Gas Turbine Performance Upgrade Options Fern Engineering

This book presents tools for valuing and controlling corporate innovation. It combines a well-established theoretical framework with case studies at Siemens that illustrate the practice of valuing and controlling innovation and underline the strong link between theoretical concepts and practical application. Innovation is a key factor determining the success of companies and since corporate innovation consumes large quantities of resources, the issue of how best to distribute these resources among different projects is crucial. For an optimal resource allocation, companies need valuation tools to assess the benefits, costs and risks of competing projects. The energy sector is an example of a market that is strongly driven by innovation, and as such the book describes the processes and the potential of digitalizing product development and outlines the valuation process for a long-term innovation project in this sector – the development of the latest Siemens gas turbine.

Many of the economic road blocks which have previously served to discourage the implementation of alternative power generation technologies can now be

readily overcome through effective energy resource optimization. It is now a fact that solid financial returns can be achieved from combined heating, cooling and power generation projects by integrating energy and cost efficiency goals, and seeking a match between power production and heating/cooling requirements. This book is intended to serve as a road map to those seeking to realize optimum economic returns on such projects. The first section provides an introduction to basic heat and power thermodynamics, with an overview of heat and power generation technologies and equipment. The second section explores the infrastructure in which the project must be implemented, including environmental considerations, as well as utility rate structures. The third section provides detailed coverage of a broad range of technology types, and discusses how opportunities for their application can be identified and successfully exploited. The final section takes you through each step of project development, implementation and operation. Numerous examples are provided of actual field applications, with supporting documentation of system layouts and performance. The text is supplemented with more than one thousand graphics, including photos, cutaway drawings, layout schematics, performance curves, and data tables.

This study identifies vital gas turbine (GT) parameters and quantifies their

influence in meeting the DOE Turbine Program overall Integrated Gasification Combined Cycle (IGCC) plant goals of 50% net HHV efficiency, $1000/kW capital cost, and low emissions. The project analytically evaluates GE advanced F class air cooled technology level gas turbine conceptual cycle designs and determines their influence on IGCC plant level performance including impact of Carbon capture. This report summarizes the work accomplished in each of the following six Tasks. Task 1.0--Overall IGCC Plant Level Requirements Identification: Plant level requirements were identified, and compared with DOE's IGCC Goal of achieving 50% Net HHV Efficiency and $1000/KW by the Year 2008, through use of a Six Sigma Quality Functional Deployment (QFD) Tool. This analysis resulted in 7 GT System Level Parameters as the most significant. Task 2.0--Requirements Prioritization/Flow-Down to GT Subsystem Level: GT requirements were identified, analyzed and prioritized relative to achieving plant level goals, and compared with the flow down of power island goals through use of a Six Sigma QFD Tool. This analysis resulted in 11 GT Cycle Design Parameters being selected as the most significant. Task 3.0--IGCC Conceptual System Analysis: A Baseline IGCC Plant configuration was chosen, and an IGCC simulation analysis model was constructed, validated against published performance data and then optimized by including air extraction heat recovery

and GE steam turbine model. Baseline IGCC based on GE 207FA+e gas turbine combined cycle has net HHV efficiency of 40.5% and net output nominally of 526 Megawatts at NOx emission level of 15 ppmvd@15% corrected O2. 18 advanced F technology GT cycle design options were developed to provide performance targets with increased output and/or efficiency with low NOx emissions. Task 4.0--Gas Turbine Cycle Options vs. Requirements Evaluation: Influence coefficients on 4 key IGCC plant level parameters (IGCC Net Efficiency, IGCC Net Output, GT Output, NOx Emissions) of 11 GT identified cycle parameters were determined. Results indicate that IGCC net efficiency HHV gains up to 2.8 pts (40.5% to 43.3%) and IGCC net output gains up to 35% are possible due to improvements in GT technology alone with single digit NOx emission levels. Task 5.0--Recommendations for GT Technical Improvements: A trade off analysis was conducted utilizing the performance results of 18 gas turbine (GT) conceptual designs, and three most promising GT candidates are recommended. A roadmap for turbine technology development is proposed for future coal based IGCC power plants. Task 6.0--Determine Carbon Capture Impact on IGCC Plant Level Performance: A gas turbine performance model for high Hydrogen fuel gas turbine was created and integrated to an IGCC system performance model, which also included newly created models for moisturized syngas, gas shift and

