Canadian Natural Resources Limited
GENERAL PRESSURE VESSEL INFORMATION **Job # 10.113190**

District: GP South	**Skid No. 58757**
Facility: Hamburg Water injection	**Location (LSD): 13-20-96-09 W6M**
Vessel Name & Equipment Number: Free Water Knock Out	
Orientation: Horizontal	
Status: In Service	**Regulatory Inspection**

PRESSURE VESSEL NAMEPLATE DATA

"A" or "G" or "S" (Sask.) or BC Registration Number. **A0435016**		CRN Number **A 2352.32**	
Vessel serial number: 2040 V100		Size: 8 ft x 38 ft approx	
Shell thickness: 31.7 mm		Shell material: SA 516 70N	
Head thickness: 30.7 mm		Head material: SA 516 70N	
Tube wall thickness:		Tube material:	
Tube diameter:		Tube length:	
Channel thickness:		Channel material:	
Design pressure	Shell: 2779 (403 psi)	Operating pressure	Shell:
	Tubes:		Tubes:
Design Temp.	Shell: 38°C	Operating temperature	Shell:
	Tubes:		Tubes:
X-ray: RT-1		Heat treatment: No	
Code parameters: ASME VIII DIV 1		Joint efficiency (if on nameplate):	
Manufacturer: Plains Oil Ltd.		Year built: 1997	
Corrosion allowance: 3.2 mm		Manway Yes	

PRESSURE SAFETY VALVE NAMEPLATE DATA

Tag Number(s)	Manufacture	Model	Serial Number	Set Pressure	Capacity	Set Date
	Crosby	**453110L46/91**	**807-06461**	**408 psi**	**2259 gal/min**	**2009**
CRN#	Serviced by	Block valve	Location	Size	Code Stamp	
	Crosby	**No**	**Inlet piping**	**4 x 6**		

SERVICE CONDTIONS-INDICATE ALL THAT APPLY

Sweet X	Sour	Oil X	Gas X	Water X
Amine	LPG	Condensate	Air	Glycol
Other (Describe):				

Inspection Interval _____PSV Service Interval_____
(Determined by MIC in conjunction with Chief Inspector following guidelines of CNRL's Owner-User Inspection Program)
Reports reviewed and accepted by:

Mechanical Integrity Coordinator_____Date_____

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External Inspection Items	G	F	P	N/A	Comments
Insulation Verify sealed around manways, nozzles, no damage present, and there is no egress of moisture.	X				**Vessel is 60% insulated. Cladding in good condition. Straps are secure. Wall closure is sealed. No egress of moisture.**
External Condition Assess paint condition, areas peeling, record any corrosion, damage, etc (record location, size and depth of corrosion or damage)	X				**Paint is in good condition. No exposed metal. No damage.**
Leakage Record any leakage at flanges, threaded joints, weep holes on repads, etc.	X				**No leaks found.**
Skirt/ Saddle Assess condition of paint, fire protection, concrete. Look for corrosion, buckling, dents, etc. Look at vessel surface area near supports. Verify no signs of leakage at attachment to vessel and attachment welds are acceptable. Ground wire attached?	X				**Saddle is bolt to steel structure. No evidence of corrosion at saddle to shell. Paint is in good condition-no exposed metal. No distortion. No buckles. Skid is welded to pilings above ground level. Ground wire is attached to saddle and to skid.**
Anchor Bolts Hammer tap to ensure secure. Look for cracking in threads or signs of deformation.	X				**Anchor bolts are tight and secured. No sign of deformation.**
Concrete foundation Check for cracks etc.				X	
Ladder / Platform Describe general condition, ensure support is secure to vessel, and describe any hazards.				X	
Nozzle Assess paint, look for leakage, and ensure stud threads are fully engaged. Record any damage, deflection, etc. Are nozzles gusseted?	X				**Threaded nozzle joints are fully engaged. Studs fully engaged to nuts – no short bolts. Nozzles are not gusseted. No damage. No deflections. Paint in good condition – no exposed metal.**
Gauges Ensure gauges are visible, working, no leakage, and suitable for range of MAWP/ Temp.	X				**Gauges are visible, working and suitable for range of MAWP.**
External Piping Ensure pipe is well supported. All clamps, supports, shoes, etc. in place. Look for evidence of structural overload, deflection, etc. Paint condition, external corrosion?	X				**Paint is in good condition – no exposed metal. Piping is well supported with clamps and supports in place. No structural overloads or deflections noted.**
Valving Ensure no leaks are visible. Valves are properly supported and chained if necessary.		X			**All valves are well supported. Liquid seepage at pressure gauge valve.**
PSV Ensure PSV is set at pressure at or below that of vessel. Discharge piping is same size as inlet to valve and is properly supported and routed. Ensure no block valves between psv and vessel or if there are they are locked open.	X				**Located on inlet piping – removed for service No block valve between vessel and PSV.**
NDE methods Was UT/ MPI done on vessel (MI coordinator to review results)	X				**Ultrasonic corrosion survey carried out – pipe metal thickness detected below nominal minus corrosion allowance. Thickness calculations carried out: 3" Elbow – nominal thickness is 5.5mm / min thickness is 4.1mm / T min thickness is 1.6mm 4" Elbow – nominal thickness is 6.0mm / min thickness is 5.0mm / T min thickness is 1.6mm.**
Other					

