Surface Production Operations: Design of Oil Handling Systems and Facilities

Ken Arnold & Maurice Stewart

Volume One  Third Edition
Surface Production Operations
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Surface Production Operations
Design of Oil Handling Systems and Facilities

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THIRD EDITION
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Acknowledgments to the Third Edition

A number of people helped to make possible this revised third edition of *Surface Production Operations, Volume 1—Design of Oil and Water Handling Facilities*. A real debt is owed to the 45,000-plus professional men and women of the organizations that I’ve taught and worked with through my 35-plus years in the oil and gas industry and made a reality the ideas in this book. The companies are too numerous to name, but it’s worth emphasizing that a consultant only makes suggestions—it’s the engineers, managers, technicians, and operators who are faced with the real challenge. I have been privileged to work with the “best-of-the-best” companies in the world, and this book is dedicated to them for their vision and perseverance.

Although I can’t mention everyone who has helped me along the way, I would like to say thank you to my colleagues and friends: Jamin Djuang of PT Loka Datamas Indah; Chang Choon Kiang, Amran Manaf, and Ridzuan Arrifin of Petroleum Training Southeast Asia (PTSEA); Clem Nwogbo of Resourse Plus; Khun Aujchara and Bundit Pattanasak of PTTEP; Al Ducote and Greg Abdelnor of Chevron Nigeria Limited, and David Rodriguez of Chevron Angola (CABGOC).

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Importance was the contribution of Heri Wibowo of STC, who was responsible for coordinating the entire typing and drafting effort. Heri was also responsible for editing and pulling it all together at the end. However, we take full responsibility for any errors that still remain in this text.

Lastly, I would like to thank my wife, Dyah who has been my inspiration, providing support and encouragement when needed.

Maurice Stewart

The first editions of this book were based mostly on materials I had developed and gathered over the years based on what was then 20 years worth of experience and interaction with some very talented people at Shell and Paragon Engineering Services (now AMEC Paragon). Maurice provided first drafts of several chapters, additional materials and technical assistance.

The second edition was created by Maurice and I furnishing guidance and technical material to a group of AMEC Paragon engineers who made modifications to the existing chapters. These engineers were: Eric Barron, Jim Cullen, Fernando De La Fuente, Robert Ferguson, Mike Hale, Sandeep Khurana, Kevin Mara, Matt McKinstry, Carl Sikes, Mary Thro, Kirk Trascher and Mike Whitworth. David Arnold pulled it all together.

This edition contains significant amounts of new material which was developed and gathered primarily by Maurice as a result of his years of teaching and consulting using the original editions as a guide. I served mostly as a technical reviewer adding little in the way of new materials. Maurice deserves most of the credit for this edition.

Ken Arnold
About the Book

*Surface Production Operations, Volume 1—Design of Oil and Water Handling Facilities*, is a complete and up-to-date resource manual for the design, selection, specification, installation, operation, testing, and troubleshooting of oil and water handling facilities. It is the first volume in the Surface Production Operations series and is the most comprehensive book you’ll find today dealing with surface production operations in its various stages, from initial entry into the flowline through separation, treating, conditioning, and processing equipment to the exiting pipeline. Featured in this text are such important topics as gas–liquid separation, liquid–liquid separation, oil treating, desalting, water treating, water injection, crude stabilization, and many other related topics.

This complete revision builds upon the classic text to further enhance its use as a facility engineering process design manual of methods and proven fundamentals. This new edition includes important supplemental mechanical and related data, nomographs, illustrations, charts, and tables. Also included are improved techniques and fundamental methodologies to guide the engineer in designing surface production equipment and applying chemical processes to properly detailed equipment.

All volumes of the Surface Production Operations series serve the practicing engineer by providing organized design procedures; details on suitable equipment for application selection; and charts, tables, and nomographs in readily usable form. Facility engineers, designers, and operators will develop a “feel” for the important parameters in designing, selecting,
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specifying, operating, and troubleshooting surface production facilities. Readers will understand the uncertainties and assumptions inherent in designing and operating the equipment in these systems and the limitations, advantages, and disadvantages associated with their use.
Preface to the Third Edition

Ken Arnold and I initially wrote the Surface Production Operations two-volume series with the intention of providing facility engineers with a starting point for addressing the design and operation of surface production facilities. This text provides the basic concepts and techniques necessary to design, specify, and manage oil and gas production facilities.

In the early 1980s, Ken and I developed and taught a number of graduate-level production facility design courses. These courses were taught in the petroleum engineering department of the University of Houston, Tulane University, and Louisiana State University. In the mid-1980s, we took our course lecture notes and published the two-volume Surface Production Operations series. These books became the standard for the industry and have been used by thousands in every oil producing region of the world since their first printing.

We developed and taught two 5-day intensive continuing education courses dealing with oil and gas handling facilities; they were based on our production facility design experience, with emphasis on how to design, select, specify, install, operate, test, and troubleshoot. These courses became so well known through presentations in Southeast Asia, Northern and West Africa, the North Sea, Western and Southern Europe, China, Central Asia, the Democratic Republic of Congo, India, Central and South America, Australia, Canada, and throughout the United States, that in the late 1980s, in response to the many requests by international oil and gas companies and design consultants, we developed additional 5-day seminars devoted to all aspects of production facility design. The continuing-education course lecture notes developed for the 20-plus 5-day courses was the starting point for the expansion and extensive revision of this series.
Preface to the Third Edition

The third edition of *Surface Production Operations, Volume 1—Design of Oil and Water Handling Facilities*, builds upon the classic text to further enhance its use as a production facility engineering design manual. Every chapter has been significantly expanded and thoroughly updated with new material. Every chapter has been carefully reviewed and older material removed and replaced by newer design techniques. It is important to appreciate that not all of the material has been replaced, because much of the so-called older material is still the best available today, and still yields good designs. Additional charts and tables have been included to aid in the design methods or in explaining the design techniques. This book further provides both fundamental theories where applicable and directs application of these theories to applied equations, expressed in both SI and field units, essential in the design effort. A conscious effort has been made to offer guidelines of sound engineering judgment, decisions, and selections with applicable codes, standards, and recommended practices.