CO2 removal subsystems. This performance model was analyzed for two gas turbine technology based subsystems each with two Carbon removal design options of 85% and 88% respectively. The results show larger IGCC performance penalty for gas turbine designs with higher firing temperature and higher Carbon removal.

Gas Turbine Combined Cycle Power Plants

Modern Gas Turbine Systems

Scientific and Technical Aerospace Reports

Configuration and Performance of Fuel Cell-combined Cycle Options

Power Generation Options

Strategies, Tools, and Best Practice From the Energy and Technology Sector

The January, 1988 draft topical report, entitled "An Assessment of Off-Design Particle Control Performance on Direct Coal-Fired Gas Turbine Systems" [Ref. 1.1], identified the need to assess potential trade-offs in turbine aerodynamic and thermodynamic design which may offer improvements in the performance, operational and maintenance characteristics of open-cycle, direct coal-fired, combustion gas turbines. In this second of a series of three topical reports, an assessment of the technical options posed by the above trade-offs is presented. The assessment is based on the current status of gas turbine technology. Several industry and university experts were contacted to contribute to the study. Literature

sources and theoretical considerations are used only to provide additional background and insight to the technology involved.

The natural gas, indirect-fired, carbonate fuel-cell-bottomed, combined cycle (NG-IFCFC) and the topping natural-gas/solid-oxide fuel-cell combined cycle (NG-SOFCCC) are introduced as novel power-plant systems for the distributed power and on-site markets in the 20-200 mega-watt (MW) size range. The novel NG-IFCFC power-plant system configures the ambient pressure molten-carbonate fuel cell (MCFC) with a gas turbine, air compressor, combustor, and ceramic heat exchanger: The topping solid-oxide fuel-cell (SOFC) combined cycle is not new. The purpose of combining a gas turbine with a fuel cell was to inject pressurized air into a high-pressure fuel cell and to reduce the size, and thereby, to reduce the cost of the fuel cell. Today, the SOFC remains pressurized, but excess chemical energy is combusted and the thermal energy is utilized by the Carnot cycle heat engine to complete the system. ASPEN performance results indicate efficiencies and heat rates for the NG-IFCFC or NG-SOFCCC are better than conventional fuel cell or gas turbine steam-bottomed cycles, but with smaller and less expensive components. Fuel cell and gas turbine systems should not be viewed as competitors, but as an opportunity to expand to markets where neither gas turbines nor fuel cells alone would be commercially viable. Non-attainment areas are the most likely markets.

This handbook surveys the range of methods and fuel types used in generating energy for industry, transportation, and heating and cooling of buildings. Solar, wind, biomass, nuclear, geothermal, ocean and fossil fuels are discussed and compared, and

the thermodynamics of energy conversion is explained. Appendices are provided with fully updated data. Thoroughly revised, this second edition surveys the latest advances in energy conversion from a wide variety of currently available energy sources. It describes energy sources such as fossil fuels, biomass (including refuse-derived biomass fuels), nuclear, solar radiation, wind, geothermal, and ocean, then provides the terminology and units used for each energy resource and their equivalence. It includes an overview of the steam power cycles, gas turbines, internal combustion engines, hydraulic turbines, Stirling engines, advanced fossil fuel power systems, and combined-cycle power plants. It outlines the development, current use, and future of nuclear power.

