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PRESSURE BARRIER POLICY MODEL PLAN - NOT INTENDED FOR ACTUAL USE; HYPOTHETICAL - EXEMPLARY PURPOSES ONLY

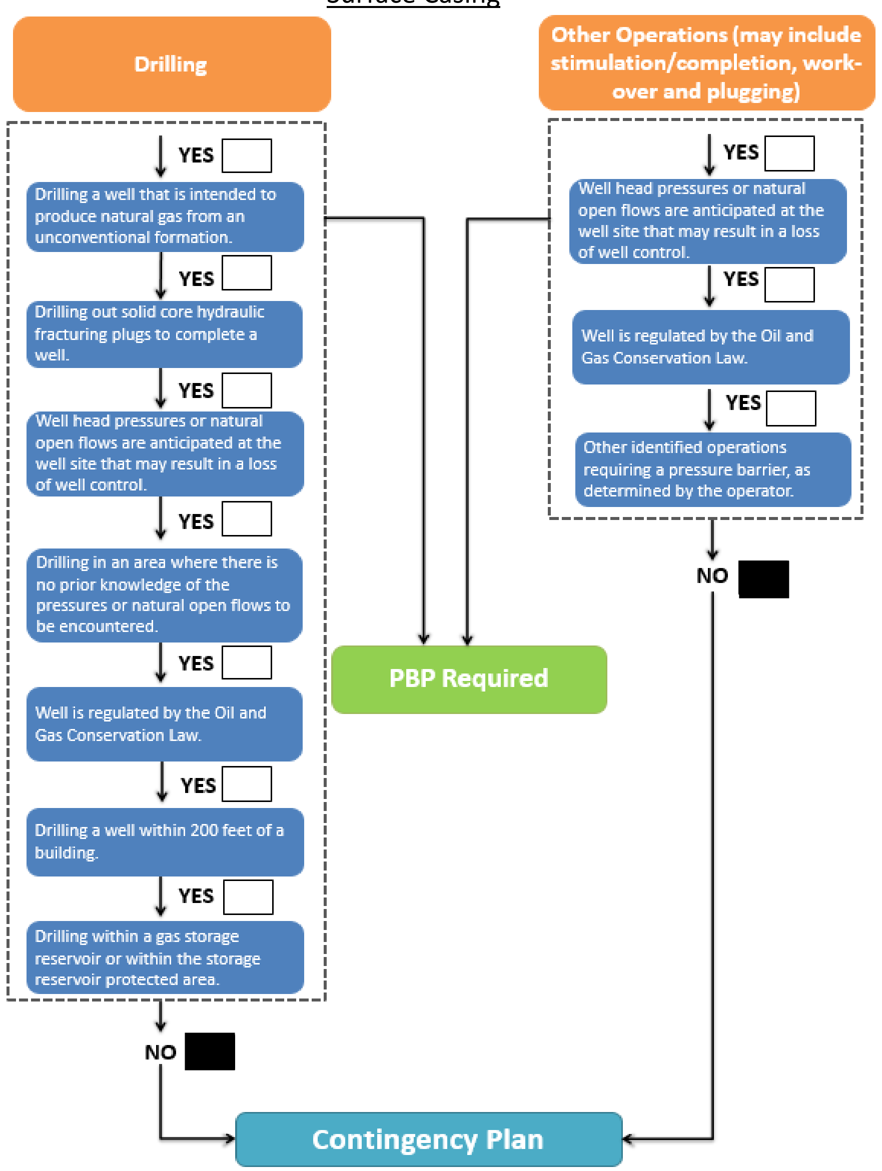
Operator A - Pressure Barrier Policy - Unconventional Well; 3-String Design; Operation: Drilling

