The following documentation is an electronically-submitted vendor response to an advertised solicitation from the *West Virginia Purchasing Bulletin* within the Vendor Self-Service portal at ***wvOASIS.gov***. As part of the State of West Virginia's procurement process, and to maintain the transparency of the bid-opening process, this documentation submitted online is publicly posted by the West Virginia Purchasing Division at ***WVPurchasing.gov*** with any other vendor responses to this solicitation submitted to the Purchasing Division in hard copy format.

Header 1

List View

General Information | Contact | Default Values | Discount | Document Information | Clarification Request

Procurement Folder: 1165807
Procurement Type: Central Contract - Fixed Amt
Vendor ID: VS0000032017
Legal Name: RMF Engineering, Inc. P.C.
Alias/DBA: RMF Engineering
Total Bid: $0.00
Response Date: 02/14/2023
Response Time: 13:19
Responded By User ID: rmfengineering
First Name: Kyra
Last Name: Coley
Email: kyra.coley@rmf.com
Phone: 4105760505

SO Doc Code: CEOI
SO Dept: 0211
SO Doc ID: GSD2300000007
Published Date: 2/9/23
Close Date: 2/14/23
Close Time: 13:30
Status: Closed
Solicitation Description: Campus Chill Water Loop / Plant Evaluation and Enhancements
Total of Header Attachments: 1
Total of All Attachments: 1

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Solicitation Response

Proc Folder:	1165807
Solicitation Description:	Campus Chill Water Loop / Plant Evaluation and Enhancements
Proc Type:	Central Contract - Fixed Amt

Solicitation Closes	Solicitation Response	Version
2023-02-14 13:30	SR 0211 ESR02142300000003800	1

VENDOR

VS0000032017
RMF Engineering, Inc. P.C.

Solicitation Number: CEOI 0211 GSD2300000007

Total Bid: 0 **Response Date:** 2023-02-14 **Response Time:** 13:19:00

Comments:

FOR INFORMATION CONTACT THE BUYER
Melissa Pettrey
(304) 558-0094
melissa.k.pettrey@wv.gov

Vendor
Signature X **FEIN#** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	Campus Chill Water Loop / Plant Evaluation				0.00

Comm Code	Manufacturer	Specification	Model #
81101508			

Commodity Line Comments: This is RMF's Expression of Interest, as stated in the RFP. Our understanding is that no fee is required to be submitted at this time.

Extended Description:

Campus Chill Water Loop / Plant Evaluation

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Centralized Expression of Interest
Architect/Engr

Proc Folder: 1165807	**Reason for Modification:**
Doc Description: Campus Chill Water Loop / Plant Evaluation and Enhancements	
Proc Type: Central Contract - Fixed Amt	

Date Issued	Solicitation Closes	Solicitation No	Version
2023-01-30	2023-02-14 13:30	CEOI 0211 GSD2300000007	1

BID RECEIVING LOCATION

BID CLERK
DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
2019 WASHINGTON ST E
CHARLESTON WV 25305
US

VENDOR

Vendor Customer Code: C01005-00

Vendor Name : RMF Engineering, Inc., PC

Address :

Street : 5520 Research Park Drive, Suite 300

City : Baltimore

State : Maryland **Country :** USA **Zip :** 21228

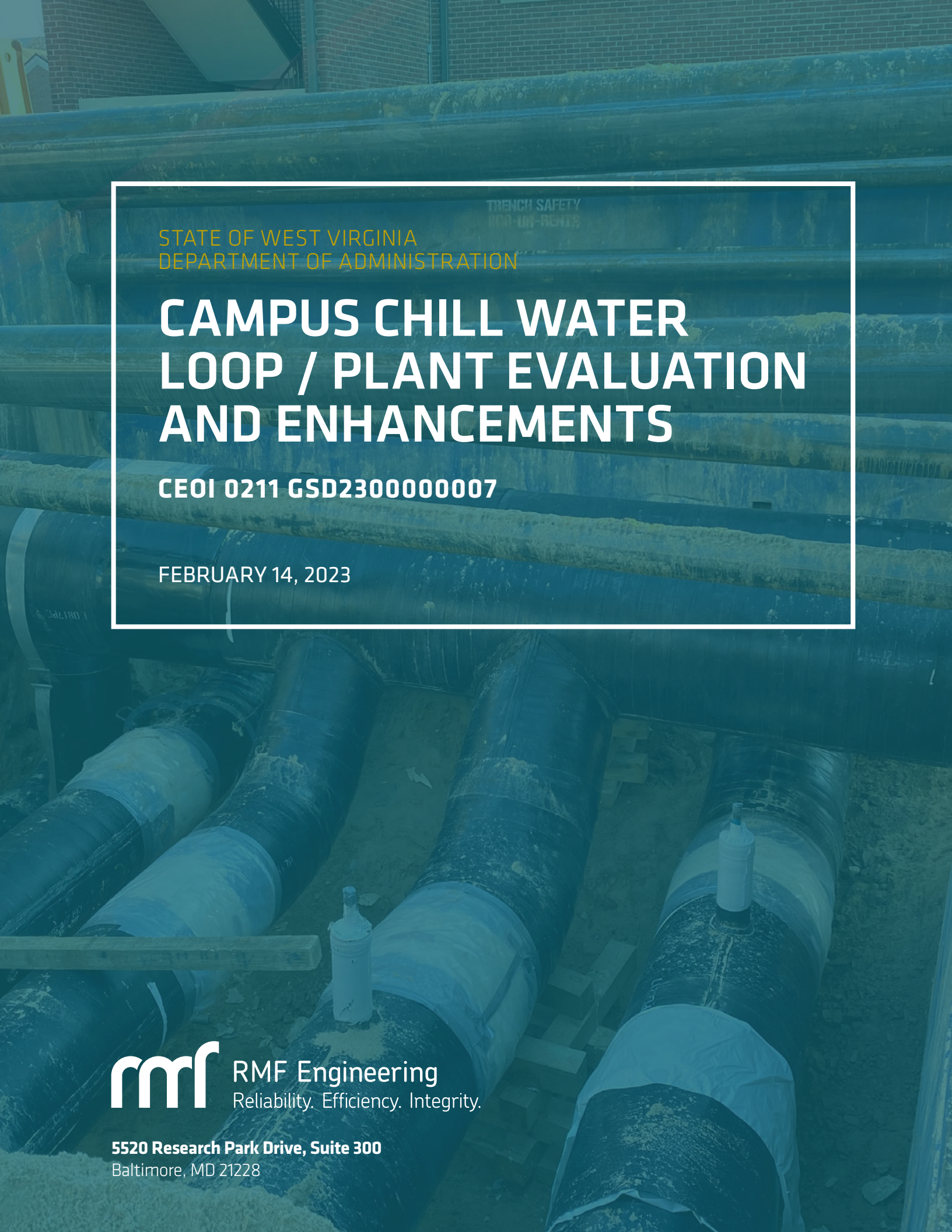
Principal Contact : Robert Smith, PE

Vendor Contact Phone: 410.576.0505 **Extension:** 5347

FOR INFORMATION CONTACT THE BUYER
Melissa Pettrey
(304) 558-0094
melissa.k.pettrey@wv.gov

Vendor Signature X  **FEIN#** 52-1279953 **DATE** February 14, 2023

All offers subject to all terms and conditions contained in this solicitation



STATE OF WEST VIRGINIA
DEPARTMENT OF ADMINISTRATION

CAMPUS CHILL WATER LOOP / PLANT EVALUATION AND ENHANCEMENTS

CEOI 0211 GSD2300000007

FEBRUARY 14, 2023

RMF Engineering
Reliability. Efficiency. Integrity.

5520 Research Park Drive, Suite 300
Baltimore, MD 21228

RMF Engineering
Reliability. Efficiency. Integrity.

February 14, 2023

Ms. Melissa Pettrey
Senior Buyer
State of West Virginia
Department of Administration, General Services Division
2019 Washington Street, East
Charleston, WV 25305

RE: Campus Chill Water Loop / Plant Evaluation and Enhancements – CEOI 0211 GSD2300000007

Dear Ms. Pettrey and Members of the Selection Committee:

RMF Engineering, Inc., PC (RMF) is pleased to submit our Expression of Interest (EOI) for the Campus Chill Water Loop / Plant Evaluation and Enhancements project at the West Virginia State Capitol Complex in Charleston.

RMF is nationally recognized as a leader in the planning and design of campus infrastructure for both chilled water plants and distribution. It would be a privilege for us to work with you and your colleagues on this important undertaking for the West Virginia General Services Division (the Agency). As you review RMF's qualifications and approach in this submittal, we wish to highlight the following which we believe make us uniquely qualified for this project:

- **Chilled Water Expertise.** For 40 years, RMF has been nationally recognized for our efforts in the development, renovation, expansion and commissioning of central utility plants and chilled water distribution systems. RMF has provided these services for over 125 major chilled water plants and chilled water distribution systems in the last ten years. Many of our district energy projects have won industry awards. Our goal is to work closely with stakeholders to maximize energy efficiency and provide designs with operational considerations in mind. Our repeat work at The Ohio State University, University of Massachusetts Amherst, Massachusetts Institute of Technology, Harvard University, Ohio University, Yale University, NC State University, Georgia Tech and others is a testament to the technical excellence and high level of service that RMF provides to our clients.
- **Assessment Experience.** RMF has been performing condition assessments/inspections for campus utility infrastructure for decades and is considered a leading industry expert. We have surveyed, assessed and documented equipment, utility manholes, handholes, vaults, pipes and underground structures for institutions including the Architect of the Capitol of the US, University of Maryland, Massachusetts Institute of Technology, Harvard University, University of Massachusetts Amherst, University of Vermont and the University of Florida. We employ dedicated teams of mechanical, electrical and structural assessors with a staff of over 100 employees trained and annually recertified in Permit Required Confined Space per OSHA 1910.146, all with an excellent safety record.
- **Modeling & Planning Abilities.** RMF maintains an in-house Master Planning team made up of registered engineers, energy auditors, LEED accredited professionals, and other specialists. RMF's planning is comprehensive and includes energy source alternatives, generation, storage, distribution and terminal use aspects of utilities. Hydraulic modeling is used to to simulate the campus piping network, determine the capacity of the existing system and identify bottlenecks, excessive velocities and risks, and to optimize the distribution piping. RMF's team proposed for this project includes specialists in hydraulic modeling and master planning.

RMF Engineering
Reliability. Efficiency. Integrity.

- **Highly Qualified Team.** The team selected for this project has a long history of working together on projects requiring careful consideration of technical complexities, economics and environmental constraints. Our team is led by Eric Chrencik, PE, whose expertise includes project management of large chilled water plant and distribution assessment, design, upgrade and renovation projects. The career of Mechanical Engineer, Bill Mahoney, PE, has focused on the design of central plants and the distribution systems that serve them. Both Mr. Chrencik and Mr. Mahoney understand the technical requirements of developing a design that can be implemented in phases around the Agency's and other stakeholders' operations. Our proposed team also includes professionals specializing in electrical engineering, civil engineering, and hydraulic modeling. If structural services become needed for the project, RMF has an in-house Structural Engineering team led by registered structural engineers with decades of experience.

  To supplement our in-house expertise, we have included Intertek-ATI as a subconsultant for pipe thickness and condition testing; Intertek's professionals have extensive experience with underground utilities assessment and non-destructive testing (NDT) techniques. These testing methods include several non-invasive types that can be performed while the lines are in service, without cutting open the piping.

  RMF also maintains relationships with numerous architecture firms experienced in central plant and utility expansion and renovation projects; we are prepared to include an architect as a subconsultant should architectural services become necessary to achieve the goals of the project.

- **Flexibility.** Through RMF's recent experience, we bring an understanding of how to execute assessment and upgrade projects that minimize disruption to the institution's mission and maximize use of existing assets. Some of this work was follow-on improvements at facilities we originally designed; however, many of our renovation and expansion projects are at plants that were designed by firms other than RMF. Facility directors recognize our firm's expertise to develop solutions that take into account long-term operations and maintenance issues.

RMF achnowledges receipt of Addendum 1, issued February 9, 2023.

We sincerely appreciate your consideration of RMF for this project and look forward to a successful relationship with the West Virginia General Services Division. If you should need any additional information, please contact me at 410.576.0505 or bob.smith@rmf.com.

