SUMMIT A Inspection Services Ltd. The Peak in Integrity and Quality Inspection

Report # 002799-02

Cover Page – Pressure Vessel																				
Client:	Canad	ian Natural I	Resources L	.im	ited	Insp	pection Date:	December 9, 2015												
Facility:	Grand	Forks 04-01	Battery			LSI):	04-01-013-13 W4M												
Requested By	: Kyle H	Huculak				A#/	SN/NB#:	A0161444												
Equipment:	Free V	Vater Knock	out #2					·												
	·		Equir	pm	ent St	atus														
In Service		Standby	11	Sweet Service				Insulated												
Not In Service		Unknown			Sou Sou	ır Serv	vice	Not Insulated												
			P	roo	cedure	۲		1												
SISL-20 UT Cor	rrosion Sur	vey, Rev. 1, 2	013		SISL-	-24 P	ressure Vessel V	E/VI Insp., Rev. 0, 2013												
								2												
Technicians/Inspectors Certifications																				
Tyler Morrison		API-51	0# 49000		I	SI# 0	00801	CGSB II -UT# 15005												
Technique																				
Technique UT Thickness MPI (Dry Powder) Visual (External) LPI (Visible Aqueous)																				
UT Shearwave	Ę	MPI (Wet Flue	orescent)		Visual (Intern	al) 🗌 Ll	PI (Visible Solvent Removable)												
\Box UT (C-scan)	L	_ MPI (Wet Vis □ PVT	ible)	Н	Hardnes	s (Mie (Tal	crodur) [] Ll	PI (Fluorescent Water Washable)												
Automated UT		Holiday Detec	tion	Н	Chemica	al Etch	ning	Phased Array RVT Hardness (Telebrinel) LPI (Fluorescent Solvent Removable) Automated UT Holiday Detection Chemical Etching												
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	Equip	ment					Consu	umables												
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Nameplate / PRD Audit Form												
			Equi	pment N	ameplate							
Tag / Eqpt #:			•		Built:	March 1980						
Asset #:					MWP:	517 kPa @	93°C	MDN	MDMT:			
Vessel Name:	Free '	Water Kno	ockout #2		RT:	RT-2			JE: 1	00%		
Reg. No.:	A016	1444			C.A.:	NIL						
S/N:	LM-1	671			Dia. Shell	96" I.D.	Di	Dia. Boot:				
NB #:				Dia. Ac	cumulator		Dia. Ga	s Dome:	Dome: No Access			
CRN:	C-880)5.2		Heat '	Treatment	Unknown						
	No	minal	Material	M	Material							
Shell 1:	7.931	nm	SA-285-C		Head 1:	12.70 mm		SA-285-	<u>C</u>			
Shell 2:	CEI	Notoo Lim	vited		Head 2:	15 mm		SA-285-	C			
PRD Information												
PRD	S/N:				Mo	del of PRD:						
T	ag #:				Colo	our of PRD:	Blue					
Set Pres	sure:				Inlet /	Outlet Size:		3"/3				
	acity:				Conne	ction Type:	Threaded	1				
Date of Last Sel	rvice:				Deels V	ode Stamp:	No					
AS	CDN.				DIOCK V	D L ocotion	NO					
Manufact	urer.					D Location	V CSSCI					
PRD Inspection												
Was the MAWP of the	e vessel	greater or	equal to the PRD set	pressure?								
Has the PRD been ser	viced w	ithin the pa	st 6 years?									
Were the bonnet seal a	and blow	vdown adju	istment seal wires st	ill intact?								
Was the PRD installed	l vertica	lly?										
Was the CRN register	ed in th	e appropria	te province?									
If the valve was a pilo	t operat	ed valve, w	as the pilot vent plu	g removed?								
If there was an isolatir electronic interlock in	ng valve place?	on the PR	D inlet or outlet, was	s it properly	car-sealed op	oen or was there	e an					
Was the inlet piping d	iameter	equal to or	greater than the PR	D inlet?								
Was there discharge p	iping at	tached to th	ne PRD?									
Was the discharge pip	ing free	from obstr	ruction?									
Was the discharge pip	ing free	of pockete	ed areas?									
Was the discharge pip	ing diar	neter equal	to or greater than th	e PRD disc	harge size?			\boxtimes				
Was the discharge pip	ing dow	nstream fro	om the PRD free fro	m reductior	is in size or re	strictions?		\boxtimes				
Was the PRD discharg	ge pipin	g self-drain	ing either by design	or with a w	eep hole?							
Was the discharge pip	ing inde	ependently	supported and ancho	ored properl	y?							
Was the PRD discharg	ge pipin	g assemble	d so that it will not u	inthread dui	ring a PRD rel	lease?						
Was the final discharg	e direct	ed to a safe	e location and not im	pinging upo	on other equip	ment or person	nel?					
Was the PRD service	tag attac	ched to the	PRD and was the set	rvice tag leg	gible?			\square				
Did any lifting levers	appear t	o be operal	ble and positioned co	orrectly?								
Did the PRD appear to	be free	from exce	ssive vibration?									
Did the PRD appear to	be inst	alled prope	erly and was the PRI	O housing fr	ee of any med	chanical damag	e?					

Detailed Inspection Comments

Inspection Scope:

- An API-510 external inspection was completed on the Free Water Knockout #2.
- The vessel was inspected to meet regulatory requirements.
- Partial access was available to the vessel for external visual inspection.
- The internal condition of the vessel was assessed using ultrasonic thickness measurements.
- The vessel was operating at the time of inspection.

