Plans To Build A Stirling Engine

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Design News 2003

Design and Development of Stirling Engines for Stationary Power Generation Applications in the 500 to 3000 Horsepower Range. Volume 1. Technical Report 1980 This project was Phase I of a multiphased program for the design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Phase I comprised the conceptual design and associated cost estimates of a stationary Stirling engine capable of being fueled by a variety of heat sources, with emphasis on coal firing, followed by the preparation of a plan for implementing the design, fabrication and testing of a demonstration engine by 1985. The development and evaluation of conceptual designs have been separated into two broad categories: the A designs which represent the present state-of-the-art and which are demonstrable by 1985 with minimum technical risk; and the B designs which involve advanced technology and therefore would require significant research and development prior to demonstration and commercialization, but which may ultimately offer advantages in terms of lower cost, better performance, or higher reliability. The majority of the effort in Phase I was devoted to the A designs.

Miniature Internal Combustion Engines Malcolm Stride 2007 Model engineers have been making models of internal combustion engines since the invention of the real thing, but it has always been surrounded by a mystique, and a perceived difficulty that has put many people off.

Design and Fabrication of a Meso-scale Stirling Engine and Combustor Thomas N. Raber 2005 Power sources capable of supplying tens of watts are needed for a wide variety of applications including portable electronics, sensors, micro aerial vehicles, and mini-robotics systems. The utility of these devices is often limited by the energy and power density capabilities of batteries. A small combustion engine using liquid hydrocarbon fuel could potentially increase both power and energy density by an order of magnitude or more. This report describes initial development work on a meso-scale external combustion engine based on the Stirling cycle. Although other engine designs perform better at macro-scales, we believe the Stirling engine cycle is better suited to small-scale applications. The ideal Stirling cycle requires efficient heat transfer. Consequently, unlike other thermodynamic cycles, the high heat transfer rates that are inherent with miniature devices are an advantage for the Stirling cycle. Furthermore, since the Stirling engine uses external combustion, the combustor and engine can be scaled and optimized semi-independently. Continuous combustion minimizes issues with flame initiation and propagation. It also allows consideration of a variety of techniques to promote combustion that would be difficult in a miniature internal combustion engine. The project included design and fabrication of both the engine and the combustor. Two engine designs were developed. The first used a cylindrical piston design fabricated with conventional machining processes. The second design, based on the Wankel rotor geometry, was fabricated by through-mold electroforming of nickel in SU8 and LIGA micromolds. These technologies provided the requisite precision and tight tolerances needed for efficient micro-engine operation. Electroformed nickel is ideal for micro-engine applications because of its high strength and ductility. A rotary geometry was chosen because its planar geometry was more compatible with the fabrication process. SU8 lithography provided rapid prototypes to verify the design. A final high precision engine was created via LIGA. The micro-combustor was based on an excess enthalpy concept. Development of a micro-combustor included both modeling and experiments. We developed a suite of simulation tools both in support of the design of the prototype combustors, and to investigate more fundamental aspects of combustion at small scales. Issues of heat management and integration with the micro-scale Stirling engine were pursued using CFD simulations. We found that by choice of the operating conditions and channel dimensions energy conversion occurs by catalysis-dominated or catalysis-then-homogeneous phase combustion. The purpose of the experimental effort in micro-combustion was to study the feasibility and explore the design parameters of excess enthalpy combustors. The efforts were guided by the necessity for a practical device that could be implemented in a miniature power generator, or as a stand-alone device used for heat generation. Several devices were fabricated and successfully tested using methane as the fuel.

Stirling-Steele Engine Ronald J. Steele 1994

Decision-Making in Engineering Design Yotaro Hatamura 2006-06-01 This book is a sequel to The Practice of Machine Design, and The Practice of Machine Design, Book 3 – Learning from Failure. It deals with what happens inside the human mind during such activities as design and production, and how we reach decisions. Unlike other regular machine design textbooks or handbooks that describe how to accomplish good designs, the present volume explains what the designer thinks when making design decisions. A design starts with a vague concept and gradually takes shapes as it proceeds, and during this process the mind extracts elements and makes selections and decisions, the results expressed in sketches, drawings, or sentences. This book aims at exposing the reader to the processes of element extraction, selection, and decision-making through real-life examples. Such a book has never been published before. An explicit description of the processes of making decisions, on the contrary, has been greatly needed by designers, and the managers of design groups have been much aware of such a lack. The non-existence of this type of book in the past is due to the following three reasons: the benefit of describing the mind process of design was never made clear, the method of such clarification was unknown, and no one ever invested the vast energy for producing such a manifestation. Under these circumstances, we the members of the “Practice of Machine Design Research Group” boldly tackled the problem of expressing the decision processes in design and have documented our findings in this book.

