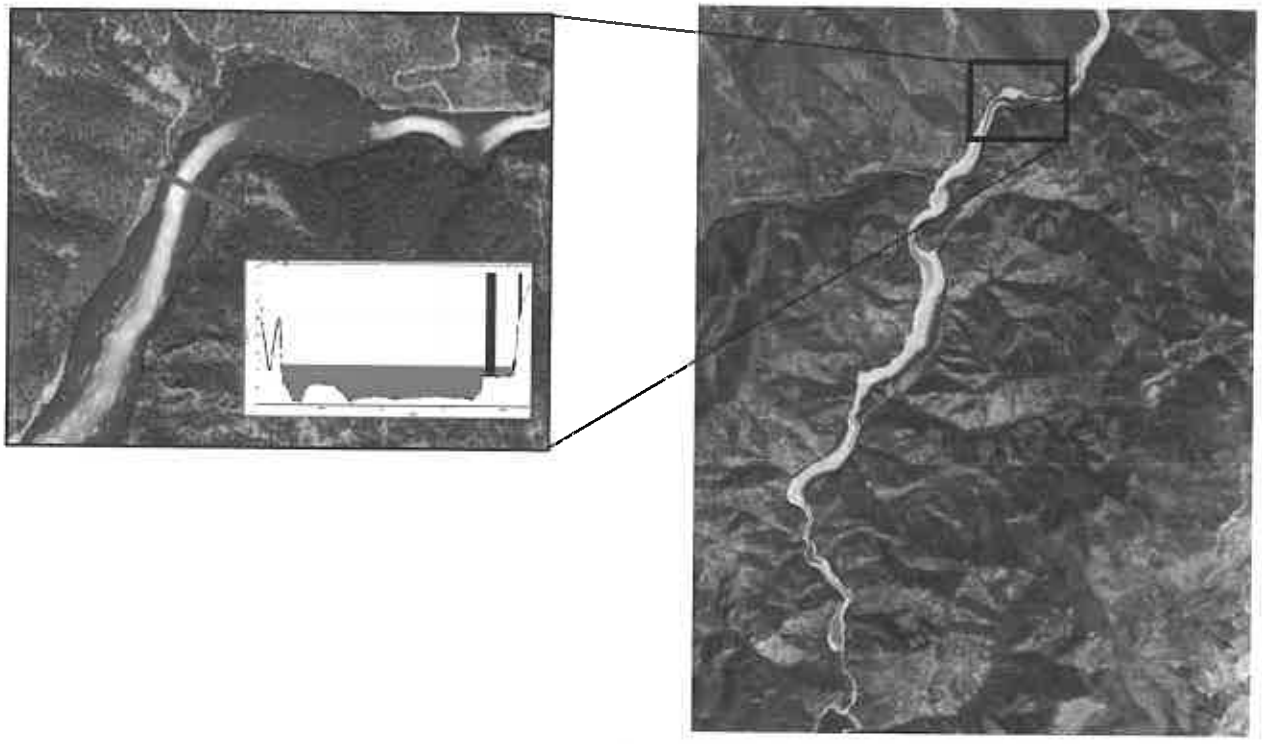
PROPOSAL NUMBER
ENGWR-P17-G002 REVISION 0

PRESENTED ON
FEBRUARY 28, 2017

QUALIFICATIONS FOR A
FLOOD WARNING AND ANALYSIS MAPPING EXPRESSION OF INTEREST

PRESENTED TO THE STATE OF WEST VIRGINIA
IN RESPONSE TO CEOI 0606 HSE1700000003



Cover Photos: Snapshots of ENERCON HEC-RAS 2D Model

ENERCON
Excellence—Every project. Every day.

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February 28, 2017
ENGWR-P17-G002 Revision 0

State of West Virginia
Bid Clerk, Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, West Virginia 25305-0130

Re: Centralized Expression of Interest 0606 HSE1700000003 "Flood Warning and Analysis Mapping"

Dear Bid Clerk:

Enercon Services, Inc. (ENERCON) is pleased to submit this response to the State of West Virginia's Centralized Expression of Interest (CEOI) 0606 HSE1700000003 for floodplain mapping, hydrologic and hydraulic modeling, flood mitigation planning and other related activities.

ENERCON, founded in 1983, is an employee-owned firm specializing in engineering, environmental, and management services with 27 offices around the country, including Pittsburgh, Pennsylvania. ENERCON's clients include most major electric utilities, chemical and nuclear fuel cycle facilities, oil and natural gas companies, the federal government and many Fortune 500 companies. ENERCON is the premier provider of engineering and environmental services to the nuclear industry and was ranked as the #1 nuclear firm by Engineering News-Record in 2015. This work requires a keen attention to detail and rigorous quality assurance processes. Our clients have confidence their products and services are delivered on time while exceeding expectations.

For over 33 years, our focus at ENERCON has been to provide high quality, cost-effective solutions for our clients. We accomplish this by integrating our efforts with our clients' needs in a partnership of mutual goals and objectives. We understand that planning and execution go hand-in-hand for effective project management and cost control. In this competitive economic environment, we are judged and measured against our competitors by only the success of our most recent project. As such, it is vital for us to meet and exceed every one of your expectations. This project will be as important to us as it is to you.

In the following pages, we hope you will see evidence of ENERCON's recent expertise in flood hazard and risk assessments conducted throughout the United States in a variety of hydrologic settings. We are confident our highly specialized capabilities bring a value-added service no other firm can match. Per the solicitation instructions, our qualifications are summarized economically; more extensive corporate and personal resumes are available for review as needed by the State.

Thank you for your consideration. If you have any questions or require further information, please contact me at 412.871.2708 or via email at skline@enercon.com. ENERCON looks forward to supporting the State of West Virginia on this project.

Sincerely,

Shaun W. Kline, Ph.D., P.E. (Pennsylvania #PE085658)
Engineering and Water Resources Lead | Environmental Services Group | Enercon Services, Inc.
1501 Ardmore Boulevard | Suite 200 | Pittsburgh, Pennsylvania 15221-4451
Office: 412.871.2708 | Mobile: 352.514.3340 | Fax: 724.733.4630 | skline@enercon.com

TABLE OF CONTENTS

1.0 FIRM EXPERIENCE AND QUALIFICATIONS

First and foremost, the culture at ENERCON is best summarized by our tag line: ***Excellence – Every Project, Every Day***. Enercon Services, Inc. (ENERCON), founded in 1983, specializes in engineering, environmental, and management services. ENERCON's clients include most major electric utilities, chemical and nuclear fuel cycle facilities, oil and natural gas companies, the federal government and many Fortune 500 companies. In many areas, ENERCON is an industry leader providing solutions for emergent regulatory initiatives. ENERCON achieved the following positions in the current Engineering News – Record (ENR) rankings: ***#1 Nuclear Firm, #9 Power Firm, #33 Pure Designers, #53 Design Firm, #103 Environmental Firm, #117 Global Design Firms***.

Over the past 27 years, ENERCON has seen significant growth, starting from three people and four clients, ENERCON now has more than 1,400 full-time employees, and maintains 27 offices nationwide. In 1992, ENERCON created an Employee Stock Ownership Program and is currently an Employee-Owned Company. Over the past 15 years, ENERCON has worked hard to achieve continuous profitable growth and is a financially healthy firm. Expectations and planning show continued growth in the years to come. Due to the continued growth, over the past 3 years, ENERCON has acquired 3 new firms which operate as subsidiaries to ENERCON, they are MARACOR Technical Services, Talisman International, and Tri-County Engineering.

Currently, ENERCON consists of five service groups: 1) Environmental Services Group (ESG); 2) New Plant Services Group; 3) Power Generation Services Group; 4) Power Delivery Services Group; and 5) ENERCON Federal Services Group. Each group has complementary services and is structured to support different client needs for environmental, engineering, design, and compliance services. These groups provide our clients with a single source for comprehensive services. Support for the State of West Virginia projects will come from the Environmental Services Group using professionals out of the Pittsburgh, PA, Oklahoma City, OK and Tulsa, OK offices.

ENERCON has a strong, diversified staff consisting of registered professional engineers (civil, mechanical, electrical, chemical, environmental, nuclear, computer, control systems, fire protection, architectural, structural), professional geologists, hydrologists, seismic hazards analysts, systems analysts, probabilistic risk analysts, maintenance specialists, licensing specialists, senior operators, emergency planning professionals, chemistry and health physics specialists, and environmental professionals. Many of our professionals hold advanced degrees, certifications and have been published in a number of professional journals and peer reviewed publications. Several of these advanced degree professionals will be part of the team assembled for the work (refer to Section 2 for the team). As a testimony to our leading expertise, ENERCON encourages the State of West Virginia to review some of the most recent publications by ENERCON personnel listed here:

- Electric Power Research Institute, "Riverine Probabilistic Flooding Hazard Analysis Pilot, Proof-of-Concept Study for a Nuclear Power Plant," 2014 Technical Update.
- Knighton, J., E. White, E. Lennon and R. Rajan, "Development of probability distributions for urban hydrologic model parameters and a Monte Carlo analysis of model sensitivity," Hydrological Processes, 28, pp. 5131-5136, 2014, DOI: 10.1002/hyp.10009.
- S. Pande, L. Bastidas, S. Bhulai, M. McKee, "Parameter-dependent convergence bounds and complexity measure for a class of conceptual hydrological models," Journal of Hydroinformatics, 14.2, 2012.
- S. Pande, L. Arkesteijn, L. Bastidas, "Complexity regularized hydrological model selection," International Environmental Modelling and Software Society (iEMSs) 7th Intl. Congress on Env. Modelling and Software, San Diego, CA, USA, 2014.

