

Urna Vitae LLC

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Overview

Urna Vitae LLC is my one-person consulting company that draws on my over 30 years' experience in bioprocessing and biorefining R & D, manufacturing operations and manufacturing plant engineering design. My hands-on bench, pilot plant, manufacturing plant, and architectural and engineering companies experience allows me to assist clients with all aspects of the commercialization of a new process.

I have been a lead process engineer or a consultant for half a dozen \$100 million plus new or expanded manufacturing plant projects and have developed processes or plant designs for fine chemicals, food and animal feed products, biofuels and biopesticides. My expertise includes large-scale bacterial and fungal fermentations, organic and amino acids, industrial enzymes, corn refining, and biotransformations.

Services Offered

I provide a range of services to the bioprocessing and biorefining industries, from high-level advice to roll-up-the-sleeves detailed process and plant design document development and review. These include:

- Comprehensive business plan development
- Due diligence and technology evaluation
- Process simulation cost models to support process development, site selection, and plant design
- Manufacturing plant design with a client's architectural and engineering company
- Process automation design
- Existing process troubleshooting and optimization

Credentials

B.S. Biochemistry, The Pennsylvania State University

M.S. Chemical Engineering, University of Minnesota

Typical Project Experience

More details on these and other projects are available at urnavitae.com

Valent BioSciences LLC – Biopesticides Plant Modeling – Osage, Iowa

Consultant contracted to develop a set of detailed SuperPro Designer® and SchedulePro® manufacturing process simulation models for *Bacillus thuringiensis* (Bt) and related biopesticides and aminoethoxyvinylglycine (AVG) from *Streptomyces* sp. fermentation. Models showed equipment utilization and predicted raw material and utility consumption and wastewater generation over time to determine the optimum sizes of storage vessels and utility equipment. Models also provided for labor utilization and all operating and capital costs to allow for a detailed understanding of manufacturing costs and optimization of each process.

Confidential Client – Plant Growth Regulator Manufacturing Capacity Increase

Consultant contracted to assist client with increasing manufacturing capacity of a plant growth regulator made by fermentation. Developed design basis and pro forma production plan based on projected future year sales. Developed detailed fermentation, harvest and recovery SuperPro Designer® simulation models of the existing process and determined the maximum capacity of each piece of equipment. Used simulation models to demonstrate the downstream processing train had sufficient capacity with addition of only a single larger filter/dryer. Developed scope of work for overall project including addition of raw materials storage, fermentor and filter/dryer and required process automation changes to integrate new equipment into the existing plant.

Valent BioSciences LLC – Biorational Research Center – Libertyville, Illinois

Consultant on the design of a \$28 million, 80,000 SF research complex containing laboratories, pilot plants, greenhouses and supporting facilities for development of biorational pesticides. Coordinated the design of the greenhouses and headhouse with users, architects, engineers and the greenhouse manufacturer. Reviewed and commented on design documents, including fermentation and downstream processing laboratory and pilot plant areas.

Valent BioSciences Corporation – Greenfield Biopesticides Plant – Osage, Iowa

Consultant/Lead Process Engineer for preliminary and detailed design of \$150 million greenfield biopesticides fermentation plant in Iowa. Developed block flow and process flow diagrams and process design basis. Reviewed and provided comments on material & energy balance, P&IDs, piping specifications, equipment specifications, instrument specifications, shop drawings, and 3-dimensional equipment and piping models. Actively involved in selection of distributed control system vendor and development of plant process control systems. Recommended cost savings and process improvement opportunities.

BioAmber Inc. – Brownfield Bio-Succinic Acid Plant – Sarnia, Ontario

Fermentation Consultant for preliminary design of \$120 million brownfield succinic acid fermentation plant in Ontario. Key member of core engineering team that developed conceptual design of second generation plant. Reviewed and guided development of process flow diagrams and equipment specifications. Recommended fermentation and recovery process technologies based on current industry practices. Reviewed and commented on order of magnitude cost estimate and recommended cost savings opportunities. Provided guidance on regulatory approach to manufacturing plant design and operation.

Confidential Client – Greenfield Amino Acid Fermentation Plant – Iowa

Lead Process Engineer for project to translate a preliminary European design for a \$100 million greenfield amino acid fermentation plant to a Midwestern US location. Reviewed and commented on block flow and process flow diagrams and equipment specifications. Developed recommendations for \$25 million in value engineering opportunities to reach client's target budget. Obtained US pricing on major equipment and part of estimating team for US preliminary total installed cost estimate.

