

## SHELL & TUBE INSPECTION REPORT

LSD: 07-27-051-19W5M

Date: JUNE 07, 2014

SAP Equipment ID: 66038580

SHELL & TUBE STATIC DATA										
Plant		Ansell Gas Plant		Op Unit			System			
Prov. Insp. #		A0402803		CRN			L6180.2			
Equipment Description		C5 Exchanger					Serial #			
Manufacturer		Thermotech Energy Systems					Vessel Class			
Internal Access:		YES		Description: 8" channel flange			Year Built			
							1999			
SHELL SIDE DATA										
MAWP		485		PSI		@		350 °F		
MDMT								-20 °F		
CODE : U							Sweet		PWHT : NO	
Diameter		8.625"		Length		(T/T)		in		
OAL		90		in		Horizontal				
Shell Mat'l		SA-106-B		Thickness		0.322		in		
Corr Allowance		0.063		in						
Nozzle Mat'l				Thickness				mm / in		
Corr Allowance				mm / in						
Internal Coating:		YES — NO		Internal Clad :		YES — NO		Capacity		
								m <sup>3</sup>		
Manway :		yes — 8" flange		Inspection Port :		NO		Saddle		
Nozzle Rating		lb ANSI		Painted :		YES		Insulated		
								NO		
Operating Pressure				kPa / PSI		Operating Temperature		°C / °F		
TUBE/CHANNEL SIDE DATA										
MAWP		485		PSI		@		350 °F		
MDMT								-20 °F		
CODE : U							Sweet		PWHT : NO	
Diameter		8.625" channel		Length		(T/T)		mm/in		
OAL		8.5		in		Horizontal				
Shell Mat'l		SA106-B		Thickness		0.322		in		
Corr Allowance		0.063		in						
Nozzle Mat'l				Thickness				mm / in		
Corr Allowance				mm / in						
Internal Coating:		YES — NO		Internal Clad :		YES — NO		Capacity		
								m <sup>3</sup>		
Manway :		YES — 8" channel flange		Inspection Port :		NO		Skirt — Legs — Saddle		
Nozzle Rating		lb ANSI		Painted :		YES		Insulated		
Operating Pressure				kPa / PSI		Operating Temperature		°C / °F		
SHELL SIDE PSV STATIC DATA										
Serial No.	Location	Set Pressure	Capacity	Manufacturer	Model / Type	Service Date / Company				
CE-27698-A10	Off stabilizer feed drum	486psi	17606scfm	Farris	26KA12-120/S5M	12-sep-11. Wizard. Tag PSV-1011				
SHELL SIDE PSV DETAILS										
Type (Thread/Flange)		ANSI Rating		Size (mm)						
PRD Inlet	Flanged			3"						
PRD Outlet	Flanged			4"						
Tube side PSV STATIC DATA										
Serial No.	Location	Set Pressure	Capacity	Manufacturer	Model / Type	Service Date / Company				
C27216A10	Off stabilizer tower	485psi	3199scfm	Farris	286FA12-120/55M	Sept-2011, Wizard. Tag PSV-1003				
Tube side PSV DETAILS										
Type (Thread/Flange)		ANSI Rating		Size (in)						
PRD Inlet	Flanged			1.5"						
PRD Outlet	Flanged			2"						
NDE Equipment records										
Procedure#	Description	Manufacturer	Model#	Serial#	Due Date					

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### INSPECTION SUMMARY

Exchanger in plant 1 inlet building. A visual external and internal inspection was conducted on exchanger during plant turnaround.

**External:**

Shell, channel and piping are in good condition. No paint deterioration, corrosion or damage noted. Piping well supported. Vessel is securely bolted to steel beams, anchor bolts in good condition. Building skid is grounded but no direct ground connection found. Saddle supports are seal welded. Dataplate is securely attached to vessel and legible. Shell side PSV was found to be off the stabilizer tower. Tube side PSV was found to be off Stabilizer feed drum. There are numerous valves between exchanger shell side / tube side and corresponding PSV's. These must be locked open during plant operation. Both PSVs set at MAWP. UT corrosion survey performed by Streamline Inspection June 2014.

