

## Applications and functions of wet fountain fittings used in pre-salt cluster of santos basin

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### Abstract

"Fountain fitting" - deep and ultra-deep in the waters oil and natural dig it up removal for needed which is main underwater of equipment is one Petrobras well in Brazil the mouth with (Wet Christmas Tree – fountain armature) between WCT installed (Production Adapter Base - production adapter base) (PAB). This equipment is a wellhead equipment used to install oil and gas wellhead, control it and control the mode of operation. There are Fontan fittings for surface (for wells drilled on land) and subsea (offshore wells). According to its construction, it is horizontal and has three steps. Fountain accessories consist of tube and belt head, Christmas tree fountain. The belt head located at the bottom of the fountain shield is used to hang the protective belt, close the gap between the pipes, etc. It is for the Pipe head to hang and seal the pump compressor pipe lowered into the well attached to the belt head. The resource head directs the product from the well to the discharge line, enabling control and monitoring of the well. The fountain armature is equipped with a pressure gauge and thermometer. BOP and fountain of the armature absolutely different equipment that it is clarify need a lot people this two underwater equipment mix it up because it can each two of them the well in the mouth is installed. Dump Blow-Out Preventer (BOP) of wells digging, completion and processing during use which is security equipment. His main components drawers (rams), annular discharge against preventers and suffocation and don't kill are lines (choke & kill lines). Fountain pipes are lowered into the well where the fountain is expected to shoot. It is necessary to hang these pipes from something at the wellhead and direct the product of the well to the outside through it, and for this, it is necessary to mold the space between the fountain pipes and the production line. In order for the fountain to pump in an optimal mode, to regulate the use of reservoir energy, it is necessary to create counter pressure at the well mouth by any means. Therefore, the equipment at the mouth of the fountain well must be able to create any back pressure in the discharge line, including closing the well. In addition, the wellhead equipment should allow to measure the pressures behind the pipe, in the discharge line, and also to inject gas or liquid into the well if necessary.

**Keywords:** Fountain fittings; Santos basin; Wells; Components; Functions

### 1. Introduction

Well to the barrel the rock done bringing of liquid unwanted flow during (this unwanted the flow is called "shock") drilling is stopped and of the blow to the explosion transformation prevent get for invasive fluid the well from the barrel should be excluded." To the well control " (of blows exclusion operation) annular of explosion prevent it purchase, suffocation line and other of equipment use by doing out held).

Underwater the well from being dug up and upon completion after Dump The Counter Preventer (BOP) is removed and the well in the mouth fountain armature is installed. Fountain armature your bed extraction stage use is being Ago

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addition, two type exploitation there is a well , production and hitter wells . Every type the well for fountain armature one up to is different [1].

This article , we go deep and ultra-deep in the waters installed main two the well the type explain we will do Then the fountain armature and The core of the Extraction Adapter Base (PAB).

## 2. Types of wells

To their destinations according to wells the following whom classified to be done can :

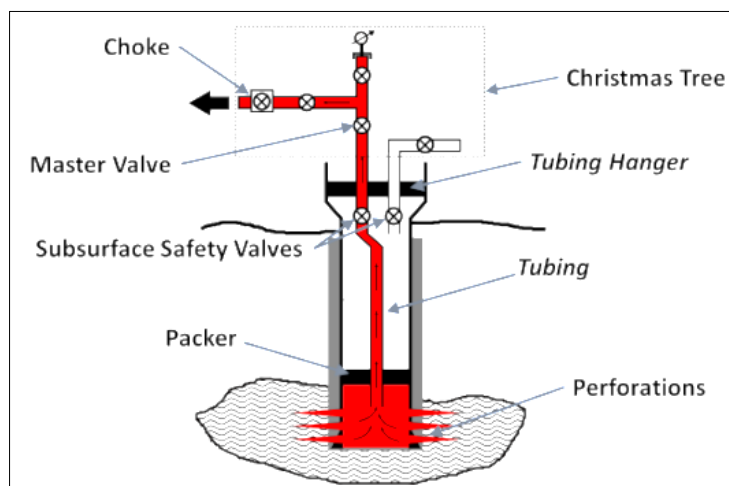
- Initiative exploration wells ( risky predpriyatie ): formerly unexcavated in the field dug up exploration the well
- Assessment well : hydrocarbon of reserves volume to confirm for from discovery after excavated addition well
- Exploitation wells: of the bed processing decision given after dug up and completed wells . Two type exploitation has a well :
  - Production well : commercial on the scale hydrocarbon product make for dug up and completed well
  - Striker well : Liquid and either the gas porous to layer by hitting dug up and completed well Liquid pore pressure ni increase for layer hit can and either so of liquids disposal for fluid various porous to the rocks hit can