Sincerely,

Robert Smith, PE
Vice President and Principal-in-Charge
RMF Engineering, Inc., PC

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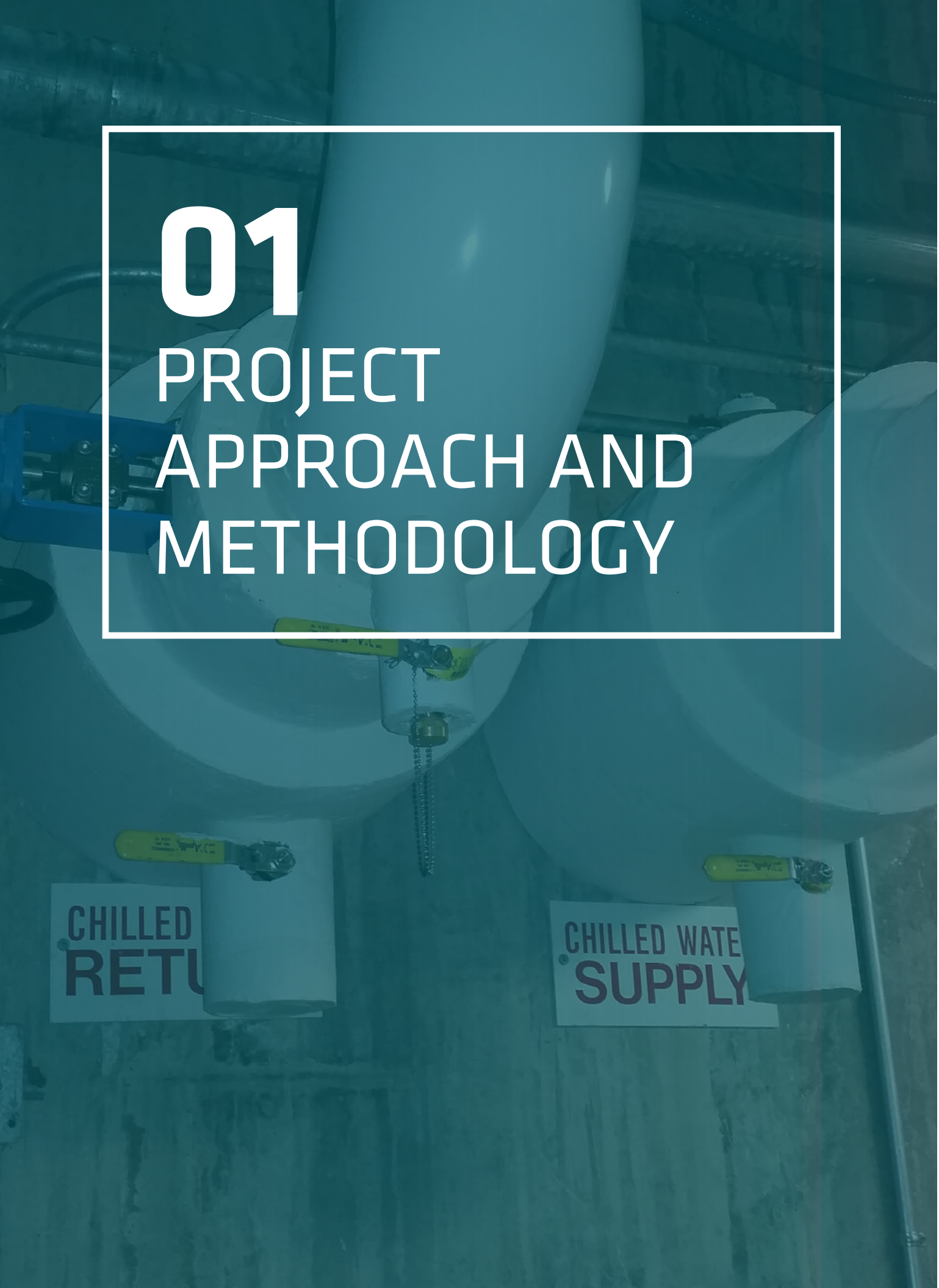


01 PROJECT APPROACH AND METHODOLOGY

01 | PROJECT APPROACH AND METHODOLOGY

Temporary Chiller Plant for Phased Construction
University of Massachusetts Amherst


Completed North Plant
University of Massachusetts Amherst

APPROACH AND METHODOLOGY

The West Virginia State Capitol campus is comprised of 11 buildings serviced by a Central Chilled Water Plant. The Central Plant serves general office space cooling as well as critical campus cooling loads such as data centers and special operations areas. The plant equipment consists of three 1,200 ton chillers, two 770 ton chillers, cooling towers to support heat rejection from the chillers, and free cooling heat exchangers. Additionally, the 770 ton chillers are backed up with power from two 1,000 kW natural gas generators to limit electrical usage during peak demand periods. At the plant and throughout the campus is a Trane Ensemble building management system.

The overall goal of the project is to provide the State of West Virginia with equipment assessment, design, and construction administration services to analyze and optimize the existing chilled water plant and campus chilled water delivery system. The initial effort will begin with data collection, including drawing reviews, trend data analysis, operator/facilities team interviews, and on-site field investigation to verify existing conditions. This effort will provide an understanding of the existing plant equipment arrangement and pumping configuration, building connection details, and specific issues with the chilled water system.

RMF has included Intertek as a subconsultant on our team to assist with pipe thickness and condition testing; we have worked successfully with Intertek's technicians on multiple prior projects, including a similar project for the Architect of the Capitol discussed below and later in this submittal. Intertek's team resumes and certifications are included in this package.

While evaluating original plant design criteria and building documentation, it is paramount that typical plant operating parameters including flow rates, operating temperatures, and pressures are validated and optimized. RMF will collect chiller plant operating data from the Trane Ensemble system and develop lexisting system load profiles for the campus. These load profiles, along with the specific plant piping configuration and equipment design data, will be input into hydraulic modeling software (PIPEFLO). The results will show hydraulically remote building(s), peak flow rates and velocities, potential choke points, and the chilled water distribution pump head requirement at peak load. The results will be compared to existing operating data. Recommendations for improvements will be made from the results which may include piping reconfigurations at plant, at the buildings, and plant or building controls revisions.

RMF performed this exact data collection and hydraulic modeling method at the FDA and Architect of the Capitol (AOC). At the FDA, two interconnected chiller plants and tertiary building pumps were modeled to determine adequate system distribution pressures and if there were any potential failure points in the system. Due to the criticality of the FDA's research buildings, a redundant 20" distribution main was recommended from this hydraulic analysis to provide a reduction in plant pumping head requirements, as well as provide system redundancy and reliability.

At AOC, RMF modeled the existing chilled water plant and distribution system to determine how much future capacity could be exported in the existing chilled water distribution piping. Additionally, pipe integrity testing was performed on the chilled water system with guided wave radar and pulsed eddy current technologies. Guided wave radar travels hundreds of feet to determine pipe thickness without disassembly of the piping system. Pulsed eddy current testing was also utilized

01 | PROJECT APPROACH AND METHODOLOGY

Allston District Energy Facility Condenser Water Pumps
Harvard University

Allston District Energy Facility Free Cooling System
Harvard University

to eliminate the need for insulation removal. At AOC, pipe testing revealed that no pipes were in immediate danger of failure or were compromised. This provided the facilities team with a high level of confidence for expanding their chilled water system without the need for major distribution upgrades.

After the RMF team has an overall understanding of the existing plant and building piping configurations through these evaluations, additional plant efficiency enhancements and control strategies will be reviewed. Options for improving plant efficiencies may include converting existing primary-secondary systems to variable-primary only, optimizing condenser water system operation by utilizing additional cooling tower fill surface area when multiple cooling towers are available, evaluating free cooling versus pre-cooling, and load shedding of the chilled water system.

At University of Massachusetts Amherst (UMass Amherst), RMF prepared a programmatic report identifying improvements that could be made to their existing North Chiller Plant and ISB Chiller Plant. These improvement recommendations were incorporated into a chiller plant replacement, chilled water distribution system expansion, free cooling addition, and condenser water system optimization. RMF prepared design documents and oversaw construction for all of these recommendations. The North Chiller Plant was originally a primary-secondary system that was completely overhauled and replaced with a new plant and variable-primary pumping system. Building connections were reviewed and documented to understand expected system hydraulics. The chilled water distribution system was expanded to completely loop the system for system reliability and a reduction in pumping head requirements. Lastly, free cooling was incorporated at the North Chiller Plant with a dedicated winter cooling tower sized appropriately for the winter load.

At the UMass Amherst ISB Chiller Plant, RMF prepared design documents and oversaw construction for a 3,500 ton cooling tower addition, 250 HP condenser water pump, and condenser water system controls optimization. Sequences were reviewed and modified to operate additional cooling towers with less chillers, when system demand allowed, to improve condenser water supply temperature to the chillers and reduce cooling tower fan energy.

Equipment sequencing is an important part of the load shedding scheme and will be reviewed for the 770 ton chillers and their associated 1000 kW natural gas generators. At Harvard University, RMF designed the generator and switchgear control system to include load shedding and load restoration of chillers and the associated unit substations that power the pumps and cooling tower fans. It is anticipated that the load to support two 770 ton chillers, pumps, cooling towers, and ancillaries will exceed capacity of one generator, therefore a sequence that includes mechanical equipment staging and starting/paralleling of the generators will be required. A consideration will be identifying and implementing generator modes of operation, which may include testing and demand response modes.

The projects at AOC, FDA, UMass Amherst, and Harvard had similar design and construction approaches that incorporated phased construction when required, designs that met specific criteria for each campus and incorporated technology and energy conservation measures unique to each campus. This specific experience will enhance the delivery of the improvement recommendations for the State of West Virginia.

01 | PROJECT APPROACH AND METHODOLOGY

Chiller at the East Campus Utility Plant
University of Cincinnati

Corroded Water Pipe
National Institutes of Health

Phased Construction Approach

It is understood that there are critical buildings and cooling loads on the West Virginia State Capitol campus chilled water loop. Data centers and special operations areas cannot be without cooling for extended periods of time. Many times, cooling systems cannot go without cooling at all. Improvements for these buildings will need to be designed with phased construction to limit chilled water shutdowns. This phased approach may be identified with sequences of work on drawings, multiple bid packages, hot taps, cut-in of shutoff valves during the winter months so that work can occur during the summer without a system shutdown, and pre-purchase specifications to expedite equipment procurement.

At the University of Cincinnati, RMF provided design documents to install 6,000 tons of chilled water generating capacity in an existing central utility plant. Multiple bid packages were prepared to separately facilitate and expediate demolition, structural steel installation, equipment procurement, and equipment installation. This phased approach allowed the University expedite construction to support the campus' growth. Another strategy for phased construction is to strategically install temporary chillers to support the chilled water district while work is being completed in the plant and/or buildings. This strategy was utilized at UMass Amherst. A temporary 1,500 ton chiller plant was installed to support the chilled water distribution system while the North Chiller Plant was under construction. Full design documents were prepared to capture this scope of work.

Design Standards/Criteria and QC Plan

All designs will comply with the most current editions of International Building Code, Mechanical Code, and Energy Code (among others). RMF will interview operators and the facilities team to understand specific chilled water system improvement needs. Where deficient, study and design documents will incorporate energy improvements and recommendations to bring chiller systems up to current code requirements. To ensure that this work meets quality standards, a principal not included in the detailed analysis or design phases of the project will regularly review the project at various strategic timeframes. This third party review will identify minor issues that can be overlooked when designers become too familiar with a project. RMF's quality assurance program is proven effective in providing technically accurate plans and specifications, as well as overall coordination among design disciplines and sub-consultants.

There are two quality control reviews and procedures that are unique to RMF's approach–Systems Analysis Quality Control and Constructability Quality Control Review. The Systems Analysis Quality Control occurs during the initial qualitative and quantitative system analysis phase. This includes reviews of equipment usages and operating conditions specific to the West Virginia Capitol Campus. The Constructability Quality Control Review begins with accurate field survey and as-built documentation of the existing site by RMF Engineers. Plan and specification reviews at all stages of design, including comment review and incorporation, constructibility, equipment access, and phasing implications are thoroughly reviewed during this stage.

01 | PROJECT APPROACH AND METHODOLOGY

Cooling Tower Testing, Ronald Reagan Washington National Airport
Metropolitan Washington Airports Authority

Cooling Tower Testing, Ronald Reagan Washington National Airport
Metropolitan Washington Airports Authority

Technology and Energy Conservation

RMF's expertise is in planning, designing, and delivery of chilled water plants and distribution systems. We will leverage our experience and expertise from large chiller plant design, including work at AOC, FDA, UMass Amherst, the University of Cincinnati, and Harvard University, to incorporate the latest improvements in technologies and energy conservation measures at the West Virginia Capitol Campus.

Technologies to be considered are variable-primary pumping systems, additions of variable frequency drives to constant speed equipment, upgrades to high efficiency chillers, free cooling sequencing and operational improvements, and condenser water system controls optimization.

An example of RMF's experience with incorporating energy efficiency technologies into chiller plant and distribution design is our work for the Metropolitan Washington Airports Authority (MWAA) at Ronald Reagan Washington National Airport. The intent of the project was to evaluate the existing plant and building connections, provide recommendations for improved operations, and install a 1,150 ton chiller to support a Terminal addition. The existing primary-secondary system was dated and had a bypass valve to control secondary pump discharge pressure in lieu of VFDs. Additionally, the building pumps were put in series with the plant distribution pumps (which varied from the original design with a decoupler/bridge-tender control and resulted in over-pumping at the building handoffs). From these recommendations, RMF prepared design drawings and oversaw construction of a chiller addition, the addition of VFDs to 300 HP distribution pumps, reconfigured building connections for improved chilled water delivery, and updated control sequences at the Central Utility Plant as well as at the buildings. MWAA was also under strict electrical usage requirements from leadership. A thermal energy storage tank on the chilled water system was reviewed and sequences optimized to fully charge and discharge the tank during optimal time intervals to limit electrical demand charges due to electrical usage at the plant. Additional details of this project are included in Section 2 of this submittal.

02 QUALIFICATIONS, EXPERIENCE & PAST PERFORMANCE

FIRM OVERVIEW

Founded in 1983, RMF Engineering (RMF) has been on the forefront of complex Mechanical, Electrical and Plumbing engineering solutions since before terms like sustainability, LEED and green requirements were common terminology. In our 40 year history, we have become nationally recognized for our quality analysis, planning, design and commissioning of campus utility generation and distribution systems, as well as buildings.

