



Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists

Ralph D. Nelson, Jr., P.E.
Senior Civil Engineer

Education

Northeastern University - Bachelor of Science in
Civil Engineering, 1981
IFIM Training - National Biological Service,
Ft. Collins, Co. - 1994

Registrations and Professional Affiliations

Registered Professional Engineer - Maine 1986
American Society of Civil Engineers - Member
Tau Beta Pi - National Engineering Honor Society
Chi Epsilon - National Civil Engineering Honor Society

SUMMARY OF EXPERIENCE

Mr. Nelson has 23 years of experience as a civil/structural, hydraulic engineer in the planning, licensing and permitting support, and design and construction of hydroelectric and industrial projects. He has served as Project Engineer and Engineer for feasibility studies, environmental studies, hydrologic and hydraulic studies, provided engineering support for licensing and permitting activities, performed and reviewed designs in steel, wood, and concrete, and performed or coordinated surveys and construction layout. He has performed structural analysis and design for powerhouses, dams and intake structures, and appurtenant structures.

Wind Specific

Mr. Nelson has participated on several wind energy projects, serving as project engineer and lead engineer. Mr. Nelson has performed wind-energy analysis, detailed evaluation of wind generating equipment, wind feasibility studies, supporting site design of road layouts, hydrologic and hydraulic analysis and design, and performed supporting engineering cost estimates. In support of permitting requirements, Mr. Nelson has participated in meetings with State officials, and authored major sections of permit applications. Mr. Nelson has also offered expert testimony before the Maine State Board of Environmental Protection for other linear energy projects.

Dam Safety Specific

Mr. Nelson has participated in numerous Part 12 Safety Inspections as project engineer, reviewing previous safety inspection reports (where available) and project records, participating in the hydraulic and hydrologic analysis, planning and participating in the inspections of the facilities, performing the stability analyses, and authoring the reports. He has also participated in condition evaluations of existing facilities for the purpose of determining current value, degree of obsolescence, and replacement costs in support of property tax assessments.

Mr. Nelson has been involved in many phases and aspects of hydraulics and hydrology. He has performed Probable Maximum Flood (PMF) and Inflow Design Flood (IDF) analysis, including developing the Probable Maximum Storm (PMS) and the Probable Maximum Precipitation (PMP) using HMR51 and HMR52, and calculated the PMF and IDF using HEC1 and DAMBRK, and completed Emergency Action Plan (EAP) Studies. He has performed backwater models using HEC2 to evaluate the impacts of planned hydroelectric developments or modifications on upstream facilities, structures or riverbanks, to determine the limits of impoundments and impacts of modification to the hydraulic control structures, to assess the potential for riverbank erosion of sensitive archeological sites, evaluate a reach hydraulics considering fish habitat, and to determine the limits of impoundment of dams. He has performed hydrologic and hydraulic studies using two-dimensional flow models (TABS and FastTABS - now SMS), and complex spreadsheets and

GIS Arc/Info mapping to quantify fish habitat for numerous species and life stages. He also used the two-dimensional flow models to evaluate hydraulics and scour at an existing and proposed bridge site.

Mr. Nelson has served on a number of projects addressing erosion including; identification and characterization of erosion sites and remedies for 22 miles of the Connecticut River between Vernon, Vermont and Turners Falls, Massachusetts; hydraulic analysis of 20 miles of the Kennebec River to determine the erosion potential at specific locations under various flows; engineering design for the stabilization of a fine sand river channel on the Passumpsic River, Barnett, Vermont; and engineering support for embankment stabilization at an archaeological site on the Dead River in Eustis, Maine.

CHEOPS specific

Mr. Nelson has served on a number of projects addressing the modeling of hydro-project or system operation with DTA's CHEOPS software. Mr. Nelson has served as technical lead and modeler on small and large systems, from single developments on a small New England river to multi-development projects on the Columbia and Catawba Rivers. The scope of work typically includes a review of the system hydrology, developing daily inflows to the projects, analysis of historical operation, setup of the CHEOPS software to simulate existing and future operation, calibration to historical operation records, verification of model performance, calibration reports, model runs simulating existing and future conditions with variations in operation requirements, Operation Model reports, and presentations before stakeholder groups.

