Solar® Turbines
A Caterpillar Company

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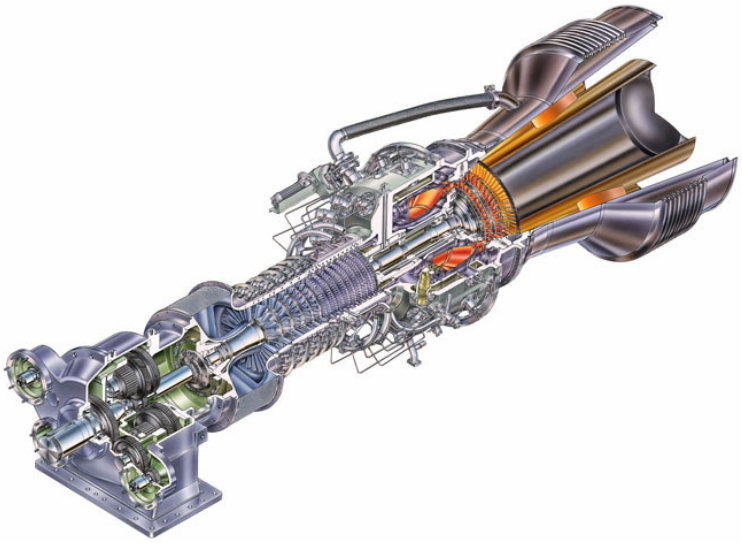
(COG CHP APPLICATION)
（焦炉煤气热电联产的应用）

FOUR TITAN 130 GENERATOR SETS
四台大力神 130 发电机组



Inquiry No. CN11-0004
2011 年 1 月 18 日

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SUMMARY

SCOPE OF SUPPLY

供货范围概要

Titan 130/Power Generation/C
Titan 130/发电/C

TITAN 130 ONSHORE TURBINE GENERATOR SET
大力神 130 陆上燃气轮机发电机组

BASIC PACKAGE (4) 基本的撬装成套设备(4 套)

- *Titan* 130 single-shaft industrial turbine engine
- Radial engine air inlet collector
- Axial exhaust diffuser
- Epicyclic main reduction-drive gearbox
- Generator
- Turbine / generator control system
- Start system
- Fuel system
- Lubricating oil system
- 316L stainless steel piping and manifolds
- Base skid with drip pans
- Onskid electrical wiring
- Onskid digital display

- *Titan* 130 单轴工业燃气轮机发动机
- 径向发动机进气口集箱
- 轴向排气扩压箱
- 行星主减速齿轮箱
- 发电机
- 燃气轮机/发电机控制系统
- 启动系统
- 燃料系统
- 润滑油系统
- 316L 不锈钢管道与母管
- 带接油盘的底座
- 橇装电气布线
- 橇装数字显示器

SPECIAL ENGINE REQUEST FOR COKE OVEN GAS APPLICATION
发动机使用焦炉煤气时的特殊要求

SER 09-0500 is applicable to this project. Many customer features have been added to the packages to enhance engine performance and address safety concerns for coke oven gas application. The customer features include low BUT dual fuel system, additional control features, anti-corrosive turbine hardware, hazardous gas sensors, addition CO2 cylinders, TEWAC generators, and all motor and electronic components meet NACE CII, Div 2, Group B requirements, etc.

SER 09-0500 适用于本项目。 在机组上增加了许多客户特殊要求，以提高发动机的性能和焦炉煤气应用的安全性。 这些客户特殊要求包括低热值燃气双燃料系统、额外的控制特性、防腐燃气轮机硬件、危险

气体传感器、加大二氧化碳钢瓶、 全封闭水冷发电机，所有电动机和电子元件满足 NACE CII, Div 2, B 组的防爆特殊要求。

GAS TURBINE ENGINE(4)
燃气轮机发动机(4 台)

- Turbine model, *Titan* 130
- 燃气轮机型号：*Titan* 130

GEARBOX (4)
减速齿轮箱(4 台)

- Main reduction-drive gearbox, 1500 rpm for 50-Hz generator
- 主减速齿轮箱，输出转速 1500RPM，50Hz 发电机

GENERATOR (4)
发电机 (4 台)

- Custom Generator will be provided. TEWAC generator output is 11,000 volts, 50 Hz, with Class F insulation and Class B temperature rise
- 将提供定制的发电机 ：TEWAC 发电机的输出为 11000V，频率为 50Hz，绝缘等级为 F，温升等级为 B

START SYSTEM (4)
启动系统 (4 套)

- Direct-drive AC motor / variable frequency drive start system
- 直接驱动交流电动机/变频驱动启动系统

FUEL SYSTEM (4)
燃料系统 (4 套)

- Dual Fuel, Coke Oven Gas and Liquid Fuel
- COG coalscing filter **(Customer provides)**
- Offskid liquid fuel boost system and filter **(Customer provides)**
- Block and Bleed Off-Skid Module with Leak Detection
- 双燃料系统，焦炉煤气和液体燃料
- 撬外焦炉煤气精密过滤器（**客户提供**）
- 橇装液体燃料加压系统及过滤器（**客户提供**）
- 橇装燃料隔离和放空模块，带泄露检测装置

LUBE OIL SYSTEM (4)
润滑油系统 (4 套)

- Carbon steel oil tank
- Main lube oil pump
- AC pre/post lube pump
- 120 VDC backup post-lube pump
- Strainers
- Oil filter system with replaceable elements

- Filter transfer valve (carbon steel)
- Indicating and control devices including:
  - Supply pressure
  - Supply temperature
  - Filter differential pressure
  - Drain line temperatures
  - Tank level
  - Pressure regulator
  - Temperature regulator
- Tank vent separator
- Tank vent flame trap
- Stainless steel piping (up to 4" dia.)
- Stainless steel tubing and dual ferrule compression fittings
- 碳钢润滑油箱
- 主润滑泵
- 交流前/后润滑泵
- 120 伏直流备用后润滑泵
- 粗过滤器
- 滑油过滤系统带可更换滤芯
- 过滤器切换阀（碳钢）
- 显示与控制装置包括：
  - 供油压力
  - 供油温度
  - 过滤器差压
  - 排污管道温度
  - 油箱液位
  - 压力调节器
  - 温度调节器
- 油箱排气口油气分离器
- 油箱排气口阻火器
- 不锈钢管道（直径最大到 4 英寸）
- 不锈钢管和双套圈卡式接头

LUBE OIL COOLER （4）, with two (2) extra, loose shipment
润滑油冷却器（4 台）, 增加两台，单供

- Water / Oil Cooler, Simplex (Off-Skid)
- 水/油冷却器，单体（撬外布置）

LUBE OIL TANK HEATER SYSTEM (4)
润滑油箱加热器系统 (4 套)

- Lube oil tank heater, 3-phase AC
- Lube oil type, petroleum base, viscosity grade C32
- 润滑油箱加热器，三相交流电
- 润滑油的类型：石油基、粘度等级 C32

LUBE OIL FILTER
润滑油过滤器

- Lube Oil Filters, Duplex
- 润滑油过滤器，双联

TURBOTRONIC 4 CONTROL SYSTEM (4)
TURBOTRONIC 4 控制系统 (4 套)

- Allen-Bradley ControlLogix control processor
- A-B 1794 Flex I/O modules
- TT4000S onskid display and monitoring system
- Turbine thrust bearing temperature monitoring
- RSLogix 5000 programming software
- ControlNet 1.5 communications
- Combination Generator Control Module with
  - Voltage regulation
  - Automatic synchronization
  - Power metering
  - Load sharing
  - Protective functions
- Package sensors
- Backup shutdown system
- Control power circuit breaker panel
- Carbon steel onskid controls J-boxes and panels

- Allen-Bradley ControlLogix 控制处理器
- A-B 1794 Flex I/O 模块
- TT4000S 橇装显示与监控系统
- 燃气轮机推力轴承温度监测
- RSLogix 5000 编程软件
- ControlNet 1.5 通信
- 组合发电机控制模块，具有下述功能：
  - 电压调整
  - 自动同期
  - 功率计量
  - 负荷分配
  - 保护功能
- 机组传感器
- 后备停车系统
- 控制电路断路器面板
- 碳钢橇装控制箱及控制面板

TURBOTRONIC 4 CONTROL SYSTEM (ONSKID) (4)
TURBOTRONIC 4 控制系统（橇装）(4 套)

- Allen-Bradley ControlLogix control processor
- Allen-Bradley 1794 Flex I/O modules
- TT4000S *onskid* display and monitoring system
- Vibration monitoring
  – X and Y proximity probes at each of the three engine bearings
  – Main reduction drive accelerometer
- Turbine thrust bearing temperature monitoring
- RSLogix 5000 programming software
- ControlNet 1.5 internal system communication network
- Combination Generator Control Module with
  - Voltage regulation

  - Automatic synchronization
  - Power metering
  - Load sharing
  - Protective Functions
- Package sensors
- Backup shutdown system
- Carbon steel controls J-boxes and panels
- Offskid auxiliary control interface, desktop personal computer
  - TT4000 display and monitoring system
- Supervisory communications interface, Ethernet interface
- Control screen engineering units, metric, ℃ and kPa
- Language for control screen displays, English
- Language for screen displays, dual (English and simplified Chinese)
- Engine performance map
- Printer logger, 240 VAC, 1 phase
- Exhaust heat recovery application interface

- Allen-Bradley ControlLogix 控制处理器
- Allen-Bradley 1794 Flex 输入/输出模块
- TT4000S 橇装显示与监控系统
- 振动监测
  – 共有三个发动机轴承，在每一个的 X、Y 方向上安装位移计进行监测
  – 主减速齿轮箱上加速计
- 燃气轮机推力轴承温度监测
- RSLogix 5000 编程软件
- ControlNet 1.5 内部系统通信网络
- 组合发电机控制模块，具有下述功能：
  - 电压调整
  - 自动同期
  - 功率计量
  - 负荷分配
  - 保护功能
- 机组传感器
- 后备停车系统
- 碳钢橇装接线箱及控制面板
- 橇外辅助远程控制接口、台式个人计算机
  - TT4000 显示与监控系统
- 监控通信接口、以太网接口
- 控制屏显示单位，公制单位，℃ 和 kPa
- 控制屏所用语言：英语
- 屏幕显示语言：双语（英语和简体中文）
- 发动机性能图
- 打印机记录器，240 VAC，单相
- 余热回收装置控制接口

GENERATOR CONTROL AND MONITORING (4)
发电机控制与监测 (4 套)

- Kilowatt import control
- Kilowatt control
- 功率输入控制

- 功率控制

ACCESSORY EQUIPMENT
附属设备

- Turbine compressor cleaning system, dual (on-crank and on-line, for each package)
- Purchaser-supplied air supply for self-cleaning filter
- 120 VDC power supply with VRLA batteries, charger and racks(for each package)
- Turbine compressor cleaning system, portable tank(one unit for three packages)
- 燃气轮机压缩机清洗系统，双工（盘车清洗和在线清洗,每台机组配一套）
- 压缩空气气源买方提供
- 120 VDC 电源，带 VRLA 蓄电池、充电器和蓄电池架(每台机组配一套)
- 燃气轮机压缩机清洗系统、可移动式水箱(共用一套)

MISCELLANEOUS
杂项

- Long-term preservation (for each unit)
- English language Operation and Maintenance Instruction manual
- Operation and Maintenance Instruction manual on CD-ROM (4CDs)
- English language package labels (for each package)
- Simplified Chinese language package labels (for each package)

- 适合长期保存的包装 (每台机组配一套)
- 英文版操作与维修说明书(每台机组配一套)
- CD 版的操作与维修说明书(4 片)
- 机组上的英文标签(每台机组配一套)
- 机组上的简体中文标签(每台机组配一套)

TEST, QUALITY ASSURANCE AND CERTIFICATION
试验、质量保证及证书

- Standard Factory Testing per Solar Specifications
- Customer observed factory test, noninterference
- Quality control data on CD-ROM
- Quality Control Documentation, Level 1
- NEC compliant package without certification

- 按照 Solar 公司的规范进行标准在厂内试验
- 客户观测下的在厂内试验，不受干扰
- CD 版的质量控制文件
- 质量控制文件，1 级
- 符合 NEC（美国国家电气规程）的成套机组（不提供证书）

AIR INLET SYSTEM (4)
进气系统 (4 套)

