

**Table 1. Summary of secondary seal buffer and barrier seal piping plan monitoring**

API Plan	Technology	Scenario					
		VOC Emissions	Condition monitoring leakage detection		Catastrophic Failure Consequence		No liquid in seal chamber
			Primary Seal	Secondary Seal	Primary Seal	Secondary Seal	
Historic Practice Pressure Switch on Drain Line	Contacting Containment	Good	Leakage would need to exceed 15L/min to alarm	Manual air test (pump offline <sup>5</sup> )	Pressure alarm <sup>1</sup> Process leakage to atmos > 0.1cc/min <sup>6</sup>	No way of detecting failure	Inner seal fails potentially catastrophically
	Non Contacting Gas Lift	Acceptable <sup>2</sup>	Leakage would need to exceed 15L/min to alarm	Manual air test (pump offline <sup>5</sup> )	Pressure alarm <sup>1</sup> Process leakage to Atmos > 45cc/min <sup>6</sup>	No way of detecting failure	Inner seal fails potentially catastrophically
75 Condensing Leakage	Contacting	Good	Leakage detection <sup>4</sup> visual unless optional Level Transmitter API 682 4th is specified	Manual Air test (pump offline <sup>5</sup> )	Level alarm <sup>1 2</sup> Process leakage <sup>6</sup> to Atmos > 0.1 cc/min	No way of detecting failure	Inner seal fails potentially catastrophically
	Non Contacting Gas Lift	Acceptable <sup>2</sup>	Leakage detection <sup>4</sup> visual unless optional level Transmitter API 682 4th is specified	Manual Air test (pump offline <sup>5</sup> )	Level alarm <sup>1 2</sup> Process leakage <sup>6</sup> to Atmos > 45 cc/min	No way of detecting failure	Inner seal fails potentially catastrophically
76 Vaporising Leakage	Contacting	Good	Leakage detection <sup>5</sup> via pressure transmitter - Flow rate~50L/min (90gr/min)	Manual Air test (pump offline <sup>5</sup> )	Level alarm <sup>1 2</sup> Process leakage <sup>6</sup> to Atmos > 0.1 cc/min	No way of detecting failure	Inner seal fails potentially catastrophically
	Non Contacting Gas Lift	Acceptable <sup>2</sup>	Leakage detection <sup>5</sup> via pressure transmitter - Flow rate~50L/min (90gr/min)	Manual Air test (pump offline <sup>5</sup> )	Level alarm <sup>1 2</sup> Process leakage <sup>6</sup> to Atmos > 45 cc/min	No way of detecting failure	Inner seal fails potentially catastrophically
53B	Pressurised Dual Wet 53B	Zero	Pressure Transmitter	Pressure Transmitter	Pressure alarm Process fluid will contaminate Barrier fluid over time	Pressure Alarm Inner seal will contain Process <sup>7</sup>	Seal faces lubricated by Barrier Liquid Fluid - Barrier fluid temperature will increase
74	Pressurised Dual Gas 74	Zero	N2 Flow Transmitter	N2 Flow Transmitter	High Flow Alarm if insufficient N <sub>2</sub> flow available process fluid will not be contained by outer seal	High Flow Alarm Inner seal will not contain Process	Seal faces lubricated by Gas Barrier Fluid

<sup>1</sup> Assumes a containment seal will contain; No guarantee if regular period static tests of the containment system are not performed

<sup>2</sup> Figures Form API 682 4th edition Annex F. 1.3 Predicted leakage rates

<sup>3</sup> Assume API 682 4th edition philosophy and use of transmitter 3rd edition would rely on trending frequency of the level switch

<sup>4</sup> Assumes fluid is primarily condensing (>C5) Level transmitter optional (API 682 4th) - A switch is optional in earlier editions of API 682

<sup>5</sup> Assumptions C3 Propane Seal chamber 18 Barg. Orifice 3mm (as specified by API 682) Note: Reducing the orifice size will increase alarm sensitivity at the risk of blockage

<sup>6</sup> Assumes 50mm seal / Seal Chamber Pressure 2.75 Bar

<sup>7</sup> Assumes inner seal has reverse pressure capability