

Lng regasification process pdf

Understanding the LNG Regasification Process: A Comprehensive Guide (PDF Available)

Lng regasification process pdf is a crucial topic for anyone involved in the global energy landscape, from industry professionals and engineers to policymakers and students. This article delves deep into the intricate world of Liquefied Natural Gas (LNG) regasification, providing a comprehensive overview of the technologies, challenges, and significance of transforming super-cooled LNG back into its gaseous state for distribution and consumption. We will explore the fundamental principles behind various regasification methods, discuss the critical equipment involved, and touch upon the economic and environmental considerations. Whether you're seeking detailed information for a project, research, or simply to expand your knowledge, this guide aims to be an invaluable resource, covering the essential aspects of the LNG regasification process, with an emphasis on clarity and technical accuracy, mirroring the depth you might expect from a detailed PDF document.

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Introduction to LNG Regasification

Liquefied Natural Gas (LNG) plays an increasingly vital role in meeting global energy demands. Its ability to be transported across vast oceans in a liquefied state, occupying significantly less volume than its gaseous form, makes it a cornerstone of international energy trade. However, for natural gas to be delivered to end-users via pipelines, it must be converted back from its liquid form to a gaseous state. This critical transformation is known as regasification. The LNG regasification process is a complex engineering feat, involving sophisticated technologies to safely and efficiently raise the temperature of LNG from its cryogenic state (around -162°C) to ambient temperatures. This article provides an in-depth exploration of this essential industrial process, offering insights into its various methods, the equipment employed, and the surrounding operational and environmental considerations, akin to a comprehensive study you might find in an LNG regasification process PDF.

The Science Behind Liquefied Natural Gas (LNG)

Natural gas, primarily composed of methane (CH_4), is a fossil fuel formed over millions of years. While it exists as a gas at standard atmospheric pressure and temperature, its transportation over long distances is economically challenging due to its low density and the vast volume it occupies. To overcome this, natural gas is cooled to extremely low temperatures, approximately -162 degrees Celsius (-260 degrees Fahrenheit), at which point it liquefies. This process, known as liquefaction, reduces the volume of natural gas by a factor of about 600. This significantly increases the energy density, making large-scale maritime transportation feasible in specialized cryogenic tankers. Understanding this fundamental physical change is key to appreciating the complexities of the subsequent LNG regasification process.

Why LNG Regasification is Essential

The primary purpose of LNG regasification is to make liquefied natural gas usable for consumers and industries. Once LNG reaches its destination port, it must be returned to its gaseous state before it can be injected into the existing natural gas pipeline infrastructure. This infrastructure is designed to handle natural gas at specific pressure and temperature conditions. Without regasification terminals, the vast quantities of LNG imported via ships would be unusable for most applications, including power generation, industrial heating, and residential use. Therefore, regasification facilities are critical nodes in the global energy supply chain, bridging the gap between LNG production and consumption markets.

Key Components of the LNG Regasification Process

An LNG regasification terminal comprises several key components designed to handle the cryogenic liquid and safely convert it back to gas. These include:

- **Storage Tanks:** Large, insulated cryogenic tanks designed to store the imported LNG at its low temperature and atmospheric pressure.
- **Unloading Arms/Hoses:** Equipment used to transfer LNG from the ship's tanks to the terminal's storage tanks.
- **Pumps:** Cryogenic pumps are utilized to move LNG from storage to the regasification units.
- **Regasification Units (Vaporizers):** The core equipment where the heat transfer occurs to vaporize the LNG.
- **Send-Out Compressors:** These units boost the pressure of the regasified natural gas to match pipeline requirements.
- **Control Systems:** Sophisticated systems monitor and control all aspects of the process to ensure safe and efficient operation.
- **Safety Systems:** Including emergency shutdown systems, fire suppression, and leak detection to manage the inherent risks associated with cryogenic liquids and flammable gas.

Common LNG Regasification Technologies

Several technologies are employed for the regasification of LNG, each with its advantages and disadvantages, often depending on factors like location, available energy sources, and environmental regulations. The choice of technology significantly impacts the design and operational cost of a regasification terminal. Exploring these methods provides a detailed understanding of the LNG regasification process PDF.

