Attachment 3

Corrected Pages to WCAP-17072-NP (Non-Proprietary)

Prior calculations assumed that contact pressure from the tube would expand the tubesheet bore uniformly without considering the restoring forces from adjacent pressurized tubesheet bores. In the structural model, a tubesheet radius dependent stiffness effect is applied by modifying the representative collar thickness (see Section 6.2.4) of the tubesheet material surrounding a tube based on the position of the tube in the bundle. The basis for the radius dependent tubesheet stiffness effect is similar to the previously mentioned "beta factor" approach. The "beta factor" was a coefficient applied to reduce the crevice pressure to reflect the expected crevice pressure during normal operating conditions in some prior H* calculations and is no longer used in the structural analysis of the tube-to-tubesheet joint. The current structural analysis consistently includes a radius dependent stiffness calculation described in detail in Section 6.2.4. The application of the radius dependent stiffness factor has only a small effect on the ultimate value of H* but rationalizes the sensitivity of H* to uncertainties throughout the tubesheet.

The contact pressure analysis methodology has not changed since 2007 (Reference 1-9). However, the inputs to the contact pressure analysis and how H* is calculated have changed in that period of time. The details describing the inputs to the contact pressure analysis are discussed in Section 6.0.

The calculation for H* includes the summation of axial pull out resistance due to local interactions between the tube bore and the tube. Although tube bending is a direct effect of tubesheet displacement, the calculation for H* conservatively ignores any additional pull out resistance due to tube bending within the tubesheet or Poisson expansion effects acting on the severed tube end. In previous submittals, the force resisting pull out acting on a length of a tube between any two elevations *h1* and *h2* was defined in Equation (1-1):

$$F_i = (h_2 - h_1)F_{HE} + \mu \pi d \int_{h_1}^{h_2} P\, dh \tag{1-1}$$

where:

F_{HE} = Resistance per length to pull out due to the installation hydraulic expansion,

d = Expanded tube outer diameter,

P = Contact pressure acting over the incremental length segment dh, and,

μ = Coefficient of friction between the tube and tubesheet, conservatively assumed to be 0.2 for the pull out analysis to determine H*.

The current H* analysis generally uses the following equation to determine the axial pull out resistance of a tube between any two elevations *h1* and *h2*:

[ ]a,c,e (1-2)

Where the other parameters in Equation (1-2) are the same as in Equation (1-1) and [

]a,c,e A detailed explanation of the

revised axial pull out equation are included in Section 6.0 of this report. However, the reference basis for the H* analysis is the assumption that residual contact pressure contributes zero additional resistance to tube pull out. Therefore, the equation to calculate the pull out resistance in the H* analysis is:

$$F_i = \mu \pi d \int_{h_1}^{h_2} P dh \tag{1-3}$$

1.3.2 Leakage Integrity Analysis

Prior submittals of the technical justification of H* (Reference 1-9) argued that K was a function of the contact pressure, P_c, and, therefore, that resistance was a function of the location within the tubesheet. The total resistance was found as the average value of the quantity μK, the resistance per unit length, multiplied by L, or by integrating the incremental resistance, $dR = \mu K\, dL$ over the length L, i.e.,

$$R = \mu \overline{K} (L_2 - L_1) = \mu \int_{L_1}^{L_2} K\, dL \tag{1-4}$$

Interpretation of the results from multiple leak rate testing programs suggested that the logarithm of the loss coefficient was a linear function of the contact pressure, i.e.,

$$\ln K = a_0 + a_1 P_c, \tag{1-5}$$

where the coefficients, a_0 and a_1 of the linear relation were based on a regression analysis of the test data; both coefficients are greater than zero. Simply put, the loss coefficient was determined to be greater than zero at the point where the contact pressure is zero and it was determined that the loss coefficient increases with increasing contact pressure. Thus,

$$K = e^{a_0 + a_1 P_c}, \tag{1-6}$$

and the loss coefficient was an exponential function of the contact pressure.

The B* distance (L_B) was defined as the depth at which the resistance to leak during SLB was the same as that during normal operating conditions (NOP) (using Equation 1-4, the B* distance was calculated setting $R_{SLB} = R_{NOP}$ and solving for L_B). Therefore, when calculating the ratio of the leak rate during the design basis accident condition to the leak rate during normal operating conditions, the change in magnitude of leakage was solely a function of the ratio of the pressure differential between the design basis accident and normal operating plant conditions.