The ENERCON water resources group within ESG is an experienced staff of professional engineers, geologists, and scientists with expertise in drainage, hydrology, hydraulics (1D and 2D), riverine flooding, dam break analyses, floodplain mapping and risk analysis. Flooding and floodplain analyses are a core competency of the team assembled in this CEOI. The water resources group has a collection of engineers, hydrologists, and technical specialists (key individuals are listed in Section 2), with knowledge to support the engineering and floodplain mapping services for the State of West Virginia. ENERCON has extensive experience with software such as HEC-HMS, HEC-GeoHMS, HEC-RAS, HEC-GeoRAS, FLO-2D, and ArcGIS and extensions. The ENERCON flooding team can also draw from the additional staff of an organization that includes more than 1,200 engineers and environmental professionals. We are able to perform this new work in combination with other ongoing flooding evaluations and mapping due to our considerable staff depth.

The water resources team at ENERCON has been performing flooding and floodplain analyses for the past 10 years; further, many individuals on the team have previous experience in this type of work. ENERCON engineers have performed modeling for large and small river hydrology, coastal flooding, local precipitation runoff and combined (i.e., surge and river flooding) event analyses for open coastlines, coastal estuaries and riverine locations. To date, ENERCON has evaluated flooding hazards and performed floodplain mapping at over 30 power plant locations around the United States, including a specialized flood evaluation on the Ohio River. At each location, ENERCON also evaluated the effects from flooding, including wave action, wave forces and erosion/sedimentation estimates. The approaches used and analyses performed by ENERCON comply to FEMA standards, but ENERCON also goes beyond the typical FEMA analyses (see table at right).

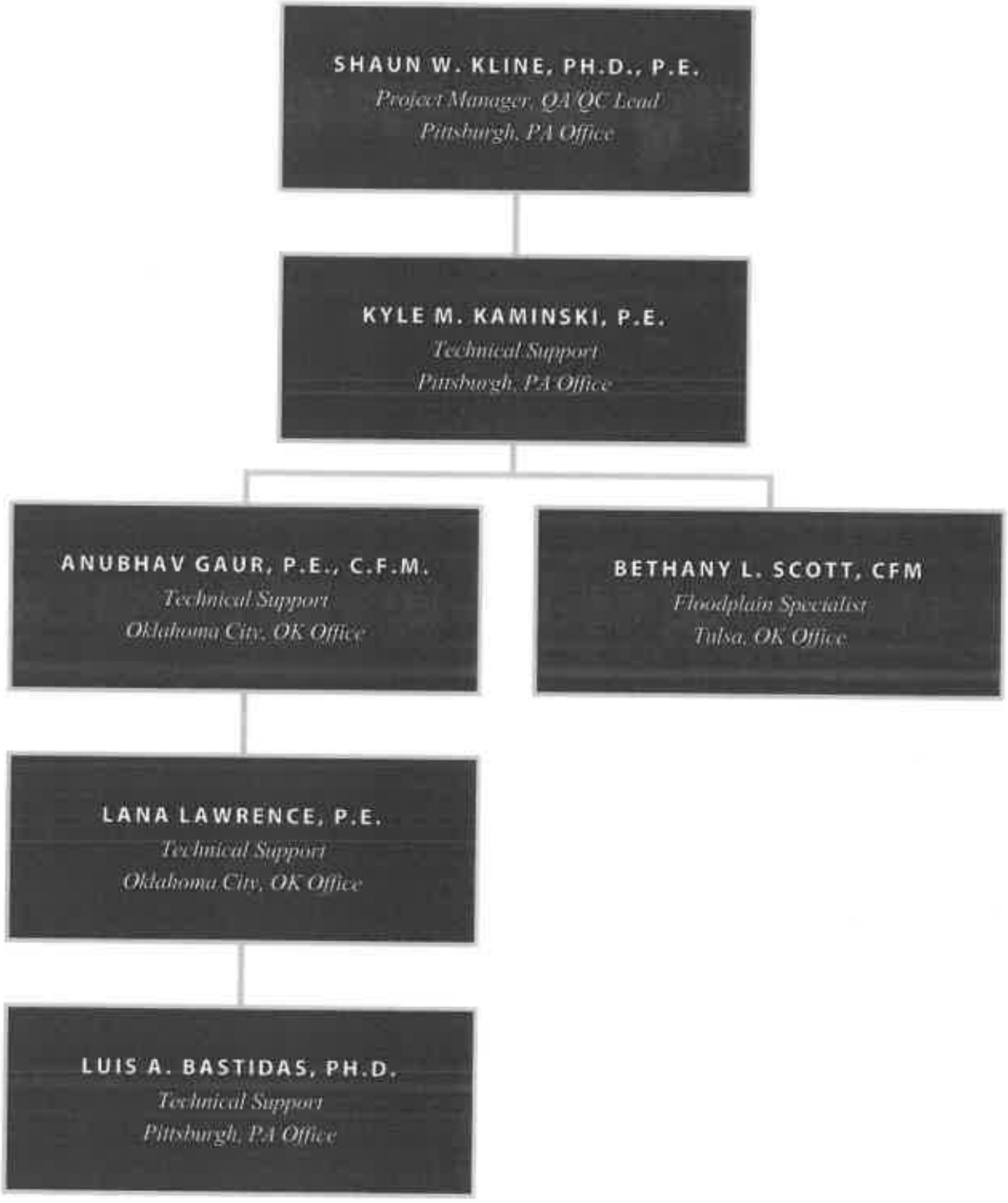
	FEMA	ENERCON
CURRENT TOPOGRAPHY AND INPUTS	✓	✓
APPROACH		
Historic Flood Data	✓	✓
Modeling	✓	✓
Full Probabilistic Evaluations		✓
EVENTS OF INTEREST		
"Normal" day		✓
Common (>1% Exceedance)		✓
100-year (1% Exceedance)	✓	✓
Extreme (<1% Exceedance)		✓
FLOOD IMPACTS		
Erosion Assessments		✓
Wave Action (Runup + Overtopping)	✓	✓
Flood Loadings	✓	✓
Projectile Strikes		✓
Damage Estimates + Risk Assessment		✓
Identification of Affected Populations		✓
MAJOR OUTPUTS		
Flood Maps	✓	✓
Location-specific Flood Durations		✓
Location-specific, Risk-Based Profile		✓

The team also has experience with floodplain permitting. Floodplain permits can be required by counties and municipalities as one portion of the overall permitting process for existing or proposed structures within a FEMA-designated 100-year floodplain or floodway area. For proposed sites adjacent to a river or stream, ENERCON modeled the hydrologic and hydraulic properties of the stream and assisted our clients in the development of a site layout. If a site is deemed to be within the flood hazard area, ENERCON researches flood data, assesses the site and determines retroactive control measures to protect existing structures. The installation of protective measures for a site can be beneficial from a risk standpoint to protect capital investments from the natural effects of rapidly rising and fast-moving floods.

Additionally, our staff of engineers have a vast amount of experience developing engineering designs for storm drainage systems, drainage reports, storm water detention ponds, spill retention ponds, roadways, grading, parking lots, erosion and sediment control at numerous site across the United States. ENERCON's geotechnical engineers and geologists have extensive experience evaluating subsurface conditions for a variety of project types.

1.1 PROJECT TEAM

1.1.1 KEY ORGANIZATIONAL CHART



1.1.2 KEY TEAM MEMBER DESCRIPTIONS

SHAUN W. KLINE, PH.D., P.E. | *Project Role: Project Manager, QA/QC Lead*

Mr. Kline is a degreed water resources Professional Engineer (PA) and earth scientist (geomorphology) with over 10 years of applied experience in applied surface hydrology/hydraulics. Mr. Kline was the project manager and/or technical lead for flooding hazard reevaluations at nine U.S. utility locations. Specific experience applicable to this project includes:

- Directed, reviewed and performed calculations related to site-specific and regional meteorological studies; riverine flooding, local intense rainfall, flood loadings, debris strikes and sedimentation (erosion/scour);
- Author of multiple reports submitted to federal regulators and agencies, which were reviewed and accepted by contracted hydrologic/hydraulic experts;
- Served as the subject matter expert for site flooding and as utility representative in regulatory inspections and audits (each concluded successfully for the client);
- Performed FEMA-funded research to quantify overland wave propagation.

KYLE M. KAMINSKI, P.E. | *Project Role: Lead Technical Engineer*

Mr. Kaminski is a registered Professional Engineer (WV, IA, IN, KY, MD, OH, PA and VA) with over 6 years of civil engineering technical experience. He is currently a project engineer with particular emphasis in surface water engineering and is an expert in hydrologic and hydraulic analyses and coastal modeling. Mr. Kaminski has extensive experience in:

- Determination of extreme meteorological phenomena, including probable maximum precipitation, probable maximum floods, hurricanes and wind storms.
- Surface water hydrology including model calibration and verification and statistical analyses.
- Flooding analyses for streams and rivers, including hydrologic evaluations of watersheds and hydraulic conveyance of stream and river channels and floodplains.
- Dam engineering and hydroelectric projects, particularly in the design-storm analyses, spillway capacity analyses, reservoir routing, dam failure analyses, and determination of inundation impacts.
- Floodplain mapping and emergency action planning.
- Experience with Quality Assurance (QA) and Quality Control (QC) procedures.

ANUBHAV GAUR, P.E., C.F.M. | *Project Role: Technical Support*

Mr. Gaur is a Professional Engineer (OK) that has extensive experience in hydraulic design which includes storm sewer design, channel realignment, and detention pond design.

Coordinated drainage submittals to the Army Corps of Engineers and FEMA including LOMR.

Providing hydrologic engineering support for flooding (re-)evaluations.