Open Rack Vaporizers (ORVs)

Open Rack Vaporizers are one of the most common and widely used technologies. In this system, LNG flows through tubes arranged in an open frame structure. Seawater is pumped over these tubes, providing the necessary heat to vaporize the LNG. The seawater typically flows by gravity, making the process energy-efficient as it doesn't require external pumping for the heat transfer medium itself. The primary concern with ORVs is the potential for freezing of the seawater if ambient temperatures are low, which can be mitigated through various design considerations and operational adjustments.

Submerged Combustion Vaporizers (SCVs)

Submerged Combustion Vaporizers utilize a direct-fired method. In an SCV, natural gas is burned in a combustion chamber, and the hot flue gases are bubbled through a pool of water, which in turn heats the LNG flowing through submerged tubes. This method is highly efficient and compact, but it requires a significant amount of fuel gas for the combustion process and produces greenhouse gas emissions. The water acts as an intermediary, transferring heat from the combustion gases to the LNG. SCVs are often preferred in locations where seawater is not readily available or when rapid vaporization is required.

Shell and Tube Heat Exchangers (STHEs)

Shell and Tube Heat Exchangers are a more traditional heat transfer technology adapted for LNG regasification. In this setup, LNG flows through tubes (the tube side) while a heating medium flows around these tubes within a shell (the shell side). The heating medium can be seawater, hot water from a dedicated boiler, or even waste heat from other industrial processes. STHEs offer good control over the vaporization process and can be designed for high efficiency. They are often used in conjunction with other technologies or in smaller-scale applications.

Ambient Air Vaporizers (AAVs)

Ambient Air Vaporizers are designed to utilize the heat present in the surrounding air. These units consist of large finned tubes through which LNG flows. The large surface area of the fins maximizes heat transfer from the ambient air to the LNG, causing it to vaporize. AAVs are particularly useful in warmer climates and can be a more environmentally friendly option as they don't consume significant amounts of other energy sources or water. However, their efficiency is dependent on ambient air temperature, and they can be less effective in very cold weather. They also tend to be larger in footprint compared to other vaporization methods.

The Step-by-Step LNG Regasification Journey

The regasification process, regardless of the specific technology employed, follows a general sequence of steps. Upon arrival at the terminal, LNG is offloaded from the vessel into the cryogenic storage tanks. From these tanks, cryogenic pumps increase the pressure of the LNG, preparing it for vaporization. The pressurized LNG is then fed into the chosen type of vaporizer. Within the vaporizer, heat is transferred from an external medium (seawater, combustion gases, or ambient air) to the LNG, causing it to transition from a liquid to a gaseous state. The now gaseous natural gas is then typically passed through a series of filters to remove any impurities. Following vaporization and filtration, the natural gas is compressed to the required pressure for injection into the onshore pipeline network. Throughout this entire process, sophisticated monitoring and control systems ensure that the temperature, pressure, and flow rates are maintained within safe and optimal parameters.

Operational Considerations and Safety in LNG Regasification

Operating an LNG regasification terminal demands stringent attention to safety and operational excellence. The cryogenic nature of LNG presents significant hazards, including the risk of frostbite upon contact and the potential for rapid expansion if it warms up and vaporizes unexpectedly. Furthermore, natural gas itself is highly flammable. Therefore, terminals are equipped with extensive safety systems, including:

- Advanced leak detection and monitoring equipment.
- Emergency shutdown (ESD) systems capable of rapidly isolating sections of the plant.

- Fire suppression systems tailored for cryogenic and flammable gas environments.
- Regular training and drills for personnel on emergency response procedures.
- Strict adherence to international safety codes and standards.

Operational considerations also include optimizing energy efficiency, managing the thermal stresses on equipment due to extreme temperature changes, and ensuring the quality of the regasified gas meets pipeline specifications, such as dew point control to prevent liquid formation in the downstream network.

Environmental Impacts and Mitigation Strategies

While LNG is often considered a cleaner-burning fossil fuel compared to coal or oil, its regasification process is not without environmental considerations. The primary concern relates to energy consumption, particularly in methods like SCVs that burn fuel gas. Additionally, using seawater as a heating medium in ORVs can lead to thermal pollution if the discharged water is significantly warmer than the receiving body. Mitigation strategies include:

- Maximizing energy efficiency in all processes to reduce fuel consumption and emissions.
- Exploring waste heat recovery opportunities from nearby industrial facilities.
- Implementing advanced cooling technologies for discharged seawater to minimize thermal impact.
- Utilizing renewable energy sources where feasible to power auxiliary systems.
- Continuous monitoring of emissions and environmental parameters.