The NRC Staff raised several concerns relative to the credibility of the existence of the loss coefficient versus contact pressure relationship used in support of the development of the B* criterion:

Table 1-1 List of Conservatisms in the H* Structural and Leakage Analysis (Continued)

Assumption/Approach	Why Conservative?
A [ ]^{a,c,e}	This is conservative because it reduces the stiffness of the solid and perforated regions of the tubesheet to the lowest level for each operating condition (see Section 6.2.2.2.2).
Pressure is not applied to the [ ]^{a,c,e}	Applying pressure to the [ ]^{a,c,e} (see Section 6.2.2.2.4).
The radius dependent stiffness analysis ignores the presence of the [ ]^{a,c,e}	Including these structures in the analysis would reduce the tubesheet displacement and limit the local deformation of the tubesheet hole ID (see Section 6.2.4.4).
The tubesheet bore dilation [ ]^{a,c,e} 2250 (NOP conditions).	Thermal expansions under operating loads were [ ]^{a,c,e} (see Section 6.2.5).

5.3 CALCULATION OF APPLIED END CAP LOADS

The tube pull out loads[1] (also called end cap loads) to be resisted during normal operating (NOP) and faulted conditions for the bounding Model D5 plant (Byron Unit 2 , Braidwood Unit 2) for the hot leg are shown below. End cap load is calculated by multiplying the required factor of safety times the cross-sectional area of the tubesheet bore hole times the primary side to secondary side pressure difference across the tube for each plant condition.

Operating Condition	ΔP (psi) (P_{pri}-P_{sec})	Area (in^2) (Note 1)	End Cap Load (lbs.)	Factor of Safety	H* Design End ap Load (Lbs.)
Normal Op. (maximum)	[				]a,c,e
Faulted (FLB)					
Faulted (SLB)					
Faulted (Locked Rotor)					
Faulted (Control Rod Ejection)					

Notes:
1. Tubesheet Bore Cross-Sectional Area = [ ]a,c,e

The above calculation of end cap loads is consistent with the calculations of end cap loads in prior H* justifications and in accordance with the applicable industry guidelines (Reference 5-3). This approach results in conservatively high end cap loads to be resisted during NOP and faulted conditions because a cross-sectional area larger than that defined by the tubesheet bore mean diameter is assumed.

The end cap loads noted above include a safety factor of 3 applied to the normal operating end cap load and a safety factor of 1.4 applied to the faulted condition end cap loads to meet the associated structural performance criteria consistent with NEI 97-06, Rev. 2 (Reference 5-3).

Seismic loads have also been considered, but they are not significant in the tube joint region of the tubes (Reference 5-1).

H* values are not calculated for the locked rotor and control rod ejection transients because the pressure differential across the tubesheet is bounded by the FLB/SLB transient. For plants that have a locked rotor with stuck open PORV transient included as part of the licensing basis, this event is bounded by the FLB/SLB event because the peak pressure during this transient is significantly less than that of the

[1] The values for end cap loads in this subsection of the report are calculated using an outside diameter of the tube equal to the mean diameter of the tubesheet bore plus 2 standard deviations.

Table 5-1 Operating Conditions – Model D5 H* Plant

a,c,e

Parameter and Units		Plant		
		Byron Unit 2 and Braidwood Unit 2[1]	Catawba Unit 2[2]	Comanche Peak Unit 2[3]
Power - NSSS	MWt	3600.6	3499	3628
Primary Pressure	psia	2250	2250	2250
Secondary Pressure	Psia (Low T_{avg}/ High T_{avg})			
Reactor Vessel Outlet Temperature	°F (Low T_{avg}/ High T_{avg})			
SG Primary-to-Secondary Pressure Differential (psid)	Psid (Low T_{avg}/ High T_{avg})			

(1) PCWG-2741, Bryon/Braidwood Units 1 and 2 (CAE/CBE/CCE/CDE) "Approval of Category IV PCWG Parameters to Support an Uprating Program," March 22, 2002.
(2) CN-SGDA-03-85, "Input Data for the H*/P* Effort Pertaining to Both Model D-5 and Model F Steam Generators," September 30, 2003.
(3) PCWG-06-35, Rev.1, "Comanche Peak Units 1 & 2 (TBX/TCX): Approval of Category III (for Contract) PCWG Parameters to Support the Uprate Program," October 3, 2006.