Novozymes Biologicals, Inc. – Solid State Fermentor – Salem, Virginia

Project Engineer for conceptual design and preliminary cost estimate for a novel solid state fermentor to manufacture active fungal and bacterial culture products. Developed process flow diagram, material and energy balance, general arrangement drawings and preliminary equipment specifications. Obtained equipment pricing and assembled cost estimate and final report to client.

Cargill, Incorporated – Citric Acid Evaporator Expansion – Eddyville, Iowa

Project Engineer/Lead Process Engineer for detailed engineering project to add capacity to a citric acid mechanical vapor recompression evaporator. Responsible for developing

P&IDs, hydraulic calculations, and equipment specifications. Coordinated activities of piping, mechanical, and structural design team.

Cargill, Incorporated – Lactic Acid Fermentation Process Modifications – Blair, Nebraska

Lead Process Engineer for project to modify fermentation plant that makes lactic acid for biodegradable polymers. The project included new fermentation air compressors and fermentor modifications. Responsible for coordinating design with the client and developing P&IDs, hydraulic and thermal calculations and equipment specifications.

Cargill, Incorporated – Corn Oil Refinery Upgrades – Memphis, Tennessee

Lead Process Engineer for preliminary engineering project to install a new corn oil deodorizer. Developed a detailed process simulation model of the corn oil refining process and preliminary P&IDs.

Abengoa Bioenergy New Technologies, Inc. – Starch/Cellulosic Ethanol Plant – Hugoton, Kansas

Estimator for an FEL2 +/- 20% total installed cost estimate for a greenfield ethanol plant. Plant design was a combination of a 120 MM gallon per year corn or milo starch to ethanol plant with a 10 MM gallon per year biomass to ethanol demonstration plant. Coordinated development of equipment, line, and valve lists and development of material take-offs. Developed conceptual designs of structures for structural material take-offs. Estimated material quantities and costs and assembled overall cost estimate.

Cargill, Incorporated – Wet Mill Expansion – Blair, Nebraska

Lead Process Engineer for the development of a preliminary engineering package and total installed cost estimate for a \$150 million wet mill plant expansion. The project included new corn receiving, steeping, evaporation, and milling equipment and alternative starch liquefaction and saccharification technology for ethanol production. The project also included a preliminary design for expansion of boiler capacity using electric boilers as an alternative to natural gas-fired boilers. Responsible for developing process flow diagrams, P&IDs, hydraulic and thermal calculations, equipment specifications and data sheets, and obtaining budgetary quotes from vendors. Developed preliminary equipment general arrangement drawings. Proposed and evaluated alternative design options to maximize utilization of existing equipment and minimize additional capital investment.

Cargill, Incorporated – Wet Mill Expansion – Blair, Nebraska

Lead Process Engineer for the \$140 million wet mill portion of a 110 MM gallon per year ethanol plant expansion. The project included new corn receiving, steeping, milling, evaporation and drying equipment. Responsible for coordinating design with the client and developing P&IDs, hydraulic and thermal calculations, equipment specifications, and equipment layouts. Prepared and evaluated equipment and construction bid packages and led on-site piping tie-in design team.

Covance Biotechnology Services, Inc. – Biopharmaceutical Manufacturing Plant – Research Triangle Park, North Carolina

Director of Technical Services group responsible for transferring recombinant microbial fermentation and cell culture client processes into a phase III/commercial contract biopharmaceutical manufacturing facility. The multi-product facility included fermentation and cell culture production, biomass recovery, protein purification, and API bulk filling. Led group of scientists and engineers that developed design basis documents, process flow diagrams, P&IDs, raw material specifications, equipment specifications, and standard operating procedures. Developed overall technology transfer project schedules including plant modifications and expansions necessary to accommodate client processes. Prepared manufacturing cost estimates and proposals.

Energy BioSystems Corporation – Diesel Biodesulfurization Plant – The Woodlands, Texas

Manager of Process Development group responsible for developing a conceptual design and preliminary cost estimate for a first of a kind diesel biodesulfurization plant. Process included biocatalyst production by fermentation, biotransformation using whole-cell catalysts, recovery of sulfinate byproducts for use in detergents, and dewatering of the desulfurized diesel. Prepared process flow diagrams, specified equipment, obtained budgetary quotations and assembled operating and capital cost estimates. Used process simulation software to quickly and efficiently evaluate operating and capital costs of alternative designs and guide research and development efforts.