RELEVANT PROJECT ASSIGNMENTS

Grant PUD - Priest Rapids Development - Hydro Operations Model Simulation, Columbia River, Washington - Mr. Nelson was the project engineer responsible for development and execution of DTA's CHEOPS™ computer model to simulate operation of a hydroelectric project in Washington with over 1,700 MW in generating capacity. The model was developed to evaluate the project plan for relicensing, including capital improvements, changes in project operation, and measures to protect, mitigate, and enhance (PMEs) natural resources. The model was used to evaluate the benefits and impacts associated with a complex array of alternatives for turbine-generator upgrades, PMEs, and operation constraints. The work featured detailed analysis of project data, derivation of performance curves, energy losses, and quantification of other operational data. Mr. Nelson was a writer for, and provided technical support in, the preparation of Exhibits A and B of the draft license application recently submitted to FERC for the project.

Grant PUD - Power Planning Model - Hydro Operation Model Simulation - Columbia River, Washington - Mr. Nelson was lead engineer responsible for development of DTA's CHEOPS model for client use in Power Purchasing and Marketing. A model was created and refined for specific client needs, to assist the client to determine the impacts to 60-years of future generation from planned operational changes.

Duke Power - Hydro Operation Model Simulation - Catawba Wateree Hydroelectric Project, North and

South Carolina - Mr. Nelson was technical lead engineer for the development of DTA's CHEOPS model for Duke Powers' 11-development river system, including analysis of project operation data, and presentations to the State Resource teams.

Hydro Operation Model Simulation Confidential Hydroelectric Project, North and South Carolina - Mr. Nelson was lead engineer responsible for the hydrologic analysis of basins in the southeast portion of Atlantic basins and detailed hydrologic analysis of a major river system in the Carolinas. Mr. Nelson was responsible for the development of DTA's CHEOPS model for a six-development river system, including analysis of project operation data.

Mars Hill Wind Farm Project, Mars Hill, Maine, Evergreen Windpower, LLC - Mr. Nelson served as Lead Engineer in the preliminary design of the project, featuring 7.3 miles of access roads in steep terrain, 6.4 miles of power collection and delivery lines, and the siting of up to 35 wind turbines with a maximum capacity of 50 MW.

Hidalgo Energy Facility, Edinburg, Texas - Mr. Nelson prepared a Storm Water Pollution Prevention Plan (SWPPP) for the constructed gas generating facility in compliance with the U.S. Environment Protection Agencies (EPA) National Pollutant Discharge Elimination System (NPDES) permit, and the Texas Pollution Discharge Elimination System (TPDES) program.

GLHA - BHE Chester 115 kV Tie Line - Project engineer responsible for the preliminary and final site design and permit documents for the 115 kV power line and the Powersville Road substation. Mr. Nelson also performed follow-up permit compliance work, with resulted in additional construction modifications to meet the State Permit conditions.

Bangor Hydro-Electric 345 kV Tie Line to New Brunswick Power - Engineer supporting the environmental, geotechnical, and engineering activities performed during planning, layout, study, design, and State and Federal permitting for Bangor Hydro's Second 345 kV Tie Line Project located in Washington, Hancock, and Penobscot Counties. This project involved the installation of 85 miles of transmission line including several river crossings, and the crossing of an international border.

Dingley Island Tidal Flow Restoration Project, Harpswell, Maine Corporate Wetland Restoration Partnership - Mr. Nelson was lead engineer performing the *Tidal Hydrodynamic Analysis and Erosion Potential and Sediment Transport Assessment* for the project. The project goal was to remove a portion of a 200-foot Dingley Island causeway in order to re-establish the natural tidal flow between the clam-flats on north and south sides of the causeway. DTA performed biologic studies of the clam flats and studies on the impacts of construction and restoring tidal flow. The project was constructed by the U.S. Naval Construction Battalion in 2002.

GLHA and Bangor Hydro-Electric Company, Medway Maine, GLHA - BHE Chester 115 kV Tie Line - Project engineer responsible for the site layout, and design of the stormwater management and erosion and sedimentation control plan for a proposed substation in Medway, Maine. The site featured 25 acres of development along the Penobscot River and including a 1,500-foot-long access road through terrain. Mr. Nelson performed the layout and design, pre- and post-development analyses and authored the stormwater and erosion and sedimentation control sections of the Site Location of Development (Site Law) Permit. The Site Law permit application and the stormwater sections were reviewed and approved by the DEP. Mr. Nelson also performed follow-up permit compliance work, which resulted in construction modifications to meet the State Permit conditions.

Penobscot River Hydroelectric Power System, Great Northern Paper Company (GNP), Millinocket, Maine --Hydraulic Engineer assisting in the development of an operating plan for the GNP power

system. The hydro system drainage area comprises over 3,348 square miles of the Penobscot River Basin, in which multiple dams and storage reservoirs operate as an interconnected system for electrical and mechanical power production for GNP.