Recommendations or corrective actions : Vessel is Fit for Service or describe corrective actions required)
(MIC to review corrective actions with Operations, discuss with Chief Inspector where necessary, and get remedial action implemented)
Recommendations: See Internal Summary
Summary: See Internal Summary
Vessel is fit for service.

Inspected By: Chris Maxsom **Date:** June 26, 2013

Internal Inspection Items	G	F	P	N/A	Comments
Coating Assess coating. Describe area coated, general condition of coating.				X	**Vessel is not internally coated.**
Anodes. How many, type, condition. % consumed. Are they being replaced?			X		**Two anodes consumed 95% and 25% consumed.** **Will be replaced.**
Internal Piping Is there any? If so, carbon or stainless steel. Describe condition, dents, corrosion, erosion, etc. Ensure supports are secure and any bolts are suitable for future use.	X				**4 inch gas draw stem piping is carbon steel and in good condition.** **No corrosion or mechanical damage.**
Vortex Breaker	X				**Three stainless steel vortex breakers are bolted in place and are in good condition.**
Baffles, deflector plates, Weir. If present, describe condition. Look closely at welds attached to vessel wall.	X				**Inlet deflector plate and weir plate are stainless steel and bolted securely to shell. No damage.**
Float Check for restricted movement	X				**None.**
North Head Note all corrosion, erosion or mechanical damage. (If vessel is horizontal identify direction of this head)		X			**Head is in good condition - No corrosion or mechanical damage.** **14 inch manway throat: 1 isolated pit 5/8 inch dia. x 0.110 inch deep. No external UT access.**
South Head Note all corrosion, erosion or mechanical damage. (If vessel is horizontal identify direction of this head)	X				**Good condition - No corrosion or mechanical damage.**
Shell Sections Record number of shell sections. Record location, size and depth of all erosion, corrosion or mechanical damage. Describe general condition. If any corrosion greater than corrosion allowance is observed in either shell or head, discuss with Chief Inspector before closing vessel.	X				**4 shell sections in good condition. Thin, tight scale on throughout. No corrosion or mechanical damage.**

Demister pad Is it in place? Is it clean? If any corrosion is apparent in vessel, lift pad and check top head for corrosion.	X				**Demister pad was found clean and in good condition at the time of inspection.**
Welds Inspect all welds, including attachment welds. Record all service-related damages and if there is any discuss with Chief Inspector before closing.	X				**Welds were in good condition, no corrosion or mechanical damage at time of inspection.**

Recommendations or corrective actions (indicate if fit for service)
Recommendations: 1. Repair valve at pressure gauge. 2. Fill weld isolated pit on manway using an approved CNRL weld procedure.
Summary: Vessel is in overall good condition, visual external inspection, visual internal and ultrasonic corrosion survey performed – Manway metal thickness measured below nominal nearing corrosion allowance. One isolated pit identified at 14 inch manway throat. Nominal 12.7 mm. Measured pit depth to 0.110 inch (2.8 mm) deep. Long term corrosion rate based on greatest thickness loss (manway throat) 0.175 mm per year - Loss from new 2.8 mm. Retirement Date to "T"min is year 2044. Using MAWP of vessel, Maximum allowable working pressure of vessel.
June 27: Pit was further excavated by REED Energy to remove corrosion and blended out to a max depth of 0.350 inch (8.9 mm). Nominal 12.7 mm – 8.9 mm removed = 3.8 mm remaining wall.
June 29: Pit was fill-welded by REED Energy. MT inspection carried out on repair-No cracking detected.
Vessel is fit for service.

