

ENGINEERED PUMP SERVICES, INC.

624 Perkins Drive • Mukwonago, WI (262) 363-9002 • (800) 657-0845 • fax (262) 363-9013 www.epspumps.com • email: eps@epspumps.com

INSPECTION REPORT

CUSTOMER : East Kentucky Power Cooperative **REPORT DATE: 04/20/16**

PLANT NAME: Cooper Power Plant

REPORT NO. CUST. ORDER : EKPC-

: 55294-IR1

CITY/STATE

: Somerset, Kentucky

0000106453

EQUIPMENT

: 6" HL-11

COPY : Eddie Hudson

SERVICE

: Boiler Feed Water

: Pacific

FILE

: 55294

MANF.

PAGE : 1 of 4

SERIAL NO. : Unit #2A

The pump element referenced above was pulled for routine maintenance and sent to EPS for disassembly, cleaning, and inspection on 03/22/16. There were no difficulties with disassembly which proceeded using only moderate heat and normal tools. Overall, the pump is in good condition with no abnormal damage beyond the typical rotating wear seen on pumps that have been in service for an extended period of time. It should be noted that the overall fits and clearances were marginally looser than expected, but this does not seem to have affected pump performance or reliability. All parts were blast or hand cleaned as appropriate and inspected for fit and function. The results of that inspection are detailed below by part name.

I. Rotating Components

1) Shaft

- a) Ultrasonic and magnetic particle testing did not reveal any linear indications of damage to the shaft.
- b) The total indicated runout of the shaft is marginal at .003" TIR.
- c) The bearing journals have light grooving damage.
- d) The main shaft fit (impellers and sleeves) as well as the mechanical seal fits have light fretting in some areas.
- e) The thrust collar fit is fretted and worn undersize.
- f) Dimensionally, all critical fits measure at or very near to the expected design diameters.

2) Impellers

- There is light to moderate wear on all impeller wear ring turns resulting in excessive and eccentric running clearances at each stage.
- b) NDT found MT linear indications on all eleven impellers. They are mostly in the inlet vane areas and at the shroud to wear turn transition areas.
- c) The bores are all chromed and most measure to appropriate design diameters. Several of the bores are fretted and worked oversize.

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3) Pressure Reducing Sleeve

- a) There is moderate circumferential wear and grooving on the sealing turn resulting in excessive running clearance to the pressure reducing bushing.
- b) The sleeve fit bore measures close to the expected design diameter, but is lightly fretted and worked out of round.

4) Spacer Sleeves

- a) All of the spacer sleeves have moderate contact grooving on the wear turns. .
- b) The fit bores and axial lengths all measure to the appropriate design dimensions.
- 5) Impeller Lock Nut and Pressure Reducing Sleeve Lock Nut
 - a) Both shaft nuts have pulled spanner holes and light mechanical damage from disassembly.
 - b) Both shaft nuts have light to moderate wear on the outer turn from contact with the stuffing box bushing.

II. Stationary Components

6) Suction Cover

- a) The cover is in good condition with no visible erosion damage.
- b) The fit interference to the first casing cover is actually a very small clearance fit.
- c) The case ring has light eccentric wear resulting in excessive running clearance to the impeller wear turn.

7) Casing Covers (Series)

- a) All casing covers are in good condition with no visible erosion or damage. All diffuser vanes are in good condition and none of the diffuser welds are broken.
- b) The stage length of all of the casing covers all measure within tolerance of the design value.
- c) Both the cover bushings and wear rings are lightly worn resulting in excessive running clearances to the impellers and spacer sleeves.
- d) The diffuser vanes all have appropriate axial clearance between casing sections.
- e) All register fits between casing sections are actually small clearances as opposed to light interference fits.

8) Discharge Spacer

- a) The discharge spacer is in good condition with no vane damage or erosion.
- b) Both the cover bushing and wear ring are lightly worn resulting in excessive running clearance to the impeller and spacer sleeve.
- c) The register fit turn and register fit bore both measure to the expected diameter; however, as previously mentioned, the resulting fits are light clearances instead of the design interference.

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9) Discharge Diffuser

- a) The discharge diffuser is in fair condition.
- b) The fit bore to the discharge head is marginally over the design diameter, and the bore has some gall marks and working damage from the end head and gasket spacers.
- c) The fit turn to the discharge spacer measures marginally undersize resulting in excessive fit clearance.

10) Pressure Reducing Bushing

- a) The clearance bore to the pressure reducing sleeve has light wear, and the resulting running clearance to the pressure reducing sleeve is just beyond tolerance.
- b) The tac welded hardware holding the bushing in place on the discharge head is in good condition with no visible wear or cracks.