- As a Land Development Hydrologist, duties included preparing conceptual and technical drainage studies, storm drain analysis and design, culvert design, channel diversion, detention/retention pond design and water network analysis for potable water. He also coordinated drainage submittals to the Army Corps of Engineers and FEMA.
- Hydrologic engineering support for flood studies at utility sites, including Probable Maximum Precipitation (PMP), PMF, hydraulic modeling, and dam failure analyses for utility locations.

BETHANY L. SCOTT, C.F.M. | *Project Role: Floodplain Specialist*

While working on Federal Emergency Management Agency (FEMA) watershed scale flood risk analysis projects, she was responsible for planning, research, and community involvement. Ms. Scott worked to foster collaboration between FEMA, Water Resource Board (OWRB), county, and local community officials. Ms. Scott was also responsible for analysis and mapping of FEMA flood risk. Visualization of flood risk was then used to support community outreach.

Ms. Scott used geospatial analysis of NASA Land-Use/Land-Cover data for Oklahoma in ArcGIS to calculate the specific contributions of evaporation and transpiration to the evapotranspiration variable in the hydrologic equation. Successfully quantifying the amount of water loss through direct soil evaporation and plant transpiration.

LANA LAWRENCE, P.E. | *Project Role: Technical Support*

Degreed Civil Engineer with over 14 years of experience in civil engineering design and analysis associated with hydrology and hydraulics, dam failures, probabilistic and statistical analyses, grading and drainage plans, roadway and utility improvements.

- Extensive experience with hydrologic and hydraulic engineering analyses, dam failure analyses, flood stage frequency analyses and hydrologic/hydraulic modeling;
- Hydrologic and hydraulic assessments using two-dimensional hydraulic modeling software;
- Risk and uncertainty analyses to support flood-related hazard assessments;
- Extensive experience with design of storm drainage systems, watershed delineations, erosion and sediment control projects, detention and retention ponds, grading, water and sewer urban networks.
- Project manager with experience in leading engineering team, communication with municipalities and public, coordination of work between the client, engineering team, and subcontractors.

LUIS A. BASTIDAS, PH.D. | *Project Role: Technical Support*

Mr. Bastidas has over twenty five years of successful experience as consultant engineer and academic researcher in surface and groundwater hydrology and hydraulic engineering.

- Extensive experience in modeling hydrology, hydrometeorology, river morphology, groundwater, stochastic hydrology, statistical learning theory and machine learning applied to water resources, model uncertainty and model calibration.
- Extensive experience in hydrological, water quality, drainage, stormwater, groundwater, and flood control studies, designs, and use of remote sensing for water resources.
- Experience in estimating discharges and probable values of a national river network.
- Principal Investigator in the development/application of statistical theory and methods for hydrological modeling, water resources, forecasting, uncertainty analysis, and model complexity.
- Reviewer of research papers for Water Resources Research, Advances in Water Resources, Journal of Geophysical Research-Atmospheres, Journal of Hydrology, Journal of Hydrological Sciences, Hydrological Processes, Journal of Applied Meteorology, Environmental Modeling and Software, Hydrology and Earth System Science, Journal of Hydroinformatics.
- Extensive experience writing technical publications and reports, and creating and delivering presentations for a variety of audiences including scientists, engineers, partners, and stake holders.

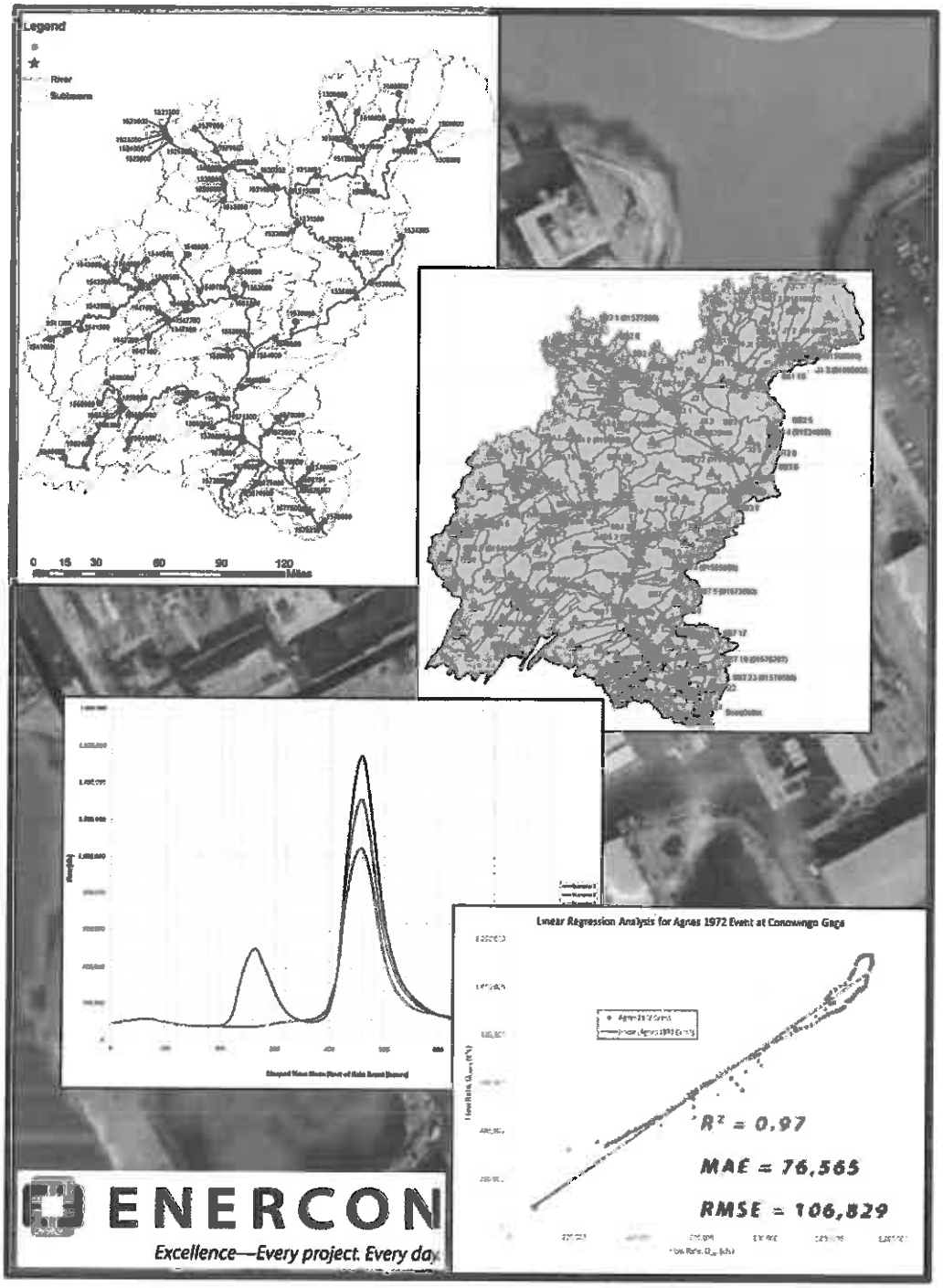
1.1.3 TEAM MEMBER SUMMARY TABLE

EMPLOYEE	PROJECT ROLE(S)	OFFICE LOCATION	TOTAL YEARS EXPERIENCE	YEARS WITH ENERCON	EDUCATION	YEAR EDUCATION COMPLETED	APPLICABLE TRAINING	YEAR TRAINING COMPLETED	PROFESSIONAL/ TECHNICAL CERTIFICATIONS AND LICENSING	YEAR RECEIVED
Shaun Kline	Project Manager, QA/QC Lead	Pittsburgh, PA	10	3.5	B.S., Civil Engineering M.S., Coastal & Oceanographic Engineering Ph.D., Geological Sciences	2006 2009 2013			Pennsylvania P.E. NCEES Model Engineer	2016 2017
Kyle Kaminski	Lead Technical Engineer	Pittsburgh, PA	6	4.5	B.S., Civil Engineering	2010			Pennsylvania P.E. Ohio P.E. West Virginia P.E. Maryland P.E. Virginia P.E. NCEES Model Engineer State of Maryland Erosion & Sediment Control Certification	PA – 2015 OH – 2015 WV – 2015 MD – 2016 VA – 2015 NCEES – 2015 MD E&S – 2016
Anubhav Gaur	Technical Support	Oklahoma City, OK	17	9.0	B.S., Civil Engineering	1999			Oklahoma P.E. C.F.M.	2016 2017
Bethany Scott	Floodplain Specialist	Tulsa, OK	6	2.0	B.S., Environmental Sciences and Natural Resources M.S., Soil Science	2010 2012	FEMA Community Rating System Course FEMA Emergency Response Training FEMA CNMS System Training	2012 2012 2012	C.F.M.	2012
Lana Lawrence	Technical Support	Oklahoma City, OK	16	5.0	B.S., Civil Engineering	1999			Oklahoma P.E.	2008
Luis Bastidas	Technical Support	Pittsburgh, PA	25	3.5	B.S., Civil Engineering M.S., Hydraulic Engineering Ph.D., Hydrology and Water Resources	1986 1990 1998				

2.0 APPLICABLE EXPERIENCE ON SIMILAR PROJECTS

2.1 FLOODPLAIN STUDIES

2.1.1 HYDROLOGIC MODELING



Over the past 5 years, ENERCON's engineers (listed in Section 2) performed Flood Hazard Reevaluations for over one-third of the nation's nuclear fleet of power plants (36 sites). The reevaluations required analysis of extreme, low-probability events ($<10^{-4}$ annual frequency, [10,000+ year return period]), well beyond what is typically used in FEMA floodplain mapping. ENERCON has prepared calculations and reports for hydrological evaluations on gauged and ungauged stream locations utilizing the most up-to-date meteorological data and flood modeling technologies. Locations of these projects have included the Atlantic, Gulf, and Pacific coasts, Lake Michigan and Lake Erie, Chesapeake Bay and a large number of major rivers (e.g., Columbia River, Brazos River, Tennessee River, Susquehanna River, Illinois River, and Upper Mississippi). All projects were completed under ENERCON's QA program (refer to Section 4 for a description on ENERCON's QA program). The list of programs used by ENERCON's engineers to perform the hydrologic analyses include: USACE HEC-HMS, EPA SWMM, FLO-2D Pro, MATLAB, CAD, ArcGIS and extensions for pre- and post-processing of results.