**Internal:**

Exchanger bonnet was removed and tube bundle pulled and cleaned for internal inspection. Shell side was found to be in good condition. No corrosion or significant mechanical damage noted. Slight wearing of the shell was noted where bundle baffle plates contact shell, but no significant wall loss was noted. Shell flange face was found to be in acceptable condition, no damage or corrosion noted. Channel bonnet was found to be in good condition. No corrosion or erosion noted on head, shell or nozzles. The partition plate was found to be securely attached with no deformation noted. There were some grinder marks noted on leading edge of partition plate fillet welds. Channel flange face was found to be in acceptable condition with no corrosion or damage noted. Tube bundle was found to be in fair condition. No erosion or corrosion was noted on bundle tubes or tube sheet. Tube ends appear to be in good condition, no corrosion or internal fouling or obstructions noted. No fretting damage to tubes was found at or near where they pass through baffle plates. One tube was found to be plugged off. Plugs securely in place.

Exchanger was found to be in good condition and fit for continued service.

### RECOMMENDATIONS

Ensure all valves between exchanger shell side and tube side and the protecting PSVs are carsealed open when plant is in operation.  
Review UT survey report.

### NONCONFORMANCES / INSPECTION DEFICIENCIES


Numerous valves between tube side / shell side and protecting PSV's. AS plant was in outage could not determine if these are locked open while vessel is in operation. These valves need to be carsealed open when in operation.

### INSPECTION PLANNING

Inspection Strategy	Availability	Inspection Interval
Inspection Date <u>June 07, 2014</u>	Date of Last Inspect _____	Date of Next Inspect _____

### REPORT CERTIFICATION

The signatures below certify that inspections/tests have been completed in accordance with the identified inspection strategy and that the specified equipment is considered fit for service until the date of next inspection.

Inspected by	<u>Ed Tymensen</u>		Date	<u>June 07, 2014</u>
Company	<u>Streamline Inspection</u>	PESL #	<u>000711</u>	API # <u>27479</u>
Reviewed and Approved by	_____	_____	Date	_____
	_____	PESL #	_____	API # _____
Criticality Assessment Rerun	_____	Inspection Planning Rerun	_____	_____
Assessed Next Inspection Date	_____			

## SHELL & TUBE INSPECTION REPORT

LSD: 07-27-051-19W5M

Date: JUNE 07, 2014

SAP Equipment ID: 66038580

### DETAILED INSPECTION VISUAL EXTERNAL

ID	Description	Condition	Location	NCR / IDR	Comments
V1	General Other (Please Explain)	Good			Overall
V2	General Corrosion	n/a			None noted
V3	General Leaks	n/a			None noted
V4	Vibration	n/a			Inspection done during shutdown
V5	Dissimilar Flange Rating	n/a			Similar flange ratings
V6	Ladder/Stairway	n/a			
V7	Heads	Good			No corrosion or damage noted
V9	Electrical Ground	Good	Building skid		Skid ground cable present and secure. No direct ground connection to vessel found
V10	Painted Inactive Corrosion	n/a			
V11	Coating/Painting	Good			No significant paint deterioration noted
V12	Expansion Joint or Bellows	n/a			
V13	Gauge/Site Glass	Good	Temp		Gauge clear and legible
V14	Shell	Good			No corrosion or damage noted
V15	Jacket	n/a			
V21	Support Other (Please explain)	Good	Piping		Well supported
V22	Foundation	Good	Steel skid		Skid on steel piles
V23	Anchor Bolts	Good			Tight and secure
V24	Saddle/Skirt	Good	Saddle		Seal welded
V25	Davit	n/a			
V26	Fireproofing	n/a			
V31	Connections Other (Please explain)	Good			All connections appear secure
V32	Small Branches	n/a			
V33	Nozzles	Good			No corrosion or damage noted
V34	Manways	n/a			Internal access through channel flange
V35	Reinforcing Pads	n/a			
V36	Inadequate Thread Engagement	Good			Adequate thread engagement
V37	Bolting	Good			All bolting tight and secure, no corrosion of threads
V38	Flanges	Good			No leaks or surface corrosion noted
V39	Leak Clamps	n/a			
V41	Insulation Other (Please explain)	n/a			
V42	Damage	n/a			
V43	Penetrations	n/a			
V44	Insulation Jacket	n/a			
V45	Banding	n/a			
V46	Seals/Joints	n/a			
V51	Relief Devices Other (Please explain)	Good			No access to tube side PSV off stab. tower at time of inspection. Ribbed off
V52	Corrosion	n/a			None noted
V53	Leaks	n/a			None noted
V54	Restricted Inlet/Outlet	n/a			No restrictions
V55	Manual Operation Lever				Ensure all valves between exchanger shell side and tube side are locked open when plant is in operation

