

EXPERIENCE PROFILE

ROBERT E. DRYDEN, P.E.

**Owner - Power & Control Engineering
System Engineer – City and Borough of Sitka Electric Dept.**

Education

U.S. Army Nuclear Weapons-Electronics Specialist, 1969-1971
Training at Redstone Arsenal, NASA Marshal Space Flight, Sandia Laboratories
Highest Security Clearance- Top Secret, Crypto

University of Alaska, B.S., Electrical Engineering, 1972
(Combined degree with studies in electronics and electric power, electives in fluid dynamics, mechanics of materials, thermodynamics, and aerodynamics.)

Various, specialized studies in Computer Analysis of Power Systems and Cold Regions Engineering, 1973 to 1976, Computer Interface and Plant Control 1997 GE, SKM Systems analysis 2006, SKM Arc Flash Analysis 2011.

Registration

Registered Professional Engineer - Alaska, No. 4188 E since 1976.

Publications

"Distribution Conductor Economics" published by Northwest Public Power, 1978, republished by Electrical World Magazine

Experience

Mr. Dryden is a lifelong Alaskan, who has worked in construction and engineering throughout the state for 33 years. In high school and college he was active in amateur radio and worked as a highway construction surveyor, dump truck driver, State weighmaster, and concrete and asphalt inspector. As a consulting engineer, since 1972, he has completed hundreds of projects within Alaska, primarily related to the electric power industry and the fuel industry.

Mr. Dryden is currently the System Engineer for the City of Sitka Electric Department, beginning in 2003. He is in charge of the majority of engineering activities, hydro and diesel generation, transmission, distribution, control and instrumentation. This work is done directly or by directing engineering consultants. His employment with the City ends May 31, 2012.

Mr. Dryden is the owner of Power & Control Engineering, formed in 1989. Although still active, this firm ceased full time activity when the move was made to Sitka. The firm is a sole proprietorship serving the electric power industry and petroleum distribution and storage industries. His activities and clients continued from his work as a partner in Dryden & Larue, Consulting Engineers, established in 1977, and as an employee of Robert W. Retherford and Associates beginning in 1972.

Power & Control Engineering offers a broad base of experience, backed by many close associations with other engineering and construction firms. Small projects are handled directly, and larger projects are usually approached by a group of engineers, offering the best and most efficient balance of talent for the project.

Mr. Dryden has specialized in diesel generation, gas turbine generation, industrial control systems, heat recovery systems, and bulk fuel storage. His background also includes design and construction experience in substations, transmission, distribution, relaying, and control systems as well as experience in hydroelectric and steam generating plants.

Mr. Dryden was a partner in the consulting firm Dryden & LaRue, Inc. from its formation in 1977 through 1990. Dryden & LaRue, Inc. is an electrical engineering consultant to electric utilities throughout Alaska on design, master planning, analysis, and studies associated with electrical generation, transmission, and distribution in rural and urban Alaska. In November 1990 Mr. Dryden left Dryden & LaRue to continue his practice as Power & Control Engineering. Dryden & LaRue continues primarily as a Transmission & Distribution Consulting firm.

Immediately after forming Dryden & LaRue, Mr. Dryden was employed as a full time contract employee with Matanuska Electric Association. He filled the role of systems planner which included computer modeling of the entire system, preparation a \$32,000,000 loan, and many technical and troubleshooting assignments.

Prior to forming Dryden & LaRue, Mr. Dryden was employed by Robert W. Retherford Associates as a Project Engineer from 1972 until 1977, with a short break in Cordova, as Utility and City Engineer.

He has been involved with numerous projects relating to diesel power generation; transmission and distribution line design; substation design; industrial control and instrumentation; computer analysis of power systems; economic analysis and feasibility studies; waste heat recovery; power system planning; construction bid preparation, administration and management; rate design and power cost studies; and project management.

Throughout his career Mr. Dryden has offered complete services to the clients, beginning with feasibility studies, loan applications, design, permitting, contract documents, supervision of construction, hands-on start-up, troubleshooting, and closeout.

