CASE STUDY

FLUXDRIVE®

MOODY GARDENS
GALVESTON ISLAND

"The motor and pump are both operating at noticeably lower temperatures with the Flux Drive ASD installed, and the noise and vibration are substantially reduced, compared to the adjacent pumps. This will also reduce our maintenance costs and improve the overall reliability of these pumps."
- Greg Whittaker
Animal Husbandry Manager, Moody Gardens® Aquarium

Moody Gardens® Aquarium Pyramid Installs Flux Drive ASD, Energy Savings Will Recoup Investment in 14 months

In February of 2010 Flux Drive personnel installed a Flux Drive Adjustable Speed Drive (ASD) at the Moody Gardens® Aquarium in Galveston Texas with the goal of evaluating the potential cost saving and operational improvements that an ASD can offer over existing throttle valve control systems. The ASD was installed on a 50 HP motor which drives the pump providing filtration flow for the Caribbean exhibit.

The Aquarium at Moody Gardens®, built in 1999, is a 1.5 million-gallon aquarium and a tribute to the North Pacific, Caribbean, Tropical Pacific and South Atlantic Oceans. The facility features close-up views of penguins, sharks, seals, seahorses, moray eels and much more. Moody Gardens® hosts over 2 million guests a year and is an active participant in a waste water recovery project and has several initiatives to become a leader in sustainability efforts. Improving energy efficiency is high on the Moody Gardens® priorities and finding solutions that work in the harsh saltwater environment while maintaining the aquariums critical life support exhibits has been a challenge.

Situation:
When the aquarium was built in 1999, the designers chose to install multiple motors, pumps and control valves to regulate the water flow through the critical sand filter applications supporting the sealife in the large saltwater aquariums. Filter flow control was maintained by throttling back the valves while keeping all the pumps running. Unfortunately, using throttling valves for flow control has proven to have several drawbacks including poor energy efficiency. Reliability was also a concern since the pump room is locateed in a damp and often wet environment that had even flooded during a recent hurricane or two. With all this in mind, the electronic VFD was just not an option for this critical application.

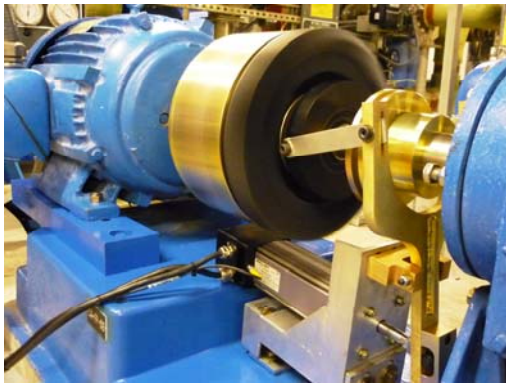

Figure 1 - Flux Drive ASD at Moody Gardens

Due to the high monthly energy costs to run each motor driven filter pump (approximately $18,000 / year) the Mood Gardens® facility management team had been actively researching ways to reduce the power consumption for this critical filtering application. After observing an installation of a Flux Drive ASD operating in a damp and flood prone environment at the Houston Zoo, the Moody Gardens® staff decided to evaluate a Flux Drive ASD running on one of their filter pump applications. (See Figure 1)

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Figure 2 – Pump/Filter Application fitted with LimiTorque® Control Valve

Technical Discussion of Pump System Design and Operation:

Moody Gardens® has five (5), 1500 gpm – Ingersoll-Dresser filter pumps (Model GRP 8 x 6 x 13) and ten (10) Neptune - Benson sand filters servicing the Caribbean exhibit to provide continuous filtration. The aquarium exhibit is designed to have one pump provide water to two sand filters rated at a maximum flow rate of 750 gpm each. Filter flow is adjusted by one LimiTorque® control valve located at the pump discharge. A backwash procedure on the sand filters occurs once per week and requires full flow during that operation. (See Figure 2 for the original system layout)

The Flux Drive team acquired condition readings on the original motor/pump installation and recorded energy usage, pump flow rates, vibration and operating temperatures of the motor and pump. It was quickly determined that the flow control provided by the Limitorque® control valve was extremely limited and provided almost no energy savings. This was also confirmed by reviewing the pump design curves provided by the OEM, Ingersoll-Dresser Pumps.