## SHELL & TUBE INSPECTION REPORT

LSD: 07-27-051-19W5M

Date: JUNE 07, 2014

SAP Equipment ID: 66038580

### DETAILED INSPECTION VISUAL INTERNAL

ID	Description	Condition	Location	NCR / IDR	Comments
V1	General Other (Please Explain)	Good			Overall
V2	Corrosion (depth, length, width)	n/a			No corrosion noted
V3	Erosion	Fair	Shell		Minor shell wall loss, wear marks, where tube bundle baffles contact shell, no concern at this time
V4	Distortion	n/a			No distortion noted
V5	Blisters	n/a			No blisters noted
V6	Deposits	n/a			No deposits noted
V7	Heads	Good			No corrosion or damage noted
V8	Welds	Good			No corrosion or welding defects noted
V9	Nozzles	Good			No corrosion or damage noted
V10	Shell	Good	Shell		Minor shell wall loss, wear marks, where tube bundle baffles contact shell, no concern at this time
V11	Gasket Surfaces	Good	Shell and channel flange faces and channel nozzle flange faces		No corrosion or damage noted
V21	Internals Other (Please explain)	Good	Channel partition plate		Securely attached, no distortion
V22	Demister	n/a			
V23	Baffle/Weir	n/a			
V24	Sparger	n/a			
V25	Thermowells	n/a			
V26	Metallic Linings	n/a			
V27	Nonmetallic Linings	n/a			
V30	Other Welded Attachments	n/a			
V31	Tubes	Good	Tube bundle		No corrosion or damage noted externally or internally (as visible). Bundle baffles in good condition.
V32	Tube sheet	Good			

### DETAILED INSPECTION OTHER TECHNIQUES

ID	Location	Observation/Measurement	Acceptance Criteria	NCR / IDR	Comments
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

**SHELL & TUBE INSPECTION REPORT**

LSD: 07-27-051-19W5M

Date: JUNE 07, 2014

SAP Equipment ID: 66038580

**DETAILED INSPECTION TUBE INSPECTION**

Tube #	Flaw Type	Flaw Length	Location on Tube	Wall Loss	NCR / IDR	Comments

**DETAILED INSPECTION UT THICKNESS**

CML	Nom. Thk	Current Reading	Short Term Corr Rate	Long Term Corr Rate	Remaining Life	Comments



