CONTENT:

This document contains Instructions for providing adequate isolation barriers (or shut-offs) when removing surface control equipment while drilling or working over wells. These instructions are also applicable for well repair work, performed by the Drilling & Workover organization with and without a rig on location.

1.0 OBJECTIVE:

The purpose of this GI is to ensure safe operations during drilling and well repair work by strict compliance to the guidelines. Deviation from these guidelines will not be permitted unless a waiver is obtained from the Vice President, Drilling and Workover or designated representatives.

2.0 BACKGROUND:

When drilling or working over wells, with or without a rig, situations arise where surface equipment such as Blow Out Preventors (BOPs), wellheads, master valves and trees have to be removed for various reasons. In these situations, surface well control is temporarily removed and is substituted with down-hole isolation barriers so that the reservoir pressure is isolated and work can continue around the wellhead safely. More than one isolation barrier or shut-off is normally required in certain wells in case of unexpected failure of the primary barrier. Adequate back-up barriers reduce the chances of uncontrolled surface flow (blowout) and costly repair work.

3.0 MINIMUM REQUIREMENT: *

The following guidelines will apply at all times unless a waiver has been obtained from Management (as described in paragraph 6.2). The mandatory number of barriers or shut-offs in each case is the minimum; any additional barriers are optional, dictated by the well condition and down-hole completion equipment.

3.1) **Oil Wells** (GOR less than 850scf/bbl)

2 shut-offs, at least one of which is mechanical. (*See notes below*)

3.2) **Oil Wells** (GOR more than 850 scf/bbl)

3 shut-offs, at least two of which are mechanical. (*See notes below*)

Notes: *

a) **For completing wells with tubing and down-hole packer**, the 3 shut-off guideline is applicable to tubing only. A minimum of 2 shut-offs is required for the Tubing/Casing Annulus (tubing hanger and packer seals). If one of the two shut-offs is deemed to be ineffective or questionable, then the annulus will have to be filled with kill fluid to act as a reliable barrier.

b) **For de-completing well with down-hole packer**, the shut-off guideline is applicable to the Tubing and Tubing / casing Annulus (TCA). ***The shut-offs for the tubing/casing annulus are:***

- Packer.
- Tubing Hanger.
- Positive pressure test of Casing.

If any one of the shut-offs is deemed to be ineffective or questionable, then **additionally** a Cement Plug or a Thru-Tubing Drillable Bridge-Plug (TTBP) must be placed above the producing / injecting zone, capped with cement. The Top of Cement (TOC) must be tagged.

c) **For de-completing wells with up-hole packer completions** it is mandatory that full circulation is established with kill fluid. If full circulation is not achieved a Cement Plug or a TTBP capped with cement is required. The TOC must be tagged.

d) When changing the tree above the master valve on wells that have a pressure tested master valve, only one barrier in addition to the master valve is required. This additional barrier should be mechanical.

3.3 **Water Injection Wells**

- If positive WH pressure, 2 shut-offs are required, one of which is mechanical.
- If no WH pressure, 1 shut-off is required.

Note: It is acceptable to nipple up or nipple down the BOPs on top of the injection tree by closing the 10" ball valve and continuously pumping kill fluid down the well-bore. No additional shut-offs are required as long as the tree was never removed and has been pressure tested prior to nippling up/down the BOP's.

3.4 **Gas Wells**

3 shut-offs, at least two of which are mechanical.

Notes: *

a. **For completion,** the 3 shut-off guideline is applicable to the tubing only. A minimum of 2 shut-offs is required for the tubing-casing annulus (tubing hanger and packer seals). If one of the two shut-offs is deemed to be ineffective or questionable, then the annulus will have to be filled with overbalanced kill fluid to act as a reliable shut-off.

b. **For de-completion** positive pressure test of Tbg. & TCA with kill fluid in both sides is **mandatory.**

c. When changing the tree above the master valve on wells that have a pressure tested master valve, only one barrier in addition to the master valve is required. This additional barrier should be mechanical.

3.5 **Water Supply Wells** (with or without submersible pump)

- If well flows to surface, 1 shut-off is required.
- If well does not flow to surface, no shut-off is required.

4.0 TYPES OF ISOLATION BARRIERS:

4.1 A number of acceptable isolation barriers or shut-off alternatives are available and can be used under different operating conditions. These barriers can be separated into two main groups: Mechanical and Non-Mechanical.

4.2 The following are examples of Mechanical and Non-Mechanical isolation barriers. The type of barrier to utilize will depend on the well condition and down-hole completion equipment. These barriers include, but are not limited to:

Mechanical:
- Drillable or Retrievable Bridge Plug
- Retrievable Tubing Plug
- Back Pressure Valve
- Valve Back-Seat
- Surface Valve
- Subsurface Safety Valve (SSSV)
- Un-perforated Casing

Non-Mechanical:
- Kill Fluid
- Cement

GLASS AND CERAMIC DISKS:
Both types can be considered a barrier when completing a well under the following conditions:

a. The disks must be rated to hold the formation pressure from below. The working pressure must be a minimum of 20% higher than the anticipated formation pressure.
b. They are only used during BOP nipple down and tree nipple up operations.
c. A negative test must be successfully performed on the disks.
d. After the negative test, the integrity of the disks may not be compromised by any subsequent operation (e.g.: wireline, CT work, dropped objects, etc.)
e. They must be used in conjunction with a BPV.

5.0 RELIABILITY OF ISOLATION BARRIERS:

5.1 Equipment Testing

5.1.1 Vendor Testing: Prior to delivery of a new mechanical pressure isolation device, the vendor must conduct the required and appropriate hydrostatic pressure tests per Saudi Aramco Materials System Specification (SAMSS) to insure that the device meets design specifications.

5.1.2 Field-Testing: Whenever a mechanical isolation barrier is installed in a well, every effort should be made to field test and insure the barrier is holding. Since plugs are designed to hold pressure from above, below or from both directions, the field test should be designed according to the plug functionality.

5.1.3 While drilling or working over a well, if BOPE repairs are required, the mechanical isolation barriers must be installed and positive tested.

5.2 Kill Fluid

5.2.1 A kill fluid can be used as one of the isolation barriers as mentioned in section 4.2 above. In order for the kill fluid to be effective as an isolation barrier, two conditions must be met:

a) The hydrostatic pressure of the kill fluid column must exceed the reservoir pressure.

b) The wellbore kill fluid must remain static at surface for a period of time (as per item 5.2.2 below) to insure the presence of a competent barrier.

5.2.2 The following are the minimum mandatory observation times for a kill fluid to be declared static:

Oil Well (GOR less than 850 scf/bbl):	1 hour Oil
Well (GOR more than 850 scf/bbl):	2 hour
Gas Well	3 hours
Water Injector	1 hour
Water Supply Well	30 minutes

6.0 WAIVER:

6.1 The above instructions will be mandatory when drilling or working over a well (with or without a rig) by the Drilling & Workover organizations, unless prior management approval has been secured. A written waiver to divert from the established guidelines must be obtained when an unusual well situation dictates the need for fewer barriers than stipulated. Obtaining a waiver to reduce the number of isolation barriers or shut-offs is highly discouraged and should only be considered when there are no other alternatives.

6.2 The waiver will be requested by submitting Waiver Request Form Waiver - 01 (see Appendix I) documenting the well situation, explaining why a waiver is necessary and explaining the impact of the waiver. Waiver signature approval level will be Vice President of Drilling and Workover or designated representative.

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