BOP CLASSIFICATION SYSTEM
FOR
ONSHORE NEWFOUNDLAND AND LABRADOR

INTERPRETATION NOTE

ISSUED UNDER THE PETROLEUM DRILLING REGULATIONS (CNR 1150/96)

PREPARED BY THE PETROLEUM RESOURCE DEVELOPMENT DIVISION
UPDATED; DECEMBER 2004

GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR
Department of Natural Resources

INTRODUCTION

This Interpretation Note is intended to clarify the Newfoundland and Labrador Department of Natural Resources (NLDNR) requirements, to assist operators when sourcing blowout prevention (BOP) equipment for use in standard overbalanced drilling programs. The blowout prevention system requirements, where air, gas, or foam (underbalanced drilling) is being considered, must still meet the requirements of section 74(3) of the *Petroleum Drilling Regulations (CNR 1150/96)* and contain the maximum formation pressure that is anticipated.

The classification system clearly distinguishes between the depth limitations while drilling versus pressure testing of the production liner/casing. Blowout preventer pressure ratings are controlled during the drilling phase by the requirement to maintain a stack that has a minimum pressure rating of 50% of the anticipated maximum reservoir pressure. As currently exists, the pressure testing of production liner/casing requires a surface test that is equivalent to 90% of maximum reservoir pressure. Therefore for each class of BOP, there will be a depth range that will require greater pressure capability for testing of the production string than required for drilling of the main hole. The decision is left to the discretion of the Operator but in no way will it prejudice the testing requirements of the production liner/casing. The review of the casing program must still consider the testing requirements of the production liner/casing.

While standard equipment combinations similar to those utilized in Alberta are given, the classification system is structured to be consistent with the *Petroleum Drilling Regulations (CNR 1150/96)* and subsequent amendments.

NEWFOUNDLAND AND LABRADOR ONSHORE BOP CLASSIFICATION SYSTEM

BASIS: The rated working pressure for all drilling operations is 50 % of the maximum anticipated bottom hole pressure taken as 11 kPa/m. This classification does not guarantee the BOP system can be used to meet the pressure testing requirements of the production liner/ casing. See Appendix 1 for schematics of BOP Classifications

CLASS	MINIMUM PRESSURE (MPa)	DEPTH (m)	PARTICULARS	REFERENCE
I(mud)	**13.8**	**0 - 500**	• **conductor casing min. of 1 m into bedrock or 30 m whichever is lesser** • **no surface casing set** • **drilling spool c/w quick opening valve & min. 50 mm line to pit** • **diverter c/w hydraulic control** • **casing head c/w two valved outlets (threaded or flanged)**	**Petroleum Drilling Regulations (CNR 1150/96) Part IV Well Control Section 52(5)**
I(air)	**5.5 (static)**	**500 - surface casing setting depth**	• **conductor casing min. of 1 m into bedrock or 30 m whichever is less** • **no surface casing set** • **rotating head & spool c/w 100 mm line to pit (>5.5 MPa)** • **full opening drill through valve (>5.5 MPa) below spool**	**Petroleum Drilling Regulations (CNR 1150/96) Part V Drilling Operations and Procedures Section 74**
II	**13.8**	**surface casing setting depth - 2500**	• **surface casing cemented to surface** • **drilling spool c/w quick opening valve & min. 50 mm line to pit. Flanged pipe connections from drilling spool to connection to choke manifold, but may contain threaded fittings thereafter** • **annular, pipe and blind rams c/w hydraulic controls near rig floor, accumulator and remote.** • **casing head c/w two valved outlets (threaded or flanged)**	**HCR required for all situations.** **Section 58(3),(4)** **Manual adjustable chokes permitted**

III	**20.7**	**2500 - 3700**	• **surface casing cemented to surface** • **intermediate casing cemented to a minimum of 300 m above surface casing** • **drilling spool c/w full opening remotely activating valve at least 75 mm in size** • **all flanged pipe connections from drilling spool to last valve on choke manifold** • **min. of two adjustable chokes, one must be automatic with controls near drill floor** • **min. of 75 mm line to flare pit/tank**	**Automatic choke required Section 58(7)**
IV	**34**	**3700 - 6100**	**Similar to Class III with following additions:** • **dual drilling spools c/w choke and kill lines that are all min. 75 mm throughout. Upper spool contains HCR** • **in addition, a lower spool is plumbed in so as to provide an emergency auxiliary bleed-off line.**	
V	**69**	**6100 - 12500**	**Similar to Class IV requirements except:** • **higher pressure rating** • **both chokes automatic** • **another set of pipe rams required**	
VI	**105**	**12500 - 19000**	**Similar to Class V except** • **higher pressure rating** • **second annular may be requested**	**section 55(3)**

DISCUSSION OF LOCATION OF BLIND RAMS VS. PIPE RAMS

AEUB in all its schematics always has the lower most set of rams identified as pipe rams with the blind rams always positioned in the stack above the pipe rams. The *Petroleum Drilling Regulations (CNR 1150/96),* administered by NLDNR do not specify the location of the preventers.

