE	1,576	63.9	1,668	1,576	92
J-5196	987	37	TRUE	1,409	37	TRUE	1,040	37	TRUE	1,001	37	1,409	1,001	408
J-5197	1000	20	TRUE	1,777	23	TRUE	1,381	23.1	TRUE	1,343	23.1	1,777	1,343	434
J-5198	987	41	TRUE	1,198	41	FALSE	896	41	FALSE	863	41	1,198	863	335
J-5199	1000	20	TRUE	1,706	20	TRUE	1,335	20.3	TRUE	1,299	20.3	1,706	1,299	407
J-5200	987	41	TRUE	1,126	41	FALSE	834	41	FALSE	801	41	1,126	801	325

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J-5201	1000	20	TRUE	1,722	21	TRUE	1,356	21.5	TRUE	1,319	21.6	1,722	1,319	403
J-5202	987	41	TRUE	1,139	41	FALSE	866	41	FALSE	835	41	1,139	835	304
J-5203	1000	20	TRUE	1,645	20	TRUE	1,317	20	TRUE	1,285	20	1,645	1,285	360
J-5204	987	41	TRUE	1,272	41	FALSE	947	41	FALSE	912	41	1,272	912	360
J-5205	1000	20	TRUE	1,712	21	TRUE	1,353	21	TRUE	1,317	21	1,712	1,317	395
J-5206	987	41	TRUE	1,295	41	FALSE	957	41	FALSE	921	41	1,295	921	374
J-5207	1000	20	TRUE	1,729	21	TRUE	1,365	21.1	TRUE	1,330	21.1	1,729	1,330	399
J-5208	987	41	TRUE	1,172	41	FALSE	887	41	FALSE	856	41	1,172	856	316
J-5209	987	41	TRUE	1,209	41	FALSE	908	41	FALSE	874	41	1,209	874	335
J-5210	987	41	TRUE	1,325	41	FALSE	977	41	FALSE	940	41	1,325	940	385
J-5214	987	41	TRUE	1,288	41	FALSE	945	41	FALSE	908	41	1,288	908	380
J-5217	1000	20	TRUE	1,797	20	TRUE	1,398	20.2	TRUE	1,360	20.2	1,797	1,360	437
J-5217	558	51.4	TRUE	1,073	51	TRUE	715	51.4	TRUE	674	51.4	1,073	674	399
J-5218	1000	20	TRUE	1,755	21	TRUE	1,375	21	TRUE	1,338	21	1,755	1,338	417
J-5219	613	37	TRUE	1,348	37	TRUE	999	37.1	TRUE	962	37.1	1,348	962	386
J-5221	723	60	FALSE	667	60	FALSE	433	60	FALSE	401	60	667	401	266
J-5223	1,000	20	TRUE	1,330	20	TRUE	1,090	20.4	TRUE	1,064	20.4	1,330	1,064	266
J-5223	1000	20	TRUE	2,027	20	TRUE	1,946	20	TRUE	1,880	20	2,027	1,880	147
J-5224	508	50	TRUE	1,339	50	TRUE	1,251	50	TRUE	1,202	50	1,339	1,202	137
J-5225	1,000	20	TRUE	4,419	20	TRUE	4,236	20	TRUE	4,131	20	4,419	4,131	288
J-5226	343	33.3	TRUE	3,239	33	TRUE	3,116	33.2	TRUE	3,026	33.2	3,239	3,026	213
J-5227	1000	20	TRUE	4,341	20	TRUE	4,152	20	TRUE	4,044	20	4,341	4,044	297
J-5228	318	59.8	TRUE	2,455	60	TRUE	2,312	59.8	TRUE	2,218	59.8	2,455	2,218	237
J-5230	1000	20	TRUE	1,766	23	TRUE	1,375	23.7	TRUE	1,337	23.7	1,766	1,337	429
J-5231	360	36.4	TRUE	1,190	36.4	TRUE	926	36.4	TRUE	897	36.4	1,190	897	293
J-5232	1000	20	TRUE	1,706	20	TRUE	1,349	20	TRUE	1,314	20	1,706	1,314	392
J-5233	360	39	TRUE	1,297	39	TRUE	965	39	TRUE	929	39	1,297	929	368
J-5234	1000	20	TRUE	4,009	45	TRUE	3,241	50.8	TRUE	2,923	52.4	4,009	2,923	1086
J-5234	1,000	20	TRUE	1,706	20	TRUE	1,348	20	TRUE	1,314	20	1,706	1,314	392
J-5235	1000	20	TRUE	1,770	20	TRUE	1,377	20.5	TRUE	1,339	20.5	1,770	1,339	431
J-5237	850	20	TRUE	2,912	20	TRUE	2,610	20	TRUE	2,509	20	2,912	2,509	403
J-5238	1,000	20	TRUE	3,494	20	TRUE	3,042	20.9	TRUE	2,835	23.4	3,494	2,835	659