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

City of St. Paul,

1992-1998

Construction of a new power plant- 3500 kW, Six Engine Generators The plant building was 50' x 120', tilt up concrete with office, storage, mezzanine, bathroom and locker room. The exhaust system was an automated manifolded system to meet current air quality regulations. The six generation units were relocated from the old power plant while keeping the entire town in lights. The switchgear was extensively modified and much automation and metering added to the system. The plant is equipped with waste heat recovery and furnishes all the space heat for the City's shops and public works complex.

Sub consultants were utilized for design of architectural, civil and structural, and building electrical and mechanical systems. Power & Control Engineering was responsible for overall design and project management, as well as specific design of the electrical, control, and mechanical systems directly related to power generations. Mr. Dryden spent approximately 6 months on site getting the plant up and functioning.

Subconsultants -- Vector Engineering, Polar Consult (structural), Cash Barner (architects)

Project Cost \$2,500,000

Frosty Fuels, (Reeve Aleutian Airways) Cold Bay

1994-1995

Complete tank farm upgrade, storage, dispensing, truck loading, aviation fuel handling. This included the design and implementation of a PLC control system for truck and aircraft loading, as well as tank farm monitoring and alarm.

Project Cost \$3,500,000

System Studies Barrow Utilities

1995

Distribution system studies for existing conditions as well as proposed major load additions including DEW line site, line upgrades, capacitor controls, remote monitoring, metering. Assisted in implementing all these projects over subsequent years.

Generation Systems studies include future requirements, economic analysis of turbine vs. reciprocating engine prime movers, waste heat possibilities, etc. Review and tune up of relaying and controls.

Generation Addition, Barrow Utilities

1995-1996

Installation of a 6800 kW Solar Gas Turbine, and upgrade of existing plant relaying and fault protection systems. This included interface problems between governors and neutral reactor installations. Subconsultants Vector Engineering, BCG Engineering, and LCMF.

Project Cost \$2,600,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Nushagak Electric Coop., Plans and Studies 1995

Distribution system studies for long range planning and construction workplan.

Generation System studies include capacity, plant upgrades, choice of future generation options.

Nushagak Electric Coop. Cooling System Upgrade 1994-1995

Complete rebuild of cooling and waste heat recovery section of the power plant. This includes extensive modification of piping and pumping systems, addition of improved temperature controls. Purpose is to substantially improve cooling capacity of plant, temperature control precision, upgrade quantity and quality of waste heat.

Fees: \$10,000 Project Cost \$175,000

Barrow Utilities, 2 1500 kW Natural Gas Fired Generators 1994-1995

Assistance with final design issues, assisted with startup. On-going integration and technical assistance. This work was to try to find a balance between operational problems, emission requirements, maintenance issues, and the optimal lean burn system used by Cat. I eventually re-designed ignition to use a double high level spark system to prevent misfire.

P&C Fees \$20,000 Project Cost \$7,000,000

Delta Western, Juneau Tank Farm 1994 to 1995

This is a large bulk fuel tank farm located in Juneau, including containment system, 6 ea. 500,000 gallon tanks, 2 ea. 300,000 gallon tanks, full automated electronic truck loading systems with remote computer controls, safety systems controlled by central PLC system, marine terminal, pipelines, 50 x 100 foot office building and product storage facility. P&C had primary responsibility for fuel storage and handling systems as well as all electrical and electronic systems. Civil work, marine terminal, pipeline design was handled by R&M Engineers of Juneau and building and associated electrical systems were handles are architectural engineers. R. Dryden supervised startup of all systems on site.

Fees \$90,000 Construction Cost \$5,500,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Bonanza Fuel Inc. Bulk Fuel Tank Farm 1994 to 1995

This is a large bulk fuel tank farm located in Nome, including containment, 5 ea. 611,000 gallon tanks, truck loading systems, overfill controls, etc. Primary engineer on the project. LCMF did structural work. R. Dryden supervised construction and startup of all systems on site.

