

A photograph of a large dam with multiple spillways, with water cascading over them. The sky is overcast.

HYDROLOGIC & HYDRAULIC ENGINEERING

OUR H & H EXPERTISE

At RIZZO International, Inc. one of our featured areas of expertise is Hydrologic and Hydraulic engineering, analysis, and design. We have a dedicated team of highly educated engineers who focus on the nuances of this field in order to provide the most appropriate engineering solutions. In particular, our engineers possess expertise relating of rainfall, runoff, infiltration, flow accumulation, coastal effects (e.g., tsunamis and storm surges), and risk analysis.

Our Hydrologic and Hydraulic services cover a broad variety of projects, including nuclear power facilities and dams, as well as other project applications. RIZZO provides an experienced risk-based perspective to hydrologic and engineering design. We are accustomed to working on complex projects within the framework of federal, state and local regulatory requirements, as well as projects with stringent Quality Assurance/Quality Control requirements such as site development for nuclear power projects.

We maintain a presence on standards committees such as the committee to update the American Nuclear Society standard for Probabilistic Flood Hazard Assessment (ANSI/ANS-2.8). This position reflects our position at the forefront of new analysis methods such as Probabilistic Flood Hazard Assessment. We have also contributed to International Atomic Energy Agency guidance documents for Probabilistic Flooding Hazard Assessment.

ANALYSIS & DESIGN

With over 30 years of experience, RIZZO is well equipped to provide a full range of hydrologic and hydraulic analysis and design services. Our services include:

- Watershed modeling
- Local precipitation modeling
- Probabilistic Flood Hazard Assessment (PFHA)
- Flooding Fragility Analysis
- Coastal Engineering analysis: waves, storm surges, tsunamis
- Low-water analysis

- Recirculation Studies
- Dam break studies
- Probable Maximum Flood (PMF) studies
- Inflow Design Flow
- Inundation maps
- Stormwater Management
- Hydraulic design of spillways & other structures
- Geographic Information Systems (GIS)

With a thorough understanding of hydrologic and hydraulic processes, we can formulate effective analysis and design solutions that are appropriate to specific project requirements.

PROJECT PLANNING

We work hand-in hand with our clients to develop an effective work plan, schedule, and budget, a process that is aided by our strong understanding of the regulatory framework associated with water-related development projects.

SOFTWARE CAPABILITIES

RIZZO engineers are adept at using software tools to model complex hydrologic and hydraulic flood scenarios. In order to provide the appropriate level of detail to each project solution, we maintain expertise in a range of hydrologic and hydraulic computer programs, including 1D, 2D, and 3D hydrodynamic models for river flooding, rainfall runoff modeling, and coastal modeling. RIZZO's software expertise includes many programs, such as:

- FLO-2D
- Delft3D
- SLOSH
- HMR52
- HEC-HMS
- HEC-RAS
- HEC-SSP
- HEC-RPT
- HEC-RESSIM
- Flowmaster
- HY-7
- HY-8
- ADH
- SWASH
- EPA-SWMM
- MODFLOW
- ArcGIS
- Civil3D

HYDROLOGIC & HYDRAULIC ENGINEERING

DAMS PROJECTS

OSAGE RIVER BASIN - PMF ANALYSIS - MISSOURI



RIZZO performed a Probable Maximum Flood analysis for the Bagnell Dam site in accordance with the Federal Energy Regulatory Commission (FERC) methodologies. The total watershed area above

the Bagnell Dam is 14,000 square miles. The Bagnell Dam impounds the immense Lake of the Ozarks, and the upstream watershed includes 5 major Army Corps flood storage projects, as well as hundreds of other dams and reservoirs. The runoff model considered the complex network of rivers, streams, lakes and gated spillway controls for the six major flood storage dams upstream of the Bagnell Dam site.

TAUM SAUK DAM - DAM BREAK ANALYSIS - MISSOURI

RIZZO performed dam break analyses for the Taum Sauk Pumped Storage Project. The analyses were performed using HEC-RAS for an Arc-GIS-developed model. The model included three reservoirs, 40 miles of the Black River, and several highway bridges. RIZZO also performed flood impact studies in response to directives from FERC.

SILVER LAKE DAM - SPILLWAY DESIGN - MICHIGAN



RIZZO developed a spillway redesign for the Silver Lake Reservoir Dam. The new spillway design balanced various constraints including environmental impact, hydro power output, construction cost,

and regulatory compliance. The objective of the redesign was to reduce the length of the spillway. RIZZO's new spillway design resulted in a 35% reduction in spillway length.

LAKE BLACKSHEAR – DAM BREAK ANALYSIS

RIZZO performed a Dam Break analysis for the Lake Blackshear Dam. The analysis provided an in-depth evaluation of the potential inundation effects due to a Dam Break event. Both sunny-day and hydraulic mechanisms were considered. The hydraulic failure was evaluated by applying the Probable Maximum Precipitation (PMP) to the upstream watershed to determine Probable Maximum Flood (PMF) conditions at the dam site. The hydrologic and hydraulic models were developed using HEC-HMS and HEC-RAS, respectively, and inundation maps were prepared to illustrate results.

NUCLEAR PROJECTS

NEW NUCLEAR POWER REACTORS - GLOBAL EFFORTS

RIZZO has contributed hydrologic and hydraulic analyses (including PMF studies, as well as dam break, storm surge, and tsunami analyses) for many new nuclear reactor siting projects, including preparing Chapter 2 of several Combined Operating License Applications (COLAs). Our global participation in new nuclear reactor sites includes:

- Callaway NPP Units 2 & 3, Missouri, USA
- Braka NPP, United Arab Emirates
- Bell Bend NPP, Pennsylvania, USA
- Borssele (KCB2) NPP, Netherlands
- Calvert Cliffs NPP Unit 3, Maryland, USA
- Akkuyu NPP, Turkey.

FLOOD HAZARD REEVALUATIONS - USA

Since the tsunami at Fukushima-Daiichi (2011), RIZZO has participated in reevaluating flooding hazards for nine power reactor sites in the US. We have performed extensive analysis in support of these reevaluations, including dam break analyses, PMF studies, Local Intense Precipitation analyses, and independent technical review of similar studies completed by third parties. Our work involved the following plants:

- Comanche Peak Nuclear Power Plant
- Callaway Energy Center
- Wolf Creek Generating Station
- Palo Verde Nuclear Generating Station
- Susquehanna Steam Electric Station
- Calvert Cliffs
- Point Beach Nuclear Plant, Wisconsin
- St. Lucie Plant, Florida
- Seabrook Station, New Hampshire

BRUCE PROBABILISTIC FLOOD HAZARD EVALUATION - CANADA

RIZZO conducted a two-phase flooding hazard evaluation for the Bruce Nuclear Generating Station. The first phase of the analysis was a deterministic hazard analysis that evaluated all potential external flooding hazards (similar to the Recommendation 2.1 analyses for U.S. plants). The second phase of the analysis was a detailed probabilistic analysis for storm surge and local intense precipitation (the two flooding sources that were not screened out by the deterministic analysis).