The Water Management Plan (WMP) was developed by DE&S, which prescribes operating criteria for four hydro facilities located at the upstream portion of GNP's hydro system. Hydrologic and hydro system operation analysis was required to develop criteria to meet multiple resource needs. The analysis included computer simulated operation under various operating criteria, and evaluation of the effectiveness of the operating criteria to meet the water users objectives and goals.

Palmer Falls Hydroelectric Station, Dam Repair and Rehabilitation Project, Hudson River, Glens Falls, N.Y., International Paper Company - Project and Design Engineer responsible for the repair and rehabilitation of a 400-foot-long, 90-foot-high Ambursen dam on the Hudson River and crest retrofit with a 6-foot-diameter Bridgestone Rubber Dam. Mr. Nelson's responsibilities included design, specification and shop drawing review for dam resurfacing, modifications to the concrete structures, and appurtenances. His responsibilities also included evaluation of crest control upgrade options, resulting in a feasibility study and design of two options for crest control upgrade, hinged flashboards and pneumatic crest control. The Bridgestone rubber dam option yielded better crest control and economic advantages, and was the first hydroelectric installation in the Northeast.

Stone Dam, Great Northern Paper Co., Millinocket, Maine - Structural engineer for installation of rubber dam, including evaluation of intake hydraulics. Assisted with revisions to Emergency Action Plan to address hypothetical dike failure. Design/specification of inflatable rubber flashboard system. Design of concrete repairs of non-overflow structures.

Dashville Project, Central Hudson Gas & Electric, Esopus, New York - Structural engineer supporting the design of the pneumatic flashboard system, rehabilitation of the intake rehabilitation, trashracks, 40-foot-high retaining walls, cofferdams and site work.

Niagara Mohawk Power Company, Emergency Action Plan (EAP) for the Mechanicville Hydroelectric Project, Hudson River, New York - Project and Lead Engineer for the EAP. The studies involved routing of the ½ PMF and sunny day failure conditions,

incorporating the complex hydraulics of the Mohawk River confluence, to determine the inundation limits. Ralph was responsible for developing and executing the Dambreak model, performing other hydrologic analyses, production of the Inundation Maps, and authoring the engineering and EAP reports.

St. Lawrence-FDR Power Project, Emergency Action Plan (EAP) for the FDR Power Project, St. Lawrence River, New York, New York Power Authority (NYPA) - Project engineer for the studies. Ralph was lead hydraulic engineer for the project, which was an update and upgrade of earlier analysis for the five major water retaining structures of the FDR Power Project. The project consisted of the analysis of the five major water retaining structures and various routing reaches along the 39 miles downstream through Canada to the Beauharnois Hydroelectric Complex. The work involved site review of the facilities and structures; review of the 1960 construction drawings; development of breach criteria; coordination with NYPA, Ontario Power Generation, and Hydro Quebec; development of the hydraulic dambreak model for the Grasse River, St. Lawrence River and tributaries; calibration; and execution of the analysis. The project also featured a major mapping exercise, which included creating a seamless three-dimensional digital map of the United States and Canada in ESRI ARC-INFO format. Ralph used the computer programs Dambrk, RiverCAD, MS Excel, and AutoCAD to complete his work. The DE&S GIS department authored program code to project the inundation surfaces into the Arc-Info GIS mapping.

Ellsworth Hydroelectric Project, Ellsworth Dam Rehabilitation, Union River, Maine, Bangor Hydro-Electric Company - Engineer responsible for hydraulic and structural evaluations of the Ellsworth Project. The Project features an upstream storage project and earthen embankment dam and a downstream generating facility and 380-foot-long Ambersen Dam constructed within a gorge. Mr. Nelson was responsible for calculations of the PMS, PMP, and PMF determination using HMR52, and HEC1 in compliance with FERC requirements for dam safety studies. He was also responsible for the IDF selection for Graham Lake Dam and the Ellsworth Dam using the N.W.S. computer program DAMBRK. With the new IDF flows and elevations Mr. Nelson completed a structural analysis of the 70-foot-high, 380-foot-long Ellsworth Ambursen Dam, constructed in 1907, and authored a supplement to the second consultants safety inspection report to the FERC.

Murphy Dam, New Hampshire Department of Environmental Services, Pittsburgh, New Hampshire - Hydrologic/hydraulic engineer participating in the

development of the PMF, spillway adequacy assessment, dam failure analysis, and EAP inundation mapping for this hydroelectric project located in northern New Hampshire. Also responsible for review of existing documentation of the upper Connecticut River and field survey of the site and sections along the 55-mile downstream reach.