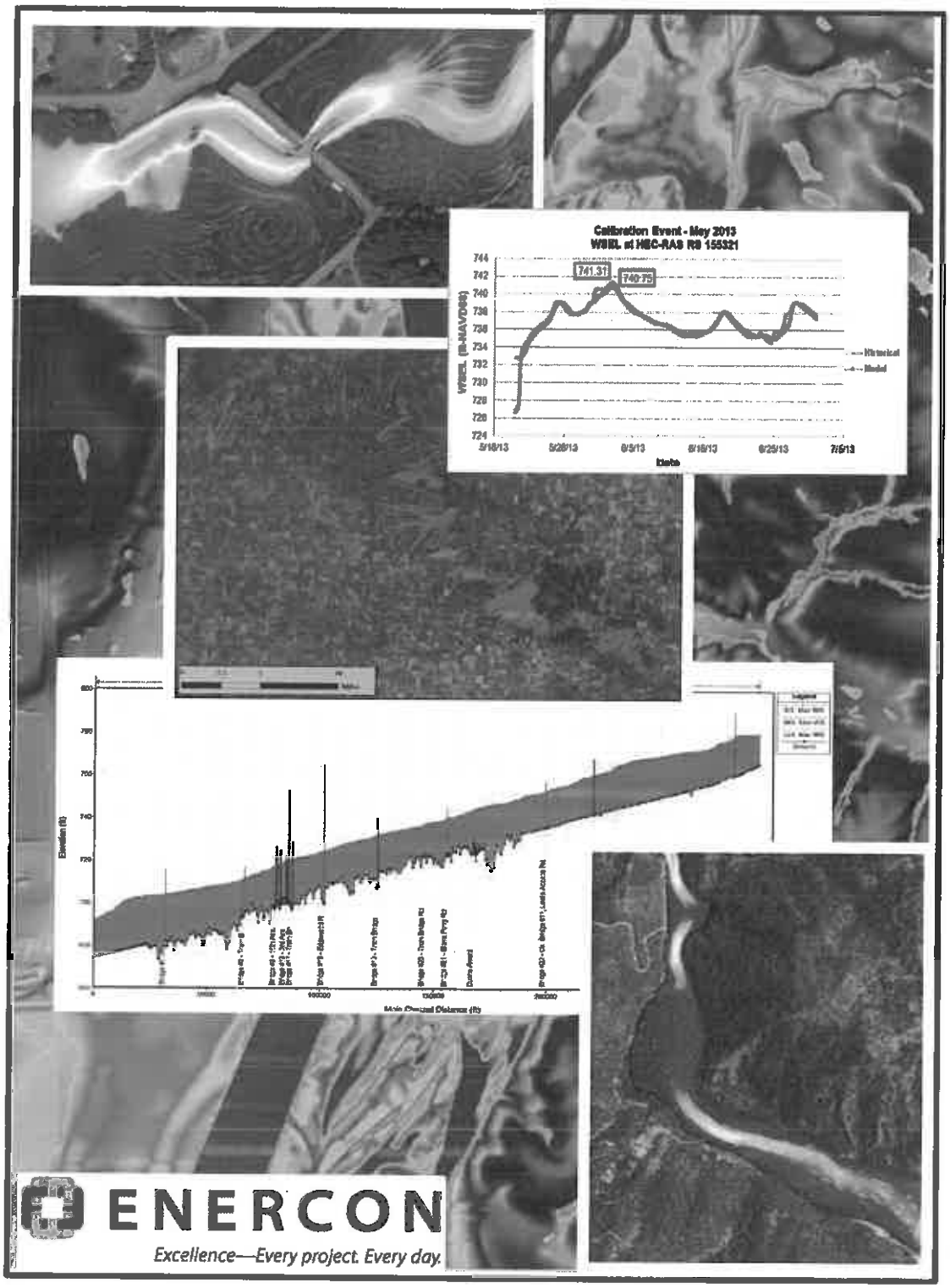
The project types varied from simplified analyses using conservative inputs to detailed studies requiring refined parameter estimates. The basin sizes for the hydrologic portion of the evaluations ranged from just over 1 mi^2 to over 98,000 mi^2, some studies covering multiple states with over 100 sub-basins and a vast range of topographic, hydrologic, and demographic settings. Each project location required investigation of site-specific data, namely soils, land uses, impervious areas, topography, stream flow gages, and dams and levees. The modeling scope of each evaluation included basin delineation, rainfall estimation (for various return frequency events as well as historical events), infiltration determination, rainfall to runoff transformation, baseflow separation/estimation, flood routing and reservoir routing. In some instances, multiple methods (i.e., more than one rainfall to runoff transformation method or infiltration method) were used to determine the most appropriate choice for the particular setting. Once the hydrologic models were built they were calibrated/validated using objective functions for measuring goodness of fit and model adequacy. Ultimately, the models were used to determine the flood wave hydrographs and peak flood discharges at selected locations. ENERCON has customized our approach to be as site-specific as available data allows.

Depending on the application and location, return frequencies for the events have been computed from the 1-year up to the 1,000,000 year event (or greater [e.g., Probable Maximum Flood]). ENERCON also developed and applied statistical regressions and extreme-value fits on the stream gauge records to ensure the validity of the hydrologic results. Ultimately, Hydrologic results were input into hydraulic models for flood routing (refer to Subcategory B – Hydraulic Analyses). At the conclusion of the evaluations, ENERCON wrote summary reports that included detailed sections on the hydrologic modeling. The reports explained each basins hydrologic setting, flood history, as well as describe the hydrologic calculation approaches, methods, and procedures used to determine the flow estimates. Comparisons were also made with previously performed analyses to determine if the hazard was bounded or not bounded; if the hazard was not bounded, the difference in each component was evaluated quantitatively. The report, calculations and hydrologic model files were ultimately reviewed by federal regulators (e.g., Nuclear Regulatory Commission, U.S. Army Corps of Engineers). Representing our clients, ENERCON has presented responses to reviewer questions for each evaluated site, and to date, all of ENERCON's submitted reports and hydrologic models have been accepted by the federal regulators.

To further demonstrate ENERCON's industry-leading skills and approach, ENERCON engineers have published articles and professional papers in peer-reviewed journals. Most recently, ENERCON engineers have been at the forefront of quantify modeling uncertainty as it applies to flood hazards and overall risk.

Images on the cover sheet to this section show some of the hydrologic models and analyses developed and performed by ENERCON.

2.1.2 HYDRAULIC MODELING



Similar to the hydrologic experience, over the past 5 years, ENERCON's engineers (listed in Section 2) performed Flood Hazard Reevaluations for over one-third of the nation's nuclear fleet of power plants (36 sites). The reevaluations required analysis of extreme, low-probability events ($<10^{-4}$ annual frequency, [10,000+ year return period]), well beyond what is typically used in FEMA floodplain mapping. All projects were completed under ENERCON's QA program (refer to Section 4 for description). Applying the results of the hydrologic analyses, ENERCON prepared calculations and reports for hydraulic evaluations on gauged and ungauged stream locations. Modeling was developed using advanced computer software working from GIS-based platforms. The list of programs used by ENERCON engineers to perform the hydraulic analyses include: USACE HEC-RAS (1D and 2D), EPA SWMM, FLO-2D Pro, RiverFLO-2D, Delft3D and MATLAB, CAD, ArcGIS and extensions for pre- and post-processing of results.

