ENGINEERED PUMP SERVICES, INC.
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(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**	: 01/17/22
PLANT NAME	: Spurlock Station	**REPORT NO.**	: 56731-IR1
CITY/STATE	: Maysville, KY	**CUST. ORDER**	: TBD
EQUIPMENT	: 12x12x14 HDB-6	**COPY**	: Tony Ring
SERVICE	: Boiler Feed		
MANF.	: Byron-Jackson	**FILE**	: 56731
SERIAL NO.	: Unit 2A	**PAGE**	: 1 of 4

The subject pump was pulled from service at Spurlock Station after experiencing a hard rub (Summer 2021) during operation. It was received at EPS on 11/01/21. The pump assembly was completely dismantled and all parts except for the shaft were glass bead blast cleaned. NDT was performed on all seven impellers and the shaft. Each component was visually and dimensionally inspected. The results of the inspection are as follows.

Summary:
Overall, the pump is in good condition with only very light wear and no areas of concern; a few of the components have diameters that have "moved" out of round during pump operation or disassembly, but most items measure very close to the expected design dimensions. Disassembly of the pump proceeded with only moderate difficulty using light heat and normal tools. The results of the individual parts inspections are listed below by name and item number. The only unusual observation was that the balance sleeve was cracked as received. There was no clear indication as to what caused this. See the pages attached to this report for full dimensional information and non destructive testing results.

Shaft (167) – Overall, the shaft is in very good condition with only minor (under .0015" TIR) runout. During disassembly, several of the fit turns were lightly galled during removal of the impellers. The major impeller and sleeve turns all measured to the expected diameters and provided ideal fit interferences and running clearances to the corresponding mating parts. Both bearing journals are lightly grooved, and there is minor visible wear on the spiral breakdown grooves on the coupling end. Based on the service report from removing this pump element, it is assumed that this was the area that made hard contact with the bearing cover and caused the noise heard at the plant during operation. Magnetic particle and ultrasonic NDE analysis did not reveal any linear indications of damage to the shaft.

BY: Aaron Stull

INSPECTION REPORT

Impellers (176) - Most of the impeller bores are in good condition with the exception of the 3rd stage which was lightly out of round; the resulting fit interferences to the shaft are all very close to design specification. All series seal turns (hub and eye) appear to be laser weld (40-45 Rc) surface hardened, and the process seems to have performed well during pump operation. Each turn is only lightly worn resulting in marginally excessive running clearances to the corresponding case rings and stage pieces. NDT examination of the impellers found few or no linear indications on all seven impellers.

Impeller Retaining Ring - Split (256) - Overall, the impeller split rings are in fair condition with light thrust damage and tool marks from disassembly.

1st Stage Shaft Sleeve (217) - The shaft sleeve is in good visual condition with only light wear on the outer turn; dimensionally, the fit bore to the shaft is lightly out of round and appears to have collapsed during the assembly or disassembly process.

Wear Rings - Case (205) - Typically speaking, all case rings are in good visual and dimensional condition. The main exceptions are the outboard 1st stage ring and booster ring which are moderately out of round on both the fit turn and sealing bore. Most of the case rings have a little or no visible wear and measure close to the expected design diameter; as mentioned previously, all resulting running clearances to the impeller turns are only marginally excessive. With the exception of the previously mentioned 1st stage outboard ring, the fit clearances to the volute casing are very close to design specifications.

Stage Pieces (009) – Typically speaking, all stage pieces are in very similar condition to the case wear rings with marginally excessive running clearances to the impellers and very good fit clearances to the volute casing. There is only very light visible wear in some of the sealing bores and no evidence of water erosion on the sealing faces.

Balance Sleeve (218) – As mentioned in the introduction, the balance sleeve was cracked as received. The crack location is close to the split ring face. Dimensionally, the sleeve measures close to expected dimensions, and the material (420 SS) seems to be the correct hardness for this application. There does not seem to be any obvious reason for the crack, and there was no ancillary damage caused to the pump element.

Volute Bushing (26) - The volute bushing is in good condition. Visually, there is light fretting in the aligning fit bore to the end head, but the bore measures to the correct diameter. The fit turn to the volute has a marginally oversize fit clearance to the volute case receiving bore.