Northfield Mountain Pumped Storage Hydroelectric Project, Connecticut Riverbank Management Master Plan, Connecticut River, Massachusetts, Northeast Utilities Service Company, Inc. - Engineer responsible for the hydraulic mathematical modeling of the 22-mile-long Turners Falls reservoir between Turners Falls, Massachusetts and Vernon, Vermont. Also, authored a report which addressed riverbank movement between 1939 and 1990 using aerial photographs and available mapping. In addition, Ralph completed a tractive force erosion analysis and report which used the tractive force technique to identify river flows capable of initiating river embankment erosion.

St. Lawrence-FDR Power Project, Development of Prototype Bathymetry and Environmental GIS Data within Lake St. Lawrence, St. Lawrence River, New York, New York Power Authority - Project engineer for the study. He performed hydrological analysis on gage records at nine gages in Lake St. Lawrence, performed global positioning system (GPS) bathymetric survey, prepared bathymetric data for import to ARC/INFO GIS, and performed analysis on the data. The bathymetry data collection was unique in that DE&S and a geophysical subconsultant teamed to use dual frequency sonar and multiple frequency Ground Penetrating Radar (GPR) to remotely sense bottom depths, areas of aquatic vegetation, and substrate materials. Positions were collected using a GPS in real-time corrected mode (RTCM) using Coast Guard DGPS Stations and local GPS base stations. Mr. Nelson formatted this survey data for input into ARC/INFO GIS for mapping and analysis.

Augusta Hydroelectric Project, FERC AIR - Tailrace Habitat Study, Kennebec River, Maine, Edwards Manufacturing Company - Project Engineer responsible for the hydraulic modeling of the Augusta Hydroelectric Project tailrace habitat study as directed by a FERC Additional Information Request (AIR). The project entailed studying the proposed expansion impacts upon project tailrace aquatic habitat values for eight species and a total of 32 life stages for 30 separate river flows under high and low tides, for the existing and proposed project conditions. Mr. Nelson developed a flow model for the 45 acres of tailrace habitat using a two dimensional, hydrodynamic, finite element

computer program. He also performed fieldwork with biologists to gather field data for model calibration and verification. The flow model contained 5,770 nodes and 2,100 elements, to represent the three powerhouse tailraces, tributary inflows, gate discharges, 900-foot-long spillway discharges, three bridges, and eight bridge piers. The tailrace area is subject to tidal fluctuation, which was incorporated into the model. Ralph developed a computerized spreadsheet to interface the finite element model results with habitat suitability index curves to compute the habitat values at each model cell for all the species/lifestage and flow regime combinations. Ralph prepared the data for input into ARC/INFO GIS for further mapping and analyses. The GIS coverages mapped existing conditions, habitat quality and quantity, and the effects of proposed operation on habitat.

Bath-Woolwich Bridge, Flood Flow Analysis and Scour Study, Kennebec River, Bath, Maine, Hardesty and Hanover - Project Engineer responsible for hydrologic and hydraulic analysis of 20 miles of the Kennebec River to establish the hydraulic design criteria for the bridge construction and scour protection. The project entailed replacement of an existing lift-span passenger and railway bridge with an upstream bascule bridge and fixed bridge options. The hydraulic and scour study focused on the effects of new and existing construction on the river flow characteristics, flood stages, and scour. The hydrologic and hydraulic analyses featured a one-dimensional hydrodynamic flood model to analyze tidal fluctuations, coastal storm surges, and river flood flows to establish maximum water surface elevations, and peak design flows. The analyses also featured a two-dimensional finite element flow model to compute detailed flow characteristics and pier effects for the bridge crossing area. The analyses were calibrated to existing conditions under a range of river flows and used to predict conditions during construction, and future conditions. Subsequent contract with the Maine Department of Transportation (MDOT) required analyses of multiple pier configurations, intended to provide the bidding contractors with a matrix of pier/scour options for the design/build bid.

Great Works Hydroelectric Project, Fort James Operating Company - Lead Hydraulic Engineer in support of the Great Works Project relicensing on the Penobscot River, Maine. Primary project responsibility is for an instream flow investigation of anadromous, catadromous, and resident fish species habitat in the project bypass reach. Participated in agency consultation process for scoping the instream flow studies. Participation included a characterization of the

complex hydraulics of the bypass reach, including multiple ledge outcrops, a deepwater pool, backwater effects, reverse (upstream) flow, and multiple eddy currents. Owing to the complex hydraulics, standard IFIM habitat quantification techniques or advanced two-dimensional spatial methods could not be employed. Instead, a customized habitat mapping and quantification study protocol was developed with fisheries agencies through the consultation process. Other project duties include engineering support for relicensing activities, including developing hydraulic rating curves, flow duration curves, and flood flow analyses. Assisted with preparation of draft license application.