### 2.1. Initiative exploration wells (risky predpriyatie) and evaluation well:

Contains hydrocarbons which is of layers certain making for exploration wells is dug. Discovery to confirm for water from storage informations is collected. All informations since collected after exploration the well to the rules suitable as is closed. Evaluation the well also information collect and layer from the test to hold for is dug. With reserves connected uncertainties reduce for one the rule as , assembly test , drilling belt test , lay up and down depth certain making , within the layer gas-oil and oil-water of interfaces depth certain making , nuclear and either fluid of samples gathering and other evaluations to be carried can \_ Test done upon arrival after evaluation the well cancellation to be can \_ Both intelligence , both too evaluation wells again exploitation be given and extraction to the well become can \_

### 2.2. Use wells

Without drilling after the well in place cemented and drilling solution with stuffed from the corpus consisting of ( steel pipes ) which one is a well . Then drill of liquid removal and production and either for injection ( striker ). needed which is all of equipment installation with completion should be done .



**Figure 1** Schematic of a well completed for production

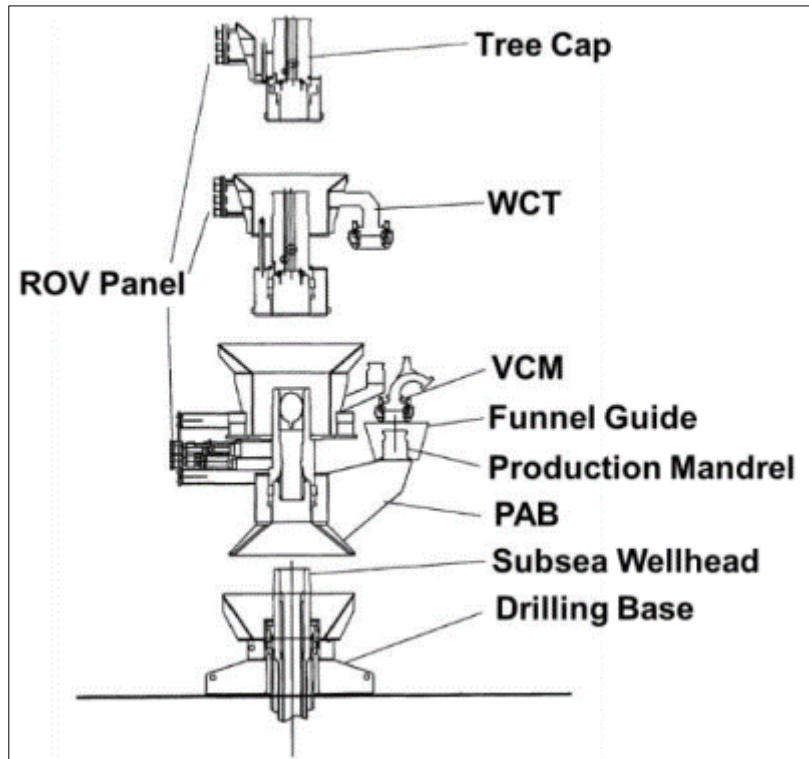
Figure 1 Production of the well scheme shows \_ 1. choke- suffocator 2. master valves- main valve 3. subsurface safety valves- underground security valves 4. packer - packer 5. Christmas tree- fountain armature 6. tubing hanger- belt hanger 7. tubing- belt 8. perforations

This nun one belt that it is observation to do We know that this is production which is of liquid to the surface transmitted one is a pipe. Pipe and body between annular zone packer and belt hanger through from the surface isolation is being usually, underwater the well Artificial Lift Method whom gas from the elevator use is doing so gas \_ ring in the form of

is shot and belt throughout installed gas lifting valves throughout to the pipe flows. Pipe the belt and to the ring at the entrance pipe of the hanger under installed underground security valves named one security there is a valve . Ago addition, well in the mouth one row from valves consisting of fountain armature is installed [2].