Introduction

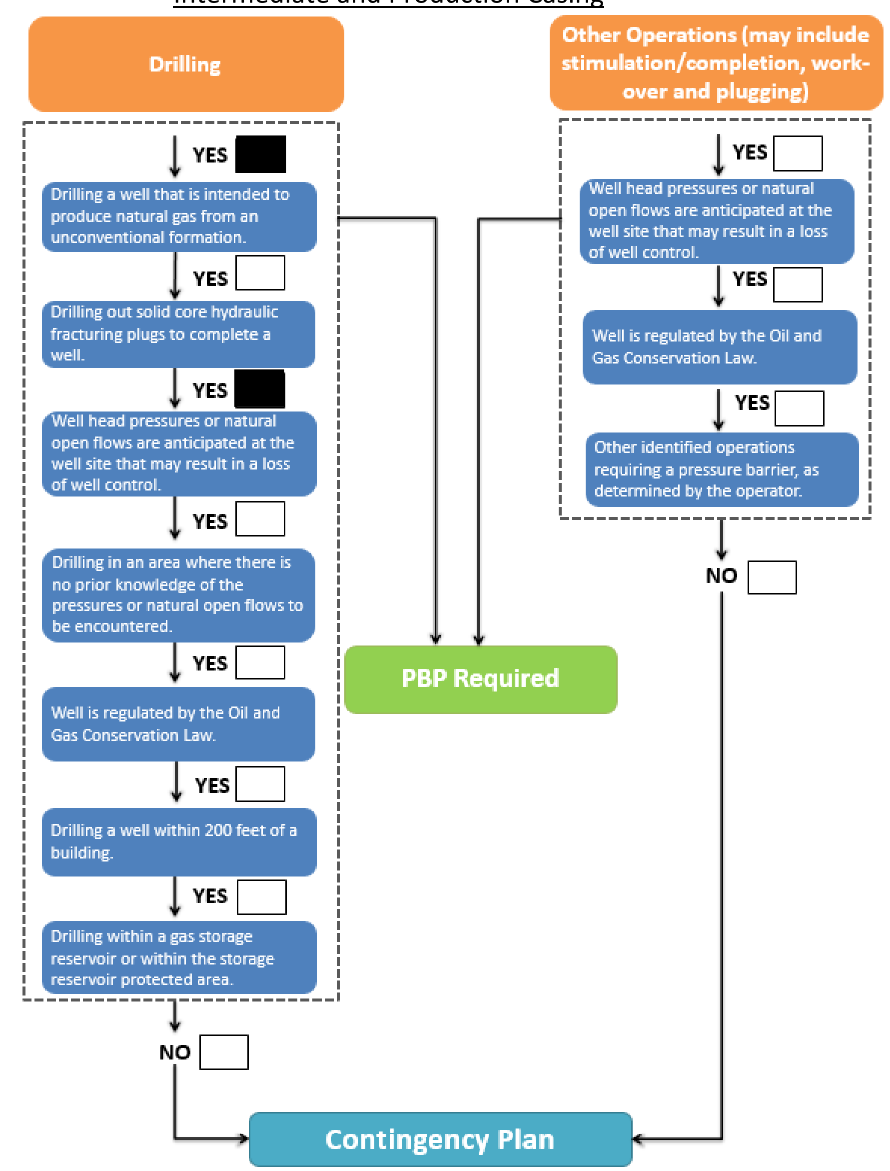
Section 78a.55 (relating to control and disposal planning; emergency response for unconventional wells) outlines the requirements for the development and maintenance of Preparedness, Prevention and Contingency (PPC) plans for unconventional well sites. See 25 Pa. Code § 78a.55. DEP developed this guidance and audit process/model plan, set forth below, to address certain requirements of this section relating to the maintenance of well control. Specifically, Section 78a.55(d) requires unconventional well operators to develop a Pressure Barrier Policy (PBP). See 25 Pa. Code § 78a.55(d). DEP interprets this provision as requiring unconventional operators to consider and identify when and what type of pressure barriers are needed during oil and gas operations; including, but not limited to, drilling (casing and cementing), hydraulic fracturing, completion, alteration, plugging, workover activities and maintenance and/or repair of associated equipment. Further, and in accordance with 25 Pa. Code § 78a.72(i), at least two mechanical pressure barriers are required between the open formation and the atmosphere that are capable of being tested during well drilling and completion operations. Related requirements can be found in Sections 78a.71 (relating to use of safety devices – well casing), 78a.72 (relating to use of safety devices – blow out prevention equipment) and associated API Standards or Recommended Practices incorporated by reference, 78a.74 (relating to venting of gas), 78a.84 (relating to casing standards), 78a.76 (relating to drilling within a gas storage reservoir area), 78a.87 (relating to gas storage reservoir protective casing and cementing procedures) and 79.12 (relating to waste prevention).