Maine Independence Energy Project, Casco Bay Energy, Falmouth, Maine - Project Engineer working with a interdisciplinary team permitting the 520 MW natural gas-fired power plant located in Veazie, Maine along the Penobscot River. Ralph was responsible for the preliminary and final site plans, the stormwater management plans, erosion and sedimentation control plans, and stormwater quantity and quality computations for the development and design of the mile-long access road serving the site. The stormwater management plans were required in accordance with the 1997 Stormwater Management Laws for the State of Maine. The stormwater management incorporated a variety of runoff treatments resulting in no significant increase in stormwater peak discharges off-site. Ralph participated in the permitting effort at the Federal, State and local levels. Mr. Nelson also prepared the Spill Prevention, Countermeasures and Control Plan (SPCC) and the Storm Water Pollution Prevention Plan (SWPPP) documents for the facility.

Maritimes & Northeast Pipeline Project, Maritimes & Northeast Pipeline LLC, Augusta, Maine - Project Engineer working with a interdisciplinary team permitting the 300-mile-long pipeline from Westbrook to Baileyville, Maine. Ralph prepared the stormwater management plans, erosion and sedimentation control plans, the site plans, and stormwater quantity and quality computations for the pipeline and two 12-acre compressor stations along the pipeline. Ralph also prepared stormwater management plans for the permanent access roads serving the pipeline, which were in sensitive or threatened watersheds. The stormwater management plans were required in accordance with the 1997 Stormwater Management Laws for the State of Maine. The stormwater management incorporated a variety of runoff treatments resulting in no significant increase in stormwater peak discharges off-site and also addressed stormwater quality, in which phosphorus and suspended solids

were treated using vegetated swales, and vegetated buffers. Ralph participated in the permitting effort at the Federal, State, and local levels.

Veazie Town Business Park, Town of Veazie, Veazie Maine - Project Engineer responsible for conceptual and final layout, stormwater analysis, mitigation and report, Erosion and Sedimentation control, preparation of plans and details, coordination with the Maine Department of Environmental Protection, and preparing the permit application.

MEPCO Tie Line Project, Weldon 115 kV Line, Great Northern Paper Company, Millinocket, Maine - Project Engineer responsible for permitting and design of the Tie line project, including Stormwater and Erosion control analysis, design and reporting. Involved the coordination of field survey, siting, and design of a 115 kV/345 kV substation and access roads. Mr. Nelson worked with an inter-disciplinary team of scientists, biologists, and engineers to gather field data in support of route selection and preliminary design. Mr. Nelson was responsible for the site layout, stormwater analysis and design, erosion control design, preparation of design reports, preparation of permit and license documents, and coordination of the engineering disciplines.

Jordan Dam Part 12 Dam Safety, Alabama Power Company - Engineer responsible for performing stability analyses of the Jordan Dam powerhouse, dam, and appurtenant structures in compliance with FERC Part 12 requirements.

Veazie Dam Inflatable Flashboards, Bangor Hydro-Electric Company, Veazie, Maine - Structural engineer for the design of a 550-foot-long bladder actuated steel crest gate system. Design scope included hydraulic analyses, structural modifications to the spillway, and piping and electrical layout.

Milford Hydroelectric Project, Backwater Analysis, Bangor Hydro-Electric Company - Project Engineer responsible for HEC-2 backwater model used to evaluate the project impact on upstream lands and islands.

FMC Corporation, Energy Cost Reduction Analysis, Rockland, Maine - Engineer for study of means to reduce energy costs. Included analysis of multiple options, e.g., affiliate wheeling, municipalization, in-plant generation/cogeneration with steam turbines, gas turbines, and diesels. Primary responsibilities focused on studies of historical and future energy use,

cost estimates, energy rate study, and projection of energy use and costs.

FMC Corporation, Maintenance Shutdown Scheduling Project, Rockland, Maine - Project Engineer responsible for creating, implementing, and tracking FMC maintenance and capital projects during multiple two-week facility-wide maintenance shutdowns. Ralph worked as a team member with the FMC engineers to create and track resource-levelized schedules for all shutdown work. The schedules were printed in a two-day format for use by FMC Planners and Maintenance foremen. The schedules were updated daily during the shutdown work. Ralph also assisted FMC by providing informal scheduling training and ongoing technical assistance.

Bowater/ Paper, Upgrade and Frequency Conversion Study, Millinocket, Maine - Project Engineer responsible for producing schedules and cost estimates for the project study. Ralph worked with the project manager to produce cost estimates and schedules for the three upgrade options at two sites.