11) End Head

- a) Both gasket faces have some very light water erosion or pitted areas; for the internal gaskets, it looks like there are wash or drag marks on the fit turn to the discharge diffuser.
- b) Similar to the discharge diffuser, there is light working damage from the gasket spacer.
- c) There is a very small area of overlay weld at the flange to fit turn interface. It can only be assumed that this was an attempt to get a metal to metal seal on the inside of the flange face. The weld has started to corrode.

12) Assembly Rail and Keys

- a) The assembly rail has some drag marks and light galls, but it is straight overall and can be re-used.
- b) The impeller keys are all in good condition.



Photo 1: Typical Bearing Journal Wear

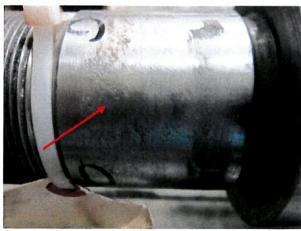


Photo 2: Shaft Fretting On Thrust Collar Fit

INSPECTION REPORT

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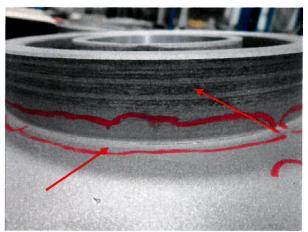


Photo 3: Typical Impeller Wear And Indications

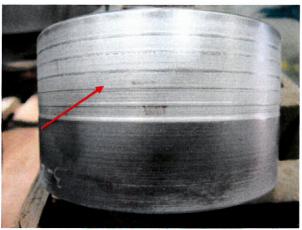


Photo 4: Typical Wear On Spacer Sleeves

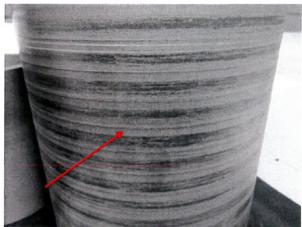


Photo 5: Wear On Pressure Reducing Sleeve

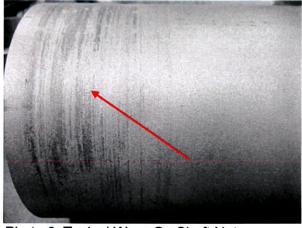


Photo 6: Typical Wear On Shaft Nuts

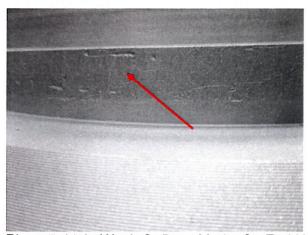
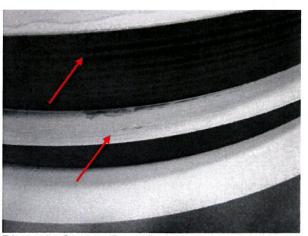


Photo 7: Light Wash Or Drag Marks On End Head Photo 8: Gasket Face Damage On End Hea



SALES ORDER: 55417 INSP. BY: ACS DATE: 10-21-15						
		2) Ru		10 6	9 5	8 4
		NOTES AND GENERAL COMMENTS: 1) Refer to the attached NDE Report for results of the ultrasonic and magnetic particle testing of the shaft 2) Refer to the impeller Data Sheet or Summary Sheet for component fits.	7th Stage Impeller	6th Stage Impeller	5th Stage Impeller	4th Stage Impeller
		NDE Report for Data Sheet or	3.623	3.623	3.623	3.623
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		onic and majornent fit	0025	002	002	002
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				ac	20 Thrust Collar	TE Bearing Journal
		12	_			umal
		<u> </u>		2.375	2.499	3.375
		4		.000	.000	.000
				.000	.000	.000
01 ACS 10-21-15				.000	.000	.000
PART NO. NOTE WEIGHT		17		.000	.000	.000
PART NAME: SHAFT INSPECTION PART NO. : 105-500-001 NOTE : PACIFIC 6" LS-11 BFP WEIGHT : DRAFT: GCW SCALE : NTS PAGE : 1 of 2	ENGINEERED PUMP SERVICES, INC. MUKWONAGO, WISCONSIN	19 20 21				

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DIAMETER

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90°

180°

270°

LOC DESCRIPTION

DIAMETER

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90° -.0015

180°

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-001

LOCATION

SHAFT

INDICATED SHAFT RUNOUT @

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-.003 .00

-.003 .000

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14 10th Stage Impeller 13 9th Stage Impeller 12 8th Stage Impeller

[8]

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15 11th Stage Impeller 16 Press. Red. Sleeve