External Inspection Comments:

Vessel:

- The nameplate was found and appeared to be secure and legible. All tack welds were in place.
- The ASME stamp and A# were found stamped on the nameplate and were legible.
- The CRN appeared to be registered in Alberta.
- The vessel was painted. The paint appeared to be well bonded and in good condition. No indications of external corrosion or rust stains were present on the vessel.
- The vessel was insulated. The cladding was not sealed against the west insulation ring around the circumference of the vessel. The cladding was no longer properly sealed against the nozzles, manway and building walls. The cladding was deteriorated on the top east head. No indications of external corrosion under insulation were visible.
- The shell and heads appeared to be in good condition. No dents, bulges or other distortions were visible.
- All vessel welds appeared to be of good quality and in good condition. No indications of misalignment or other rejectable welding defects were visible.
- All nozzles appeared to be in good condition and no evidence of undue stress appeared to be present.
- The vessel and associated components did not appear to be subject to excessive vibration. No indications of fretting were seen.
- The vessel has no handholes or inspection openings.
- The vessel has one, 16" O.D. manway, and it appeared to be in good condition. The manway has no support arm.
- Access to the inside of the vessel was also available through a flanged opening in the end of the vessel.
- The vessel was supported by support saddles. There was crevice corrosion occurring between the saddle supports base and the building floor. The corrosion appears to be wrapping the base of the supports and was corroding the anchor welds as well.
- The vessel sat on a concrete and steel foundation and floor. The foundation and floor appeared to be in good condition. The vessel appeared to sit level and did not appear to lean. There were cracks on the south east side of the concrete foundation.
- The ground cable was found attached to the support and appeared to be secure and intact.
- All anode connection wires appeared to be secure and properly installed, with isolation kits present on the flange bolting.

Piping and Instrumentation:

- The piping was painted. Minor paint deterioration and rusting were present; however, no measureable external corrosion was visible.
- The piping was also insulated. The insulation cladding appeared to be in good condition. All edges and supports appeared to be properly sealed. No indications of external corrosion under insulation were visible.
- All piping appeared to be adequately supported and in good condition. All supports and support shoes were in place and appeared to be in good condition.
- There were no piping support U-bolts installed on the pipe shoes located inside the building.
- All flange bolting was in place and appeared to be properly engaged.
- All threaded connections appeared to be in good condition. No signs of cross-threading were visible.
- A slow leak was noted from the west flange of the control valve located on the produced water outlet piping.
- All gauges, sight glasses, thermometers, control valves, meter run and associated instrumentation appeared to be in good condition.
- The vessel operating temperature and pressure, as read on the gauges, were below the nameplate design values.
- The piping and associated components did not appear to be subject to excessive vibration. No indications of fretting were visible.
- All branch connections appeared to be in good condition and no evidence of undue stress appeared to be present.

Overpressure Protection:

- The vessel was protected by one PRD. No block valves were present.
- The PRD was attached to the vessel.
- All flange bolting was in place and appeared to be properly engaged.
- The PRD was painted blue.
- The PRD was discharging to the system.
- There was no safe access to the PRD at the time of inspection. The PRD service records should be reviewed to verify the set pressure and last serviced date.

Ultrasonic Corrosion Survey Comments:

The internal condition of the vessel was assessed via an ultrasonic corrosion survey on a representative sample of the vessel and the associated piping. The UT data has been evaluated based on a T-min value calculated via ASME Code Calculation.

Results of the corrosion survey found no indications of internal corrosion and all areas that were inspected appeared to be in good condition.

Please refer to the attached corrosion survey report for further details of the inspection results.

	Material	Nominal	Diameter	ID/OD	C.A.	Low Reading	Calculated T-min	Life Expectancy	Comments
Tab TML Description		in	in		in	in	in	Years	
Inlet Building 4 Free Water Knockout #2 (a) Vessel									
400 Bottom East Head	SA 285 C	0.500	96.000	OD	0.000	0.557	0.260	100+	
410 Upper North Shell (west end)	SA 285 C	0.312	96.000	OD	0.000	0.350	0.260	100+	
415 Upper North Shell (east of center)	SA 285 C	0.312	96.000	OD	0.000	0.348	0.260	100+	
420 Middle North Shell (east of center)	SA 285 C	0.312	96.000	OD	0.000	0.344	0.260	100+	
425 Bottom Shell (east end)	SA 285 C	0.312	96.000	OD	0.000	0.341	0.260	100+	
430 Bottom Shell (west end)	SA 285 C	0.312	96.000	OD	0.000	0.345	0.260	100+	
435 Bottom West Head	SA 285 C	0.591	96.000	OD	0.000	0.683	0.260	100+	
(b) Nozzles									
470 6" Outlet Elbow (short radius)	SA 234 WPB	0.432	6.625	OD	0.000	0.440	0.245	100+	
									Indications of internal
									corrosion and pitting
									appear to be occurring in
									the elbow to a low of
									.246". Nominal thickness
480 3" Outlet Elbow	SA 234 WPB	0.300	3.500	OD	0.000	0.246	0.189	37.8	is .300".
(c) Outlet Piping									
460 4" Outlet Elbow	SA 234 WPB	0.237	4.500	OD	0.063	0.252	0.090	100+	
	64 22 4 W P P	0.007	4 500	0.0	0.052	0.100	0.000	76.0	Indications of internal corrosion appear to be occurring in the elbow to a low of .190". Nominal
465 4" Outlet Elbow	SA 234 WPB	0.237	4.500	UD	0.063	0.190	0.090	76.2	thickness is .237°.
(d) Outlet Piping									
475 4" Outlet Elbow (short radius)	SA 234 WPB	0.237	4.500	OD	0.063	0.194	0.090	86.6	indications of internal corrosion and pitting appear to be occurring in the elbow to a low of .194". Nominal thickness is .237".
477 3" Outlet Elbow	SA 234 WPB	0.300	3.500	OD	0.063	0.251	0.080	100+	Possible indications of internal corrosion may be occurring in the elbow to a low of .251". Nominal thickness is .300".