Table 5-2 Steam Line Break Conditions

Parameters and Units[(1)]	Byron Unit 2 and Braidwood Unit 2	Catawba Unit 2	Comanche Peak Unit 2
Peak Primary-Secondary Pressure (psig)	[		] a,c,e
Primary Fluid Temperature (°F) (HL and CL)			
Secondary Fluid Temperature (°F) (HL and CL)			

[(1)] All Model D5 H* plants are 4-loop plants.
HL – Hot Leg
CL – Cold Leg

Table 5-3 Feedwater Line Break Conditions

Parameters and Units	Byron Unit 2 and Braidwood Unit 2	Catawba Unit 2	Comanche Peak Unit 2
Peak Primary-Secondary Pressure (psig)	[		] a,c,e
Primary Fluid Temperature (°F) (No load – HL and CL)			
Secondary Fluid Temperature (°F) (HL and CL)			]
HL – Hot Leg CL – Cold Leg			

Table 5-4 Locked Rotor Event Conditions

Parameters and Units	Byron Unit 2 and Braidwood Unit 2$^{(1)}$	Catawba Unit 2$^{(1)}$	Comanche Peak Unit 2$^{(1)}$
Peak Primary-Secondary Pressure (psig)	[		] a,c,e
Primary Fluid Temperature (°F)* (HL/CL)			
Secondary Fluid Temperature (°F)* (HL and CL)			
Primary Fluid Temperature (°F)** (HL and CL)			
Secondary Fluid Temperature (°F)** (HL and CL)			

$^{(1)}$ Active Loop
*Low T_{avg}
**High T_{avg}
HL – Hot Leg
CL – Cold Leg
NA – Not Applicable

Table 5-5 Control Rod Ejection

Parameters and Units	Byron Unit 2 and Braidwood Unit 2	Catawba Unit 2	Comanche Peak Unit 2
Peak Primary-Secondary Pressure (psig)	[		] a,c,e
Primary Fluid Temperature (°F)* (HL and CL)			
Secondary Fluid Temperature (°F)* (HL and CL)			
Primary Fluid Temperature (°F)** (HL and CL)			
Secondary Fluid Temperature (°F)** (HL and CL)			]
*Low T_{avg} **High T_{avg} HL – Hot Leg CL – Cold Leg NA – Not Applicable			

Table 5-6 Design End Cap Loads for Normal Operating Plant Conditions, Locked Rotor and Control Rod Ejection for Model D5 Plants

Plant	Low T_{avg} End Cap Load w/Safety Factor (lbf)	High T_{avg} End Cap Load w/Safety Factor (lbf)	Locked Rotor End Cap Load (lbf)	Control Rod Ejection End Cap Load (lbf)
Byron Unit 2 and Braidwood Unit 2	[			] a,c,e
Catawba Unit 2				
Comanche Peak Unit 2				

Therefore, $h_{nominal}$ = [ ]a,c,e inch (i.e., [ ]a,c,e and η = [ ]a,c,e when the tubes are not included. From Slot (Reference 6-5), the in-plane mechanical properties for Poisson's ratio of 0.3 are:

Property		Value
E_P^* / E_P	=	[ ]a,c,e
ν_p^*	=	
G_P^* / G_P	=	
E_y^* / E_y	=	
G_y^* / G_y	=	
E	=	Elastic modulus of solid material

where the subscripts P, d and y refer to the pitch, diagonal and thickness directions, respectively. These values are substituted into the expressions for the anisotropic elasticity coefficients given previously. The coordinate system used in the analysis and derivation of the tubesheet equations is given in Reference 6-4. Using the equivalent property ratios calculated above in the equations presented at the beginning of this section yields the elasticity coefficients for the equivalent solid plate in the perforated region of the tubesheet for the finite element model.

The three-dimensional structural model is used in two different analyses: 1) a static structural analysis with applied pressure loads at a uniform temperature and 2) a steady-state thermal analysis with applied surface loads. The solid model and mesh is the same in the structural and thermal analyses but the element types are changed to accommodate the required degrees of freedom (e.g., displacement for structural, temperature for thermal) for each analysis. The tubesheet displacements for the perforated region of the tubesheet in each analysis are recorded for further use in post-processing. Figure 6-2 and Figure 6-3 are screen shots of the three-dimensional solid model of the Model D5 SG. Figure 6-4 shows the entire 3D model mesh.