### 3. Main components

Petrobras two in Brazil number underwater equipment, Production Adapter Base (PAB) and using a wet Fontan Fixture (WCT). Makes that this exploitation of the well underwater well mouth in the system is installed (Figure 2). In this section we underwater well mouth system, extraction adapter base and fountain armature about addition details present we will do

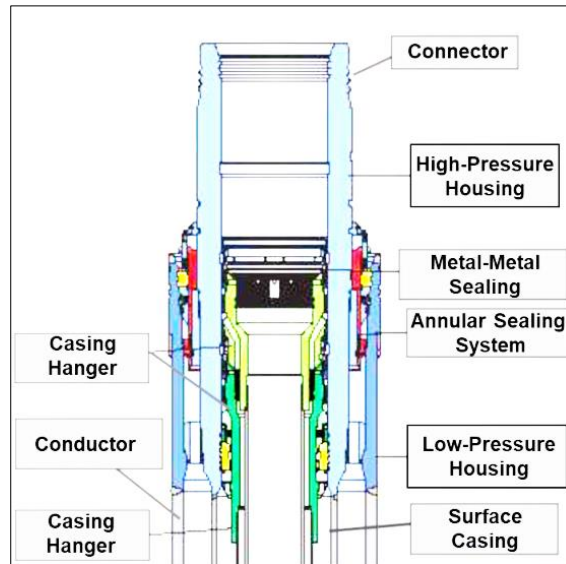


**Figure 2** Scheme of PAB and WCT to be installed in the subsea wellhead system

Figure 2. Schematic of the Production Adapter Base (PAB) and Wet Fountain Fitting for installation in a subsea wellhead system. 1. ROV Panel (remote operated valves) - remotely management which is valve panel 2. Tree cap- fountain cap 3. WCT - Wet Fountain Fitting 4. (VCM) "Vertical Connection Module" - Vertical Connection Module 5. Funnel guide - funnel head 6. production mandrel - production mandrel (производственная оправка) 7. PAB ( Production Adapter Base The) 8. subsea wellhead- underwater the well the mouth or heading 9. drilling base - drilling base

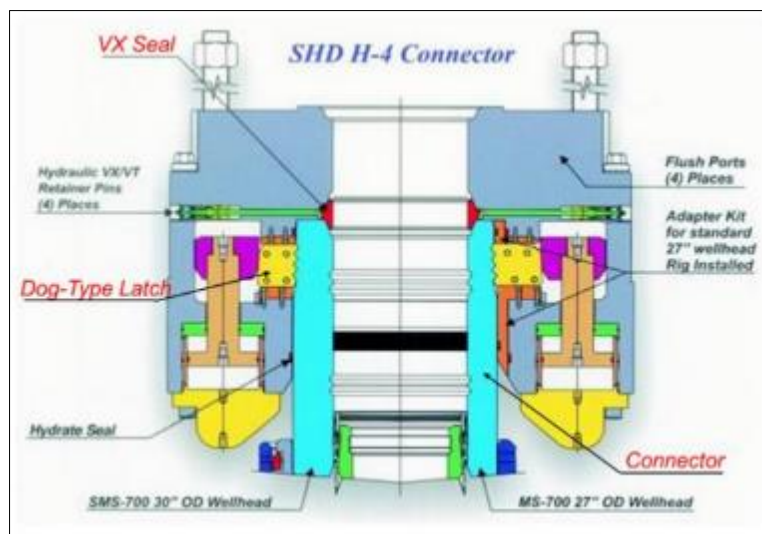
#### 3.1. Underwater wellhead system

Underwater wells are drilled in stages. After the phase is drilled, the casing is assembled in sections, lowered into the open pit and cemented in place (in some cases the first casing, called the conductor, may not be cemented).