- 3-Stage medium velocity type air filter, 1st stage self cleaning filter
- Turbine air inlet silencer with support brackets, carbon steel
- Air inlet system scope / process: standard system
- 三级中速空气过滤器，第一级才用反吹自清式
- 带承托架的燃气轮机进气消声器，碳钢材质

- 进气系统范围/工艺：标准系统

EXHAUST SYSTEM (4)
排气系统 (4 套)

- Companion Flange, 6 ft Inside Diameter
- Bellows, 6 ft diameter, 24-1/4 in. long
- Exhaust system scope / process: standard system

- 配对法兰，内径 6 英尺
- 膨胀节，直径 6 英尺，长度 24.25 英寸
- 排气系统范围/工艺：标准系统

ENCLOSURE (4)
消防隔音罩 (4 套)

BASIC ENCLOSURE
隔音罩的基本构成

- Complete Enclosure for Skid-mounted Package
- Internal Trolley Beam
- Combustible Gas Monitoring System
- Ventilation System
- Dust Protection, Barrier Type Filters
- Fire Detection and Suppression System
- Dust protection system, barrier-type filters
- Enclosure fire and gas detection system
- CO_2 fire suppression system
- CO_2 fire suppressant cylinder cabinet

- 隔音罩覆盖撬装机组
- 内部滑轮导轨
- 可燃气体监测系统
- 通风系统
- 防尘，挡板式过滤器
- 火灾探测与灭火系统
- 防尘系统，挡板式过滤器
- 机罩的火灾与气体探测系统
- 二氧化碳灭火系统
- 二氧化碳灭火钢瓶柜

EQUIPMENT HANDLING SYSTEM (4)
设备处理系统 (4 套)

Equipment handling system
设备处理系统

- CO2 Isolation Valves, Switches, and Software - Off-skid
- 二氧化碳隔离阀、开关及软件：橇外布置

CUSTOMER SERVICES
售后服务

- Field Verification Testing
- Site Training
- Six (6) months site operation monitoring assistance
- Twelve months remote monitoring(within WARRANTEE period)
- Two ways freight and labour cost in WARRANTEE period
- 现场验证试验
- 现场培训
- 6 个月现场运行监控协助
- 12 个月远程监控(在质量保证期内)
- 质量保证期内双程运费和人工费

SERVICE PARTS
售后服务配件

Start-up/Commissioning Consumable Parts w/Hand Tool kit
启动/调试易损件，手工工具箱

Operation Consumable Parts - 2 Years
两年运行易损件

One set injector
一套喷嘴

OPTIONAL
单列可选项

Recommended Spare Parts List
推荐配件清单

SECTION 1

BASE BID SCOPE OF SUPPLY

第一部分

基本投标供货范围描述

TITAN 130 ONSHORE TURBINE GENERATOR SET
大力神 130 陆上燃气轮机发电机组

BASIC PACKAGE
基本的撬装系统

TITAN 130 TURBINE GENERATOR SET
TITAN 130 燃气轮机发电机组

The *Titan*™ 130 turbine generator set is a completely integrated, fully operational package equipped with all accessories and auxiliary systems necessary for normal operation when connected to suitable facilities.
Titan™ 130 燃气轮机发电机组是全天候运转的高度集成的系统，配备了与之相适应的辅助设备和外部连接装置。

Designed specifically for industrial service applications where an economical solution to basic power needs is required, the generator set is a compact, lightweight unit requiring minimum floor space for installation. Proven packaging features greatly reduce installation costs, time, materials, and labor.
为工业应用而专门设计的 TITAN 130 燃气轮机发电机组具有重量轻，占地面积小的特点。 成熟的撬装设计特点可以大幅度减少用户的安装费用，材料，和人工费用。

The package features a fit-for-purpose, pre-engineered and standardized design that is restricted to onshore applications where functionality and cost effective operation, without customization, is desired.
TITAN 130 燃气轮机发电机组成套设备是专门为陆上发电应用设计的，没有客户化的特征，预制且定型设计的燃气轮机发动机机组在达到运行功能的同时能实现成本效率。

The generator set includes:
发电机组包括如下主要系统：

- *Titan* 130 single-shaft industrial turbine engine
- Radial engine air inlet collector
- Axial exhaust diffuser
- Epicyclic main reduction-drive gearbox
- Generator
- Turbine / generator control system
- Start system
- Fuel system
- Lubricating oil system
- 316L stainless steel piping and manifolds
- Base skid with drip pans
- Onskid electrical wiring
- Onskid digital display

- *Titan* 130 单轴工业燃气轮机发动机
- 径向发动机进气集箱
- 轴向排气集箱
- 行星式主减速齿轮箱
- 发电机
- 燃气轮机/发电机控制系统
- 启动系统
- 燃料系统
- 润滑油系统

- 316L 不锈钢管道和总管
- 带接油盘的底座
- 橇装电气布线
- 橇装数字显示器

The engine, gearbox and generator constitute the major elements of the package. These elements are installed on heavy-steel base frames in an "in-line" arrangement. The base frames are structural steel assemblies with beam sections and cross members welded together to form rigid foundations. Mechanical interface connection points for package utilities are conveniently located on the outer skid edge. Electrical connection points are made in onskid junction boxes and terminal strips.

发动机、变速箱和发电机是成套设备的主要部件。 这些部件直线布置方式安装在重型钢基架上。基架由结构钢装配而成，带横梁和横向构件，它们焊接在一起，形成刚性基础。 出于方便考虑，成套设备的机械接口连接点位于底盘的外缘。 电气连接点设在橇装接线盒和接线条内。

The gearbox is bolted directly to the engine and coupled by means of a splined interconnecting drive shaft, eliminating the need for field alignment. The gearbox and generator are connected by means of a flexible dry-disk, shear-type coupling enclosed in a coupling guard. Jacking points are provided to facilitate alignment of the generator to the gearbox.

变速箱直接用螺栓联结在发动机上，通过一个花键联接传动轴联接，不需要进行场对中。变速箱和发电机通过一个封闭在联轴器罩内的柔性干盘剪切式联轴器进行联接。设置起重吊点，以便于将发电机对准变速箱。

Package piping and manifolds are 316L stainless steel material. This applies to all package piping systems including the start, fuel and lube oil systems, and supply, drain and vent lines up to and including four inches in diameter. In addition, the associated flange assembly hardware is 316 stainless steel or equivalent. Piping sizes six inches in diameter and larger are carbon steel. All tubing connections use dual-ferrule compression fittings (Swagelok brand). All tubing is 316L stainless steel with 316 stainless steel fittings.

撬上的管道及总管的材质为 316L 不锈钢。 这一材质用于所有设备系统的管道上，包括启动系统、燃料系统和润滑油系统、供给管道、排污管道和通风管道，以上原则适用直径不超过 4 英寸的管道。此外，相关的法兰装配材质也为 316L 不锈钢或同等材料。 直径等于或大于 6 英寸的管道为碳钢材质。所有小管件连接采用双套圈卡式接头（Swagelok 品牌）。 所有管件的材质为 316L 不锈钢，接头的材质为 316 不锈钢。

The following items are not stainless steel unless specifically included elsewhere in this proposal:
除非本技术协议书中有特殊规定，下述项目不使用不锈钢：

- Valve bodies or blocks and system functional components
- Pipe support brackets
- Oil tank cover assemblies with connection piping and fittings welded in place
- Sliding lube oil drain couplings and plates
- Pipe flexible couplings
- Filter housings
- Lube oil tank
- Optional lube oil cooler
- Controls J-boxes and panels

- 阀体和系统功能部件
- 管道支架
- 油箱盖和配件
- 滑动润滑油排污管接头及板材
- 管道挠性联接器
- 过滤器外壳

- 润滑油箱
- 可选的润滑油冷却器
- 控制接线箱（J-box）与控制面板

Throughout this proposal, all references to package orientation (left, right, clockwise, counterclockwise, etc.) are based on standing at the "aft" end of the package looking forward. The aft end of the package is always the same end as the turbine engine exhaust.

在本建议书中，提到的所有设备方向（左、右、顺时针、逆时针等）都是站在设备后端向前看。 设备后端始终与燃气轮机发动机排气装置的后端相同。

The onskid electrical equipment is in accordance with NFPA 70 (NEC) requirements for electrical equipment installed in Class I, Group D, Division 2 hazardous locations. All on-skid package wiring is made with cable in cable trays or frame shelfs for physical protection. When supplied, the offskid auxiliary control interface, variable frequency drives, and battery charger are non-explosionproof and must be installed in a nonhazardous location.

橇装电气设备符合 NFPA 70 (NEC)关于安装在一级、D 组和二类危险位置内的电气设备的要求。 所有橇装设备的布线电缆敷设在电缆槽或框架上，以便进行人体防护。 当提供非防爆的非橇装辅助控制接口、变频驱动装置和蓄电池充电器时，它们必须安装在安全位置。

ELECTRICAL SYSTEM TYPE
电气系统的类型

NEC Class I, Group B, Division 2
NEC 一级、B 组、二类

Onskid electrical equipment is in accordance with NFPA 70 (NEC) requirements for electrical equipment installed in Class I, Group B, Division 2 hazardous locations. All onskid package wiring is made with cable in covered stainless steel cable trays for physical protection.

橇装电气设备符合 NFPA 70 (NEC)关于安装在一级、B 组和二类危险位置内的电气设备的要求。 所有橇装设备的布线电缆敷设在遮盖着的不锈钢电缆槽内，以便进行人体防护。

3-PHASE AC POWER RATING
三相交流电额定功率

380 Volt, 50 Hz, 3-Phase AC Power Rating
380 伏、50 赫、三相交流电额定功率

The package 3-phase motors and other 3-phase electrical components are rated for 380-Vac, 50-Hz electric power. The required 3-phase contactors are not provided. Refer to the package electrical utilities list for power requirements.

三相电动机和其它三相电气部件额定电力为 380-Vac、50-Hz。 要求的三相电流接触器不予提供。 功率要求请参考电气设备列表。

220 Volt, 50/60 Hz, Single-Phase AC Battery Charger Power Rating
220 伏、50 赫、单相交流电蓄电池额定功率

The package battery charger is rated for 220-Vac, 50/60-Hz electric power. Refer to the package electrical utilities list for power requirements.

蓄电池充电器的额定电力为 220-Vac、50/60-Hz。 功率要求请参考电气设备列表。

SINGLE-PHASE AC LIGHTING AND SPACE HEATER POWER RATING
单相交流电照明与空间加热器额定功率

220 Volt, 50 Hz, Single-Phase AC Lighting and Space Heater Power Rating

220 伏、50 赫、单相交流电照明与空间加热器额定功率

The package single-phase lighting and heater loads are rated for 220-Vac, 50-Hz electric power. Refer to the package electrical utilities list for power requirements.

单相照明与空间加热器的额定电力为 220-Vac、50-Hz 。 功率要求请参考电气设备列表。

GAS TURBINE ENGINE
燃气燃气轮机发动机

TITAN 130 GAS TURBINE
TITAN 130 燃气燃气轮机

The *Titan* 130 gas turbine engine is a self-contained, completely integrated prime mover of a single-shaft axial-flow design. The main reduction-drive gearbox, including accessory drive pads, is a separate, close-coupled unit located at the inlet end of the turbine.

Titan 130 燃气燃气轮机是整装的完全集成式原动机，为单轴轴流式设计。 主减速传动变速箱（包括附件传动装置安装座）是一个单独的紧凑耦合式装置，安装在燃气轮机的入口端。

The engine assembly consists of:

发动机的装配件包括：

- Main reduction-drive gear with accessory drive pads
- Air inlet collector with flexible flange connection
- Axially split case in the vertical plane, 14-stage axial-flow compressor with variable geometry control on the inlet guide vanes and first five rows of stators
- Annular combustor with 21 fuel injectors
- 3-stage turbine assembly
- Turbine exhaust collector
- 带附件传动装置安装座的主减速传动齿轮
- 带挠性法兰连接的进气口收集器
- 垂直平面内的有轴向接合缝的外壳、14 级轴流压缩机（入口导流叶片和前五排定子上带有可变尺寸控制装置）
- 带有 21 个燃料喷射器的环形燃烧器
- 三级燃气轮机装配件
- 燃气轮机排气集管

The components of the *Titan* 130 engine are maintained in accurate alignment by mating flanges with pilot surfaces and are bolted together to form a rigid assembly. The gear unit with an accessory drive assembly is driven by the compressor rotor shaft. The accessory drive supports and drives the main lube oil pump and other accessories, depending on the application, and supports the starter.