With over 260 staff in 11 offices, RMF is a client-focused practice routinely ranked as one of the top MEP firms in the country. We are proud of our prompt responsiveness, industry-leading tech savvy and project teams who have extensive histories of working together as specialized units. As a result, you can expect to receive the highest quality contract documents, the most intelligent engineering solutions and a team that is known for seeing every project through to completion.

Full Service Engineering

We offer our clients a full range of engineering services to provide maximum energy efficiency and sustainability across their entire operational portfolio. Starting with Energy Master Planning all the way through to Commissioning, our focus is to provide technical expertise and a high level of service that leads to long-lasting relationships.

2022
CSE
MEP GIANTS

RMF ranked 42nd out of 100 in CSE's MEP Giants

2022
ENR
TOP 500

RMF ranked 294th out of 500 in ENR's Top 500

2022
EC&M
TOP 40

RMF ranked 24th out of 40 in EC&M's Electrical Design Firms

OUR FULL RANGE OF SERVICES INCLUDES:

- MECHANICAL ENGINEERING
- ELECTRICAL ENGINEERING
- COMMISSIONING
- CIVIL / STRUCTURAL ENGINEERING
- THERMAL UTILITY INFRASTRUCTURE
- CONTROLS ENGINEERING
- SUSTAINABLE DESIGN
- MASTER PLANNING
- CONSTRUCTION QUALITY MANAGEMENT
- ENERGY ASSESSMENT

260+ EMPLOYEES

11 OFFICES

40 YEAR HISTORY

RMF specializes in the critical thinking required to design mechanical systems engineered for maximum reliability and efficiency. Critical analysis, superior planning, experience-based design and ease of maintenance are key components that go into making every RMF project flexible and energy efficient.

FINDING THE RIGHT PATH

Utility distribution is dependent on well-planned underground alignment, attention to rights-of-way, boundaries and site sensitivities, and careful coordination with end-users. With our civil-mechanical-electrical-structural design team working together under one roof, RMF ensures the accuracy of these systems. We have designed hundreds of miles of underground utility systems, and our vast experience includes hydraulic analysis for chilled water and hydronic systems. RMF's in-house utility design expertise includes:

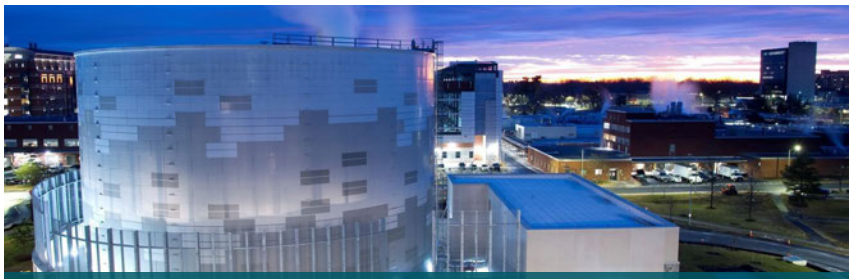
- Chilled water
- Steam & condensate
- Low and high temperature hot water
- Electrical ductbanks
- Domestic water
- Natural gas & fuel
- Utility tunnels
- Underground structures
- Site design
- Sediment & erosion control
- Permitting
- Pedestrian traffic
- Vehicular access

CHILLED WATER EXPERIENCE

RMF has provided the survey, analysis, planning, design and start-up of chilled water systems including chillers, cooling towers, pumping systems, thermal storage, piping, valving and controls at many facilities.

RMF approaches each chilled water system as an independent and site-specific application. Concepts that are cost-effective at one installation may not be as benficial at another. Some concepts that have been effectively utilized include:

- Variable Speed Pumping
- Distributed Pumping
- Non-Electric Prime Movers (Steam Turbine, Gas Engine, Absorption)
- High Efficiency Machines (Low kW Per Ton)
- Free Cooling Utilizing Plate and Frame Heat Exchanger Technology
- Control Optimization of Loading
- Parallel Machines
- Cooling Tower Optimization (WB Selection, Condenser gpm/ton, Fan & Fill Enhancements, Acoustics, Induced vs. Forced Draft, etc.)
- Interconnection of Multiple District Plants
- Automatic Condenser Tube Cleaning Systems
- Water Treatment Programs
- Thermal Storage (Ice & Chilled Water)



Chilled Water Thermal Storage Tank
National Institutes of Health

SUBJECT MATTER EXPERTISE: HYDRAULIC MODELING

Corey Gray, PE, LEED GA is RMF's subject matter expert (SME) on hydraulic modeling for master planning of campus utilities. In an article in the Spring/Summer 2020 edition of *District Energy* magazine, he explains how he uses submetering data to make hydraulic modeling more accurate. For instance, the types of submetering data used "could include building energy load and flows, as well as system pressures. A snapshot can be taken of what is happening within the system and the hydraulic model adjusted to try to best match that snapshot through a calibration effort. Items to be adjusted to match this snapshot would include pipe roughness, lengths, number of fittings, etc."

"For chilled-water systems, improvement of pipe roughness though pipe replacement can result in some distribution pumping savings, which in turn can equate to energy savings. Also, improving the hydraulic model though calibration can result in greater predictability of the model results in the design of future additions to the distribution network."

District Energy Facility Chillers
Harvard University

Central Chilled Water Plant Renovation & Expansion
George Mason University

PROJECT PROFILE: CENTRAL CHILLER PLANT EXPANSION

The Central Utility Plant, located in the University of Vermont's Green Historic District in the center of the campus, was expanded by 5,500 GSF on two levels to accommodate the new chillers, pumps, pipes, ancillary equipment, electrical and ventilation system requirements.

The project included the addition of one 1,500-ton electric centrifugal chiller and 0.57 kW/ton auxiliaries, with provisions for a future 1,500-ton unit, bringing the plant's ultimate installed cooling capacity to 5,730 tons. The addition also included a free cooling and pre-cooling system made up of multiple 250-ton heat exchangers, pumps and dedicated cooling towers, to directly produce chilled water using cold cooling tower water without chiller compressors, when ambient conditions permit.

CHILLER PLANT EXPERIENCE

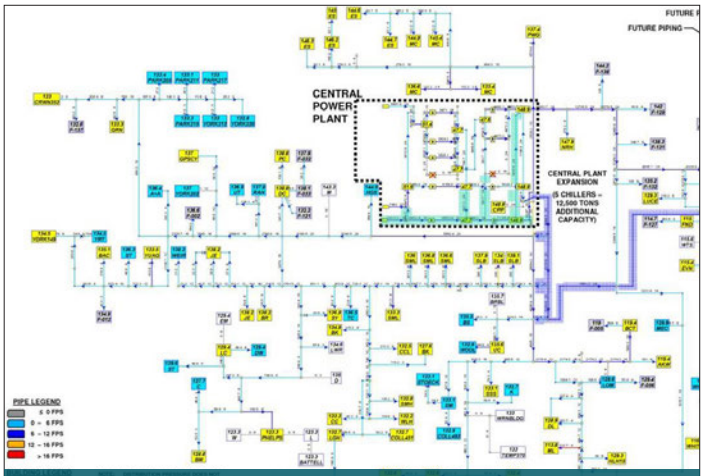
RMF has been collaboratively developing near- and long-term "road maps" to provide reliable heating, cooling and power systems and proven infrastructure since 1983 for leading institutions across the country. RMF has designed over 125 major cooling plant expansions, plant renovations and utility distribution projects in the last 10 years. Because of the large volume of our work with multiple ongoing chiller projects, we have a close connection to construction activities and construction costs and have a proven track record of cost control. Our chiller plant projects have included, among others:

- New East Chiller Plant & Cooling Towers (5,600 TONS)
  West Virginia University
- Life Sciences Chilled Water Plant Expansion (3,600 TONS)
  West Virginia University
- East Regional Chilled Water Plant & Distribution (20,000 TONS)
  The Ohio State University
- South Campus Central Chilled Water Plant (30,000 TONS)
  The Ohio State University
- Chilled Water Plant Renovation & Addition (58,200 TONS)
  US Capitol Power Plant
- Chilled Water Plant Renovation & Expansion (60,000 TONS)
  National Institutes of Health
- Addition & Modernization of Chilled Water Plant (30,000 TONS)
  National Institute of Standards and Technology
- Chilled Water Plant (13,500 TONS)
  Walter Reed National Military Medical Center
- Central Chiller Plant Expansion, Renovation, & Thermal Energy Storage (6,000 TONS)
  Univ. of Maryland Baltimore County
- Chilled Water Plant Renovation & Expansion (32,500 TONS)
  Johns Hopkins Hospital
- Chilled Water Plant (50,000 TONS)
  University of Pennsylvania
- Science Area Chilled Water Plant (20,000 TONS)
  Yale University
- Additions & Modifications to Multiple Plants (26,000 TONS)
  University of Virginia
- Chilled Water Plant Addition (11,000 TONS) *Fairfax Hospital*
- Central Chilled Water Plant Renovation & Expansion (6,000 TONS)
  George Mason University
- North Chiller Plant (6,000 TONS)
  UMass Amherst

HYDRAULIC MODELING

In order to determine if a heating or cooling distribution pumping and piping system is effectively and efficiently delivering the product, RMF will perform a hydraulic nodal analysis. RMF utilizes this model to simulate the campus piping network, determine the capacity of the existing system and identify bottlenecks, excessive velocities and risks. Models are then prepared to determine if a distribution and pumping system can support proposed load growth and different scenarios (Primary variable, etc.) can be applied. The performance of the system is modeled in several ways using a range of temperature differentials. RMF will perform the necessary hydraulic computer based simulations using Pipe-Flo or KYPipe to optimize the distribution piping.

Each pipe segment is evaluated based upon the flow velocity and pressure loss. The specific pump curves are entered into the model to provide a more accurate energy analysis. The evaluation of the pressure loss within each pipe segment is based upon the required pump size and energy consumption. The modeling can determine if "over-pumping" conditions may be occurring, creating energy inefficiencies. Once a computer based hydraulic model is created, it can be manipulated in several ways to evaluate the effects of new flows associated with new or modified pumps or the extension of branch lines. Iterations of division valve closures can be simulated to determine the effects of outages. New interstitial loops can be modeled to simulate the benefits of improvements.



Central Power Plant and Distribution Hydraulic Model
Yale University

This modeling approach can be used to determine optimum system configurations (loops, radials, etc.) as well as pipe size. The firm has developed detailed economic modeling of various installation techniques to determine the most cost effective site-specific application.

WEST VIRGINIA EXPERIENCE: SELECTED PROJECTS

- US Department of Veterans Affairs / Huntington, WV
  - Construct New Boiler Plant, Huntington VAMC
- Momentiv Performance Materials / Friendly, WV
  - Underground Piping Replacement Study
- Morgantown Municipal Airport / Morgantown, WV
  - On Call and Planning Services, including: Emergency Generator Evaluation, MEP System Analysis, and Commercial Terminal Roof Drain Replacement
- West Virginia University / Morgantown, WV
  - Downtown Chiller Plant
  - Animal Care & Consulting Service
  - Chemistry Research Expansion Study
  - East Chiller Plant Relocation Study
  - Utility Infrastructure Upgrades Phases 1 & 2
  - Life Sciences Chiller Plant & Utility Distribution Upgrades
  - Utility Master Planning and Analysis

02 | EXPERIENCE & PAST PERFORMANCE

Prevention of cooling tower icing is a key design consideration for safe free cooling operation

Freeze Prevention is an important design element for cold climate operation

Free Cooling System Installation (3,000 Tons)
Harvard University

US Capitol Power Plant Free Cooling Heat Exchangers (10,000 Tons) / Architect of the Capitol

Free Cooling System (500 Tons)
University of Massachusetts Amherst

Free Cooling System (1,700 Tons)
Georgia Tech

FREE COOLING SYSTEMS

Free cooling often represents a cost effective and energy efficient method of chilled water generation when outdoor ambient conditions are capable of sufficient heat exchange.

The primary goal of free cooling is to avoid the energy costs that are associated with operating a chiller compressor. As outside temperatures sufficiently decrease, a cooling tower can shift its duty from chiller heat rejection to generating cold water.