[ ] a,c,e

with the elasticity coefficients calculated as:

[ ] a,c,e

[ ] a,c,e

[ ] a,c,e

[ ] a,c,e and [ ] a,c,e

where [ ] a,c,e and [ ] a,c,e

The variables in the equation are:

$\overline{E}_p^*$ = Effective elastic modulus for in-plane loading in the pitch direction,

$\overline{E}_z^*$ = Effective elastic modulus for loading in the thickness direction,

$\overline{\nu}_p^*$ = Effective Poisson's ratio for in-plane loading in the thickness direction,

$\overline{G}_p^*$ = Effective shear modulus for in-plane loading in the pitch direction,

$\overline{G}_z^*$ = Effective shear modulus for transverse shear loading,

$\overline{E}_d^*$ = Effective shear modulus for in-plane loading in the diagonal direction,

$\overline{\nu}_d^*$ = Effective Poisson's ratio for in-plane loading in the diagonal direction, and,

ν = Poisson's ratio for the solid material,

E = Elastic modulus of solid material,

γ_{RZ} = Transverse shear strain

τ_{RZ} = Transverse shear stress,

$[D]$ = Elasticity coefficient matrix required to define the anisotropy of the material.

Table 6-6 Summary of H* Byron Unit 2 Analysis Mean Input Properties

Plant Name	Byron 2
Plant Alpha	CBE
Plant Analysis Type	Hot Leg
SG Type	D5

Input	**Value**	**Unit**	**Reference**
Accident and Normal Temperature Inputs			
NOP T_{hot}	a,c,e	°F	PCWG-2741
NOP T_{low}		°F	PCWG-2741
SLB TS ΔT		°F	1.3F, Rev. 2
SLB CH ΔT		°F	1.3F, Rev. 2
Shell ΔT		°F	PCWG-2741
FLB Primary ΔT		°F	1.3F, Rev. 2
SLB Primary ΔT		°F	1.3F, Rev. 2
SLB Secondary ΔT		°F	1.3F, Rev. 2
Secondary Shell ΔT Hi		°F	1.3F, Rev. 2
Secondary Shell ΔT Low		°F	1.3F, Rev. 2
Cold Leg ΔT		°F	PCWG-2741
Hot Standby Temperature		°F	PCWG-2741
Operating Pressure Input			
Faulted SLB Primary Pressure	a,c,e	psig	1.3F, Rev. 2
Faulted FLB Primary Pressure		psig	1.3F, Rev. 2
Normal Primary Pressure	2235.0	psig	PCWG-2741
Cold Leg ΔP	a,c,e	psig	PCWG-2741
NOP Secondary Pressure – Low		psig	PCWG-2741
NOP Secondary Pressure – Hi		psig	PCWG-2741
Faulted FLB Secondary Pressure		psig	1.3F, Rev. 2
Faulted SLB Secondary Pressure		psig	1.3F, Rev. 2

Table 6-7 List of SG Models and H* Plants With Tubesheet Support Ring Structures

Plant	Alpha	SG Model	TS Support Ring?	General Arrangement Drawing
Braidwood – 2	CDE	D5	a,c,e	1103 J99 Sub 3
Byron – 2	CBE	D5		1103J99 Sub 3
Wolf Creek – 2	SAP – Use Callaway (SCP) SG Drawings	F		1104J54 Sub 2
Salem – 1	PSE – Use Seabrook -2 (NCH) SG Drawings	F		1104J86 Sub 9
Surry – 1	VPA***	51F		1105J29 Sub 3
Surry – 2	VIR***	51F		1105J29 Sub 3
Turkey Point – 4	FLA***	44F		1105J45 Sub 3
Millstone – 3	NEU	F		1182J08 Sub 8
Comanche Peak – 2	TCX	D5		1182J16 Sub 1
Vandellos – 2	EAS	F		1182J34 Sub 1
Seabrook – 1	NAH	F		1182J39 Sub 3
Turkey Point – 3	FPL**	44F		1183J01 Sub 2
Catawba – 2	DDP	D5		1183J88 Sub 2
Vogtle – 1	GAE	F		1184J31 Sub 13
Vogtle – 2	GBE	F		1184J32 Sub1
Point Beach – 1	WEP**	44F		1184J32 Sub 1
Robinson – 2	CPL**	44F		6129E52 Sub 3
Indian Point – 2	IPG	44F		6136E16 Sub 2

** Model 44 F – These original SGs have been replaced.

*** Model 51F – These original SGs have been replaced.

Table 6-8 Conservative Generic NOP Pressures and Temperatures for 4-Loop Model F

(These values do not exist in operating SG and are produced by examining worst-case comparisons.)

