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## A Working Party Report on

# $CO_2$ Corrosion Control in Oil and Gas Production

## Design Considerations

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# Preface

Corrosion is a natural potential hazard associated with oil and gas production and transportation facilities. This results from the fact that an aqueous phase is normally associated with the oil and/or gas. The inherent corrosivity of this aqueous phase is then dependent on the concentration of dissolved acidic gases and the water chemistry. The presence of $H_2S$, $CO_2$, brine and/or condensed water with the hydrocarbon not only give rise to corrosion, but also can lead to environmental fracture assisted by enhanced uptake of hydrogen atoms into the steel. $CO_2$ is usually present in produced fluids and, although it does not cause the catastrophic failure mode of cracking associated with $H_2S$*, its presence can nevertheless result in very high corrosion rates particularly where the mode of attack on carbon and low alloy steels is localised. In fact $CO_2$ corrosion, or 'sweet corrosion', is by far the most prevalent form of attack encountered in oil and gas production and is a major source of concern in the application of carbon and low alloy steels. Hence, the need to have a document which systematically addresses the steps, considerations and parameters necessary to design oil and gas facilities with respect to $CO_2$ corrosion.

This document sets the scene on design considerations specifically related to $CO_2$ corrosion. It has been developed from feedback of operating experience, research results and operators' in-house studies. Particular attention has been given to the chemistry of the produced fluid, the fluid dynamics and physical variables which affect the performance of steels exposed to $CO_2$-containing environments. The focus is on the use of carbon and low alloy steels as these are the principal construction materials used for the majority of facilities in oil and gas production offering economy, availability and strength.

This document is a practical, industry oriented guide on the subject for use by design engineers, operators and manufacturers. It incorporates much of the recent developments in the understanding of the ways in which detailed environmental and physical conditions affect the risk of $CO_2$ corrosion. It also describes means of corrosion control. It is comprehensive in addressing $CO_2$ corrosion of all major items of oilfield equipment and facilities incorporating, production, processing and transportation. As such, it provides a key reference for materials and corrosion engineers, product suppliers and manufacturers working in the oil and gas industry.

* 'Sour corrosion', resulting from the presence of $H_2S$, is the subject of EFC Publications Numbers 16 and 17.

# Acknowledgements

The $CO_2$ Corrosion Work Group of the EFC Working Party on Corrosion in Oil and Gas Production held its first meeting in September 1993. Since then, several meetings have been held to address industry-wide issues related to engineering design for $CO_2$ corrosion. The organisation of the Work Group was undertaken by representatives from worldwide oil and gas producers, manufacturers, service companies and research institutions.

In achieving the primary objective, parameters affecting $CO_2$ corrosion, its mechanism and methods of control have been discussed during the Work Group meetings. These aspects form the core of the present document, Sections of which have been prepared by the Work Group members.

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