The development of innovative regasification technologies that minimize energy demand and environmental footprint is an ongoing area of research and development.

The Future of LNG Regasification Technologies

The global demand for LNG is expected to continue growing, driving innovation in regasification technologies. Future developments are likely to focus on improving energy efficiency, reducing the environmental impact, and increasing the flexibility and modularity of regasification units. Emerging technologies include floating storage and regasification units (FSRUs), which offer greater flexibility and can be deployed more quickly than onshore terminals. Research is also ongoing into more efficient heat transfer fluids and designs that can operate effectively across a wider range of ambient temperatures. The aim is to make the LNG regasification process more sustainable and cost-effective, ensuring its continued importance in the global energy mix.

Frequently Asked Questions

What are the primary environmental concerns associated with LNG regasification, and how are they mitigated?

Key environmental concerns include greenhouse gas emissions (methane slip), potential for spills, and noise pollution. Mitigation strategies involve advanced leak detection and repair, stringent safety protocols, and noise abatement technologies during unloading and vaporization.

What are the different types of LNG regasification technologies, and what are their pros and cons?

Common technologies include Open Rack Vaporizers (ORVs), submerged combustion vaporizers (SCVs), and ambient air vaporizers (AAVs). ORVs are efficient but require significant seawater intake. SCVs are compact but have higher energy consumption and potential for NOx emissions. AAVs are environmentally friendly but have lower throughput and are temperature-dependent.

How does the regasification process impact the energy efficiency and operational costs of an LNG import terminal?

Energy efficiency is crucial, as the regasification process itself consumes energy. Choosing the right vaporization technology and optimizing heat exchange can significantly reduce operational costs. Factors like ambient temperature, seawater temperature, and the specific LNG composition also play a role.

What are the key safety considerations and risk management protocols in an LNG regasification facility?

Safety is paramount due to the cryogenic nature of LNG and its flammability. Protocols include robust containment systems, emergency shutdown procedures, fire suppression systems, vapor dispersion modeling, and strict operational guidelines to prevent leaks and manage potential hazards.

How is the regasified natural gas quality controlled and monitored to meet pipeline specifications?

Quality control involves monitoring the temperature, pressure, and composition of the regasified gas. Odorants are added to meet safety standards for distribution. Advanced analytical instruments are used to ensure the gas meets the required specifications for pipeline injection, including heating value and impurity levels.

What are the economic drivers and future trends influencing the demand for LNG regasification infrastructure?

Economic drivers include energy security, diversification of energy sources, and the price competitiveness of natural gas. Future trends point towards increased demand in regions with growing energy needs, the development of floating storage and regasification units (FSRUs) for flexibility, and innovations in more efficient and environmentally friendly regasification technologies.

Additional Resources

Here are 9 book titles related to LNG regasification processes, presented as a numbered list with short descriptions:

1. LNG Regasification Technologies: Design and Operations

This book offers a comprehensive overview of the various technologies employed in LNG regasification. It delves into the engineering principles behind different terminal designs, focusing on the thermodynamic processes, equipment selection, and operational considerations crucial for efficient and safe regasification. Readers can expect detailed explanations of key components like vaporizers and storage tanks.

2. Terminal Operations and Safety: A Guide to LNG Regasification Facilities

Focusing on the practical aspects of managing and operating an LNG regasification terminal, this title addresses the critical safety protocols and best practices. It covers site selection, construction challenges, commissioning, and ongoing maintenance. The book emphasizes risk assessment

and mitigation strategies essential for preventing accidents and ensuring environmental compliance within these complex industrial sites.

3. Thermodynamics and Heat Transfer in LNG Regasification

This text provides an in-depth exploration of the fundamental thermodynamic and heat transfer principles that underpin LNG regasification. It dissects the energy exchanges involved in transforming cryogenic LNG into usable gas, with detailed analysis of heat exchanger performance and efficiency. The book is ideal for engineers and researchers seeking a rigorous understanding of the core scientific mechanisms.

