LONG INTERNATIONAL

# WILLIAM L. REEVES, P.E.

William L. Reeves is a Senior Principal with Long International and has over 45 years of U.S. and international consulting and project execution experience involving the design, engineering, procurement, project management, construction, construction management, start-up, and commissioning of industrial and utility steam and power cogeneration systems. Mr. Reeves has experience with construction contract and change order dispute analysis and resolution, cost and schedule control, and arbitration/litigation support and expert witness report and testimony. His project experience includes steam and power generation projects firing conventional fossil fuels, biomass, and waste fuels utilizing conventional and emerging technologies including Low $NO_x$ and Ultra Low $NO_x$ burners, pulverized coal systems, stokers, bubbling fluidized beds, circulating fluidized beds, and several first-of-a-kind new technologies. Mr. Reeves also has experience with fired and waste heat recovery steam generators operating from low pressure to supercritical and steam temperatures up to 1000 °F, combustion turbine generators, steam turbine generators, natural gas and oil fired engine generators, material handling systems, water treatment systems and instrumentation and controls. Mr. Reeves has provided expert testimony in court and has presented and published numerous articles on the subjects of the design, engineering, procurement, construction, and operation of steam and power systems.

## EDUCATION

B.S., Chemical Engineering, University of Akron, 1973

## PROFESSIONAL REGISTRATIONS

Registered Professional Engineer, Ohio (No. 47903), Tennessee (No. 2970)
and North Carolina (No. 009399)

## PROFESSIONAL AFFILIATIONS

American Boiler Manufacturers Association

## TECHNICAL EXPERIENCE

Representative U.S. and international technical experience includes:

- Development of proposals for the complete engineering, procurement, construction, start-up, and commissioning of steam and power projects including development of construction plans, schedule, and firm cost estimates.
- Development and analysis of contract guarantees including potential bonus/penalty liquidated damage value assignment, performance buy down parameters, and required make good guarantees.
- Development and analysis of project risk control matrix.
- Design, specification, request for bid, bid analysis, procurement, and issuance of purchase orders for the procurement of steam and power generation major equipment.
- Final development and negotiation of construction contracts for subcontractors for the construction of steam and power projects.

- Steam and power plant design process engineering including development of plant design basis, heat and mass balances diagrams, major equipment design and predicted performance, process flow diagrams, piping and instrumentation diagram development, motor list and parasitic power calculation, instrument list, and material take-offs.
- Development of project execution plans including project management plans and procedures.
- Project cost and schedule control and management of request for information and change orders.
- Final negotiation of cost disputes and contract close-out of steam and power projects.
- HAZOP reviews and safety audits.
- Construction claims preparation, analysis, defense, and negotiation of settlements.
- Deposition and expert witness report and testimony.
- CPM schedule analysis of the impacts of delays, disruption, acceleration, and loss of labor productivity.
- Direct and indirect damage and liquidated damage assessments.
- Identification and evaluation of major engineering, equipment performance, and construction problems and their cause/effect relationship on cost and schedule overruns and liquidated damage bonus/penalty effect.
- Explosion and major incident failure investigation and cause determination and recommended modifications in the design and/or operating procedures to mitigate the potential for reoccurrence.
- Technical and commercial due diligence studies for prospective buyers of steam and power generation assets.

**PROJECT EXPERIENCE**

Having been in responsible charge of the development, design, engineering, procurement, construction, start-up, and commissioning of steam, power, and utility projects for over 45 years, Mr. Reeves has comprehensive steam and power project experience, which includes, but is not limited to, the following:

- Provided technical expert witness investigation, report, and testimony for a contractor involved in a dispute with a consortium partner for the engineering, procurement, and construction (EPC) of a supercritical power plant facility located in Saudi Arabia.
- Provided expert witness investigation and report for contractor in a dispute with an owner regarding contract specifications for biomass fuel and effects on project performance due to owner lack of conformance with the contract requirements to provide biomass fuel as specified in the contract.
- Provided investigation, expert witness report, deposition, and trial testimony for a contractor in dispute with an owner regarding a breach of contract and alleged technical deficiencies in the contractor's work.
- Start-up and commissioning of a 2600 MWe pulverized coal fired power generation station consisting of two 1300 MWe supercritical steam generators and steam turbine generators operating at 3500 psig and 1000 °F steam conditions at the throttle.
- Start-up and commissioning of a 400 ton/day municipal solid waste incineration plant utilizing mass burn technology to provide steam and chilled water for downtown buildings through an underground utilities loop.
- Design, engineering, procurement, construction management, start-up, and commissioning for a 1,100,000 pph coal, petroleum coke, and natural gas-fired facility. The facility included a field-erected circulating fluid bed (CFB) fired steam generator designed to provide 650 psig/750 °F superheated steam to existing steam turbine generators. The facility also included complete coal and pet coke material