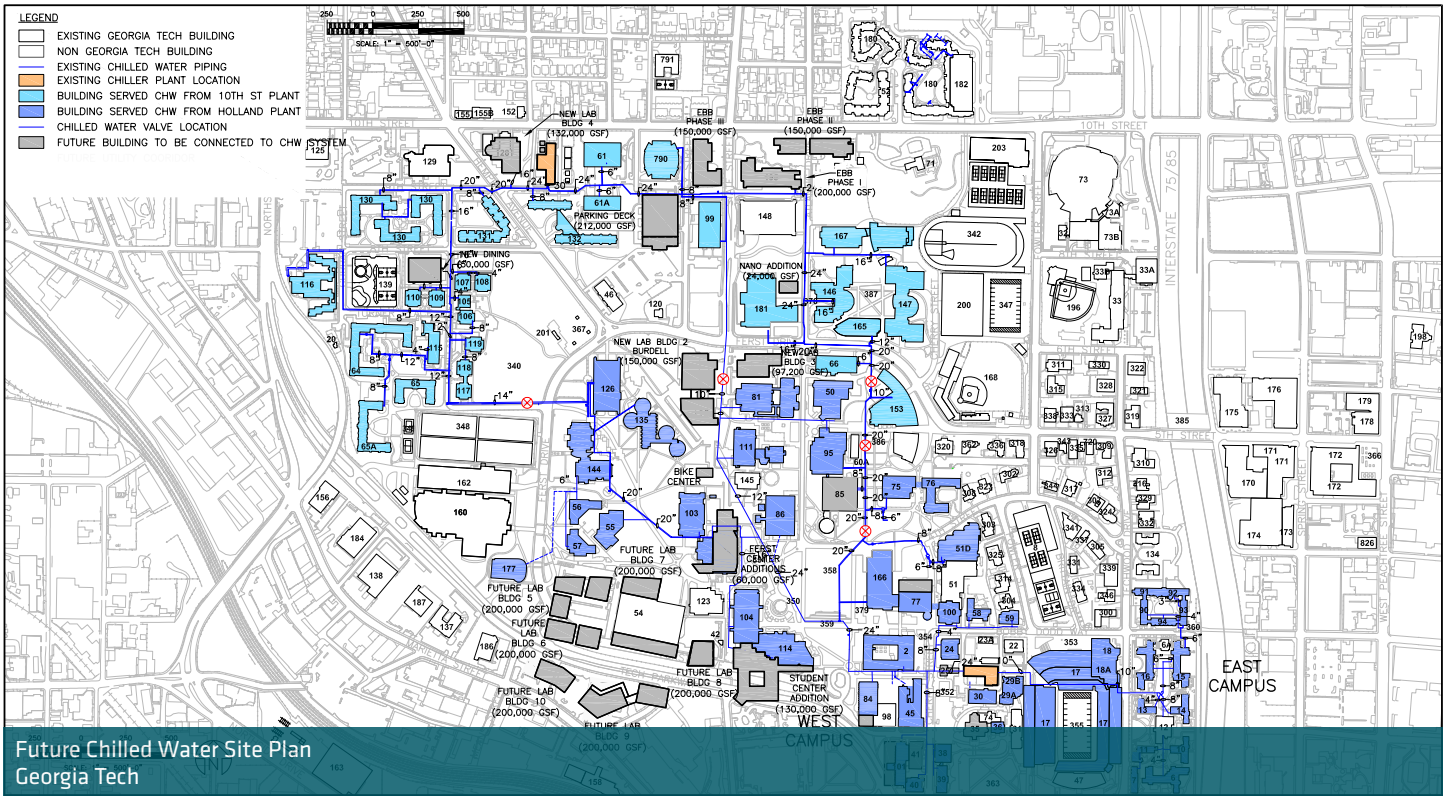
The more common free cooling process is when chilled water is cooled through the use of isolating heat exchangers in the cooling towers condenser water loop. The key factor to free cooling is when ambient conditions (°F WB) allow the cooling tower to produce "chilled water" for the system. Plate-and-frame heat exchangers are usually acceptable for the moderate temperatures and low pressures that operate in water circuits. Plate exchangers can function properly with only a narrow temperature approach (as low as 2°F, depending on size).

During the winter especially, because of the reduced cooling loads, little dehumidification is involved and the "free cooling" chilled water temperature can usually be higher than those during summer operation.

A major concern when operating a cooling tower during the winter for free cooling is freeze protection. If a cooling tower does not have the appropriate load, excessive amounts of ice may form inside or on the unit which could lead to a significant reduction in thermal capacity or a catastrophic equipment failure. Considerations may include the piping arrangement (free cooling vs. pre-cooling), system winterization such as heat trace and basin heating, and cooling tower sequencing.

RMF's successive experience with free cooling systems has been extensive, with some large systems producing up to 10,000 tons of "free" chilled water. Projects have included:

- National Institutes of Health (10,000 tons)
- US Capitol Power Plant (10,000 tons)
- Harvard University (3,000 tons)
- Georgia Tech (1,700 tons)
- Pfizer, Inc. – New London, Connecticut (1,500 tons)
- George Mason University (1,400 tons)
- University of Georgia (1,000 tons)
- University of Massachusetts Amherst (500 tons)
- University of Vermont (500 tons)
- Dartmouth College (415 tons)



Future Chilled Water Site Plan
Georgia Tech

CAMPUS UTILITY MASTER PLANNING

RMF has prepared over 100 energy plant and utility master plans, primarily for higher education and medical/research campuses. Utility master planning typically includes chilled water, steam, low and medium temperature hot water, domestic water, fire protection water, stormwater and sanitary sewers, natural gas, medical gasses, fuel oil, normal power, emergency power and telecommunications. RMF's planning is comprehensive and includes energy source alternatives, generation, storage, distribution and terminal use aspects of utilities.

Condition Assessment

The first step in preparing a utility master plan is to prepare a thorough analysis of the existing plant and distribution system. This evaluation includes identifying the efficiency, age, physical condition, capacity, reliability, and useful life of the existing systems. This can include visual surveys, non destructive and/or destructive testing, and reviews of operating logs.

Energy Audit

RMF next performs an energy audit, which includes assessments and analysis of utility bills, energy consumption records, and utility production data to determine the effective use of energy by the existing facility.

Load Analysis

A load analysis is performed, which includes a determination of peak and past load curves, seasonal production characteristics, and identifies where individual campus loads occur.

Future Projection

RMF works with the campus building master planners to project the utility loads of future buildings and the impact of the growth on the existing infrastructure systems.

Firm Plant Capacity Analysis

A reliability analysis is routinely performed to determine the reliable utility capacity when the largest subsystem is out of service.

System Optimization

A variety of alternatives are analyzed for life-cycle cost effectiveness. Initial construction cost estimates and a present-worth analysis is prepared for each option to justify the optimal solution. For example, chilled water system types are determined by their cost effectiveness. A System could utilize high efficiency electric centrifugal chillers, steam turbine-driven chillers, steam absorption chillers, gas-fired absorption chillers or thermal storage.

Hydraulic Modeling

A computerized model analysis is prepared by RMF for each campus network, which simulates the performance of the mechanical pumping and piping system. The computer model will identify any existing restrictions in the system, and can identify the fluid carrying capabilities of the system for supporting additional growth. Future buildings can be easily added to the model to determine any deficiencies. Hydraulic modeling is a tool for planning and evaluating corrective solutions such as supplemental piping, replacement piping, and piping system modifications.

02 | EXPERIENCE & PAST PERFORMANCE

ENERGY MODELING

RMF has on staff an ASHRAE certified Building Energy Modeling Professional (BEMP) and eight highly trained energy modeling professionals who are routinely involved with evaluating potential energy conservation measures and the development of whole building energy optimization studies. Our engineers are trained to utilize the most current energy modeling protocols and utilize the most advanced energy modeling programs (IESVE, eQUEST, Carrier HAP, Trane TRACE, etc.). We routinely create and analyze whole building energy models for code compliance, utility rebates and Performance Rating (LEED, Green Globes, ASHRAE 189, etc.) certification. RMF's energy modelers work with the Engineers and Architects in an integrated design process to evaluate and optimize potential energy conservation measures which include building envelope design, enhanced lighting designs, HVAC system selection, renewable power generation and utility power usage in order to provide Owners with the most efficient project design.

SUSTAINABLE DESIGN

RMF is skilled in energy auditing and identifying methods for reduction in annual utility operating costs. The significance of the mechanical and electrical systems within a building warrants consideration of energy efficient design. The MEP systems should always incorporate energy conservation technologies, which reduce energy costs without compromising the reliability of the support systems. Currently, RMF has on staff over 30 LEED Accredited Professionals, and has designed over 100 projects striving for–or having achieved–LEED Certification ranging from Certified to Platinum level.

CONSTRUCTION ADMINISTRATION

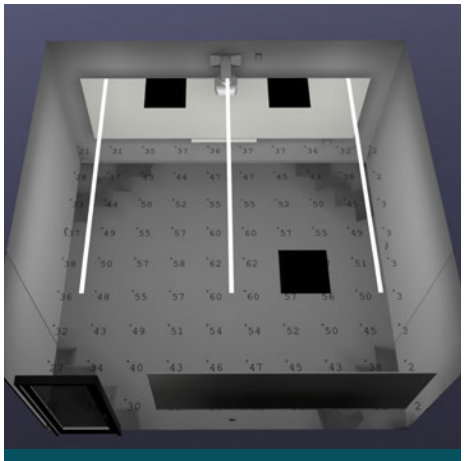
RMF offers construction administration services on a daily, weekly, or less frequent basis as required by the client. The firm maintains a field department of mechanical, electrical, civil and structural engineering services, as well as architectural support. The department affords the client a comprehensive staff to ensure that construction correspondence is logged and processed in a timely fashion. RMF believes that the design engineers are best suited to address issues in a timely manner during construction. The design engineers will remain engaged in the project throughout construction.

A key area of RMF's qualify control during construction consists of frequent and timely site observations. Projects often call for numerous site visits throughout the construction sequence until final acceptance. Construction issues are continuously identified to minimize significant punch-list items at the project's closeout.

Construction phase services typically include:

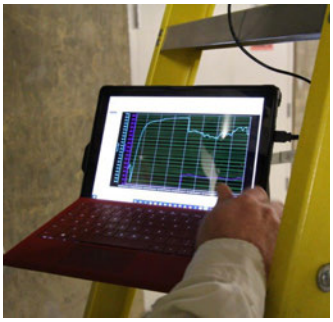
- Review of shop drawings
- Review of submittals, materials installed, etc.
- Request for information processing
- Conduct / attend progress meetings
- Maintain minutes of progress meetings
- Review applications for payment
- Conduct site inspections / periodic site visits
- Submit punch list
- System commissioning and testing
- Safety inspections

Construction Administration



Design for Energy-Efficient Classroom Lighting

Building Energy Modeling Report



CHILLED WATER DISTRIBUTION SYSTEM HYDRAULIC MODELING AND DATA LOGGING

US FOOD AND DRUG ADMINISTRATION | SILVER SPRING, MD

» COMPLETION DATE

2020

» COST

$1 Million

» SERVICES PROVIDED

Civil Engineering
Mechanical Engineering
Structural Engineering
Electrical Engineering
Hydraulic Modeling

» REFERENCE

Mr. Marty Borenstein
US Food & Drug Administration
301.796.3623
marty.borenstein@fda.hhs.gov

» RELEVANT RMF TEAM MEMBERS

Corey Gray,
Hydraulic Modeler & Master Planner

Steven Buckler,
Civil Engineer

Eric Chrencik,
Mechanical Engineer

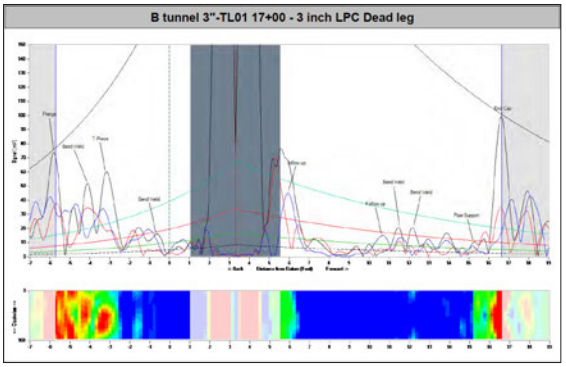
RMF developed and calibrated a detailed hydraulic model for the campus chilled water distribution piping system at the US Food and Drug Administration (FDA) Headquarters campus. The model utilized computer software to simulate the performance of pumps, chillers, piping, and on/off only valves. Calibrations were performed to ensure accurate modeling so that outage scenarios and future campus planning could be predicted with a high level of confidence. This extra service was of high importance to the FDA to build certainty into the accuracy of the computer model. New chiller mapping was also developed for the campus.

RMF began with a field verification of the visible utility distribution piping in walkable tunnels and the utility plants to accurately construct hydraulic models. The computer software modeling began at the two (2) chilled water plants and ended at the tertiary pumps/main valves in each building. Using the existing site maps and records as reference documents, RMF created new GIS mapping using ArcMap. Map features were created for buildings, roads, sidewalks, etc., as well as individual utility systems (piping and manholes). Several high-quality software packages were available for analyzing the chilled water system. KYPipe was used because it allowed the user to bring in background maps (CAD) for distribution systems so the model could be set up in a map format rather than a schematic diagram.

In addition, RMF performed data logging of seventeen (17) individually metered buildings' chilled water data to record water flow, supply water temperature, return water temperature and system differential pressure. The data logging was field-intensive and required several steps:

- **Initial Field Setup Services:** RMF performed a site visit to each building and identified locations for data logging equipment installation. Instruments were purchased and installed by RMF staff. Independent readings of water flow, temperature and pressure were then taken to ensure data logging equipment was recording properly and within tolerance.
- **Data Analysis:** RMF personnel retrieved data from each building's data logger at the end of the cooling season, then data was compiled and analyzed for accuracy and then provided in Excel format to the project team. Flows, temperatures and pressures were re-checked to ensure accuracy and to ensure data logging devices were recording properly.
- **Removal of Data Logging Equipment:** At the conclusion of the testing, RMF removed all data logging equipment and worked with the site operator to ensure all installed measurement devices were properly re-connected to the original GE Panametrics D868 flow recording devices.
- **Final Reporting and Training:** RMF provided a final report of all findings during the data logging exercise and compiled and conducted training for the owner of how to re-conduct data logging efforts for future use.