4. LNG Terminal Design: From Concept to Commissioning

This book serves as a practical guide for the entire lifecycle of an LNG regasification terminal. It walks through the stages of conceptualization, feasibility studies, detailed engineering design, procurement, construction, and final commissioning. The focus is on the interdisciplinary nature of terminal development, bringing together civil, mechanical, electrical, and process engineering expertise.

5. Process Control and Optimization in LNG Regasification

This title delves into the sophisticated process control systems and optimization strategies used in modern LNG regasification terminals. It discusses the implementation of advanced control loops, real-time monitoring, and data analytics to ensure optimal performance, energy efficiency, and product quality. The book is valuable for professionals aiming to enhance the operational effectiveness of regasification plants.

6. Environmental Impacts and Mitigation in LNG Regasification

This book examines the environmental considerations associated with LNG regasification activities. It covers potential impacts on air and water quality, noise pollution, and the associated regulatory frameworks. The text also explores innovative technologies and operational practices aimed at minimizing the environmental footprint of LNG terminals.

7. Material Science and Engineering for Cryogenic Applications in LNG

This specialized title focuses on the materials used in the demanding cryogenic environment of LNG regasification. It discusses the properties and selection criteria for materials exposed to extremely low temperatures, high pressures, and corrosive substances. The book is essential for engineers involved in the design, fabrication, and maintenance of cryogenic equipment within LNG facilities.

8. Economic Feasibility and Project Management of LNG Regasification Terminals

This book addresses the financial and managerial aspects of developing and operating LNG regasification terminals. It explores market analysis, investment appraisal techniques, and strategies for managing large-scale infrastructure projects. The title provides insights into the economic drivers and challenges inherent in the LNG regasification business.

9. Emerging Trends and Future of LNG Regasification Technologies

This forward-looking book explores the latest advancements and future directions in LNG regasification. It covers innovations in vaporizer technologies, modular and floating regasification units (FRUs), and integration with renewable energy sources. The text discusses how these developments are shaping the industry and addressing evolving global energy demands.

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LNG Regasification: A Comprehensive Guide to the Process

This ebook provides a detailed exploration of the LNG regasification process, covering its crucial role in global energy security, environmental considerations, technological advancements, and future trends. Understanding LNG regasification is vital for policymakers, energy professionals, and anyone interested in the future of natural gas.

Ebook Title: "LNG Regasification: From Liquefaction to Delivery – A Practical Guide"

Contents:

Introduction: Overview of LNG and the regasification process, its importance in the global energy market.

Chapter 1: The LNG Value Chain: A step-by-step breakdown of the entire LNG supply chain, from production to end-user consumption, highlighting the regasification stage.

Chapter 2: Regasification Technologies: Detailed explanation of various regasification technologies (open-rack, submerged combustion, and others), their advantages, disadvantages, and suitability for different applications. Comparison of different technologies based on efficiency, cost, and environmental impact. Case studies of specific projects using different technologies.

Chapter 3: Safety and Environmental Considerations: Focus on safety protocols and environmental regulations surrounding LNG regasification, including emission control measures and risk mitigation strategies. Discussion of the environmental impact of LNG regasification compared to other energy sources. Analysis of best practices in safety and environmental management within regasification plants.

Chapter 4: Economic Aspects of Regasification: Analysis of the economic viability of regasification projects, including capital costs, operational expenses, and revenue streams. Discussion of market factors influencing regasification project profitability. Examination of government policies and regulations affecting the economics of regasification.

Chapter 5: Future Trends and Innovations: Exploring emerging technologies and future trends in LNG regasification, such as the integration of renewable energy sources and advancements in efficiency and automation. Discussion of future market projections for LNG regasification, considering factors like the growing demand for natural gas and the push for cleaner energy solutions.

Conclusion: Summary of key findings and future outlook for LNG regasification.

Detailed Explanation of Contents:

Introduction: This section sets the stage by defining LNG and its significance in the global energy mix. It introduces the concept of regasification and its importance within the overall LNG value chain.

Chapter 1: The LNG Value Chain: This chapter provides a holistic view, placing regasification in context with upstream liquefaction, transportation, and downstream distribution. This helps readers understand the bigger picture and the role of regasification within it.