Automotive Stirling Engine Development Project William D. Ernst 1997 The objectives of the Automotive Stifling Engine (ASE) Development project were to transfer European Stirling engine technology to the United States and develop an ASE that would demonstrate a 30% improvement in combined metro-highway fuel economy over a comparable spark ignition (SI) engine in the same production vehicle. In addition, the ASE should demonstrate the potential for reduced emissions levels while maintaining the performance characteristics of SI engines. Mechanical Technology Incorporated (MTI) developed the ASE in an evolutionary manner, starting with the test and evaluation of an existing stationary Stirling engine and proceeding through two experimental engine designs: the Mod I and the Mod II. Engine technology development resulted in elimination of strategic materials, increased power density, higher temperature and efficiency operation, reduced system complexity, long-life seals, and low-cost manufacturing designs. Mod Ii engine dynamometer tests demonstrated that the engine system configuration had accomplished its performance goals for power (60 kW) and efficiency (38.5%) to within a few percent. Tests with the Mod II installed in a delivery van demonstrated a combined fuel economy improvement consistent with engine performance goals and the potential for low emissions levels. A modified version of the Mod II was identified as a manufacturable ASE design for commercial production. In conjunction with engine technology development, technology transfer proceeded through two ancillary efforts: the Industry Test and Evaluation Program (ITEP) and the NASA Technology Utilization (TU) project. The ITEP served to introduce Stirling technology to industry, and the TU project provided vehicle field demonstrations for thirdparty evaluation in everyday use and accomplished more than 3100 hr and 8,000 miles of field operation. To extend technology transfer beyond the ASE project, a Space Act Agreement between MTI and NASA-Lewis Research Center allowed utilization of project resources for additional development work and emissions testing as part of an industry-funded Stirling Natural Gas Engine program.

Annual Report to Congress on the Automotive Technology Development Program. First 1979

Popular Mechanics 1986-02 Popular Mechanics inspires, instructs and influences readers to help them master the modern world. Whether it’s practical DIY home-improvement tips, gadgets and digital technology, information on the newest cars or the latest breakthroughs in science -- PM is the ultimate guide to our high-tech lifestyle.

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Energy Research Abstracts 1990

The Philips Stirling Engine Clifford M. Hargreaves 1991 This book is about the Stirling engine and its development from the heavy cast-iron machine of the nineteenth century into the efficient high-speed engine of today. It is not a handbook: it does not tell the reader how to build a Stirling engine. It is rather the history of a research effort spanning nearly fifty years, together with an outline of principles, some technical details and descriptions of the more important engines. No one will dispute the position of Philips as the pioneer of the modern Stirling engine. Hence the title of the book, hence also the contents, which are confined largely to the Philips work on the subject. Valuable work has been done elsewhere but this is discussed only marginally in order to keep the book within a reasonable size. The book is addressed to a wide audience on an academic level. The first two chapters can be read by the technically interested layman but after that some engineering background and elementary mathematics are generally necessary.Heat engines are traditionally the engineer's route to thermodynamics: in this context, the Stirling engine, which is the simplest of all heat engines, is more suited as a practical example than either the steam engine or the internal-combustion engine. The book is also addressed to historians of technology, from the viewpoint of the twentieth century revival of the Stirling engine as well as its nineteenth century origins.

Three LTD Stirling Engines You Can Build Without a Machine Shop Jim R. Larsen 2010-06-20 My history with stirling engines. -- A brief history of stirling engines. -- The stirling engine explained. -- What makes a good striling engine? -- Working with aluminum. -- Working with acrylic. -- Thermoforming vinyl. -- Tools needed for these projects. -- Engine #1 - the reciprocating stirling engine. -- Engine #2 - horizontal flywheel magnetic drive stirling engine. -- Engine #3 - vertical flywheel magnetic drive stirling engine. -- Appendices.

Eleven Stirling Engine Projects You Can Build Jim B. Larsen 2012 Presents eleven projects demonstrating how to build simple, fun, and educational Stirling engines from available kits.

