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Use of the ALARP Principle for Evaluating Environmental Risks and Impacts of Produced Water Discharged to Sea

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Abstract

When produced water from offshore production is discharged to sea, it contains some oil (aliphatic and aromatic components), production chemicals and NORM (Naturally Occurring Radioactive Substances). These groups of substances are traditionally treated in different ways in the regulations and standards.

Regulations of oil in produced water are mainly related to max concentrations and the total discharge of the aliphatic (dispersed) fraction. Regulation of chemicals is based on the environmental risk profile of each production chemical, although efforts are made towards regulations based on risk assessment of the discharge of the mixture of substances. For discharge of NORM dissolved in the produced water, no limit values are imposed. For NORM solids (scale, sludge, sand) from process equipment, discharge to sea is in general not allowed – it is re-injected or taken to a deposit onshore.

Management of safety risks takes place based on the principle that risks shall be reduced to a level As Low As Reasonably Practicable (ALARP). The concept of environmental risk is not as unambiguously defined as safety risks. With respect to accidental environmental impacts, the parallel is relatively straightforward, but with respect to planned environmental impacts (e.g. emissions/discharges during operation) the parallel to the safety ALARP is not so clear; the consequence (the environmental impact) is not linked to a certain frequency – i.e. we cannot talk about risk as: likelihood times consequence. Costs are normally defined as money, effort and time. But what if the cost of a reduced HSE risk is an increase in another HSE risk? Produced water re-injection might cause increased CO₂ emissions. Handling solid NORM when shipping it to shore causes health risks to the people handling the NORM. Can that risk be justified, based on the possible reduction in environmental risk by not discharging the solid NORM to sea instead?

The paper highlights the above issues and proposes a method named *integrated HSE ALARP assessment* for supporting such analysis. The environmental risks of discharge with produced water to sea of oil, chemicals and NORM, respectively, are used to illustrate these principles.

Introduction

The development of the concept of risk has previously taken place with respect to safety risk. An important principle developed is the obligation to reduce risk to a level As Low As Reasonably Practicable (ALARP). The concepts of health risk and environmental risk are also widely used now – and as parallel to the ALARP principle, the principles of Best Available Technology / Best Environmental Practice (BAT / BEP) has been developed with respect to environmental impacts. These principles are to a wide extent analogous to the ALARP principle used in health & safety.

In this paper, an overall common definition of HSE risk is sought. This makes weighting of different HSE risks against each other more transparent and objective. The ALARP principle traditionally weight safety risk reduction against the increased cost/effort required for achieving the risk reduction. In this paper, a concept for weighting safety risk against environmental and health risk is presented, using produced water as an example. Also a situation where increased environmental impact was weighted against reduced safety risk is presented.

Environmental Risk

In order to use the ALARP principle on environmental risk reduction, it is necessary to establish a common understanding of the concept of risk. In connection with environmental management, the following definitions are usually used (ISO 14001, 2004):