Chapter 2: Regasification Technologies: This is a core chapter, providing in-depth analysis of different regasification methods. It compares and contrasts these methods based on various parameters, making it easy for readers to understand the choices available and their implications. Real-world examples further solidify this understanding.

Chapter 3: Safety and Environmental Considerations: This chapter addresses critical concerns, focusing on the safety protocols, environmental impact, and mitigation strategies employed in modern regasification plants. This section promotes responsible and sustainable practices.

Chapter 4: Economic Aspects of Regasification: This section delves into the financial aspects, covering capital investment, operational costs, and market dynamics influencing profitability. This chapter provides crucial information for project developers and investors.

Chapter 5: Future Trends and Innovations: This forward-looking chapter examines potential technological advancements and future scenarios for the industry, providing insights into the evolving landscape of LNG regasification. Future market projections are also discussed.

Conclusion: This section summarizes the key takeaways from the ebook, reinforcing the importance of LNG regasification and offering a final perspective on its future role in the global energy landscape.

Keywords: LNG regasification, LNG regasification process, regasification technologies, open-rack regasification, submerged combustion vaporization, SCV, LNG terminals, natural gas, energy infrastructure, energy security, environmental impact of LNG, LNG safety, economic analysis of LNG regasification, future of LNG, LNG market trends.

Recent Research and Practical Tips

Recent research highlights the increasing importance of LNG regasification in meeting growing global energy demands while also focusing on minimizing environmental impact. Studies are exploring the optimization of regasification technologies to improve efficiency and reduce emissions. Practical tips include optimizing vaporization rates to minimize energy consumption, implementing advanced monitoring systems for safety and efficiency, and adhering to strict environmental regulations to minimize the environmental footprint. The integration of renewable energy sources into regasification facilities is also gaining traction as a practical and sustainable solution. Furthermore, advancements in automation and data analytics are improving operational efficiency and safety in LNG regasification plants.

FAQs

1. What is LNG regasification? LNG regasification is the process of converting liquefied natural gas (LNG) back into its gaseous state for use in power generation, industrial processes, and residential heating.
2. What are the main regasification technologies? The primary technologies include open-rack vaporizers, submerged combustion vaporizers (SCV), and direct vaporization. Each has its advantages and disadvantages depending on factors like scale, location, and cost.
3. What are the environmental concerns related to LNG regasification? While LNG itself is a relatively cleaner fuel, regasification processes can emit greenhouse gases. Mitigation strategies include optimizing vaporization efficiency and adopting emission control technologies.
4. What are the safety considerations in LNG regasification? LNG is cryogenic and flammable, demanding stringent safety protocols to prevent accidents. This includes specialized equipment, rigorous training, and emergency response plans.
5. What is the economic viability of LNG regasification projects? The economic feasibility depends on various factors including natural gas prices, capital costs, operating expenses, and regulatory frameworks. Detailed economic assessments are crucial before embarking on such projects.
6. What are the future trends in LNG regasification? Future trends include increased automation, the integration of renewable energy sources, and the development of more efficient and environmentally friendly technologies.
7. How does LNG regasification contribute to energy security? By providing a reliable and flexible source of natural gas, LNG regasification enhances energy security for nations, reducing dependence on single pipeline sources.
8. What are the major players in the LNG regasification industry? Major players include energy companies, engineering firms, and terminal operators involved in the design, construction, and operation of regasification facilities worldwide.

9. Where can I find more information on LNG regasification projects? Industry journals, government reports, and company websites provide detailed information on specific LNG regasification projects and their associated data.

Related Articles:

1. The Future of LNG Transportation: Discusses advancements in LNG carrier technology and their impact on the global LNG trade.
2. Economic Analysis of LNG Imports: Examines the economic benefits and challenges associated with importing LNG.
3. Environmental Regulations for LNG Terminals: Details the environmental regulations and permits required for LNG terminal construction and operation.
4. Safety Protocols in LNG Handling and Storage: Focuses on safety standards and best practices for handling and storing LNG.
5. Comparison of Different LNG Vaporization Technologies: Provides a detailed comparison of various vaporization technologies, including their efficiency, cost, and environmental impact.
6. Case Studies of Successful LNG Regasification Projects: Presents case studies of successful LNG regasification projects, highlighting their key features and challenges.
7. The Role of LNG in the Energy Transition: Explores the role of LNG as a transitional fuel in the shift towards a cleaner energy future.
8. Geopolitical Implications of the Global LNG Market: Discusses the geopolitical implications of LNG trade and its impact on international relations.
9. LNG Regasification and its Impact on Local Communities: Examines the socio-economic impact of LNG regasification projects on local communities.