Extensive computer modeling was performed. The hydraulic modeling took into account the lengths of pipe, fittings, valves, diameters, roughness factors, demand flows, and pressures. Actual manufacturers' data from the chilled water pump performance curves was incorporated for increased accuracy. The data logger information was then used to reflect 'as built' conditions for calibrating the model. The results suggested that additional campus piping (20" diameter) was needed to ensure reliability and redundancy, and was subsequently designed and constructed.



» **COMPLETION DATE**

2021

» **COST**

$3 Million

» **SERVICES PROVIDED**

Civil Engineering
Mechanical Engineering
Structural Engineering
NDT
Hydraulic Modeling

» **REFERENCE**

Mr. Chris Potter
Deputy Director – Utilities & Power Plant Operation
Architect of the Capitol
202.226.3864
cpotter@aoc.gov

» **RELEVANT RMF TEAM MEMBERS**

Corey Gray, *Hydraulic Modeler & Master Planner*

Steven Buckler, *Civil Engineer*

Robert Smith, QA/QC & *Mechanical Engineer*

Eric Chrencik, *Mechanical Engineer*

William Mahoney, *Mechanical Engineer*

Jared Markle, *Electrical Engineer*

CHILLED WATER PIPE INTEGRITY TESTING AND HYDRAULIC MODELING

ARCHITECT OF THE CAPITOL | WASHINGTON, DC

The chilled water distribution piping throughout the US Capitol Complex dates back to the mid 1930s and 1950s and ranges from as large as 16" to 42" in diameter, serving 17 major Congressional- and Supreme Court-affiliated buildings. Because of concern about age, corrosion, and reliability, RMF led an investigation into the condition and performance of the utility piping that served the Capitol Complex. These pipes were both direct buried as well as routed through underground tunnels all around the US Capitol grounds. The piping provides chilled water, steam, high pressure condensate, and low-pressure condensate to Capitol Hill buildings.

RMF's work included a condition assessment, non-destructive testing, hydraulic modeling study, and subsequent design for utility distribution system repairs and upgrades. The work began with a visual condition assessment of the accessible portions of the distribution system followed by non-destructive testing (NDT).

Guided Wave Testing was performed to determine pipe wall thickness, and over 100 measurements were taken. The guided wave travels hundreds of feet in both directions and determines the physical condition of the pipe without disassembly. The basic methodology for determining the utility pipe integrity from the measurements was based on calculating the maximum operating pressure for a given wall thickness as outlined in ASME B31 Code for Pressure Piping. The testing revealed that none of the pipes were in danger of immediate failure, and a walk-through of the tunnels revealed them to be mostly dry, with only occasional accumulations of water on the floor. The facilities were well-maintained, with proper lighting, insulation, and ventilation, as were coatings, marking, signage, and pipe coverings.

The **Pulsed Eddy Current** (PEC) method was another pipe inspection technique used for the chilled water piping. PEC was an advantageous method of nondestructive testing because it did not require the insulation and jacket to be removed for insulation types such as Foamglas and fiberglass, whereas other techniques did. UT, Magnetic Particle Inspection, and Phased Array tests were also used to supplement the GW and PEC testing in order to complete the pipe integrity evaluation.

Hydraulic models of the steam and chilled water distribution piping system were developed to simulate the hydraulic performance of the network, which represented several miles of piping. Pipeflo software was utilized to calculate flows (GPM), pipeline velocities (FPM) and friction losses (FT) in an effort to uncover bottlenecks, locations of excessive flow and friction losses manufactured. Pump curve data from the actual secondary chilled water pumps was used in creating the models for optimal accuracy. The computer model was an excellent predictive tool to determine where locations in the chilled water distribution system would experience insufficient flows under peak operating conditions. The computer model was also useful in determining how much additional cooling load could be confidently added to the chilled water system without compromising delivery to existing buildings. Future needs were also identified with respect to utility distribution for steam, and chilled water, and the hydraulic model was used to simulate future operating conditions under different build out scenarios.

» **COMPLETION DATE**

2019

» **COST**

$6.6 Million

» **SERVICES PROVIDED**

Civil Engineering
Mechanical Engineering
Structural Engineering
Electrical Engineering

» **REFERENCE**

Mr. Aaron Lee
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Design Department
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703.572.3620
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» **RELEVANT RMF TEAM MEMBERS**

William Mahoney,
PM & Mechanical Engineer

Corey Gray,
Hydraulic Modeler

Eric Chrencik,
Mechanical Engineer

Robert Smith,
QA/*QC*

CHILLED WATER PLANT EXPANSION, RONALD REAGAN WASHINGTON NATIONAL AIRPORT

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY | WASHINGTON, DC

The purpose of this project was to provide additional capacity in the Central Plant to accommodate expansion of the airport terminal. The expansion added another pier north of the existing B/C Concourse, to provide approximately 167,000 SF of conditioned space for terminal operations along with 92,000 SF of conditioned space for North & South Security Screening Checkpoints.

The Central Plant provides chilled water for cooling and high temperature hot water (HTHW) for heating to the existing B/C terminal and several hangars.

The scope of engineering work included:

- Retrofit of five cooling tower cells, including replacement of the entire mechanical system (fan, gear drive, extended drive shaft, motor and supports), distribution system (internal piping and spray nozzles) and concrete shell and fan stack repairs.
- Replacement of the 2-speed motor starters on five cooling towers with variable frequency drives.
- Installation of a sixth concrete cooling tower cell, similar to the existing cells, utilizing ceramic tile fill, a drive system with the motor out of the airstream, and a variable frequency drive for the motor.
- Replacement of the motor starters on five chilled water distribution pumps with variable frequency drives.
- Installation of an electric centrifugal chiller (1,150 nominal tons), similar to the existing five chillers in operation at the plant.
- Installation of a chilled water loop pump and a condenser water pump, sized to accommodate the flows for the added 1,150-ton chiller.
- Facility Improvement Measurements (FIMs) including tertiary building pump connection modifications, secondary chilled water pump control optimization, and thermal energy storage tank charging optimization.

The plant also utilized a 22,050-ton hour thermal storage tank to manage operating costs. Proper planning helped to overcome significant challenges including construction phasing and planning for equipment rigging adjacent to an active railway. The project was completed under budget two months early.

» **COMPLETION DATE**

2017

» **COST**

$20 Million

» **SERVICES PROVIDED**

Mechanical Engineering
Electrical Engineering
Structural Engineering
Civil Engineering

» **REFERENCE**

Mr. Ted Mendoza
Capital Project Manager
UMass Amherst
413.362.9287
tmendoza@facil.umass.edu

» **RELEVANT RMF TEAM MEMBERS**

William Mahoney,
PM & Mechanical Engineer

Eric Chrencik,
Mechanical Engineer

Robert Smith,
QA/*QC*

NORTH & ISB CHILLER PLANT UPGRADES

UNIVERSITY OF MASSACHUSETTS AMHERST | AMHERST, MA

The University of Massachusetts Amherst (UMass Amherst) anticipated steady growth in construction on campus, so RMF was commissioned to develop a Comprehensive Campus Energy Plan. As a result of the study, upgrades to two plants were recommended in order to connect new and additional existing buildings to the centralized chilled water systems.

Temporary chillers were designed and set up to provide continuous service to critical systems. The North Plant is built over the site of the original Polymer Plant; bid documents for the phased construction allowed temporary demolition of the original plant while it continued to operate. Final demolition began when winter loads allowed the temporary system to handle the campus demand.

A new North Plant was built in a parallelogram arrangement and a second plant at the Integrated Science Building was expanded. The North Plant was fit-out with two new chillers and two relocated chillers, for an initial capacity of 4,310 Tons. At full build out, the installed capacity is 6,000 Tons. The pump system is variable primary, operated in parallel with another plant on the district system.

The North Plant was designed for four, 1,600 Ton, field-erected cooling towers, with three initially installed. Each cooling tower was designed for 4,800 GPM of condenser water flow at 95F EWT, 85F LWT and 78F WB using 75 HP fans controlled by variable frequency drives. Due to the small winter load required, a 200 Ton winter cooling tower, selected for winter operation only, was installed to provide free cooling duty. This winter cooling tower eliminated the need for freeze protection at the field-erected cooling towers, which are drained.

Three new 7,200 GPM condenser water pumps at 100 feet of head were provided for N+1 redundancy. Each pump was 250 HP, 1200 RPM and provided with variable frequency drives. A new sand filtration system was installed to improve water quality of the condenser loop. Cooling tower support grille elevated approximately 10' above the roof was installed to support the field-erected cooling towers. Cooling tower access stairs, catwalks, railings and platforms were installed around all cooling tower cells to allow for full access to the basins and fan decks.

Provided N+1 capacity at the Integrated Sciences Building chiller plant, a 3,500 Ton cooling tower designed for 4,667 GPM of condenser water flow at 103 EWT, 85F LWT and 78F WB using 75 HP fans controlled by variable frequency drives was installed. Pipeline heat tracing and a sump steam educator were installed for freeze protection. Additionally, a 200 Ton winter cooling tower was installed to serve low load free cooling tower conditions.

One new 5,000 GPM condenser water pump at 159 feet of head was provided. The pump was 250 HP, 1800 RPM and provided with a variable frequency drive. The concrete cooling tower basin and sump were expanded to support the cooling tower structure.

» **COMPLETION DATE**

Ongoing

» **COST**

$16.6 Million

» **SERVICES PROVIDED**

Mechanical Engineering
Electrical Engineering
Structural Engineering
Civil Engineering

» **REFERENCE**

Mr. Tim Lagrange
Project Manager
University of Cincinnati
513.558.4273
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» **RELEVANT RMF TEAM MEMBERS**

William Mahoney,
Mechanical Engineer

Eric Chrencik,
Mechanical Engineer

Corey Gray,
Hydraulic Modeler

EAST CAMPUS UTILITY PLANT INFRASTRUCTURE UPGRADES

UNIVERSITY OF CINCINNATI | CINCINNATI, OH

RMF was hired by the University of Cincinnati (UC) to provide a design to integrate 6,000 tons of new cooling generation equipment into their existing East Central Utility Plant (ECUP), which serves the medical center campus and is cross connected with the rest of the university and a separate remote plant. The space identified for the new cooling equipment is a former boiler room in the historic 100-year-old ECUP. The ECUP is a sprawling complex, with chillers in two portions of the building and boilers in another section. A buried TES system is located immediately outside.

RMF provided the design for the demolition of a large boiler in an earlier project. The current scope includes the phased demolition of the original bag house and coal silo as one bid package, prepurchases of magnetic bearing chillers, direct drive factory assembled cooling tower cells and replacement 15 kV main switchgear as a second bid package, and the installation of the cooling generation system, switchgear, and ancillary systems as a third bid package.

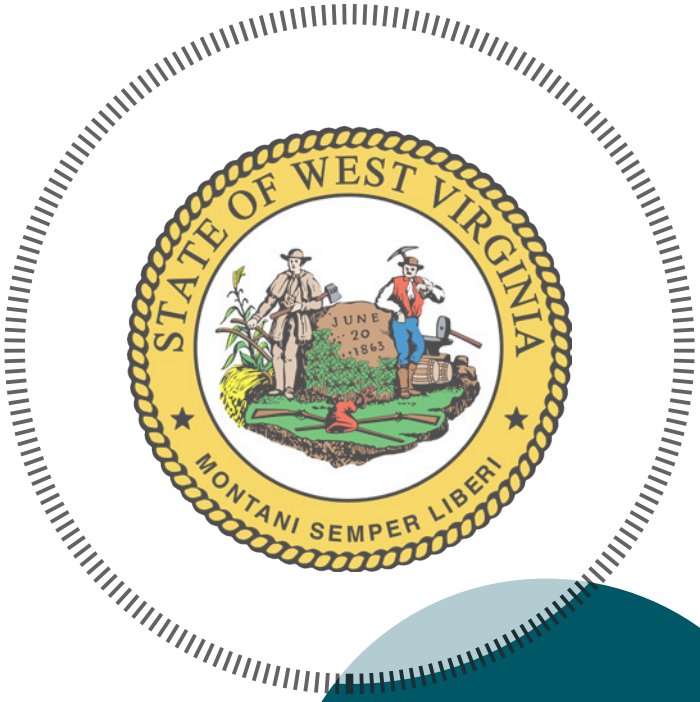
The new cooling equipment will be located in a portion of the original boiler room, separated from an existing boiler that will remain in operation by a new interior wall. The large baghouse opening through the roof is repurposed as an equipment access hatch to the switchgear room, which is situated on a new mezzanine above the chillers.

The headers for the new chilled water equipment are cross connected with the existing plant headers, to allow any new piece chiller or pump to be operated with the existing chillers and pumps. The new chillers can also be used to charge the TES system. As a part of the design, RMF hydraulically modelled the existing and new plant pipe systems, to ensure that pump heads and flow rates were capable of supporting the proposed dispatch scheme.

Cut-overs will be coordinated for the winter, low-load period, to allow for uninterrupted service to the medical center. Additionally, the project was phased in multiple bid packages including break-ahead demolition and structural steel work in Bid Package 1, procurement of equipment in Bid Package 2, and installation of chillers, cooling towers, pumps, electrical equipment, and ancillary equipment in Bid Package 3.

This chilled water capacity addition, within the historic boiler plant, will allow the university to seamlessly increase capacity and transition to more efficient chilled water generation equipment, with little to no service interruptions. The final design maintains the aesthetics of the original facility, while allowing for the new usage "behind the façade". The layout positions the plant to add additional capacity as more chillers in the other portions of the building reach the end of their useful lives.