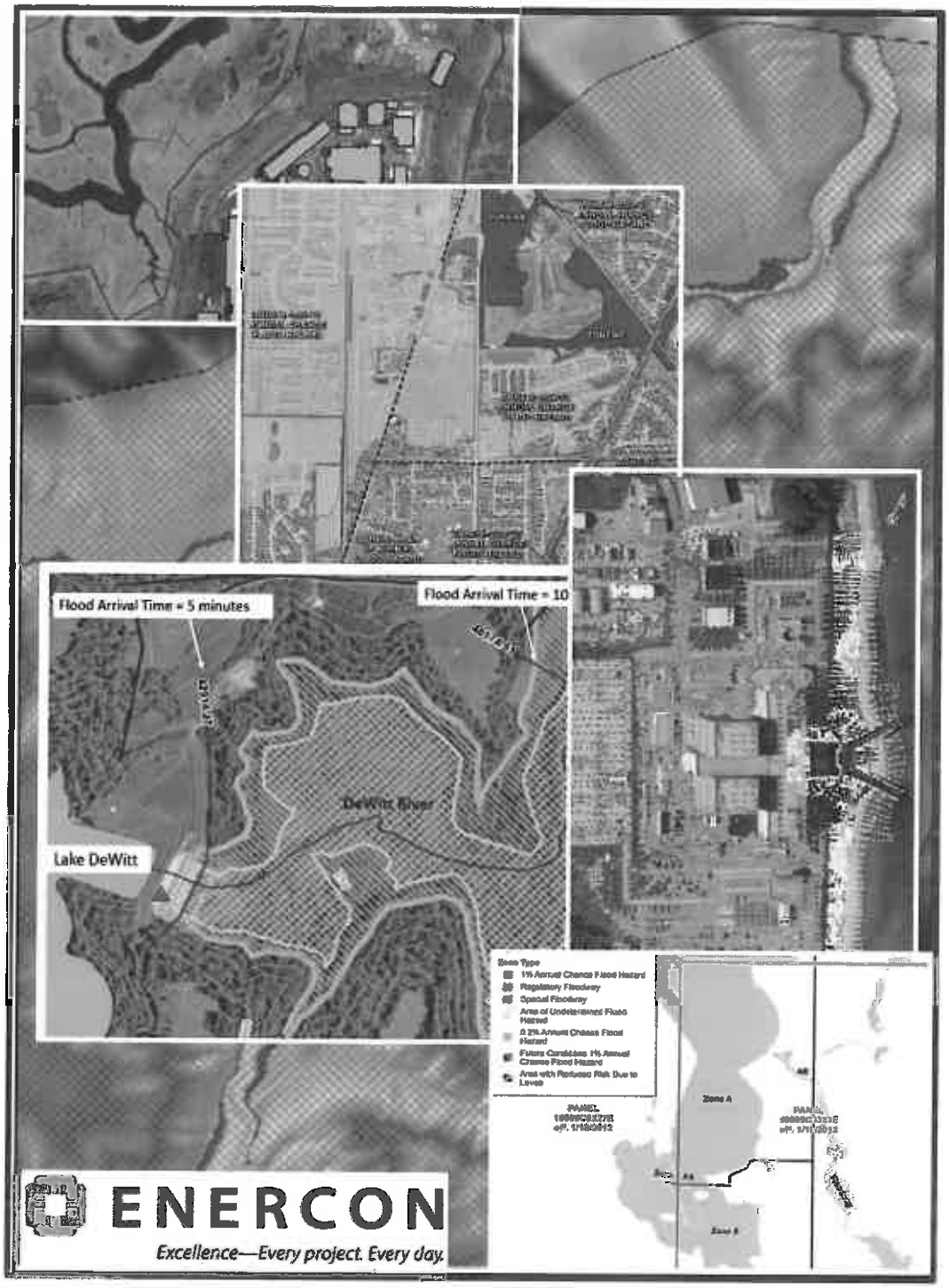
The hydraulic models were used to perform flooding evaluations to determine the maximum water surface elevation profiles for a number of flood mechanisms, including extreme event warm- and cool-season flooding, dam failure flooding, ice-jam failure flooding, and related effects of each mechanism. The reach lengths for the hydrologic portion of the evaluations ranged from several thousand feet to nearly 40 miles. Each model was developed and customized by ENERCON, incorporating surveys and other topographic data to develop the desired accuracy for the cross-sections and accurate representation of hydraulic features.

Depending on the application and location, return frequencies for the events have been computed from the 1-year up to the 1,000,000 year event (or greater [e.g., Probable Maximum Flood]). If data was available, the hydraulic models were built and calibrated/validated using objective functions for measuring goodness of fit and model performance. Hydraulic results were post-processed (often in GIS) to generate floodplain maps for further analyses (refer to Subcategory C – Floodplain Mapping & GIS Data Development). At the conclusion of the evaluations, ENERCON wrote summary reports that included detailed sections on the hydraulic modeling. The reports described the modeling inputs, methods and procedures used to determine the water surface profile estimates. Comparisons were also made with previous analyses to determine if the hazard was bounded or not bounded; if the hazard was not bounded, the difference in each component was evaluated quantitatively. Each report, calculation and all of the hydraulic model files were ultimately reviewed by federal regulators (e.g., Nuclear Regulatory Commission, U.S. Army Corps of Engineers). Representing our clients, ENERCON has presented responses to reviewer questions for each evalauted site, and to date, all of ENERCON's submitted reports and hydrologic models have been accepted by the federal regulators.

The most challenging aspects of the projects were the complexity required for the hydraulic models (e.g., HEC-RAS). One location of interest was at the confluence of three rivers, with a gated navigation/water level control dam just downstream of the confluence, as well as other navigation control dams and canals upstream and downstream of the project area. ENERCON applied advanced features of the HEC-RAS modeling system, including in-line gated dams, dam operational rules curves, and split flow, to accurately and thoroughly model the river conditions during extreme flooding. ENERCON created a two-dimensional model using RiverFLO-2D to better characterize the flow velocity profiles in the floodplains and more accurately predict loading stresses at key areas. Another stream location required a very detailed model to properly account for a series of three run-of-river hydroelectric dams, the presence of 14 major contributing USACE flood storage reservoirs within the basin and coordination/collaboration with various stakeholders (i.e., owner, federal regulators [NRC, FERC] and other consultants).

Images on the cover sheet to this section show some of the hydraulic models and analyses developed and performed by ENERCON.

2.1.3 FLOODPLAIN IDENTIFICATION, MAPPING & DFIRM PRODUCTION



Similar to the Sub-Category's A and B applicable experience, over the past 5 years, ENERCON's engineers (listed in Section 2) performed Flood Hazard Reevaluations (FHRs) for over one-third of the nation's nuclear fleet of power plants (36 sites). The reevaluations required analysis of extreme, low-probability events ($<10^{-4}$ annual frequency, [10,000+ year return period]), well beyond what is typically used in FEMA floodplain mapping. These projects required many of the essential GIS/mapping steps listed in the FEMA DFIRM specifications, Floodplain Boundary Standards and FEMA Procedure Memorandum 38.

ENERCON GIS supports various types of infrastructure siting, permitting, and environmental review in meeting local, state, and federal environmental compliance. Our client base includes utilities, municipalities, governmental agencies, energy companies (oil and gas, nuclear, fossil fuel, and wind generation, etc.), and a variety of private sector companies with projects located all across the country. Applying the results of the hydraulic analyses, ENERCON specialists prepared floodplain maps and databases over the spatial domains of hydraulic models. For the projects, ENERCON's GIS team used the Environmental System Research Institute's (ESRI) ArcGIS products including ArcView, ArcMap, ArcGlobe, ArcScene, ArcHydro, HEC-GeoRAS (USACE product), HEC-GeoHMS (USACE product), Spatial Analyst (Extension), , 3-D Analyst (Extension), Publisher (Extension), Python (non-ESRI product).

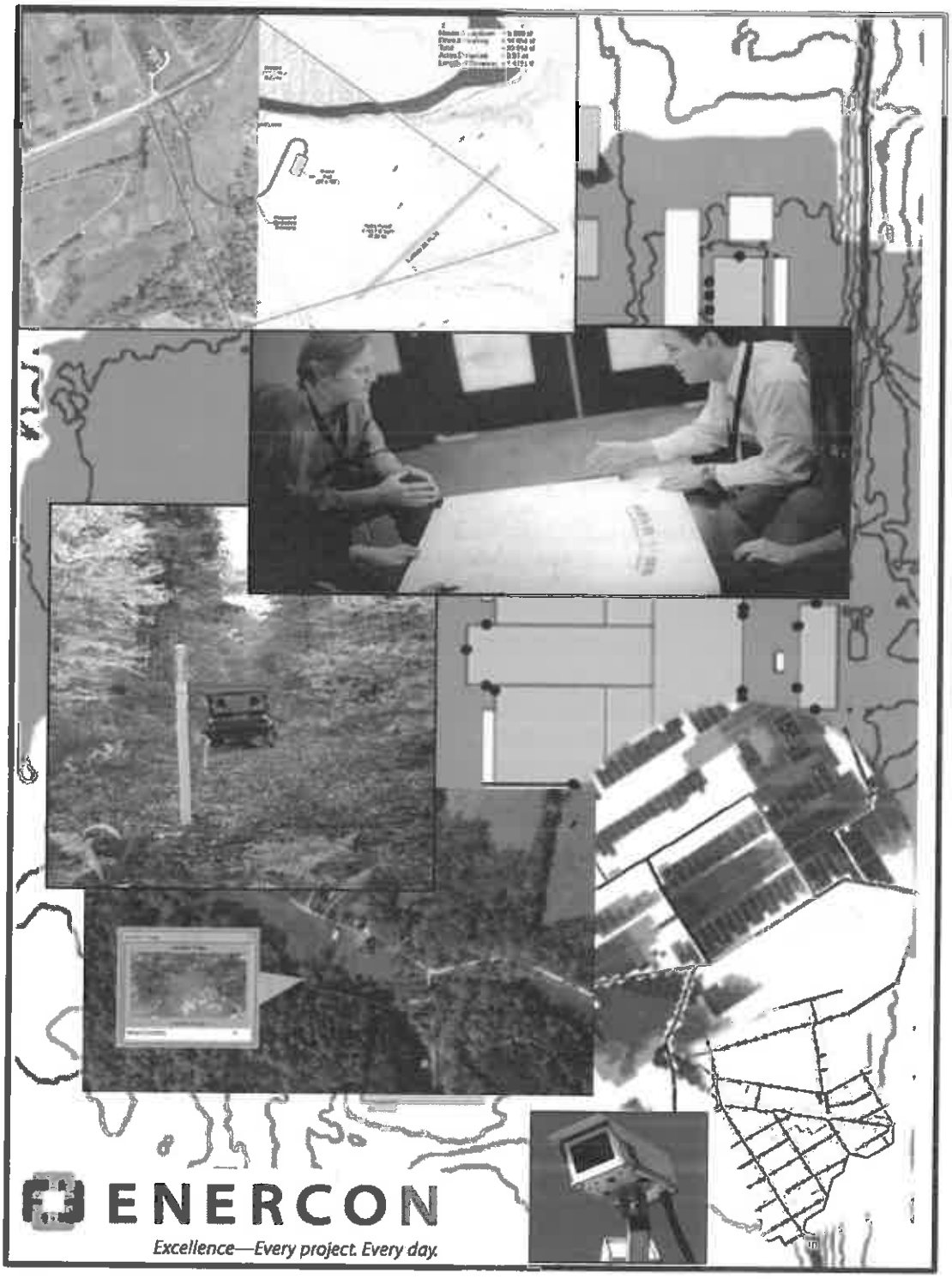
For each project, the raw working GIS dataset of files was assembled for modeling input. This included U.S. Geological Survey base maps, aerial imagery, LiDAR, topographic data and, bathymetric data, surveys, structures, populations, boundaries, and floodways that were assembled from various data sources. The data would then be projected and georeferenced to a common geographic coordinate system. Vertical and horizontal datum shifts were applied if required. Once the modeling was complete, an automated program (such as HEC-GeoRAS or Python) was used to re-import hydrologic and hydraulic modeling outputs into the GIS workspace for creation of the maps and databases which would include the delineated floodplain boundaries and floodways for the various return period flooding events examined. The databases could be efficiently queried for other purposes and additional data layers could easily be incorporated. The delineated floodplain maps and database files were reviewed by federal regulators (e.g., Nuclear Regulatory Commission, U.S. Army Corps of Engineers). Representing our clients, ENERCON has presented responses to reviewer questions for each evalauted site, and to date, all of ENERCON's submitted floodplain maps and database files have been accepted by the federal regulators.