Volute Case (001) - The volute case is in good condition. Dimensionally, all fit bores measure consistently to the same diameter with close to equal depth between the upper and lower case halves. As mentioned above, the majority of fit clearances to the stationary rings meet design specifications, and there is no evidence of any water erosion damage anywhere in the casing.

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Hardware – Overall, the hardware is in fair condition. Several of the main joint volute cap screws are lightly damaged from disassembly. The nuts and studs for the volute are in fair condition with only minor tool damage. All of the internal splitters and fasteners are in good condition.

Digital Photographs:

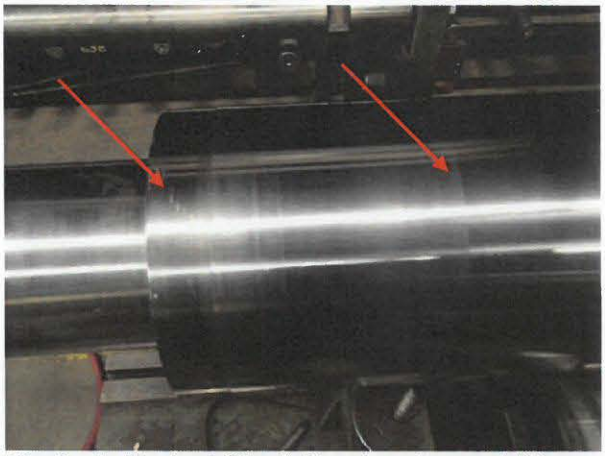

Photo 1: Typical Shaft Bearing Journal Wear

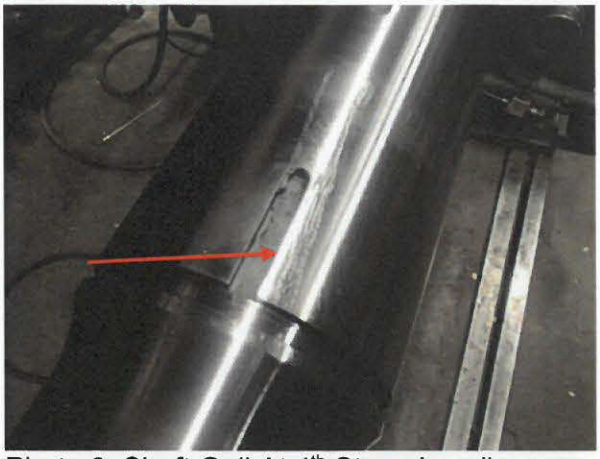

Photo 2: Shaft Gall At 4th Stage Impeller

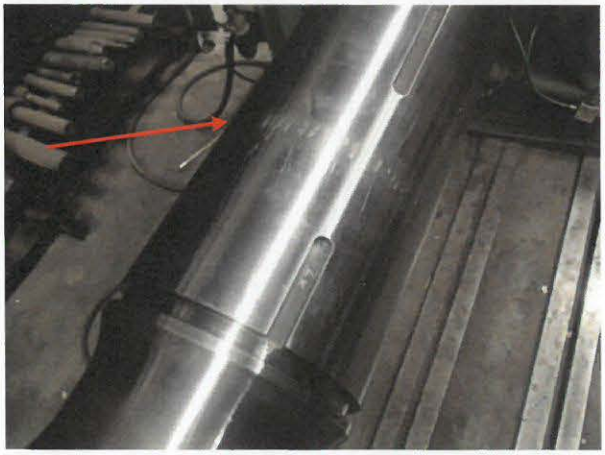

Photo 3: Shaft Gall On Center Impeller Fit

Photo 4: Typical Wear On Impeller Turns

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Photo 5: Cracked Balance Sleeve (As Received)