Fees \$100,000

Project Value \$3,300,000

In later years we added two more tanks and associated piping for another 1.2 million or so.

North Slope Borough, Dept. of Industrial Development 1993-1995

Walakpa Gasfield Generation Upgrade. This plant is unmanned, remotely operated, and powers the primary gasfield for Barrow. This project included design of a modular steel framed generator building 40 x 44, installation of three 125 kW gas, spark ignited generators, automated switchgear, SCADA control system, waste heat recovery, etc. This project also included energy management study, conversion of the heating systems at the well houses and manifold buildings. LCMF designed the modular buildings and I designed the rest. A major part of the project was arranging and supervising the transport of the four buildings by truck to Dead Horse, and then by Roligon to the remotes site where they were set on a prepared set of permafrost based piles and connected together.

Fees \$80,000

Project Value \$900,000

Naknek Electric Association 1993

Pipeline from City Dock to NEA tank farm, 1 mile, 6" steel pipe, with pig launching and catching systems, cathodic protection. This included design of system as well as negotiation of right of way.

Fees \$35,000

Construction Value \$325,000

Iliamna Electric Coop 1993

Upgrade of plant cooling, heat recovery systems, and fuel delivery systems. This included an automated speed control system for waste heat circulation pumps, automatic fan controls, and upgrade of fuel controls to include accounting for fuel use on each engine. The programmable logic controls for fuel and cooling were converted from older TI systems to Mitsubishi PLC's.

Fees \$6000

Construction Value \$35,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Akiachak Plant Upgrade 1992

Added Caterpillar 320 kW prime unit, new switchgear, waste heat recovery system.

Fees \$25,000

Construction Value \$185,000

Nome Joint Utilities (1992-1995)

Waste Heat and Cooling System Upgrade 8,000 kW City Plant. Redesigned entire plant cooling system, including two 16 cylinder EMD's and a 4400 kW 3616 Caterpillar engine. The heat recovery system was used to heat the City Water Supply system and numerous buildings near the plant.

Fuel Storage system for main plant. This is an interim fuel storage system containing 40,000 gallons in double wall tanks and enclosed in a steel dike system, complete with fill controls, alarms, etc. This was designed to guarantee security of the storage system, since it is very close to a critical river.

City Water Pressure Control System. This included design of an automatic variable speed water pumping system for the Nome water supply system to allow water use reduction in winter, response to firefighting needs, and to save pumping energy.

Fees \$50,000

Construction Value \$250,000

Marathon Oil (1992-1995)

Modification of power drilling supply system on the Steelhead Platform to accommodate 8000 hp of variable speed drives. This included specifying harmonic rated 5,000 kVA air cooled transformers, installation of transformers including seismic considerations, modification of cooling systems and bus work. System was 4000 Amp three phase at 600 volts and installed in a 15' x 25' room.

This work included installation of a solid state 2000 kVA infinitely variable power factor controller for the platform.

Additional work on Steelhead included modification of synchronizing circuits on main turbines and many misc. projects related to the power system and overall systems troubleshooting. Did some troubleshooting and study work on the Dolly Varden platform.

Estimated fees \$75,000

Project Value \$500,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Nushagak Electric Coop 1993

Tank Farm Addition 850,000 gallons with steel diking and pipe extensions.

Substation Rebuild and Upgrade. Completely rebuilt stepup substation, adding new feeder, high and low voltage bus structures, new recloser, double ended switching, two 2500 kVA transformer banks.

Estimated fees \$60,000 Project Value \$950,000

Totem Oil Products, Haines, Alaska (1990-91)

Construction of a new 3.5 million gallon tank farm facility including a marine terminal and over the road truck loading facility. The truck loading equipment is computer controlled, and was interfaced to the tank farm valve and safety systems which were controlled by programmable logic controller. A Petrovend (cardlock) system was installed to supply fuel to trucks and logging equipment. All equipment tied together for inventory and financial control of product. This project was designed in concert with Hansen Engineering(civil) and Lium Engineering(structural) of Juneau.