For certain other projects, ENERCON's GIS group has developed GIS models that link specific documents within an interactive base map layer, where data, reports and permits can be viewed visually with their correct geographic location and contained within a single data management system. This customized system creates a user-friendly conceptual database based on the application and cartographic needs, which has served our clients as an excellent tool for managing project information. On other projects, ENERCON specialists have integrated GIS with demographic and socioeconomic data from the U.S. Census and other sources allowing detailed analysis of local and regional populations (and trends).

Similarly, with a focus on environmental assessment projects, the ENERCON GIS group has extensive experience utilizing the Federal Emergency Management Agency (FEMA) Flood Map Service Center, and accessing official state and county Flood Insurance Rate Map (FIRM) data, both digital and raster imagery panels. For many of our projects, using ESRI ArcGIS mapping software applications, ENERCON incorporates available FEMA imagery with project geospatial data and via GIS processes and applies a screening process for the presence of flood plains potentially associated with project locations. Many of the project have included cartographic expertise similar to the design of appropriate FEMA mapping deliverables in support of report submittals.

Images on the cover sheet to this section show some of the maps developed and analyses performed by ENERCON.

2.2 TECHNICAL SUPPORT



ENERCON has extensive project experience involving technical reviews and evaluations of flood studies, calculations, mapping and reports. Most recently, an ENERCON utility client analyzed flooding hazards at several of their power plants facilities. The client has a large portfolio of power plants, including 29 hydroelectric dams and 3 nuclear power plants (with six operating reactors). Near the end of the project, the client retained ENERCON to provide the Owner's and Technical Review of over 30 calculations related to flooding. These calculations included hydrologic evaluations, hydraulic evaluations and floodplain mapping. ENERCON was retained because of our strong reputation of quality engineering, our ability to analyze large-basin hydrology and river hydraulics, and our thorough understanding of quality assurance procedures. The more than 30 calculations reviewed were analyzed to determine the worst-case riverine flooding scenarios. ENERCON provided reviews of the evaluation methodologies and conformance to federal regulatory guidance documents. ENERCON also provided recommendations for improvements to quality and thoroughness of the models, methodologies, and data documentation to better facilitate regulatory reviews and acceptance. On another project for that client, ENERCON prepared a series of abbreviated Standard Technical Information Documents (STIDs) for a number of client-owned dams. STIDs are comprehensive summary reports in support of regulatory reviews.

As part of the post report FHR process, ENERCON engineers were retained to complete additional technical projects that have encompassed project scoping activities for planning, analysis, and design of flooding mitigation features. The projects have included: permitting, design, cost estimating, flood warning and emergency plans, walkdowns, site investigations/reconnaissance, economic damage estimates and follow on hydrologic and hydraulic engineering projects.

ENERCON engineers have also worked on projects in converting developed flooding models into real-time and/or forecast warning systems though web-based services and databases. The systems can be linked to notification systems, such as publically accessible websites, text messages or email (i.e., electronic mailing lists) to properly notify officials, planners, emergency responders and the general public. For some ENERCON projects, ENERCON's engineers have also created interactive inundation maps from the model outputs. Model outputs inundation maps can be provided in formats compatible with freely available, interactive mapping software such as Google Earth™ or other spatial rendering software (e.g., GIS).

3.0 CAPACITY AND CAPABILITY OF THE FIRM

3.1 INITIATING EMERGENT WORK AUTHORIZATIONS

Project Managers have the authority to negotiate and implement any new Task Order that does not require contractual changes. Each ENERCON division has key operating managers who can review and negotiate contract changes. If emergency responses are required, Project Manages have the authority to initiate new Tasks while written Task Orders are being processed provided they remain within specified corporate limitations. Senior management can extend those authorizations if needed. Per our corporate policy, any emergency work authorization exceeding $50,000 requires the approval of our President. These polices have been developed to control costs and maintain effective communication on project cost control.

3.2 CONTINGENCY TO ADJUST TO UNFORESEEN ISSUES

As ENERCON's list of preferred engineering and technical support contracts have grown, we make a concentrated effort to reach out and secure talent within our organization from across the country that have direct engineering and environmental experience needed on specific projects. All offices communicate in weekly conference calls to address priority project needs, limitations on key resources, and high visibility project issues. These conferences include all senior ENERCON management, up to and including our Chief Operating Officer and President.

ENERCON actively recruits young talent from a number of colleges across the country. We are always nurturing the development of new incoming engineers and scientists for future needs. ***We employ eight (8) full-time recruiters*** focused squarely on identifying available talent and securing qualified engineers and technical staff. ENERCON maintains a resume database of over 20,000 engineers, and technical staff. Should you have a sudden increased need for our services under this contract, ***we have immediate s access to over 1,100 personnel located in our other 27 offices as well as the resources of our subcontractors.***

3.3 PROCESS TO ADJUST TO TASKS THAT DO NOT FALL WITHIN THE CONTRACT'S CORE STATEMENT OF WORK

Normal Changes – ENERCON organizes our contracts with a single point of contact between the ENERCON project manager and your project manager. Any necessary changes in scope required by field operations with normal time constraints can be quickly communicated to your Project Manager by our Project Manager.

Alternative Method, Direct Communication to Task Order Manager – When a Task Order is assigned, ENERCON assigns a Project (Task Order) Manager to complete the work. Scope Changes to individual Task Orders can be sent directly to the Project Manager when rapid response is needed.

Alternative Method, General Task Order or Retainer – If needed, we have established had a limited retainer project for rapid response to emergency issues. This method allows us to respond to minor scope issues that can be covered by the retainer while waiting for contracts to generate a Task Order. Our typical method for this process is to limit the retainer to $7,500 or less as negotiated.

Alternative Method, Notification of Field Change – When prosecuting a Task Order, Project Managers are trained to inform you of any changes in conditions that warrant a change in scope. This is accomplished via telephone and backed up via email or letter communication from the Project Manager. ENERCON will not proceed with the change in scope until we receive written notification from you to do so.

3.4 APPROACH TO PROJECT WORK SCOPE AND TRACKING

ENERCON has a corporate-wide project controls, cost, and time tracking system. This software collects and stores essential information necessary for us to monitor and track critical labor and project parameters. Our personnel and project information is maintained in this system, and employees enter their time directly into the system daily. In addition to electronic time keeping and invoicing, our system provides real-time financial and cost status to our Project Managers. Our system interfaces with Primavera so that resource expenditures can be exported in order to generate Cost Performance Index (CPI) and Schedule Performance Index (SPI) factors for larger projects.

Our system tracks multiple tasks for each project. Each task is assigned resources with man-hours specified by individual. No individual can exceed the authorized level of hours for a specified task without prior Project Manager approval. This assures that any deviations from the planned level of effort are immediately identified and evaluated so that appropriate corrective actions are developed and implemented. Our system allows each person on the project team the ability to view the project data. The system accumulates time against each project and tasks as time is entered and charged to a task, giving direct feedback on progress and charges to date. Our system fully integrates into our financial management systems, so all information on project costing, including direct project labor, other direct costs such as travel and living, subcontracts, and equipment leasing and rentals, are automatically entered as the charges are incurred.

4.0 QUALITY ASSURANCE / QUALITY CONTROL MEASURES

ENERCON has developed and maintains a Quality Assurance program which meets the criteria defined by the Nuclear Regulatory Commission in 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" meeting the ANSI N45.2-1977 and NQA-1-2008 / NQA-1a-2009: QA program standards. The NQA-1a-2009 is one of the most stringent QA program standards and our QA Program has been audited by a number of domestic and international organizations. As such, ENERCON maintains a staff of five full time QA department employees who are strictly dedicated the applying and ensuring the program requirements to ENERCON products and services. For quality control, ENERCON uses formalized engineering (corporate standard) procedures (CSPs), design verification, peer review and our Engineering Review Board to constantly grade, maintain, and improve the quality and completeness of our calculations, designs, and reports. While the QA department ensures global quality, the ENERCON Project Manager (PM) is tasked with ensuring that all QA procedures are followed.

Engineering procedures are followed to ensure consistency, completeness, thoroughness, and accuracy of our work. Calculations are prepared following an approved, specified format and a documented procedure to meet these objectives. Calculations are independently design verified by a second engineer. In modeling space, the design verifier usually either recreates the model, checks all inputs individually or tests the model by an alternative calculation or method to validate and assess the confidence of the results. After calculations are completed and design verified, peer reviews are performed when needed. Peer reviews, performed by a senior engineer familiar with the project, are focused on the appropriateness of work scope, level of detail, methodologies employed, consistency with the regulatory guidance, and the level of detail compared to the project goals and engineering objectives.