This document represents a pressure barrier policy for Operator A applicable during drilling and completion of an unconventional well equipped with surface, intermediate, and production casing.

Surface Casing



Intermediate and Production Casing



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Requirement	Conditional Requirement	Recommended Practice	Response (Underline Appropriate Response or Provide Requested Information)				
PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
Is a BOP required? If no, proceed to Contingency Plan Section.			Y or **N**	**Y** or N	**Y** or N	see contingency plan for surface hole	§ 78a.72, § 78a.87(a)(2), or § 78a.55(d)
Identify all operations during which a BOP must be used.			BOP to be used during (underline): Drilling; Altering; Stimulation; Workover; Reconditioning; Plugging	BOP to be used during (underline): **Drilling**; Altering; Stimulation; Workover; Reconditioning; Plugging	BOP to be used during (underline): **Drilling;** Altering; Stimulation; Workover; Reconditioning; Plugging	see contingency plan for surface hole	§ 78a.72 and § 78a.87(a)(2)
	If drilling in an underground gas storage reservoir, has the drilling as well as the casing and cementing plan, been approved by DEP and provided to the storage operator?		Y or N or **NA**	Y or N or **NA**	Y or N or **NA**	not drilling in underground gas storage reservoir	§ 78a.76(a)
	If drilling in an underground gas storage reservoir, are there procedures for controlling anticipated gas storage reservoir pressures and flows at all times when drilling from 200 feet above the gas storage reservoir horizon to the depth at which the gas storage protective casing will be installed?		Narrative or **NA**	Narrative or **NA**	Narrative or **NA**	not drilling in underground gas storage reservoir	§ 78a.87(a)(1)-(2)
Are there be at least two *mechanical pressure barriers* in place during well drilling and completion operations?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(i)
		Please briefly describe the *mechanical pressure barrier* s in use.	Narrative or **NA**	**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	annular preventer, blind rams, and pipe rams for intermediate and production hole sections	
Are there *well barrier elements* , including one or more casing strings of sufficient cemented length and strength, to address unexpected events, such as blowouts, explosions, fires, and casing failures, during installation, completion and operation?			**Y** or N	**Y** or N	**Y** or N		§ 78a.71
		Please briefly describe the procedures in place to address an event where a casing string may malfunction or become defective.	Narrative or **NA**	**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	see contingency plan for surface hole; soft shut-in and annular flow directed to gas buster for intermediate and production hole sections; contact well control vendor in all cases; access to SBM kill fluids will be available	
		Will any fluid barriers be used during this operation?	Y or **N** or NA	**Y** or N or NA	**Y** or N or NA		

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Requirement	Conditional Requirement	Recommended Practice	Appropriate Response or Provide Requested Information)				
PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
		If fluid barriers will be used, please provide a brief description, including type (e.g., oil based mud (OBM), synthetic-based mud (SBM) or water based mud (WBM)), anticipated pounds per gallon (ppg) weight) of the fluids, and how they will be used.	**Narrative (see notes)**	**Narrative (see notes)**	**Narrative (see notes)**	surface and intermediate hole sections drilled on air; production hole section on air to kickoff point; switch to 15.4 ppg SBM at KOP; access t SBM kill fluids while drilling on air through intermediate hole section	
		Please provide a brief description of the BOP and ancillary equipment, casing and well head configurations that will be available and may be utilized during drilling, stimulation/ completion, workover, and plugging.	Narrative or **NA**	**Narrative (see BOP and Ancillary Equipment addendum)** or NA	**Narrative (see BOP and Ancillary Equipment addendum)** or NA		§ 78a.71(a), § 78a.72(i), and § 78a.55(d)
Is there a procedure for documenting BOP inspection? Recording this information in the driller's log or other official operator documentation (electronically or otherwise) is sufficient for achieving compliance?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(f)
	What is the maximum anticipated surface pressure (MASP) in pounds per square inch (psi) for the relevant operations that the BOP and ancillary equipment, casing and well head could be subjected to?		MAP: _________ or **NA**	MAP: **1500 psi** or NA	MAP: **4800 psi** or NA		§ 78a.84(d) or (f)
		Please provide a brief description of how the MASP was determined. For example, estimates developed through reference of available pressure gradient maps followed by adjustments for formation and wellbore fluids represent one useful procedure.	Narrative or **NA**	**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	based on shoe depth and pressure gradient from known experience for intermediate and production hole sections	
		What is the pressure rating (PR) (psi) of the BOP?	PR: ___________ or **NA**	PR: **5K** or NA	PR: **5K** or NA		