Est. Fees \$150,000 Est. Project Value \$2,800,000

Morse Construction Group-Everett Washington (1991-1992)

Proprietary Electronic Control system for large vertical automatic welding machine. This custom built machine is used to build large tanks with up to 1.5" thick steel plate shells. We designed the electronic and electrical controls, built the prototype system, refined the system and did the design and specifications to allow production of the equipment. The equipment has been used in many parts of the country on many large tank projects, without any failures.

Est. Fees \$37,000 Est. Project Value \$200,000

US Air Force, Site Clear (1990-91)

Upgrade of 25 MW Steam plant, upgrade and add 30 cubicles to 5 kV switchgear, add high voltage feeders, add new exciter systems to steam generators, add new frequency controls to plant. Acted as technical advisor to the prime contractor, Alcan Electric. Designed and assisted in installation of switchgear interface systems as well as general technical assistance in overall project, including on site high voltage and control changeovers, wrote procedures, operating instructions, and did as built drawings. All work was done hot, without any plant outages, not one second.

Est. Fees. \$25,000 Ext. Project Value \$4,500,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Naknek Electric Assn., Naknek (1989)

Upgrade 1.8 million gallon tank farm, adding steel diking, an impervious liner system, transfer pumping, new piping, and fuel heating systems.

Est. Fees. \$30,000 Est. Project Value \$350,000

Sand Point Electric, Sand Point (1989)

Complete Design of new power diesel power plant for Sand Point Electric. S. C. Drew & Associates acted as engineering and construction supervisor.

Fees \$40,000 Est. Project Value \$1,500,000

Kodiak Electric Association (1988)

Move and reinstall four Fairbanks-Morse generation modules, approximately 2200 kW each, including fuel system, airstart, conversion of controls to programmable controller, SCADA interface, metering, and construction of a maintenance facility. Did design, construction management, and startup.

Est. Fees: \$125,000 Est. Project Value: \$800,000

Naknek Electric Association (1984)

Installation of two Caterpillar 3516 Generators, 1135 kW each. Included removal of two English Electric units, modification of engine controls, switchgear, fuel system, cooling and waste heat recovery system.

Est. Fees: \$20,000 Est. Project Value: \$650,000

Nushagak Electric Association (1988)

Installation of one Caterpillar 3516 Generator, 1135 kW. Including modification of engine controls, switchgear, fuel system, cooling and waste heat recovery system.

Est. Fees: \$20,000 Est. Project Value: \$325,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Iliamna Newhalen Electric Coop Inc.

Installation of Unit #4 a 565 KW Caterpillar 3512 generator

Est. Fees: \$20,000 Est. Project Value: \$210,000

Southwest Region School District (1988)

Complete rebuild of two school/village power plants, including feasibility study, design, materials ordering and expediting, construction supervision and startup. The old plants were 100% stripped out. Two existing generators and one new generator re-installed, new waste heat recovery and cooling system, new switchgear, new floor, walls, lighting, etc.

Est Fees: \$25,000 Est. Project Value: \$275,000

Nome Joint Utilities, Nome 1987

Design and Engineering supervision on 3.4 million gallon fuel storage facility, truck loading, and automated pumping and control systems. This included remote control of the tank farm security systems, valving, and pumps to deliver fuel to a truck loading rack about 1 mile away and keep the power plant tanks full. This was done with a programmable logic controller through low level logic lines (telephone).

Est Fees: \$90,000 Est. Project Value \$2,200,000

Unalakleet Valley Electric Coop., Unalakleet (1986)

Design of tank farm upgrade including new diking, 180,000-gallon tank, and all permitting activities.

Est. Fees: \$12,000 Est. Project Value: \$300,000

Bristol Bay Borough, Naknek (1986)

Design of a 400 kW standby electrical and heating plant for the high school, clinic, bus barn, and future swimming pool. This includes design and implementation of a load and heat demand sensing analog computer to optimize the utilization of the diesel.

