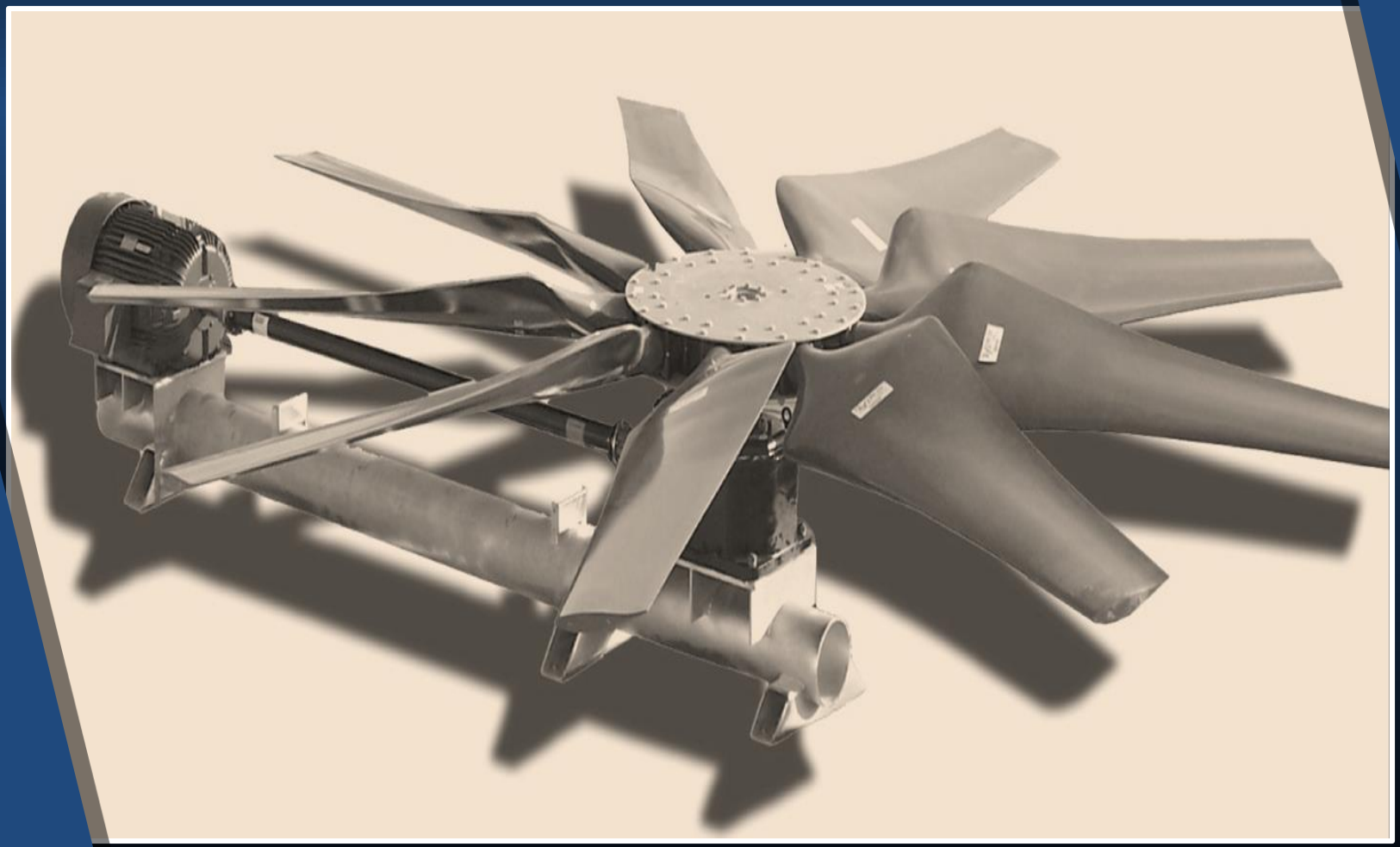
Permanent Magnet Motors for Cooling Tower Applications