For the final review and approval step, ENERCON uses an Engineering Review Board (ERB) that follows a formalized, internal process to review major design deliverables and calculations. Calculations and reports are submitted to an independent ERB after completion, design verification, and peer review. Senior engineers within our organization who have not participated in the performance of any project work deliverables, are assigned to review and grade the work product. This procedure was developed to provide the standard measures of engineering product quality.

Each engineering report or calculation is graded in each of the categories listed above as appropriate. Scores are assigned to each item, and an overall grade is assigned. Comment/Resolution forms document the reviewers' comments, which are returned to the lead engineer to accept or reject the comments. Work products with unacceptable grading are rejected for use, and require the work to be corrected. Clients only receive deliverables that have successfully passed each internal ENERCON review phase. Grades for performance with the ERB are tracked, and published internally on dashboards showing the ERB's assessment of work product quality. Lessons learned from past similar projects are applied to the current projects underway and future projects.

Once the deliverable is submitted to the client and client has a chance to provide comments, the ENERCON originator, design verifier and peer reviewer are all part of the resolution process, following the same procedures as mentioned above to resolve all comments. Meetings are held as necessary until all comments are resolved to the satisfaction of the client. If the client and stakeholder identifies a concern or issue beyond the typical comment cycle such as a deficiency, error or performance issue, ENERCON initiates its Corrective Action program and performs a root cause analysis or apparent cause analysis to resolve and correct the deficiency or issue. All actions are then documented in the corrective action report and shared as a lesson learned. All re-work required as a result of a deficiency or error is performed as warranty work until the problem is corrected in the deliverable.

APPENDIX A:
PROJECT REFERENCES

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ENERCON has prepared these tables as a quick look up of our references. A thorough breakdown by client with project names, services provided, contract value, and project schedule adherence is given on the following pages. ENERCON has numerous other past projects in the last 5 years with these clients; however, only those relevant to this scope of work in this SOQ have been listed. ENERCON welcomes the DNRC to contact these individuals to attest to our capabilities, work ethic and schedule/cost adherence.

CONTACT NAME	Vinod Aggarwal	Ronnie Lingle	Collin Keller
CLIENT	Exelon Corporation	NextEra Energy	First Energy
PHONE NUMBER	610.765.5762	561.691.2151	330.315.6801
EMAIL	Vinod.Aggarwal@Exeloncorp.com	Ronnie.Lingle@fpl.com	kellerc@firstenergycorp.com

CONTACT NAME	James Kent	Scott Maze	Andy Langdon
CLIENT	Tennessee Valley Authority	PG&E	Energy Northwest
PHONE NUMBER	256.729.3177	805.542.9591	509.377.8721
EMAIL	jakent@tva.gov	SxM9@pge.com	aalangdon@energy-northwest.com

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Client/Company Name: Exelon
Client/Company Contact: Mr. Vinod Aggarwal
Contact Title: Director of Engineering
Contact Phone Number: 215-841-4126
Contact Email: Vinod.Aggarwal@Exeloncorp.com

Number of Projects: 10

Project Names:
Byron Flood Evaluation
Braidwood Flood Evaluation
Dresden Flood Evaluation
LaSalle Flood Evaluation
Limerick Flood Evaluation
Peach Bottom Flood Evaluation
Calvert Cliffs Flood Evaluation
Oyster Creek Flood Evaluation
Clinton Flood Evaluation
Quad Cities Flood Evaluation

Contract Value:
Byron $ 301,354.20
Braidwood $279,749.96
Dresden $560,000
LaSalle $370,003
Limerick $288,000
Peach Bottom $324,000

Summary of Services Provided:
The evaluations each incorporated a basin wide hydrologic runoff model (HEC-HMS computer program) and a hydraulic riverine model (HEC-RAS computer program) to perform flooding evaluations for a number of flood mechanisms including: extreme event warm and cool season flooding; dam failure flooding; ice-jam flooding; local intense precipitation; surge and seiche flooding; and related effects of these flooding mechanisms. Coastal and lakeside locations also utilized the Delft3D model to create 2D hydrodynamic models to evaluate surge, wind, wave, and runup. Flood inundation mapping, warning time, and travel time were developed to evaluate plant response and preparedness evaluations. The goal of the projects was to determine the maximum water surface elevation at and determine/map the flood inundation area at each site, if any.

Meteorological data sets, combined with USGS stream gage records, were used to produce calibrated rainfall/runoff relationships capable of accurately reproducing the effects of storms-of-record. Evaluation of the Local Intense Precipitation (LIP) was performed using a two-dimensional hydraulic model (FLO-2D). Modeling was developed using advanced computer software working from GIS-based and CAD-based platforms.

On several projects ENERCON also created a two-dimensional model (RiverFLO-2D) to better characterize the complex flow velocity profiles in the floodplains around the sites. The models included gated locks and dams, highway bridges, and flood control levies. All topographic analysis, land and soil cover conditions, and riverine model geometry were developed from GIS-based and CAD-based

topographic and informational digital files. Additionally, for several of the analyses, ENERCON worked with Applied Weather Associates (AWA) to develop site specific probable maximum precipitation estimates.

For the Exelon projects, the most challenging aspects were the number of projects occurring concurrently and the sheer size of several contributing basins to each project location. For many of the projects, the site was situated between a series of three run-of-river hydroelectric dams and required coordination with various stakeholders (owner, NRC, FERC, and other consultants) to perform the studies.

For each project ENERCON prepared the flood hazard evaluation report for submittal to the federal regulatory commission to include a summary of the current design basis, flood hazard mechanism analyses, and interim actions to address analyses that exceed current design basis. ENERCON also supported Exelon in the federal regulatory commission audit reviews and addressed follow-up requests for information from the federal regulatory commission. The projects were completed on time and within budget.

Client/Company Name: First Energy
Client/Company Contact: Mr. Collin Keller
Contact Title: Manager, Fleet Design Engineering
Contact Phone Number: 330-315-6801
Contact Email: kellerc@firstenergycorp.com

Number of Projects: 3

Project Names:	**Beaver Valley Flood Evaluation** **Davis-Besse Flood Evaluation** **Perry Flood Evaluation**
Contract Value:	**Beaver Valley $500,000** **Davis-Besse $515,736** **Perry $1,400,000**

Summary of Services Provided:
The evaluations each incorporated a basin wide hydrologic runoff model (HEC-HMS computer program) and a hydraulic riverine model (HEC-RAS computer program) to perform flooding evaluations for a number of flood mechanisms including: extreme event warm and cool season flooding; dam failure flooding; ice-jam flooding; local intense precipitation; surge and seiche flooding; and related effects of these flooding mechanisms. Coastal and lakeside locations also utilized the Delft3D model to create 2D hydrodynamic models to evaluate surge, wind, wave, and runup. Flood inundation mapping, warning time, and travel time were developed to evaluate plant response and preparedness evaluations. The goal of the projects was to determine the maximum water surface elevation at and determine/map the flood inundation area at each site, if any.

Meteorological data sets, combined with USGS stream gage records, were used to produce calibrated rainfall/runoff relationships capable of accurately reproducing the effects of storms-of-record. Evaluation of the Local Intense Precipitation (LIP) was performed using a two-dimensional hydraulic model (FLO-2D). Modeling was developed using advanced computer software working from GIS-based and CAD-based platforms. All topographic analysis, land and soil cover conditions, and riverine model geometry were developed from GIS-based and CAD-based topographic and informational digital files.

For the Beaver Valley Project, the most challenging part of the project was the dam failure inundation analyses of 16 major USACE flood storage dams, as well as several run-of-river navigation control dams, and many smaller dams in the basin. Hydrologically-induced, seismically-induced, and "sunny day" failure scenarios were analyzed to determine the worst case flooding scenario. ENERCON developed flood inundation mapping, warning time, and travel time to evaluate plant response and preparedness evaluations and had to coordinate with several federal agencies to obtain the data for the evaluation.

For the Perry Project, the most challenging aspect of the project was the design of channel improvements to increase the conveyance capacity of an adjacent stream, and the rerouting of a second adjacent stream to divert the effects of extreme flooding away from the plant site and discharge to Lake Erie. The project required coordination between several state agencies including multiple local, state, and federal agencies to establish a design that minimized or eliminated potential impacts to the Lake Erie shoreline and wetland areas. The stream rerouting incorporates a diversion berm that was also analyzed for dam failure

scenarios. ENERCON coordinated the evaluation of a site-specific probable maximum precipitation analysis through a specialty meteorological consultant (Applied Weather Associates). ENERCON developed flood inundation information and mapping to include warning time and flood duration to evaluate plant response and preparedness evaluations.

For each project ENERCON prepared the flood hazard evaluation report for submittal to the federal regulatory commission to include a summary of the current design basis, flood hazard mechanism analyses, and interim actions to address analyses that exceed current design basis. ENERCON also supported First Energy in the federal regulatory commission audit reviews and addressed follow-up requests for information from the federal regulatory commission. The projects were completed on time and within budget.