lng regasification process pdf: Handbook of Liquefied Natural Gas Saeid Mokhatab, John Y. Mak, Jaleel V. Valappil, David Wood, 2013-10-15 Liquefied natural gas (LNG) is a commercially attractive phase of the commodity that facilitates the efficient handling and transportation of natural gas around the world. The LNG industry, using technologies proven over decades of development, continues to expand its markets, diversify its supply chains and increase its share of the global natural gas trade. The Handbook of Liquefied Natural Gas is a timely book as the industry is currently developing new large sources of supply and the technologies have evolved in recent years to enable offshore infrastructure to develop and handle resources in more remote and harsher environments. It is the only book of its kind, covering the many aspects of the LNG supply chain from liquefaction to regasification by addressing the LNG industries' fundamentals and markets, as well as detailed engineering and design principles. A unique, well-documented, and forward-thinking work, this reference book provides an ideal platform for scientists, engineers, and other

professionals involved in the LNG industry to gain a better understanding of the key basic and advanced topics relevant to LNG projects in operation and/or in planning and development. - Highlights the developments in the natural gas liquefaction industries and the challenges in meeting environmental regulations - Provides guidelines in utilizing the full potential of LNG assets - Offers advices on LNG plant design and operation based on proven practices and design experience - Emphasizes technology selection and innovation with focus on a fit-for-purpose design - Updates code and regulation, safety, and security requirements for LNG applications

Ing regasification process pdf: LNG Receiving and Regasification Terminals Ram R. Tarakad, 2003

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Ing regasification process pdf: Progress in Exergy, Energy, and the Environment Ibrahim Dincer, Adnan Midilli, Haydar Kucuk, 2014-06-17 This thorough and highly relevant volume examines exergy, energy and the environment in the context of energy systems and applications and as a potential tool for design, analysis, optimization. It further considers their role in minimizing and/or eliminating environmental impacts and providing for sustainable development. In this regard, several key topics ranging from the basics of the thermodynamic concepts to advanced exergy analysis techniques in a wide range of applications are covered.

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Ing regasification process pdf: Advances in Natural Gas Technology Hamid Al-Megren, 2012-04-11 Natural gas is a vital component of the world's supply of energy and an important source of many bulk chemicals and speciality chemicals. It is one of the cleanest, safest, and most useful of all energy sources, and helps to meet the world's rising demand for cleaner energy into the future. However, exploring, producing and bringing gas to the user or converting gas into desired chemicals is a systematical engineering project, and every step requires thorough understanding of gas and the surrounding environment. Any advances in the process link could make a step change in gas industry. There have been increasing efforts in gas industry in recent years. With state-of-the-art contributions by leading experts in the field, this book addressed the technology advances in natural gas industry.

Ing regasification process pdf: Oil and Gas Production Handbook: An Introduction to Oil and Gas Production Havard Devold, 2013

Ing regasification process pdf: The Outlook for Floating Storage and Regasification Units (FSRUs) Brian Songhurst, 2017

Ing regasification process pdf: Sustainable Development Of Energy, Water And Environment Systems - Proceedings Of The 3rd Dubrovnik Conference Zeljko Bogdan, Naim Afgan, Neven Duic, Zvonimir Guzovic, 2007-06-12 Sustainability is a new, important discourse aimed at promoting a new strategy in the development of energy, water and environmental (EWE) systems — the key components that affect the quality of life on our planet. It is becoming increasingly clear that the quest for sustainable development requires integrating economic, social, cultural, political and ecological factors. The behavior and properties of an EWE system arise not merely from the properties of its component elements, but also to a large degree also from the nature and intensity of their dynamic interlinkages. This volume helps clarify the complexity of these problems by providing a deeper understanding of the implications of the different aspects of sustainability. This work contains a collection of selected, peer-reviewed and state-of-the-art reflecting papers that were presented at the Third Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems that was held in June 5-10, 2005 in Dubrovnik, Croatia.