Inspected By: Chris Maxsom **Date:** June 26, 2013

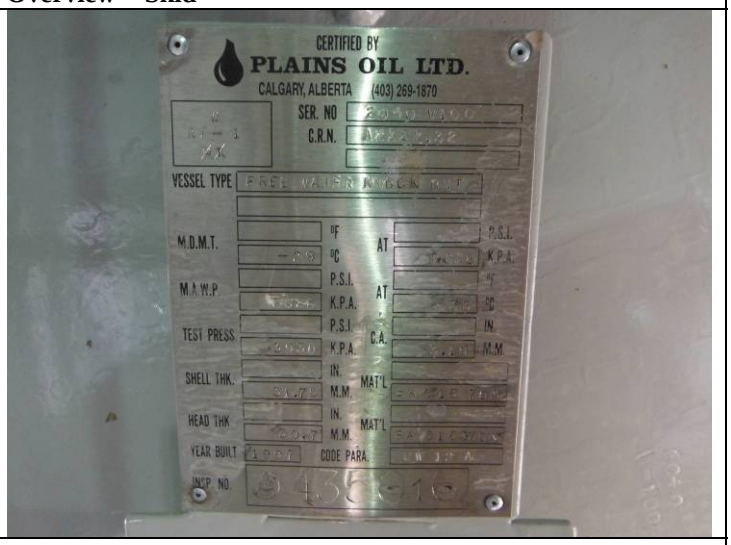
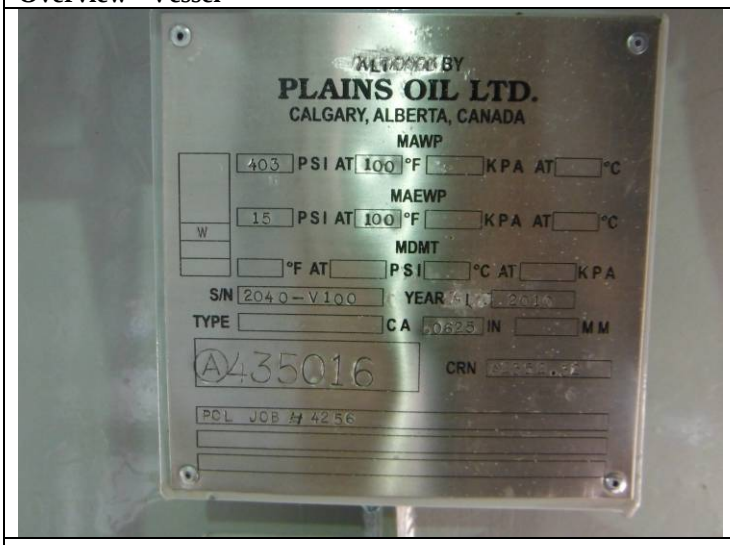
Shell Calculation:

$$\frac{P\ (\text{MAWP of vessel}) \times R\ (\text{Inside radius of the vessel or pipe})}{S/4\ (\text{Tensile Strength of metal/safety factor of 4}) \times E\ (\text{Efficiency Factor}) - 0.6 \times P\ (\text{MAWP of vessel})}$$