Miniature Ringbom Engines James R. Senft 2000

Comparison of Conceptual Designs for 25 Kwe Advanced Stirling Conversion Systems for Dish Electric Application National Aeronautics and Space Administration (NASA) 2018-08-16 The Advanced Stirling Conversion System (ASCS) Project is managed by NASA Lewis Research Center through a cooperative interagency agreement with DOE. Conceptual designs for the ASCS's were completed under parallel contracts in 1987 by Mechanical Technology Inc. (MTI) of Latham, NY, and Stirling Technology Company (STC) of Richland, WA. Each design features a free-piston Stirling engine, a liquid metal heat pipe receiver, and a means to provide about 25 kW of electric power to a utility grid while meeting DOE's long term performance and cost goals. An independent assessment showed that both designs are manufacturable and have the potential to easily meet DOE's long term cost goals. Shaltens, Richard K. and Schreiber, Jeffrey G. Glenn Research Center NASA-TM-102085, E-4806, DOE/NASA/33408-3, NAS 1.15:102085 DE-AT04-85AL-33408; RTOP 776-81-63...

Build a Two Cylinder Stirling Cycle Engine David J. Gingery 2016-10-20 Instructions for building a Two Cylinder Stirling Cycle Engine.

How I Built a 5-Hp Stirling Engine L. Merrick Lockwood 2007 "Everyone needs power. Merrick Lockwood wants to use stirling engines to make that power. This book tells how Mr. Lockwood and his team, spent several years developing a simple, low tech, 5-HP Stirling engine in Dhaka, Bangladesh. It's the story of what worked then and what didn't along with Mr. lockwood's advice on which approaches would work well today. Lockwood's team built a Stirling engine that could burn agricultural garbage (in this case rice husks), however different burners could be designed today to burn previously wasted fuels. Lockwood shows how he used the simple ideas from historic Stirling engines along with his team's innovations to make his engines work. This book is filled with detailed descriptions of Mr. Lookwood's engines along with 34 pages of drawings that have survived. The book includes 184 photographs that show the tools, and methods of fabrication that Lookwood used."--Publisher's description.

An Introduction to Low Temperature Differential Stirling Engines James R. Senft 1996

Popular Science 1976-04 Popular Science gives our readers the information and tools to improve their technology and their world. The core belief that Popular Science and our readers share: The future is going to be better, and science and technology are the driving forces that will help make it better.

First Annual Report to Congress on the Automotive Technology Development Program 1979

Popular Science 1977-04 Popular Science gives our readers the information and tools to improve their technology and their world. The core belief that Popular Science and our readers share: The future is going to be better, and science and technology are the driving forces that will help make it better.

Testing of Stirling Engine Solar Reflux Heat-pipe Receivers 1993 Alkali metal heat-pipe receivers have been identified as a desirable interface to couple a Stirling-cycle engine with a parabolic dish solar concentrator. The reflux receiver provides power nearly isothermally to the engine heater heads while de-coupling the heater head design from the solar absorber surface design. The independent design of the receiver and engine heater head leads to high system efficiency. Heat pipe reflux receivers have been demonstrated at approximately 30 kW{sub t} power throughput by others. This size is suitable fm engine output powers up to 10 kW{sub e}. Several 25-kW{sub e}, Stirling-cycle engines exist, as well as designs for 75-kW{sub t} parabolic dish solar concentrators. The extension of heat pipe technology from 30 kW{sub t} to 75 kW{sub t} is not trivial. Heat pipe designs are pushed to their limits, and it is critical to understand the flux profiles expected from the dish, and the local performance of the wick structure. Sandia has developed instrumentation to monitor and control the operation of heat pipe reflux receivers to test their throughput limits, and analytical models to evaluate receiver designs. In the past 1.5 years, several heat pipe receivers have been tested on Sandia's test bed concentrators (TBC's) and 60-kW{sub t} solar furnace. A screen-wick heat pipe developed by Dynatherm was tested to 27.5 kW{sub t} throughput. A Cummins Power Generation (CPG)/Thermacore 30-kW{sub t} heat pipe was pushed to a throughput of 41 kW{sub t} to verify design models. A Sandia-design screen-wick and artery 75-kW{sub t} heat pipe and a CPG/Thermacore 75-kW{sub t} sintered-wick heat pipe were also limit tested on the TBC. This report reviews the design of these receivers, and compares test results with model predictions.