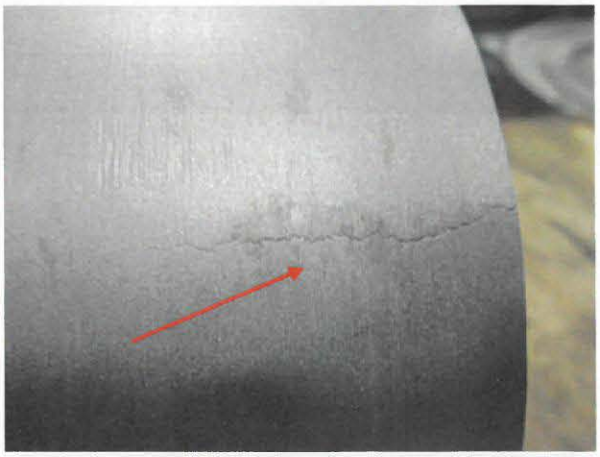


Photo 6: Cracked Balance Sleeve (When Clean)

Photo 7: Light Wear On 1-2 Sleeve Turn

Photo 8: Fretting In 1-2 Sleeve Fit Bore

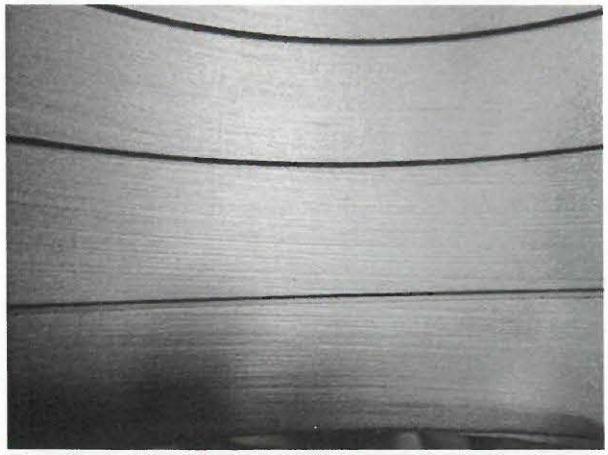


Photo 9: Light Wear On Center Stage Piece

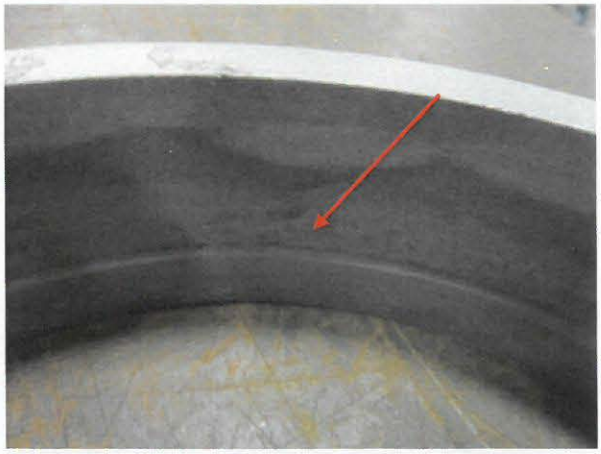
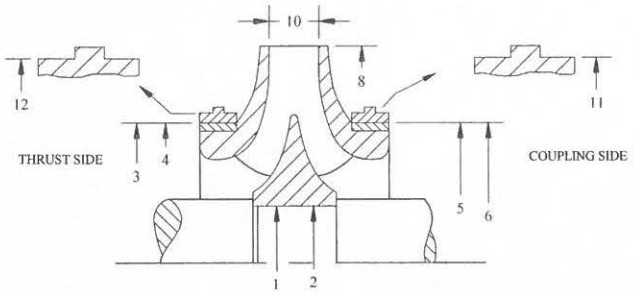
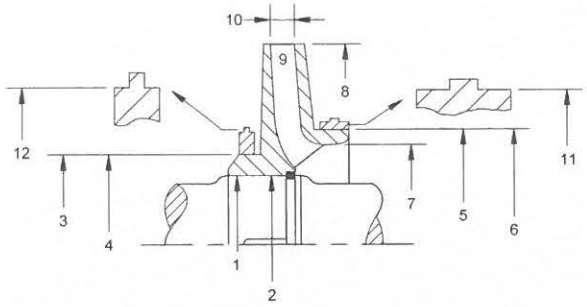


