Ge ms5002 gas turbine pdf

Let industrial buyers find your company and send you their request for quotations.Get Started The MS5002 was introduced in the 1970s and has been updated and up-rated over the years to meet the industry’s increasing output requirements. The fleet continues to demonstrate ease of operation and very high reliability and availability. It is a two-shaft, heavy-duty gas turbine designed for high operating efficiency over a wide range of speed and load conditions. This turbine is designed for mechanical drive applications such as gas boosting, gas injection/re-injection, pipelines, LNG plants and gas storage. It has a broad operating speed range to meet the requirements of the most common driven equipment (centrifugal compressors and pumps) as well as the ability to burn a large variety of gas and liquid fuels. With simple and robust designs, complete maintenance can be performed on site without the need for specialized tooling or service shop assistance. The high-pressure shaft has a 16-stage (17 for MS5002D), axial-flow compressor and a single-stage, high-energy turbine. First-stage nozzles are air cooled and second-stage nozzles are variable angle type. The low-pressure shaft is a single-stage, high-energy turbine. Twelve combustion chambers are contained within a single wrapper, a wide range of gaseous and liquid fuels can be burned, and a DLN combustion system is also available. A centralized lube oil system supplies clean, cooled, pressurized oil to lubricate the gas turbine and the driven equipment including the oil required for any compressor seals. The information in this webpage is wrong or out-of-date? Please contact info(at)etn-gasturbine.eu , MAIN PROPULSION - TURBINE ENGINE• MAKE GENERAL ELECTRIC $\square$?Steam Turbine• TYPE/NO/YEAR -|200595|1976• PRESS 96 Psig• SHP/RPM 43000|3468• GEARBOXGENERAL ELECTRIC, Type: MDT-130, No:205246, Hp: 43000, Rpm:5960-3468-8300-103STEAM TURBINE GENERATOR• MAKE GENERAL ELECTRIC $\square$?2 Units• TYPE/NO DEV718150460|150462-65• RATING/RPM 2500|10103-1800• PRE/EX PRE/TEMP 865 Psia|2.5 Ga|9500F• GOVERNOR WOODWARD, Pr No: 8902-086, Sr No:1228485-1313586• GEARBOX Unclear tag• ALTERNATORGENERAL ELECTRIC, Type: ATL, No:8400547-725, Kva: 3125, Vol: 450, Amp:4009, Pf: 0.8, Hz: 60, Kw: 2500, Rpm: 1800COP PUS TURBINE• TYPE/NO RL-1211|74T1352• PRESS/RPM/TEMP 50-395 Psig|1750|230F• GOVERNOR WOODWARD, Pr No: A8516-038, Sr No:13358794• HYD PUMP VICKERS, Unclear tagTURBINE GENERATOR• MAKE PETERBROTHERHOOD - 3PETERBROTHERHOOD• TYPE FRAME-12|54020-B-CD FRAME-12|TM54020• KW/RPM 3000-3750|9975-1800 3000-3750|9975-1800• PRESS/YEAR 60 Kg/Cm2|1990 60 Kg/Cm2|1990• GOVERNORWOODWARD, Uncleartag, PROACT DRIVER -IVWOODWARD, Uncleartag, PROACT DRIVER $\square$?IV• ALTERNATORBRUSH - 3 Units,Type: BJHW 11877/4,No:37510A-1G-2G-3G,Kva: 4688, Vol: 4160,Amp: 650.6, Pf: 0.8,Hz: 60, Rpm: 1800,Year: 1989KATO, Type:AA28423000, No:22615, Kva: 4687.5,Vol: 3402-4160, Amp:651, Pf: 0.8, Hz: 60,Kw: 3750, Rpm: 1800STEAM TURBINE GENERATOR024L))WARM MATIC BONO SUDRFWM1500/95|NF-3319|1991 1500000 Kcal/h|5 BarRBL, Type: 2205D, No: 409711, Vol: 440, Kw: 5.5,Hz: 60, Year: 19910153) CARGO TURBINEAEG KANIS3 Units GT-40 BW, S/N : 17732/1972.GT-5456IV|17731|1972 3500|7650-1335* Solar Gas Turbines, Taurus 60, Version 7002, A Caterpillar Company* Solar Gas Turbines, Centaur 40, Version 4702, A Caterpillar Company* Steam Turbine [FRAME-12] Generators [4688kw, 60Hz] PETERBrotherhood Ltd.* GE Steam Turbine Generators Type :DEV718150460, 3125kva, 60Hz* STEAM TURBINE GENERATOR, WARM MATIC BONO SUDRFWM1500/95|NF-3319|1991 1500000 Kcal/h|5 BarRBL, Type: 2205D, No: 409711, Vol: 440, Kw: 5.5,Hz: 60, Year: 1991* COP PUS TURBINE, Type:RL-1211* KONGSBERG Gas Turbine, Model :KG2-3 with Gear* AEG KANIS, GT-40 & GT-54.