HIGH VELOCITY HOT OIL FLUSH

FOLLOWING MAJOR TURNAROUND ON WESTINGHOUSE 501AA

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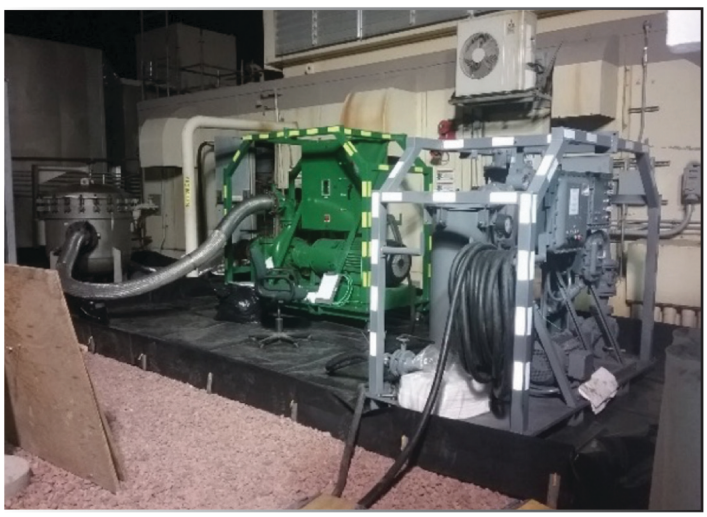
Case Study

SYNOPSIS

RIG provided high velocity hot oil flush services on the Unit #1 Westinghouse 501AA located in West Phoenix.

GLOBAL LEADERS
IN PRECOMMISSION & PLANT MAINTENANCE



Lube Oil Supply Header Tie-In

PRE JOB & ARRIVAL

RIG was contacted by DR/Siemens Turbine Repair team after an alternate flush contractor was not able to achieve adequate flows to flush the Turbine. After discussing the jumper arrangement and proper equipment, RIG was contracted to perform high velocity hot oil flush services on the Unit #1 Westinghouse 501AA located in West Phoenix.

RIG technicians arrived on site on Day 1, completed site specific safety training, and conducted a safety walk down of the work area. A Job Safety Analysis (JSA) was completed prior to starting. Equipment was offloaded from transport and inspected. All RIG high flow filtration skids, filter carts, and hoses arrived to the job site hydrotested, checked for functionality, and free of contamination.

SET-UP

RIG equipment was staged in the designated area. Stainless Steel bearing jumpers were installed on the outboard and inboard sides of turbine, on the generator, inboard and outboard of the exciter, and the "S" clutch. All jumpers included valves allowing flow to be focused to individual bearing supply points. Prior to arrival the main lube oil reservoir was drained into a frac tank and cleaned. Once jumpers were installed and external flush equipment rigged, the lube oil reservoir was filter filled for flush.

Figure 1. Lube Oil Supply Header Tie-In

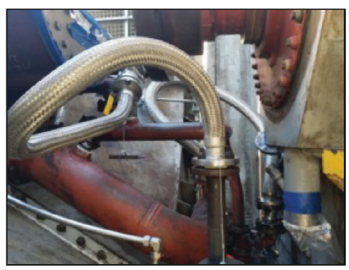


Figure 2. Jumpers

Figure 3. Jumpers

Figure 4. Jumpers

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FLUSH

Utilizing the Variable Frequency Drive on RIG's 2000 GPM flushing skid, technicians started circulation system slowly while checking for leaks. Oil flow was increased providing a calculated turbulent flow of 32,958 Reynolds number. RIG's flushing system flowed through a 25 bag filter kettle loaded with 1um bag filters. Heat and fine filtration was provided in a "kidney loop" configuration on the main lube oil reservoir by a 150 GPM pump skid. 1um beta 1000 filter cartridges were loaded into the filter vessel. The target temperature for the flush was between 120-160 degrees Fahrenheit. Heat cycling and pneumatic vibrators were used to encourage the migration of contamination out of the system.

Once maximum flow was achieved a final leak check was performed system wide. The leak check passed and circulation was continued for a 36-hour course flush to remove the bulk of contamination.

Figure 5. External Flush Setup

INSPECTIONS

At the conclusion of the 36 hour course flush, the flushing skid was shut down and inspection screens were installed at each bearing supply point. Flushing skid was restarted for a two-hour run to assess contamination levels in the system. The initial screens revealed a large amount of contamination remaining in the system. Screens were reinstalled at 24-hour intervals until improvement dictated final inspections. Each screen pass required two consecutive clean screens at two hour runs meeting API 614 visual cleanliness standards. The final verification screens were approved by DR/Siemens on Day 5.

Oil samples were pulled and a laser particle analyzer was utilized to provide ISO particle counts throughout the flush. The initial ISO particle count at the start of the flush was out of the detectable limits for the particle analyzer. The first complete particle count was an ISO 22/20/16 on 1/31/18. A final oil sample was taken and sent to a 3rd party lab resulting in an ISO particle count of 14/12/8.