Photo 10: Fretting In Volute Bushing Bore

	DESCRIPTION	STAGE 1		1ST STG. SLV.		STAGE 2		STAGE 3		STAGE 4		STAGE 5		STAGE 6		BOOSTER	
1	SHAFT DIAMETER AT IMPELLER	5.498	5.498	5.504	5.504	5.514	5.514	5.519	5.519	5.509	5.509	5.514	5.514	5.519	5.519	5.519	5.519
2	IMPELLER BORE DIAMETER	5.495	5.496	5.500	5.501	5.510	5.511	5.516	5.518	5.506	5.506	5.511	5.512	5.515	5.516	5.515	5.516
	FIT CLEARANCE	(0.003)	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)
3	IMPELLER HUB RING TURN	9.231	9.234	6.734	6.735	6.734	6.735	6.735	6.736	6.735	6.736	6.734	6.735	6.735	6.736	6.735	6.736
4	STAGE PIECE BORE	9.254	9.256	6.751	6.752	6.750	6.750	6.752	6.753	6.750	6.751	6.751	6.753	6.750	6.751	6.752	6.753
	RUNNING CLEARANCE	0.020	0.025	0.016	0.018	0.015	0.016	0.016	0.018	0.014	0.016	0.016	0.019	0.014	0.016	0.016	0.018
5	IMPELLER EYE RING TURN	8.984	8.986	N/A	N/A	8.483	8.484	8.482	8.484	8.483	8.485	8.482	8.483	8.482	8.483	7.234	7.235
6	CASING RING BORE	9.001	9.002	N/A	N/A	8.502	8.503	8.501	8.502	8.502	8.503	8.501	8.502	8.501	8.503	7.250	7.251
	RUNNING CLEARANCE	0.015	0.018	N/A	N/A	0.018	0.020	0.017	0.020	0.017	0.020	0.018	0.020	0.018	0.021	0.015	0.017
7	IMP. EYE DIA./ROTATION (*)	7.86	Dual	N/A	N/A	7.26	CCW	7.25	CCW	7.25	CW	7.26	CW	7.25	CW	6.49	CW
8	IMP. MAJOR DIA. / VANE DIA.	11.74	Full	N/A	N/A	13.85	Full	13.86	Full	13.87	Full	13.87	Full	13.86	Full	10.15	Full
9	# OF VANES / B-VANE LENGTH	3	0.28	N/A	N/A	5	0.24	5	0.24	5	0.25	5	0.25	5	0.26	11.00	0.66
10	DISCHARGE PASSAGE WIDTH	1.83		N/A		1.36		1.35		1.34		1.36		1.36		0.47	
11	CASING RING FIT TURN	9.749	9.752	N/A	N/A	9.499	9.500	9.499	9.500	9.499	9.500	9.499	9.499	9.498	9.501	9.498	9.502
	CASING RING FIT BORE	9.752	9.753	N/A	N/A	9.501	9.502	9.502	9.503	9.501	9.502	9.502	9.503	9.502	9.503	9.502	9.503
	FIT CLEARANCE	0.000	0.004	N/A	N/A	0.001	0.003	0.002	0.004	0.001	0.003	0.003	0.004	0.001	0.005	0.000	0.005
12	STAGE PIECE FIT TURN	9.746	9.754	9.499	9.500	9.498	9.499	9.498	9.499	9.498	9.499	9.499	9.500	9.499	9.499	9.498	9.499
	STAGE PIECE FIT BORE	9.752	9.753	9.501	9.502	9.501	9.502	9.502	9.503	9.501	9.502	9.502	9.503	9.502	9.503	9.502	9.503
	FIT CLEARANCE	(0.002)	0.007	0.001	0.003	0.002	0.004	0.003	0.005	0.002	0.004	0.002	0.004	0.003	0.004	0.003	0.005
13	IMP. HUB RING HARDNESS (Rc)	40 Rc		35 Rc		40 Rc		40 Rc		40 Rc		40 Rc		40 Rc		40 Rc	
14	STAGE PIECE HARDNESS (Rc)	55 Rc		55 Rc		55 Rc		55 Rc		55 Rc		55 Rc		55 Rc		55 Rc	
15	IMP. EYE RING HARDNESS (Rc)	40 Rc		N/A		40 Rc		40 Rc		40 Rc		40 Rc		40 Rc		40 Rc	
16	CASING RING HARDNESS (Rc)	55 Rc		N/A		55 Rc		55 Rc		55 Rc		55 Rc		55 Rc		55 Rc	