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Client/Company Name: NextEra Energy (NEE)
Client/Company Contact: Mr. Ronnie Lingle
Contact Title: Flood Evaluation Fleet Manager
Contact Phone number: 561.691.2151
Contact Email: Ronnie.Lingle@nexteraenergy.com

Number of Projects: 5

Project Names:
Duane Arnold Flood Evaluation
Point Beach Flood Evaluation
Seabrook Evaluation
St. Lucie Flood Evaluation
Turkey Point Flood Evaluation

Contract Value:
Duane Arnold $701,300
Point Beach $623,000
Seabrook $1,032,000
St. Lucie $618,000
Turkey Point $480,000

Summary of Services Provided:
For the inland projects, the evaluations each incorporated a basin wide hydrologic runoff model (HEC-HMS computer program) and a hydraulic riverine model (HEC-RAS computer program) to perform flooding evaluations for a number of flood mechanisms including: extreme event warm and cool season flooding; dam failure flooding; ice-jam flooding; local intense precipitation; surge and seiche flooding; and related effects of these flooding mechanisms. Coastal and lakeside locations also utilized the Delft3D model to create 2D hydrodynamic models to evaluate surge, wind, wave, and runup. Flood inundation mapping, warning time, and travel time were developed to evaluate plant response and preparedness evaluations. The goal of the projects was to determine the maximum water surface elevation at and determine/map the flood inundation area at each site, if any.

Meteorological data sets, combined with USGS stream gage records, and NOAA records were used to produce calibrated rainfall/runoff relationships capable of accurately reproducing the effects of storms-of-record. Evaluation of the Local Intense Precipitation (LIP) was performed using a two-dimensional hydraulic model (FLO-2D). Modeling was developed using advanced computer software working from GIS-based and CAD-based platforms. All topographic analysis, land and soil cover conditions, and riverine model geometry were developed from GIS-based and CAD-based topographic and informational digital files.

For the Seabrook Project, the most challenging aspect of the project was the lack of available data and complexity of the coastal region for the evaluating the flood hazard. Meteorological and topographic data sets (georeferenced with GIS software), along with historical tide/wave/water level gage observations, were used to develop, calibrate and validate the model parameters. A suite of 20,000 synthetic hurricanes were developed parameters were developed and screened to identify the bounding surge cases locally. These cases were then simulated in the detailed hydraulic and wave model to determine the surge and wave impacts at Seabrook. Wave runup was computed using industry-standard methods. Additional challenges included simulating the complex interactions of riverine flooding effects (runoff and dam failure

simulations) combined with tide water level rises and nor'easter and hurricane surge effects. Advanced coastal science was applied in solving the analyses, including lessons learned and knowledge gained from the observed effects of Hurricane Sandy. At the conclusion of the project, ENERCON successfully mapped the final flood inundation areas and loading forces at various buildings were computed.

For each project ENERCON prepared the flood hazard evaluation report for submittal to the federal regulatory commission to include a summary of the current design basis, flood hazard mechanism analyses, and interim actions to address analyses that exceed current design basis. ENERCON also supported NEE in the federal regulatory commission audit reviews and addressed follow-up requests for information from the federal regulatory commission. The projects were completed on time and within budget.

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Client/Company Name: Tennessee Valley Authority (TVA)
Client/Company Contact: Mr. James Kent
Contact Title: Flood Evaluation Fleet Manager
Contact Phone number: 256.729.3177
Contact Email: jakent@tva.gov

Number of Projects: 4

Project Names:
Fleet Wide Flood Evaluation Calculation Reviews
Standard Technical Information Documents (STIDs)
Browns Ferry 2-D Flood and Inundation Modeling
Fleet Wide Interim Actions Development

Contract Value:
Flood Evaluation Reviews $31,000
STIDs $30,000
Browns Ferry $108,718
Interim Actions $37,000

Summary of Services Provided:
ENERCON has been selected as an Engineer of Choice (EOC) for the TVA in the area of Dam Safety and Engineering for open contract awards of up to $11 million.

TVA has a large portfolio of power plants, including 29 hydroelectric dams and 3 nuclear power plants (with six operating reactors). TVA retained a consultant to analyze the potential flooding at their power plants as part of the NRC post-Fukushima initiative evaluating the flood protection and preparedness of the U.S. nuclear fleet. TVA retained ENERCON to provide the Owner's and Technical Review of over 30 calculations related to flooding scenarios. ENERCON was retained because of our strong reputation of quality engineering, our ability to analyze large-basin hydrology and river hydraulics, and our thorough understanding of safety quality procedures.

More than 30 calculations to determine the worst case flooding scenario. ENERCON provided reviews of analysis methodologies and evaluations of conformance to regulatory guidance documents. We also provided advice on improvements to quality and thoroughness of the modeling performed, methodologies employed, and data documentation to better facilitate regulatory reviews and acceptance. As follow on work ENERCON prepared a series of abbreviated Standard Technical Information Documents (STIDs) for a number of TVA-owned dams in support regulatory reviews.

Most recently, ENERCON developed a two-dimensional model for the Browns Ferry site using widely used in the industry FLO-2D computer software. The comprehensive, highly-detailed model allowed to compute more accurately the inundation area and water depths at each location of interest throughout the site. In addition, multiple scenarios were analyzed as part of the evaluation. The more accurate and detailed model allows TVA's stakeholders to make informed decisions related to compensatory measures for the identified vulnerabilities. Interim actions were then developed to mitigate select flood inundated areas. To date, the projects were completed on time and within budget.

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Client/Company Name: Pacific Gas and Electric (PG&E)
Client/Company Contact: Mr. Scott Maze
Contact Title: Acting Manager, Fukushima Response Program
Contact Phone number: 805.542.9591
Contact Email: SxM9@pge.com

Number of Projects: 2

Project Names:	**Diablo Canyon Flood Evaluation** **Diablo Canyon Flood Mitigating Strategies**
Contract Value:	**Diablo Canyon Flood Evaluations $ 630,000** **Diablo Canyon Mitigating Strategies $150,000**

Summary of Services Provided:
ENERCON has developed hydrologic runoff models (HEC-HMS computer program) and hydraulic riverine models (HEC-RAS computer program) to perform flooding evaluations for Diablo Creek. Modeling was developed using advanced computer software working from GIS-based and CAD-based platforms. All topographic analysis and riverine model geometry were developed from GIS-based and CAD-based topographic and informational digital files.

Hydrologic and hydraulic models were developed to calculate the Probable Maximum Flood (PMF) for Diablo Creek. Hydrologic modeling of the Diablo Creek watershed was conducted using the USACE HEC-HMS computer software. Hydrologic modeling was developed to estimate a PMF runoff hydrograph at the DCPP site resulting from the PMP. The critical PMF runoff hydrograph was then used as input to hydraulic modeling. Hydraulic modeling, utilized the USACE HEC-RAS software to compute PMF water surface elevations and inundation areas along Diablo Creek through the DCPP site.

Follow on work included the development a 2-D hydraulic model using the FLO-2D computer software. The comprehensive, highly-detailed model allowed to compute more accurately the inundation area and water depths at each location of interest throughout the site. The more accurate and detailed model allows PG&E's stakeholders to make informed decisions related to compensatory measures for the identified vulnerabilities. Interim actions were then developed to mitigate select flood inundated areas.

The most difficult aspects of the project were the defining the proper rainfall input for the project location. Many parts of California, including the project area, are subject to rain shadowing effects that can create an under or over estimation of runoff.

Client/Company Name: Energy Northwest
Client/Company Contact: Mr. Andy Langdon
Contact Title: Project Lead
Contact Phone number: 509.377.8721
Contact Email: aalangdon@energy-northwest.com

Number of Projects: 1

Project Names: **Columbia Flood Evaluation**

Contract Value: **Columbia Flood Evaluation $ 500,000**

Summary of Services Provided:
ENERCON has developed hydrologic runoff models (HEC-HMS computer program) and hydraulic riverine models (HEC-RAS computer program) to perform flooding evaluations for Columbia River. Modeling was developed using advanced computer software working from GIS-based and CAD-based platforms. All topographic analysis and riverine model geometry were developed from GIS-based and CAD-based topographic and informational digital files.

The Columbia River watershed upstream of the CGS site has a total drainage area of approximately 98,000 sq miles. The Yakima and Snake River watersheds, downstream of the site and tributary to the Columbia River, have watershed drainage areas of 6,156 sq miles and 108,000 sq miles, respectively. The Columbia, Yakima, and Snake River watersheds were divided into nine sub-regions or river basins, as shown in above Figure. The Kootenai-Pend Oreille-Spokane Sub-region was broken into three separate drainage basins, one for each major river. The Columbia River watershed was split into five sub-regions or drainage basins including the Upper Columbia, Headwaters Columbia, Kootenai, Pend Oreille, and Spokane. The Yakima watershed is considered a single sub-region, since it is less than 10,000 square miles. Three sub-regions were identified in the Snake River watershed including the Upper Snake, Middle Snake, and Lower Snake.

Due to the large area of the sub-regions located within the Columbia and Snake River watersheds, sub-regions were further reduced into sub-basins. The Probable Maximum Precipitation (PMP) Calculation sub-basin delineations were developed to reduce sub-basin drainage areas to less than 10,000 square miles as Hydro Meteorological Report (HMR) 57 limits the development of PMP storms to a 10,000 square mile area. Sub-basins were also subdivided at the location of major dams, in anticipation of the need to conduct dam failure analyses. Drainage areas for sub-basins located in the Columbia River watershed range from 300 up to 4,000 square miles. Sub-basin delineation in the Snake River watershed resulted in sub-basin drainage areas that range from 2,000 up to 9,000 square miles.

Hydrologic and hydraulic models were developed to calculate the Probable Maximum Flood (PMF) for Columbia River watershed upstream of the CGS site. Hydrologic modeling of the Columbia River watershed upstream of the CGS site was conducted using the USACE HEC-HMS computer software. Hydrologic modeling was developed to estimate a PMF runoff hydrograph at the DCPP site resulting from the PMP. The critical PMF runoff hydrograph was then used as input to hydraulic modeling. Hydraulic modeling, utilized the USACE HEC-RAS software to compute PMF water surface elevations along Columbia River near the CGS site. The project was completed on time and within budget.