Industrial Gas Turbines

Fundamentals of Rotating Equipment

Gas Turbine Powerhouse

Gas Turbine Engineering Handbook

Performance and Operability

Industrial Gas Turbines: Performance and Operability explains important aspects of gas turbine performance such as performance deterioration, service life and engine emissions. Traditionally, gas turbine performance has been taught from a design perspective with insufficient attention paid to the operational issues of a specific site. Operators are not always sufficiently familiar with engine

performance issues to resolve operational problems and optimise performance. Industrial Gas Turbines: Performance and Operability discusses the key factors determining the performance of compressors, turbines, combustion and engine controls. An accompanying engine simulator CD illustrates gas turbine performance from the perspective of the operator, building on the concepts discussed in the text. The simulator is effectively a virtual engine and can be subjected to operating conditions that would be dangerous and damaging to an engine in real-life conditions. It also deals with issues of engine deterioration, emissions and turbine life. The combined use of text and simulators is designed to allow the reader to better understand and optimise gas turbine operation. Discusses the key factors in determining the perfomance of compressors, turbines, combustion and engine controls Explains important aspects of gas and turbine perfomance such as service life and engine emissions Accompanied by CD illustrating gas turbine performance, building on the concepts discussed in the text

The Gas Turbine Engineering Handbook has been the standard for engineers involved in the design, selection, and operation of gas turbines. This revision includes new case histories, the latest techniques, and new designs to comply with recently passed legislation. By keeping the book up to date with new, emerging topics,

Boyce ensures that this book will remain the standard and most widely used book in this field. The new Third Edition of the Gas Turbine Engineering Hand Book updates the book to cover the new generation of Advanced gas Turbines. It examines the benefit and some of the major problems that have been encountered by these new turbines. The book keeps abreast of the environmental changes and the industries answer to these new regulations. A new chapter on case histories has been added to enable the engineer in the field to keep abreast of problems that are being encountered and the solutions that have resulted in solving them. Comprehensive treatment of Gas Turbines from Design to Operation and Maintenance. In depth treatment of Compressors with emphasis on surge, rotating stall, and choke; Combustors with emphasis on Dry Low NOx Combustors; and Turbines with emphasis on Metallurgy and new cooling schemes. An excellent introductory book for the student and field engineers A special maintenance section dealing with the advanced gas turbines, and special diagnostic charts have been provided that will enable the reader to troubleshoot problems he encounters in the field The third edition consists of many Case Histories of Gas Turbine problems. This should enable the field engineer to avoid some of these same generic problems

'Fundamentals of Rotating Equipment' is an overview of the main types of rotating machinery in industry, and covers such aspects as system

dynamics, surge control, vibration and balancing, radial bearing design, performance parameters, rotor system design and operation, rotor axial (thrust) forces, performance objectives and mechanical restraints, auxiliary systems and seals. This book will enhance rotating equipment reliability and safety throughout the many industries where such equipment is vital to a successful business. Over recent years there have been substantial changes in those industries which are concerned with the design, purchase and use of special purpose (ie critical, high-revenue) rotating equipment. Key personnel have been the victims of early retirement or have moved to other industries: contractors and end-users have reduced their technical staff and consequently have to learn complex material 'from scratch'. As a result, many companies are finding that they are devoting unnecessary man hours to the discovery and explanation of basic principles, and having to explain these to clients who should already be aware of them. In addition, the lack of understanding by contractors and users of equipment characteristics and operating systems often results in a 'wrong fit' and a costly reliability problem. The stakes can be high, and it against this background that this book has been published. It is the outcome of many years experience and is based on well-honed teaching material which is easily readable, understandable and actually enjoyable! This is a five

*volume set. The volumes are: 1. Fundamentals of Rotating Equipment 2. Pumps 3. Compressors 4. Auxiliary Systems 5. Reliability Optimization thru Component Condition Monitoring and Root Cause Analysis * A distillation of many years of on-site training by a well-known US Engineer who also operates in the Middle East. * A Practical book written in a succinct style and well illustrated throughout. * An overview of the main types of rotating machinery in industry.*

Final Report

Modern Power Systems

Rehabilitation for Life Extension and Cogeneration

A Development Perspective For Biomass-Fuelled Electricity Generation Technologies

Utilization of Waste Heat in Trucks for Increased Fuel Economy

Report to Congress

A significant addition to the literature on gas turbine technology, the second edition of Gas Turbine Performance is a lengthy text covering product advances and technological developments. Including extensive figures, charts, tables and formulae, this book will interest everyone concerned with gas turbine technology, whether they are designers, marketing staff or users.