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Requirement	Conditional Requirement	Recommended Practice	Appropriate Response or Provide Requested Information)				
PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
For a BOP with a PR greater than 3,000 psi, are controls accessible for actuation and additional controls present, not associated with the hydraulic system of the rig, at a minimum distance of 50 feet?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(c)
Is there a procedure for a comprehensive test (pressure and operation) of the ram-type BOP and related equipment for implementation prior to use?			Y or N or Alternate or **NA**	**Y** or N or Alternate or NA	**Y** or N or Alternate or NA	follow API Standard 53 Edition 5 for all BOP testing	§ 78a.72(e)
Is there a procedure in place to have the annular type BOP tested per the manufacturer's published instructions, or the instructions of a professional engineer, prior to it being placed in service?			Y or N or Alternate or **NA**	**Y** or N or Alternate or NA	**Y** or N or Alternate or NA	follow API Standard 53 Edition 5 for all BOP testing; also see *Initial BOP Test Procedure/Checklist from Manufacturer*	§ 78a.72(e)
	Is there a procedure for a shoe test in place? Note that a shoe test may include a Formation Integrity Test (FIT) or Leak Off Test (LOT). If gas will be produced inside of the intermediate casing, a shoe test is required. Note also that a single shoe test per drilling pad may be acceptable for all wells on the pad. Subsurface conditions and an evaluation of well construction, as performed by the operator, should determine whether or not this is technically appropriate.		Y or N or **NA**	Y or **N** or NA	**Y** or N or NA	no annular production planned - no relief valve necessary; shoe test completed to determine adequate support for mud weight in production hole section	§ 78a.83c.(b)
		What is the FIT/LOT test in equivalent ppg?	LOT/FIT: ______ or **NA**	LOT/FIT: ______ or **NA**	**LOT**/FIT: **1,900 psi** or NA		
		How has the competency of the casing seat been determined?	Narrative or **NA**	Narrative or **NA**	**Narrative (see notes)** or NA	shoe test conducted in association with intermediate casing shoe prior to drilling production hole section; drill on air to KOP; LOT to support mud weight at intermediate shoe/based on operator experience in the area	§ 78a.72(a)
		Based on the competency and maximum anticipated pressure at the casing seat, is a hard shut in permissible?	Y or N or **NA**	Y or **N** or NA	Y or **N** or NA		§ 78a.72(a) and § 78a.83c(b)

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Requirement	Conditional Requirement	Recommended Practice	Appropriate Response or Provide Requested Information)				
PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
Do the pipe fittings, valves and unions placed on or connected to the BOP system have working pressure ratings in excess of the MASP?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(d)
Is there a procedure in place to visually inspect the equipment during drilling operations? (Note: please see Appendix A for citation clarification).			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(f)
Have all ram testing procedures in place been developed in accordance with API Standard 53 or a different a procedure approved by DEP?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA	follow API Standard 53 Edition 5 for all BOP testing	§ 78a.72(f)
Are pipe rams tested daily for closure during drilling operations, in accordance with API Standard 53, or has a different procedure been approved by DEP?			Y or N or Alternate or **NA**	**Y** or N or Alternate or NA	**Y** or N or Alternate or NA	follow API Standard 53 Edition 5 for all BOP testing	§ 78a.72(f)
Are blind rams tested for closure on each round trip or at least daily on days with multiple round trips; or are they tested in accordance with API Standard 53 or a different procedure been approved by DEP?			Y or N or Alternate or **NA**	**Y** or N or Alternate or NA	**Y** or N or Alternate or NA	follow API Standard 53 Edition 5 for all BOP testing	§ 78a.72(f)
Are all inspection and closure test results recorded in the driller's log before the end of the tour or has a different procedure been approved by DEP?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(f)
Are all lines, valves, and fittings between the closing unit and the BOP stack flame resistant and characterized by working pressures that meet or exceed those of the BOP system?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(g)
Does the minimum cemented intermediate casing meet the applicable requirements or has DEP approved an alternative method?			Y or N or **NA**	**Y** or N or NA	Y or N or **NA**		§ 78a.72(k)