receiving, storage and handling systems, ash storage and handling systems, limestone receiving, storage and handling systems, boiler feedwater pumps, Selective Non-Catalytic Reduction (SNCR) system, air emission control system, continuous emission monitoring system, Foxboro distributed control system, and a new 250-foot dual-wall stack. This system was housed in a new engineered structural steel building.

- Engineering for the conversion of the two existing 27 MWe pulverized coal fired utility boilers to a biomass fired system. The goal of this project was to convert two (2) identical 1950 vintage Riley wall-fired coal boilers to stoker fired biomass units with a total capacity of 47 MWe. Modifications to the system included replacing the lower furnace and ash hoppers with a larger furnace, over-fire air system, and installation of a new water-cooled vibrating grate stoker system. The upgrade also required replacement of all the existing fans, air heaters, and economizers; a complete new fuel receiving, handling, storage, and reclaim system, air quality control systems, and upgrades for the electrical and controls systems.
- Design and engineering for a 42 MWe combined heat and power (CHP) generation facility firing woody biomass. The circulating fluidized bed (CFB) fired steam generator produced 710,000 pph of steam at 1450 psig and 951 °F. System included all required waterside auxiliaries, fuel handling, receiving, storage, and reclaim system, and SNCR and fabric filter baghouse for air pollution control.
- Design, engineering, procurement, construction, start-up, and commissioning for a 13.5 MWe combined cycle natural gas-fired cogeneration facility. This facility included the installation of a new 7.5 MWe Solar combustion turbine coupled to a new fully fired 170,000 pph steam capacity heat recovery steam generator designed to produce 450 psig/600 °F superheated steam. The project also included the controls upgrade of an existing 6 MWe steam turbine that was driven by steam from the new HRSG. The entire powerhouse including the new equipment, the existing steam turbine, and a 200,000 pph natural gas and #6 fuel oil back-up boiler that were upgraded to a new ABB/Bailey distributed control system.
- Design, engineering, procurement, construction, start-up, and commissioning for a first-of-a-kind facility that processed 1300 tons/day of 60% moisture content paper mill sludge from local paper mills. The sludge was received, handled, dried, and combusted along with natural gas or coal to produce power, process steam, and glass aggregate as sellable products. The markets for the glass aggregate included sandblasting grit, abrasives, roofing shingle granules, asphalt aggregate, chip seal aggregate, and decorative landscaping. This facility included: one B&W 230,000 pph steam generator with two special design cyclone furnaces, extensive material handling equipment, complete sludge drying system, and state-of-the-art emission controls including SNCR and fabric filter baghouse. This facility received POWER Magazine's 1999 Power Plant of the Year Award.
- Design, engineering, procurement, construction, start-up, and commissioning for repowering of a coal fired CHP facility. Project included a new steam generation facility capable of producing 765,000 pph of steam at 1430 psig and 900 °F including all required waterside auxiliaries, low $NO_x$ burners, FD fans and drives, PLC control system, economizers, ductwork and breeching, and stacks. The project also included the conversion of an existing 550,000 pph steam capacity combustion engineering pulverized coal fired boiler to natural gas firing and the addition of a 200,000 pph steam capacity auxiliary back-up package boiler that was complete with all required appurtenances.
- Engineering and construction management for the first commercial carbon burn-out (CBO) facility built in the United States. This facility utilized patented technology developed to reduce the high carbon content of fly ash resulting from low $NO_x$ burner conversion of pulverized coal-fired utility boilers. The heat recovered from the CBO process resulted in an improvement to the utility boiler heat rate. The CBO plant processed the fly ash in an efficient manner to reduce the carbon content and provide a superior additive product for concrete. This facility converted over 100,000 tons per year of high carbon fly ash into a concrete additive product and recovered over 50 mmbtus per hour of thermal energy that was

injected into the host utility heater cycle. Developed the necessary engineering and construction documents from the process parameters developed by the technology owner.