**Figure 3** Underwater the well the mouth of the system example . 1. casing hange - protector belt hanger 2. conductor-connection , transmitter 3. connector 4. high-pressure housing- high pressurized corpus 5. metal-metal sealing - from metal to the metal stamp 6. annular sealing system- annular sealing system 7. low-pressure housing- down pressurized corpus 8. surface casing and rust protection belt

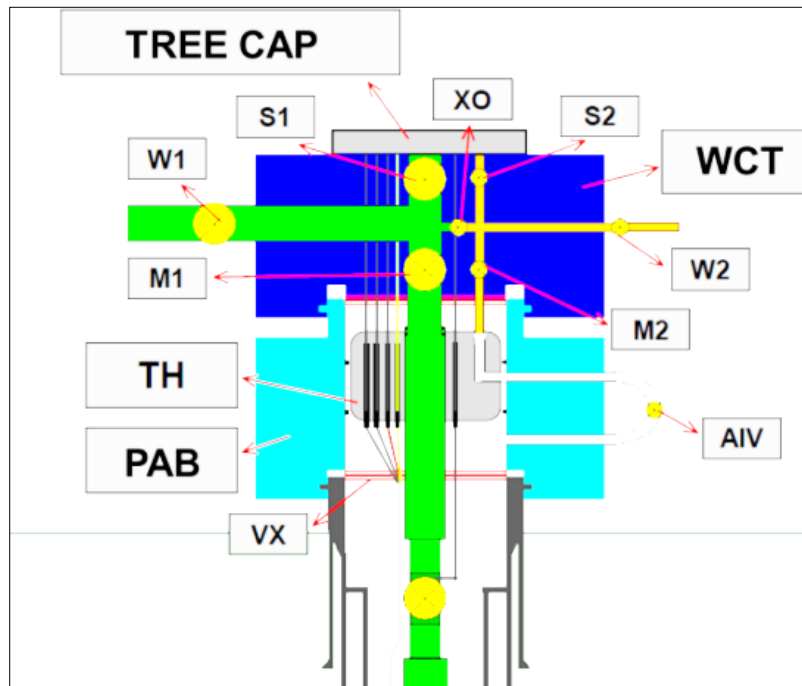
Underwater the well the mouth of the system main components shows \_ Conductor up in the part one part equipment , " Down pressurized it is called " corpus " ( belt ) . Conductor to the well is installed , then the second phase is dug . " Above ground the so-called "belt " . the second belt ( body ) " High pressurized has a " body " . and his up that it will be saved is combined . High pressurized corpus down pressurized of the corpus into fixed . " Halevi sealing ( leakage ) system " conductor and over there belt between annular from the field each which don't leak prevent takes \_ other of belts up at the end " High Pressurized Inside the case ( belt ) . fitted " belt has a hanger . High pressure of the corps up in the part Dump Counter Preventer (BOP) / Fountain Fitting Must be connected which is one there is a connector . Figure 4. Discharge Counter Preventer (BOP) / Fountain Fitting connection about details shows \_ Dump Counter Preventer (BOP) / Fountain Fitting combinations between sealing by means of "VX Seal" . is done . Dump Counter Preventer (BOP) / Fountain Fitting dowel locks (dog locks with ) mechanical as is fixed [3].



**Figure 4** Schematic of the connector. 1. VX seal- VX seal 2. Hydraulic VX/VT Retainer Pins. Places- Hydraulic locking pins VX/VT. places 3. flush ports places- washing port places 4. Adapter kit for standard 27 wellhead Rig installed - Standard 27 wells the mouth adapter kit for installed 5. Dog-Type latch- Dog type lock 6. connector - connector 7. Sms-700 30 i OD wellhead - Sms-700 30 OD well the mouth 8. MS-700 27 " OD wellhead -MS-700 27 ии OD wellhead

### 3.2. Mining adapter database. ( PAB )

A Production Adapter Base (PAB) is subsea equipment installed during well completion. It is installed in the underwater wellhead system ( Figure 2 ). The belt can then be installed and the belt hanger installed inside the Production Adapter Base ( PAB ) . **Figure 5** shows a schematic of the Production Adapter Base ( PAB ) and Fontan Armature WCT assembly. Parallel to the pipeline, we see several auxiliary lines intersecting the belt suspension. One of the lines is connected to an underground safety valve, which is a normally closed valve. Thus, this auxiliary line brings hydraulic pressure to open such safety valves. Other auxiliary lines are found only in the production wells of Pre-Salt . They go right down to the depth of the well. Between the lines, there are lines for injecting inhibitors, especially against scaling, into the well casings. There are hydraulic lines to operate the "smart completion valves". There is also a line connected to a constant pressure gauge in the well .