Est. Fees: \$20,000 Est. project Value: \$200,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.
Nushagak Electric Cooperative, Inc., Dillingham (1980-1989)

Design and engineering supervision of 1,000,000-gallon tank farm, 1 mile pipeline through downtown Dillingham, marine terminus, and all associated oil spill plans and marine transfer manuals. This project included a unique steel diking system and fuel preheating using waste heat from the diesels.

Est. Fees: \$120,000 Est. Project Value: \$790,000

This included detailed design, implementation, and programming of automated fuel handling, and coolant temperature controls using programmable controllers.

Designed and supervised a 1,250 kW generation addition including the building expansion, switchgear and cooling systems. Designed and supervised a 1 mile 12.5 kV overhead to underground line conversion. Responsible for a waste heat recovery system supplying heat to a local school, several construction work plans and a sectionalizing study.

Est. Fees: \$90,000 Est. Project Value: \$1,750,000

Project Engineer responsible for major expansion which includes a new garage, warehouse, shop addition, addition of two caterpillar 3516 generators and expansion of the waste heat system to include exhaust recovery. LCMF was a structural engineering sub on this project.

Est. Fees: \$120,000 Est. Project Value: \$2,000,000

Naknek Electric Association, Inc., Naknek (1979-1986)

Designed and supervised installation of two, 1250 kW generators including the building, switchgear, instrumentation and cooling systems. Responsible for 4 miles of 24.9/14.4 kV transmission line and 12-mile conversion plus switchgear and controls for connection to the Air Force Base generation facility. Designed and supervised installation of a waste heat recovery system supplying heat to several major local buildings. Installed bulk transfer pipeline system and 1.5 million gallon tank farm. Accomplished complete rebuild of cooling, control, and fuel system on four older engines within the existing plant.

Est. Fees: \$220,000 Est. Project Value: \$3,000,000

Ongoing work includes major substation metering changes and feeder switchgear upgrades; also, cooling and control modifications, lube oil handling and disposal systems.

Est. Fees: \$40,000 Est. Project Value: \$250,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Pedro Bay, Twin Hills, Kokhanok, and Igiugig (1983-1986)

Design and construction responsibilities for complete generation, distribution systems, and generation tank farms at these bush communities.

Est. Fees: \$110,000

Est. Project Value: \$1,200,000

U.S. Coast Guard, Narrow Cape and Shoal Cove (1984)

Major modification and upgrade of automated generation switchgear at two LORAN C transmitter sites. Replaced circuit breakers, rewired controls, and modified the bus substantially. Work done directly with onsite personnel. Redo as-builts and provide system training files, materials, and classes.

Est. Fees: \$50,000

Est. Project Value: \$200,000

Levelock Village Council (1983-1984)

Responsible for design, supervision and logistics for a 350 kW diesel plant, fuel storage and distribution system for this small community.

Est. Fees: \$70,000

Est. Project Value: \$650,000

Iliamna-Newhalen-Nondalton Electric Cooperative, Inc. (1982-1983)

Project Engineer responsible for the design and installation of 1,000 kW fully automated generation and distribution system for the communities of Iliamna, Newhalen, and Nondalton including 50 miles of underground cable. Personally handled the majority of planning, design, estimating, purchase and logistics of materials and equipment, testing, and start-up. Assisted with establishing operating procedures and initial planning for the utility.

Est. Fees: \$150,000 Est. Project Value: \$3,600,000

Homer Electric Association, Inc. (1980-1982)

Moved an Enterprise DSG-38 diesel generator from the old Homer Plant to Seldovia and worked with Coop employees to install the unit, including grouting, shaft alignment, high voltage cabling, plumbing, and switchgear overhaul. The following year designed a low profile substation for the same plant.

Est. Fees: \$60,000

Est. Project Value: \$600,000

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Petersburg Municipal Light and Power (1979-1980)

Developed a comprehensive, long-range transmission and distribution system plan. Assisted with troubleshooting and many minor system upgrades and repairs.