SHAFT

INDICATED SHAFT RUNOUT @

Coupling fit DESCRIPTION LOCATION

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3rd Stage Impeller

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18 Shaft Sleeve, Minor

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17 Shaft Sleeve, Major

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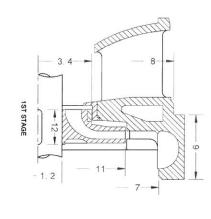
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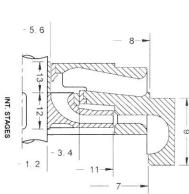
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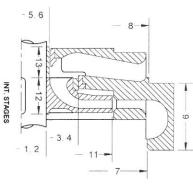
2nd Stage Impeller

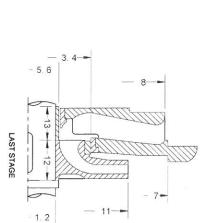
1st Stage Impeller Shaft Sleeve, Major Shaft Sleeve, Minor CE Bearing Journal

3.504









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SPACER SLV LENGTH	HUB LENGTH	IMPELLER DIA.	NUMBER OF VANES	STAGE LENGTH	CLEARANCE	CASE FIT TURN	CASE FIT BORE	CLEARANCE	SPACER SLV TURN	BUSHING BORE	CLEARANCE	IMP EYE TURN	CASE RING BORE	CLEARANCE	SHAFT DIA @ IMP.	IMPELLER BORE DIA.	DESCRIPTION
2.251	2.745	12.375	7	5.001	.001002	17.370 - 17.371	17.372	.014020	4.257 - 4.260	4.274 - 4.277	.014019	8.503 - 8.505	8.519 - 8.522	.003	3.623	3.626	IMP #1
2.249	2.742	12.380	6	4.999	.001002	17.371 - 17.372	17.373	.013017	4.258 - 4.260	4.273 - 4.275	.016020	7.372 - 7.374	7.390 - 7.392	.002003	3.623	3.625 - 3.626	IMP #2
2.250	2.751	12.370	6	5.001	(.000)001	17.372	17.372 - 17.373	.017022	4.257 - 4.260	4.277 - 4.279	.018022	7.372 - 7.374	7.392 - 7.394	.003004	3.623	3.626 - 3.627	IMP #3
2.250	2.745	12.370	6	5.000	.001002	17.372	17.372 - 17.373 17.373 - 17.374 17.372 - 17.373	.016022	4.256 - 4.260	4.276 - 4.278	.016020	7.372 - 7.374	7.390 - 7.392	.003004	3.623	3.626 - 3.627	IMP #4
2.251	2.750	12.375	6	4.999	(.000)001	17.372	17.372 - 17.373	.017022	4.257 - 4.260	4.277 - 4.279	.017023	7.372 - 7.373	7.390 - 7.395	.003	3.623	3.626	IMP #5
2.251	2.741	12.375	6	5.000	.001002	17.371 - 17.372	17.373	.017022	4.256 - 4.260	4.277 - 4.278	.017022	7.371 - 7.374	7.391 - 7.393	.003004	3.623	3.626 - 3.627	IMP #6
2.251	2.746	12.375	6	5.000	.002003	17.371 - 17.372 17.371 - 17.372	17.374	.016022	4.256 - 4.260	4.276 - 4.278	.015018	7.373 - 7.375	7.390 - 7.391	.002003	3.623	3.625 - 3.626	IMP #7
2.250	2.748	12.370	6	5.001	(.000)001	17.372	17.372 - 17.373	.014021	4.255 - 4.260	4.274 - 4.276	.017021	7.372 - 7.374	7.391 - 7.393	.002003	3.623	3.625 - 3.626	IMP #8
2.249	2.752	12.380	6	4.999	.001003	17.371 - 17.372	2 - 17.373 17.373 - 17.374 17.373 - 17.374	.014020	4.256 - 4.260	4.275 - 4.277	.018022	7.371 - 7.374	7.392 - 7.393	.003	3.623	3.626	IMP #9
2.249	2.751	12.370	6	5.001	.001002	17.372	17.373 - 17.374	.015022	4.255 - 4.260	4.273 - 4.275	.018022	7.373	7.391 - 7.393	.00 200.	3.623	3.626 - 3.627	01# dWI
2.251	2.743	12.375	6	N/A	.003	17.249	17.252	N/A	N/A	N/A	.016018	7.373 - 7.374	7.390391	.003004	3.623	3.626 - 3.627	IMP #11