**Figure 5** Main valves of production Wet Fountain Fitting and production adapter base

The Production Adapter Base ( PAB ) is the "Production Mandrel" to which the "Vertical Connection Module" (VCM) of the flow line will be connected. Previously, the oiler had to be next to the drilling rig during the installation of the well rig. The flow line connection to the Fontan fitting was made on the drilling platform. Then the fountain armature was lowered for installation and the liner simultaneously paid the flow line . Using the SBM, the rig can establish a connection between the production adapter base (PAB) and the flowline on the seabed. It is not necessary to bring the equipment to the surface . The flow line is lowered by hanging using a special operating tool and mounted on the production mandrel. Another advantage is that the fountain fixture can be removed for well intervention/operation and flowlines do not need to be removed.

### 3.3. Wet Fountain Fixture

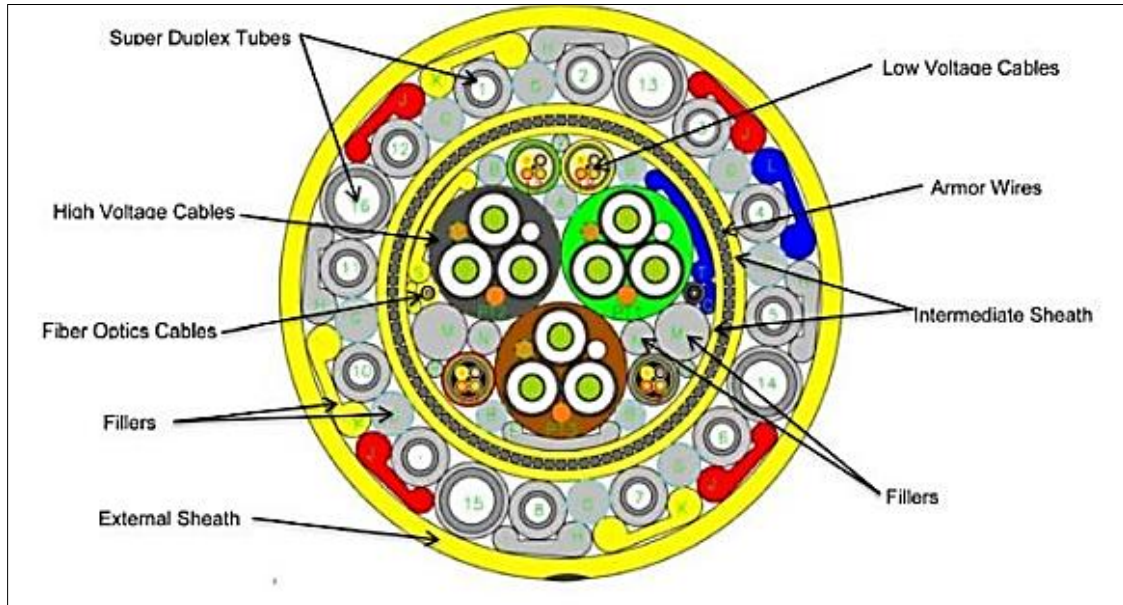
The Fontan fitting consists of a series of valves that control the flow and access to the pipes and rings . (Fig. 5) It is important to remember that Petrobras does not use a choke valve in the Fontan fitting to control the flow rate of the produced fluid; the choke valve is located on board the platform. For the production well, the green pipes in Figure 5 deliver the produced fluid to the flow lines with three valves : main valve M1, flap valve W1, and buffer valve S1. Additionally, the orange and white pipes are service/gas lift lines that connect to the annular area between the production pipe and the casing. Likewise, there are three valves in the service/gas lift line: main valve M1, wing (throttle) valve W1, and buffer valve S1. In addition, there is an annular space intervention valve HMK, located in the Production Adapter Base ( PAB ), which closes when the fountain armature is removed to prevent any leakage into or from the annulus during well intervention/operation . When necessary, a crossover valve on the XO can connect the service line to the production line [4].



## 4. Functions

### 4.1. Valve control

The fountain fixture has an Underwater Electrical Module (SEM) that receives control signals from the surface. The SEM then activates the solenoid drive of the pilot valve. Hydraulic power from the pilot valve will actuate the valves shown in Figure 5. The control signal, hydraulic power and electrical energy are sent from the surface to the subsea equipment using the control umbilical (hose cable) (Figure 6).