UT THICKNESS INSPECTION RESULTS

(e)	Outlet Piping									
										Indications of internal
										corrosion and pitting
										appear to be occurring in
										the elbow to a low of
										.188". Nominal thickness
	485 3" Outlet Elbow	SA 234 WPB	0.216	3.500	OD	0.063	0.188	0.080	100+	is .216".
										Indications of internal
										corrosion appear to be
										occurring in the bottom of
										the pipe to a low of .180".
										Nominal thickness is
	487 Bottom of 3" Outlet Pipe	SA 106 B	0.216	3.500	OD	0.063	0.180	0.080	100+	.216".
										Indications of internal
										corrosion appear to be
										occurring in the bottom of
										the pipe to a low of .193".
										Nominal thickness is
	489 Bottom of 3" Outlet Pipe	SA 106 B	0.216	3.500	OD	0.063	0.193	0.080	100+	.216".

All static information in the report was obtained from the vessel nameplate. The only blanket assumption made in the report is all piping and fittings are assumed to be either SA-106B or SA-234WPB material with a joint efficiency of 1.00, operate at the same pressure and temperature as the associated vessel, and were manufactured at the same time as the associated vessel.

The remaining life expectancies in this report should only be used as a general guide and may or may not be entirely accurate.







SUMMIT Inspection Services Ltd.













Inspection Summary

External Summary:

- The cladding was not sealed against the west insulation ring around the circumference of the vessel, nozzles, manway, and building walls; the cladding was deteriorated on the top east head.
- Crevice corrosion was occurring between the saddle supports base and the building floor, wrapping the base of the supports and corroding the anchor welds as well.
- Minor cracks were seen on the south east side of the concrete foundation.
- There was no piping support U-bolts installed on the pipe shoes located inside the building.
- There was no safe access to the PRD at the time of inspection. The PRD service records should be reviewed to verify the set pressure and next service date.
- A slow leak was noted from the west flange of the control valve located on the produced water outlet piping.

Internal Summary:

The internal condition of the vessel was assessed via an ultrasonic corrosion survey. Results of the corrosion survey found no indications of internal corrosion and all areas that were inspected appeared to be in good condition.

<u>Criticality Evaluation</u>

	Yes	No	N/A
1.) Does the vessel appear to be fit-for-service?	\bowtie		
2.) Was the measured UT thickness less than the calculated minimum required thickness (T-Min) for any component, where internal corrosion problems were identified?			
3.) Were any rejectable MT indications found?			
4.) Is the remaining life of any component less than 10 years, where internal corrosion problems were identified?			
5.) Should NCR's or Action Items be recommended as a result of the inspection?	\boxtimes		

Comments:

Repair and seal the insulation cladding around the nozzles, manway, and around the building to prevent moisture entrapment and corrosion under the insulation.

Install U-bolts on the piping supports inside the building.

Confirm the PRD service records (set pressure, last serviced date).

Mitigate the crevice corrosion in between the vessel's support and floor; replace the corroded anchor bolts.

RED – Vessel Inspection Results are deemed RED if <u>any</u> of the following occurred:

- The measured UT thickness was less than the calculated minimum required thickness (T-Min) for any component, where internal corrosion problems were identified.
- The remaining life for any component is calculated to be past due (less than 0 years), where internal corrosion problems were identified.
- Any rejectable MT Indications were found.
- The PRD Set Pressure is above the vessel MAWP.
- Any other issue was found that affects the vessels fitness-for-service.

YELLOW – Vessel Inspection Results are deemed YELLOW if <u>any</u> of the following occurred:

- NCR's or Action Items NOT affecting the continued fitness-for-service of the vessel were recommended as a result of the inspection.
- UT readings below (Nominal Corrosion Allowance) were found, where internal corrosion problems were identified.
- The remaining life for any component is calculated to be less than 10 years, where internal corrosion problems were identified.
- Any issues were identified that should be brought to the attention of the client.

GREEN – Vessel Inspection Results are deemed GREEN if <u>all</u> of the following are true:

- All UT Readings are above (Nominal Corrosion Allowance), or no internal corrosion problems were identified.
- No MT indications were found.
- No NCR's or Action Items were recommended as a result of the inspection.
- The vessel has been declared fit-for-service by the ISI Inspector.

Reviewed and Accepted by: (SUMMIT Inspection Services Ltd.)

Maria Savulescu

Assigned Intervals:

Vessel: ____ PRD:

Date:

Certification #:

Chief Inspector Signature:_____

Chief Inspector Certification #:_____

ISI #000162

Facility: Grand Forks 04-01 Battery

TABLE OF CONTENTS

Tab #	Tag	Description	Reg #	Serial #	NB #	
<u>Inlet Buil</u>	ding					
4 Free V	Water Knockout #2					

-	Free water Knockout #2			
	(a) Vessel	A0161444	LM-1671	
	(b) Nozzles			
	(c) Outlet Piping			
	(d) Outlet Piping			
	(e) Outlet Piping			



Facility: Grand Forks 04-01 Battery

ITEM LIST



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4 Free Water Knockout #2

(a) <u>Vessel</u>

400 Bottom East Head
410 Upper North Shell (west end)
415 Upper North Shell (east of center)
420 Middle North Shell (east of center)
425 Bottom Shell (east end)
430 Bottom Shell (west end)
435 Bottom West Head