This book covers the design, analysis, and optimization of the cleanest, most efficient fossil fuel-fired electric power generation technology at present and in the foreseeable future. The book contains a wealth of first principles-based calculation

methods comprising key formulae, charts, rules of thumb, and other tools developed by the author over the course of 25+ years spent in the power generation industry. It is focused exclusively on actual power plant systems and actual field and/or rating data providing a comprehensive picture of the gas turbine combined cycle technology from performance and cost perspectives. Material presented in this book is applicable for research and development studies in academia and government/industry laboratories, as well as practical, day-to-day problems encountered in the industry (including OEMs, consulting engineers and plant operators).

Natural gas being the cleanest fossil fuel today is receiving tremendous rise in demand for both industrial and domestic energy requirements. The availability of natural gas requires it to be transported from the production area through pipeline in most cases to the consumers; this requires compressor station mostly driven by gas turbine. The development of gas pipeline system requires important data such as appropriate pipe sizes, gas rate, required delivery pressure, appropriate compressor and gas turbine sizes. The investment for the pipeline and compressor station is capital intensive and therefore the techno-economic and environmental risk assessment tool to rapidly assess the pipeline becomes imperative. The objective of this project is to look at advanced pipelines and the close coupling of the compression system with advanced prime mover cycles. The investigation offers a comparative assessment of traditional and novel prime mover options including the design and off-design performance of gas turbine engine and the

economic analysis of the system. The originality of the work lies in the technical and economic optimization of gas turbines and fluid movers, based on current and novel cycles for a novel pipeline application in a wide range of climatic conditions. The techno-economic and environmental risk assessment (TERA) tool created is made up of a number of modules, starting with the pipeline and compressor station modules which compute the necessary flow parameters and compressor performance, as well as the required compressor power. The next is the gas turbine performance simulation module, TURBOMATCH software was used to simulate the performance of the selected gas turbine engines at design and off-design conditions and it computes the thermodynamic conditions in the core of the engine. Receiving information from the performance simulation module, the emission module, which is based on combustion equations, estimates the amount of emission over the period of operation of the gas turbine. The economic module, which is essential to the tool, receives information from all the other modules to establish the life cycle cost and use the net present value (NPV) methodology to assess the plant. It also calculates all associated costs, as well as the cost of transporting natural gas. The economic module establishes the economic pipe size for any particular throughput. The electric motor drive module is the parallel arm of the methodology, handling all the modules as explained earlier except the gas turbine performance and emission modules. This allows a comparative assessment of gas turbine and electric motor drives to be carried out under any prevailing conditions. This methodology is unique to natural gas pipeline techno-economic

assessment and no previous studies have looked at various aspects of the pipeline project before selecting a prime mover or an economic pipe size. This study further uses a genetic algorithm optimization tool to optimize gas turbine selection and compressor station location along the pipeline, based on total cost objective function. The optimization is limited to a particular pipe size and gas throughput. The use of various pipe sizes as well as varying throughput will be a major area for further studies. The results from the individual models are presented in chapters 3, 4 and 5. The result of the integrated modules under case study one and two shows that the transportation of 0.5 million cubic meter per day of natural gas over long distance interstate pipeline for both prime movers is uneconomical. The economic pipe size for 3.0 million cubic meter per day of natural gas is 609.6 mm (24") pipe size for the two prime movers with transportation cost of $0.063/m3 and $0.056/m3 for gas turbine and electric motors respectively. This is equivalent to $1.46/GJ and $1.30/GJ which agrees with the cost of natural gas transportation in literature. The result of the optimization shows a clear preference for the selection of a 34 MW plant for the pipeline and throughput considered since this presents the minimum cost which is the definition of the genetic algorithm optimizer. It is worth noting that this techno-economic tool, which is made of many modules, can be used to rapidly assess the profitability or otherwise of a natural gas pipeline project.