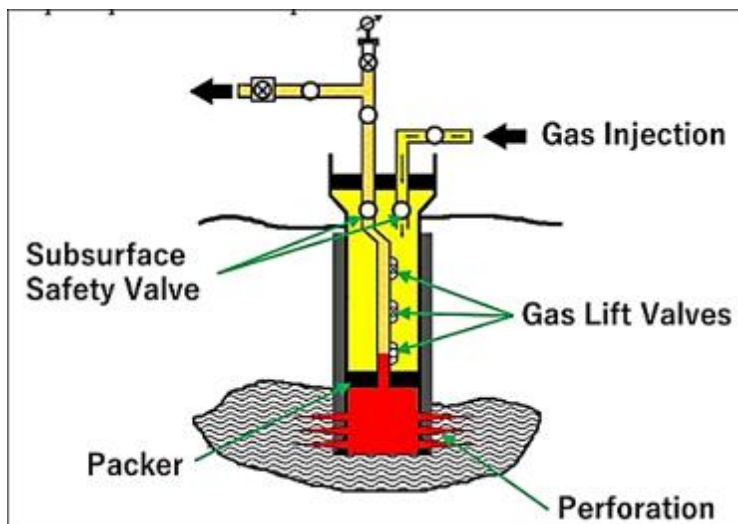


**Figure 6** An example of the cross-section of a hose cable. 1. super Duplex Tubes - super duplex tubes. 2. Low Voltage Cables - Low Voltage Cables. 3. High Voltage Cables - High voltage cables. 4. Armor wires- armored wire. 5. fiber optics cables - fiber optic cables. 6. intermediate sheath intermediate cover. 7. fillers. 8. external sheath

The subsea hydraulic control fluids used to operate the valve are usually water-based, meaning that the fluid can be discharged into the ocean without environmental impact. Water-based hydraulic fluid consists of di-mineralized water, MEG (antifreeze) and other additives. To increase the accessibility of the Fontan fixture, in addition to the remote valves, the Fontan fixture has redundant valves activated by a Remotely Operated Valve Panel (ROV). Figure 2 shows the position of the panels where the levers are located to actuate such valves. Figure 2 shows the position of the panels where the levers are located to actuate such valves [5].

### 4.2. Gas lift

Gaslift is a widely used artificial lifting method in offshore fields. Compared to other methods, the gas lift is very reliable because it has no rotating parts inside the well (the gas compressor is located on board the production platform) and during maintenance the gas lift valves can be replaced without removing all the production tubing. In a production operation, the service line of the Fontan fixture may inject gas (nitrogen gas or natural gas) into the circuit to be used as a gas lift. The injected gas enters the pipe through the gas lift valves installed along the pipe (Fig. 7).



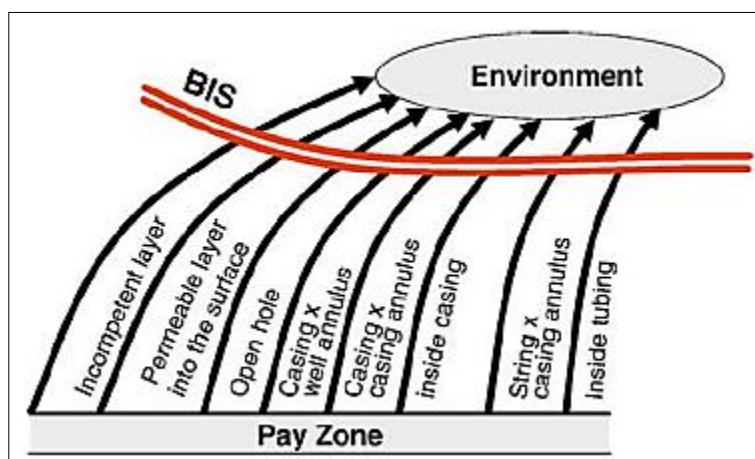
**Figure 7** Schematic of a production well equipped with a gas lift1. Subsurface Safety Valve 2. Gas injection- gas lifter 3. Gas lift Valves- Gas lifting valves 4. Packer-packer 5. Perforation- Perforation

#### 4.3. Provision of Flow

During production, hydrates and paraffins can accumulate inside flow lines and risers due to low temperatures. Accumulation of hydrate and paraffin reduces productivity and can eventually completely block subsea pipelines. For example, accumulated hydrate can be dissolved in methanol, ethanol, or glycol circulating within production lines. At this time, the main valves M1 and M2 are both closed and the crossover valve XO is opened (Fig. 5). Methanol or other liquid is injected into the production line through the service line and the XO crossover valve.