Niagara Mohawk Power Company (NMPC), Beaver River Valuation Study, New York - Project Engineer responsible for site review and cost estimates. The project involved the detailed review and condition assessment of fourteen hydroelectric generating facilities in conjunction with tax valuations in the Towns of Moreau, Colonie, Parishville, and Croghan in New York. The work included assessment of the general condition and performance of the facilities based on observations made during site visits and information provided by Niagara Mohawk, a qualitative analysis of the factors and conditions which affect the life of the facilities, cost estimates for NMPC real estate division for the Cost of Replacement (COR) and Replacement Cost New (RCN) valuation scenarios, and an assessment of the performance of the facilities based on the current condition and history of the facilities maintenance and rehabilitation work which has extended the useful life the facilities. Opinions were made as to the life expectancy of the facilities based on these assessments.

Clark Fork Project, FERC Initial Consultation Document, Clark Fork River, Noxon, MT and Cabinet Gorge, ID, Washington Water Power - Project Engineer responsible for hydrologic analysis in support of the initial consultation document (ICD) preparation. He performed analysis on gage data creating all supporting analyses and graphics, such as; flow duration curves, wet, dry and average water years, and average daily flows. Mr. Nelson also assisted by

performing analysis and preparing graphics of the aquatic survey (fish composition) data.

Plum Island Wind Energy Feasibility Study, Plum Island, New York, N.Y., New York Power Authority - Project Engineer for the feasibility study of a wind energy project on Plum Island, Suffolk County, New York. Plum Island is located just off the northeast tip of Long Island, New York. Responsibilities included coordination of the meteorological consultant, review of applicable wind turbine technology, wind energy estimates, project layout, cost estimates, managing the photo simulations, and coauthoring and managing the study report. The study of the wind data for the island and local region revealed that the island possessed excellent wind resources. The island is the site of the U.S. Department of Agriculture Plum Island Animal Disease Center for the study of infectious diseases and has a peak electrical requirement of 2.4 MW. The project size studied was a 9 MW project composed of eighteen 500 kW wind turbines on 40-meter tubular towers. Excess power would be delivered to a utility on Long Island via an existing submarine cable.

Falls Village Hydroelectric Station, Maintenance and Rehabilitation Project, Housatonic River, Connecticut, Northeast Utilities Service Company - Project and Design Engineer for the Maintenance and Rehabilitation Project. Responsibilities included design, specification, shop drawing review, and inspection for the forebay modifications, trashracks and support steel, new trash rake, concrete deck and appurtenances. The project involved the demolition and replacement of the penstock intake structure, and the installation of a hydraulic trashrack. The new trashracks and intake deck were supported by high strength steel tubing.

Falls Village Unit No. 4 Hydroelectric Generation Facility, Housatonic River, Connecticut, Northeast Utilities Service Company - Project and Design Engineer responsible for design and specification of a 5.8 MW single unit expansion. Responsibilities included design of modifications to the existing canal and forebay, intake structure, 36-foot-high counterfort forebay wall, ice and trash sluiceway, 8-foot-high-by-30-foot-wide hydraulic sluice gate support structure and energy dissipation structure, powerhouse structural and architectural details, contract specifications and the evaluation of turbine bids.

Bulls Bridge Unit No. 7, Housatonic River, Connecticut, Northeast Utilities Service - Design Engineer responsible for project layout, canal modifications, penstock layout and analysis,

powerhouse layout, and turbine/generation specifications for a single-unit expansion.

Ellsworth Hydroelectric Project - Graham Lake Dam Remedial Measures Project, Union River, Maine, Bangor Hydro-Electric Company - The remedial measures project was initiated due to low slope stability factors of safety for this earthen storage dam. Mr. Nelson served as Project Engineer providing engineering assistance in the project and in the preparation of the U.S. Army Corps of Engineers 404 Permit Application by authoring sections of the application and calculating construction fill quantities and wetland surface areas affected by construction. DE&S also conducted feasibility studies to determine cost-effective approaches to remediation for wetland impacts. Mr. Nelson served with a team of Biologists and Scientists, as Project Engineer responsible for the field survey, layout, design, specification, and construction monitoring of the wetland creation (mitigation) project. The project involved the excavation, filling, and grading to create a wetland in an upland area with consideration of site hydrology and protection of adjacent wetlands. The project was developed and constructed in compliance with the Maine Department of Environmental Protection Wetland Protection Rules (CH 310) and the Federal Clean Water Act Section 404(b)(1).

