OPG – Darlington Nuclear Station Ontario, Canada

Main Feedwater Pumps Vibration Reduction from Coupling Upgrade

Presented by:

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Pump Information

- 16 Main Feedwater Pumps – 4 per unit
- Sulzer-Bingham model 300x300x450 MSD
- Horizontal, 2 stage
- Horizontally split volute
- 1st stage - double suction, 2nd stage – single
- Design conditions – 485 liter/sec @ 630 meters total dynamic head

Bearing Information

- Journal-type radial bearings with babbit-lined shells
- Kingsbury tilting pad thrust bearing on non-drive end
- Lubricated with cooled and filtered oil from shaft driven pump
- Motor-driven aux oil pump supplies oil at startup

Motor Information

- 3600 kW, 3600 RPM CGE unit
- Babbitt radial bearings, fed with oil from pump
- Windings cooled by shaft driven fan blowing through water HX

Pump Trouble History

- Pump thermal growth caused high vibrations on drive-end bearing
- Vibrations consistently exceeded the alarm limits on pump drive end for all pumps
- Eventually the plant raised the alarm limits from 60um (2.4mils) to 85um (3.4mils)

Original Coupling

- Typical KopFlex Gear Coupling per original pump design
- Plant suspected that coupling was “locking up” due to pump thermal growth and coupling wear.
- Plant Concerns: Vibration, coupling greasing, wear, etc.

Design Proposal

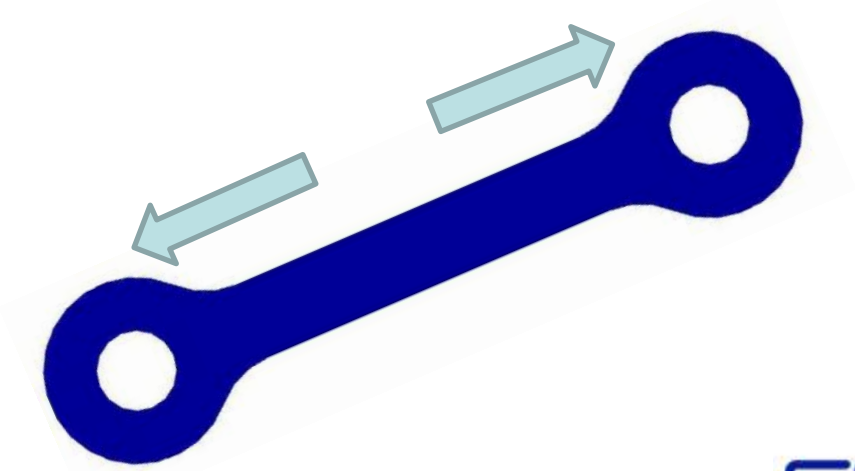
- Sulzer was requested to provide a coupling upgrade to a flexible coupling
- Coupling was chosen based on high flexibility and low axial and angular spring rates
- Selected coupling went through rotor dynamics analysis to confirm compatibility with existing equipment.