(b) <u>Nozzles</u>

470 6" Outlet Elbow (short radius)480 3" Outlet Elbow

(c) <u>Outlet Piping</u>

460 4" Outlet Elbow 465 4" Outlet Elbow

(d) Outlet Piping

475 4" Outlet Elbow (short radius)477 3" Outlet Elbow

(e) <u>Outlet Piping</u>

485 3" Outlet Elbow487 Bottom of 3" Outlet Pipe489 Bottom of 3" Outlet Pipe

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ITEM LIST



ITEMS	Total	Last Inspection
Equipments	1	1
Vessel components	1	1
Piping components	4	4
Accessory components	0	0
TML's in the facility	16	16



CONDITION INDICATOR

		Last Inspection	Nominal Thickness	Thinnest Reading	Critical Thickness	Corrosion Rate	Condition Indicator
Tab	TML Description	Date	in	in	in	in/vr	Vears
		Date	III			111/ y I	1 cars
Inle	<u>t Building</u>						
4	Free Water Knockout #2						
	(a) <u>Vessel</u>						
	400 Bottom East Head	Dec 2015	0.500	0.558	0.260	0.000	100+
	410 Upper North Shell (west end)	Dec 2015	0.312	0.350	0.260	0.000	100+
	415 Upper North Shell (east of center)	Dec 2015	0.312	0.348	0.260	0.000	100+
	420 Middle North Shell (east of center)	Dec 2015	0.312	0.344	0.260	0.000	100+
	425 Bottom Shell (east end)	Dec 2015	0.312	0.341	0.260	0.000	100+
	430 Bottom Shell (west end)	Dec 2015	0.312	0.345	0.260	0.000	100+
	435 Bottom West Head	Dec 2015	0.591	0.684	0.260	0.000	100+
	(b) <u>Nozzles</u>						
	470 6" Outlet Elbow (short radius)	Dec 2015	0.432	0.440	0.245	0.000	100+
	480 3" Outlet Elbow	Dec 2015	0.300	0.246	0.189	0.002	37.8
	(c) <u>Outlet Piping</u>						
	460 4" Outlet Elbow	Dec 2015	0.237	0.252	0.090	0.000	100+
	465 4" Outlet Elbow	Dec 2015	0.237	0.190	0.090	0.001	76.2
	(d) <u>Outlet Piping</u>						
	475 4" Outlet Elbow (short radius)	Dec 2015	0.237	0.194	0.090	0.001	86.6
	477 3" Outlet Elbow	Dec 2015	0.300	0.251	0.080	0.001	100+
	(e) <u>Outlet Piping</u>		•				•
	485 3" Outlet Elbow	Dec 2015	0.216	0.188	0.080	0.001	100+
	487 Bottom of 3" Outlet Pipe	Dec 2015	0.216	0.180	0.080	0.001	100+
	489 Bottom of 3" Outlet Pipe	Dec 2015	0.216	0.193	0.080	0.001	100+



COMMENT LIST

Tab Equipment	Date Inspected	Comments	Condition indicator
Inlet Building			
4 Free Water Knockout #2			
(b) <u>Nozzles</u>			
480 3" Outlet Elbow	Dec 2015	Indications of internal corrosion and pitting appear to be occurring in the elbow to a low of .246". Nominal thickness is .300".	37.8
(c) <u>Outlet Piping</u>		1	
465 4" Outlet Elbow	Dec 2015	Indications of internal corrosion appear to be occurring in the elbow to a low of .190". Nominal thickness is .237".	76.2
(d) <u>Outlet Piping</u>		1	
475 4" Outlet Elbow (short radius)	Dec 2015	Indications of internal corrosion and pitting appear to be occurring in the elbow to a low of .194". Nominal thickness is .237".	86.6
477 3" Outlet Elbow	Dec 2015	Possible indications of internal corrosion may be occurring in the elbow to a low of .251". Nominal thickness is .300".	
(e) <u>Outlet Piping</u>			
485 3" Outlet Elbow	Dec 2015	Indications of internal corrosion and pitting appear to be occurring in the elbow to a low of .188". Nominal thickness is .216".	
487 Bottom of 3" Outlet Pipe	Dec 2015	Indications of internal corrosion appear to be occurring in the bottom of the pipe to a low of .180". Nominal thickness is .216".	
489 Bottom of 3" Outlet Pipe	Dec 2015	Indications of internal corrosion appear to be occurring in the bottom of the pipe to a low of .193". Nominal thickness is .216".	
	L		



Index: 4				Free V	Vater H	Knocke	out #2		Р	roduct:				JE:	100%
Component: (a	ı)			Vessel					D	rawing:	4			Dia:	96 (in) OD
TML:		400	Bottom	East He	ad				Μ	fgDate:	Mar 198	30		CA:	0.000 ⁽ⁱⁿ⁾
Registration: A	0161444	4							Μ	aterial:	SA 285	С		Nominal:	0.500 (in)
CRN: C	-8805.2									MWP:	75	psi @	181 ° F	T-min:	0.260 (in)
						_		_				•			
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec												Loss	Rate Indicator
		2015												(in)	(in/vr)
Temperature 'F		55												()	(111, 51)
Тор	1	0.581													
	2	0.580													
	3	0.581													
	4	0.577													
	5	0.558													
	6	0.562													
	7	0.576													
Bottom	8	0.595													
Comments:															
Scan Minimum ((in)	0.558													
Avg Thickness (i	(in)	0.576													
Avg Loss															
Avg Loss Rate	e														
Max Loss Rate	e														
Avg.Condition Indi	icator														
Min.Condition Indi	icator														