Figure 6. 1st Screen Pull

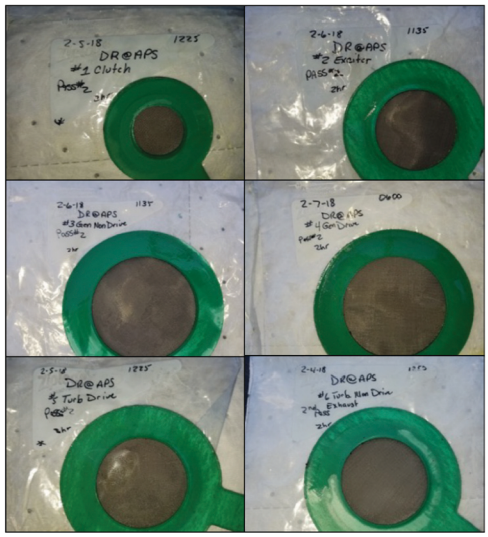

Figure 7. Final Screen Pulls

POST FLUSH

After verification of system cleanliness the RIG supply, discharge lines, and jumper materials were removed. The mechanically cleaned piping was reinstalled by DR/Siemens millwrights. Foreign material exclusion practices were used on all connections open to the atmosphere. The main lube oil reservoir was cleaned. Filling of the main lube oil reservoir was performed using 1um beta 1000 filtration and verified clean using the on-site laser particle counter. Filters, waste oil, and oily rags were properly disposed of on site. RIG equipment was removed from site and housekeeping was conducted in the work area.

Figure 8. Reservoir Cleaning

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Appendix I: Final Screen Pulls

RELIABLE INDUSTRIAL GROUP

Machine Condition	NORMAL
Lubricant Condition	NORMAL

Machine Name: Dr/Aps West Phoenix W501AA Cumb Turbine
Machine ID: Unit #1

Analysis Report

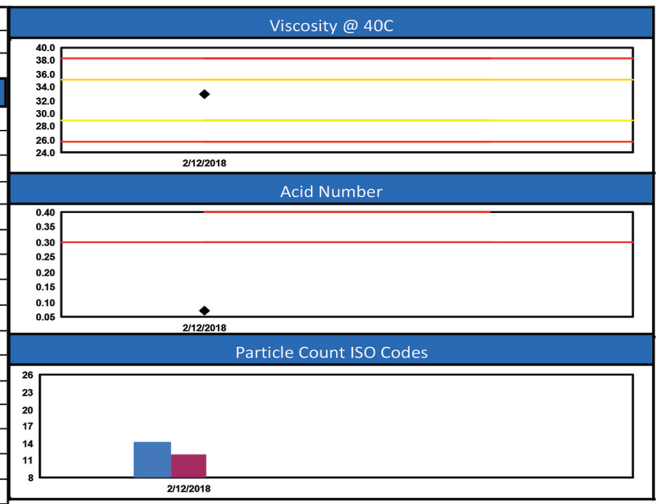
Component Information			Sample Information		Customer Information	
Machine Type:	Combustion Turbine	Sump Size: Unknown	Received:	02/13/2018	PetrolinkUSA, LLC	
Lubricant:	ChevronTexaco/GST 32		Report:	02/13/2018	3021 E. Fourth Ave.	
Machine MFG:	UNKNOWN		Sample No.:	3166 - 1 - 329 - 1	Columbus, OH 43219	
Machine MOD:			Analyst/Test:	MM / PARKF	Contact:	Jason Bandy

PROBLEMS No problems found with current sample.

COMMENTS The results for this sample indicate normal conditions. Please continue scheduled sampling.

CUSTOMER NOTES

Date Sampled		NEW OIL	2/12/2018				
Lab No		1842243	2156943				
Machine / Lube Cond.			N / N				
ELEMENTAL SPECTROSCOPY (ppm) ASTM D5185 Mod (-) indicates below detection limit							
Wear Metals	Iron	-	-				
	Copper	-	-				
	Lead	-	-				
	Aluminum	-	-				
	Tin	-	-				
	Nickel	-	-				
	Chromium	-	-				
	Titanium	-	-				
	Vanadium	-	-				
	Silver	-	-				
Additives	Calcium	-	-				
	Magnesium	-	-				
	Phosphorus	-	100				
	Zinc	-	8				
	Barium	-	-				
	Molybdenum	-	-				
Contaminants	Silicon	-	-				
	Boron	-	-				
	Lithium	-	-				
	Sodium	-	-				
	Potassium	-	-				
PARTICLE COUNT (particles per ml) ISO 4406:99							
Pore Block Particle Count Alarm Limits Marginal (18/16/14)							
Pore Block ISO Code		17/16/12	14/12/8				
>4 Micron		868	94				
>6 Micron		337	36				
>14 Micron		25	2				
>50 Micron		1	0				
>100 Micron		0	0				
VISCOSITY (centistokes) ASTM D445 MOD							
Viscosity@40°C		33.3	32.9				
ACID NUMBER (mg KOH/g) ASTM D974 MOD							
Acid Number		0.09	0.07				
WATER (PPM) a-ASTM D6304C b-IWI-134* c-Crackle d-IWI-135* e-IWI-370*							
Water			14 (a)				



Testing performed by Insight Services ®, an ISO/IEC 17025:2005 accredited laboratory L-A-B Accredited Certificate Number 2221 Testing. (*) - Not in scope of accreditation. PetrolinkUSA, LLC assumes sole responsibility for the application of and reliance upon results and recommendations reported by TestOil, whose obligation is limited to good faith performance.

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