

Preface

Natural gas has been a valuable energy commodity for many centuries. According to *Encyclopaedia Britannica*, the ancient Chinese were the first to observe the seeps and the use of natural gas in 600 BC with the first utilisation of it in the home during the great empire of Persia, now Iran, in 100 AD. It was not until 1803–1812 when the first gas lighting was patented in London by Frederick Winsor and the first company was then founded in London, England. It was during this century (19th) that natural gas for home lighting was also used directly from the wellhead in Fredonia, New York. Although natural gas was unpopular prior to the eighteenth century due to the use of manufactured gas such as ‘coal gas’, it was towards the latter part of the nineteenth century that most industrial countries started using natural gas and thus large transmission and distribution pipelines were constructed in transferring the gas to the required areas. The steady utilisation of natural gas grew to the peak during the 1960s to mid-1970s when the shortage of crude oil enforced most industrial nations to find alternative ways of harnessing energy and natural gas has since become one of the main fossil fuel energy sources. Natural gas is colourless with high flammability and energy value and together with its convenience has resulted in a rapid rise to extensive use as a fuel today.

As the utilisation of natural gas became more frequent as one of the main alternative choice of energy source it enabled rapid technological advancement and attainment of knowledge and understanding in various related disciplines of natural gas. Particularly over the last decades, there has been constant progress in research and innovation with regard to the production of natural gas, transmission, distribution, utilisation, safety and management in both upstream and downstream processes. The authors, whose backgrounds are outlined below, independently recognised that whilst there are numerous academically orientated books as well as conference publications and standards available that address the upstream process of natural gas and certain specialised texts addressing narrower areas of application, there is an absence of an academically and industrially oriented book that covers, as far as possible, the downstream process, that is, after the wellhead to gas processing plants and finally to consumers.

The book starts in a logical manner with the opening Chap. 1 describing the fundamentals of natural gas. Subsequent to the wellhead the gas must be transmitted and distributed to its final destination, that is, the consumers. These transmission and distribution processes require thorough understanding of their systems and design which are described in Chap. 2. The gas should also be stored or transported for later use as Liquefied Natural Gas (LNG), this is exposed in Chap. 3. Natural gas which contains certain physical characteristics should flow through various transmission and distribution designed network systems as is described in Chap. 4. No matter where the gas is being transferred to, the accurate control of it together with understanding its quality are pertinent which could eventually reflect on the overall capital expenditures of the gas. It is thus with this in mind that a comprehensive understanding of instrumentation and measurement systems have been provided in Chap. 5. Although natural gas has become one of the main energy sources, the accidental release and subsequent ignition of flammable gas and vapour clouds has led to a number of incidents with catastrophic consequences on oil and gas platforms. Chapter 6 therefore provides inclusive understanding of fire and explosion and safety aspects, where appropriate, of the natural gas. The utilisation of natural gas, including an overview of the heat transfer and heat exchangers, has also been given in Chap. 7. Within almost all the downstream processes the viability of the natural gas is dependent on how the gas business and the related projects should be managed and sustained, which is the subject matter of Chap. 8. In the last Chap. 9, the authors have provided various innovation management models from their own experience and borrowed from various disciplines, with a few case studies which over the last decade have become vital ingredients in the future sustainability of the gas industry.

Prior to commencing their cooperation on this book, GGN and NEC cooperated for many years as committee members of Institution of Gas and Mangers (IGEM) in Continuous Professional Development (CPD) and organized various conferences and short courses in gas safety and technology. Also, GGN and NEC had cooperated in research and consultancy projects, particularly involving gas processing and metering systems. The incentive to cooperate and write the book came from frequent requests from those in academia and industry for a text that was suited to their applications-oriented needs in the downstream process and yet which covered a wide breadth of knowledge. Although, together, the authors have experience in a wide range of gas engineering and safety applications, the very large number of concerns that exist in industry has meant that expertise has been sought from specialist companies and individuals, where appropriate. These specialists are thanked in a later section of this introduction.

Ghasem G. Nasr is Professor of Mechanical Engineering and Innovation at University of Salford, Manchester, England and he is the head of Petroleum and Gas Engineering in the School of Computing, Science and Engineering (CSE) and Director of sprays and petroleum technology research groups. Graduating in Mechanical Engineering, Fuel Technology (PgDip) and Energy Science (MSc) from the University of Middlesex and Sussex University, respectively, and Heat Transfer and Fluid Mechanics (Ph.D.) from the University of Swansea, he moved

into project engineering management and energy utilization between 1988 and 1995 to Tata Steel, Wales, and subsequently acted as a Senior Consultant in Europe and the Middle East before moving to the University College of Manchester (now Stockport College) managing the engineering department. He then joined the University of Salford in 2001 as a leader of Gas Engineering and Management. He has over 25 years' experience in innovation and research in many areas of spray production and gas utilisation and has been consultant to over 120 companies in New Product Development (NPD), innovation and research. He was a founder of 'Spray Research Group' and has authored 130 papers, including editorship of books and journals, and acquired 7 patents and was a lead author of the book *Industrial Sprays and Atomisation (SV, 2001)*. He has also held a number of executive appointments in various academic, professional and steering committees. Currently, he is a member of PDC of IGEN and Executive Member of steering committee of Praxis-Global. He has also been guest speaker on many international platforms and delivered over 100 advanced short courses in various related subjects. He is a Chartered Engineer, a Fellow of the Institution of Gas Engineers and Managers (FIGEM) and of the Institute of Mechanical Engineers (FIMechE) and Member of FEANI EurIng and Institute of Liquid Atomisation and Spraying Systems (ILASS). Recently, he has been appointed as a director of Technology and Innovation at the Salvalco Ltd.

Norman E. Conner joined the North Western Gas Board as a student engineer in 1950 and began studying Mechanical Engineering at Warrington and St. Helens Technical Colleges. In 1953 he was awarded a Whitworth Society prize and a Technical State Scholarship to study Gas Engineering at the University of Leeds, graduating in 1957 with an Honors B.Sc., Degree. He returned to the North Western Gas Board as a production engineer in the South Lancashire group and was appointed Chief Chemist at the Warrington Production Station in 1958. In 1964 he left to take up an appointment as a Lecturer in Gas Engineering at the Royal College of Advanced Technology, Salford. He is a Chartered Engineer, a Fellow of the Institution of Gas Engineers and Managers and of the Energy Institute. He represented the University on the IGEN Education, Training and Academic Committees for many years and has been Chairman of the North Western Section of E.I., and the Manchester Gas Association. He received an M.Sc., Degree and Senior Lectureship in 1977. During his career he was actively involved in running Conferences/Symposia in gas engineering, fuel utilisation and chemical engineering at the University. He is also a co-author of: *Industrial Gas Utilisation Engineering Principles and Practice* Bowker 1977. He was involved in setting up and teaching on the M.Sc., course in Gas Engineering and Management with colleagues (A.L. Bowler and Dr. R. Pritchard) in the late 1980s, later becoming Course Director. He is still actively involved in the Gas and Petroleum Engineering programme at the University.

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