DATA PAGE



Loss rate term:Mid Term 3Data printed in:Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*S*E + 1.8*P)

SIGMA 4.2.7.9 12-January-2016

Calibration correction: ON

DATA PAGE

Index: 4 Component: (a) TML: Registration: A016 CRN: C-880	1444)5.2	410	Upper	Free Vesse North S	Wate l Shell (w	r Kno	ckout #	2		H D M M	Product: prawing: (fgDate: Iaterial: MWP:	4 Mar 198 SA 285 75	30 C psi @	181 ° F	JE: Dia: CA: Nominal: T-min:	100% 96 (in) OD 0.000 (in) 0.312 (in) 0.260 (in)
		1	2	3	4	5	6		7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec 2015													Loss	Rate Indicator
Temperature °F		70													(in)	(in/yr)
Top Bottom Comments:	1 2 3 4 5 6 7 8 9 10 11 12	0.357 0.357 0.358 0.352 0.353 0.352 0.350 0.350 0.350 0.351 0.352														
Scan Minimum (in)		0.350														
Avg Thickness (in) Avg Loss Avg Loss Rate Max Loss Rate Avg.Condition Indicator Min.Condition Indicator	r	0.353														



Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Ro / (S*E + 0.4*P)

Material correction: **ON**

Calibration correction: ON

DATA PAGE

Index: 4 Component: (a) TML: Registration: A016 CRN: C-880	51444 05.2	415	Upper	Free Vesse North	e Wate el Shell (er Kn east of	ockou	ıt #2		l D M N	Product: Prawing: IfgDate: Iaterial: MWP:	4 Mar 198 SA 285 75	0 C psi @	181 ° F	JE: Dia: CA: Nominal: T-min:	100% 96 (in) OD 0.000 (in) 0.312 (in) 0.260 (in)
		1	2	3		4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec 2015													Loss	Rate Indicator
Temperature °F		70													(in)	(in/yr)
Тор	1	0.356														
	2	0.353														
	3	0.353														
	4	0.355														
	5	0.356														
	6	0.358														
	7	0.351														
	8	0.351														
	9	0.350														
	10	0.350														
Bottom	11	0.331														
Comments:	12	0.540														
Scan Minimum (in)		0.348														
Avg Thickness (in)		0.353														
Avg Loss																
Avg Loss Rate																
Max Loss Rate																
Avg Condition Indicate	r															
Min.Condition Indicate	or .															
miniconuntrin multato																



Loss rate term:Mid Term 3Data printed in:Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Ro / (S*E + 0.4*P)

TML: 415

Calibration correction: ON

DATA PAGE

Index: 4 Component: (a) TML: Registration: A016 CRN: C-880	51444 05.2	420	Middle	Free Vesse North	Water	Knock(out #2		l D M N	Product: Drawing: 4 IfgDate: 1 Iaterial: 5 MWP:	4 Mar 198 SA 285 75	30 C psi @	181 ° F	JE: Dia: CA: Nominal: T-min:	100% 96 (in) OD 0.000 (in) 0.312 (in) 0.260 (in)
Inspection Dates Temperature °F		1 Dec 2015 70	2	3	4	5	6	7	8	9	10	11	12	Total Loss (in)	Loss Condition Rate Indicator (in/yr)
Тор	1 2 3 4 5 6 7 8 9 10 11	0.347 0.348 0.350 0.348 0.344 0.344 0.346 0.347 0.348 0.351 0.352													
Bottom Comments: Scan Minimum (in)	12	0.352													
Avg Thickness (in) Avg Loss Avg Loss Rate Max Loss Rate Avg.Condition Indicato Min.Condition Indicato	ır r	0.348													



Loss rate term: Mid Term 3 Data printed in: Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Ro / (S*E + 0.4*P)

SIGMA 4.2.7.9 12-January-2016

Calibration correction: ON

DATA PAGE

Index: 4 Component: (a) TML: Registration: A016 CRN: C-880	1444)5.2	425 4	Botton	Free Vesse n Shell	Wate 1 (east e	er Kı	nocko	ut #2		I D M N	Product: prawing: (fgDate: Iaterial: MWP:	4 Mar 198 SA 285 75	30 C psi @	181 °F	JE: Dia: CA: Nominal: T-min:	100% 96 (in) OD 0.000 (in) 0.312 (in) 0.260 (in)
		1	2	3		4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec													Loss	Rate Indicator
Temperature °F		70													(in)	(in/yr)
East West Comments:	1 2 3 4 5 6 7 8 9 10 11 12	0.344 0.343 0.345 0.343 0.344 0.351 0.345 0.345 0.345 0.346 0.344 0.341 0.341														
Scan Minimum (in)		0.341														
Avg Thickness (in) Avg Loss Avg Loss Rate Max Loss Rate Avg.Condition Indicato Min.Condition Indicato	r r	0.344														



Loss rate term: Mid Term 3 Data printed in: Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Ro / (S*E + 0.4*P)