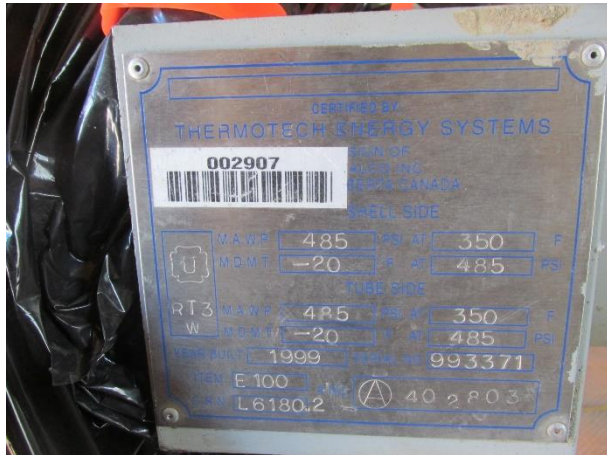
# **SHELL & TUBE INSPECTION REPORT**

LSD: 07-27-051-19W5M

Date: JUNE 07, 2014

SAP Equipment ID: 66038580

## **PHOTOS**



Dataplate



Exchanger overview



Saddle supports, seal welded, bolted to Beam



Channel bonnet



Channel nozzle flange face



Channel flange face and partition plate



**SHELL & TUBE INSPECTION REPORT**

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Date: JUNE 07, 2014

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**PHOTOS**



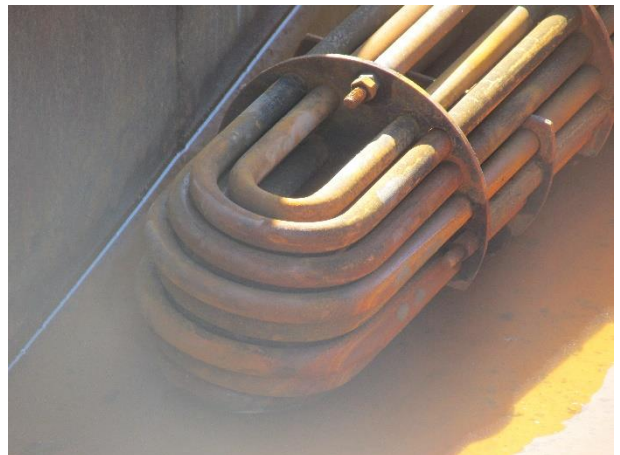
Channel bonnet internal



Tube bundle tube sheet



Tube bundle



Tube bends



Tubes and baffles



Tube internal



## SHELL & TUBE INSPECTION REPORT

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### PHOTOS



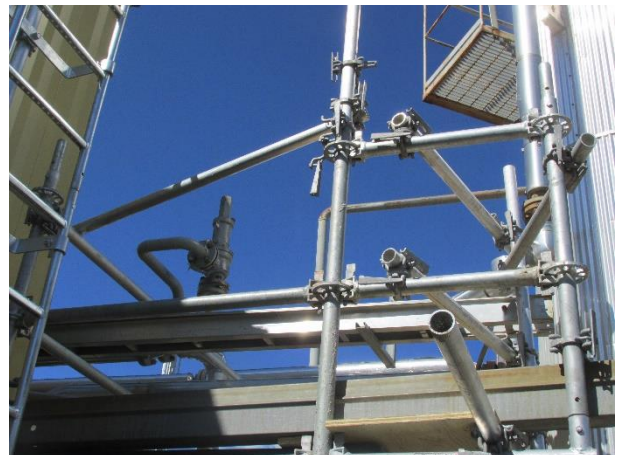
Tube bundle close up



Tube to tubesheet



Shell side internal



Tube side PSV off stabilizer tower



Shell side PSV service tag



Shell side PSV off stabilizer feed drum

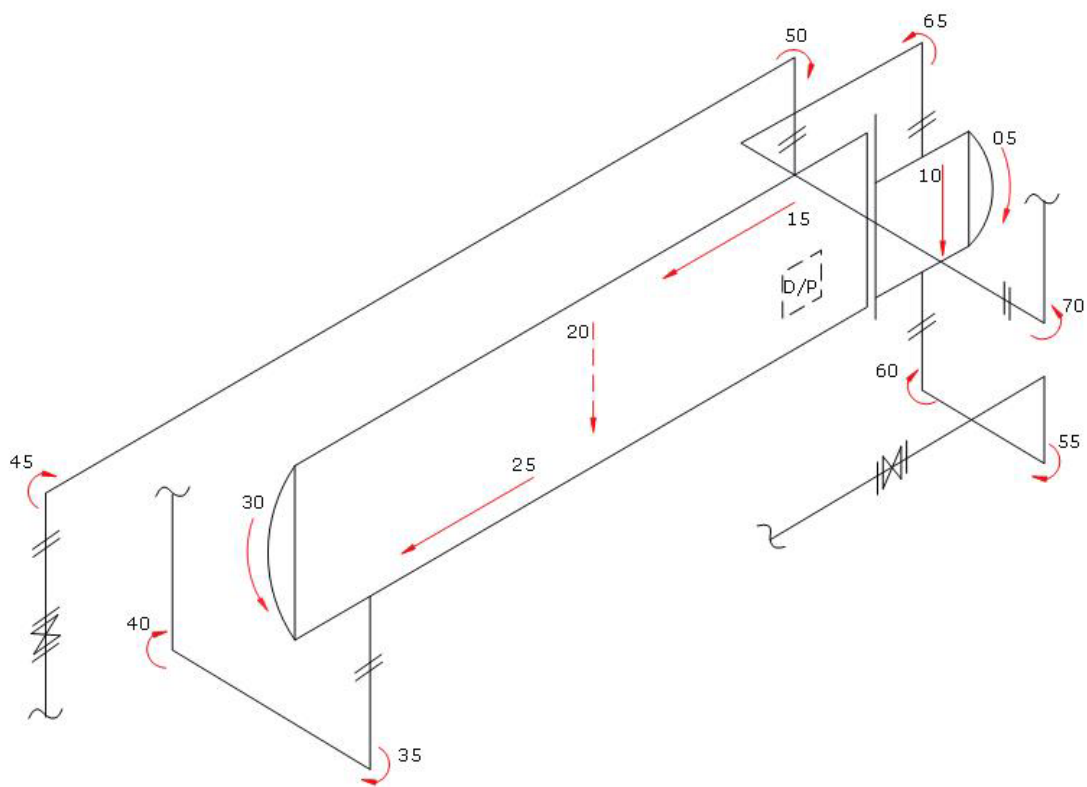




Location Name:	ANSELL GAS PLANT	LSD:	7-27-51-19W5
A#:	A0402803	Equipment/Tag No.	E-110
Equipment Description:	EXCHANGER	Serial Number:	993371
		CRN: (or other ID#)	L6180.2
MAWP:	485 PSI	Design Temp:	350°F
Shell Material:	SA-106-B	Head Material:	SA-234-WPB
Shell Thickness:	0.322"	Head Thickness:	0.256"
Corrosion Allowance:	0.063"	Date Built:	1999
Size:	8.625"	Manufacturer:	THERMOTEC ENERGY
RT:		Pipe / Rolled Plate:	PIPE

Notes:











## Ultrasonic Corrosion Survey

Survey Name: Husky Energy

Date: Jun 11, 2014

Inspector: W. Gill

LSD: 07-27-051-19W5      Area: Ansell      Location: Gas Plant  
A #: A0402803      Tag Number: E-110      Vessel Name: Exchanger  
CRN: L6180.2      Year Built: 1999      Serial Number: 993371  
Vessel CA: 1.6 mm      Manufacturer: Thermotech Energy  
Shell MAWP: 485psi      MAWTF: 350°F      Tube MAWP:      MAWTF:

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>05</b>	Head	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Gas Boot	<b>Min</b>	7.240	7.156	1.022	8.179	
<b>OD:</b>	8.625"	<b>Avg</b>	8.460			Assumed	<b>Remaining Life:</b>