PART NAME: PUMP INSPECTION
PART NO.: 105-500-003
MATERIAL: PACIFIC 6" LS-11 STAGE
WEIGHT: LBS. DRAFT:
SCALE: NTS PAGE:: ENGINEERED PUMP SERVICES, INC.
MUKWONAGO, WISCONSIN DRAFT: DSB PAGE : 2 OF 2



3710 N. Richards Road, Milwaukee, WI 53212 1-800-337-4884 L-A-B Accredited Certificate Number L2243

MAGNETIC PARTICLE INSPECTION CERTIFICATION REPORT

CUSTOMER					LC	CATIC	DN/COI	NTACT DATE				PAGE#		
ENGINEERED PU	MP SE	IP SERVICES				LT:	S, INC	0		3-	31-2016	1 OF 1		
P.O. NUMBER		ITE	W DE	SCRIE	IPTION/PN LOT N					JMBE	R	QUANTITY		
36461			5	SHAF	HAFT			N/A				1		
JOB NUMBER			JOB	NO.			SUR	FACE COND	ITION		MATE	MATERIAL TYPE		
W0316-43693			5529	94-01			A	S MACHINE	ED		CARBON STEEL			
TYPE OF EXAM	IOITAN	٧		E	CAMINAT	ION ST	ΓANDA	RD		Α	CCEPTANCE S	STANDARD		
MAGNETIC PA	RTICL	.E			AST	ME7	709			CUS	ST SPEC / N	O LINEARS		
ADDITIONAL INSTRUCT	IONS/IN	IFORMATIC	N			ND	E PRO	CEDURE			DRAWING N	IO. OR PMS NO.		
ı	N/A					QO	CP 500	0 REV.3			- 1	N/A		
MT EQUIPMENT TYPE		T EQUIPME RIAL NUME			VEHICL TYPE		V	'EHICLE BAT NUMBER		PAF	RTICLE TYPE	PARTICLE BATCH NUMBER		
PARKER HAND YOKE		19772			WATE	R	N/A				14A	01-9130-80		
CURRENT TYPE	PART	TICLE APPLICATION MI			ON METHOD CIRCUL			AR FIELD AMPERAGE			LONGITUDIN	AL FIELD AMPERAGE		
DC		SPI	RAY					N/A				N/A		
ITEM/PART	NUMBE	R		ACCEPT		REJ	REJECT			EFEC	T TYPE/REMAR	RKS		
SHA	FT				1	0	,	NO REJECT	TABLE IN	TIONS NOTED				
	0.140													
T1	DEAD	2011			. 5			00111151	TO (01)					
Technician: JUSTIN PEARSON			L	_evel	: Dat	te:	İ	COMMENTS/SKETCH:						
SIGNATURE ON FILE II 3-3				<u>1-201</u>	6	JOB NUMBER: 55294 CUSTOMER: EKPC-COOPER PUMP: PACIFIC 6" HL-11 BFP								
Technician:			L	.evel	: Da	ate:								



3710 N. Richards Road, Milwaukee, WI 53212 1-800-337-4884

ULTRASONIC INSPECTION CERTIFICATION

CUSTOMER				LOCATION/CONTACT						DATE	PAGE #		
ENGINNERED PU	ENGINNERED PUMP SERVICES					LT	S, INC			3-31-2016	1 OF 1		
P.O. NUMBER		ITE	M D	ESCR	IPTION/PN	1			LOT NU	IMBER	QUANTITY		
36461				SHAFT					N/	Α	1		
JOB NUMBER			JO	B NO.			SUR	ACE CONDI	TION	MATE	MATERIAL TYPE		
W0316-43693			552	294-01	1		A	S MACHINE	D	CARBON STEEL			
TYPE OF EXAM	NATIO	N		E	XAMINAT	ION S	TANDA	RD		ACCEPTANCE S	ACCEPTANCE STANDARD		
ULTRASO	NIC				AST	M A !	578		NO	CRACKS OR SE	AMS ALLOWED		
ADDITIONAL INSTRUCT	IONS/II	NFORMATI	ON			ND	DE PRO	CEDURE		DRAWING N	NO. OR PMS NO.		
1	N/A					Q	CP 600	0 REV.3			N/A		
UT EQUIPMENT TYPE		T EQUIPME			TRANSDU TYPE		TRA	ASDUCER SIZE	TRAN	NSDUCER SERIAL NUMBER	COUPLANT BATCH NUMBER		
PANAMETRICS	(07014660)3		C106	6		0.5"		579177	14A REDI-BATH 01-9130-80		
SENSTIVITY	LEVEL	•		CALI	BRATION	BLOC	KS SIZ	E/SERIAL NU	MBER		EDESCRIPTION		
41.1 🖸	В			DSC / 788						RASTER SCAN / BACK WALL REFLECTION			
ITEM/PART I	NUMBE	R		A	CCEPT	REJ	ECT	7.55	RKS				
SHAI	тт				1	(0	NO REJEC	TED				
										in simunian i e iji e			
Technician: JUSTIN	PEAF	RSON	Le	vel:	Dat	e:		Comment	s/Sketo	ch:			
SIGNATURE ON FILI	=		П		3-31	I-201		JOB NUM					
	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		••		- 0 0					PC-COOPER 6" HL-11 BFP			
Technician:			Le	vel:	Date	e:							