PAUL HUMBERT
TOWER ENGINEERING, INC

Conventional Drive System Arrangement

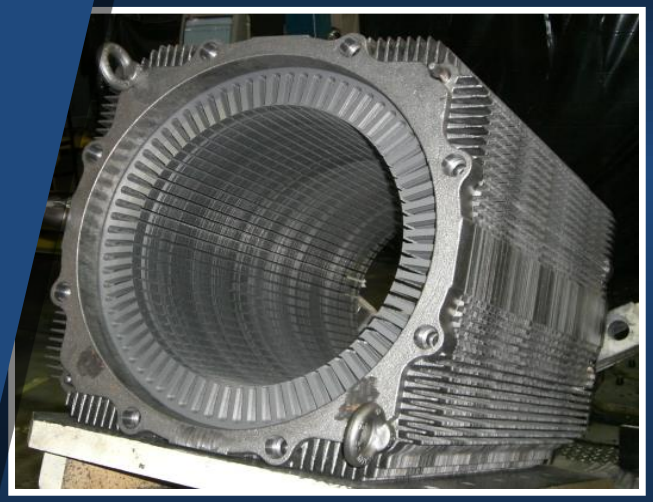


PM Motor Fan Drive System

Features & Benefits

- Permanent Magnet Technology
- Improved Reliability
- Adjustable Speed Capability
- Quiet Operation
- Built-in Anti-rotation Capability
- Built-in Motor Heater Capability
- Reduced Maintenance Costs
- Improved Safety
- Soft Start Tower Stress Reduction
- Long Term Warranty
- Lower Energy Consumption

Permanent Magnet Technology

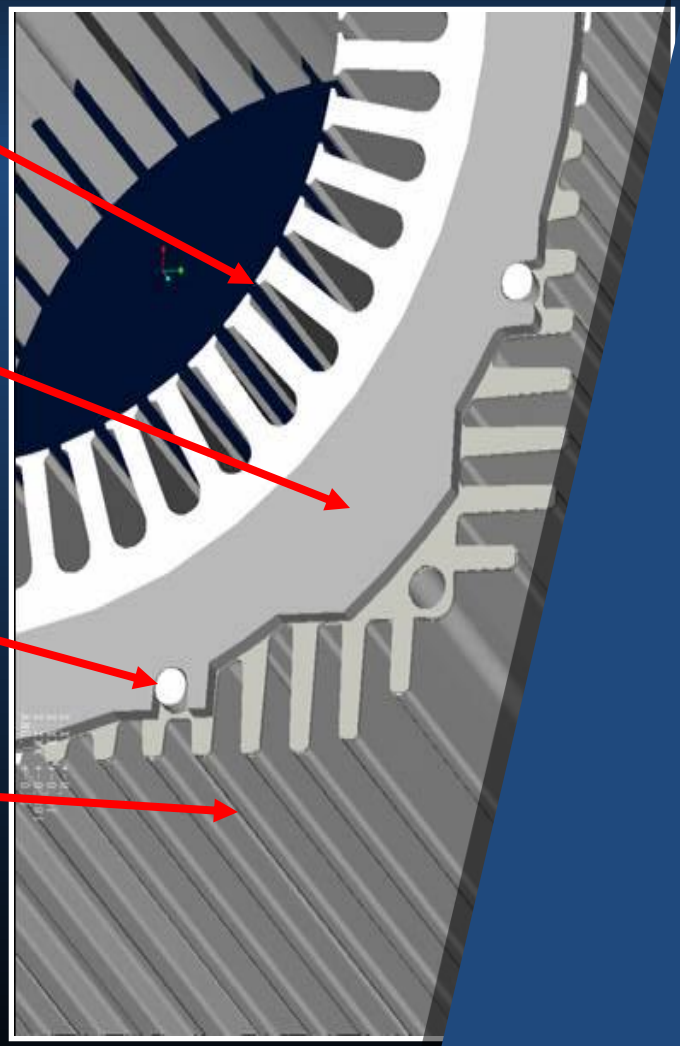


Stator slots integral to laminated frame. One piece frame /stator results in superior heat dissipation.

One piece end plates on frame for precise bracket fits.

Welded thru bolts for rugged construction.

Totally finned surface for optimized heat transfer.



Improved Reliability

Inpro Labyrinth Seal

Water Flinger

CT Paint System

- Ingress Protection - IP56
  - The first numeral defines the degree of protection against dust .