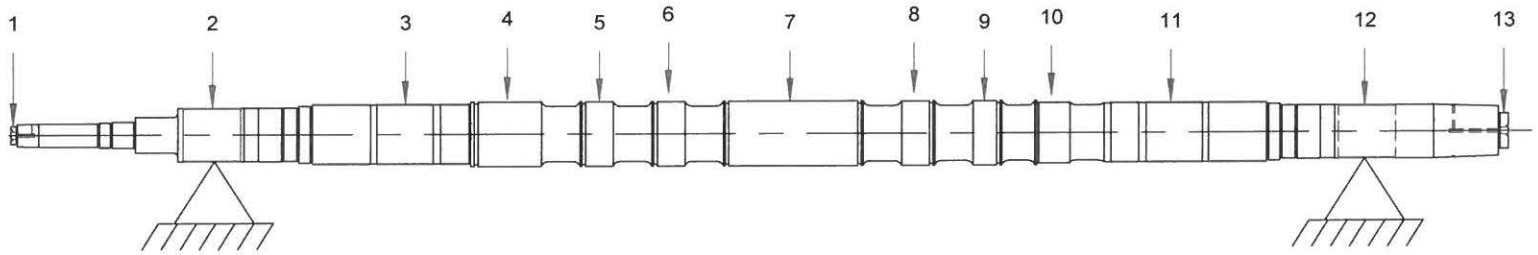
EPS NO : 56731

DATE : 01/14/22

INITIALS : ACS

ENGINEERED PUMP SERVICES, INC.
MUKWONAGO, WISCONSIN

01	PART NAME: INSPECTION - IMPELLERS	
RJK, 09/27/05	PART NO. :102-500-115	
	NOTE :USE FOR B-J TYPE HDB BFP"S	
	WEIGHT :- -	DRAFT: RJK
	SCALE :NTS	PAGE : 1 of 2



	1	2	3	4	5	6	7	8	9	10	11	12	13
0°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0005	0.0000	0.0000	-0.0005	0.0000	0.0000	0.0000
180°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Diameter	2.499 - 2.500	5.250	5.485	5.504	5.509 - 5.510	5.514 - 5.515	5.519	5.519 - 5.520	5.504	5.499 - 5.500	5.485	5.250 - 5.251	3.471 Minor

1 ACS 01-14-22

UNLESS OTHERWISE SPECIFIED

ALL DIMENSIONS ARE IN INCHES

TOLERANCES:

DECIMALS: .X ± .1; .XX ± .01; .XXX ± .005

ANGULAR ± .25°

SURFACE ROUGHNESS 125

3RD ANGLE PROJECTION

DRAWN BY SMG

CHECKED BY ACS

ENGINEERED PUMP SERVICES, INC.

MUKWONAGO, WISCONSIN

SIZE A | PART NAME SHAFT INSPECTION

PART NO. 102-500-115

MATERIAL 416 STAINLESS STEEL

SCALE NTS | WEIGHT LBS. | SHEET 2 OF 2 | REV 1

REMOVE ALL BURRS AND SHARP EDGES .03 MAX RADIUS OR CHAMFER.

This test is accredited and meet(s) the requirements of ISO/IEC 17025 as verified by the ANSI-ASQ National Accreditation Board/ANAB. Refer to certificate and scope of accreditation (L-2243 Milwaukee).