Coupling Benefits

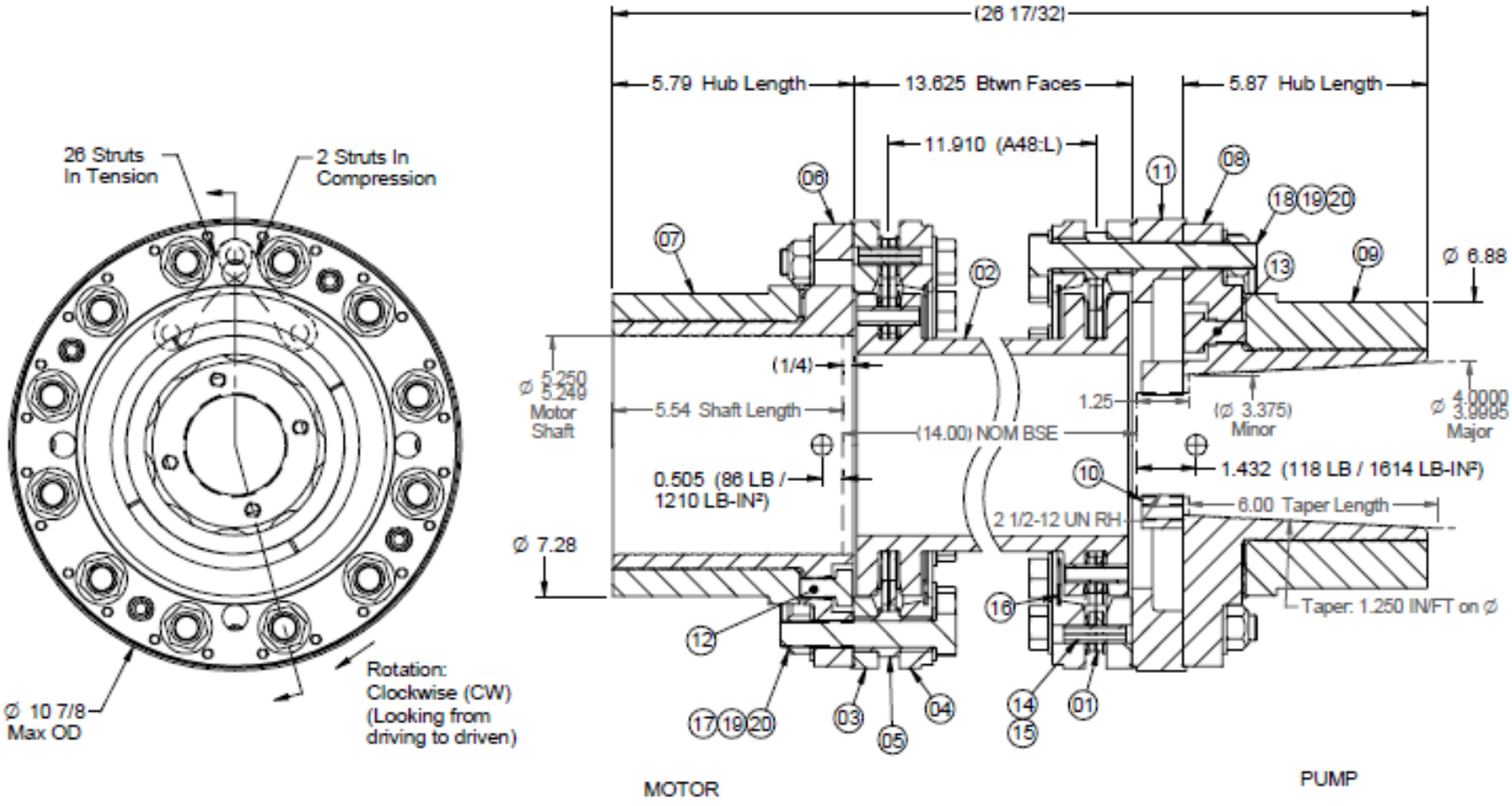
- UltraFLEXX design capable of higher misalignment than normal disc (shim pack) couplings
- UltraFLEXX spring rates (reactionary forces) are extremely low, which helps to dynamically decouple shafts
- Keyless Anderson Clamp Hub allowed for easy installation and axial spacing adjustment without moving motor during alignment

Coupling Design Elements

- Hybrid design between diaphragm and disc
- Carries torque like spokes on a bicycle wheel
- Torque-carrying elements are loaded purely in tension which lowers bending stresses