* YUMPU automatically turns print PDFs into web optimized ePapers that Google loves. Copy Gas Turbines Catalog - GE Energy Extended embed settings Your request has been submitted. Thank you for your interest. A specialist will be in touch with you shortly. MS 5002 GAS TURBINE A through D evolution GE Power Systems Oil & Gas gepower.com FOREWORD The MS5002 is one of the mo Views 342 Downloads 64 File size 1MB Report DMCA / Copyright DOWNLOAD FILE Recommend Stories MS 5002 GAS TURBINE A through D evolution GE Power Systems Oil & Gas gepower.com FOREWORD The MS5002 is one of the most successful gas turbine for mechanical drive applications in the 30 MW class. Since 1970 GE Nuovo Pignone has shipped more than 620 units, and millions of trouble-free operating hours have been logged. In response to market needs the MS5002 has undergone a series of upgrades represented by models B, C and most recently the MS5002D. The D model is rated at 43,000 HP with a heat rate of 8,650 BTU/HP-hr and is the most powerful and efficient configuration in the MS5002 family. The D model is based on GE Nuovo Pignone’s most recent achievements coming from advanced aerodynamic axial compressor design, extensive experience in gas turbines for Oil & Gas applications, and combines the proven design ideas of scaling with the state of the art in materials, cooling/ sealing technology and design techniques. MS5002 EVOLUTION HISTORY General Electric began development of the MS5002 in 1969. The first frame five two-shaft models, the MS5002A and MS5002B, were developed simultaneously to take advantage of the highly successful single-shaft 5001M and N compressor designs. In 1987 the MS5002B rating was increased to 38,000 HP as the MS5002C, through the application of advanced materials technology and design features that were more resistant to high temperature damage and wear. MS5002D: The Ultimate Performance Improvement Step The MS5002D represents the latest joint development by Nuovo Pignone and GE: • The most significant feature of the MS5002D uprate is the replacement of the MS5002 compressor section with a slightly modified 17 stage compressor derived from the MS6001B and new compressor rotor/stator blading and casings. Uprating to a modified MS6001B compressor increases the airflow and results in increased pressure ratio and thus power. • The output is further increased with a new first stage nozzle design with a reduced throat area which fully exploits the higher pressure ratio of the new axial compressor while limiting the maximum firing temperature rise to a level acceptable for reliability of nozzles and buckets. Nozzle replacement is not mandatory for a C to D retrofit but without it the power increase would be reduced by about 0.75%. • Advanced seals for the high pressure packing, No.2 bearing, and Stage 2 shrouds provide an additional performance improvement. The design change to the new MS5002D 17 stage compressor requires replacement of the compressor rotor/stator blading and casings. Table 1: Comparison of MS5002 performance features OPERATOR CONSOLE MS5002A MS5002B MS5002C MS5002D CIMPLICITY Viewer CIMPLICITY Viewer NT NT CIMPLICITY Viewer Engr’g Workstation B/N Mach Mgmnt SW GERS PEMS GEMIS Toolbox NT NT Compressor Stages 15 16 16 17 Pressure Ratio 7.4 8.8 8.8 10.8 921-1690 927-1700 966-1770 986-1807 Firing Temperature (°C - °F) Red Xcvr. Plant D Plant D CIMPLICITY Server CIMPLICITY Server NT Exhaust Temperature (°C - °F) 524-975 491-915 517-963 CIMPLICITY Server NT Red Xcvr. 509-948 Red Xcvr. Unit Da Unit Da Air Flow (Kg/sec) - (Ib/sec) 351-773 438-966 123.4-274.1 141.4-311.7 Red Xcvr. Mark VI Bentley Nevada Output (kW - hp) Heat Rate (kJ/kW-h - Btu/hp-h) Table 1 Control Module 19.575-26.250 26.100-35.000 28.340-38.005 32.580-43.690 I/O Net Mark V 13.837-9.780 12.493-8.830 12.470-8.814 12.239-8.650 Gas Turbine Control Mark VI Remote I/O Mark VI-Integrated Control System Modular Simplified Building Block Architecture Prox Inputs GAS TURBINE EMISSION CONTROL When uprating an existing gas turbine, the impact on emission levels must be considered. Thermal NOx is generated by the fixation of atmospheric nitrogen in the flame and an increase in firing temperature increases this effect. Since uprating from the 5002B to C or D increases the firing temperature NOx control must be considered. Options to reduce thermally generated NOx without steam/water injection (dry emission control) are as follows: LOW NOX LOUVERED COMBUSTION LINERS (APPLICABLE TO MS5002B, C AND D) A “lean head end” (LHE) louvered combustion liner is available for MS5002 units. The louvered slot pattern and dilution hole pattern have been