- Design, engineering, procurement, and construction of three additional CBO facilities each converting between 200,000-300,000 tons per year of 15-20% carbon content fly ash into less than 2% carbon content concrete additive. These systems included specially designed bubbling fluidized bed combustors, high temperature flue gas and solids to water heat exchangers, and fabric filter collectors for material recovery. The marketable ash was pneumatically conveyed to 40,000-ton capacity loadout storage domes for storage and later reclaim to loadout silos.
- Provided the design/build demolition of an entire power plant including two 20 MW GE LM2500 gas turbines and one 10 MW steam turbine, Vogt HRSG's, gas compressors, complete water treatment system, electrical system, and Bailey DCS instrumentation/controls. This facility was relocated to a new site in Mexico. This equipment was originally installed in an expansion of an existing steam plant which provided district heating. All work had to be carefully coordinated and performed without interrupting the continuous operation of the existing steam power plant. Since all equipment was to be sold for reuse and installation, extreme care was required in demolition and special packaging of the equipment for shipment.
- Performed all the engineering and construction management services associated with the installation of a new anhydrous ammonia-based SNCR system for a 300 MWe pulverized coal-fired power generation unit. The project consisted of equipment specification and procurement, integration into the existing utility, structural steel design, piping design, electrical design, controls coordination and start-up. The engineering included development of all major equipment and construction bid packages and evaluation and recommendation of selected vendors.
- Design, engineering, procurement, construction, start-up, and commissioning of a 440,000 pph stoker fired steam generator operating at 1500 psig and 1000 °F steam conditions. Project included a complete biomass receiving, storage, handling, and reclaim system, and a state-of-the-art air quality control system consisting of an electrostatic precipitator, SCR/CO catalyst, trona injection, and wet scrubber.
- Design, engineering, procurement, construction, start-up, and commissioning for a new 1,885 gpm demineralized water treatment facility to convert river water to ultra-pure water for use in the high pressure boilers and facility process. This system included the following equipment: flash mixer/ flocculator, clarifier, pretreatment chemical dosing system, gravity filters, clearwell, strong acid cation exchangers, decarbonator, strong base anion exchangers, resin regeneration systems, neutralization system, 50,000-gallon demineralized water storage tank, feedwater heat exchangers, condensate return pumps, 1,250,000 pph deaerator, deaerator transfer pumps, controls system, building, and all required auxiliaries for a complete operational system.
- Design, engineering, procurement, construction, start-up, and commissioning for a multi-fuel conversion and repowering project. A 450,000 CFB fired steam generator was converted to multi-fuel capability firing coal, biomass, and paper mill sludge providing steam to a 45 MWe steam turbine generator. The system included replacement of the air heater and mechanical collector, installation of a new economizer, and Foxboro Distributed Control System (DCS) modifications including new processors, I/O capability, and programming. The project included a new 100,000 pph package boiler which included a low $NO_x$ burner, FD Fan, economizer, breeching and stack, burner management system (BMS), continuous emissions monitoring system (CEMS), foundations, structural steel, piping and valves, insulation and lagging, and instrumentation and controls.
- Engineering for the complete new installation of two bubbling fluidized bed boiler systems firing biomass to cogenerate process steam and power. The project included two bubbling fluidized bed boilers and a nominal 20 MWe steam turbine generator. The facility design included complete scope of supply for a

green-field operating cogeneration facility consisting of site work; concrete; foundations; buildings; structural steel; waterside auxiliaries; water treatment; material handling and storage bins for biomass, ash, and limestone; stack; distribution and plant piping; electrical, instrumentation and distributed control system; electrical including power distribution and utility interconnects; and other miscellaneous requirements.