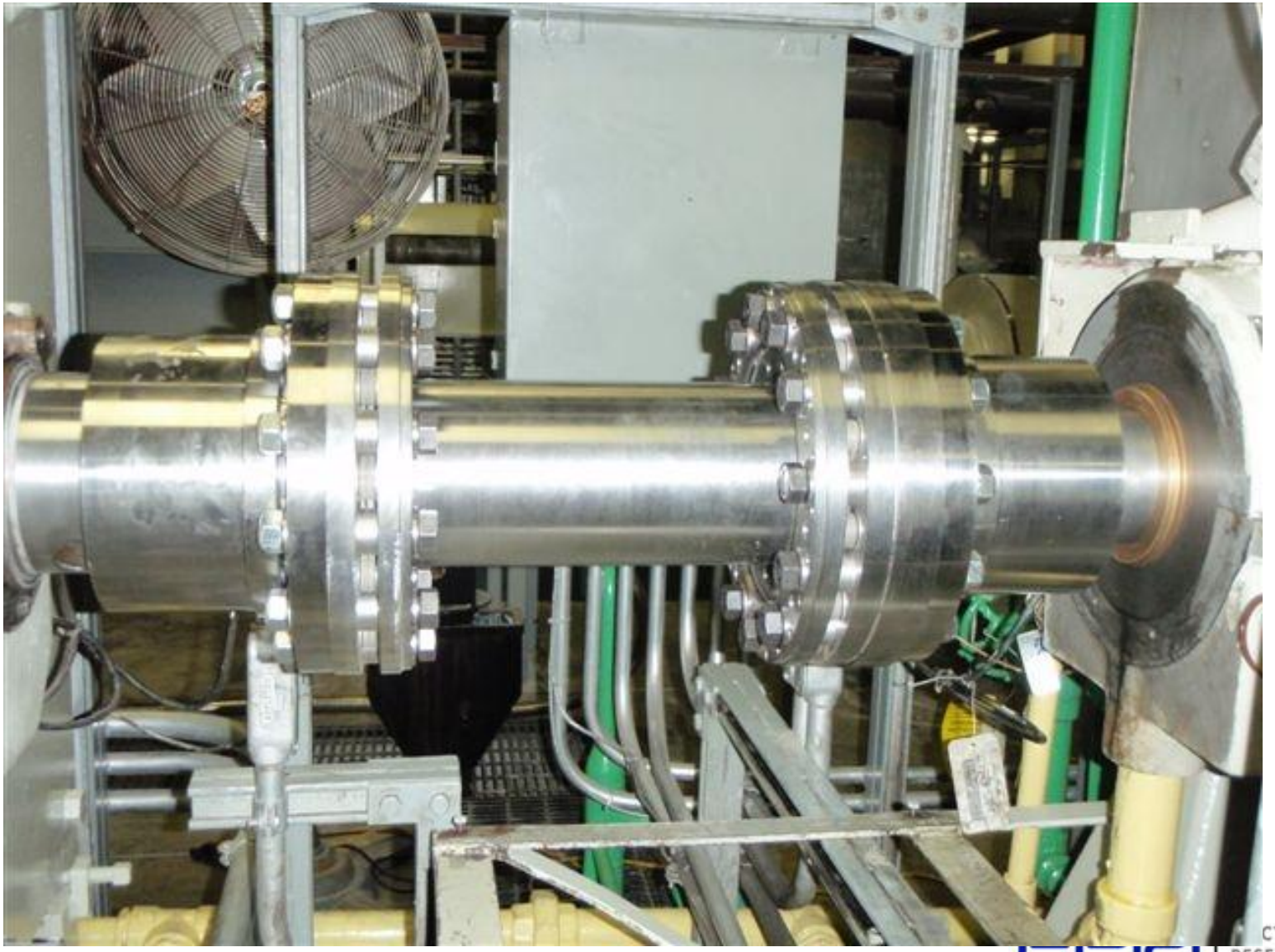
Coupling Drawing



As found Motor Shaft condition

Anderson Clamp Hub was installed over the gouged shaft without having to make any repairs or modifications.

Installed UltraFLEXX Coupling



Vibration Results of Upgrade

- First coupling installed in Sep. 2009 with CCA and Sulzer onsite help
- Immediate results were seen in pump drive-end bearing
- Vibrations were dramatically reduced from 85um (3.4mils) to 25um (1 mil) on the pump drive end.
- Alarm levels were reset to original set points

After Coupling Upgrade

	Cold Start Recirc Mode		Three Pump Mode			Hot Start Three Pump Mode		
Position	Overall um p-p	1x um p-p	Overall um p-p	1x um p-p	Velocity mm/s rms	Overall um p-p	1x um p-p	Velocity mm/s rms
MOBV	34	22	31	22	1.5	33	22	1.2
MOBH	19	13	25	15	1.0	25	15	1.1
MIBV	32	22	25	16	1.3	27	18	1.2
MIBH	22	15	22	13	1.7	20	14	1.7
PIBV	22	14	24	14	2.2	23	14	2.2
PIBH	32	20	28	17	1.5	27	18	1.6
POBV	10	4	17	9	1.9	16	6	2.0
POBH	12	4	17	9	0.9	17	9	1.1

Original levels were 85um p-p (3.4 mils)

Results of Coupling Upgrade

- Several more pumps have had coupling upgrades with the same immediate results
- The remaining pumps will be upgraded over the next few years
- New installation procedure written by CCA and OPG along with Sulzer oversight allowed for successful secondary installations
- Coupling greasing PM's now eliminated, freeing up maintenance resources
- Eliminate risk of pump unavailability from high vibrations leading to unit derate