Normal Operating, Bounding			
Secondary Surface Temperature			a,c,e
Primary Surface Temperature Cold Leg Hot Leg			
Primary Pressure Cold Leg Hot Leg			
Secondary Pressure			
End Cap Pressure			
Structural Thermal Condition			
Reference Temperature			

Table 6-9 Generic NOP Low T_{avg} Pressures and Temperatures for 4-Loop Model F

Normal Operating, Low T_{avg}			
Secondary Surface Temperature			a,c,e
Primary Surface Temperature Cold Leg Hot Leg			
Primary Pressure Cold Leg Hot Leg			
Secondary Pressure			
End Cap Pressure			
Structural Thermal Condition			
Reference Temperature			

Table 6-10 Generic NOP High T_{avg} Pressures and Temperatures for 4-Loop Model F

Normal Operating, High T_{avg}			
Secondary Surface Temperature			a,c,e
Primary Surface Temperature Cold Leg Hot Leg			
Primary Pressure Cold Leg Hot Leg			
Secondary Pressure			
End Cap Pressure			
Structural Thermal Condition			
Reference Temperature			

Table 6-11 Generic SLB Pressures and Temperatures for 4-Loop Model F

Main Steam Line Break		
Secondary Surface Temperature	[	] a,c,e
Primary Surface Temperature Cold Leg Hot Leg		
Primary Pressure Cold Leg Hot Leg		
Secondary Pressure		
End Cap Pressure		
Structural Thermal Condition		
Reference Temperature		

Table 6-12 Generic FLB Pressures and Temperatures for 4-Loop Model F

Feedwater Line Break		
Secondary Surface Temperature	[	] a,c,e
Primary Surface Temperature Cold Leg Hot Leg		
Primary Pressure Cold Leg Hot Leg		
Secondary Pressure		
End Cap Pressure		
Structural Thermal Condition		
Reference Temperature		

Table 6-13 Conservative Generic SLB Pressures and Temperatures for 4-Loop Model F (These values do not exist in operating SG and are produced by examining worst-case comparisons.)

Main Steam Line Break, High Temp		
Secondary Surface Temperature	[	] a,c,e
Primary Surface Temperature Cold Leg Hot Leg		
Primary Pressure Cold Leg Hot Leg		
Secondary Pressure		
End Cap Pressure		
Structural Thermal Condition		
Reference Temperature		

Table 9-1 Reactor Coolant System Temperature Increase Above Normal Operating Temperature Associated With Design Basis Accidents
(References 9-12 and 9-13)

SG Type	Steam Line/Feedwater Line Break		Locked Rotor (Dead Loop)		Locked Rotor (Active Loop)		Control Rod Ejection	
	SG Hot Leg (°F)	SG Cold Leg (°F)	SG Hot Leg (°F)	SG Cold Leg (°F)	SG Hot Leg (°F)	SG Cold Leg (°F)	SG Hot Leg (°F)	SG Cold Leg (°F)
Model F	[							] a,c,e
Model D5								
Model 44F								
Model 51F								

* Best estimate values for temperature during FLB/SLB are used as discussed in Section 9.2.3.1.

Table 9-2 Reactor Coolant Systems Peak Pressures During Design Basis Accidents
(References 9-12 and 9-13)

SG Type	Steam Line Break (psia)	Feedwater Line Break (psia)	Locked Rotor (psia)	Control Rod Ejection (psia)
Model D5	[			] a,c,e
Model F				
Model 44F				
Model 51F				]

Table 9-3 Model F Room Temperature Leak Rate Test Data

Test No.	EP-31080	EP-30860	EP-30860	EP-29799	EP-31330	EP-31320	EP-31300	
Collar Bore Dia. (in.)								a,c,e
Test Pressure Differential (psi)	Leak Rate (drops per minute – dpm)							
1000								a,c,e
1910								
2650								
3110								
ΔP Ratio	Leak Rate Ratio (normalized to initial ΔP)							Average LR Ratio
1								a,c,e
1.91								
2.65								
3.11								