    5 = Dust protected

    6= No Ingress of dust per IEC 34-5 this degree of protection is not applicable to rotating equipment such as motors and generators but applicable to electrical enclosures
  - The second numeral defines the degree of protection against water.

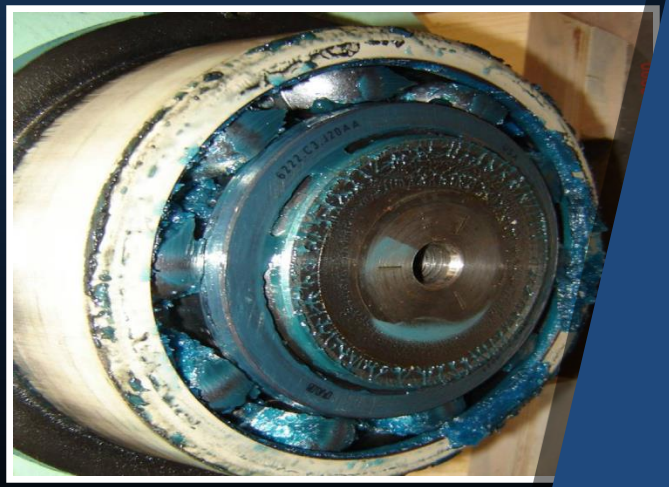
    5 = Protected against water jets

    6 = High pressure jets from all directions, (limited ingress permitted)

Improved Reliability

- 100% grease fill rate.
  - Eliminates voids.
- Mobil SHC460 & 220 Synthetic Grease.
- 63 & 62 series ball bearings for smaller HP ratings.
- Ceramic coated OD of ODE to prevent current damage. Ceramic sleeve for 5800 frame motors.
- AC bearings for large HP ratings or to increase L10 life.
- Bearing L10 life min 100,000 hrs.
- Re-lubrication interval based on 17,500 hrs of operation 40° C ambient & 750 FPM Min airflow.
  - Goal of lubed for life in future.

Grease & Motor Bearings



Ceramic Coated Bearing OD

Improved Reliability

- Vacuum Pressure Impregnated (VPI) Insulation System
  - Insulation System developed for the most demanding applications. (i.e. Navy Service, Off Shore Oil Drilling, Submersible Motors)

VPI Insulation System

Quiet Operation

Loaded Noise Levels (A-weighted)		
Average	High Speed	Low Speed
Induction NEMA Motor Tower	82.3 dBA	74.4 dBA
PM Motor	77.7 dBA	69.0 dBA

- Clemson University Test Data
- Data verified by Clean Air Engineering (3rd Party Testing Agency).

Reduced Maintenance Costs

- No Oil Changes or Leaks
- No Gear Reducer Change-outs
- No Drive Shaft Change-outs
- No Flex Disc Change-outs
- No “Tricky” Re-alignment Issues

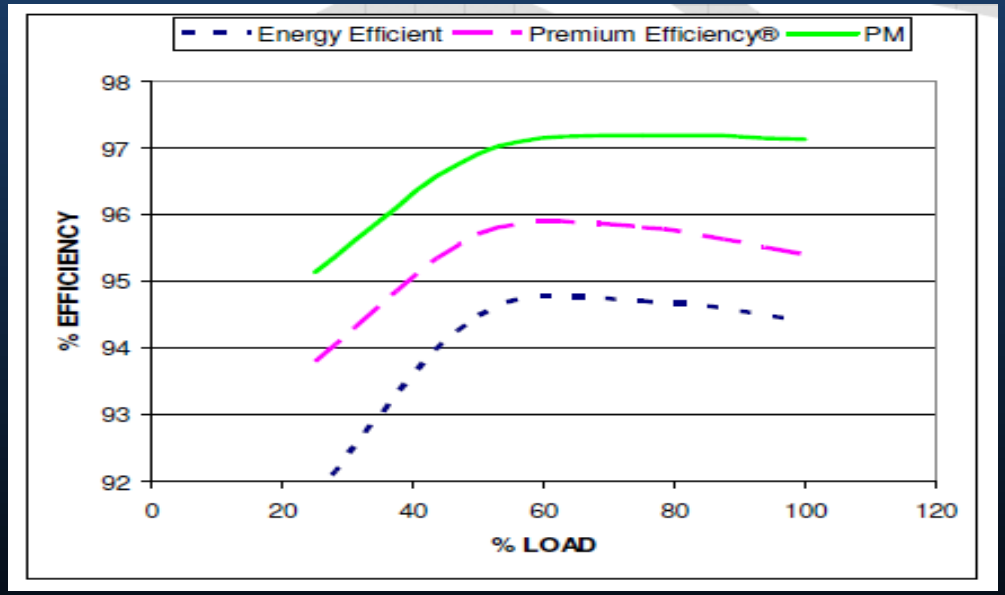
Substantial Savings on Multi-Cell Cooling Towers