- Design, engineering, procurement, construction, start-up, and commissioning for the conversion of an existing recovery boiler to a bubbling fluidized bed boiler firing tire derived fuel (TDF), wood waste, and paper mill sludge. This system included: one bubbling fluidized bed boiler designed to produce 450,000 pph of steam at 850 psig and 825F, an SNCR $NO_x$ reduction system; fuel handling systems for the sludge, wood waste, and TDF; sand feed and reclaim system; ash handling system; and a new distributed control system. The unit fed an existing 25 MWe steam turbine generator.
- Design, engineering, procurement, construction, start-up, and commissioning for a new 150,000 pph steam capacity, coal-fired steam plant designed for future cogeneration. The project included a 150,000 pph boiler designed for 750 psig operation, utilizing a traveling grate spreader stoker. Balance of plant equipment included all waterside auxiliaries, fans and drives, baghouse, structural steel, foundations, electrical system, and instrumentation and controls.
- Design, engineering, procurement, construction, start-up, and commissioning for the conversion of a 100,000 pph steam capacity B&W pulverized coal-fired boiler to a pulverized wood-fired boiler. Sawmill waste was received from surrounding sawmills and dried in a Cascade Dryer System to minus 10% moisture and then pulverized to minus 1/16" before being pneumatically conveyed to two suspension burners. The dryer utilized the boiler flue gas for the necessary heat for drying.
- Design, engineering, procurement, construction, start-up, and commissioning for an ash handling and storage system on a large utility station. This system included: two pneumatic ash handling systems (one for precipitator unloading and one for transfer to an existing loadout silo) with a 1000-ton capacity storage silo including controls and piping. The system design flow rate was 25 tons/hour.
- Design and preliminary engineering for a new facility to receive, dry, and pelletize virgin wood producing 200,000 ton per year of wood pellets that were to be used in the European heating and power generation markets. The engineering included specification and recommendation of all major system components, assisting in the application of the environmental permits, and development of the facility site layout. The design included a wood fired system to provide heat for the biomass dryer required in the pelletizing operation.
- Design, engineering, procurement, construction, start-up, and commissioning for a new 75,000 pph steam capacity steam generator operating at 215 psig and a total steam temperature of 525 °F when firing coke oven gas and/or natural gas. This facility included all auxiliary equipment including a new building, distribution piping modifications, waterside auxiliaries, emergency diesel generator, distributed control system, and two large air compressors for supply to the boiler house and other parts of the plant. All equipment was designed for operation in a corrosive steel mill (coke oven gas) environment.
- Design and engineering for a 37 MWe wood-fired cogeneration downtown central utility facility. The facility included a field-erected wood-fired boiler designed to provide 1200 psig/950 °F superheated steam to a nominal 37 MWe steam turbine generator. A portion of the 325,000 pph of steam was utilized to provide hot water to for the Central Heating Plant. The facility also included a complete material storage and handling system, ash storage and handling system, reverse osmosis water treatment system, deaerator, boiler feedwater pumps, SNCR system, precipitator, continuous emission monitoring system, Westinghouse distributed control system, and a new 50,000-gallon capacity No. 2 fuel oil tank. This system was housed in a new engineered structural steel building on a very small downtown city center site.

- Design, engineering, procurement, construction, start-up, and commissioning for a 250,000 pph steam generation facility. This facility included one field-erected, 250,000 pph steam generator designed to produce 300 psig, 550 °F superheated steam firing natural gas or No. 2 fuel oil, along with an 800 gpm demineralized water treatment system complete with three-train anion/cation units and a condensate polishing system for total plant feedwater requirements, and complete waterside auxiliaries including a 675,000 pph deaerator, new boiler feedwater pumps for all facility boilers, and a new distributed control system for all facility boilers. This system was housed in a new three-story building.
- Design, engineering, procurement, construction, start-up, and commissioning of a new 400,000 pph natural gas fired steam generation facility. The facility included the installation of two 200,000 pph natural gas and biogas fired steam generators designed to produce 400 psig saturated steam. Auxiliaries included water softeners, reverse osmosis filtration system, deaerator, boiler feedwater pumps, blowdown heat recovery, chemical feed systems, steam coil air heaters, economizers, and DCS system.

## PROFESSIONAL EXPERIENCE

**Long International, Inc.**
*Atlanta, Georgia Area (March 2018 to Present)*

As a Senior Principal with Long International, Mr. Reeves provides a variety of services including, but not limited to, claims preparation, construction contract and change order dispute analysis, schedule delay, disruption and acceleration analyses, cost and damages analyses, and arbitration/litigation support and expert witness report and testimony.

**ESI Inc. of Tennessee**
*Atlanta, Georgia (September 1979 to March 2018)*

Mr. Reeves served as President and Chief Executive Officer of ESI, an engineering, procurement, and construction company that is the Special Forces™ of the steam and power industry. Mr. Reeves became the President and Chief Executive Officer of ESI in 1984. In this position, Mr. Reeves was responsible for short and long-range planning, development of strategic alliances, marketing, and all company business-related matters. Under his direction, ESI designed and built numerous new steam and cogeneration facilities for many Fortune 500 companies and both regulated and non-regulated electric utilities. Prior to occupying the role as President and Chief Executive Officer, Mr. Reeves joined ESI as Manager of Engineering and Construction in 1979 and became Vice President, Operations in 1982.