<b>Spec:</b>	ASME VIII Div.1	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>10</b>	Head	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Gas Boot	<b>Min</b>	8.460	7.157	1.022	8.179	
<b>OD:</b>	8.625"	<b>Avg</b>	8.810				<b>Remaining Life:</b>
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	SA-106-B
<b>15</b>	Shell	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Cylindrical	<b>Min</b>	8.890	6.579	1.600	8.179	
<b>OD:</b>	8.625"	<b>Avg</b>	9.270				<b>Remaining Life:</b>
<b>Spec:</b>	ASME VIII Div.1	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	SA-106-B
<b>20</b>	Shell	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Cylindrical	<b>Min</b>	8.640	6.579	1.600	8.179	
<b>OD:</b>	8.625"	<b>Avg</b>	8.920				<b>Remaining Life:</b>
<b>Spec:</b>	ASME VIII Div.1	<b>Comments:</b>					<b>Retirement Date:</b>



## Ultrasonic Corrosion Survey

Survey Name: Husky Energy

Date: Jun 11, 2014

Inspector: W. Gill

LSD: 07-27-051-19W5      Area: Ansell      Location: Gas Plant  
A #: A0402803      Tag Number: E-110      Vessel Name: Exchanger  
CRN: L6180.2      Year Built: 1999      Serial Number: 993371  
Vessel CA: 1.6 mm      Manufacturer: Thermotech Energy  
Shell MAWP: 485psi      MAWTF: 350°F      Tube MAWP:      MAWTF:

<b>TML Description</b>		Baseline				<b>Material:</b>	SA-106-B
<b>25</b>	Shell	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Cylindrical	<b>Min</b>	8.230	6.579	1.600	8.179	
<b>OD:</b>	8.625"	<b>Avg</b>	8.660				<b>Remaining Life:</b>
<b>Spec:</b>	ASME VIII Div.1	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	SA-234-WPB
<b>30</b>	Head	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	Ellipsoidal	<b>Min</b>	7.160	4.902	1.600	6.502	
<b>OD:</b>	8.625"	<b>Avg</b>	8.660				<b>Remaining Life:</b>
<b>Spec:</b>	ASME VIII Div.1	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>35</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	3.423	0.489	3.912	2.540	0.045
<b>OD:</b>	2.375"	<b>Avg</b>	3.710				<b>Remaining Life:</b> 15.44 Years
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>	No corrosion found				<b>Retirement Date:</b> 11/1/2029

