Preface

Pipelines represent an extremely safe way to transport hydrocarbons across the world. A barrel of crude oil or petroleum product shipped by pipeline reaches its destination safely more than 99.99% of the time. In addition, most incidents do not impact the public or the environment, since they are occurring and wholly contained within the operators' facilities. Efforts are however necessary to ensure that health, safety, security, and environmental concerns are addressed throughout all planning, construction, and operational phases of pipeline operations. Integrity management programs can prevent releases and accidents by defining adequate evaluation, inspection, and maintenance procedures.

The research project G5055 'Development of novel methods for improved safety assessment of gas pipelines with security implications,' supported by NATO Science for Peace and Security (SPS) program, addressed some of the safety issues listed above. The main results of this project are collected in this volume together with the contribution of experts operating in the wider fields of pipe safety, with the aim of offering the overall picture of the technical discussion going on in this area.

The SPS G5055 project was dedicated to the study of steel degradation in gas pipeline. Tests were performed on some serviced pipeline sections provided by utilizers settled in Italy and in Ukraine, operating in wide production and distribution areas. The research focus was on non-destructive mechanical tests and electrochemical evaluation of degradation. The objective was to describe and if possible to model the in-service degradation of pipeline steel via the examination of structural and fractographical features.

In fact, during their lifetime, pipelines are exposed to demanding working conditions and aggressive media. In long-term exploitation, material aging increases the risk of fracture and the possibility of significant economic losses and severe environmental consequences. Thus, understanding damage evolution in steel represents a main purpose to be persecuted in order to predict reliably the residual life of pipelines and the connected risks.

Failure in operation of the considered strategic infrastructures can be prevented by continuous monitoring. Non-destructive experimental techniques can evidence in-bulk degradation phenomena like material embrittlement, particularly critical in gas transportation systems for the danger of bursts and explosions. Data collected on site and inserted in validated prediction models allow to estimate the evolution of the ongoing processes and to plan the retrofitting interventions that ensure the maintenance of adequate safety margins.

Crack growth in pipeline steel is often assisted by hydrogen, by a mechanism that depends strongly on the physico-chemical characteristics of transported fluid. Hydrogen embrittlement is considered in a few papers in this book, together with the main corrosion issues that are known to cooperate to pipeline degradation.

The capability of detecting defects is mandatory to improve the safety performance of the investigated systems and of related components; some innovative methods are described to evidence the presence of corrosion and its evolution with time.

Improved safety of pipelines can be provided by assessing different damaging scenarios in a risk-based context, with the combination of complementary inspection techniques.

Finally, a significant contribution to pipeline safety is provided also by the ongoing technological progresses in materials and components, partly described in this book.

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NATO OTAN This project is supported by: The NATO Science for Peace and Security Programme