SIGMA 4.2.7.9 12-January-2016

Calibration correction: ON

Facility: Grand Forks 04-01 Battery

DATA PAGE

Index: 4 Component: (a) TML: Registration: A016 CRN: C-880	1444)5.2	430	Botton	Free Vessel	Water l (west en	• Knoc	kout #2] I M N	Product: Drawing: AfgDate: Aaterial: MWP:	4 Mar 198 SA 285 75	30 C psi @	181 ° F	JE: Dia: CA: Nominal: T-min:	100% 96 (in) OD 0.000 (in) 0.312 (in) 0.260 (in)
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec												Loss	Rate Indicator
Temperature °F		2015												(in)	(in/yr)
Fast	1	0.360													
Last	2	0.300													
	3	0.350													
	4	0.347													
	5	0.347													
	6	0.346													
	7	0.349													
	8	0.350													
	9	0.348													
	10	0.345													
	11	0.347													
West	12	0.352													
Comments:															
Scan Minimum (in)		0.345													
Avg Thickness (in)		0.349													
Avg Loss															
Avg Loss Rate															
Max Loss Rate															
Avg.Condition Indicato	r														
Min.Condition Indicato	r														



Loss rate term:Mid Term 3Data printed in:Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Ro / (S*E + 0.4*P)

TML: 430

Calibration correction: **ON**

Index: 4				Free V	Vater F	Knocko	out #2		T	Product				ΙF·	10	0%
Component: (a))			Vessel					ם ת	rawing: 4	4			Dia:	10	96 (in) OD
TMI ·	/	135	Rottom	West H	Pad				M	foDate•]	Mar 198	80		CA:	0.0)00 (in)
Bagistration: A	016144/	1 1 1 1 1 1	Dottom	west In	cau				N	Intorial.	SA 285	C		Nominal	0.4	501 (in)
CDN. C	010144- 0005 7	r							14.		SA 205 75	nci @	191 °E	T min	0.	$2 \in \mathbf{O}(in)$
CKN: C-	-8803.2									MWP:	73	psi @	101 1	I-min;	0.2	200 (m)
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss	Condition
Inspection Dates		Dec 2015												Loss	Rate	Indicator
Temperature °F		55												(in)	(in/yr)	
Тор	1	0.693														
	2	0.695														
	3	0.699														
	4	0.699														
	5	0.702														
	6	0.703														
	7	0.707														
	8	0.691														
	9	0.684														
	10	0.694														
_	11	0.692														
Bottom	12	0.700														
Comments:																

DATA PAGE

Scan Minimum (in)	0.684
Avg Thickness (in)	0.697
Avg Loss	
Avg Loss Rate	
Max Loss Rate	
Avg.Condition Indicator	
Min.Condition Indicator	



Loss rate term: Mid Term 3 Data printed in: Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*S*E + 1.8*P)

SIGMA 4.2.7.9 12-January-2016

Calibration correction: ON

Index: 4				Free	Wat	ter K	nocko	ut #2]	Product:				JE:	100%
Component: (c)				Outle	t Pipir	ng				D	rawing:	4			Dia:	4.500(in) OD
TML:		460	4" Out	let Elb	ow					\mathbf{M}	IfgDate:	Mar 198	30		CA:	0.063 (in)
Registration:										N	Taterial:	SA 234	WPB		Nominal:	0.237 (in)
CRN											MWP	75	nsi @	181 °F	T-min·	0.090(in)
on a													P == 0	101 1	1 11111	0.020
		1	2	3		4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec 2015													Loss	Rate Indicator
Temperature °F		70													(in)	(in/yr)
Тор	1	0.261														
	2	0.252														
	3	0.252														
	4	0.258														
	5	0.258														
	6	0.255														
	7	0.260														
Bottom	8	0.256														
Comments:																
Scan Minimum (in)		0.252														
Avg Thickness (in)		0.257														
Avg Loss																
Avg Loss Rate																
Max Loss Rate																
Avg Condition Indicator	•															
Min Condition Indiator																
wini.Condition Indicator	5															

DATA PAGE



Loss rate term:Mid Term 3Data printed in:Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

SIGMA 4.2.7.9 12-January-2016

Calibration correction: **ON**

Index: 4				Free V	Water 1	Knocko	ut #2			Product	:			JE:	10	0%
Component: (c)				Outlet I	Piping				I	Drawing	:4			Dia:	4.5	$500^{(in)}$ OD
TML:		465	4" Outl	et Elboy	N				N	AfgDate	: Mar 198	80		CA:	0.0)63 (in)
Registration:									Ι	Material	: SA 234	WPB		Nominal:	0.2	237 (in)
CRN:										MWP	: 75	psi @	181 ° F	T-min:	0.0)90 (in)
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss	Condition
Inspection Dates		Dec 2015												Loss	Rate	Indicator
Temperature °F		70												(in)	(in/yr)	
Тор	1	0.214												0.023	0.001	100 +
	2	0.202												0.035	0.001	100+
	3	0.201												0.036	0.001	100+
	4	0.194												0.043	0.001	86.5
	5	0.190												0.047	0.001	/0.1
	7	0.192												0.049	0.001	99.1
	8	0.170												0.027	0.001	100+
Bottom	9	0.210												0.027	0.001	100+
Comments:																
Dec 2015	Band	Indicati	ons of in	ternal co	rosion ap	pear to be	occurring	g in the e	elbow to	a low of .	190". Non	ninal thick	mess is .23	7".		
Scan Minimum (in)		0.190														
Avg Thickness (in)		0.201														
Avg Loss		0.036														
Avg Loss Rate		0.001														
Max Loss Rate		0.001														
Avg.Condition Indicate	or															
Min.Condition Indicate	or	76.2														