用带导向面的对接法兰将 *Titan* 130 发动机部件精确调整对正，将各个构件用螺栓连接成刚性组合体。带有一个附件传动组件的齿轮传动装置由压缩机转子轴驱动。 根据应用情况，附件传动装置支承和驱动主润滑油泵和其它附件并支承发动机起动机。

The continuous power cycle and rotating motion of the gas turbine provides several advantages over other types of engines, including lightweight, relatively low maintenance, fewer moving parts and wear points, and a higher quality of AC power in generator applications.

燃气燃气轮机的连续动力循环和旋转运动比其它类型的发动机有几个优点，包括重量轻、维修保养相对少、运动件少、磨损点少和发动机用的交流功率质量高。

The turbine produces compressed air from the compressor, combustion within the combustion chamber, and power delivery from the three-stage turbine assembly. The axial-flow aerothermal design contributes to the uni's relatively high efficiency. Additionally, cycle parameters have been selected and the

aerodynamic design of each section has been executed to attain the highest possible performance consistent with reliable service and long life in industrial applications.

燃气燃气轮机的压缩机生产压缩空气，燃气在燃烧室内燃烧，由三级燃气轮机组件输送动力。 轴流式气动热设计使得设备的效率相对较高。 此外，已经选定循环参数并完成了每一部件的气动设计，以便于在工业应用时尽可能维持最高程度的服务性能和使用寿命。

The exceptionally compact *Titan 130* gas turbine has three basic sections: compressor, combustor, and turbine.

特别紧凑的 *Titan 130* 燃气燃气轮机有三个基本部件： 压缩机、燃烧器和燃气轮机。

Air is drawn into the air inlet of the gas turbine and is compressed by the 14-stage axial flow compressor. The compressed air is directed into the combustion chamber in a steady flow. Fuel is injected into the pressurized air within the annular combustion chamber. During the turbine start cycle, this fuel / air mixture is ignited and continuous burning is maintained as long as there is adequate flow of pressurized air and fuel. The hot pressurized gas from the combustion chamber expands through and drives the turbine, dropping in pressure and temperature as it exits the turbine. In this way, the energy of the fuel is transformed into the rotating power of the turbine output shaft.

空气被吸进燃气燃气轮机的进气口，然后被 14 级轴流压缩机压缩。 压缩空气被稳定地导入燃烧室内。 将燃料注入环形燃烧室内的压缩空气内。 在燃气轮机的起始循环期间，这一燃料/空气混合物被点燃，只要有足够的压缩空气和燃料流，就维持混合物继续燃烧。 从燃烧室出来的热的压缩空气扩散经过并驱动燃气轮机，热压缩空气的压力和温度在扩散出燃气轮机的过程中降低。 这样，燃料的能量转变成燃气轮机输出轴的额定功率。

For stoichiometric combustion, the gas turbine requires approximately one fourth of the total air it compresses. The excess air is used to cool the combustion chamber and mixes with the combustion products to reduce the gas temperature at the inlet to the first turbine stage. The cooling air keeps metal temperatures in the combustion chamber and turbine section at design levels consistent with component service life objectives.

对于化学计量燃烧而言，燃气轮机需要的空气约为其压缩的空气总量的四分之一。 过量的空气被用于冷却燃烧室和与燃烧产物混合以便降低第一燃气轮机级入口处的燃气温度。 冷却空气使得燃烧室和燃气轮机部件的金属温度符合构件使用寿命要求的设计温度水平。

The gas turbine output shaft is mechanically attached to both the compressor and turbine sections of the engine to form a "solid" or "single" shaft configuration. This feature enhances speed stability and response under constant and varying load conditions, which is a highly desirable feature in generator applications requiring precise frequency control.

燃气轮机的输出轴以机械方式与压缩机和发动机的燃气轮机部分连接，形成一个“结实的”或“单独的”轴构造。 这一特征提高了恒定负荷和变动负荷情况下的速度稳定性，对于要求精确频率控制的发电机，这一特征非常可取。

GEARBOX
变速箱

1500 rpm Main Reduction Drive for 50-Hz Generator
50Hz 发电机用 1500 rpm 主减速传动

The main reduction-drive gearbox is an epicyclic star-gear industrial design selected specifically for the generator set application. The gearbox is coupled to the turbine through a balanced high-speed shaft, splined at both ends. The epicyclic design facilitates a straight-through shafting arrangement, avoiding offset problems and permitting engine, gear, and generator alignment from a common base. Gear lubrication is provided by the package common lube oil system.

主减速传动变速箱是一个工业设计的周转行星齿轮，专门选择这样的变速箱用于发电机组。 变速箱通过一个平衡式高速轴与燃气轮机连接，在轴的两端用花键联接。 周转行星齿轮设计便于实现直连式轴系布置，避免了偏移问题，可以从同一个基座上对准发动机、齿轮和发动机。 齿轮润滑通过成套设备的公共润滑油系统实现。

The gearbox reduces the output speed of the turbine to the required operating speed of the generator and is designed for continuous-duty operation at an output speed of 1500 rpm for 50-Hz service.

变速箱将燃气轮机的输出速度降至要求的发电机运行速度，变速箱设计成在输出速度 1500rpm、频率 50Hz 工况下连续工作。

The output shaft is coupled to the generator through a flexible disk-type dry coupling enclosed in a coupling guard.

输出轴通过一个封闭在联轴器罩内的柔性盘式干燥联轴器与发电机联接。

Alignment Tool. One (1) set of alignment tooling is provided, per sales order, to align the reduction gearbox output shaft with the generator input shaft.

对中工具： 为每个合同提供一套对中工具，用于校正减速箱输出轴和发电机输入轴。

GENERATOR
发电机

A TEWAC (totally enclosed water to air cooled) generator will be provided**.** The generator is rated at 11kv, 50Hz, 1500rpm.

提供一台全封闭空气/水冷发电机。发电机标定是 11KV，50HZ，1500RPM。

Generator standard features include:

发电机主要特征如下：

- Suitable for installation in hazardous area, ie. Hydrogen
  适合安装在危险区域，例如含氢地域
- Cooling form: IC8 A1W7
  冷却：IC8A1W7
- Protection degree: IP54
  防护等级 IP54
- Temperature monitoring via RTD's
  -6 single element RTD's in stator
  -1 double element RTD per bearing
  用 RTD 监控温度
  定子上安装 6 个单元件传感器
  每个轴承上安装一个双元件传感器
- Black heat anti-condensation heaters in generator and exciter
  在发电机和励磁器上装防凝结加热器
- Main terminal box including:
  Line side:
  -3 Current transformers with 1 core
  Neutral side:
  -3 x Current transformers with 1 core
  -1 x Cross current transformer 1 core
  -3 x Current transformers with 1 core L/S
  主接线箱包括:
  出线端：
  3 个电流互感器, 1core
  中心端
  3 个电流互感器 1 core

1 个横流互感器 1 core
3 个电流互感器带 1core L/S

- Jacking oil system (to reduce required starting torque)
  加力油系统（减少启动时的扭距力）

START SYSTEM
启动系统

The start system provides torque to initiate rotation and assist the engine to self-sustaining speed. At self-sustaining speed, the start system disengages and the engine continues to accelerate under its power to loading speed.

启动系统提供力矩来旋转设备并到达发动机自稳定转速。 发动机到达自稳定转速后，启动系统脱扣，发动机在自身动力推动下，继续加速至满负载速度。

DIRECT-DRIVE AC MOTOR DRIVEN
交流电动机直接驱动式

The direct-drive AC start system consists of two squirrel-cage, 3-phase AC induction motors with a common solid-state variable frequency drive (VFD). The start motors are specifically designed to provide high breakaway starting torque and acceleration from stand-still to starter drop-out speed. The motors are of explosionproof / flameproof construction and standard motor frame size and include integral over-temperature protection thermostats. Each motor includes a space heater suitable for 115 / 230-volt, single-phase power connection. Separate cable entries are provided for power connections, thermal protection wiring, and the space heater wiring. Starting power is transferred to the engine via the accessory drive gearbox and over-running clutch and shaft assemblies.

交流马达直接启动系统包括两个鼠笼式三相交流感应电动机，它们共用一个固态变频驱动器。起动电动机专门设计成能提供高起动力矩和加速度将发动机从静态加速至断开速度。电动机采用防爆/防火构造，电动机的外形尺寸和一般标准电动机尺寸一样，集成了防止过热的温控器。每台电动机包含一个空间加热器，可接 115 / 230 伏、单相电源。电动机电源连线、过热保护接线和空间加热器接线入口分别单独设置。电动机起动动力通过辅机驱动齿轮箱、超速离合器和输出轴总成传递给发动机。

FUEL SYSTEM
燃料系统

The fuel system, in conjunction with the electrical control system, includes all necessary components to control ignition and fuel flow during all modes of operation.
燃料系统，配合电气控制系统，包含了在所有运行模式情况下，从点火控制和燃料流量调节所必需的所有部件。

DUAL FUEL SYSTEM
双燃料系统

A dual fuel system is provided and includes all the hardware and software components necessary to maintain turbine speed and provide a constant generator output frequency and/or load depending on the generator set mode of operation. The fuel system, in conjunction with the electrical control system, includes all necessary components to control the fuel pressure, schedule fuel flow during start-up, and modulate fuel flow during operation. The system operates on either natural gas or liquid fuel, and includes the controls for automatic changeover from one type of fuel to the other during operation. The

fuel system also provides the necessary instrumentation for the control system to monitor the operation and automatic shutdown of the unit in the event of a malfunction.

提供一套双燃料系统，包括维持燃气轮机转速必需的所有硬件和软件，根据发电机组的运行模式，提供一个恒定发动机输出频率和/或负荷。燃料系统，配合电气控制系统，包含了燃料压力控制、起动期间的燃料设定流量、调整运行期间的燃料流量，所有必需组件。燃料系统可以使用气体或液体燃料，包含在运行期间从一种燃料自动转换至另一种燃料的控制装置。燃料系统也提供了控制必需的仪器仪表，以便监控设备正常运行或在出现故障时自动关机。

Pilot System. The pilot system is a fail-safe fuel shutoff system in the event of a control system failure. The fuel pilot system requires external compressed air at the connection located at the side of the package base. Reference the “Package Utility Requirements List” for airflow and pressure requirements.
引燃系统：引燃系统具有控制系统发生故障时自动切断燃料供应的特点。引燃系统需要在设备基座一侧的连接处提供外部压缩空气。关于空气流量和压力的要求，请参考“公用工程表”。

GAS FUEL SYSTEM
气体燃料系统

Fuel Requirements. The natural gas fuel system requires a constant supply of fuel to the customer connection located on the side of the package base. The fuel quality must conform to Solar Specification ES 9-98. The gas fuel should be free of sulfur, contaminants, entrained water, and liquid hydrocarbons. Please also refer to Solar's Product Information Letter (PIL) 162: "Recommendations for the Sourcing, Handling, Storage, and Treatment of Fuels for Solar Gas Turbines", to ensure the supply of high quality fuel required for optimum performance. Reference the “Package Utility Requirements List” for fuel flow and pressure requirements.
燃料要求：天然气燃料系统需要通过机体外侧的气体连接管提供稳定的燃料供应。燃料质量必须符合 Solar 公司的 ES 9-98 技术规格书中的规定。气体燃料不应含有硫、污染物、夹带的水和液烃。为了获得高质量的燃料，请您参考索拉公司公司的产品情况说明函（PIL）162：“Solar 燃气轮机燃料采购、运输、存储与处理建议”，达到最佳性能。 关于燃料流量和压力的要求，请参考“公用工程表”。

LIQUID FUEL SYSTEM
液体燃料系统

Liquid Fuel Pump / Motor. An AC motor-driven main fuel pump is provided to raise the system pressure to a level sufficient for fuel distribution to the engine. A blank plate is located at the side of the package base for routing cables or conduits for electrical interconnection to the liquid fuel motor inside the package.
液体燃料泵/电动机： 提供一台交流电机驱动的主燃料泵，用于将系统压力升高至将燃料喷射至发动机内部的水平。设备基座一侧设置一块盲板，用于将电缆或导线管联接至设备内部的液体燃料电动机。