changed to provide more of the dilution air flow at the head end of the liner resulting in a much “leaner” combustion system than the standard louvered liner. This shifting of dilution air flow quenches the products of combustion faster reducing the time available for NOx formation. The result is a reduction in NOx of approximately 30% compared to the standard louvered liner. The LHE liner is the simplest approach to reducing NOx on an MS5002 repowered turbine. DRY LOW NOX COMBUSTION SYSTEM (APPLICABLE TO MS5002C AND D) The Dry Low NOx combustion system reduces NOx emission without steam or water injection on gas fuel units through lean-premixed burning in multi-zone combustion liners, and by new fuel control equipment which directs fuel to different liner zones depending upon the mode of operation. The DLN system is able to reduce the NOx level for an MS5002C or MS5002D as indicated in the table below: DLN - Dry Low NOx combustion system Emission levels @ 15% O2 - ISO conditions - natural gas NOx 42 CO 50 The primary parts that must be replaced for this retrofit are combustion casings, combustion liners, combustion covers and first and second stage fuel nozzles. Modifications to the fuel supply system (added gas splitter valves) and to the control panel are also required. CONTROL SYSTEM UPGRADE When planning the uprate of gas turbine plant equipped with a MARK II control system, it is recommended that the control system be replaced with a MARK V or MARK VI system. The MARK II due to its age is no longer supported and the availability of spare parts and service is no longer guaranteed. In addition, the older technology represented by this model cannot support modern control features such as DCS communication, alarm log and troubleshooting functions, Remote Monitoring & Diagnostics and DLN control. on nt SW Color Laser Remote Communication Laser Printer Plant Data Highway - Ethernet Plant Data Highway - Ethernet Historian NT Red Xcvr. Unit Data Highway - EGD Unit Data Highway - EGD PCL 90-70 ada Control Module Driven Load: - compressor - pump - etc.... I/O Net Field Data Acquisition Remote I/O Advantages offered by the Mark V Control System include: • SIMPLEX or Triple Modular Redundant (TMR) configuration • Proven High Reliability – MTBFO (Mean Time between Forced Outages) in excess of 30,000 hours • Capability of integrated turbine/driven load/auxiliaries controls • Advanced diagnostics and user interface for configuration and troubleshooting • Windows NT-based graphical interface using CIMPLICITY ™ In addition, upgrading to the Mark VI Control System offers the following added value: • Modular and scalable VME architecture allowing further I/O cards expansion beyond turbine & compressor controls (e.g., process valves, BOP, etc.) • Distributed and remote I/O capability reducing wiring and installation costs • peer-to-peer communication between all GENP controls (PLC, HMI, etc...) through an Ethernet® -based LAN. This enables very fast (100 executions/sec) integrated controls and graphics of the whole gas turbine/driven load/auxiliaries controllers arrangement, client/ server capability, redundant servers, additional communication links to external control systems, and, finally, the capability to remotely access and control from outside the DCS plant LAN. ADVANCED TECHNOLOGY (AT) MS5002A/B UPRATE TO MS5002C Thermal Barrier Coated (TBC) Combustion Liners Three major changes differentiate the advanced technology combustion liners of the MS5002C & D from previous designs. These changes are TBC coating, hardfacing on the collars and crossfire tubes, and splash plate cooling around the crossfire tube collar. The TBC consists of a bond coat applied to the surface and an insulating oxide applied over the bond coat. This .015 inch thick coating provides an insulating layer that reduces the underlying base metal temperature and mitigates the effects of hot streaking or uneven gas temperature distributions. Splash plate cooling and hard facing mitigates cracking in critical areas of the liner such as the louvers and dilution/mixing hole region. Transition Piece Hastelloy-X has been retained as it provides excellent tolerance to high temperatures and has good crack resistance. A new floating inner seal design with side seals and increased corner radii on the aft frame improves wear and crack resistance. The new cylinder mount arrangement of the aft bracket reduces cracking in the bodyto-mount region and increases the torsional stability of the transition piece. 