DATA PAGE

Index: 4 Component: (b) TML: Registration: CRN:		470	6" Out	Free Nozzl let Elbo	Wate es ow (she	e r Kn ort radi	ockou	ut #2		I D M N	Product: rawing: 4 (fgDate: 1 laterial: 5 MWP:	4 Mar 198 SA 234 75	60 WPB psi @	181 °F	JE: Dia: CA: Nominal: T-min:	100% 6.625 (in) OD 0.000 (in) 0.432 (in) 0.245 (in)
		1	2	3	4	4	5	6	7	8	9	10	11	12	Total	Loss Condition
Inspection Dates		Dec 2015													Loss	Rate Indicator
Temperature °F		70													(in)	(in/yr)
Тор Bottom Comments: Scan Minimum (in)	1 2 3 4 5 6 7 8 9 10 11	0.482 0.469 0.467 0.462 0.461 0.452 0.440 0.450 0.448 0.455 0.455														
Avg Thickness (in) Avg Loss Avg Loss Rate Max Loss Rate Avg.Condition Indicato Min.Condition Indicato	r r	0.458														



Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

Calibration correction: ON

DATA PAGE

Index: 4 Component: (d) TML: Registration: CRN:		475	4" Out	Free Outle	e Wa et Pipin bow (si	ter Kung hort rad	nockou lius)	ıt #2		l D M N	Product: prawing: [fgDate: [aterial: MWP:	4 Mar 198 SA 234 75	80 WPB psi @	181 ° F	JE: Dia: CA: Nominal: T-min:	10 4.4 0.0 0.2 0.2	0% 500 (in) OD)63 (in) 237 (in))90 (in)
		1	2	3		4	5	6	7	8	9	10	11	12	Total	Loss	Condition
Inspection Dates		Dec													Loss	Rate	Indicator
Temperature °F		70													(in)	(in/yr)	
South Pit East Pit Comments:	1 2 3 4 5 6 7	0.208 0.209 0.213 0.213 0.216 0.194 0.196													0.029 0.028 0.024 0.024 0.021 0.043 0.041	0.001 0.001 0.001 0.001 0.001 0.001 0.001	100+ 100+ 100+ 100+ 100+ 86.5 92.5
Dec 2015 Scan Minimum (in)	Band	: Indicatio 0.194	ons of ir	nternal	corrosi	on and p	oitting app	pear to be	e occurrii	ng in th	e elbow to	a low of	.194". No	ominal thicknes	s is .237".		
Avg Thickness (in)		0.207															
Avg Loss		0.030															
Avg Loss Rate		0.001															
Max Loss Rate		0.001															
Avg.Condition Indicate	or	96.6															
Min.Condition Indicate	or	86.6															



Index: 4]	Free W	ater K	nockou	ıt #2		P	roduct:			JE:	10	0%		
Component: (d)			(Outlet Pi	ping				D	rawing:	4		Dia:	3.5	500 ⁽ⁱⁿ⁾ OD		
TML:		477.3	" Outle	t Elbow					Μ	fgDate:	Mar 198	30			CA:	0.0)63 (in)
Registration:									М	[aterial:	SA 234	WPB			Nominal:	0.3	300 (in)
CRN			$\mathbf{MWP} \cdot \mathbf{75 nsi} @ 181 ^{\circ}\mathbf{F}$											31 ° F	T-min.	0.080 (in)	
- Child												P*** 0			1 11111	010	
		1	2	3	4	5	6	7	8	9	10	11	12		Total	Loss	Condition
Inspection Dates		Dec													Loss	Rate	Indicator
m () n		2015													(in)	(in/vr)	
Temperature °F		70													()	(111, 91)	
Тор	1	0.281													0.019	0.001	100 +
	2	0.278													0.022	0.001	100 +
	3	0.276													0.024	0.001	100 +
	4	0.269													0.031	0.001	100 +
	5	0.253													0.047	0.001	100 +
	6	0.273													0.027	0.001	100 +
Bottom	7	0.272													0.028	0.001	100 +
Comments:																	
Dec 2015	Band:	Possible	indicatio	ons of inte	rnal corro	sion may	be occur	ring in th	e elbow	to a low o	f .251". I	Nominal	thickn	ess is .300".			
						-		-									
Scan Minimum (in)		0.251															
Avg Thickness (in)		0.272															
Avg Loss		0.028															
Avg Loss Rate		0.001															
Max Loss Rate		0.001															
Avg.Condition Indicat	or																
Min.Condition Indicate	or																
	~-																

DATA PAGE



Index: 4				Free V	Vater H	Knocko	out #2		Р	roduct:				JE:	10	0%
Component: (b)]	Nozzles					D	rawing: 4				Dia:	3.5	500 ⁽ⁱⁿ⁾ OD
TML:		480	3" Outle	t Elbow	7				Μ	fgDate: N	/lar 198	30		CA:	0.0)00 ⁽ⁱⁿ⁾
Registration:									Μ	aterial: S	SA 234	WPB		Nominal:	0.3	300 (in)
CRN:	MWP: 75 psi @ 181 °F											T-min:	0.1	89 (in)		
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss	Condition
Inspection Dates		Dec												Loss	Rate	Indicator
T 4 9E		2015												(in)	(in/vr)	
Temperature 'F		70														
Тор	1	0.303														
	2	0.282												0.018	0.001	100+
	3	0.274												0.026	0.001	100+
D' 4	4	0.261												0.039	0.001	66.0 27.9
Pit	5	0.246												0.054	0.002	37.8
Bottom	7	0.275												0.027	0.001	100+ 100+
Comments:	,	0.279												0.021	0.001	1001
Comments.	Dand	. Indiantia										0.40" No	minal this lunces is 20	2"		
Dec 2015	Band		ons of Inte	ernal corr	osion and	a pitting ap	opear to c	be occur	ring in the	e of wodie	a low of .	.246°. NO	minal thickness is .30	J.		
Scan Minimum (in)		0.246														
Avg Thickness (in)		0.274														
Avg Loss		0.026														
Avg Loss Rate		0.001														
Max Loss Rate		0.002														
Avg.Condition Indicat	or	78.5														