Energy BioSystems Corporation – Diesel Biodesulfurization Pilot Plant – The Woodlands, Texas

Project Manager responsible for developing a preliminary capital cost estimate for a diesel biodesulfurization pilot plant. Responsible for developing process flow diagrams, P&IDs, and equipment specifications. Sourced equipment and assembled capital cost estimate and construction schedule. Coordinated design activities with building facilities manager and

local municipality to assure compliance with all local, state, and federal health, safety, and environmental regulations.

Novo Nordisk BioChem North America, Inc. – Manufacturing Scheduling – Franklinton, North Carolina

Project Manager of international project team charged with selecting a manufacturing planning and scheduling software package to be used by all Novo Nordisk multi-product enzyme manufacturing plants worldwide. Compiled functional requirements list from project stakeholders and identified critical functional requirements. Compiled master list of potential suppliers and screened them against critical functional requirements. Met with vendors and arranged performance trials. Developed and maintained project schedule.

Novo Nordisk BioChem North America, Inc. – Industrial Enzyme Plant Expansion – Franklinton, North Carolina

Senior Process Engineer for the design and construction of a \$30 million multi-product industrial enzyme plant expansion. The project included addition of seed and production fermentors to an existing building. Reviewed P&IDs and general arrangement drawings and designed process control strategies. Member of fermentation start-up team responsible for performing loop tests, water batches, sterility tests and plant start-up.

Novo Nordisk BioChem North America, Inc. – Industrial Enzyme Plant – Franklinton, North Carolina

Senior Process Engineer for the design and construction of a \$60 million multi-product industrial enzyme plant expansion. The project included installation of a new fermentation building with seed and production fermentors, harvest chillers, batch mixing tanks, and sterile nutrient dosing tanks as well as laboratory and office facilities. Responsibilities included review of P&IDs and general arrangement drawings, design of process control strategies, preparation of standard and emergency operating procedures, loop tests, water batches, sterility tests, and plant start-up in collaboration with the project automation team.

Novo Nordisk BioChem North America, Inc. – Cellulase Manufacturing – Franklinton, North Carolina

Senior Process Engineer for the transfer of cellulase fermentation manufacturing into the Franklinton, North Carolina enzyme manufacturing plant. Responsible for developing the overall project schedule including capital projects to modify the existing plant. Developed batch recipes, raw material specifications, bills of materials, and process control strategies and trained plant operations personnel. Supervised product start-up and manufacturing.

Novo Nordisk BioChem North America, Inc. – Lipase Manufacturing – Franklinton, North Carolina

Senior Process Engineer for the transfer of a new lipase product from the Novo Nordisk pilot plant in Denmark to fermentation manufacturing in Franklinton, North Carolina. Responsible for developing the overall project schedule including capital projects to modify the existing plant. Developed batch recipes, raw material specifications, bills of materials, and process control strategies and trained plant operations personnel. Supervised product start-up and manufacturing.

Novo Nordisk BioChem North America, Inc. – Amylase Manufacturing – Franklinton, North Carolina

Senior Process Engineer for the transfer of amylase fermentation manufacturing from a Danish manufacturing plant into the Franklinton, North Carolina plant. Responsible for translating recipes and raw material specifications, developing bills of materials, programming the process control system, and training operations personnel.

Bio-Technical Resources – Recombinant Human Serum Albumin – Manitowoc, Wisconsin

Research Engineer for the due diligence evaluation of a Delta Biotechnology Ltd (Nottingham, UK) fermentation process to manufacture recombinant human serum albumin in yeast. Client contracted with Bio-Technical Resources to evaluate the technical and economic feasibility of the Delta Biotechnology process. Reviewed Delta's research and development results and developed an operating and capital cost model to estimate manufacturing costs for the fermentation, recovery, and purification processes.

Bio-Technical Resources – meta-Hydroxyphenylacetylene – Manitowoc, Wisconsin

Research Engineer for the development of a fermentation biotransformation process to produce a high performance polymer intermediate with applications in stealth technology for the US Air Force. Developed and piloted the manufacturing process and prepared an operating and capital cost model to guide research and development efforts.

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