The Stirling Engine Manual James G. Rizzo 1999

Free-Piston Stirling Engine Conceptual Design and Technologies for Space Power, Phase 1 National Aeronautics and Space Adm Nasa 2018-11-19 As part of the SP-100 program, a phase 1 effort to design a free-piston Stirling engine (FPSE) for a space dynamic power conversion system was completed. SP-100 is a combined DOD/DOE/NASA program to develop nuclear power for space. This work was completed in the initial phases of the SP-100 program prior to the power conversion concept selection for the Ground Engineering System (GES). Stirling engine technology development as a growth option for SP-100 is continuing after this phase 1 effort. Following a review of various engine concepts, a single-cylinder engine with a linear alternator was selected for the remainder of the study. The relationships of specific mass and efficiency versus temperature ratio were determined for a power output of 25 kWe. This parametric study was done for a temperature ratio range of 1.5 to 2.0 and for hot-end temperatures of 875 K and 1075 K. A conceptual design of a 1080 K FPSE with a linear alternator producing 25 kWe output was completed. This was a single-cylinder engine designed for a 62,000 hour life and a temperature ratio of 2.0. The heat transport systems were pumped liquid-metal loops on both the hot and cold ends. These specifications were selected to match the SP-100 power system designs that were being evaluated at that time. The hot end of the engine used both refractory and superalloy materials; the hot-end pressure vessel featured an insulated design that allowed use of the superalloy material. The design was supported by the hardware demonstration of two of the component concepts - the hydrodynamic gas bearing for the displacer and the dynamic balance system. The hydrodynamic gas bearing was demonstrated on a test rig. The dynamic balance system was tested on the 1 kW RE-1000 engine at NASA Lewis. Penswick, L. Barry and Beale, William T. and Wood, J. Gary ENGINE DESIGN; HEAT TRANSFER; PISTON ENGINES; SPACE POWER REACTORS; STIRLING ENGINES; GAS BEARINGS; HEAT RESISTANT ALLOYS; PRESSURE VESSELS; REFRACTORY MATERIALS; T...

Liquid Piston Engines Aman Gupta 2017-07-21 Whether used in irrigation, cooling nuclear reactors, pumping wastewater, or any number of other uses, the liquid piston engine is a much more efficient, effective, and “greener” choice than many other choices available to industry. Especially if being used in conjunction with solar panels, the liquid piston engine can be extremely cost-effective and has very few, if any, downsides or unwanted side effects. As industries all over the world become more environmentally conscious, the liquid piston engine will continue growing in popularity as a better choice, and its low implementation and operational costs will be attractive to end-users in developing countries. This is the only comprehensive, up-to-date text available on liquid piston engines. The first part focuses on the identification, design, construction and testing of the liquid piston engine, a simple, yet elegant, device which has the ability to pump water but which can be manufactured easily without any special tooling or exotic materials and which can be powered from either combustion of organic matter or directly from solar heating. It has been tested, and the authors recommend how it might be improved upon. The underlying theory of the device is also presented and discussed. The second part deals with the performance, troubleshooting, and maintenance of the engine. This volume is the only one of its kind, a groundbreaking examination of a fascinating and environmentally friendly technology which is useful in many industrial applications. It is a must-have for any engineer, manager, or technician working with pumps or engines.

Design and Development of Stirling Engines for Stationary-power-generation Applications in the 500- to 3000-hp Range. Phase I Final Report 1980 The first phase of the design and development of Stirling engines for stationary power generation applications in the 373 kW (500 hp) to 2237 kW (3000 hp) range was completed. The tasks in Phase I include conceptual designs of large Stirling cycle stationary engines and program plan for implementing Phases II through V. Four different heater head designs and five different machine designs were prepared in sufficient detail to select a design recommended for development in the near future. A second order analysis was developed for examining the various loss mechanisms in the Stirling engine and for predicting the thermodynamic performance of these engines. The predicted engine thermal brake efficiency excluding combustion efficiency is approximately 42% which exceeds the design objective of 40%. The combustion system designs were prepared for both a clean fuel combustion system and a two-stage atmospheric fluidized bed combustion system. The calculated combustion efficiency of the former is 90% and of the latter is 80%. Heat transport systems, i.e., a heat exchanger for the clean fuel combustion system and a sodium heat pipe system for coal and other nonclean fuel combustion systems were selected. The cost analysis showed that for clean fuels combustion the proposed 2237 kW (3000 hp) system production cost is $478,242 or $214/kW ($159/hp) which is approximately 1.86 times the cost of a comparable size diesel engine. For solid coal combustion the proposed 2237 kW (3000 hp) system production cost is approximately $2,246,242 which corresponds to a cost to power capacity ratio of $1004/kW ($749/hp). The two-stage atmospheric fluidized bed combustion system represents 81% of the total cost; the engine represents 14% depending on the future price differential between coal and conventional clean fuels, a short payback period of the proposed Stirling cycle engine/FBC system may justify the initial cost. (LCL).