Liquid Fuel Variable Frequency Drive. A variable frequency drive (VFD) is provided to control the flow of liquid fuel by adjusting the speed of the fuel pump. The VFD is housed in a NEMA cabinet, designed for wall mounting installation off-skid in a non-hazardous location. A snubber resistor is included.
液体燃料变频驱动装置： 提供一个变频驱动器，通过调整燃料泵的转速来控制液体燃料的流量。变频驱动器安装在一个符合 NEMA 标准的柜内，设计成橇外壁挂式，安装在安全区域。包含一个电阻限流器。

Air Assist System. The air assist system supplies pressurized air directly into the fuel injectors for liquid fuel atomization. During the start cycle, the fuel system requires a supply of external compressed air to the connection located at the side of the package base. Once the engine becomes self-sustaining, the compressor discharge air (Pcd) is used to atomize the fuel. The air quality must be in accordance with Solar Specification ES 2201. Reference the “Package Utility Requirements List” for air assist requirements.
空气辅助系统：空气辅助系统将压缩空气直接供入燃料喷咀中，雾化液体燃料。在起动期间，燃料系统需要从设备基座一侧的连接管获得压缩空气。发动机到达自持转速后，使用燃机压缩机段的压缩空气

（PCD）将燃料雾化。压缩空气质量必须符合 Solar ES 2201 规定。关于空气辅助系统的要求，请参考“公用工程表”。

Liquid Fuel Drain. A liquid fuel drain is included for the small quantity of unburned liquid fuel that collects after shutdown. The drain connection is located at the side of the package base.
液体燃料泄放： 提供一个液体燃料泄放口，以便将停机后收集的少量未燃烧燃料排泄掉。泄放连接管位于设备基座一侧。

Fuel Requirements. The liquid fuel system requires a constant supply of fuel to the connection located on the side of the package base. The fuel quality must conform to Solar Specification ES 9-98. Typical acceptable liquid fuels include Grades 1 and 2 fuel oil, Grades 1 and 2 diesel, and Kerosene (JP-8, JP-5, or commercial grade). Please also refer to Solar's Product Information Letter (PIL) 162: "Recommendations for the Sourcing, Handling, Storage, and Treatment of Fuels for Solar Gas Turbines", to ensure the supply of high quality fuel required for optimum performance. Reference the “Package Utility Requirements List” for fuel flow and pressure requirements.
燃料要求：液体燃料系统从设备基座一侧的连接管获得提供稳定流量的燃料。燃料质量必须符合 Solar ES 9-98 的要求。可接受的代表性液体燃料包括一级和二级燃油、一级和二级柴油和煤油（JP-8、JP-5 或商业等级）。 也请您参考 Solar 公司的产品情况说明函（PIL）162： “Solar 燃气轮机燃料采购、搬运、存储与处理建议，以确保提供高质量的燃料，达到最佳性能。” 关于燃料流和压力的要求，请参考“公用工程表”。

Block and Bleed Off-Skid Module with Leak Detection. In addition to the standard on-skid fuel system module; an off-skid block and bleed module with leak detection is supplied with the package; allowing for the isolation of the gas fuel system outside of the package enclosure. This off-skid module includes the following:
撬装的燃料隔离和放空模块（带泄露检测装置）除了标准的燃气轮机橇装燃料系统模块之外，还提供一个布置在机组外的橇装隔离和放空模块（带泄露检测装置），用于隔离设备外部的燃气系统。橇外布置的模块包括下述部件：

- An unenclosed module consisting of one shut-off valve, a vent valve, and a leak detection transmitter
- The software required to control and monitor all module components in the turbine control system
- 一个开式模块：包括一个关断阀、一个排气阀和一个泄露传感器
- 在燃机控制系统中用于控制和监测模块元件的软件

LUBE OIL SYSTEM
润滑油系统

The package lube oil system consists of a complete system suitable for operation with purchaser-supplied lube oil conforming to Solar's Specification ES 9-224. The lubrication system circulates oil under pressure to the various working parts of the drive train rotating elements. The system is supplied from the lube oil tank located in the driver steel base frame. Proper oil temperatures are maintained by thermostatic control valve and optional oil cooler.
机组润滑油系统为一个完整系统，买方需按照 Solar 公司 ES 9-224 规定来提供润滑油。润滑系统将润滑油加压后输送到转动部件处。润滑油从位于机组底部的润滑油箱向系统供油。通过温控制阀和可选项的油冷却器来维持合适的油温。

The lubrication system incorporates the following components:
润滑系统包含下述组件：

- Carbon steel oil tank, integral with the package frame
- Engine-driven, rotary screw type, primary pump
- Motor-driven auxiliary pumps including AC pre/post and 120 VDC backup post-lube pump
- Oil filter system with replaceable elements

- Offskid oil cooler
- Oil level, pressure, and temperature indication
- Oil pressure transducers
- Pressure and temperature regulators
- Strainers
- Oil tank vent separator
- Oil tank vent flame trap

- 碳钢油箱，和机组底座构成一个整体
- 发动机驱动的螺杆式主润滑泵
- 电动机驱动的辅助泵，包括交流驱动的预/后润滑泵和 120 伏直流电备用润滑泵
- 滑油过滤系统包括可更换的滤芯
- 橇外布置的滑油冷却器
- 液位、压力和温度指示器
- 油压传感器
- 压力与温度调节器
- 粗滤器
- 油箱排气口的油气分离器
- 油箱排气口阻火器

The filters are supplied with a six-way transfer valve with differential pressure indication and alarm. The transfer valve and the lube oil filter cannisters are fabricated from carbon steel and the external surfaces are painted per Solar's standard paint system. The system includes all supply and drain piping and manifolds internal to the skid. The interconnect piping between the skid edge connection and the offskid-mounted oil cooler is not supplied as part of this system.
过滤系统内一同提供带有差压指示与报警功能的六通输送阀。输送阀和润滑油过滤器外壳采用碳钢制造，外表面按照 Solar 公司的标准油漆系统的油漆进行涂漆。系统包含了撬内部的所有供给管、排泄管和歧管。燃机撬体和撬外的的滑油冷却器之间的连接管道不属于本供货范围内。

Lube Oil Cooler. A water / oil lube oil cooler is provided and designed for off-skid installation. The water-cooled, tube-type cooler lowers the oil to operating temperature. Connections for lube oil supply to and from the cooler are located at the side of the package base.
润滑油冷却器：提供一个撬外布置的油/水冷却器。管式水冷滑油冷却将滑油冷却至工作温度。滑油冷却器的滑油输入和输出连接管都位于设备基座一侧。

3-Phase AC Lube Oil Tank Heater
三相交流电润滑油箱加热器

A 3-phase AC lube oil tank heater ensures that lube oil temperature remains above 10°C (50°F) for starting at cold temperatures. See utility list for power supply and density.
三相交流电润滑油箱加热器，确保润滑油温度维持在 10°C(50°F)以上，保证机组在低温环境下起动。见公用工程表中列出的功率和密度要求。

LUBE OIL TYPE
润滑油类型

Solar's Specification ES 9-224 defines the type of lube oil acceptable for use in Solar's gas turbine engines, gears and driven equipment during normal operating service.
Solar 公司的 ES 9-224 规范定义了 Solar 公司的燃气轮机发动机、齿轮和被驱动设备在正常运行期间可以使用的润滑油的类型。

Lube Oil Filter. Duplex oil filters are provided to remove contaminants from the lube oil system. The lube oil filter drain connection is located at the side of the package base.

润滑油过滤器： 提供双联油滤器，用于清除润滑油系统中的污染物。 润滑油过滤器排泄连接管位于设备基座一侧。

TURBOTRONIC 4 CONTROL SYSTEM
TURBOTRONIC 4 控制系统

The *Turbotronic* 4 control system, operating on 24-Vdc power, provides for automatic starting, acceleration to operating speed, sequencing control, engine and driven equipment monitoring during operation, and normal and malfunction shutdown.
24 伏直流电驱动的 *Turbotronic 4* 控制系统，提供自动启动，加速至工作速度，过程控制，发动机和被驱动设备的检测，用于运行，正常和非正常停车工况。

During operation, the control system, by means of automatic warning and shutdown devices, protects the turbine engine and driven equipment from possible damage resulting from hazards such as turbine over speed, high engine temperature or vibration, low lubricating oil pressure and excessive oil temperature.
在运行期间，控制系统通过自动报警与停车装置保护燃气轮机发动机和驱动设备不受燃气轮机超速、发动机超或振动、润滑油低压和油温过高等危险造成的损坏。

The main elements of the system are the Allen-Bradley ControlLogix control processor, A-B 1794 Flex I/O input/output modules, Combination Generator Control Module (CGCM), TT4000S Display and Monitoring system, package sensors, backup shutdown system and circuit breaker panels.
控制系统的主要元件为 Allen-Bradley ControlLogix 控制处理器、A-B 1794 Flex 输入/输出模组、组合发电机控制模组(CGCM)、 TT4000S 显示与监视系统、成套设备传感器、备用停机系统和断路器面板。

The control processor (controller) performs proportional control, start-up, operation and shutdown sequencing and protection functions, as well as detection and annunciation of abnormal operating conditions. Control for these functions comes from signals the controller receives from solid-state devices, control switches, speed, pressure and temperature transmitters, relays, solenoids, and vibration sensors. These components provide the controller with the data necessary to control and maintain desired process conditions while maintaining engine speed and temperature at safe levels.
控制处理器（控制器）可以执行比例控制、起动、运行与停机过程和保护功能，以及探测和报告异常运行状态。 控制器收到固态信号，实现这些控制功能，固态信号来自控制开关、压力与温度传感器、继电器、电磁阀和振动传感器。这些部件向控制器提供控制和维持要求的工艺操作条件所必需的数据并维持发动机转速和温度在安全水平。

In the event of an abnormal condition or malfunction, the control system indicates the nature of the malfunction. When an alarm or shutdown is displayed, a sequence of appropriate operations begins in response to the detected condition. In the event of a control system failure, the backup system initiates a shutdown while operating the lubricating oil system and other subsystems, as required, to avoid engine and driven equipment damage during shutdown.
如果发生异常情况或故障，控制系统会指示故障的性质。当显示报警或停机时，根据查明的故障启动一合适的过程程序。如果控制系统出现故障，备用系统根据需要在操作润滑油系统期间开始停机，以避免发动机和驱动设备在停机期间受损。

Standard Engine Rotor Temperature Monitoring
标准发动机转子温度检测

The turbine engine incorporates the following standard temperature monitoring:
燃气轮机发动机安装了下述标准温度检测：

- Turbine thrust bearing temperature monitoring
- RTDs at all turbine lube oil drain lines
- 燃气轮机推力轴承温度检测

- 所有燃气轮机润滑油排泄管路上的电阻式温度检测器（RTD）

Combination Generator Control Module (CGCM)
组合发电机控制模块 (CGCM)

The CGCM is a highly integrated control module that combines multiple generator control and protection functions in a single device. It is an integral part of the *Turbotronic* 4 control system for power generation applications. Refer to the Generator Control and Monitoring section for more information.
组合发电机控制模块 (CGCM)是一个高度集成的控制模组，在一个装置中包含了多种发电机控制与保护功能。 它是用于发电的 *Turbotronic* 4 控制系统的一个主要部分。 更多信息请参考“发电机控制与监控”部分。

CONTROL SYSTEM TYPE
控制系统的类型

Onskid Control System
橇上控制系统

The control system components are mounted in one or more carbon steel panels located on the package skid. The panels contain the key elements of the system including the Control Processor, the I/O Modules, the Vibration Monitoring System, the Combination Generator Control Module and the TT4000S display unit. The operator interface includes lighted switches for Start / Starting, Normal Stop / Stopping and Backup System Active / Reset; and switches for Increase / Decrease, Off / Local / Remote, Horn Silence, Acknowledge, Reset and Emergency Stop. The TT4000S Display System provides the following key features:
控制系统的组件安装在设备撬体上的一个或多个碳钢面板上。控制面板上含有控制系统的主要元件，包括控制处理器、输入/输出模组、振动监测系统、组合发电机控制模组和 TT4000S 显示装置。操作人员界面包括发光的启动开关、正常停机开关、备用系统操作/复位开关；加负荷/减负荷手动开关、脱机/就地/远程控制、气笛、确认、复位和紧急停机的开关。TT4000S 显示系统具有下述主要特征：