3710 N. Richards Road, Milwaukee, WI 53212 1-800-337-4884 L-A-B Accredited Certificate Number L2243

MAGNETIC PARTICLE INSPECTION CERTIFICATION REPORT

CUSTOMER				LC	CATIC	N/CON	NTACT		PAGE#				
ENGINEERED PU	MP SE	ERVICES		LTS, INC					3-31-2016		1 OF 1		
P.O. NUMBER		ITE	M DESC	RIPTION/PI	N			LOT N	JMBE	R	QUANTITY		
36463			IMPE	LLERS		N					11		
JOB NUMBER			JOB N	0.		SURF	ACE COND	ITION		MATERIAL TYPE			
W0316-43699	<u> </u>		55294-	01		A	S RECEIVE	ΕD		STEEL			
TYPE OF EXAM	NATIO	N		EXAMINAT	ION ST	TANDA	RD		Α	CCEPTANCE S	STANDARD		
MAGNETIC PA	RTICL	.E		ASTM	1 E 70	9-08			NT SPEC / N	NO LINEARS			
ADDITIONAL INSTRUCT	IONS/IN	IFORMATIC	N		ND	E PRO	CEDURE			DRAWING N	IO. OR PMS NO.		
	N/A				QC	CP 500	REV.3			N/A			
MT EQUIPMENT TYPE		T EQUIPME RIAL NUME		VECHII TYPE		V	EHICLE BAT NUMBER		PAI	RTICLE TYPE	PARTICLE BATCH NUMBER		
V1-60		88001	CARRI #2	ER		7346L15			14A	14K082			
CURRENT TYPE	PART	ICLE APPL	METHOD	CI	RCULA	LAR FIELD AMPERAGE			LONGITUDINAL FIELD AMPERAG				
DC		SPI	RAY				2000	2000			N/A		
ITEM/PART	NUMBE	R		ACCEPT	REJE	ECT		D	EFEC	T TYPE/REMAR	RKS		
IMPELI	ERS			0	11	11 LINEAR INDICA				ATIONS 1/16" TO 4"			
				1100 11 1000									
								40 1000					
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Technician: ANTHO	IV DA	1											
Technician: AN IHO	VY PA	DRON			ate:		COMMEN	IIS/SKI	EICH	1:			
_ Aanway	1 a	h	112	3-	31-20	16	CUSTOM	ER INF	ORM	ATION:			
			*			- 1	Job Numb Customer:			205			
Technician:			Lev	/el: Da	ate:		Pump: Pac						



3710 N. Richards Road, Milwaukee, WI 53212

Defect Map

Page 1 of 3

	rage 1 or .
Customer: EPS	Date: 3/31/16
Part Number: Impellers	Customer P.O. Number: 36463
Job Number: W0316-43699	



Linear indications found on hub turn from 1/16" - 3/16".



Linear indications found on hub turn and vane outlet from 1/16" - 4".



Linear indications found on hub turn from 1/16'' - 4''.



Linear indications found on hub turn from 1/16'' - 3/16''.



3710 N. Richards Road, Milwaukee, WI 53212

Defect Map

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Customer: EPS	Date: 3/31/16
Part Number: Impellers	Customer P.O. Number: 36463
Job Number: W0316-43699	



Linear indications found on hub turn and vane outlets from $1/16'' - \frac{1}{4}''$.



Linear indications found on hub turn and vane inlets from 1/16'' - 1/2''.



Linear indications found on hub turn from 1/16'' - 1/8''.



Linear indications found on hub turn and vane inlet from 1/16" - 1/4".



3710 N. Richards Road, Milwaukee, WI 53212

Defect Map

	Page 3 of
Customer: EPS	Date: 3/31/16
Part Number: Impellers	Customer P.O. Number: 36463
Job Number: W0316-43699	



Linear indications found on hub turn from 1/16" - 1/8".



Linear indications found on hub turn at 1/4".



Linear indications found on hub turn from 1/16" -3/16".