Technologies & Applications : an Integrated Approach to Energy Resource Optimization

Power
Gas Turbine Handbook
ASME Technical Papers
2018 CFR Annual Digital e-Book Edition, 40 Protection of Environment - Parts 50 to 51
Equipment and Devices for Power Plant

This book provides a simple detail of the most important known electrical generation systems and a greater detail of the devices of the auxiliary system, and it is an integral part of a comprehensive system that the new electrical engineer needs to get acquainted with in order to facilitate the box to deal with it in the projects to which he belongs. We hope that this book is a useful book and a reference for the most important devices and equipment and their secrets to achieve the goal, which is to bring new engineers to experience and knowledge in easy and uncomplicated ways. New and renewable energy systems will play an important role in the sustainable development of a future energy strategy. Recent development in this field has proved that the virtual

energy system including new and renewable energy sources is feasible. The promotion of renewable sources of energy is a high priority, for security and diversification of energy supply, environmental protection, and social and economic cohesion.This volume discusses the latest research on new and renewable energy resources and their utilization, emphasizing the present state of the art in the field and potential future development.

Energy appears to be a fundamental driving force of economic and political strategies as well as planetary stability. Energy-related issues such as (1) the availability of new energy sources and viable technologies, (2) the disparity in access to energy sources, (3) the role of energy in our societies (energy societal metabolism), (4) the energy support to the life of our cities (where about half of world population is going to live very soon), and (5) the energy demand for food security all over the world, are “hot” problems that humans will have to face within the framework of sustainability (ecologically sound production and

consumption patterns associated with socially acce- able life styles), in terms of policies, technological development and economic processes. A coherent energy strategy is required, addressing both energy supply and demand, security of access, development problems, equity, market dynamics, by also taking into account the whole energy lifecycle including fuel production, transmission and distribution, energy conversion, and the impact on energy equipment manufacturers and the end-users of energy systems. Issues of energy efficiency and rebound effect must also be taken into proper account. In the short term, the aim should be to achieve higher energy efficiencies and increased supply from local energy sources, in particular renewable energy sources.

Power Systems

Nuclear Energy for Hydrogen Generation through Intermediate Heat Exchangers

2004 New and Renewable Energy Technologies for Sustainable Development, Evora, Portugal, 28 June-1 July 2004

Progress in Gas Turbine Performance
Combined Heating, Cooling & Power Handbook
Techno-economic Study of Gas Turbine in Pipeline Applications

This book describes recent technological developments in next generation nuclear reactors that have created renewed interest in nuclear process heat for industrial applications. The author's discussion mirrors the industry's emerging focus on combined cycle Next Generation Nuclear Plants' (NGNP) seemingly natural fit in producing electricity and process heat for hydrogen production. To utilize this process heat, engineers must uncover a thermal device that can transfer the thermal energy from the NGNP to the hydrogen plant in the most performance efficient and cost effective way possible. This book is written around that vital quest, and the author describes the usefulness of the Intermediate Heat Exchanger (IHX) as a possible solution. The option to transfer heat and thermal energy via a single-phase forced convection loop where fluid is mechanically pumped between the heat exchangers at the nuclear and hydrogen plants is presented, and challenges associated with this tactic are discussed. As a second option, heat pipes and thermosyphons, with their ability to transport very large quantities of heat over relatively long distance with small temperature losses, are also examined.
Modern gas turbine power plants represent one of the most efficient and economic conventional power generation technologies suitable for large-scale and smaller scale