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PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
Have all welded or used casing strings used to anchor BOPs, or any new casing used to anchor BOPs with pressure ratings greater than 3,000 psi been pressure tested after cementing?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.84(d) or (f)
Is the pressure test procedure compliant (no more than 10% decrease in pressure over a 30 minute period) or has an alternative test method been approved by DEP?			Y or N or Alternate or **NA**	**Y** or N or Alternate or NA	**Y** or N or Alternate or NA		§ 78a.84(d) or (f)
Has certification of the pressure test been confirmed (entry and signature of the person performing the test in the driller's log)?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.84(f)
		Please provide a brief description and schematic of the well head assembly that clearly indicates which string of casing the "A" section of the well head will be attached to during the referenced operation. (Note: that schematics are readily available from well head manufacturers.)	Narrative or **NA**	**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	schematic for production hole section drilling depicted; note that "A" section for intermediate hole section is surface casing	
		Are there other completed wells on the pad adjacent to the well that is the subject of the PBP	**Y** or N or NA	**Y** or N or NA	**Y** or N or NA		
	Please briefly describe how other wells on the pad have been secured and/or monitored during the current operation. At a minimum, the relevant regulatory notification requirements of the area of review (AOR) must be satisfied when the operation is hydraulic fracturing.		**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	**Narrative (see notes)** or NA	anti-collision procedures in place; wellheads secured and clearly marked; real-time monitoring of all tubing, production and production annuli	§ 78a.52a(c)(3) and § 78a.73(c)

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PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
Is there an International Association of Drilling Contractors (IADC) certified individual or other individual certified by a DEP approved organization present on site during operations requiring a BOP?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(h)
Is the IADC certification available for review on site?			Y or N or **NA**	**Y** or N or NA	**Y** or N or NA		§ 78a.72(h)

Requirement	Conditional Requirement	Recommended Practice	Appropriate Response or Provide Requested Information)				
Contingency Plan							
PBP Audit Questions			Surface Hole Section	Intermediate Hole Section	Production Hole Section	Notes	Regulatory Citation
If excess gas is encountered during operations not requiring a pressure barrier, can it be flared, captured or diverted in a manner that does not create a hazard to public health or safety?			**Narrative (see notes)**	**Narrative (see notes)**	**Narrative (see notes)**	all excess gas diverted to flare stack during drilling of surface hole; gas buster rigged up during drilling of intermediate and production hole sections - capable of 5 mmcfpd intake; access to SBM kill fluids will be available	§ 78a.74
		Provide a brief description of the size, construction and length of the equipment used to manage any excess gas encountered. If a flare line will be used, include a brief description of the method used to anchor it and any igniters that will be used; and indicate if redundant igniters are present.	**Narrative (see notes)**	**Narrative (see notes)**	**Narrative (see notes)**	diverter system run to flare stack through steel line; flare stack is situated approximately 100 feet from the rig floor; flare stack is anchored by three steel cables placed at 120-degree spacings radially; igniter assembly is weather resistant and capabe of ignition in extreme environments; redundant igniters are present	
		If BOP equipment will not be utilized during drilling, completion, workover or plugging of the well, please briefly explain why or describe what type of *well barrier elements* are in place and provide the details of a contingency plan for managing unanticipated *kicks* or a *loss of well control.*	**Narrative (see notes)**	Narrative or **NA**	Narrative or **NA**	BOP used for intermediate and production hole sections; contingency plan for surface hole listed above	§ 78a.72
		Is there an IADC or equivalent methodology in place to kill the well or control a *kick* , if required?	Y or N or **NA**	Y or N or **NA**	Y or N or **NA**		
		Briefly describe the methodology in place to kill the well or control a *kick.*	**Narrative (see notes)** or NA	Narrative or **NA**	Narrative or **NA**	don't anticipate sustained flow while drilling surface hole; if well flows, divert to flare stack and flow well safely until zone blows down	