Improved Safety

Conventional Drive Equipment Multi- Component Failure

Increased Efficiency

- Permanent Magnet (PM) motors provide higher efficiencies.
- Limitations of motor control and magnet material performance / cost previously restricted their use.
- Dramatic improvements represent a viable alternative today.



1 - ½ % to 2 - ½% Increased Efficiency

Increased Efficiency

Mechanical Losses

- Conventional Drive Trains lose energy through couplings, drive shafts and gear reducers.
- Gear efficiencies are typically stated at 96% (4% transmission loss).
- Actual transmission losses are greater ***...up to 15%***.

Lower Energy Consumption

Clemson University	2-Speed, 326T Induction Motor	PM Motor FL4493
Fan Load	41.5 Hp	41.5 Hp
Gearbox and couplings Efficiency	90.2%	N/A
Motor Horsepower	46.0 Hp	41.5 Hp
Motor Efficiency	90.0%***	93.1%
Drive (VFD)	N/A	98.8%
Input kW	38.1	33.6
Total Efficiency	81.2%	92.0%

4.5 kW Savings

- Clemson University Test Data
- Existing motor is 22 years old; new induction motor is 93.5% efficient.
- Gearbox manufacturer states gearbox efficiency at 96%, but test data indicates mechanical system (gearbox, couplings & driveshaft) is 90.2%.
- Data verified by Clean Air Engineering (3rd Party Testing Agency).