Table 9-4 Model F Elevated Temperature Leak Rate Test Data

Test No.	EP-31080	EP-31080	EP-30860	EP-30860	EP-29799	EP-29799	EP-32800	EP-32800	EP-31300	EP-31300	
Collar Bore Dia. (in.)											a,c,e
Test Pressure Differential (psi)	Leak Rate (drops per minute –dpm)										
1910											a,c,e
2650											
3110											
ΔP Ratio	Leak Rate Ratio (normalized to initial ΔP)										Average LR Ratio
1											a,c,e
1.39											
1.63											

Table 9-5 H* Plants Operating Conditions Summary [(1)]

a,c,e

Plant Name	SG Type	Number of Loops	Temperature Hot Leg (F) High T_{avg}	Temperature Cold Leg (F) High T_{avg}	Temperature Hot Leg (F) Low T_{avg}	Temperature Cold Leg (F) Low T_{avg}	Pressure Differential Across the Tubesheet (psi) High T_{avg}	Pressure Differential Across the Tubesheet (psi) Low T_{avg}
Byron Unit 2 and Braidwood Unit 2	D5	4						
Salem Unit 1	F	4						
Robinson Unit 2	44F	3						
Vogtle Unit 1 and 2	F	4						
Millstone Unit 3	F	4						
Catawba Unit 2	D5	4						
Comanche Peak Unit 2	D5	4						
Vandellos Unit 2	F	3						
Seabrook Unit 1	F	4						
Turkey Point Units 3 and 4	44F	3						
Wolf Creek	F	4						
Surry Units 1 and 2	51F	3						
Indian Point Unit 2	44F	4						
Point Beach Unit 1	44F	2						

(1) The source of all temperatures and pressure differentials is Reference 9-21.

Table 9-6 H* Plant Maximum Pressure Differentials During Transients that Model Primary-to-Secondary Leakage (1)

a,c,e

Plant Name	FLB/SLB Pressure Differential (psi)	Locked Rotor Pressure Differential (psi)	Control Rod Ejection Pressure Differential (psi)	Normal Operating Pressure Differential High T_{avg} (psi)
Byron Unit 2 and Braidwood Unit 2				
Salem Unit 1				
Robinson Unit 2				
Vogtle Unit 1 and 2				
Millstone Unit 3				
Catawba Unit 2				
Comanche Peak Unit 2				
Vandellos Unit 2				
Seabrook Unit 1				
Turkey Point Units 3 and 4				
Wolf Creek				
Surry Units 1 and 2				
Indian Point Unit 2				
Point Beach Unit 1				

(1) The source of all pressure differentials is Reference 21.

Table 9-7 Final H* Leakage Analysis Leak Rate Factors

a,c,e

Transient	SLB/FLB			Locked Rotor				Control Rod Ejection			
Plant Name	FLB-SLB/NOP ΔP Ratio (High T_{avg})[2]	VR[3] @ 2672 psia	SLB/FLB Leak Rate Factor(LRF)	LR/NOP ΔP Ratio	VR[3] @ 2711 psia	Leak Rate Factor (LRF)	Adjusted LR LRF[1]	CRE/NOP ΔP Ratio	VR[3] @ 3030 psia	Leak Rate Factor (LRF)	Adjusted CRE LRF[1]
Byron Unit 2 and Braidwood Unit 2			**1.93**								
Salem Unit 1			**1.79**								
Robinson Unit 2			**1.82**								
Vogtle Unit 1 and 2			**2.02**								
Millstone Unit 3			**2.02**								
Catawba Unit 2			**1.75**								
Comanche Peak Unit 2			**1.94**								
Vandellos Unit 2			**1.97**								
Seabrook Unit 1			**2.02**								
Turkey Point Units 3 and 4			**1.82**								
Wolf Creek			**2.03**								
Surry Units 1 and 2			**1.80**								
Indian Point Unit 2			**1.75**								
Point Beach Unit 1			**1.73**								

4. Includes time integration leak rate adjustment discussed in Section 9.5.
5. The larger of the ΔP's for SLB or FLB is used.
6. VR – Viscosity Ratio