**I. C. Thomasson Associates, Consulting Engineers**
*Nashville, Tennessee (May 1978 to September 1979)*

Mr. Reeves worked as a Design Engineer and was involved in the design and construction of several new industrial steam plant facilities. His duties included design, specification, and selection of major equipment and development of specifications and bid documents for construction contractors.

**Babcock and Wilcox Company**
*Cincinnati, Ohio (June 1973 to May 1978)*

Mr. Reeves began his career as a Field Engineer in the Fossil Power Generation Division. As a Field Engineer, he was responsible for the start-up and operation of industrial and utility boilers and all plant-related

equipment with an emphasis on industrial and utility coal-fired and municipal solid waste-fired installations. He also performed boiler explosion investigations.

**PUBLICATIONS AND SPEAKING ENGAGEMENTS**

"Coal to Natural Gas Conversion Challenges – Part 1," *Energy Source*, March 2018.

"Package Boiler Design and Procurement Guidelines – Part 2," *Energy Source*, January 2018.

"Package Boiler Design and Procurement Guidelines – Part 1," *Energy Source*, October 2017.

"Distributed Generation," *Energy Source*, July 2017.

"Cogeneration – Once in a Lifetime Opportunity," *Energy Source*, January 2014.

"Boiler MACT Conversion or Natural Gas Conversion…This is the $64,000 Question," *Energy Source*, October 2013.

"What is My Next Energy Move?" *Energy Source*, July 2013.

"Federal EPA Finalizes Boiler MACT & GACT," *Energy Source*, April 2013.

"Designing a Successful Utility Biomass Material Handling System" with Jeffrey White, P.E., presented at 2011 Electric Power Conference.

"Biomass Conversion of 50 MW Pulverized Coal Fired Power Plant" with Brian Cloninger P.E., presented at 2010 PowerGen Conference.

"What Are My Fuel and Technology Choices?" *Energy Source*, April 2007.

"Can You Afford Not to Switch to Coal?" *Energy Source*, January 2005.

"The Federal EPA Finally Delivers on Boiler MACT Promise," *Energy Source*, October 2004.

"The Buyers Guide to Package Boiler Design – Part 5," *Energy Source*, April 2004.

"The Buyers Guide to Package Boiler Design – Part 4," *Energy Source*, January 2004.

"The Buyers Guide to Package Boiler Design – Part 3," *Energy Source*, October 2003.

"The Buyers Guide to Package Boiler Design – Part 2," *Energy Source*, July 2003.

"The Buyers Guide to Package Boiler Design – Part 1," *Energy Source*, April 2003.

"Maintaining Boiler Safety," *Plant Engineering*, April 2001.

"Turning Municipal Sewage Sludge into Construction Products" with Richard O'Conor, *Energy Source*, April 2000.

"How to Kill a Boiler," *Papermaker*, October 1998.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #10," *Energy Source*, January 1997.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #9," *Energy Source*, October 1996.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #8," *Energy Source*, July 1996.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #7," *Energy Source*, April 1996.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #6," *Energy Source*, January 1996.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #5," *Energy Source*, October 1995.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #4," *Energy Source*, July 1995.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #3," *Energy Source*, January 1995.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #2," *Energy Source*, October 1994.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Mistake #1," *Energy Source*, July 1994.

"The 10 Most Common Mistakes in Planning/Designing/Construction of Steam & Cogeneration Facilities – Introduction & Overview," *Energy Source*, April 1994.

"Secrets to Success in Wood Firing – Part 6," *Energy Source*, January 1994.

"Secrets to Success in Wood Firing – Part 5," *Energy Source*, October 1993.

"Secrets to Success in Wood Firing – Part 4," *Energy Source*, April 1993.

"Secrets to Success in Wood Firing – Part 3," *Energy Source*, October 1992.

"Secrets to Success in Wood Firing – Part 2," *Energy Source*, July 1992.

"Innovative System Saves Money and Energy for Cascades Mill," *Pulp & Paper Canada*, June 1992.

"Secrets to Success in Wood Firing – Part 1," *Energy Source*, April 1992.