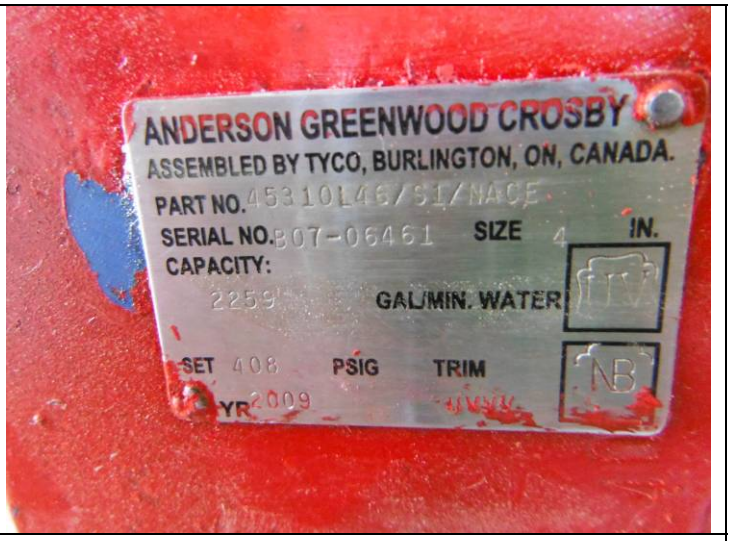
Required Values:

Pressure (MAWP):	403	psi
Inside Radius:	6.5	in
Tensile Strength:	60000	lbs
Efficiency Factor:	1	

result:	0.177494545	in
result:	4.508361453	mm

LSD	Overview - Skid
	
Overview - Vessel	**Data plate**
	
Alteration data plate	**Alteration data plate**
	
Liquid seepage at pressure gauge valve	**PSV location - Removed for service**

PSV



PSV data plate

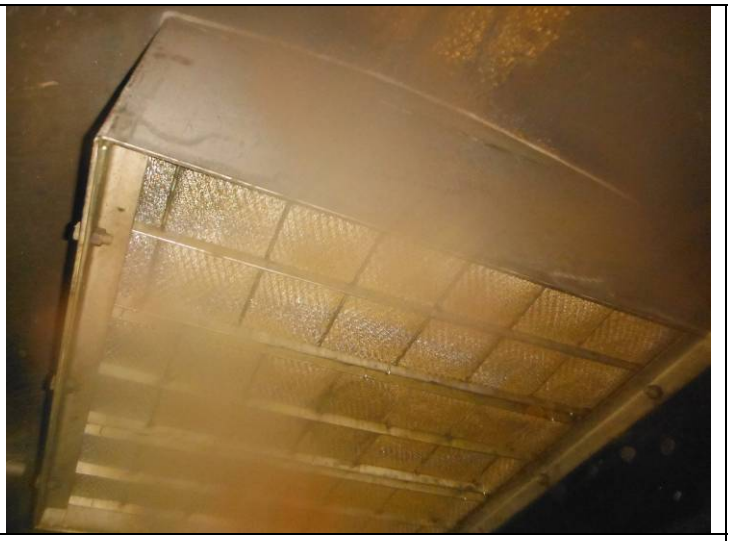
Inlet deflector

East manway

South head

Bottom shell

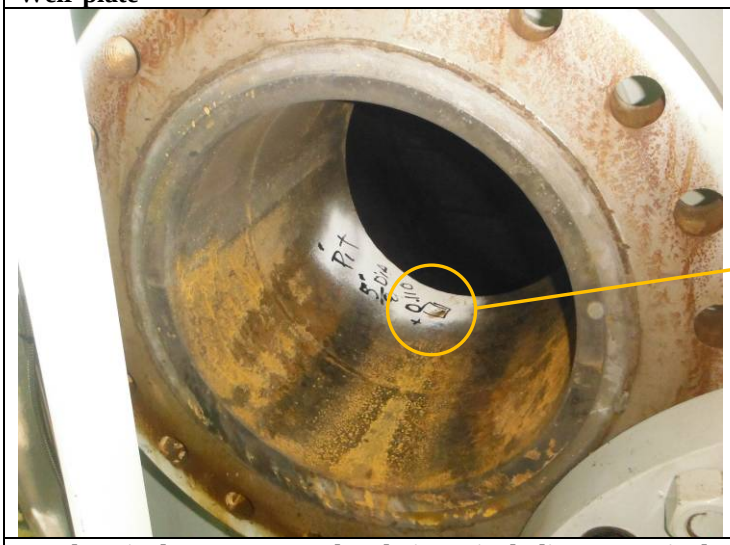
Vortex breakers



Demister pad

Weir plate

North head to shell weld 6:00 position



North 14 inch manway - Isolated pit 5/8 inch dia. x 0.110 inch depth

	
Pit excavated to 0.350 inch depth	**Final repair MT carried out – No cracking detected.**