- Operation Summary – Overview of key operation parameters
- Temperature Summary – Display of all monitored temperatures
- Vibration Summary – Display of all vibration readings
- Alarm Summary – Display of all malfunctions with date and time stamping
- Event Log – Display of date and time stamped sequence of events with sorting and filtering functions
- Strip Chart – Display of real time data for selected analog signals in strip chart format. Configurable with legend, cursor and zoom features.
- Trigger Log – Stores data surrounding specified events. Data can be played back using the Strip Chart feature.
- Program Constants – Password protected display and modification of controls constant values
- Generator Summary – Display of all monitored generator parameters

- 运行概要－主要运行参数纵览
- 温度概要－显示所有监测的温度
- 振动概要－显示所有振动读数
- 报警概要－显示所有故障（带有日期和时间）
- 事件日志－显示带日期与时间的事件顺序，带有分类和过滤功能
- 条状显示－以条状格式显示选择的模拟信号的实际时间数据，可配置图标、光标和放大功能
- 触发日志－存储特定事件周围的数据。可利用条状记录特征重新播放数据。
- 程序常量－密码保护的显示和控制系统常量值的设定
- 发电机概要－显示所有监测的发电机参数

Auxiliary Desktop PC for Offskid Control Interface
橇外布置的辅助台式电脑控制器

In addition to the TT4000S display unit located on the package skid, an Auxiliary Desktop PC with full TT4000 Display and Monitoring System capabilities is provided for use at a secondary location determined by the user.
除了安装在设备撬上的 TT4000S 显示装置之外，也提供带全部 TT4000 显示与监控系统的辅助台式电脑，供用户确定的第二个地点使用。

Data Storage and Display
数据存储与显示

Data can be viewed in a strip chart format in real time, trended, analyzed online, or exported for off-line viewing. All logs are self-describing repositories, containing site information, tag information, and the historical data itself. The data can be viewed online using the Historical Trend Display. The Historical Trend Display allows selection of up to 10 variables for viewing in a digital strip chart format. The objective of historical data monitoring is to provide information of a type and in a format that allows informed decisions to be made in the areas of operation, maintenance, and optimization of the turbo machinery and associated equipment. The information is collected for on-line viewing and analysis or may be exported for storage and off-line analysis.
数据 可以用条形图的格式进行实时查看，在线分析其趋向或输出以便离线查看。所有记录均为带自描述的知识库，包含了现场信息、标签信息和自身的历史数据。可以利用历史趋势显示器来在线查看数据。以数字条形图格式查看数据时，历史趋势显示器允许选择多达 10 个变量。历史数据监控的目的是为燃气轮机及相关设备的操作、维修和优化等作出有根据的决定而提供同一类型且同一格式的信息。收集的信息供在线查看和分析或者也可输出外部进行存储和离线分析。

English and Chinese display labels
英文与中文显示标记

Package and offskid auxiliary display to be in both English and Chinese language.
撬上控制器和橇外装辅助显示器均使用英文和中文显示。

SUPERVISORY INTERFACE
监控界面

Ethernet Network Supervisory Interface
以太网通讯接口

An Ethernet interface module is installed in the control processor rack and connects to the processor through the rack backplane. The user may connect to the module with a standard 10BaseT Ethernet cable. Ethernet is suitable for applications up to 100 m (330 ft) without a hub. Data are transmitted using the Control and Information Protocol (CIP). Analog and discrete data are stored in one-dimensional arrays in the control processor, which may be read by the user. In addition, the user may send supervisory control signals to the processor. Data available include all input analogs, a number of computed values, status indications, and all active alarms and shutdowns.
一个以太网通讯模块安装在控制器的机架上。用户可以用标准的 10BaseT 以太网通讯电缆连接。适用距离可以到达 100 米（330 英尺）。通讯协议是 CIP。模拟和数字信号都储存在一维的控制储存器上，用户可以读取它。另外，用户也可以发控制命令到上面来。

Typical data include:
主要数据包括：

- Driven equipment status
  被驱动设备的状态

- Gas producer turbine speed
  燃气发生器的速度
- Power turbine speed
  动力透平的速度
- Turbine T5 temperature
  燃机 T5 温度
- Lube oil header pressure
  润滑油出口压力
- Lube oil temperature
  润滑油温度
- Ambient temperature
  环境温度
- All alarms and shutdowns
  所有的报警和停机信号
- All panel light status
  所有的控制盘显示状态

Supervisory control signals include:
操作台发出的信号

- Start （启动）
- Stop （停机）
- Acknowledge / Reset （确认和复位）
- Remote Speed / Load Set Point （远程速度和负荷设定）

The user is responsible for providing the hardware and software interfaces to the system.
用户负责提供通讯系统的软件和硬件。

DISPLAY ENGINEERING UNITS
显示工程单位

Control Screen Engineering Units in Metric - kPa
控制屏的工程单位（公制－kPa）

Temperature values are displayed in units ℃ and pressure values are displayed in kPa.
温度值以度（℃）为单位显示，压力值以 kPa 为单位显示。

Control Screen Languages in English and Simplified Chinese
控制屏的语言为英文和简体中文

Operator interface screen displays are in both English and simplified Chinese languages with selection by screen menu.
操作者界面屏幕显示用英文和简体中文，通过屏幕菜单选择。

PERFORMANCE MAP DISPLAY
性能图显示

Engine Performance Map Display
发动机性能图显示

The engine performance map displays real-time turbine generator performance corrected to standard conditions. This is a calculated performance based on package instrumentation readings. The performance map is essentially for reference and is used to monitor trends in engine performance, not to

verify absolute engine performance levels. The system includes instrumentation to measure flow of the fuel to the turbine. For gas fuel flow measurement, a loose shipped flow measuring device (Coriolis Mass Flowmeter) is provided for offskid field installation. For liquid fuel flow measurement, an onskid rotary transducer is provided.
发动机性能图显示修正到标准状态的燃气轮机发电机的实时性能。这是根据设备仪表读数计算出的性能。性能图只起基本的参考作用，用于监测发动机性能的趋势，而不是用于验证发动机的绝对性能水平。系统含有测量通向燃气轮机的燃料流量的仪表。对于燃气流量测量，需要安装一个撬外的流量测量传感器（Coriolis 质量流量计）。对于液体燃料流量计量，使用橇装的涡轮传感器。

PRINTER LOGGER
打印机记录器

240 VAC, 1 Phase Printer Logger, Specified Quantity，1 set
240VAC、单相打印机记录器、规定数量 1 台

The following functions are provided:
具有下述功能：

- **Status Print** – current value of analog and status of discrete variables. Menu selectable and automatically generated on shutdown event, followed by first out alarm print.
- **Alarm Logging** – prints alarm with time and date stamp.
- **Daily Log** – last 24 hours of elapsed time data.
- **Print Screen** – prints current screen.
- **Historical Files** – prints data from all historical files.
- **状态打印**－当前的离散变量模拟值与状态值：发生停机事件时，选择菜单，自动生成模拟值与状态值，发生第一次报警打印输出。
- **报警信号记录**－打印带有时间与日期的报警
- **日志**－经过时间数据持续 24 小时
- **打印屏幕**－打印当前屏幕
- **历史文件**－打印所有历史文件的数据

HEAT RECOVERY APPLICATION
热量回收应用

Heat Recovery Application Interface
余热回收应用接口界面

This feature provides interface between the gas turbine control and the exhaust heat recovery system (HRS) control necessary to sequence the start and stop of the gas turbine package and the HRS. This includes start permissives, stop commands, and signals necessary to ensure proper purging of the gas turbine exhaust system and HRS. Also includes some status monitoring. This feature assumes the HRS has its own primary control system, which requires only a few interface signals with the gas turbine package controls.
这一特征在燃气轮机控制装置和余热回收系统控制装置之间提供界面，这是安排燃气轮机设备和余热回收系统启动与停止顺序所必需的。包含了确保适当吹扫燃气轮机排气系统与余热回收系统所必需的启动许可、停止命令和信号，也包含一些状态监控。这一特征假定废热回收系统自身具有主控制系统，燃气轮机设备控制装置仅需要少数界面信号。

GENERATOR CONTROL AND MONITORING
发电机控制与监测

For generator control and monitoring, the *Turbotronic* 4 control system incorporates the Basler Electric / Allen-Bradley Combination Generator Control Module (CGCM). This microprocessor-based device operates as a subsystem of the main control processor and provides extensive control, protection, and monitoring features. Three excitation control modes are available:
对于发电机的控制和显示而言，*Turbotronic* 4 控制系统包含了 Basler Electric（巴斯勒电气）/Allen-Bradley（艾伦－布拉德利）组合发电机控制模组 (CGCM)。 这个基于微处理器的装置作为主控制处理机的一个子系统，具有广泛的控制、保护和显示功能。有三个励磁控制模式可以使用：

- Automatic voltage regulation - a selected generator output voltage is maintained.
- Power factor control - a constant power factor is maintained when operating in parallel with a large power source.
- Reactive power (VAR) control - a constant reactive load is maintained when operating in parallel with a large power source.
- 自动电压调整－将发电机的输出电压维持在一个设定值。
- 功率因数调节－当与一个大功率源并网运行时，维持一个恒定的功率因数。
- 无功功率（VAR）控制－当与一个大功率源并网运行时，维持一个恒定的无功功率。

The system provides the ability to automatically synchronize the unit to the bus through operator action or by receipt of an appropriate remote signal from a supervisory control system. The control system provides added package protection through preset warning indication and shutdown initiation in the event of unacceptable temperature levels in the generator stator windings. The system uses a 100-ohm platinum RTD at each generator bearing and a 100-ohm platinum RTD imbedded in each phase of the stator windings. Temperature level, warning alarm, and shutdown indications are displayed on the control system video display unit.
通过操作员的操作或监控系统的遥控信号，系统能自动将发电机与电力系统总线同步。当发电机定子绕组的温度水平超高时，控制系统通过预设的警告显示和停机启动为设备提供额外保护。系统在每一个发电机轴承处使用 100 欧姆的铂电阻，在定子绕组的每一相嵌入 100 欧姆的铂电阻。 温度水平、警报和停机指示显示在控制系统的显示器上。

KVAR/Power Factor Controller. A kVAR/power factor controller is included in the CGCM to maintain a constant reactive load (kVAR) output or constant power factor (pf) on the generator set while the unit is operating in parallel with a utility or other large source. The controller applies a signal directly to the voltage regulator adjust circuit to maintain a constant reactive load or power factor with changes in the infinite bus voltage level. From the HMI the operator can enable or disable the controller, choose kVAR or pf control mode and set the desired set points.
无功负荷/功率因数控制器： 组合发电机控制模组（CGCM）中包含了一个无功负荷/功率因数控制器，当发电机组与电网或其它大功率电源并网运行时，该控制器能够维持恒定的无功负荷 (kVAR) 输出或恒定的无功功率因数。控制器向电压调节器调节电路直接发送信号，当无线大容量布线电压水平的变换时，将无功负荷或无功功率因数维持在恒定值。操作员从人机界面可以启动或关闭控制器，选择无功负荷或功率因数控制模式并将它们设置到预定点。

The following excitation control features are available:
具有下述励磁控制特征：

- Under frequency limiting
- Over and under excitation limiting
- Reactive droop compensation
- Cross-current compensation
- Line-drop compensation
- 频率过低限制
- 励磁过高或过低限制
- 无功功率下降补偿
- 横流补偿

- 线电压降补偿

Protection features include:
保护特征包括：

- Over excitation voltage
- Over and under generator voltage
- Loss of sensing
- Loss of excitation current
- Loss of permanent magnet generator (PMG)
- Reverse VAR
- Over and under frequency
- Reverse power
- Rotating diode monitor
- Phase rotation error
- Generator overcurrent

- 励磁电压过高
- 发电机过电压和电压不足
- 电压传感信号丢失
- 励磁电流丢失
- 永磁信号丢失
- 反向无功功率
- 频率过高与过低
- 逆功率
- 旋转二极管监视
- 相位错误
- 发电机过流

NOTE: These protection features only protect the generator. Protection of the user's power distribution system and any other required generator protective functions are not included and must be handled separately using appropriately certified protective relay components with settings approved by qualified personnel based on a comprehensive analysis of the complete system.
注意： 这些保护特征只是对发电机的保护。 用户端的电力分配系统保护和任何其它要求的发电机保护功能不包含在内，这些保护必须使用已经被适当的机构认证的继电保护元器件，元器件的设定必须在全面系统分析后，由专业的人员来完成。

Current, potential and cross current transformers required for input to the CGCM are included in the generator terminal box.
发电机端子箱内包含了向组合发电机控制模组（CGCM）输入所需的电流、电压和横流传感器。

KW CONTROL
功率控制
Kilowatt Import Control
功率输入控制

The kW import control system controls the real load (kW) on a unit operating in parallel with a large source. The "import" control monitors the load imported from the utility source and adjusts the fuel flow of the turbine generator set(s) to maintain a pre-set amount of imported power from the utility at all times. This control mode is for applications where it is desired to prevent any power from being exported to the utility. Protection against excessive kW load while in parallel with a large source is provided by the turbine T5 temperature limiter system.