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>40</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	3.510	3.423	0.489	3.912	
<b>OD:</b>	2.375"	<b>Avg</b>	3.760				<b>Remaining Life:</b>
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>					<b>Retirement Date:</b>



## Ultrasonic Corrosion Survey

Survey Name: Husky Energy

Date: Jun 11, 2014

Inspector: W. Gill

LSD: 07-27-051-19W5      Area: Ansell      Location: Gas Plant  
A #: A0402803      Tag Number: E-110      Vessel Name: Exchanger  
CRN: L6180.2      Year Built: 1999      Serial Number: 993371  
Vessel CA: 1.6 mm      Manufacturer: Thermotech Energy  
Shell MAWP: 485psi      MAWTF: 350°F      Tube MAWP:      MAWTF:

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>45</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	3.423	0.489	3.912	2.540	0.039
<b>OD:</b>	2.375"	<b>Avg</b>	3.680				<b>Remaining Life:</b> 20.81 Years
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>	No corrosion found				<b>Retirement Date:</b> 4/3/2035

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>50</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	3.423	0.489	3.912		
<b>OD:</b>	2.375"	<b>Avg</b>	3.940				<b>Remaining Life:</b>
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>55</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	4.845	0.692	5.537		
<b>OD:</b>	2.375"	<b>Avg</b>	5.410				<b>Remaining Life:</b>
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>					<b>Retirement Date:</b>

<b>TML Description</b>		Baseline				<b>Material:</b>	A-234-WPB
<b>60</b>	Piping	<b>2014</b>	<b>Flag</b>	<b>CA</b>	<b>Nominal</b>	<b>T Min</b>	<b>Corr. Rate</b>
<b>Shape:</b>	90° Elbow	<b>Min</b>	4.845	0.692	5.537		
<b>OD:</b>	2.375"	<b>Avg</b>	5.660				<b>Remaining Life:</b>
<b>Spec:</b>	ASME B31.3	<b>Comments:</b>					<b>Retirement Date:</b>





## Ultrasonic Corrosion Survey

Survey Name: Husky Energy

Date: Jun 11, 2014

Inspector: W. Gill

<b>LSD:</b> 07-27-051-19W5	<b>Area:</b> Ansell	<b>Location:</b> Gas Plant
<b>A #:</b> A0402803	<b>Tag Number:</b> E-110	<b>Vessel Name:</b> Exchanger
<b>CRN:</b> L6180.2	<b>Year Built:</b> 1999	<b>Serial Number:</b> 993371
	<b>Vessel CA:</b> 1.6 mm	<b>Manufacturer:</b> Thermotech Energy
	<b>Shell MAWP:</b> 485psi	<b>Tube MAWP:</b> MAWTF: 350°F

<b>TML Description</b>	Baseline	<b>Material:</b> A-234-WPB
<b>65</b> Piping	<b>2014</b>	<b>Corr. Rate</b>
<b>Shape:</b> 90° Elbow	<b>Min</b> 32.299	<b>Flag</b> 28.243
<b>OD:</b> 2.375"	<b>Avg</b> 32.311	<b>CA</b> 4.035
<b>Spec:</b> ASME B31.3	<b>Comments:</b>	<b>Nominal</b> 32.277
		<b>T Min</b>
		<b>Remaining Life:</b>
		<b>Retirement Date:</b>

<b>TML Description</b>	Baseline	<b>Material:</b> A-234-WPB
<b>70</b> Piping	<b>2014</b>	<b>Corr. Rate</b>
<b>Shape:</b> 90° Elbow	<b>Min</b> 32.338	<b>Flag</b> 28.242
<b>OD:</b> 2.375"	<b>Avg</b> 32.364	<b>CA</b> 4.035
<b>Spec:</b> ASME B31.3	<b>Comments:</b>	<b>Nominal</b> 32.277
		<b>T Min</b>
		<b>Remaining Life:</b>
		<b>Retirement Date:</b>

**FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS**  
**As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1**

A 402803

1. Manufactured and certified by **THERMOTEC ENERGY SYSTEMS, Div. of PREMETALCO INC 5010 - 76 AVE., S.E., CAL, AB. T2E 2X2**  
(Name and address of Manufacturer)

2. Manufactured for **RENAISSANCE C/O B.D.R. 300, 1501 WESTMOUNT RD. N.W. CALGARY, AB. T2N 3M2**  
(Name and address of Purchaser)

3. Location of installation **LSD 7-27-51-19-W5M ANSEL**  
(Name and address)

4. Type **HORIZONTAL** **HEAT EXCHANGER** **993371**  
(Honz., vert., or sphere) (Tank, separator, jckt, Vessel, heat exch., etc.) (Mfg's serial No.)