Acuren Inspection, Inc.
3710 North Richards Street
Milwaukee, Wisconsin 53212

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A Higher Level of Reliability

Report Number: MIL837576

MAGNETIC PARTICLE EXAMINATION REPORT

CUSTOMER:	ACUREN SERVICE CALL #:	DATE:
ENGINEERED PUMP SERVICES	768246	01/12/2022

LOCATION/ADDRESS:	CUSTOMER CONTACT:
3710 North Richards Street Milwaukee, Wisconsin 53212	RICHARD LAUX

PART # / DRAWING #:	CUSTOMER PO #:	CUSTOMER WO #:
Impeller	3034302	56731-01

ITEM DESCRIPTION:	STAGE OF MANUFACTURE:	SURFACE CONDITION:
Impeller	In Process	Media Blasted

SURFACE PREPARATION:	COMMENT:	PARTS INSPECTED:	ACCEPTABLE:	REJECTED:
N/A	N/A	7	7	0

NDE PROCEDURE	REV.	SPECIFICATION/CODE	REV./EDITION	ACCEPTANCE STANDARD
MT-5	2	ASTM E 709-21	2021	CLIENT SPEC / NO LINEARS

MATERIAL:	THICKNESS:	QUANTITY:	ITEM TEMP.:
N/A	varied in.	7	70 °F

☑ Wet	☐ Dry	☑ Continuous	☐ AC	☐ Halfwave	Weight S/N's	
☑ Fluorescent	☐ Perm. Magnet	☐ Residual	☑ DC	☑ Fullwave	1. N/A	
☐ Yoke	☐ Spacing: ____	☐ Prod. Spacing: ____	Amps: 50%		2. N/A	
☑ Circular	☑ Direct Contact	☐ Central Conductor	Amps: ____	Yoke Daily Verification:	3. N/A	
☑ Longitudinal	☐ Wrap, Turns: ____	☐ Fixed Coil Turns	Amps: ____	☐ Acc. ☐ Rej. ☑ N/A	4. N/A	

EQUIPMENT MODEL:	SERIAL NO.:	CAL. DUE DATE:	MEDIUM MANUFACTURER:	TYPE:	COLOR:	BATCH NO.:
Magnaflux MD3-2060-LR	202289	01/09/2022	Magnaflux	14A	BLK	19G047

DEMAGNETIZATION EQUIPMENT: AC Coil — ☑ Yes ☐ No

BLACKLIGHT MFG. OR LIST APPROVED LIGHT SOURCE:	SERIAL NO.:	LIGHTMETER MFG./SN:	SERIAL NO.:	CAL. DUE DATE:	INTENSITY: 3500
Rel, Inc.	02231704	121020A	208914	08/03/2022	☐ FC ☐ LUX ☑ µW/CM²

Items	Quantity	Comments	Accept/Reject
-	7	Accepted.	Accept
-	N/A	All Impellers accepted.	Info. Only
-	INFO	Customer: EKPC-Spurlock	Info. Only
-	INFO	Pump: Byron-Jackson 12x12x14 HDB-6	Info. Only
-	INFO	Job Number: 56731-01 Order Number: 3034302	Info. Only

☐ High Temp	Wire Wheel:	Other:	Customer Contact:

Per Diem:	Unit #:	No. on Job:	Travel if Applicable: Hours: Miles Total:	Hours Worked: to and to	Total Hours:

CLIENT REPRESENTATIVE		ACUREN INSPECTOR			
		Kyle Schmidt		01/12/2022	NAS 410 II
Print Name / Signature	Date	Print Name / Signature		Date	Inspection Level

Client acknowledges receipt and custody of the report or other work ("Deliverable"). Client agrees that it is responsible for assuring that acceptance standards, specifications and criteria in the Deliverable and Statement of Work ("SOW") are correct. Client acknowledges that Acuren is providing the Deliverable according to the SOW, and not any other standards.

PEER REVIEW (IF APPLICABLE):

Print Name / Signature — Date

Client acknowledges that it is responsible for the failure of any items inspected to meet standards, and for remediation. Client has 15 business days following the date Acuren provides the Deliverable to inspect it, identify deficiencies in writing, and provide written rejection, or else the Deliverable will be deemed accepted. The Deliverable and other services provided by Acuren are governed by a Master Services Agreement ("MSA"). If the parties have not entered into an MSA, then the Deliverable and services are governed by the SOW and the "Acuren Standard Service Terms" (www.acuren.com/serviceterms) in effect when the services were ordered.