Principles of Solar Engineering D. Yogi Goswami 2022-09-06 Principles of Solar Engineering, Fourth Edition addresses the need for solar resource assessment and highlights improvements and advancements involving photovoltaics and solar thermal technologies, grid power, and energy storage. With updates made to every chapter, this edition discusses new technologies in photovoltaics, such as organic, dye-sensitized, and perovskite solar cells, and the design of solar systems and power plants. It also features battery energy storage for distributed and bulk storage and electrical integration with the main solar systems. In addition, the book includes the latest advancements in concentrating solar power plants, such as supercritical CO2 cycle. Readers will benefit from discussions of the economics of the solar energy systems, which apply to all the systems covered in the subsequent chapters. Nine Appendices are available for download by all readers. Features: Discusses new forecasting models in solar radiation that are important to the economics and bankability of large solar energy systems, such as power plants. Includes expanded coverage of high temperature thermal storage for Concentrating Solar Thermal Power (CSP), including thermal energy transport using heat exchangers. Features a new chapter on solar seawater desalination. Includes new and additional end-of-chapter example problems and exercises. A Solutions Manual will be available for instructors. The book is intended for senior undergraduate and graduate engineering students taking Energy Engineering and Solar Energy courses.

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Design and Development of Stirling Engines for Stationary-power-generation Applications in the 500- to 3000-horsepower Range. Phase I Final Report 1980 A program plan and schedule for the implementation of the proposed conceptual designs through the remaining four phases of the overall large Stirling engine development program was prepared. The objective of Phase II is to prepare more detailed designs of the conceptual designs prepared in Phase I. At the conclusion of Phase II, a state-of-the-art design will be selected from the candidate designs developed in Phase I for development. The objective of Phase III is to prepare manufacturing drawings of the candidate engine design. Also, detailed manufacturing drawings of both 373 kW (500 hp) and 746 kW (1000 hp) power pack skid systems will be completed. The power pack skid systems will include the generator, supporting skid, controls, and other supporting auxiliary subsystems. The Stirling cycle engine system (combustion system, Stirling engine, and heat transport system) will be mounted in the power pack skid system. The objective of Phase IV is to procure parts for prototype engines and two power pack skid systems and to assemble Engines No. 1 and 2. The objective of Phase V is to perform extensive laboratory and demonstration testing of the Stirling engines and power pack skid systems, to determine the system performance and cost and commercialization strategy. Scheduled over a 6 yr period the cost of phases II through V is estimated at $22,063,000. (LCL).

Stirling and Hot Air Engines Roy Darlington 2005 Hot air engines, often called Stirling engines, are among the most interesting and intriguing engines ever to be designed. They run on just about any fuel, from salad oil and hydrogen to solar and geothermal energy. They produce a rotary motion that can be used to power anything, from boats and buggies to fridges and fans. This book demonstrates how to design, build, and optimise Stirling engines. A broad selection of Roy’s engines is described, giving a valuable insight into the many different types and a great deal of information relating to the home manufacture of these engines is included in the workshop section.