02 | ORGANIZATIONAL CHART & PROJECT TEAM



RMF Engineering

PRINCIPAL IN CHARGE
ROBERT SMITH, PE

PROJECT MANAGER
ERIC CHRENCIK, PE

MECHANICAL ENGINEER
WILLIAM MAHONEY, PE

THERMAL UTILITIES ENGINEER
STEVE BUCKLER, PE

ELECTRICAL ENGINEER
JARED MARKLE, PE

HYDRAULIC MODELER / MASTER PLANNER
COREY GRAY, PE, LEED GA

SUBCONSULTANT

PIPE THICKNESS & CONDITION TESTING
INTERTEK
WILLIAM MITCHELL, JR
WILLIAM WILTSEY
JEREMY HOWE
NEIL SALSBURY

RMF will provide additional Support Engineers, Designers & field staff as required.

MAIN POINT OF CONTACT
Eric Chrencik, PE
Project Manager & Mechanical Engineer
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E eric.chrencik@rmf.com
F 410.385.0327

02 | ORGANIZATIONAL CHART & PROJECT TEAM

RMF ENGINEERING

ROBERT SMITH, PE

PRINCIPAL IN CHARGE

Mr. Smith has almost 40 years of mechanical engineering and project management experience relating to renovations and expansions of facilities. His career has focused on the analysis and design of campus utility (cooling, heating, electric) generation, distribution, and utilization systems. Mr. Smith has analyzed and designed some of the largest chilled water generation, distribution, and utilization systems throughout the United States. In addition to capital improvements, his expertise has highlighted energy efficiency upgrades such as nonelectric cooling, thermal storage and cogeneration. As Principal in Charge, his involvement with a project begins with the scope development and continues through its full execution. His participation is primarily to ensure that the objectives are being met and that each stage of deliverable is consistent with the client's expectations.

» YEARS EXPERIENCE

With Current Firm: 39

Total: 39

» REGISTRATIONS

Professional Engineer

First Grade Stationary Engineer

» EDUCATION

Bachelor of Science, 1985, Mechanical Engineering, University of Delaware

RELEVANT PROJECT EXPERIENCE

Campus Infrastructure Systems Assessment and Load Profile
Oberlin College

Utilities Infrastructure Distribution Improvements for New Robinson Hall
George Mason University

Expand the Central Utility Plant
George Mason University

New West Plant
College of William & Mary

Central Plant Chiller & Pump Replacement
US Central Intelligence Agency

Campus Utility Distribution and Central Utility Improvements
Metropolitan Washington Airports Authority

Central Utility Plant Modifications
Metropolitan Washington Airports Authority

District Energy Hydraulic Modeling Study, White Oak Campus
US Food & Drug Administration

Utility Infrastructure Assessment
University of Maryland, Baltimore County

Utility Services Study
University of Maryland, Baltimore

Infrastructure Master Plan
Towson University

Harrisburg Chiller Plant – 300 Ton Chiller Addition
Harrisburg Cooling, LLC

Plant Optimization Assessment
SUNY New Paltz

Performing Arts Center and RPCC Chilled Water Upgrades
Cornell University

Baker Institute West Wing Chiller Replacement
Cornell University

Utility Tunnel Detailed Assessments
New York Presbyterian Hospital

Power Plant Evaluation
Connecticut Valley Hospital

Utility Infrastructure Condition Assessment
MIT

Chilled Water System Expansion Planning
Tufts University

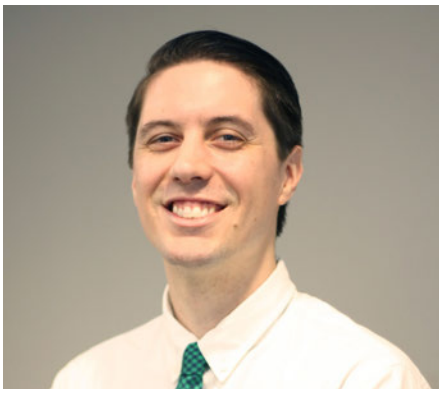
Allston Campus District Energy Facility & Distribution System
Harvard University

North & ISB Chiller Plant Upgrades
University of Massachusetts Amherst

District Energy System Assessment
Detroit Renewable Energy

Energy Infrastructure Master Plan
Northwestern University

Steam Turbine Chillers and Generators Study
University of Florida



RMF ENGINEERING

ERIC CHRENCIK, PE

PROJECT MANAGER & MECHANICAL ENGINEER

Mr. Chrencik is a mechanical engineer with experience in central plant and HVAC system design and construction administration. He has developed designs for chilled water, steam, and high temperature hot water central plant and distribution systems for government, higher education, and health care facilities, and has experience with building hydraulic models and thermal stress analysis. He also coordinates and works with other engineering disciplines as well as owners and contractors to provide complete and thorough designs.

» YEARS EXPERIENCE

With Current Firm: 11

Total: 11

» REGISTRATIONS

Professional Engineer

» EDUCATION

Bachelor of Science, 2011, Mechanical with Electrical Engineering Minor, Widener University

» PUBLICATIONS

"Moving a university's steam system toward lower-temperature district hot water", Autumn 2022 issue of *District Energy*, October 2022

"Design of a High-Temperature-Hot-Water Plant Expansion", *HPAC Engineering*, January 12, 2017

RELEVANT PROJECT EXPERIENCE

ECUP Infrastructure Upgrades
University of Cincinnati

East Chiller Plant
The Ohio State University

District Heating & Cooling Plant and Distribution
Confidential Client (Ohio)

Utilities Infrastructure Distribution Improvements for New Robinson Hall
George Mason University

Expand the Central Utility Plant
George Mason University

Historic Campus Utility Distribution Upgrades
College of William & Mary

Construct Cooling Plant and Replace Utilities Ph. IV
College of William & Mary

District Energy Hydraulic Modeling Study, White Oak Campus
US Food & Drug Administration

Interconnect Chiller Plants and Valve Vault Design Project
US Food and Drug Administration

Campus Utility Distribution and Central Utility Improvements
Metropolitan Washington Airports Authority

Exterior Utilities Infrastructure Study and Renewal Plan
Johns Hopkins University Applied Physics Laboratory

School of Dentistry to 108 North Green Street Chilled Water Extension
University of Maryland, Baltimore

Liacouras Center Chilled Water Piping Reroute
Temple University

Baker Institute West Wing Chiller Replacement
Cornell University

Performing Arts Center and RPCC Chilled Water Upgrades
Cornell University

North Campus Residential Expansion Utility Improvements
Cornell University

CCCP Chiller No. 4 Addition
Yale University

West Campus Chiller Replacement
Yale University

Science Hill Chiller Plant Free Cooling Design
Yale University

North & ISB Chiller Plant Upgrades
University of Massachusetts Amherst

Cabot and Olin Chilled Water Connections
Tufts University

Design and CA for Installation of Chiller No. 4 and Auxiliaries
University of Vermont

HSRF Chilled Water Distribution
University of Vermont

Chilled Water System Interconnect Study
University of New Hampshire

RMF ENGINEERING

WILLIAM MAHONEY, PE

MECHANICAL ENGINEER

Mr. Mahoney specializes in the design of new and renovated chilled water plants sited as stand-alone structures, or located within buildings whose primary functions are not chiller plants. He has experience in energy analysis, utility load profile analysis, master planning for growth, life cycle costing to determine the systems with the lowest owning and operating costs, preparation of bidding and construction documents for both single and multi-phase construction, construction management and commissioning. Mr. Mahoney has analyzed and designed plants using a number of chilled water generation sources including single and double effect absorption, gas engine, steam turbine, combustion turbine and variable speed electric chillers. He has designed a number of these plants with hybrid (gas/electric) configurations, to allow facilities to switch utilities in accordance with time of use rate structures. Thermal storage systems he has investigated or designed range from above ground stratified water tanks to multi-tank underground concrete structures to prefabricated, ice on coil banks. Mr. Mahoney is also well versed in the design of chilled water distribution including personnel tunnel, accessible trench, direct buried and aboveground systems. These services have been performed for clients ranging from hospitals and government agencies to commercial markets. A central plant he designed at Eisenhower Medical Center won a Regional Award from ASHRAE. His knowledge of the design and operation of systems inside buildings, as well as utility plants and infrastructure outside the buildings, is a key factor in developing a useful and accurate master plan.

» YEARS EXPERIENCE

With Current Firm: 20

Total: 37

» REGISTRATIONS

Professional Engineer (**WV:** [redacted])

» EDUCATION

Bachelor of Science, 1985, Mechanical Engineering, University of Maryland College Park

» PUBLICATIONS

"District Chilled Water Systems Design: A Tale of Two Footprints", *Engineered Systems Magazine,* 2014

RELEVANT PROJECT EXPERIENCE

Utility Infrastructure Upgrades
West Virginia University

Life Sciences Chiller Plant and Utility Distribution Upgrades
West Virginia University

New West Plant
College of William & Mary

ECUP Infrastructure Upgrades
University of Cincinnati

Chilled Water Plant No. 3
Ohio University

Chilled Water Hydraulic Analysis West Green and South/East/North Green Distribution Systems
Ohio University

West Green Chiller Plant Review
Ohio University

East Chiller Plant
The Ohio State University

District Heating & Cooling Plant and Distribution
Confidential Client (Ohio)

Campus Utility Distribution and Central Utility Improvements
Metropolitan Washington Airports Authority

Chilled Water System Improvement
University of Connecticut

Science Hill Chiller Plant Free Cooling Design
Yale University

Allston Campus District Energy Facility & Distribution System
Harvard University

Chilled Water Distribution Main Yard
Harvard University

NW Yard Utility Infrastructure Upgrade
Harvard University

Utility Infrastructure Condition Assessment
MIT

North & ISB Chiller Plant Upgrades
University of Massachusetts Amherst

Central Plant Chiller Expansion
University of Vermont

RMF ENGINEERING

STEVEN BUCKLER, PE

THERMAL UTILITIES ENGINEER

Mr. Buckler is a Project Manager within the Civil & Structural Engineering Department at RMF. He specializes in Subsurface Utility Engineering including the design, specification and construction administration of underground utility systems including utility tunnels, chilled water, high pressure steam, hot water, fuel oil, potable water, power, communications, gas, storm and sanitary piping systems. He routinely develops phasing strategies to minimize utility, vehicle and pedestrian disruptions. He is also experienced in trenchless technologies, regulatory permit approvals, cost estimating and site development projects including earthwork operations, grading, erosion, sediment control and stormwater management.

» YEARS EXPERIENCE

With Current Firm: 11

Total: 12

» REGISTRATIONS

Professional Engineer

» EDUCATION

Master of Science, 2016, Engineering Management, Johns Hopkins University

Bachelor of Science, 2010, Civil, Environmental & Infrastructure Engineering, George Mason University

» PUBLICATIONS & PRESENTATIONS

"A Civil Engineer's Approach to Utility Tunnels: Applying classical civil engineering concepts will simplify and improve project design." *District Energy Magazine,* Autumn 2020

"Built to Last: Underground Piping for District Heating and Cooling", ASCE UESI Pipelines 2020 Conference

RELEVANT PROJECT EXPERIENCE

Utilities Infrastructure Distribution Improvements for New Robinson Hall
George Mason University

Historic Campus Utility Distribution Upgrades
College of William & Mary

Signature Engineering Building Chilled Water Extension
Virginia Polytechnic Institute & State University

Dawsons Row 1 Install Chilled Water Line
University of Virginia

District Energy Hydraulic Modeling Study, White Oak Campus
US Food & Drug Administration

Interconnect Chiller Plants and Valve Vault Design Project
US Food & Drug Administration

Replace Steam and Chilled Water VV2 to VV31C
National Institutes of Health

Exterior Utilities Infrastructure Study and Renewal Plan
Johns Hopkins University Applied Physics Laboratory

Biology-Life Sciences Building Chilled Water Interconnection
Temple University

Liacouras Center Chilled Water Piping Reroute
Temple University

Main Campus North Utilities Extension
Temple University

Montgomery Garage Chiller Plant Design and Utility Master Plan Update
Temple University

Performing Arts Center and RPCC Chilled Water Upgrades
Cornell University

Chilled Water System Improvement
University of Connecticut

Residential Colleges Utility Relocation
Yale University

Science Hill Chilled Water Extension
Yale University

Allston Campus District Energy Facility & Distribution System
Harvard University

Chilled Water Distribution Main Yard
Harvard University

Chilled Water Distribution Kirkland Street Connections
Harvard University

HSRF Chilled Water Distribution
University of Vermont

Underground Chilled Water to Reed
Dartmouth College

Reitz Lawn Underground Utilities Improvements
University of Florida

RMF ENGINEERING

JARED MARKLE, PE

ELECTRICAL ENGINEER

Mr. Markle is an electrical design engineer with experience in developing construction plans, specifications, and cost estimates for sitewide medium voltage power distribution systems and sizing electrical distribution equipment including medium voltage transformers and switchgear. He specializes in developing unique and creative project approaches and phasing plans to maintain reliable power for a variety of switchgear, generator, and campus distribution projects. He also has experience in the design and setting of Protective Relay Systems, has been trained in SKM Analysis software, and provides engineering support during project construction. He has coordinated with public utilities across the Mid-Atlantic and New England regions, including complex utility interconnect agreements and service upgrades.