2-Vane Stage 1 Nozzle In 1987, the first stage nozzle was improved by reducing the number of vanes per segment from three in the original MS5002A & B designs to two in the Advance Technology design. Two vanes per segment provide increased clearance for thermal growth reducing the occurrence of sidewall cracking by a factor almost 3 to 1. This feature allows the elimination of the Hot Gas Path Inspection (HGPI). A modification of the first stage nozzle for the MS5002D presents a reduced throat area designed to optimize compressor performance (increased pressure ratio) and further raises the firing temperature. Advanced Technology GTD-111 Directionally Solidified Stage One Bucket The directionally solidified (D/S) GTD-111 Stage 1 bucket is the result of a recent GE advancement in materials. The high temperature advantage compared to equiaxed superalloys is the result of the elimination of transverse grain boundaries from the bucket. This allows for a substantial increase in creep life, thermal fatigue and impact strength. In addition these buckets are coated with PLASMAGUARD GT-29 PLUS (or GT-33), a vacuum plasma spray aluminum coating that greatly increases both corrosion and oxidation resistance. MS5002 gas tu 2 Vanes Stage One Nozzle GTD - 111 Stage One Buckets MS5002 2 urbine gas tur 2 rbine Ambient Temperature Effect on OUTPUT MS 5002D MS 5002C MS 5002B 36.876 34.407 32.066 31.938 30.000 28.098 29.885 32.000 29.501 25.956 28.058 27.096 27.096 26.100 22.002 40 59 80 Ambient Temperature (°F) 27.000 24.851 22.028 22.000 23.882 20 37.000 100 20.097 17.000 120 OUTPUT Power (kW) 42.000 AXIAL COMPRESSOR UPGRADES MS5002 UPRATE TO MS5002D All 5002 model compressors can be uprated either to the 16 stage 5002C compressor design or to the larger 17 stages MS5002D design to meet economic and power requirements. For the 5002A model this modification would have to be done in conjunction with a hot-gas-path uprate to an Advanced Technology Configuration to accommodate the increased airflow. The MS5002D compressor is the same as that of the MS6001 with two exceptions: the third stage compressor rotor blades have been modified to increase operational flexibility over the MS6001; and the 16th stage bore extraction has been eliminated since the first stage buckets are not cooled. ADVANCED SEALING SYSTEM (UPRATE OPTION FOR MS5002A/B/C AND D) Advanced sealing techniques were incorporated into the design of the MS5002D and can also be applied to the MS5002A, B and C to achieve three important improvements: better performance; increased efficiency; and a significant decrease in the rate of performance degradation. The result is better overall performance for a longer time. High Pressure Packing Seal The seal between the compressor discharge casing inner barrel and the compressor aft stub shaft is commonly referred to as the High Pressure Packing (HPP). The HPP is designed to regulate, at steady state, a constant flow of compressor discharge air required for first forward wheelspace cooling and for sealing of the No. 2 bearing. Controlling this bypass airflow to the minimum required for cooling and sealing increases the amount of air available to perform work in the cycle. This translates into a 0.5% power increase and a 0.4% heat rate decrease. This uprate consists of replacing the existing labyrinth tooth/land seal arrangement with a more effective flexible brush seal. This provides better performance with a reduced decay rate over an extended period of operation. A brush seal uprate is also available for the No. 2 Bearing. Second Stage Abradable Seals Abradable seals are designed to reduce leakage of hot gases that flow around the tips of the 2nd Stage buckets. Strips of abradable material made of a high-temperature, oxidation resistant alloy are brazed onto the casing shrouds. The bucket tip rails “cut” the abradable material away when contact occurs during