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Lees, M. L. Ang, 1990

lng regasification process pdf: LNG Risk Based Safety John L. Woodward, Robin Pitbaldo, 2010-03-25 The expert, all-inclusive guide on LNG risk based safety Liquefied Natural Gas (LNG) is the condensed form of natural gas achieved by cryogenic chilling. This process reduces gas to a liquid 600 times smaller in volume than it is in its original state, making it suitable for economical global transportation. LNG has been traded internationally and used with a good safety record since the 1960s. However, with some accidents occurring with the storage and liquefaction of LNG, a good understanding of its mechanisms, and its potential ramifications to facilities and to the nearby public, is becoming critically important. With an unbiased eye, this book leans on the expertise of its authors and LNG professionals worldwide to examine these serious safety issues, while addressing many false assumptions surrounding this volatile energy source. LNG Risk Based Safety: Summarizes the findings of the Governmental Accountability Office's (GAO) survey of nineteen LNG experts from across North America and Europe Reviews the history of LNG technology developments Systematically reviews the various consequences from LNG releases— discharge, evaporation, dispersion, fire, and other impacts, and identifies best current approaches to model possible consequence zones Includes discussion of case studies and LNG-related accidents over the past fifty years Covering every aspect of this controversial topic, LNG Risk Based Safety informs the reader with firm conclusions based on highly credible investigation, and offers practical recommendations that researchers and developers can apply to reduce hazards and extend LNG technology.

lng regasification process pdf: Low-temperature Technologies Tatiana Morosuk, Muhammad Sultan, 2020-06-10 Low-temperature technologies include the area of refrigeration and cryogenics. Since the beginning of theoretical developments and practical application, these technologies become a part of our life. Low temperatures have found application in almost all branches of industries as well as in households. These systems can be of very small capacity (few watts) up to hundreds of megawatts. In order to develop any of the technologies for successful practical application, very intensive theoretical and experimental research should be conducted. This book provides the reader with a comprehensive overview of the latest developments, perspectives, and feasibility of new low-temperature technologies and improvements of existing systems, equipment, and evaluation methods.

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lng regasification process pdf: Stratification, Rollover and Handling of LNG, LPG and Other Cryogenic Liquid Mixtures Ralph G. Scurlock, 2015-11-20 This short, practical book offers advice on the safe storage, handling and transportation of liquid natural gas (LNG), liquid petroleum gas (LPG) and other cryogenic fluid mixtures. It begins with a review of the physical properties of LNG and LPG, and a brief overview of basic handling and storage methods. The chapters that follow address more in-depth topics such as heat flows in LNG and LPG storage systems, insulation techniques and

surface evaporation phenomena. Two chapters are then devoted to the specific sequence of problems caused by stratification and rollover, and the techniques used to manage and alleviate these issues. The book then considers the use of vacuum insulated tanks for the storage of pressurised LNG, and the effective transfer of liquids avoiding 2-phase flow. It concludes with a summary of safe storage and handling protocols, and addresses the specific health issues encountered when dealing with cryogenic liquid mixtures. Throughout the book the author presents real-life case studies to illustrate the situation being discussed. Written in a practical style, it will prove an invaluable companion to anyone working with LNG, LPG or other cryogenic liquid mixtures.

lng regasification process pdf: Distillation Design and Control Using Aspen Simulation

William L. Luyben, 2006-04-20 A timely treatment of distillation combining steady-state design and dynamic controllability As the world continues to seek new sources of energy, the distillation process remains one of the most important separation methods in the chemical, petroleum, and energy industries. And as new renewable sources of energy and chemical feedstocks become more universally utilized, the issues of distillation design and control will remain vital to a future sustainable lifestyle. Distillation Design and Control Using Aspen Simulation introduces the current status and future implications of this vital technology from the dual perspectives of steady-state design and dynamics. Where traditional design texts have focused mainly on the steady-state economic aspects of distillation design, William Luyben also addresses such issues as dynamic performance in the face of disturbances. Utilizing the commercial simulators Aspen Plus and Aspen Dynamics, the text guides future and practicing chemical engineers first in the development of optimal steady-state designs of distillation systems, and then in the development of effective control structures. Unique features of the text include: * In-depth coverage of the dynamics of column design to help develop effective control structures for distillation columns * Development of rigorous simulations of single distillation columns and sequences of columns * Coverage of design and control of petroleum fractionators Encompassing nearly four decades of research and practical developments in this dynamic field, the text represents an important reference for both students and experienced engineers faced with distillation problems.