applications. Alongside this, gas turbine systems operate with low emissions and are more flexible in their operational characteristics than other large-scale generation units such as steam cycle plants. Gas turbines are unrivalled in their superior power density (power-to-weight) and are thus the prime choice for industrial applications where size and weight matter the most. Developments in the field look to improve on this performance, aiming at higher efficiency generation, lower emission systems and more fuel-flexible operation to utilise lower-grade gases, liquid fuels, and gasified solid fuels/biomass. Modern gas turbine systems provides a comprehensive review of gas turbine science and engineering. The first part of the book provides an overview of gas turbine types, applications and cycles. Part two moves on to explore major components of modern gas turbine systems including compressors, combustors and turbogenerators. Finally, the operation and maintenance of modern gas turbine systems is discussed in part three. The section includes chapters on performance issues and modelling, the maintenance and repair of components and fuel flexibility. Modern gas turbine systems is a technical resource for power plant operators, industrial engineers working with gas turbine power plants and researchers, scientists and students interested in the field. Provides a comprehensive review of gas turbine systems and fundamentals of a cycle Examines the major components of modern systems, including compressors, combustors and turbines Discusses the operation and maintenance of component parts

Carbon Capture Technologies for Gas-Turbine-Based Power Plants explores current

progress in one of the most capable technologies for carbon capture in gas-turbine-based power plants. It identifies the primary benefits and shortcomings of oxy-fuel combustion CO2 capture technology compared to other capture technologies such as pre-combustion and post-combustion capture. This book examines over 20 different oxy-combustion turbine (oxyturbine) power cycles by providing their main operational parameters, thermodynamics and process modelling, energy and exergy analysis and performance evaluation. The conventional natural gas combined cycle (NGCC) power plant with post-combustion capture used as the base-case scenario. The design procedure and operational characteristics of a radial NOx-less oxy-fuel gas turbine combustor are presented with CFD simulation and performance analysis of the heat exchanger network and turbomachinery. Overview of oxygen production and air separation units (ASU) and CO2 compression and purification units (CPU) are also presented and discussed. The most advanced stages of development for the leading oxyturbine power cycles are assessed using techno-economic analysis, sensitivity, risk assessments and levelized cost of energy (LCOE) and analysing technology readiness level (TRL) and development stages. The book concludes with a road map for the development of future gas turbine-based power plants with full carbon capture capabilities using the experiences of the recently demonstrated cycles. Analyzes more than 20 models of oxyturbine power cycles, identifying the main parameters regarding their operation, process and performance simulations and energy and exergy analysis Provides techno-economic analysis, TRL,

sensitivity and risk analysis, LCOE and stages of development for oxy-combustion turbine power plants Presents the design procedure and CFD simulation of a radial NOx-less oxy-fuel gas turbine combustor exploring its influence on heat exchanger network and turbomachinery Supports practitioners, policymakers and energy industry managers seeking pathways to convert coal-fired power plants to gas-fired plants with zero CO2 emission

Kaiparowits Power Project

A Review of Potential Turbine Technology Options for Improving the Off-design Performance of Direct Coal-fired Gas Turbines in Base Load Service. Second Topical Report

Energy Conversion

Gas Turbines for Electric Power Generation

A Renewable Source of Energy

Carbon Capture Technologies for Gas-Turbine-Based Power Plants

Title 40 Protection of Environment - Parts 50 to 51

Gas Turbines for Electric Power GenerationCambridge University Press

There has been a remarkable difference in the research and development regarding gas turbine technology for transportation and power generation. The former remains

substantially florid and unaltered with respect to the past as the superiority of air-breathing engines compared to other technologies is by far immense. On the other hand, the world of gas turbines (GTs) for power generation is indeed characterized by completely different scenarios in so far as new challenges are coming up in the latest energy trends, where both a reduction in the use of carbon-based fuels and the raising up of renewables are becoming more and more important factors. While being considered a key technology for base-load operations for many years, modern stationary gas turbines are in fact facing the challenge to balance electricity from variable renewables with that from flexible conventional power plants. The book intends in fact to provide an updated picture as well as a perspective view of some of the abovementioned issues that characterize GT technology in the two different applications: aircraft propulsion and stationary power generation. Therefore, the target audience for it involves design, analyst, materials and maintenance engineers. Also manufacturers, researchers

and scientists will benefit from the timely and accurate information provided in this volume. The book is organized into three main sections including 10 chapters overall: (i) Gas Turbine and Component Performance, (ii) Gas Turbine Combustion and (iii) Fault Detection in Systems and Materials.