Initial vibration levels measured on the motor and pump were elevated due to mis-alignment and associated looseness. The 'as found' motor to pump mis-alignment was 91.5 mils vertically and 23.1 mils horizontally. Cavitation and noise levels on the pump were noticeable and attributed to the LimiTorque® valve being partially closed. The Energy levels were measure on the motor controller at the standard operating pressure / flow as follows: 1) operating wattage with the control valve throttled at 60% closed was 31.8 kW, 2) motor current 43.7 amps, and 3) 2.4% THD (Total Harmonic Distortion, current). The output pump pressure was measured at 28.5 psig with a flow rate of 1575 gpm. The motor had a relatively hot stator frame temperature of 153 degrees F and the pump was also elevated to 111 degrees. (See Figures 4 and 6)

Figure 3 - Pump Application with Flux Drive

Technical Discussion of Solution:

A Flux Drive® ASD (Model 10-150) fitted with an Exlar linear actuator was selected for this 50 hp installation allowing for fully automatic control (with a 4 – 20 ma signal). The original motor to pump shaft distance with a Love Joy flexible coupling installed was 4 inches. This required that the motor be moved back 8" to accommodate for the Flux Drive ASD (Model 10-150) to be installed. Foundation spacer rails were utilized for relocating the motor outboard and the Flux Drive ASD was installed between the motor and the pump. (See Figure 3)

Alignment of the Flux Drive was also completed using the supplied .050" plastic shim spacers located in the airgap to verify adequate gap between the induction rotor and magnet assembly in the four clock positions. A visual inspection and equal gaps of the flexible coupling hub also confirms when the alignment is acceptable. There is no need to align using laser optical alignment equipment.

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The final alignment was recorded and documented as follows:

6.0 mils vertically and 4.4 mils horizontally. The allowable mis-alignment for the Flux Drive ASD or Coupling is noted to be 15 mils or less (for 1800 rpm) for this 10-150 ASD model.

Once the installation was completed, the pump discharge valve was fully opened to allow for full unrestricted flow past the valve. The Flux Drive team then started the motor and re-acquired the power and condition readings on the new Flux Drive® adjustable speed installation.

Overall vibration levels on the motor and pump were noted to be reduced by a factor of three (3) when compared at full speed / power. The vibration at 1 x SS were less than 0.04 in/sec horizontally, and 0.03 in/sec in the vertical and axial directions on the motor and less than 0.03 in/sec horizontally, 0.02 in/sec vertically and 0.02 in/sec axially on the pump.

With the pump flow rate reduced by the Flux Drive ASD to 1200 gpm at 1503 rpm, cavitation on the pump was eliminated and noise levels fell significantly. The motor frame housing temperature was also reduced from 153 to 126 degrees F and the pump bearing temperture was reduced from 110 to 95 degrees F. (See Figure 5 -7) Power measurements were recorded using the Fluke 345 power quality meter and found to have reduced from 31.8 kW (using a throttling valve) to just 21.5 kW using the Flux Drive ASD, resulting in a 33 % energy savings (or $5,865 / year). Additional savings could also be realized by reducing the pump flow rate even further as the exhibit filter requirements permit.