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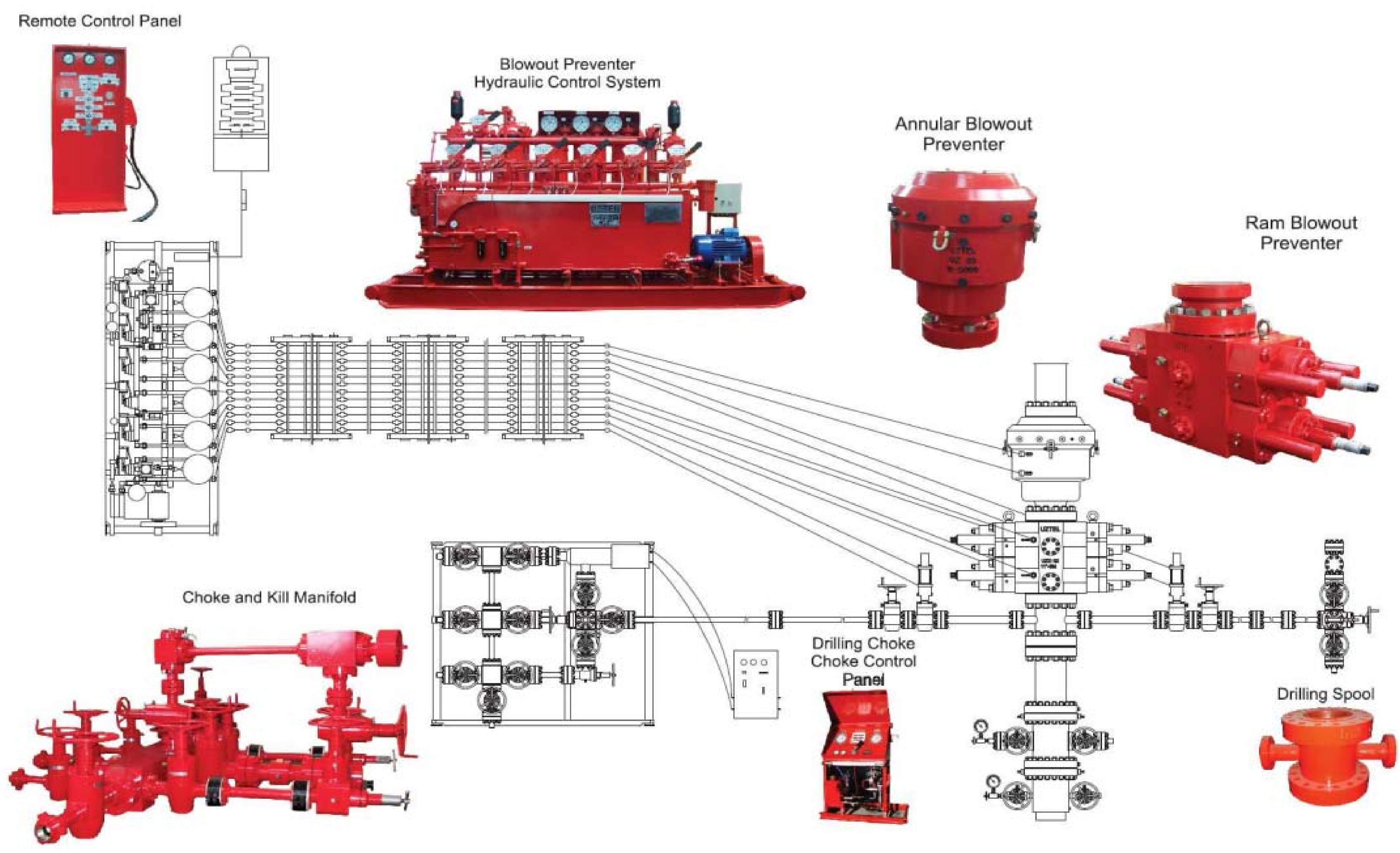
BOP and Ancillary Equipment



Adapted from Uztel Oilfield Equipment Manufacturing and Repairs (2021).