Valuing Corporate Innovation

Principles and Practices

Principles and Practice

Environmental Impact Statement

The Gas Turbine Handbook

Energy Options Impact on Regional Security

The January, 1988 draft topical report, entitled An Assessment of Off-Design Particle Control Performance on Direct Coal-Fired Gas Turbine Systems'' (Ref. 1.1), identified the need to assess potential trade-offs in turbine aerodynamic and thermodynamic design which may offer improvements in the performance, operational and maintenance characteristics of open-cycle, direct coal-fired, combustion gas turbines. In this second of a series of three topical reports, an assessment of the technical options posed by the above trade-offs is

presented. The assessment is based on the current status of gas turbine technology. Several industry and university experts were contacted to contribute to the study. Literature sources and theoretical considerations are used only to provide additional background and insight to the technology involved.

This comprehensive, best-selling reference provides the fundamental information you'll need to understand both the operation and proper application of all types of gas turbines. The full spectrum of hardware, as well as typical application scenarios are fully explored, along with operating parameters, controls, inlet treatments, inspection, troubleshooting, and more. The second edition adds a new chapter on gas turbine noise control, as well as an expanded section on use of inlet cooling for power augmentation and NOx control. The author has provided many helpful tips that will enable diagnosis of problems in their early stages and analysis of failures to prevent their recurrence. Also treated are the effects of the external environment on gas turbine operation and life, as well as the impact of the gas turbine on its surrounding environment.

This book tells the story of the power generation gas turbine from the perspective of one of the leading companies in the field over a period of nearly 100 years, written by an engineer. Especially in times of imminent global economic crises it appears to be worthwhile to reflect

on real economic values based on engineering ingenuity and enduring management of technological leadership. Though the book is primarily designed as a technical history of the BBC/ABB/Alstom power generation gas turbines, its scope is sufficiently broad to cover general development trends, including parallel competitor activities. A special benefit is the historical breakdown to the gas turbine component level, so that the book actually outlines the development of axial compressors from early beginnings, the progress in combustion technology towards extraordinary low emission values and that of axial turbines with special emphasis on early turbine cooling innovations. The sheer length of certain engineering developments over several decades allows interesting historic observations and deductions on inherent business mechanisms, the effects of technology preparations and organisational consequences. A look into the mirror of the past provides revelations on the impact of far-reaching business decisions. 2017 Winner of the Historian Engineer Award of the ASME (American Society of Mechanical Engineers

A Review of Potential Turbine Technology Options for Improving the Off-design Performance of Direct Coal-fired Gas Turbines in Base Load Service

2018 CFR Annual Print Title 40 Protection of Environment - Parts 50 to 51

Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-fifth Congress, Second Session
The Development of the Power Generation Gas Turbine at BBC – ABB – Alstom
Resource Contingency Program, Chelalis, Hermiston, and Satsop Power Projects, Lewis County, Grays Harbor County [WA], Washington County, Umatilla County [OR]
Policy Options for Stabilizing Global Climate

Everything you wanted to know about industrial gas turbines for electric power generation in one source with hard-to-find, hands-on technical information.

Gas Turbine Performance

Systems Study for Improving Gas Turbine Performance for Coal/IGCC Application

1. Forsthoffer's Rotating Equipment Handbooks

High Efficiency, Low Emission, Fuel Flexible Power Generation

Department of the Interior and Related Agencies Appropriations for 1979

Energy Research Abstracts