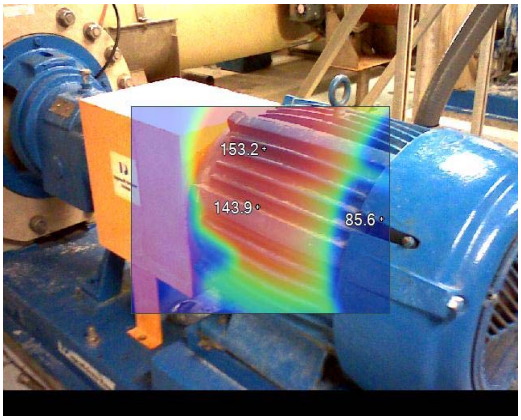

Figure 4 – Infrared temperature profile on motor before the Flux Drive Install

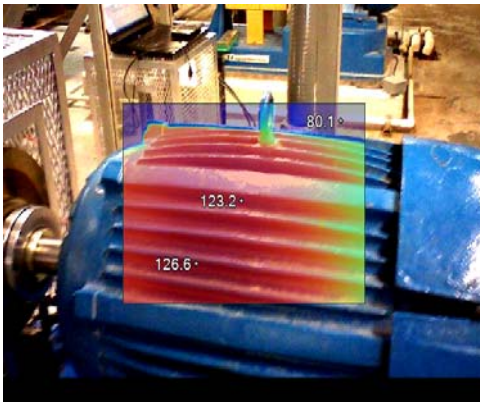

Figure 5 - Infrared temperature profile on the motor after the Flux Drive Install

Figure 6 - Infrared temperature profile on pump before the Flux Drive Install

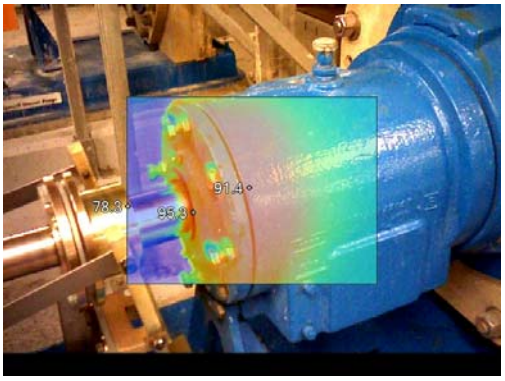

Figure 7 - Infrared temperature profile on the pump after the Flux Drive Install

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Summary and Feedback:

With the Flux Drive ASD installed, the Moody Gardens® staff devised a plan to reduce the filter flow rates to determine the best flow rate for energy savings and the best filtration efficiency for the exhibit. Over time, they will be able to determine if they can improve the energy savings even further and still provide acceptable filtration for the exhibit.

Moody Gardens® Facilities Director, Greg Whittaker commented, "The motor and pump are both operating at much lower temperatures and the noise and vibration are substantially reduced compared to the adjacent pumps. This will also reduce our maintenance costs and improve the overall reliability of these pumps in addition to the immediate energy savings."

Roy Drinnen, Moody Garden Biologist, added, "In addition to the energy savings, there are many indirect benefits that we'll realize over time with reduced wear on bearings, less frequent seal replacement, and fewer issues associated with chronic vibration."

Energy Savings Summary Table:

Power Comparison Filter Pump No. 2	Full Power	Test 2	Test 3	Test 4	Test 5 New Set Point	Test 6	Test 7 Additional Savings	Test 8
Motor RPM	1784	1786	1788	1789	1789	1790	1791	1792
Pump - RPM	1768	1670	1603	1546	1502	1493	1386	1332
Motor Power - Kwatts	31.8	27	24.5	22.5	21.5	20.9	17.61	16
KW Savings %	0	15.63%	23.44%	29.69%	32.81%	34.69%	44.97%	50.00%
$ Savings / Yr	0	$2,733.12	$4,156.62	$5,295.42	$5,864.82	$6,206.46	$8,079.79	$8,996.52
Motor - Amps	43.7	39	35.6	33.3	32	31.5	28.1	26.4
Pump - Flow	1575	1440	1356	1250	1200	1150	1080	1008
Pump/Filter - Influent (psig)	28.5	27	26.5	25.5	25.5	25	24.5	23
Pump/Filter - Effluent (psig)	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5

Flux Drive® ASD

Model 10 – 150 (50 hp)

Adjustable Speed Drive Installation