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J-5239	850	20	TRUE	3,173	20	TRUE	2,809	20	TRUE	2,690	20	3,173	2,690	483
J-5240	1000	20	TRUE	3,946	51	TRUE	3,355	53.4	TRUE	2,987	55.8	3,946	2,987	959
J-5241	850	20	TRUE	3,925	64	TRUE	3,333	64.9	TRUE	3,049	65.1	3,925	3,049	876
J-5242	321	66	TRUE	2,202	66	TRUE	1,973	66	TRUE	1,811	66	2,202	1,811	391
J-5243	321	66	TRUE	2,385	66	TRUE	2,079	66	TRUE	1,914	66	2,385	1,914	471
J-5244	1000	20	TRUE	3,955	22	TRUE	3,476	24.5	TRUE	3,183	27.1	3,955	3,183	772
J-5246	1000	20	TRUE	2,235	20	TRUE	1,541	25.3	TRUE	1,484	25.6	2,235	1,484	751
J-5247	1,000	20	TRUE	2,119	20	TRUE	1,445	24.3	TRUE	1,392	24.5	2,119	1,392	727
J-5257	1,000	20	TRUE	3,864	75.3	TRUE	3,291	75.1	TRUE	3,002	75.3	3,864	3,002	862
J-5258	1,000	20	TRUE	3,859	75.1	TRUE	3,297	74.8	TRUE	2,996	75.1	3,859	2,996	863
J-5260	1,000	20	TRUE	3,907	66	TRUE	3,315	66.4	TRUE	3,036	66.8	3,907	3,036	871
J-5261	1,000	20	TRUE	4,148	50.2	TRUE	3,257	57.2	TRUE	2,914	58.8	4,148	2,914	1234
J-5262	1,000	20	TRUE	3,973	57	TRUE	3,223	59.7	TRUE	2,925	60	3,973	2,925	1048
J-5263	1,000	20	TRUE	3,886	47	TRUE	3,399	44.8	TRUE	3,092	45.3	3,886	3,092	794
J-5264	1,000	20	TRUE	3,955	72	TRUE	3,283	73.2	TRUE	3,006	73.2	3,955	3,006	949
J-5266	1,000	20	TRUE	3,908	61	TRUE	3,313	63.2	TRUE	3,034	64	3,908	3,034	874
J-5271	1,000	20	TRUE	3,932	72	TRUE	3,287	72.9	TRUE	3,010	73	3,932	3,010	922
J-5276	1,000	20	TRUE	4,145	51	TRUE	3,264	57.7	TRUE	2,926	59.2	4,145	2,926	1219
J-5281	1,000	20	TRUE	1,788	21.2	TRUE	1,396	21.6	TRUE	1,358	21.7	1,788	1,358	430
J-5282	1,000	20	TRUE	1,815	21.7	TRUE	1,406	21.9	TRUE	1,367	21.9	1,815	1,367	448
J-5284	1,000	20	TRUE	2,226	21	TRUE	1,584	24.2	TRUE	1,525	24.5	2,226	1,525	701
J-5291	1,000	20	TRUE	2,768	20	TRUE	2,612	20	TRUE	2,531	20	2,768	2,531	237
J-5295	1,000	20	TRUE	4,618	21.4	TRUE	3,475	35.3	TRUE	3,225	36	4,618	3,225	1393
J-5296	1000	20	TRUE	1,097	20	FALSE	709	20.1	FALSE	688	20.1	1,097	688	409
J-5298	1,000	20	TRUE	3,942	30	TRUE	3,349	36.7	TRUE	3,034	40.2	3,942	3,034	908
J-5301	190	56	TRUE	750	56	TRUE	704	56	TRUE	688	56	750	688	62
J-5302	196	56	TRUE	758	56	TRUE	711	56	TRUE	695	56	758	695	63
J-5303	1,000	20	TRUE	1,111	20	TRUE	1,075	20	TRUE	1,063	20	1,111	1,063	48
J-5306	1,000	20	TRUE	4,877	26	TRUE	3,499	41.9	TRUE	3,201	41.9	4,877	3,201	1676
J-5307	1,000	20	TRUE	4,621	30.9	TRUE	3,504	41.7	TRUE	3,207	41.7	4,621	3,207	1414
J-5308	1,000	20	TRUE	4,890	25	TRUE	3,507	41.5	TRUE	3,210	41.5	4,890	3,210	1680
J-5309	1,000	20	TRUE	4,893	25.1	TRUE	3,510	41.8	TRUE	3,214	41.8	4,893	3,214	1679

FERMILAB ICW ANALYSIS
FIREFLOW REPORT
5/1/2013

With Casey's, C-4 & Minos pumps on:

			2013 Max Day			2013 Max Day with Mu2E (30 gpm) & A-0 (600 gpm)			2013 Max Day with Mu2e (30 gpm), A-0 (500 gpm) & IARC (300 gpm)					
Label	Fire Flow (Needed) (gpm)	Residual Pressure (Needed) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	High	Low	Difference
J-5310	1,000	20	TRUE	5,061	20	TRUE	3,518	40.5	TRUE	3,222	40.4	5,061	3,222	1839
J-5311	1,000	20	TRUE	4,764	20	TRUE	3,527	36.7	TRUE	3,230	37.2	4,764	3,230	1534
J-5313	618	43.3	TRUE	1,089	43.3	TRUE	1,027	43.3	TRUE	993	43.3	1,089	993	96
J-5314	499	37.3	TRUE	1,026	37.3	FALSE	400	37.3	FALSE	377	37.4	1,026	377	649
J-5315	1,000	20	TRUE	2,282	20	TRUE	2,130	20	TRUE	2,062	20	2,282	2,062	220

Number of Junction Nodes that do not meet Fire Flow Goal	10	30	32

FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - Existing System
(2 Pumps on at Casey's Pump House, 1 Pump on at C-4 Pump Station and 1 pump on at Minos)


FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - with Mu2E (30 gpm) & A-0 (600 gpm)
(2 Pumps on at Casey's Pump House, 1 Pump on at C-4 Pump
Station and 1 pump on at Minos)

FERMILAB ICW ANALYSIS
5-1-13
JUNCTION NODES NOT SATISFYING FIRE FLOW REQUIREMENT
2013 Maximum Day - with Mu2E (30 gpm), A-0 (600 gpm) & IARC (300 gpm)
(2 Pumps on at Casey's Pump House, 1 Pump on at C-4 Pump Station and 1 pump on at Minos)