PRODUCTION TECHNOLOGY FOR SUBSEA DEVELOPMENT WELLS

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ABSTRACT. This paper provides a discussion of the many points which should be considered when planning the engineering aspects of subsea development wells. The multi-discipline issues in a subsea project are presented together in order to emphasise the requirement for effective project management and close teamwork. Drilling activities including well design and rig selection are considered along with downhole completion design. This includes the differing requirements of exploration wells and development wells with respect to subsequent well utilisation. The requirements of the subsea completion, installation equipment and subsea facilities and their impact on other well design issues are presented. Recent industry efforts on subsea equipment standardisation through API 17D and other North Sea initiatives and the potential for further industry standardisation are discussed. The paper should form a useful reference for those involved in subsea projects by way of highlighting the issues which must be considered, without always presenting solutions. Information has been drawn from many references reflecting primarily North Sea operations in addition to the author's own experience.

INTRODUCTION. The issues presented are arranged under the following seven headings; Exploration and development well design issues, rig selection, downhole completion, subsea completion, subsea facilities, standardisation and project management. Subsea well production technology is the theme for the paper and it is intended to compliment Reference 1 which concentrates on drilling related subsea development well issues. The nature of a subsea development implicitly involves many disciplines and it is essential that from the earliest planning phase the potentially conflicting requirements of all the disciplines are taken into account. This paper presents these issues in order that they can be considered by personnel involved with subsea projects and together can form a coordinated approach to production technology for subsea development wells.

1. EXPLORATION AND DEVELOPMENT WELL DESIGN ISSUES

The suitability of a subsea well for completion is dependent on its nature as an exploration or development well and more specifically on the way the well was planned. This section highlights various key points which, if considered early in the well design, can help to make the well more suitable for re-entry and completion should it be required.

Seabed Location

One of the earliest design decisions for any well is the seabed location. In the case of an exploration well the seabed location is often chosen to be vertically above the target. This is usually no problem, unless other wells have been drilled or are planned close by, in which case future operations may be significantly complicated by overlapping mooring patterns or seabed wellhead obstructions. (Reference 1).

As wells become more appraisal in nature then the seabed location becomes more of an issue. A decision has to be taken on an optimum location or locations to group wells together in order to avoid the problems mentioned above. If this decision is not taken and wells are drilled individually then the potential savings from being able to reuse existing wells for either a subsea development or a platform development are reduced. The economics of a subsea project make grouped wells much more attractive through the use of combined facilities, such as flowlines and umbilicals, and the ease of future access between wells without needing a rig move. The chosen seabed location should take into account potential flowline and umbilical lengths and routings in addition to directional drilling considerations to target locations.

Well Spacing

Having decided to group wells together at one seabed location the next decision is how close they should be and how they should be spaced out and arranged. The four primary options available are; separate without accurate spacing, separate with accurate spacing, modular close spaced and template drilled. Since the cost of having wells accurately spaced but mechanically separate is only marginally more than having wells loosely spaced it is generally preferable to use some form of accurate spacing. Knowing the exact subsea location of a group of wells with respect to each other allows several future options; platform tiebacks, installation of a common subsea protection frame and more rapid installation of subsea tie-ins.