transients. The resulting groove produced in this “soft” material guarantees a tight fit of the interfacing surfaces, thus providing greatly improved sealing. Improved 1st Stage Shrouds with Spline Seals The new shroud includes a new spline seal arrangement that is designed to reduce leakage between shroud segments. The interlocking labyrinth (or “pumpkin tooth”) configuration at the intersegment interface has been replaced by a single, large spline seal (known as a “bus bar” seal) to reduce both axial and radial leakage. W-Seal “Bus Bar” Seal Side View Side View Bottom View Current Shroud Bottom View Uprate Shroud Pumpkin Teeth High Pressure Packing Seal Stage 1 Shrouds with Spline Seals UPRATES PACKAGES PARTS SCOPE OF SUPPLY • The Table below lists the components required to uprate MS5002B and C models to an MS5002D advanced technology package and rating. MS5002B to C Uprate MS5002C to D Uprate • • • • • • • • • Crossfire Tube Cap & Liner Arrangement Floating Seal Transition Pieces Turbine Case, Modification Directionally Solidified 1st Stage Buckets 1st Stage Nozzle No. 2 Bearing liner Thrust Bearing, Low Pressure (No. 4 BRG) Extended Exhaust Thermocouples • • • • • • • • • • • • • • Inlet Bell Mounth & No. 1 Bearing Complete Compressor Rotor Assembly MS5002D GTD-450 Inlet Guide Vanes Axial Compressor Forward Casing Compressor Discharge Casing Combustion chamber Wrapper Axial Compressor Stator Blades 1st Stage Nozzle, Optimized Bearing oil piping Antisurge Valves H.P. & L.P. Thrust Bearings No. 2 Bearing Assembly Starting Motor In Addition • Turbine Base Plate • Gas Fuel Piping • Inlet Ducting gas path inspection which increases the availability and reduces maintenance costs. Finally, a massive power output increase can be accomplished by retrofiting to the D configuration which renders an increase in output of more than 13% and a reduction in heat rate of 1%. The MS5002 uprate packages now available provide extraordinary savings and increased production for the installed base as a consequence of greatly increased output, improved efficiency, improved availability from extended maintenance intervals, and elimination of the HGPI. A flexible uprate path is available to match the economic and production requirements of each application. The Table below provides a summary of the benefits, achieved by uprating MS5002 A and B models: MS5002 Uprate Program Benefit Summary Performance Improvements uprating to MS5002D Output Heat Rate (LHV) MS5002A MS5002B MS5002C +64% -12% +23% -2% +13% -1% Maintenance Interval fired hours-natural gas MS5002A MS5002B MS5002C MS5002D Combustion Inspection 8.000 Hot Gas Path Inspection 24.000 Major Inspection 48.000 GE Power Systems Oil & Gas Changes in emission levels associated with a gas turbine uprate may require the addition or modification of emission controls to meet regulatory requirements. A control system upgrade or replacement in conjunction with a turbine uprate should also be considered to achieve the maximum improvement in performance and reliability. Nuovo Pignone is currently manufacturing MS5002C and MS5002D gas turbines and has also successfully uprated 5002B gas turbines to C and D technology and performance levels. In most cases the measured performance exceeded the expected ones. Nuovo Pignone S.p.A. via F. Matteucci, 2 50127 Firenze - Italy Tel. +39/055423211 Fax +39/0554232800 www.gepower.com MARK/COMK 764/II-1/2001 Studio TRE FASI(Fi) BENEFIT SUMMARY & CONCLUSIONS The MS5002D, the latest addition to the world class GE and Nuovo Pignone fleet, was created to serve the new needs of the mechanical drive market. In addition, Model D technology provides a more powerful class of uprate opportunities for the installed base of more than 620 GE MS5002 heavy-duty gas turbines. The Advanced Technology package can be applied to all existing MS5002 A and B units to reach a model C configuration with an increase in power output of approximately 7.0%. These advanced components also allow an increase in the combustion inspection interval by 50%, (up to 12,000 hours) and elimination of the hot 8.000 12.000 12.000 24.000 (eliminated) (eliminated) 48.000 48.000 48.000

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