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37.8

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

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Min.Condition Indicator

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Calibration correction: ON

Index: 4	Free Water Knockout #2								P	roduct:		JE:	10	0%			
Component: (e)				Outlet F	Piping				D	rawing: 4	1			Dia:	3.5	500 ⁽ⁱⁿ⁾ OD	
TML:		485	3" Outl	et Elboy	V				Μ	fgDate: 1	Mar 198	0		CA:	0.0)63 (in)	
Registration:									М	[aterial:]	SA 234	WPB		Nominal:	0.216 (in)		
CRN			$\mathbf{MWP} \cdot 75 \mathbf{nsi} @ 181 \circ \mathbf{F}$										T-min.	0.080(in)			
CIU.										111111	15	Pore		1 -mm,	0.0	, , , , , , , , , , , , , , , , , , ,	
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss	Condition	
Inspection Dates		Dec												Loss	Rate	Indicator	
Temperature °F		2015 70												(in)	(in/yr)		
Тор	1	0.256															
-*P	2	0.221															
Pit	3	0.188												0.028	0.001	100+	
	4	0.195												0.021	0.001	100+	
	5	0.202												0.014	0.000	100 +	
	6	0.228															
Bottom	7	0.226															
Comments:																	
Dec 2015	Band	: Indicatio	ons of in	ternal cor	rosion and	pitting ap	pear to b	e occurri	ng in the	e elbow to	a low of .	188". No	minal thickness is .216".				
Scan Minimum (in)		0.188															
Avg Thickness (in)		0.217															
Avg Loss																	
Avg Loss Rate																	
Max Loss Rate		0.001															
Avg.Condition Indicate	or																
Min Condition Indicate	or.																
Min.Condition mulcad																	

DATA PAGE



Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

Calibration correction: ON

DATA PAGE

Index: 4 Component: (e)				Free Outlet	Water Piping	Knock	out #2] D	Product: Drawing:	4	JE: Dia:	10 3.5	0% 500 (in) OD		
TML:		487	Bottom	1 of 3"	Outlet P	pe			Ν	IfgDate:	Mar 198	CA:	0.0)63 ⁽ⁱⁿ⁾		
Registration:	Material: SA 106 B												Nominal:	0.2	0.216 ⁽ⁱⁿ⁾	
CRN:										MWP:	75	T-min:	0.0)80 (in)		
		1	2	3	4	5	6	7	8	9	10	11	12	Total	Loss	Condition
Inspection Dates		Dec 2015												Loss	Rate	Indicator
Temperature °F		55												(in)	(in/yr)	
East	1	0.183												0.033	0.001	100+
	2	0.183												0.033	0.001	100 +
	3	0.199												0.017	0.000	100 +
	4	0.195												0.021	0.001	100 +
	5	0.202												0.014	0.000	100 +
	6	0.188												0.028	0.001	100 +
	7	0.194												0.022	0.001	100 +
	8	0.191												0.025	0.001	100 +
	9	0.181												0.035	0.001	100 +
	10	0.191												0.025	0.001	100 +
	11	0.182												0.034	0.001	100 +
West	12	0.184												0.032	0.001	100 +
Comments:																
Dec 2015	Band	Indicatio	ons of in	iternal c	orrosion a	ppear to b	e occurrin	g in the	bottom of	f the pipe t	o a low of	f .180". N	ominal thickness is .2	16".		
Scan Minimum (in)		0.180														
Avg Thickness (in)		0.190														
Avg Loss		0.026														
Avg Loss Rate		0.001														
Max Loss Rate		0.001														
Avg.Condition Indicat	or															
Min.Condition Indicat	or															



Material correction: **ON**

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

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Calibration correction: ON

DATA PAGE

Component: (e)Outlet PipingDrawing: 4Dia:3.500*	(in) OD	
	in)	
TML:489 Bottom of 3" Outlet PipeMfgDate: Mar 1980CA:0.063	,III)	
Registration:Material: SA 106 BNominal:0.216	0.216 (in)	
CRN: MWP: 75 psi @ 181 °F T-min: 0.080	in)	
1 2 3 4 5 6 7 8 9 10 11 12 Total Loss Con-	dition	
Inspection Dates Dec Loss Rate Inc	licator	
Temperature °F 55 (in) (in/yr)		
North 1 0.217		
2 0.204 0.012 0.000 1	00+	
0.023 0.001 1	00+	
4 0.203 0.013 0.000 1	00+	
5 0.196 0.020 0.001 1	00+	
6 0.198 0.018 0.000 1	00+	
7 0.204 0.012 0.000 1	00+	
8 0.220		
9 0.216		
10 0.210 0.006 0.000 1	00+	
11 0.206 0.010 0.000 1	00+	
South 12 0.211 0.005 0.000 1	00+	
Comments:		
Dec 2015 Band: Indications of internal corrosion appear to be occurring in the bottom of the pipe to a low of .193". Nominal thickness is .216".		
Scan Minimum (in) 0.193		
Avg Thickness (in) 0.207		
Avg Loss 0.009		
Avg Loss Rate 0.000		
Max Loss Rate 0.001		
Avg.Condition Indicator		
Min.Condition Indicator		



Loss rate term:Mid Term 3Data printed in:Imperial units.

Material correction: **ON**

Minimum readings before ignoring nominal 3

T-min: Code calculation; P*Do / (2*(S*E + 0.4*P))

TML: 489

Calibration correction: ON