Route 9 Wetland Mitigation, Route 9, in Eastern Maine, Maine Department of Transportation - Project Engineer for design and specification of wetland creation sites as mitigation for project construction impacts of MDOT realignment of Route 9. Responsibilities included coordination of survey, design, site drawings, and specifications.

New England Wind Energy Project, Kibby and Skinner Townships, Maine, Kenetech Windpower, Inc. - Engineer assisting in the project permit application to the Maine Land Use Regulatory Commission. The project involved the planned phased development of over 500 acres of hilly and mountainous terrain along the International Boundary Mountains in northwest Maine. A total project capacity of 250 MW was planned in phases using 750 windplants over 1,300 acres. A total of 30.5 miles of access roads would be constructed to access the wind turbines. Responsibilities include the development of project design criteria, development of an access road network, preliminary layout of windplants and construction laydown areas, engineering support for permit application, and engineering support for transmission line route location and design, GPS survey

locations of preliminary micro-siting of wind turbines, and coordination of survey sub-consultants.

James River Paper Company, Fall Shutdown Scheduling Project, Old Town, Maine - Project Engineer assisting James River Paper Company (JRC) to prepare for the fall 1992 ten-day, mill-wide maintenance shutdown. JRC uses mill-wide total shutdowns to perform maintenance and some capital work. Mr. Nelson assisted JRC by scheduling the mill maintenance and operations work using a critical path resource scheduling computer program. A resource-levelized critical path schedule was produced and maintained during the shutdown, which resulted in substantial contract labor expense savings and a greater utilization of mill maintenance personnel. The schedule was designed and formatted to allow the mill foremen to use it in the workplace.

SPCC Project, Bangor Hydro-Electric Company, Bangor, Maine - Project Engineer for the Spill Prevention, Control, and Countermeasures Plan for two 46 kV substations under EPA legislation 40 CFR, Part 112. Responsibilities included review of EPA regulations, site inspections, hypothetical failure and oil spill analysis, development of secondary containment options to prevent contamination of adjacent lands, and contributions to reports.

Howland Hydroelectric Project, Piscataquis River, Howland Maine, Bangor Hydro-Electric Company - Engineer responsible for the coordination of the site studies for the Howland Project. The Project was a study to determine the extent of the existing impoundment limits. Mr. Nelson's responsibilities included coordination of the survey consultant establishing horizontal and vertical control along the impoundment and included performing a field survey of river cross sections along a five-mile reach of the Piscataquis River.

Augusta Hydroelectric Project, Engineering Studies, Kennebec River, Augusta Maine, Edwards Manufacturing Company - Engineer responsible for the hydraulic analyses of 17.4 miles of river above the Edwards Dam, site inspector for soils investigation program. The project featured hydraulic and engineering studies in support of an application to FERC for relicensing of the Augusta Hydroelectric Project. Mr. Nelson created a backwater model to establish the limits of the impoundment, characterize flow in critical habitat areas, and to assess impacts to upstream riverbank structures from various potential changes to the operating headwater elevations. A tractive force technique was used to determine the

potential for embankment soils erosion at archaeological sites along the reservoir. Mr. Nelson also performed layout and cost estimates for fish passage feasibility studies and layout and cost estimates for a feasibility study of a 20 MW expansion. Site engineering services included drill inspection for the soils investigation program involving field-testing of clays and soft strata and bedrock packer tests.

Ellsworth Hydroelectric Project, Ellsworth Forebay Modifications, Union River, Maine, Bangor Hydro-Electric Company - Engineer responsible for design review of concrete and steel structures for the forebay modifications. The project involved the replacement of Review included concrete walls, piers, and steel intake gates for the new intake structure and stability analysis. Also responsible for final layout of the modification project which included layout and dimensioning of the concrete intake and the three steel penstocks.

Milford Hydroelectric Project, Safety Cable Project, Penobscot River, Bangor Hydro-Electric Company - Project Engineer responsible for design of horizontal lifelines for the Milford Hydroelectric Project, and investigations for the Veazie, Stillwater, and Orono projects. BHE had concerns for worker safety while maintenance workers were working on the crest repairing or raising flashboards. The safety cable project involves the design of a high-tensioned cable A lifeline at (13-inch-diameter) to be constructed above the Milford Dam to provide fall protection, fall prevention, and fall immersion protection for flashboard maintenance crews in all weather conditions, conforming to OSHA regulations. The cable span was 1,000 feet, designed for two-workers simultaneously falling, with consideration for flood levels and cable deflection, producing a total cable load of 84,000 pounds. Grounding and anchorage were a concern, given the condition of the abutment concrete, resulting in a large support structure and grouted, post-tensioned anchorage. Special consideration was given to the involvement of maintenance crews in the development of concepts and choice of lanyard equipment.