**L 6180.2** **993371 V REV 0** **N/A** **1999**  
(CRN) (Drawing No.) (Nat'l. Bd. No.) (Year built)

5. ASME Code, Section VIII, Div 1 **1998** **N/A** **N/A**  
Edition and Addenda (date) Code Case No. Special Service per UG-120(d)

Items 6-11 to be completed for single wall vessels, jackets of jacketed vessels, shells of heat exchangers, or chamber of multi-chambered vessels.

6. Shell (a) No. of course(s) **1** (b) Overall length (ft & in.) **7'-6"**

Course(s)			Material	Thickness		Long Joint (Cat A)				Circum. Joint (Cat. A.B. & C)				Heat Treatment			
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type	Nom	Corr	Type	Full	Spot	None	Eff.	Type	Full	Spot	None	Eff.	Temp	Time
1	8.625	7'-6"	SA106B	.322	.063	S	NONE	1	1			SPOT			85	NA	

7. Heads (a) **SA234 WPB NONE** (b) **SA234 WPB NONE**  
(Mat'l Spec. No. Grade or Type) H.T. - Time & Temp. (Mat'l Spec. No. Grade or Type) H.T. - Time & Temp.

	Location (Top Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Anex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A				
		Min	Corr	Crown	Knuckle					Convex	Concave	Type	Full	Spot	None	Eff.
(a)																
(b)	END	.256	.063		8	2:1	SE	HEAD			CONCAVE					

If removable, bolts used (describe other fastening)

8. Type of jacket **NA** Jacket closure **NA**  
(Mat'l Spec. No. Grade, size No.) (Describe as ogee & weld, bar, etc.)

9. M.A.W.P.: **485** **NA** psi at max temp **350** **NA** °F Min design metal temp **-20** °F at **485** psi  
(internal) (external) (internal) (external)

10. Impact test **NO EXEMPT PER UG 20 F & UCS 66A**  
(Indicate yes or no and the component(s) impact tested)

11. Hydro, pneu. or test press **728 PSI \*\*** Proof test **NA**

Items 12-13 to be completed tube sections.

12. Tubesheet **SA516-70N** **7.1875** **1.4375** **.125** **BOLTED**  
Stationary (Mat'l Spec. No.) Dia., in. (subject to press) Nom thk. in. Corr Allow., in. Attachment (Welded or Bolted)

13. Tubes **SA179** **.750** **14 BWG** **16** **U**  
Floating (Mat'l Spec. No.) Dia., in. Corr Allow., in. Attachment Number Type (Straight or U)

Items 14-17 incl. to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14. Shell (a) No. of course(s) **1** (b) Overall length (ft & in.) **0'-8.5**

Course(s)			Material	Thickness		Long Joint (Cat A)			Circum. Joint (Cat. A.B. & C)			Heat Treatment					
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type	Nom	Corr	Type	Full	Spot	None	Eff	Type	Full	Spot	None	Eff	Temp	Time
1	8.625	0'-8.5	SA106B	.322	.063	S	NONE	1	1			SPOT			85	NA	

15. Heads (a) **SA234 WPB NONE** (b) **SA234 WPB NONE**  
(Mat'l Spec. No. Grade or Type) H.T. - Time & Temp. (Mat'l Spec. No. Grade or Type) H.T. - Time & Temp.

	Location (Top Bottom, Ends)	Thickness		Radius		Elliptical	Conical	Hemispherical	Flat	Side to Pressure		Category A				
		Min	Corr	Crown	Knuckle	Ratio	Apex Angle	Radius	Diameter	Convex	Concave	Type	Full	Spot	None	LW
(a)	END	.256	.063		8	2:1	SE	HEAD			CONCAVE					
(b)																

If removable, bolts used (describe other fastening)

**SA193 B7 .875 X 7 12 PCS**

(Mat'l Spec. No. Grade, size No.)