*** Published data.

Lower Energy Consumption

Alcon Laboratories
North Cogen Plant
Ft Worth, TX

Two Cells

- One with existing geared solution
- One with a Direct Drive Solution

100 HP Direct Drive Motor

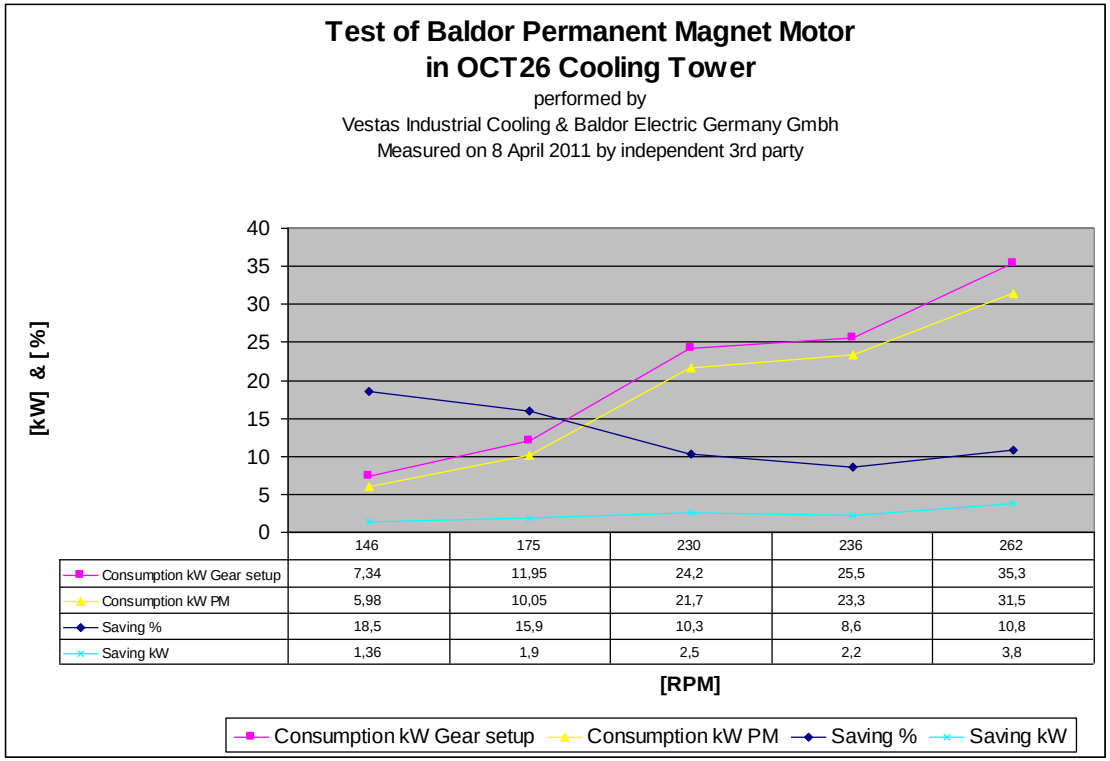
- Speed 217 rpm

7.25 kW Savings

Arrangement	Fan Design	Fan Speed	Fan Pitch (Average)	Present Motor HP	Measured Power Full Load Full Speed	Equivalency Ratio	Full Load Estimated Power Usage	Energy Savings
Direct Drive	16KW10	217	15.6°	100	80 KW	1X	80 kW	8.31%
Geared	16H10	223	7.2°	125	87.25 kW	1.983X	87.25 kW	

Lower Energy Consumption

NOVO Pharmaceutical Denmark



	146	175	230	236	262
Consumption kW Gear setup	7,34	11,95	24,2	25,5	35,3
Consumption kW PM	5,98	10,05	21,7	23,3	31,5
Saving %	18,5	15,9	10,3	8,6	10,8
Saving kW	1,36	1,9	2,5	2,2	3,8

- Baldor FL4485 Frame
- 37kW, 250 RPM, 400 V operating conditions at full load.
- Hansen Gearbox on old solution referenced to be 97% efficient.
- Energy savings ranged from 8.6% - 18.5% depending on speed.

Lower Energy Consumption

Merck Pharmaceutical

Merck Pharmaceutical (West Point, PA)
- (2) 75 HP, 127 RPM, 460V, FL4413 Motors
- Installation Oct. & Dec. 2010

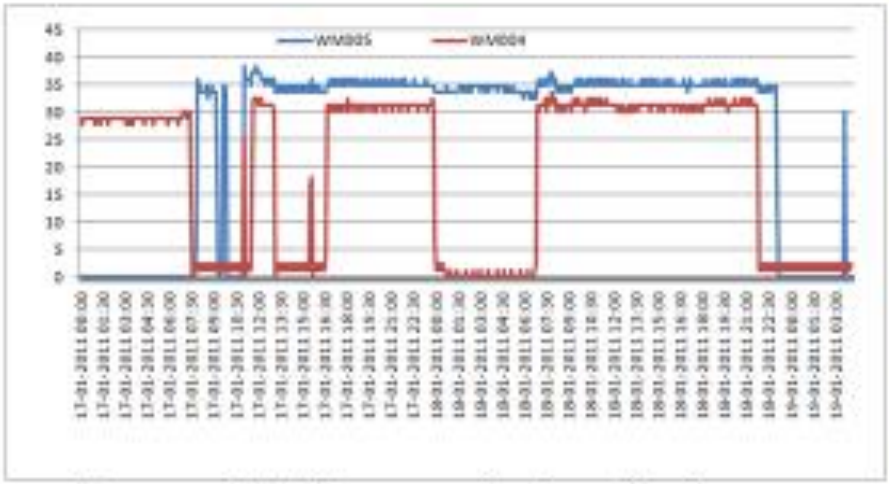
Project Update Phase - 1

Merck ran efficiency studies of their existing towers against the installed CTD products
$53K Savings in Energy over three months

Lower Energy Consumption

Cooling Tower Installation Comparison

Energy Savings



- Denmark NL Pharmacutical application
  - Cell 5: average = 35,06 kW Traditional solution
  - Cell 4: average = 31,14 kW Baldor Solution
    - Saving 3,92 kW = 11.2 %
- Cargill – Turkey
  - Analysis - Avg over 2 month period
  - 21kW vs 25kW which will be around a 16%

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Questions?