» YEARS EXPERIENCE

With Current Firm: 11

Total: 11

» REGISTRATIONS

Professional Engineer

» EDUCATION

Bachelor of Science, 2011, Electrical Engineering, Penn State

» PUBLICATIONS

"Electrical Distribution: Designing the Campus Heartbeat," [with Andrew Hay, PE], *College Planning + Management,* August 14, 2019

"Seven Tips for Transformer Design in Industrial Buildings", *Purepower Magazine,* 2018

RELEVANT PROJECT EXPERIENCE

Central Hower Infrastructure
University of Akron

District Heating & Cooling Plant and Distribution
Confidential Client (Ohio)

Harrisburg Chiller Plant – 300 Ton Chiller Addition
Harrisburg Cooling, LLC

Chiller Plant Cooling Tower Removal
University of Pennsylvania

Electrical Distribution
University of Maryland, Baltimore

Replacement of 13.2 kV Electric Feeders
Towson University

Electrical Upgrade, Jessup Correctional Complex
Maryland Department of Public Safety and Correctional Services

Exterior Utilities Infrastructure Study and Renewal Plan
Johns Hopkins University Applied Physics Laboratory

Site Power Distribution, St. Elizabeth's Campus
US Dept. of Homeland Security

P130 Mechanical and Electrical Improvements, Walter Reed National Military Medical Center
NAVFAC Engineering Command Mid-Atlantic

P131 Electrical Capacity & Cooling Towers, Walter Reed National Military Medical Center
NAVFAC Engineering Command Mid-Atlantic

Replacement of Electrical Transmission Feeders
SUNY Stony Brook University

Underground Electrical Feeder Distribution Study
SUNY Oneonta

Central Heating Plant Upgrades
SUNY Binghamton

CCCP Chiller No. 4 Addition
Yale University

Residential Colleges Utilities Relocation
Yale University

Repowering Project
Yale University

Allston District Energy Facility Distribution
Harvard University

Chilled Water Extension Widener to Cowperthwaite
Harvard University

Tunnel Sump Replacements
Harvard University

Underground Chilled Water to Reed
Dartmouth College

RMF ENGINEERING

COREY GRAY, PE, LEED GA

HYDRAULIC MODELER & MASTER PLANNER

Mr. Gray's focus is on the planning, analyzing and optimization of campus utility and infrastructure systems from both an energy and cost savings perspective. As a part of this effort, he develops life cycle cost analyses for heating and cooling systems in addition to cogeneration systems. He also regularly develops hydraulic computer models that are based upon several compressible and non-compressible software packages to simulate the performance of chilled water, steam or hot water plants and distribution networks, as well as domestic water distribution networks. These hydraulic models can be used to determine system capacity for current and future load requirements due to campus growth.

» YEARS EXPERIENCE

With Current Firm: 22

Total: 22

» REGISTRATIONS

Professional Engineer

LEED Green Associate

» EDUCATION

Bachelor of Science, 2000, Mechanical Engineering, University of Maryland, Baltimore County

» PUBLICATIONS

"Submetering for Hydraulic Modeling Calibration", *District Energy Magazine,* June 30, 2020

RELEVANT PROJECT EXPERIENCE

ECUP Infrastructure Upgrades
University of Cincinnati

Energy and Utility Master Plan
Ohio University

Chilled Water Hydraulic Analysis West Green and South/East/North Green Distribution Systems
Ohio University

Central Hower Infrastructure
University of Akron

Utilities Infrastructure Distribution Improvements
George Mason University

Central Heating & Cooling Plant Renovations & Expansion
George Mason University

Utility Infrastructure Assessment
University of Maryland, Baltimore County

Campus-wide Utility Master Plan
Morgan State University

Chilled Water Tertiary Pump Study
US Naval Academy

White Oak Campus District Energy Hydraulic Modeling Study
US Food & Drug Administration

Replace Steam & CHW VV2 to VV31C
National Institutes of Health

Alternative Tunnels Study
Architect of the Capitol

Energy Plan Implementation, Ph 1: N. Extension of Geoexchange Plant Distribution System & Utility Infrastructure Upgrades, Parrish Hall & North Quad
Swarthmore College

Mod VII Phase II Plant Expansion
University of Pennsylvania

Main Campus Utility Master Plan Update
Temple University

Campus Utility Master Plans and Energy Savings Strategy
Temple University

Barrack Hall Chilled Water Plant Condenser Water System Assessment
Temple University

Campus Utility Capacity & Condition Plan
SUNY Stony Brook University

Reconstruct Site Electric & Steam Infrastructure at Sturges Quad Area
SUNY Geneseo

Utility Master Plan
Connecticut College

Comprehensive Campus Energy Plan
University of Massachusetts Amherst

Steam & CHW Infrastructure Assessment
Harvard University

Allston District Energy Facility Distribution
Harvard University

Mechanical Equipment and Utility Plan & Condition Assessment
University of South Carolina

William H. Mitchell, Jr.
Boiler Specialist
(281) 253-9226
William.Mitchell@intertek.com

Credentials

M.S. Business Administration – Louisiana State University, Baton Rouge (1990)

B.S. Mechanical Engineering – Clemson University (1979)

Mr. Mitchell has broad experience in the energy field, including extensive experience in the power generation sector. He has experience working on large scale projects with multi-million dollar budgets. Previous work includes team management, project engineer, and execution planning advisor on large scale projects.

Recent Work/Project Experience

Intertek – Organized, led, and authored report for NDE inspection and condition assessment of underground chilled water, steam, and condensate lines serving US Capitol and surrounding buildings.

Brunel Energy (On Full Time Assignment to ExxonMobil Development Company) – As Execution Planning Advisor, led preparation of execution plans and cost/ schedule estimates for new subsea wells and flow lines to capture value in aging West African offshore oil field. Provided oversight of engineering contractor for FEED work on $90M project to drill and connect water wells for Sakhalin Island oil field pressure maintenance.

NES Global Talent (On Full Time Assignment to ExxonMobil Development Company) – As Senior Execution Planning Adviser, organized connection of subsea wells and flowlines to FPSO in Nigeria. Led completion of Gate 2 deliverables for a 480 km dilbit pipeline in Canada. Led completion of Project Plan for submarine gas pipeline serving Hong Kong power station. Prepared Project Plan and led preparation of other Gate 2 deliverables for $800M gas plant project in Australia.

Becht Engineering (On Full Time Assignment to ExxonMobil Research and Engineering) — As Project Engineer, represented client with Engineering/Procurement contractor on $300 million flare gas control project at ExxonMobil Beaumont Refinery.

Velosi Superintended Nigeria Ltd. (On Full Time Assignment to ExxonMobil Mobil Producing Nigeria) — As Project Advisor, prepared RFQ package for $14M subsea pipeline coating contract. Prepared scope of work for geotechnical sampling for shore-approach.

GDS Engineers (On Full Time Assignment to ExxonMobil Research and Engineering) — As Project Engineer, did oversight of construction, commissioning, and start-up of three GE 150 megawatt gas turbine/generators. Administered GE Technical Advisor services.

Select Publications

U.S. Patent No. 11,358,878: Systems and Methods for Separating Soluble Solutions

Specialized Professional Competence

- Project Management
- Project Economic Analysis
- Project Organization and Planning
- Contract Writing and Negotiation
- Power and Petrochemical Plant Engineering
- Freeze Concentration
- Power Plant O&M
- Thermodynamics and Heat Transfer

intertek
Total Quality. Assured.

William (Bill) Wiltsey
Electromagnetic Testing Subject Matter Expert
(408) 745-7000
william.wiltsey@intertek.com

CREDENTIALS

EPRI Qualified Data Analyst (QDA), January 1993 to Present

ASNT Level III – Electromagnetic Testing, March 1994 to Present

Mr. Wiltsey has been developing and performing Non-destructive Testing (NDT) exams continuously since 1984 while maintaining an ASNT Level III since 1994. Primary inspection applications include piping, tube, and surface Electromagnetic Testing (ET) inspections at various Nuclear Power, Fossil Power, Oil and Gas, Aerospace, Navy, Pharmaceutical and other industries. Typical techniques include Eddy Current Testing (ECT), Remote Field Testing (RFT) Pulsed Eddy Current (PEC) and Alternating Current Field Measurement (ACFM). All these ET techniques include the most advanced Array technology.

PROJECT EXPERIENCE

Participated in over 130 projects at over 50 Nuclear plants in the USA and Sweden. Participated in over 200 projects on pipelines, vessels, cranes, aerospace, and non-nuclear power plants in the USA. Work includes inspections with robotics and independent Level III Analysis.

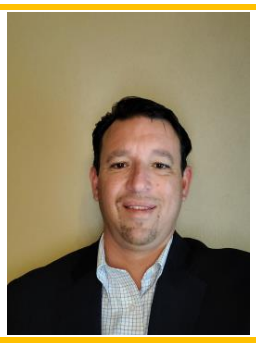
SELECT PUBLICATIONS

- 1992 – 2007: Participated in the initial EPRI QDA 'wet run' training and examination for QDA, with periodic follow-up Peer Reviews for EPRI PWR Steam Generator Examination Guidelines.
- 2009 - Participated in technical review for the ASNT second edition of the *Electromagnetic Testing Method Questions and Answers* publication.
- 2012 - Participated in technical review for the ASNT *Programmed Instruction Series* published training manual for *Electromagnetic Testing,* Copyright 2013 by The American Society for Nondestructive Testing, Inc.
- 2019 - Participated in technical reviews for the API-RP 586 *Heat Exchanger Tubing Inspection*

SPECIALIZED PROFESSIONAL COMPETENCE

- Nuclear Steam Generator Tubing Inspection
- Nuclear Heat Exchanger Tubing Inspection
- All non-Nuclear Heat Exchanger Tubing Inspection
- Pulsed Eddy Current (PEC) Inspections of Pipelines and Vessels through insulation
- QA Manager
- Surface Array Eddy Current Inspections for NASA, Oil and Gas, Renewable Fuels, Power Generation, and Pharmaceutical
- Alternating Current Field Measurement (ACFM) Array Inspections for Pipelines and Vessels, Drilling Rigs, Ship-to-Shore and other Cranes, all through thick paint and coatings

02 | ORGANIZATIONAL CHART & PROJECT TEAM



Jeremy Howe
Ultrasonic Phased Array Technician
817-487-6787
Jeremy.howe@intertek.com

CREDENTIALS

A.S. (Electronic/Electro-Mechanical), Excelsior College, Albany, NY

US Navy

NDE ASNT-TC-1A Level II UT-MT-PT-ECT with EPRI UT-PDI; NDE PAUT Valve Diagnostics

Mr. Jeremy Howe is an electronics and electro-mechanical technical professional. He has experience working in the U.S. Department of Energy, Commercial Nuclear Power Generation Industry, and the Oil/Gas Industry. Experience with phased array Research and Development testing techniques. Developed and implemented Phased Array technology techniques performing internal operation and condition diagnostics on check, motor, and air-operated valves to ASME OM Operation and Maintenance code in accordance with Nuclear Industry standard.

RECENT WORK/PROJECT EXPERIENCE

Investigated and documented root cause analysis with corrective action recommendation. Executed occupational duties safely in accordance with company and industry regulated policies, standards, and guidelines. Performed Phased Array Sectorial Scanning (PASS) for various check, manually operated, and air operated valves and managed technique development to increase workflow amongst team members, leading to multiple commendations and selection for special projects. Calibrated and performed intricate preventative maintenance of instrumentation and equipment. Experience with root cause analysis, nuclear industry standards, and array system valve diagnostics.

SPECIALIZED PROFESSIONAL COMPETENCE

- Phased Array
- Nondestructive Examination
- Project Management
- Leadership & Collaboration
- Preventative Maintenance
- Testing and Reporting
- Safety Management
- Program Support
- Business Development
- Research and Development
- System Manufacturing & Integration

02 | ORGANIZATIONAL CHART & PROJECT TEAM

Neil Salsbury
Senior Advanced NDE Specialist
210-243-2058
neil.salsbury@intertek.com

CERTIFICATIONS AND QUALIFICATIONS

ASNT Level III UT ([redacted]

ASNT Basic Level III

EPRI Fossil PDI

Level II Phased Array

Level II Liquid Penetrant

Level II Magnetic Particle

40-Hour Radiation Health and Safety

OSHA 10

OSHA 30

Active TWIC

Mr. Neil Salsbury is an experienced phased array technician with advanced nondestructive testing (NDT) and analysis/ultrasonic testing (UT) skills. Mr. Salsbury has performed advanced ultrasonics, including phased array (annular array, dual matrix array, full matrix capture (FMC), total focused method (TFM)), and time-of-flight diffraction (TOFD). These examinations have been performed in the power generation, oil and gas, pipeline, and manufacturing industries. He has also been involved with performing audits, quality control, training, and research and development.

RECENT WORK/PROJECT EXPERIENCE

Recent work includes shear wave and phased array ultrasonic and robotic penetrant testing on turbine components. Responsibilities also covered evaluating and performing nondestructive examination (NDE) procedures. Coordination of NDE requirements for testing during periods that power plants were not operating, including outages and forced shutdowns.

Conducted data analyses and counseled clients concerning advanced NDE for power generation, oil and gas plants, and pipelines facilities. Conducted client interfaces to discuss projects, testing results, planning, and coordinating NDE activities during equipment/plant outages or shutdowns.

Trained and mentored other personnel on various techniques of NDE procedures. Conducted on-the-job training audits to verify the quality of work performed. Experience with researching and preparing reports, report writing, as well as developing isometric drawings to support findings and summaries of NDE reports.