功率输入控制系统是用来控制当机组和电网或大电源并列运行时的有功功率。“输入”控制装置监控从电网输入的负荷，调整燃气轮机发电机组的燃料供给，在任何时候都保证向系统内输入预设定的功率值。这一控制模式用于防止从发电机向电网输出任何功率。当与大电源平行运行时，通过燃气轮机 T5 温度限制器系统来防止过多的负荷输出。

Kilowatt Control
功率控制

The kW control system controls the real load (kW) on a unit operating in parallel with a large source. The control monitors the load carried by the turbine generator set and adjusts turbine fuel flow to maintain a constant load under conditions of varying infinite bus frequency. Protection against excessive kW load while in parallel with a large source is provided by the turbine T5 temperature limiter system. The kW control system provides additional operational flexibility by allowing unit kW load level to be set at any desired level within the capacity of the unit.
功率控制控制系统用来控制与大电源平行运行时发电机的有功输出。控制系统监控燃气轮机发电机组的负荷，调整燃气轮机的燃料流量，在无限大容量母线频率变化的情况下维持恒定负荷。当与大电源平行运行时，通过燃气轮机 T5 温度限制器系统来防止过多的负荷输出。功率控制系统具有额外的操作灵活性，即可以在发电机容量范围内，将发电功率水平设定为任一期望水平。

ACCESSORY EQUIPMENT
附属设备

On-Crank / On-Line Engine Cleaning System
盘车/在线清洗系统

The turbine compressor combination cleaning system consists of both on-crank and on-line cleaning systems. The systems are independent of each other and include separate distribution manifolds with pressure atomizing spray nozzles in the engine air inlet collector and associated onskid piping, filter and solenoid operated shutoff valves to deliver water or approved cleaning fluid to the manifold.
燃气轮机压缩机段清洗系统包含盘车清洗系统和在线上清洗系统。两个系统相互独立，具有单独的水总管和安装在进气集箱上压力雾化喷嘴，及相关橇装管道，过滤器和电磁阀控制的关断阀向水总管输送水或认证过的清洗液。

Both systems facilitate periodic cleaning of the turbine compressor and are designed for use in salt-laden or dusty atmospheres or where compressor contamination from hydrocarbon vapors is possible.
两个系统用于对燃气轮机压缩机段进行定期清洗，两个系统可以用在含盐环境或有灰尘的环境或压缩机可能被碳氢化合物蒸汽污染的环境中。

With the on-crank system, the engine is operated at the maximum speed attainable with the start system and fuel and ignition systems deactivated. Engine cranking is initiated from the onskid gauge panel or the control console operator interface panel, and water / cleaning solution flow is activated from the operator interface panel.
盘车清洗系统在发动机的启动循环中最大自稳定速度下进行，燃料系统和点火系统保持还没有运行。从橇装的仪表板或控制主机操作员界面板启动发动机盘车清洗程序，从操作员界面板启动水/清洗液的供应。

The on-line cleaning system is operable between 90 and 100% gas producer speed with or without load, with water / cleaning solution flow activated from the operator interface panel. This system is intended to supplement the on-crank system by increasing the time intervals between periodic on-crank water, detergent or fluid cleaning, depending on site-specific contamination.
当燃气发生器在带负荷或不带负荷时的转速到 90％－100％时，在线清洗系统可以操作，水/清洗液的供给从操作员界面板启动。这一系统的目的是补充在盘车清洗系统运行后，增加清洗时间。根据现场的具体污染情况来增加的清洗系统的水、清洁剂或液体清洗的时间间隔。

For both systems, a separate source is required to supply externally pressurized water / cleaning solutions in accordance with Solar's Specification ES 9-62, regulated at 586 to 690 kPag (85 to 100 psig) at the package skid connection.
对于两个系统而言，需要按照 Solar 公司的 ES 9-62 规范使用一个单独的源头从外部提供加压的水/清洗液，在橇装联接管路口的进口压力从 586kPag 至 690kPag（85－100psig）。

Valve Regulated, Lead Acid 120-VDC Control and Accessory Power Supply
阀门调节的、酸铅 120 伏直流控制与辅助电源

The control and accessory battery system supplies 120 VDC power for the unit control system, electric fuel valve, engine bleed valves and variable guide vane actuators, and the backup post-lube oil pump. The unit 24 VDC control system includes a converter to reduce the 120 VDC supply to 24 VDC. The system includes 100 ampere-hour, valve-regulated, sealed gas-recombination, lead-acid batteries on a freestanding two-tier, two-row rack and a 20 ampere, single-phase charger. The system is designed for indoor installation in a nonhazardous area. The batteries are shipped fully charged and ready for use.
控制与辅助蓄电池系统为控制系统、电动燃料阀、发动机排泄阀、可调导叶执行机构和备用润滑油泵提供 120 伏直流电。机组的 24 伏直流电控制系统包含一个转换器，将 120 伏直流电降低为 24 伏直流电。 系统包含置于独立式两层双排支架上的 100 安培小时、阀门调整的、密封的气体复合的酸铅蓄电池和一个 20 安培的单相充电器。该系统应安装在室内的安全区域。发货时的蓄电池已经充满电，可以直接使用。

Portable Engine Cleaning System
移动式发动机清洗系统

A portable engine cleaning cart is provided to supply cleaning fluid to the on-skid edge engine cleaning system. The cart includes a stainless steel vessel to mix, hold and pressurize the cleaning solution. Compressed air is required. Refer to the Package Utility Requirements List for air flow and pressure requirements.
一个便携式发动机清洗小车用于向机组清洗系统提供清洗液。清洗小车包含一个不锈钢容器，用于混合、盛放和加压清洗液。用户需要提供压缩空气。关于压缩空气流量和压力的要求，请参考“公用工程表”。

- 26 gallon tank capacity
- 4 heavy duty wheels mounted to the corners of the tank legs
- Two wheels have foot-operated brakes
- Single fill port for water, chemical, air
- 2" aux fill port
- 304 stainless steel tank, ASME coded vessel stamp
- Stainless steel valves, filters, fittings, piping
- 150 lb couplings
- Hand wand included

- 26 加仑的罐容量
- 罐腿的角落处安装 4 个重型轮子
- 2 个轮子带有脚踏刹车
- 只有一个水、化学物质、空气填充口
- 2 英寸大小的辅助填充口
- 304 不锈钢罐、ASME 编码的容器印记
- 不锈钢阀门、过滤器、配件、管道
- 150 lb（分升）的管接头
- 手杖

MISCELLANEOUS
其它杂项

Long-Term Package Preservation
设备长期储存包装

The package is prepared for shipment with long-term preservation per Solar's Specifications ES 9-248 and ES 9-249, and Product Information Letter (PIL) 097 "Package Preservation and Preparation for Shipment," including export boxing and foil bagging. While the equipment is stored, the Buyer must arrange for periodic inspections to ensure the packing is not compromised. If still in storage after two years from date of shipment, long-term preserved items should be opened, recharged with desiccant and vapor-proof barriers resealed.
按照 Solar 公司的 ES 9-248 和 ES 9-249 规定、产品情况说明函（PIL）097 “设备装运保护与准备”对设备进行长期保护准备，包括出口装箱和箔衬袋的准备。 存储设备时，买方必须安排定期检查，以确保包装不受损。 如果从装运日期算起的两年之后仍处于存储状态，长期保存的项目应敞开，重新加入干燥剂，重新密封防汽的隔离物。

English Language Operation and Maintenance Instruction Manual
英文版操作与维修说明书

Operation and Maintenance Manual. The Operation and Maintenance Instruction Manual is provided and includes descriptive and instructional data for operating and servicing the turbomachinery package. It contains general, functional, and component descriptions and illustrations of the turbine engine and associated package systems.
操作与维修说明书： 提供操作与维修说明书，还提供燃气轮机械设备操作与维修方面的描述性和说明性数据。 说明书中包含了燃气轮机发动机和相关设备系统的一般性、功能性及构成性描述与说明。

The Operation and Maintenance Instruction Manual is written in English and contains the following four (4) volumes:
操作与维修说明书为英文版，包含下述四卷：

The Systems Operator's Guide is intended for the equipment operator to become familiar with the controls and indicators, which are described and illustrated in detail. Package operating procedures are listed for all operating conditions, and safety precautions are provided to aid in the safe operation of the equipment.
系统操作员指南：目的是让设备操作员熟悉各种控制装置和指示器，进行了详细的描述和说明。 列出了所有运行情况下的设备操作程序，提供了安全预防措施，为安全操作设备提供帮助。

Maintenance Instructions provide the maintenance and field service personnel detailed functional descriptions of package systems and procedures for preventive and corrective maintenance. Preventive procedures include periodic inspection requirements, and alignment procedures and tolerances. For major functional components, corrective procedures are furnished for cleaning, removal, installation, adjustment, and testing.
维修说明：为维修人员和现场服务人员提供了详细的设备系统功能说明和预防性与纠正性维修程序。预防程序包括周期性检查要求、对准程序和容许误差。 对于主要功能部件，提供清洗、搬移、安装、调整和试验方面的纠正程序。

Supplementary Data consists of supplier information of components and assemblies not covered or fully discussed in the Maintenance Instructions volumes. The data is arranged alphabetically by manufacturer, and is intended for Solar field service technicians.
补充数据：包括维修说明卷中未涉及或充分讨论的部件和配件的用户信息。 信息按照制造商名称的字母顺序排列，供 Solar 公司的现场服务技术员使用。

The Illustrated Parts List contains part numbers, part names, quantities, reference designators, photos, and line drawings to aid the user in locating and ordering of parts.
图示部件列表：包含部件编号、部件名称、部件数量、引用指示符、照片和线路图，以帮助用户确定部件的位置和次序。

The Operation and Maintenance Instruction Manual set is provided on CD-ROM. Four (4) CD's are supplied for each package type per project. Extra copies may be ordered at any time at an additional cost.
操作与维修说明书以只读型光盘的形式提供。每个项目每台机组提供四张 CD 光盘，也可以在任何时候订购额外的光盘。

The CD-ROM manual set includes the following features:
只读型光盘说明书具有下述特征：

- Electronic viewing of data in a windows environment
- All sections of the manual set on one CD
- Search feature including full text search for supplier data
- Ability to open graphics in a separate window for simultaneous viewing of text with the associated illustration
- PDF version for printing
- Package and Control Console photos
- Hotspot links include:
  - Ability to jump from a referenced table or figure to the table or figure icon
  - Ability to view supplier data from links in the Parts List
  - Table of content links
- 在视窗环境下用电子设备阅览数据
- 说明书的所有各章在一张 CD 光盘上
- 搜索特征，包括从全文中搜索供应商的信息
- 能够将各个图形在单独的窗口内打开，便于同时查看图示和文本。
- 可打印的 PDF 版本
- 成套设备和控制台的照片
- 热点链接包括：
  - 能够从一个引用表格或图形跳至表格或图形的图符上。
  - 能够从部件列表中的链接查看供应商信息
  - 目录链接