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Olegas Prentkovskis, Irina Yatskiv (Jackiva), Paulius Skačkauskas, Raimundas Junevičius, Pavlo Maruschak, 2022-01-24 This book reports on innovative research and developments in the broad field of transportation. It covers solutions relating to intelligent vehicles and infrastructure, energy and combustion management, vehicle dynamics and control, as well as research on human factors, logistics and security. Contributions are based on peer-reviewed papers presented at the 12th international scientific conference Transbaltica: Transportation Science and Technology, held virtually from Vilnius Gediminas Technical University, Lithuania, on September 16-17, 2021. All in all, this book offers extensive information on modern transport systems, with a good balance of theory and practice.

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through district heating networks, given prior energy valorisation, there would be a noticeable decrease in the amount of fossil fuels imported for heating. As a consequence, benefits would be experienced in the form of an increase in energy efficiency, an improvement in energy security, and a minimisation of emitted greenhouse gases. Given that heat demand is not expected to decrease significantly in the medium term, district heating networks show the greatest potential for the development of cogeneration. Due to their cost competitiveness, flexibility in terms of the ability to use renewable energy resources (such as geothermal or solar thermal) and fossil fuels (more specifically the residual heat from combustion), and the fact that, in some cases, losses to a country/region's energy balance can be easily integrated into district heating networks (which would not be the case in a "fully electric" future), district heating (and cooling) networks and cogeneration could become a key element for a future with greater energy security, while being more sustainable, if appropriate measures were implemented. This book therefore seeks to propose an energy strategy for a number of cities/regions/countries by proposing appropriate measures supported by detailed case studies.

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book reveals how to exploit pay-off profiles and trading strategies on a diversified set of commodity prices. In addition, the book explores how to price energy products and other commodities belonging to markets segmented across specific structural features. The Handbook of Multi-Commodity Markets and Products includes a wealth of proven methods and useful models that can be selected and developed in order to make appropriate estimations of the future evolution of prices and appropriate valuations of products. The authors additionally explore market risk issues and what measures of risk should be adopted for the purpose of accurately assessing exposure from multi-commodity portfolios. This vital resource offers the models, tools, strategies and general information commodity brokers and other professionals need to succeed in today's highly competitive marketplace.

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Cai, 2024-01-29 Sustainable Liquefied Natural Gas, the latest release in The Fundamentals and Sustainable Advances in Natural Gas Science and Engineering series, delivers many of the technical fundamentals needed in the natural gas industry with an additional sustainability lens. Introductory topics include liquefaction and separation technology. Advanced applications include improving operational efficiency for carriers and cargo shipping schedules, exploiting cold energy for regasification operations, and an outlook on ways to further reduce emissions. Supported by corporate and academic contributors along with two well-distinguished editors, Sustainable Liquefied Natural Gas provides today's natural gas engineers the knowledge to adjust liquefied natural gas operations in a more environmentally sustainable way. - Provides case studies and visuals to illustrate how new principles can be applied in practical situations - Presents innovative advances that are leading to improved environmental performance - Bridges theory and applications with methods and examples from worldwide contributors in academia and industry

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controlling, managing, and optimizing a host of chemical and related industries using the systems approach, the boundaries of PSE research have expanded considerably over the years. While early PSE research was largely concerned with individual units and plants, the current research spans wide ranges of scales in size (molecules to processing units to plants to global multinational enterprises to global supply chain networks; biological cells to ecological webs) and time (instantaneous molecular interactions to months of plant operation to years of strategic planning). The changes and challenges brought about by increasing globalization and the the common global issues of energy, sustainability, and environment provide the motivation for the theme of PSE2012: Process Systems Engineering and Decision Support for the Flat World. Each theme includes an invited chapter based on the plenary presentation by an eminent academic or industrial researcher Reports on the state-of-the-art advances in the various fields of process systems engineering Addresses common global problems and the research being done to solve them

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