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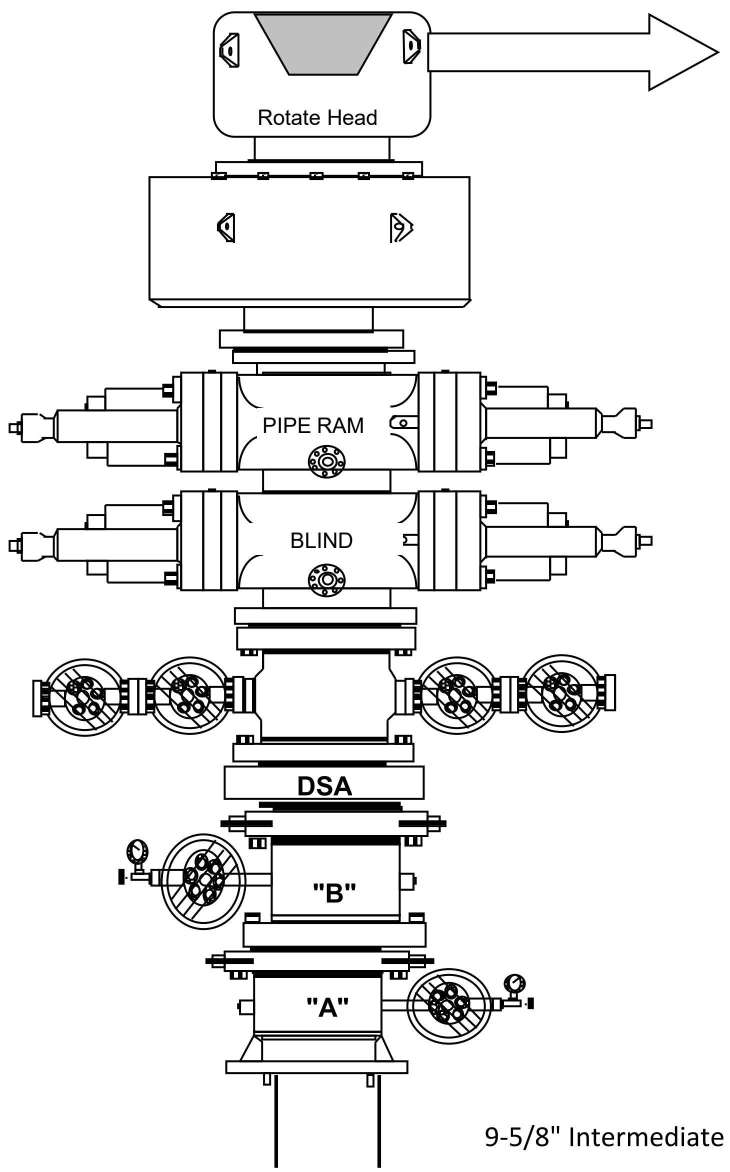
Initial BOP Test Procedure/Checklist from Manufacturer

- Use water to test BOP's. The reason is that water has less compressibility than mud.
- Make up testing assembly and set into a wellhead profile. The casing valve must be left opened and there must be personnel monitoring the outlet of casing valve all time while testing. You must ensure that personnel who monitor the outlet stay far from the BOP while it is being tested. The reason behind this step is to prevent pressure build up in the casing if the test plug is leaking.
- Circulate through choke/kill lines, choke manifold, standpipe manifold, and valves to ensure that all lines are full with water. This practice is for preventing pressure dropping off while testing.
- Line up cement unit and rig team and shut rams and valves as per each rig specific testing sequence.
- Pressure test must be low and high, respectively; and the pressure should be stabilized with minimum bleed off at least 5 minutes. Ensure that pressure recording on a chart is recorded correctly.
- Ensure that any equipment that doesn't pass a pressure test requirement is reported to supervisory personnel.
- Continue pressure testing until all equipment is tested as per each rig specification.
- Rig down testing assembly.

Wellhead Schematic



9-5/8" Intermediate Casing (connected to "A" section of well head)