There are essentially two schools of thought on this issue as follows:

Pipe Rams Below Blind Rams

- If SIP at surface exceeds rating of annular, pipe rams can be activated and blind rams can be changed out for another set of pipe rams, allowing the well to be circulated through the upper pipe rams via the spool and choke line above the lower set of pipe rams, maintaining an emergency back- up system. This "change-out" decision must be made immediately prior to commencement of circulation.
- The disadvantage with this arrangement is the inability to strip through the pipe ram since there is no outlet below the ram.

Pipe Rams Above Blind Rams

- Allows well to be secured with blind rams when pipe is out of the hole; for example, when changing out pipe rams to casing rams prior to running casing.
- Any influx can be immediately circulated out through drilling spool below pipe rams with annular as back-up.
- Allows stripping through rams bleeding off through the choke line assuming the distance between annular and pipe ram provides sufficient length to contain a tool joint

THE EFFECT OF PRESSURE TESTING REQUIREMENTS ON BOP PRESSURE RATING SELECTION

The above pressure ratings will be impacted by the casing pressure testing requirements. As presently exists, the regulations require the following minimum **surface applied** test pressures:

- 1 000 kPa for conductor pipe
- for surface and intermediate casing or liner, lesser of the
    - rated working pressure of the BOP stack;
    - 40% of maximum pore pressure anticipated during next phase of drilling;
    - calculated formation fracture pressure at the shoe.
- for production casing and production liners, a minimum of 90% of the maximum formation pressure

However, as indicated previously, section 55(2)(b) specifies that a BOP for all drilling operations below the surface casing is to have a working pressure greater than 50% of the maximum anticipated formation pressure. This selection criterion will allow pressure testing integrity for all but the production liner/casing scenario.

The following table illustrates the point by utilizing an example. A conductor pipe is set at 30 m, surface casing set at a maximum depth of 500 m, intermediate casing is set at 900 m, and a production casing is installed at 3600 m. Using this scenario, a Class III BOP system can be utilized based on the depth limitation of 3700 m. This would require a minimum of a 20.7 MPa BOP system.

BOP Class	**Minimum Pressure (MPa)**	**Depths (m)**	**Test Pressure Requirements (MPa)**							
			Conductor	**Surface**			**Intermediate**			**Production 90% of Maximum Formation Pressure**
				Lesser of:			**Lesser of:**			
				BOP Rating	**40% PP Rating**	**Fracture @ Shoe Rating**	**BOP Rating**	**40% PP Rating**	**Fracture @ Shoe Rating**	
III	20.7	30	1.0							
		500		21.0	**4.0**	11.0				
		900					21.0	**15.8**	19.8	
		3600								**35.6**

The rating of the BOP system based on the classification system would be 21 MPa (3600 x 11.0 x 0.5 = 19.8 MPa) which falls well short of the surface test pressure requirement for a production liners/casing. The maximum depth limitation for a 21.0 MPa stack that would provide pressure integrity to test at 90% of the bottom hole pressure is 2090 m although the maximum drilling depth would be 3700 m.

The following table shows the effect of the production pressure testing requirements as currently exists on the BOP pressure rating selection process and the selected Class based on a reduced production casing testing of an applied surface pressure of 80% of maximum reservoir pressure. The 80% is equivalent to a 11 kPa/m pore pressure gradient minus a gas gradient of 2.2 kPa/m to surface.

BOP Class	**Minimum Pressure Rating (MPa)**	**Maximum Depth Rating For Drilling (m)**	**Production Casing Test Pressure Requirements**		**Maximum Depth Rating For Pressure Testing Production Casing at 90% of PP (m)**	**Maximum Depth Rating For Pressure Testing Production Casing at 80% of PP (m)**
			Surface Pressure Test @ 90 % of PP (MPa)	**Surface Pressure Test @ 80 % of PP (MPa)**		
Class I	13.8	500	N/A	N/A	N/A	N/A
Class II	13.8	2500	24.8	22.0	1390	1570
Class III	20.7	3700	36.6	32.6	2090	2350
Class IV	34.0	6100	60.4	53.7	3435	3865
Class V	69.0	12 500	123.8	110.0	6970	7840
Class VI	105.0	19 500	> 193	>171.6	10600	11 930

SUMMARY TABLE:

Classification	AEUB			NDNR		
	Pressure (MPa)	**Depth (m)**	**Gradient (KPa/m)**	**Pressure (MPa)**	**Drilling Depth (m)**	**Gradient (KPa/m)**
I (mud)	N/A	0 - sur. casing	N/A	13.8	0 - 500	27.6
I (air)	4	0 - sur. casing	N/A	5.5	500 – sur. casing	11.0
IA	N/A	sur. casing - 750	N/A	N/A	N/A	N/A
II	14	sur. casing - 750	18.7	13.8	sur. casing - 2500	5.5
III	14	750 - 1800	7.8	21	2500 - 3700	5.5
III High Hazard	14	750 - 1800	7.8	N/A	N/A	N/A
IV	21	1800 - 3600	5.8	34	3700 - 6100	5.5
V	34	3600 - 6000	5.7	69	6100 - 12 500	5.5
VI	69	> 6000	<11.5	105	12 500 - 19 500	5.5