#### 4.4. Security barriers (barriers)

"integrated barrier complex" Production Adapter Base ( PAB ) is defined as "one or more barriers to prevent the involuntary flow of fluid from the permeable interval (reservoir or productive zone) to the surface, taking into account all possible paths."

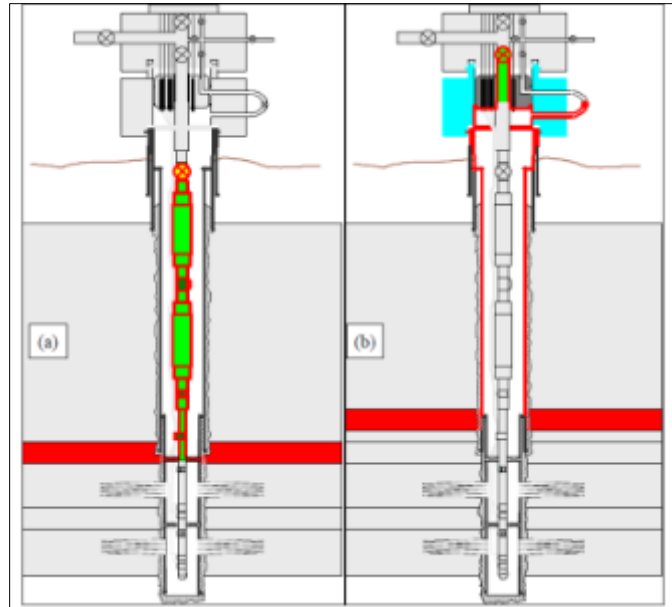


**Figure 8** Integrated set of safety barriers5)

Figure 8 graphically illustrates the definition of IEM. 1. Environment 2. Incompetent layer - a layer without any role 3. Permeable layer into the surface- Conductive layer on the surface 4. Open hole- Open well 5. Casing x well annulus- the well ring of the casing (protective belt) 6. Casing x Casing annulus- the casing ring of the protective belt 7. Inside casing- inner casing 8. String x Casing annulus- drill pipe x casing ring 9. Inside tubing- inner tube

This concept can be used in underwater production . Normally, two independent Extraction Adapter Bases ( PABs ) should be used to ensure security during operation . Figure 9 shows two independent Production Adapter Bases ( PABs )

) applied to a subsea production well during the production phase . Figure 9b shows that the Production Adapter Base B ( PAB ), fountain armature main valve and pipe hanger are safety barriers included in the Production Adapter Base ( PAB ) [6].



**Figure 9** An example of two independent LSIs used in a subsea production well: (a) this LSI consists of all components of the production strip, from impermeable rock, cement, liner, packer, to underground safety valve; (b) shallow impermeable rock, cement, casing, high pressure casing, VX seal, production adapter base, pipe hanger and main valve  
3)

## 5. Conclusion

During the production of the subsea well in Predsolevoye, two pieces of equipment were installed at the mouth: Production Adapter Base ( PAB ) and Wet Fountain Fitting ( WCT ). In this article, we have introduced some key components of a subsea wellhead system, the Production Adapter Base ( PAB ) and the Wet Fountain Fitting ( WCT ). The Production Adapter Base (PAB) is equipped with a pipe hanger. It also has production mandrels where the production line, service/gas lift line and control hose cable are installed . In addition, the fountain fixture consists of a series of valves to control production and output to the pipeline and annulus between the pipe and casing. It consists of a Remotely Operated Valve Panel ( ROV ). In terms of application, the main application of Wet Fountain Fixture ( WCT ) is production control. The Production Adapter Base ( PAB ) and Wet Fountain Fitting ( WCT ) also have access to the annulus used to pump the gas lift. In addition, it can be used to cycle inhibitors or other chemicals to solve flow assurance problems . Finally, another key point is that the Wet Fountain Fixture and PAB have several safety barriers that can constitute an IEM.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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