

MILBURN ENGINEERING, INC.

P.O. Box 779

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RESUME' - ANDREW MILBURN PE.

1999 to 2017 – Since 1999 Andrew Milburn has been active in the wind industry analyzing gear and bearing failures, performing end of warranty gearbox inspections, quality audits, due diligence reviews of wind turbine gearboxes and design modifications for existing wind turbine gearboxes.

1989 to 2017 - Andrew Milburn is a licensed Professional Engineer in the state of Washington and since 1989 has been Principal Engineer of Milburn Engineering, Inc., a licensed Washington engineering corporation specializing in gear and gearbox design and gear and bearing failure analysis.

1975 to 1989 - Mr. Milburn worked at The Gear Works in Seattle, Washington, the last 8 years of which he served as Chief Engineer. While at The Gear Works, he designed and supervised the testing, of a number of custom gear reducers. Typical projects involved taking initial customer concepts and developing detail specifications and then sizing all components and supervising the development of manufacturing drawings and component part specifications. This was followed by supervising the assembly and testing of the final product and the writing of maintenance manuals. He was also involved in failure analysis and design of modifications to other manufacturer's equipment sent to The Gear Works for repair. These projects provided valuable experience in the areas of metallurgy and heat treatment, gear design, quality control, bearing selection, seal design, lubrication, noise, vibration and testing.

Mr. Milburn is active in the American Gear Manufacturers Association (AGMA) and is currently a member of the Helical Gear Rating committee, Epicyclic Enclosed Drives committee, and the Wind Turbine Gear Committee. He was a member of the U.S. delegation working on recently released IEC 61400-4 "Design Requirements for Wind Turbine Gearboxes".

He was a co-author of the AGMA Technical Paper 90 FTM 5 "Polishing Wear"

Presented "Using Inspections and Oil Analysis to Troubleshoot Gearbox Failures" at "Practicing Oil Analysis 2000" conference, Tulsa, OK October 24, 2000.

IN ADDITION TO AGMA, he is a member of the American Society of Mechanical Engineers and the Society of Tribologists and Lubrication Engineers.

1971 to 1974 - Served as an officer in the United States Marine Corps. Assignments included Tank Platoon Commander, Motor Transport Officer and Training Instructor.

1968 to 1971 – Attended the University of Washington and graduated with a BS in Mechanical Engineering.



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PARTIAL PROJECT LIST

Design

Design of a series of different model gearboxes that consisted of a combination parallel shaft and planetary gearbox with integral oil cooled clutch used on large coal conveyor drives. Largest gearbox had a rating of 1,500 HP and 2 million inch-pounds of output torque.

Design of a 30 horsepower double helical input, twin output shaft gearbox used to drive a plastic extruder. Provided all detail and assembly drawings.

Design of a custom 2,000 horsepower right angle gearbox for a steam dryer.

Testing

Developed the test plan and supervised the full load back to back testing of several sizes of reducers up to 1500 horsepower and 2 million inch-pounds of output torque.

Supervised the static full torque test of a large reducer to determine the pinion and gear deflection so the proper lead corrections could be made.

Designed the test equipment and supervised a torsion test to yield of a large diameter planetary sun pinion.

Failure Analysis

Investigate failure of cooling fan drives and provide technical assistance in pursuit of warranty claim.

Perform due diligence analysis, design reviews, gearbox inspections and investigate gear and bearing failures of wind turbine gearboxes from 600KW to 3MW.

Investigate the failure of a 16-foot diameter gear driving the diffuser tower in a sugar factory and supervise a temporary repair. Develop drawings and specifications for a new gear, help in the selection of a vendor, and supervise the installation of the new gear.

Miscellaneous

Perform antenna gearbox stiffness calculations to verify that it met specifications.

Perform wind turbine gearbox inspections prior to the expiration of turbine warranties.

Supervise the alignment of the gear and pinion for a large coal train dumping station.



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PARTIAL CLIENT LIST

ALBERTA-PACIFIC FOREST INDUSTRIES INC., Boyle, AB
AMERICAN CRYSTAL SUGAR COMPANY, Moorhead MN
ARMY CORPS OF ENGINEERS, Seattle, WA
ATLANTIC POWER CORPORATION, BOSTON, MA
BAY AREA RAPID TRANSIT DISTRICT, Hayward, CA
BOEING COMPANY, Everett, WA
BRAD FOOTE GEAR WORKS, INC., Cicero, IL
CARTIER WIND ENERGY, INC., Longueuil, Quebec
CHERRINGTON CORPORATION, Sacramento, CA
CLIPPER WINDPOWER, Carpinteria, CA
DNV - GL, Seattle, WA
EDERER INC., Seattle, WA
EXLAR CORPORATION, Chanhassen, MN
FPL ENERGY, Livermore, CA
GEA POWER COOLING SYSTEMS INC., San Diego, CA
GEORGIA-PACIFIC, Bellingham, WA
GRANT COUNTY PUD, Ephrata, WA
GTE GOVERNMENT SYSTEMS, Mountain View, CA
ISE RESEARCH LTD, Port Coquitlam, BC
JOHNSON CONTROLS, Silverdale, WA
LEHIGH CEMENT, Mason City, IA
MACMILLAN BLOEDEL LTD., Port Alberni, BC
MERIT GEAR COPRPORATION, Antigo, WI
METSO MINERALS – BMH, Pittsburgh, PA
MIT LINCOLN LABS, Boston MA
NEG MICON USA, INC., Decatur, IL
NORTHWEST LABORATORIES OF SEATTLE, INC., Seattle, WA
PORT OF SEATTLE, Seattle, WA
PUGET SOUND ENERGY, INC., Bellevue, WA
ROCKWELL AUTOMATION - DODGE CST BUSINESS, Seattle, WA
SASKPOWER INTERNATIONAL INC., Regina, Saskatchewan
SIDNEY SUGAR, Sidney MT
SUZLON WIND ENERGY CORPORATION, Chicago, IL
TERRA-GEN POWER LLC, New York, N.Y.
TECK COMINCO METALS LTD., Trail, BC
TETRA TECH, INC, BELLEVUE, WA
THE AMALGAMATED SUGAR COMPANY, Nampa, ID
THE GEAR WORKS - SEATTLE, INC., Seattle, WA
TRANSCANADA MAINE WIND DEVELOPMENT, INC., Omaha, NE