Est. Fees: \$12,000

Est. Project Value: N/A

Matanuska Electric Association, Inc. (1978-1979)

Worked as a full-time, contract employee for this utility for 14 months as system planner and engineer. Developed the long-range planning, economic analysis and system troubleshooting. Implemented a computerized distribution analysis system including a complete model for voltage drop and fault computation with a billing system interface.

Est. Fees: \$70,000

Est. Project Value: N/A

Prince William Sound Aquaculture Corp., San Juan Salmon Hatchery (1979-81)

Designed and supervised the installation of a 75 kW hydroelectric facility, 410 kW diesel plant, fuel storage systems, water supply systems, dam, a low-voltage distribution system, and control and alarm systems. Acted as project manager on various phases of the hatchery construction.

Est. Fees: \$40,000

Est. Project Value: \$600,000

Kodiak Electric Association, Inc. (1978-1979)

Responsible for a long-range transmission plan which was developed using computerized analysis programs for modeling numerous substation and transmission alternatives. The analysis programs were written by Mr. Dryden specifically for this project using mainframe CDC Basic.

Est. Fees: \$2,000

Est. Project Value: N/A

ROBERT W. RETHERFORD ASSOCIATES

Project Engineer

Anchorage, Alaska

1972 - 1978

Golden Valley Electric Association, Inc. (1972-1974)

Acted as one of two engineers working to finalize and implement complete operational relaying scheme for transmission and substation system from Healy Coal Plant (27 MW) to Gold Hill Substation (138 kV, 60 miles) to Zehnder Substation (10 miles, 69 kV double circuit). This included relaying design, wiring and panel diagrams, and carrier control system.

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Chugach Electric Association, Inc. (1974-1977)

Repeatedly worked with Chugach Electric Association on precise fault location and repair of undersea cables across Cook Inlet. This involved work with 138 kV single conductor, solid dielectric cable as well as oil-filled, three-phase lead-jacketed cable. Refined highly precise fault location methods originally devised by Robert W. Retherford.

Kodiak Electric Association, Inc. (1973-1977)

Project Engineer for a 10 MVA substation addition. Project engineer for installation of electrical systems at the new Kodiak Power Plant (17 MW, three generators). Responsible for field testing, start up, control and troubleshooting of electrical and mechanical systems related to the new diesel plant. Dora Gropp PE was the primary electrical project engineer.

RCA-Alascom (1975)

Alyeska Pipeline (Trans Alaska Pipeline Project)- Backbone Communication System - Responsible for design, construction and testing of generation control systems for 27 unmanned remote sites. This included complete design and prototyping control boards, environmental testing, and interface with microwave telemetry and fire control. I worked in conjunction with Jack West PE.

Overall project value \$37,000,000

Homer Electric Association, Inc. (1977)

Soldotna Substation Upgrade and Transformer Tap - Designed upgrade of this major substation to 115 kV, including new breakers, substation structures, relaying, metering, and 115 kV to 69 kV transformer, 4.5 miles of 115 kV and Davit Arm transmission line. This included right-of-way and design. HEA handled actual construction.

REPRESENTATIVE PROJECTS - ROBERT E. DRYDEN P.E.

Naknek Electric Association, Inc. (1974-1975)

Project Engineer responsible for major generation expansion at Naknek diesel plant, four engine generators, switchgear, waste heat, building addition, and fuel storage facilities.

CORDOVA PUBLIC UTILITIES

Cordova, Alaska

Chief Engineer

1975 - 1976

Projects included 3/4 mile ski lift, hospital upgrade, new city hall, and utility rate studies. Personally responsible for contract preparation, bidding and construction supervision.

MATANUSKA ELECTRIC ASSOCIATION 1972-1977

Field Project Engineer for Butte Substation, Palmer Substation, and Parks Substation. I was also involved in modifications to the Eagle River substation. Working Del LaRue, we did most of the distribution and transmission design for MEA over about five years including the Goose Bay transmission line. We did several two year work plans.