Standard Drawings.
标准图纸：

Electronic Document Control:
电子文件控制：

Solar utilizes an Electronic Document Control process based on a collaborative workspace technology. This collaborative workspace allows a single location for project documentation. Document transfers between Solar, Customers, Major Suppliers, and Contractors occurs instantly through this workspace area on the web. Documents are routed, and tracked on a “real time” basis using email tasking and notifications. This process provides immediate access and complete visibility of all project documentation from the Customer “kick-off” meeting, all the way through to commissioning of the project. Upon agreement, users are provided with a user name, password, and instructions. The Electronic Document Control operates on standard Internet protocols, and meets the highest Internet security standards.
Solar 公司使用基于协同工作空间技术的电子文档控制程序。 协同工作空间允许将工程文件存在一个位置。 通过网络上的工作空间区域，文件可以即刻在 Solar 公司、客户、主要供应商和承包商之间传输。使用电子处理任务和发送通知，可以对文件进行实时发送和跟踪。 从客户的开工会议开始，直到工程试运行，这一程序可以直接访问和完全查看所有项目文件。 在签订协议后，为用户提供用户名、密码和说明。电子文件控制是基于标准的因特网协议的，满足最高的因特网安全标准。

Drawings will be available through this system per the schedule detailed below:
通过这一系统，可以获取所有图纸，如下面的详细一览表所示：

	INITIAL RELEASE	AS SHIPPED	AS INSTALLED
Drawings	Weeks (i)	Weeks (ii)	Weeks (iii)
Electrical Schematic	10	2	12
Electrical Wiring Diagram	--	2	12
Electrical Interconnect	10	2	12
Mechanical Installation (v)		2	12
In-Crate	6	2	12
Out-Crate	10	2	12
Start System Schematic	10	2	12
Fuel System Schematic	10	2	12
Lube Oil System Schematic	10	2	12
Air Drain System Schematic	10	2	12
Software Documentation (iv)	--	2	12

	首版	装运版	安装版
图纸	周 (i)	周 (ii)	周 (iii)
电路图	10	2	12
电气线路图	--	2	12
电气互联	10	2	12
机械安装 (v)		2	12
机箱内	6	2	12
机箱外	10	2	12
启动系统图解	10	2	12
燃料系统图解	10	2	12
润滑油系统图解	10	2	12
通气和排污系统图解	10	2	12
软件文件(iv)	--	2	12

(i) From completion of initial Customer “kick-off” meeting.
(ii) Upon notification of “Readiness to Ship” unit.
(iii) Upon receipt in San Diego of marked-up field changes to the drawings.
(iv) A CD-ROM of the complete Software Documentation is provided for both the “As-Shipped”, and “As-Installed” releases.
(v) The Mechanical Installation drawing is made up of two sections - an “in-crate” section (genset package), and an “out-crate” section (ancillary equipment including inlet and exhaust systems, lube oil cooler, battery system, etc.).
(i) 从客户的开工会议结束时开始
(ii) 在收到“准备装运”通知时
(iii) 在圣地亚哥收到图纸的字段改变时
(iv) 为装运版图纸和安装版图纸都提供只读存储光盘格式的完整的软件文件
(v) 机械安装图纸包含 2 部分：“板条箱内”部分（发电机组成套设备）和“板条箱外”部分（附属设备，包括进气系统、排气系统、润滑油冷却器和蓄电池系统等）

Three (3) sets of prints may be furnished upon request.
可以要求提供三套晒图。

The Operation and Maintenance Instruction manual, as described in the Documentation section of this proposal, is provided in the English language.
本建议书的文件部分中描述的操作与维修说明书以英语提供。

TEST, QUALITY ASSURANCE AND CERTIFICATION
试验、质量保证及证书

Testing And Quality Assurance. Package acceptance testing is performed at Solar's factory in accordance with Solar Specifications as generally outlined below. The purchaser or purchaser's designated representative may observe factory production tests scheduled in accordance with production and testing schedules. Unavailability of the purchaser or purchaser's representative shall not be cause for delay in the performance of the production tests.
试验与质量保证： 应按照下面给出的 Solar 公司的一般性规定在 Solar 公司的工厂里面进行成套设备接收试验。 买方或买方指定的代表可以按照生成和试验计划观看工厂生产试验。 买方或买方代表不能到场时，生产试验不得延误。

Inspection and Test Plan. An Inspection and Test Plan (ITP) is provided to describe the Quality Assurance and Quality Control Program requirements for each project. The ITP defines quality requirements for purchased and manufactured material from receiving inspection to the final package inspection. The ITP lists the primary controlling and verifying documents, codes and standards used to define the quality requirements and identifies inspection points. The ITP always includes relevant Solar documentation requirements and can include acceptable Purchaser specified requirements.
检查与试验计划： 提供检查与试验计划，该计划描述了每个项目的质量保证和质量控制计划的要求。 检查与试验计划定义了从接收检查到最终的成套设备检查期间的购买的材料和生产的材料的质量要求。 检查与维修计划列出了用于定义质量要求和确定检查点的主要的控制与检验文件、规范和标准。 检查与试验计划包含 Sloar 公司的相关文件要求，也可以包含可接受的买方规定的要求。

Gas Turbine Engine Testing. The gas turbine engine is tested in accordance with Solar Specifications to confirm that power, heat rate, and vibration levels meet Solar standards.
燃气燃气轮机发动机试验： 按照 Solar 公司的规定进行燃气燃气轮机发动机试验，以确认功率、热效率和振动等级符合 Solar 公司的规定。

Generator Testing. The generator is tested in accordance with IEEE Standard Specifications and Solar Specifications at the generator manufacturer's plant. These tests satisfy requirements for NEMA and Solar. Supplier testing is under periodic Solar quality control review to ensure compliance with required specifications.
发电机试验： 按照 IEEE（电气与电子工程师协会）的标准规范和 Solar 公司的规范在发电机制造商的工厂内对发电机进行试验。 这些试验满足 NEMA（美国全国电器制造商协会）和 Solar 公司的要求。 Solar 公司对供应商的试验质量进行定期控制检查，以确保符合要求的规定。

Quality Assurance. All testing operations are conducted under the direct control of Solar's Quality Assurance Activity. This Activity ensures compliance with the specified test limits and procedures.
质量保证： 所有试验作业都在 Solar 公司的质量保证活动的直接控制之下。 质量保证活动确保了试验作业满足规定的试验限制和程序。

Quality Control engineers maintain surveillance over the manufacture of all purchased parts and subassemblies, and are responsible for functional testing of incoming components. The same rigid standards applied to parts manufactured by Solar are applied to all parts from suppliers.
质量控制工程师对所有部件和组件的制造进行监督，负责对进入现场的元件进行功能性试验。 供应商提供的所有零部件与 Solar 公司制造的零部件采用同样严格的标准。

Customer Participation to Observe on Noninterference Basis. The purchaser is provided access to Solar's Production Test facilities to observe factory production tests scheduled in accordance with production and testing schedules. Unavailability of the purchaser shall not be cause for delay in the performance of the production tests.

在不干扰试验流程的基础上，用户可以观看试验。 买方可以进入 Solar 公司的生产试验设施内，观看按照生产与试验计划安排的工厂生产试验。 买方不能到场时，生产试验不得延误。

Quality Control Documentation. A Quality Control Data Book is provided and contains the following typical data and documents:
质量控制文件： 提供一本质量控制数据手册，手册中含有下述典型数据和文件：

- Engine and Package Acceptance Test Report
- Generator Test Report
- Solar Certificate of Compliance
- 发动机及成套设备验收试验报告
- 发电机试验报告
- Solar 公司的合格证明书

NEC Compliant Package Without Certification. The package complies with the applicable requirements of the National Electrical Code (NEC) but overall package certification is not provided.
符合 NEC（美国国家电气规程）而没有证明书的成套设备： 成套设备符合 NEC（美国国家电气规程）的适用要求，但是所有成套设备没有提供证明书。

AIR INLET SYSTEM
进气系统

The air inlet system typically consists of all components upstream of the engine inlet collector that are necessary to supply a clean, smooth flow of air to the turbine. The inlet air system components, silencers, ducting, and air inlet filter are designed to accommodate the required flow as specified on the Mechanical Interface Drawing. At this flow, the inlet pressure loss will be as low as practical consistent with requirements for cost, air filtration and acoustical attenuation. For a standard turbine air inlet arrangement, this loss is normally expected to be less than 102 mm (4 in.) of water with a clean air filter. Non-standard turbine air inlet arrangements may have higher expected losses.
进气系统通常包括发动机进口集管上游的所有部件，这些部件是向燃气轮机提供清洁、稳定的空气流所必需的。 进气系统的构件、消声器、管道和进气过滤器设计得可以供给机械界面图纸上规定的流量。 在这一规定的流量下，进口的气压损失将尽可能低，并符合成本、空气过滤和声衰减的要求。 对于标准的燃气轮机进气口布置，在安装一个清洁空气过滤器的情况下，预计这一气压损失通常小于 102 毫米（4 英寸）水柱。 燃气轮机进气口非标准排列时，预计这一气压损失会较高。

Medium Velocity Type Air Filter (3-Stage) up draft. A 3-stage medium velocity type air filtration system is included. This system provides efficient removal of salt, water and particulates. The filter housing is equipped with an access door for changing out the second and third stage filter elements. Standard features include:
中速型空气过滤器（三级），吸气口朝下。 包含了一个三级中速型空气过滤系统。 这一系统能有效去除盐、水和微粒。 过滤器罩上安装一扇通道门，用于更换二级和三级过滤元件。 标准特征包括：

- First stage is self cleaning filter
- Second stage pre-filter
- Third stage high efficiency HEPA filters, min grad H10
- Transition outlet flange
- Lifting lugs
- Differential pressure gauge
- Differential proessure transmitter
- Left-hand side access door
- Carbon steel construction

- 第一级是自清式过滤器
- 第二级预过滤器
- 第三级高效微粒空气过滤器，最低等级 H10
- 过渡出口法兰
- 吊环
- 差压计
- 差压变送器
- 左手侧通道门
- 碳钢结构

Turbine Air Inlet Silencer. A carbon steel inlet silencer with support brackets is included.
燃气轮机进气口消声器： 提供一个带支架的碳钢进气消声器。

EXHAUST SYSTEM
排气系统

An exhaust system is provided and designed to ensure a smooth transition from the turbine exhaust to the heat recovery system or the exhaust silencer. Ideally, pressure losses should be as low a possible to provide for best possible turbine performance. Typically, pressure losses will be on the order of 4 inches water column (w.c.) (102 mm w.c.) for a system with a silencer, and on the order of 6 to 10 inches w.c. (152 to 254 mm w.c.) for a system with heat recovery. Exhaust system components supplied by Solar are designed to withstand a 120-mile per hour (193 km/hr) wind load when properly installed.
提供一个排气系统，设计成能够保证燃气轮机排气系统到热回收系统或排气消声器的平稳过渡。 理想的情况是，压力损失应该尽可能低，以尽可能提供最佳的燃气轮机性能。 对于安装消声器的系统，压力损失通常为 4 英寸水柱（102 毫米水柱），对于安装热回收装置的系统，压力损失通常为 6 至 10 英寸水柱（152 至 254 毫米水柱）。 Solar 公司提供的排气系统部件的设计应保证在适当安装时能够抵抗 120 英里/小时（193 千米/小时）的风荷载。

Exhaust System Ducting – Carbon Steel
排气系统管道－碳钢

Companion flange: 6 ft (1.8 m) inside diameter.
- Bellows, 6 ft Diameter, 24.25 in. Long, Carbon Steel

配对法兰：内径 6 英尺 (1.8 米) 。
- 波纹管：直径 6 英尺 、 长度 24.25 英寸、碳钢材质

An exhaust duct bellows (for thermal expansion) is included.
包括一个排气管道波纹管（用于热膨胀）。

- Flange: 6 ft diameter
- Length: 24.25 in.
- Collar, liner and bellows: ASTM A240 T321
- Minimum bellow material thickness: 0.028 in.
- Flanges and lugs: ASTM A516-70

- 法兰：直径 6 英尺
- 长度：24.25 英寸
- 套圈、衬圈和波纹管：ASTM A240 T321
- 波纹管材的最小厚度：0.028 英寸

- 法兰和凸片： ASTM A516-70

The expansion joint installed length allows up to 3.0 in. of compression and a lateral movement of 1/4 in. lateral movement.
膨胀接的安装长度最多容许 3.0 英寸的压缩和 1/4 英寸的水平位移。

ENCLOSURE
消防隔音罩

Basic Construction. An all-steel enclosure is provided for the complete package. The enclosure is self-contained, weatherproof, insulated, sound-attenuated, and assembled on the turbine package base.
基本结构：为整套设备提供一个全钢的自支撑结构。消防隔音罩结构为整装式、防水、绝缘、降噪音，安装在燃气轮机设备基座上。