Stirling Cycle Engines Allan J. Organ 2013-11-15 Some 200 years after the original invention, internal design of a Stirling engine has come to be considered a specialist task, calling for extensive experience and for access to sophisticated computer modelling. The low parts-count of the type is negated by the complexity of the gas processes by which heat is converted to work. Design is perceived as problematic largely because those interactions are neither intuitively evident, nor capable of being made visible by laboratory experiment. There can be little doubt that the situation stands in the way of wider application of this elegant concept. Stirling Cycle Engines re-visits the design challenge, doing so in three stages. Firstly, unrealistic expectations are dispelled: chasing the Carnot efficiency is a guarantee of disappointment, since the Stirling engine has no such pretentions. Secondly, no matter how complex the gas processes, they embody a degree of intrinsic similarity from engine to engine. Suitably exploited, this means that a single computation serves for an infinite number of design conditions. Thirdly, guidelines resulting from the new approach are condensed to high-resolution design charts – nomograms. Appropriately designed, the Stirling engine promises high thermal efficiency, quiet operation and the ability to operate from a wide range of heat sources. Stirling Cycle Engines offers tools for expediting feasibility studies and for easing the task of designing for a novel application. Key features: Expectations are re-set to realistic goals. The formulation throughout highlights what the thermodynamic processes of different engines have in common rather than what distinguishes them. Design by scaling is extended, corroborated, reduced to the use of charts and fully Illustrated. Results of extensive computer modelling are condensed down to high-resolution Nomograms. Worked examples feature throughout. Prime movers (and coolers) operating on the Stirling cycle are of increasing interest to industry, the military (stealth submarines) and space agencies. Stirling Cycle Engines fills a gap in the technical literature and is a comprehensive manual for researchers and practitioners. In particular, it will support effort world-wide to exploit potential for such applications as small-scale CHP (combined heat and power), solar energy conversion and utilization of low-grade heat.

Stirling Engine Design and Feasibility for Automotive Use M. J. Collie 1979

More Ltd Stirling Engines You Can Build Without a Machine Shop Jim R Larsen 2016-02-26 Here is everything you need to know to build your own low temperature differential (LTD) Stirling engines without a machine shop. These efficient hot air engines will run while sitting on a cup of hot water, and can be fine-tuned to run from the heat of a warm hand. Four engine projects are included. Each project includes a parts list, detailed drawings, and illustrated step-by-step assembly instructions. The parts and materials needed for these projects are easily obtained from local hardware stores and model shops, or ordered online. Jim Larsen's innovative approach to Stirling engine design helps you achieve success while keeping costs low. All of the engines described in this book are based on a conventional pancake style LTD Stirling engine format. These projects introduce the use of Teflon tubing as an alternative to expensive ball bearings. An entire chapter is devoted to the research and testing of various materials for hand crafted bearings. The plans in this book are detailed and complete. This collection of engine designs is a stand-alone companion to Jim Larsen's first book, "Three LTD Stirling Engines You Can Build Without a Machine Shop."

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Handbook of data on selected engine components for solar thermal applications Lewis Research Center 1979

Stirling Engine Design Manual William Martini 2013-01-25 For Stirling engines to enjoy widespread application and acceptance, not only must the fundamental operation of such engines be widely understood, but the requisite analytic tools for the stimulation, design, evaluation and optimization of Stirling engine hardware must be readily available. The purpose of this design manual is to provide an introduction to Stirling cycle heat engines, to organize and identify the available Stirling engine literature, and to identify, organize, evaluate and, in so far as possible, compare non-proprietary Stirling engine design methodologies. This report was originally prepared for the National Aeronautics and Space Administration and the U. S. Department of Energy.

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Commerce Business Daily 1998-03

Design and Development of Stirling Engines for Stationary Power Generation Applications in the 500 to 3000 Horsepower Range. First Quarterly Report 1980 This project is Phase I of a multi-phased program for the design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Phase I comprises the conceptual design and associated cost estimates of a stationary Stirling engine capable of being fueled by a variety of heat sources, with emphasis on coal firing, followed by the preparation of a plan for implementing the design, fabrication and testing of a demonstration engine by 1985. The main effort in Phase I is the generation of state-of-the-art conceptual designs having greatest potential for prototype testing in 1985. The conceptual designs include a heat transport system for integrating the engine heater head with such energy sources as conventional oil/gas combustors, fluidized bed and other coal combustors, and combustors using coal-derived liquid fuels, and low/medium BTU gases. The heat transport systems being investigated include forced convection with gases or liquids, heat pipes, and direct firing. Currently, the leading choice for the solid fuel combustion system is the atmospheric fluidized bed, with low BTU gasification still a viable alternative. Both systems will continue to be evaluated further, but with greater emphasis on FBC. To date, there appears no clear choice among the heat pipe, forced convection gas loop, or direct firing as the prime candidate for the heat transport sub-system. Conceptual design and analysis will continue on all three sub-systems. Scale-up of United Stirling's P-75 engine to serve as the conceptual design of the 500 HP engine module is continuing. (LCL).