SPECIALIZED PROFESSIONAL COMPETENCE

- Surface replications
- Hardness evaluation
- Positive material identification
- Training and mentoring
- Time-of-flight diffraction
- Quality control
- Research and development
- Report writing

US FOOD & DRUG ADMINISTRATION
Mr. Martin Borenstein
Engineer
301.796.3623
martin.borenstein@fda.hhs.gov

UNIVERSITY OF CINCINNATI
Mr. Ronald P. Heile, PE
Project Manager
Division of Administration and Finance
Planning + Design + Construction
513.556.3159
Ronald.Heile@uc.edu

ARCHITECT OF THE CAPITOL
Mr. Chris Potter
Deputy Director
Utilities & Power Plant Operation
202.226.3864
cpotter@aoc.gov

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY
Mr. Aaron Lee
Office of Engineering, Design Department
703.572.3620
Aaron.Lee@MWAA.com

UNIVERSITY OF MASSACHUSETTS AMHERST
Mr. Ted Mendoza
Capital Project Manager
413.362.9287
tmendoza@facil.umass.edu

Building Commissioning Certification Board

CONFERRED UPON

RMF Engineering, Inc.

THE DESIGNATION OF

Certified Commissioning Firm (CCF)

FOR DEMONSTRATING A HIGH LEVEL OF COMPETENCE AND EXPERIENCE FOR THE BUILDING COMMISSIONING PROCESS BY SUCCESSFULLY DOCUMENTING PROFESSIONAL ACHIEVEMENTS AND FULFILLING PRESCRIBED STANDARDS OF PERFORMANCE AND CONDUCT REQUIRED FOR CCF.

PRESIDENT

CERTIFICATION DIRECTOR

BCCB Building Commissioning Certification Board

EXPIRES ON 11/30/2023

CCF Certified Commissioning Firm

acg AABC Commissioning Group

Annual Membership Certificate

Awarded to

RMF Engineering, Inc.

as a member in good standing of the AABC Commissioning Group for the year

2023

This company has met all requirements for membership and is entitled to all rights and privileges thereof. This certificate is renewable on an annual basis and expires December 31, 2023.

Troy N. Byers, P.E., CxA, *President*

Ray Bert, *Executive Director*

Annual Membership Certificate

awarded to

RMF Engineering, Inc.

As a member in good standing of the Energy Management Association for the year

2023

This member has met all requirements for membership and is entitled to all rights and privileges of EMA Associate Membership. This certificate is renewable on an annual basis and expires December 31, 2023.

Anna Kosova, *Executive Director*

EMA ENERGY MANAGEMENT ASSOCIATION #1260

Chris Smith, CxA, EMP, *EMA President*

02 | CERTIFICATIONS & LICENSES

West Virginia State Board of Registration for Professional Engineers

Name:	WILLIAM W. MAHONEY
WV Professional Engineer:	PE License Number: [redacted]
	PE License Status: Active
	PE Issue Date: 03/13/2006
	PE Expiration Date: 12/31/2024
Continuing Education Claim:	Qualifying Hours from Last Renewal or Reinstatement: 63.00
	Carryover Hours for Next Renewal: 15.00
	Last Renewal or Reinstatement Date*: 12/28/2022
WV Engineer Intern:	EI Certification Number:
	EI Issue Date:
Primary Address of Record:	[redacted]
Primary Employer of Record:	RMF ENGINEERING, INC. 5520 RESEARCH PARK DRIVE SUITE 300 BALTIMORE, MD 21228

The State of West Virginia

STATE BOARD OF REGISTRATION FOR PROFESSIONAL ENGINEERS

To all to whom these presents shall come Greeting

Know Ye That The State Board of Registration for Professional Engineers of the State of West Virginia, reposing special confidence in the Intelligence, Integrity and Discretion of

William W. Mahoney

DOES IN PURSUANCE OF AUTHORITY VESTED IN IT by law hereby certify that he having submitted satisfactory evidence of his ability and experience is a

REGISTERED PROFESSIONAL ENGINEER

Registration Number [redacted]

To Hold and use such title in the practice of his profession, subject to the conditions prescribed by law.

Given under the hand of the Seal of the Board at the Capitol in the City of Charleston, This 13th day of March in the year of our Lord 2006 and of the State the One Hundred Forty-Second

Members of the Board

Maryland DEPARTMENT OF LABOR

LICENSE * REGISTRATION * CERTIFICATION * PERMIT

Lawrence J. Hogan, Jr., Governor
Boyd K. Rutherford, Lt. Governor
Tiffany P. Robinson, Secretary

STATE OF MARYLAND
MARYLAND DEPARTMENT OF LABOR

STATE BOARD FOR PROFESSIONAL ENGINEERS
CERTIFIES THAT:
ROBERT DANIEL SMITH

IS AN AUTHORIZED: 05- PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	CONTROL NO
[redacted]	05-18-2023	N/A	[redacted]

Signature of Bearer — Secretary

WHERE REQUIRED BY LAW THIS MUST BE CONSPICUOUSLY DISPLAYED IN OFFICE TO WHICH IT APPLIES

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
500 N. CALVERT STREET
BALTIMORE, MD 21202-3651

ROBERT DANIEL SMITH
[redacted]

[redacted]

Maryland DEPARTMENT OF LABOR
LICENSE * REGISTRATION * CERTIFICATION * PERMIT
STATE OF MARYLAND
STATE BOARD FOR PROFESSIONAL ENGINEERS
CERTIFIES THAT:
ROBERT DANIEL SMITH
IS AN AUTHORIZED: 05 - PROFESSIONAL ENGINEER
LIC/REG/CERT [redacted] EXPIRATION 05-18-2023 EFFECTIVE N/A CONTROL NO [redacted]
Signature of Bearer — Secretary

Maryland DEPARTMENT OF LABOR

LICENSE * REGISTRATION * CERTIFICATION * PERMIT

Lawrence J. Hogan, Jr., Governor
Boyd K. Rutherford, Lt. Governor
Tiffany P. Robinson, Secretary

STATE OF MARYLAND
MARYLAND DEPARTMENT OF LABOR

BOARD OF STATIONARY ENGINEERS
CERTIFIES THAT:
ROBERT D. SMITH

IS AN AUTHORIZED: 01- FIRST GRADE ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	
[redacted]	03-19-2025	N/A	[redacted]

Signature of Bearer — Secretary

WHERE REQUIRED BY LAW THIS MUST BE CONSPICUOUSLY DISPLAYED IN OFFICE TO WHICH IT APPLIES

[redacted]

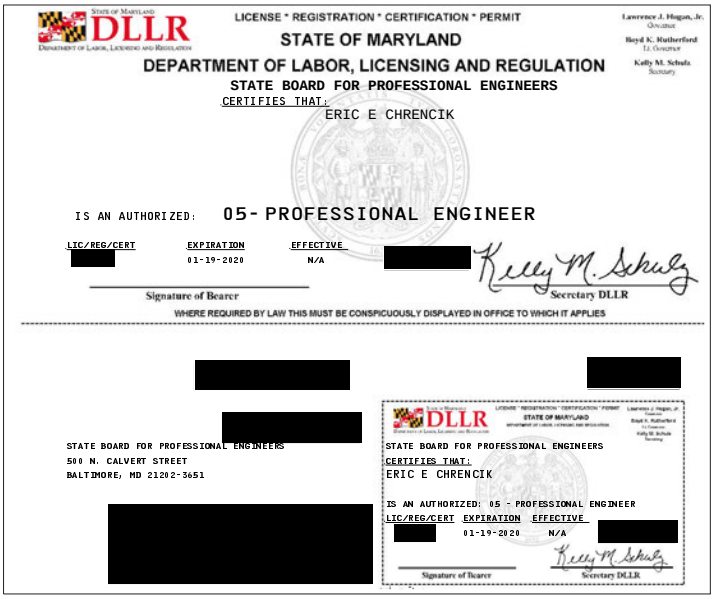
BOARD OF STATIONARY ENGINEERS
1100 N. EUTAW STREET
BALTIMORE, MD 21201

ROBERT D. SMITH
[redacted]

[redacted]

Maryland DEPARTMENT OF LABOR
LICENSE * REGISTRATION * CERTIFICATION * PERMIT
STATE OF MARYLAND
BOARD OF STATIONARY ENGINEERS
CERTIFIES THAT:
ROBERT D. SMITH
IS AN AUTHORIZED: 01 - FIRST GRADE ENGINEER
LIC/REG/CERT [redacted] EXPIRATION 03-19-2025 EFFECTIVE N/A CONTROL NO [redacted]
Signature of Bearer — Secretary

02 | CERTIFICATIONS & LICENSES



LICENSE * REGISTRATION * CERTIFICATION * PERMIT

STATE OF MARYLAND

DEPARTMENT OF LABOR, LICENSING AND REGULATION

STATE BOARD FOR PROFESSIONAL ENGINEERS

CERTIFIES THAT:

ERIC E CHRENCIK

IS AN AUTHORIZED: 05- PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE
[redacted]	01-19-2020	N/A

Signature of Bearer

Secretary DLLR

WHERE REQUIRED BY LAW THIS MUST BE CONSPICUOUSLY DISPLAYED IN OFFICE TO WHICH IT APPLIES

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
500 N. CALVERT STREET
BALTIMORE, MD 21202-3651

[redacted]

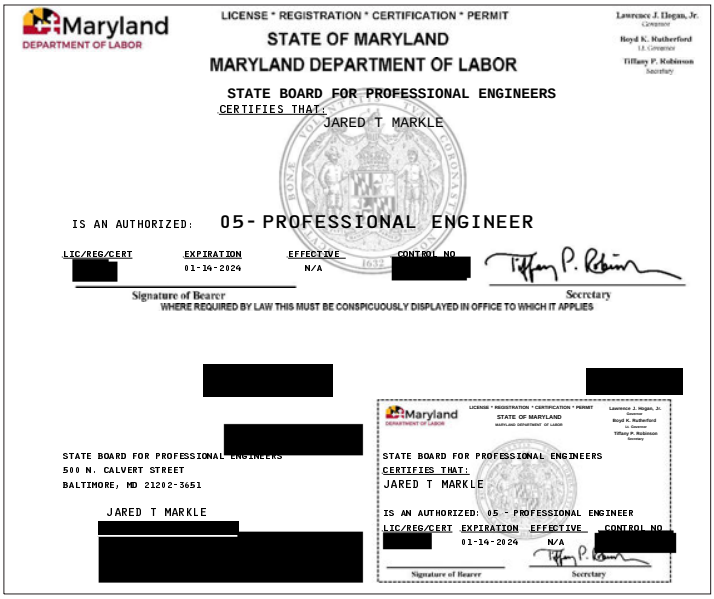
STATE BOARD FOR PROFESSIONAL ENGINEERS
CERTIFIES THAT:
ERIC E CHRENCIK

IS AN AUTHORIZED: 05 - PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE
[redacted]	01-19-2020	N/A

Signature of Bearer

Secretary DLLR



LICENSE * REGISTRATION * CERTIFICATION * PERMIT

STATE OF MARYLAND

MARYLAND DEPARTMENT OF LABOR

STATE BOARD FOR PROFESSIONAL ENGINEERS

CERTIFIES THAT:

JARED T MARKLE

IS AN AUTHORIZED: 05- PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	CONTROL NO
[redacted]	01-14-2024	N/A	[redacted]

Signature of Bearer

Secretary

WHERE REQUIRED BY LAW THIS MUST BE CONSPICUOUSLY DISPLAYED IN OFFICE TO WHICH IT APPLIES

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
500 N. CALVERT STREET
BALTIMORE, MD 21202-3651

JARED T MARKLE
[redacted]

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
CERTIFIES THAT:
JARED T MARKLE

IS AN AUTHORIZED: 05 - PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	CONTROL NO
[redacted]	01-14-2024	N/A	[redacted]

Signature of Bearer

Secretary

Maryland

DEPARTMENT OF LABOR

Results for Active Licensed Professional Engineers: 3

The following results do not include current licensees who are on inactive status.

Name	City	State	Zip	Expiration	Category	Reg. #
[redacted]						
STEVEN R BUCKLER	BALTIMORE	MD	21230	2024-01-13	PROFESSIONAL ENGINEER	[redacted]

LICENSE * REGISTRATION * CERTIFICATION * PERMIT

STATE OF MARYLAND

MARYLAND DEPARTMENT OF LABOR

STATE BOARD FOR PROFESSIONAL ENGINEERS

CERTIFIES THAT:

COREY LANCE GRAY

IS AN AUTHORIZED: 05- PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	CONTROL NO
[redacted]	01-16-2025	N/A	[redacted]

Signature of Bearer

Secretary

WHERE REQUIRED BY LAW THIS MUST BE CONSPICUOUSLY DISPLAYED IN OFFICE TO WHICH IT APPLIES

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
1100 N. EUTAW STREET
BALTIMORE, MD 21201

COREY LANCE GRAY
[redacted]

[redacted]

STATE BOARD FOR PROFESSIONAL ENGINEERS
CERTIFIES THAT:
COREY LANCE GRAY

IS AN AUTHORIZED: 05 - PROFESSIONAL ENGINEER

LIC/REG/CERT	EXPIRATION	EFFECTIVE	CONTROL NO
[redacted]	01-16-2025	N/A	[redacted]

Signature of Bearer

Secretary