Baldwin Hydroelectric Project, Connecticut River, Clarksville and Pittsburgh, New Hampshire, Baldwin Hydroelectric Corporation - Engineer responsible for site survey and field layout, and construction monitoring of the project. The project was a new development in the upper Connecticut river, consisting of 4,400-foot-long power canal, new concrete dam, and 4.4 MW powerhouse. Mr. Nelson served as owner's representative and field engineer for the Phase I excavation of the power canal where his duties included field layout, grading, inspection, measurement for

payment of the construction project, and preparation of the monthly construction reports for the FERC.

Lyons Falls Hydroelectric Project,, Kosterville Hydroelectric Development, Moose River, Lyons Falls, New York., Lyons Falls Pulp and Paper Company, Inc. - Engineer responsible for site layout, cofferdam design, and dam design for the maintenance and rehabilitation project of the Kosterville Development on the Moose River in Lyons Falls. Responsibilities also included removal of a 290-foot-long existing timber crib dam, flood protection of the powerhouse and site, demolition and replacement of the powerhouse structure, access road, site drainage, engineering support for licensing and permit applications, and construction reports to FERC.

Nelson Engineering, Tilton, New Hampshire - Responsibilities include Office Manager, Project Engineer, Survey Crew Chief, and Marketing for a new branch office. Typical work included subdivision plans, field surveys, and AutoCAD drafting.

Benton Falls Hydroelectric Project, Sebasticook River, Benton Maine, Hydra-Co. Enterprises, Inc - Design Engineer responsible for preliminary site survey, coordination of survey subconsultant, feasibility study, and final layout of new dam and 3.7 MW powerhouse on the Sebasticook River. Responsibilities included the layout and review of alternatives, cost estimates, and energy estimates. Mr. Nelson also provided engineering and survey support to the evaluation of aquatic habitat impacts. Mr. Nelson was also responsible for the design of an earthen embankment and analysis and design of the concrete dam and intake structures.

Augusta Hydroelectric Project, Kennebec River, Augusta Maine, Edwards Manufacturing Company - Engineer responsible for a feasibility assessment of the hydroelectric redevelopment of a 900-foot-long timber crib dam on the Kennebec River using two bulb turbines rated at 11.6 MW.

Moretown Hydroelectric Project, Moreton Redevelopment, Mad River, Moreton Vermont, Washington Electric Generation & Transmission Cooperative, Inc. - Design Engineer responsible for site layout, site survey, preparation of construction cost estimates, turbine-generator specification and evaluation, structural design of steel penstock, intake structure, hinged flashboards, stability analysis and improvements to existing dam.

Wrightsville Hydroelectric Project, Winnoski River, Wrightsville Vermont, Washington Electric Cooperative, Inc. - Design Engineer responsible for layout, cost estimates, site survey, penstock design, turbine selection, energy estimates, preliminary and final powerhouse design, and construction status reports to FERC for a three-unit 1.0 MW hydroelectric development.

Errol Dam Project, Androscoggin River, Errol New Hampshire Public Service Company of New Hampshire - Engineer responsible for the stability analysis of an existing timber crib dam for FERC Part 12 Inspection.

Jay Dam Project, Androscoggin River, Jay Maine, International Paper Company - Engineer responsible for stability analysis of existing dam for FERC Part 12 Safety Inspection.

Passumpic Station Hydroelectric Project, Passumpsic River Vermont, Central Vermont Public Service - Project Engineer responsible for design of 20-foot-high replacement forebay wall, sluice gates, station repairs, gate operators, and shop drawing review.

East Barnet Hydroelectric Project, Passumpsic River Vermont, Central Vermont Public Service - Design Engineer responsible for site layout, cost estimates, structural design and shop drawing review for a 15-foot-high concrete dam with a 6-foot-high hinged flashboard system.

Frog Hollow Project, Central Vermont Public Service, Rutland, Vermont - Design Engineer responsible for site layout, preliminary layout and design of penstock, powerhouse and tailrace, cost estimates, energy estimates and feasibility study.

Shelburne Station, Androscoggin River, Shelburne New Hampshire, James River Corporation - Project and Design Engineer responsible for design of three 6-foot-by-12-foot-deep sluice gates, guides, guide heaters, operators and operator support assemblies. Also responsible for the design of repairs to the powerhouse substructure piers and gate support piers.

Specialized Training and Certifications

RALPH D. NELSON, JR., P.E.

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IFIM Training - National Biological Service, Ft. Collins, Co. - 1994

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