The enclosure is constructed with a solid roof, and doors that open to provide access and clearance for engine and gearbox removal. Enclosure doors are placed in key locations for access of major components requiring inspection and maintenance, and removal by forklift or overhead crane. Internal maintenance trolley rails are located above the turbine and the gearbox. The enclosure walls and roof are treated with fiberglass material for noise attenuation and thermal insulation. The enclosure is constructed to support a roof load of 50 pounds per square foot and to withstand a wind load of 120 miles per hour.
消防隔音罩结构上有一个结实的顶盖，有移出发动机和变速箱的开门。消防隔音罩结构上的门布置在能接近关键设备的位置，便于使用叉车或吊车移出检查、维修和移除的主要部件。内部维修用的滑轮轨道布置在燃气轮机和变速箱之上。消防隔音罩的顶盖和墙壁用玻璃纤维材料做降噪音和隔热处理。消防隔音罩结构应能够支承 50 磅/平方英尺的顶盖荷载，抵抗 120 英里/小时的风荷载。

The package control panel is installed in the exterior wall of the enclosure.
设备控制面板安装在消防隔音罩结构的外壁上。

Sound Attenuation. The sound-attenuated enclosure is intended for use with suitable turbine air inlet and exhaust silencing systems in environments where lower noise levels are required. Ventilation openings are equipped with suitable silencers for additional sound attenuation. For additional sound data, reference "Noise Prediction, Guidelines for Industrial Gas Turbines" (Solar publication SPNP/898/4M).
消音： 在需要较低噪音等级的环境中，使用消音的消防隔音罩结构，安装合适的燃气轮机进气与排气消声系统。在通风口安装合适的消声器，进一步消音。要了解更多的噪音数据，请参考“工业燃气轮机噪音预估指南”（Solar 公司出版 SPNP/898/4M）。

Exterior Connections. Connections for the oil tank vent line, ventilation fan wiring, CO_2 fire suppression systems, and the turbine air inlet and exhaust are terminated outside of the enclosure.
外部连接管： 油箱通气管、通风机电线、二氧化碳灭火系统和燃气轮机进气与排气管的连接管的末端位于消防隔音罩结构外部。

Enclosure Lights. Incandescent lights are provided inside the enclosure with an on/off switch located near the enclosure door.
消防隔音罩结构照明：消防隔音罩内部安装白炽灯，开关位于消防隔音罩的门附件。

Ventilation System. The enclosure ventilation is AC motor driven. The fan supplies the airflow required for generator cooling, and ensures that the air temperature inside the enclosure remains within acceptable limits. Openings to provide adequate flow of ventilation air are strategically positioned on the enclosure roof. Standard elbow type enclosure inlet and exhaust ventilation is included as part of the enclosure scope.

通风系统： 消防隔音罩的通风采用交流电机驱动。风机提供发电机冷却所需的气流，确保消防隔音罩内部的空气温度在可接受的限度内。提供足够通风空气的开孔位于消防隔音罩结构的顶盖上。标准的弯头形进气与排气通风管道作为消防隔音罩结构的一部分。

Dust Protection System. The enclosure inlet vent is equipped with filter units consisting of disposable, barrier type panel filters to remove dust and sand. The exhaust vent also contains back draft dampers to prevent dust ingress when unit is not running.
防尘系统： 消防隔音罩进气孔安装过滤装置，过滤装置包含一次性的屏障型板式过滤器，用于清除灰尘和砂子。 排气孔也包含逆通风挡板，当装置不运行时，能阻止灰尘进入。

Fire Detection and Suppression. The complete system required for fire detection and suppression consists of a number of elements, not all of which are in Solar's scope of supply. The design, installation and regulatory approvals for the complete fire system are the responsibility of the owner and must comply with all the requirements and regulations for the geographic area in which it will be installed and operated. When properly installed and tested, the completed system will meet the requirements of the U.S. National Fire Protection Association (NFPA) Code 12. Solar's scope includes:
火灾探测与灭火： 整个火灾探测和灭火系统包括许多元件，不完全由 Solar 公司提供。 业主负责整个消防系统的设计、安装和注册审批，必须满足消防系统安装和运行区域所在地的要求和规定。 在正确安装和测试之后，整个系统将满足美国国家防火协会（NFPA）规范 12 的要求。Solar 公司的供货范围包括：

An automatic, electronically controlled fire detection and monitoring system installed in the enclosure. The primary fire detection system uses multi-spectrum infrared (MIR) detectors due to their superior performance for enclosed gas turbine applications. The secondary fire detection system consists of rate-compensated thermal detectors. The two detection methods operate independently. If fire is detected, the system activates the suppression system and communicates with the *Turbotronic* 4 package control system to initiate a shutdown.
一个安装在消防隔音罩内部的自动的、电动控制的火灾探测与监控系统。主火灾探测系统使用多谱红外探测器，因为它们对于封闭的燃气轮机具有优越的探测性能。 次火灾探测系统使用额定补偿的热探测器。 两个探测系统独立运行。当探测到火灾时，系统启动灭火系统并与 *Turbotronic* 4 设备控制系统通讯，并且开始停机。

Indicator lights, strobe lights and an alarm horn mounted on the package exterior. Included are a keyswitch to inhibit the system and a push button switch for manual activation.
安装在设备外表面上的指示灯、闪光灯和警报器。包括一个限制系统的按键开关和一个用于人工启动的按钮开关。

Rack-mounted carbon dioxide cylinders that provide primary total flooding distribution and secondary metered distribution to maintain the design concentration of 37% carbon dioxide for 20 minutes.
安装在机架上的二氧化碳罐向主灭火系统提供全淹没二氧化碳，向次灭火系统提供计量的二氧化碳，使次灭火系统 37％的二氧化碳浓度持续 20 分钟。

The following required items are not in Solar's scope of supply:
下面必要的部件不由 Solar 公司提供：

Approved interconnecting piping, pressure switches and manual lockout valves.
经认证的的连接管管、压力开关和人工闭锁阀门。

NFPA-12 total flooding test of the system at site.
符合 NFPA-12 要求的灭火系统全泻放现场试验。

Combustible Gas Monitor. A single-channel combustible gas monitoring system is provided to continuously monitor for combustible gases within the enclosure. The gas sensor is monitored by the fire and gas detection / release system.

可燃气体监测器： 提供一个单通路可燃气体监测系统，连续监测消防隔音罩结构内的可燃气体。可燃气体传感器由火灾与气体探测/释放系统监测。

The start signal is interlocked with the combustible gas monitoring system to ensure the atmosphere is clear prior to initiating turbine engine start. An alarm or engine shutdown is initiated if the gas monitor fails.
起动信号与可燃气体监测系统联锁，以确保大气在起动燃气轮机发动机之前是干净的。如果可燃气体监测器出现故障，发出报警或停止发动机。

Package warning signs in English and Chinese. Provide warning signs (labels) for gases in Engilsh and Chinese on package enclosure.
英文和中文版设备警告标志。 在设备消防隔音罩结构上提供英文和中文版可燃气体警告标志。

DUST AND/OR MOISTURE PROTECTION
防尘和/或防潮

Barrier-Type Filter. The enclosure ventilation inlet for each enclosure compartment is equipped with a single-stage, disposable, barrier-type filter unit equipped with a DP alarm switch. The ventilation exhaust openings are equipped with back-draft dampers to prevent ingress of dust when the unit is not running.
屏障型过滤器： 每个消防隔音罩结构间隔区的通风进气口安装一个单级的、一次性的、屏障式过滤器，过滤器上带有一个压差报警开关。 通风排气孔安装一些逆向通风挡板，当装置不运行时，能阻止灰尘进入。

FIRE AND GAS DETECTION
火焰与可燃气体探测器

Fire and Gas Detection and Monitoring System. An automatic, electronically controlled fire and combustible gas detection and monitoring system is installed in the enclosure. The primary fire detection system uses multi-spectrum infrared (MIR) detectors due to their superior performance for enclosed gas turbine applications. The system includes an automatic optical integrity feature to provide a continuous check of the optical surfaces, detector sensitivity and electronic circuitry of the detector-controller system and automatic fault identification with digital display of system status in numerical code. The secondary fire detection system consists of rate-compensated thermal detectors. The two detection methods act independently in detecting and reporting a fire.
火焰与可燃气体的探测与监控系统：在消防隔音罩内部安装一个自动的、电动控制的火焰与可燃气体探测与监控系统。主火灾探测系统使用多谱红外探测器，因为它们对于封闭的燃气轮机具有优越的探测性能。系统具有自动的光学整体特征，对探测器－控制器系统的光学表面、探测器敏感度和电子电路图进行连续的检查，系统状态数字显示器以数字码的形式自动确定故障。 次火灾探测系统使用额定补偿的热探测器。在探测和报告火灾时，两种探测方法相互独立。

The fire and gas system control panel provides system supervision (for open circuit, ground fault or loss of integrity), initiates alarm and release of fire suppression agent and visual display of system status. The suppression system agent release is activated automatically with release solenoids located on the fire suppression skid. The suppression system can also be activated by electrical push button on the turbine enclosure or manually at the suppression skid. If a fire is detected, the detectors transmit an electrical signal to the fire and gas system control panel to activate the fire alarm and suppression system.
火焰与可燃气体系统控制面板提供系统监视（开路、接地故障或整体性损失），启动报警、灭火剂释放以及系统状态的视觉显示。 灭火系统的灭火剂释放由灭火滑轨上的释放螺线管自动启动。 灭火系统也可以通过燃气轮机消防隔音罩结构上的电气按钮启动或者通过灭火滑轨人工启动。 探测到火灾时，探测器将电子信号传输至火与气体系统控制面板来启动火灾报警和灭火系统。

The enclosure is equipped with two gas detectors: one at the turbine enclosure ventilation air inlet and one at the ventilation exhaust to provide continuous monitoring for combustible gases at the enclosure ventilation inlet and outlet. The detectors are diffusion-based, point-type infrared devices that provide

continuous monitoring of combustible hydrocarbon gas concentrations. The turbine start signal is interlocked with the fire and gas monitoring system to ensure the atmosphere is safe prior to initiating turbine engine start.
消防隔音罩结构上安装两个气体探测器。 一个位于燃气轮机消防隔音罩结构的通风进气口，另一个位于通风排气口，分别用来连续监测消防隔音罩结构通风进气口和排气口的可燃气体。 探测器是基于扩散的点式红外装置，能连续监测可燃碳氢气体的浓度。 燃气轮机起动信号与火灾和可燃气体监测系统联动，以确保大气在起动燃气轮机发动机之前是安全的。

FIRE SUPPRESSION SYSTEM
灭火系统

CO_2 Fire Suppression System. The enclosure is equipped with a CO_2 fire suppression system consisting of a primary total flooding distribution system and a secondary metered distribution system to extend the design concentration of 34% CO_2 for 20 minutes. The system is designed in accordance with the U.S. National Fire Protection Association Code 12.
二氧化碳灭火系统： 消防隔音罩内安装一个二氧化碳灭火系统，由主全淹没灭火系统和次计量灭火系统组成，使二氧化碳设计浓度 34％持续 20 分钟。 系统按照美国全国消防协会规范 12 进行设计。

On detection of fire, the detectors transmit an electrical signal via the fire control panel to activate the fire suppression system release solenoids located on the fire suppression skid. On receipt of this signal, the solenoid actuated control heads activate the discharge valves on the primary and extended extinguishing cylinders, releasing the extinguishing agent into the enclosure. CO_2 pressure actuates the pressure trip operated dampers that close all vent openings. CO_2 release control heads are also provided with manual release levers.
探测到火灾时，探测器通过火灾控制面板输送电子信号，启动位于灭火滑轨上的灭火二氧化碳释放螺线管。 收到信号后，螺线管驱动控制头，控制头启动主灭火罐和扩展灭火罐上的排泄阀，向消防隔音罩结构内释放灭火剂。 二氧化碳的压力驱使压力跳闸装置启动所有通风口挡板。 二氧化碳释放控制头也安装人工释放杠杆。

FIRE SUPPRESSANT CYLINDER CABINET
灭火剂钢瓶柜

CO_2 Fire Suppressant Cylinder Cabinet. The weatherproof fire suppressant cylinder cabinet is sized to house the CO_2 extinguishant cylinders and is equipped with doors for servicing. The manual pull levers are routed, by cable, to break glass pull stations on the exterior wall of the cabinet.
二氧化碳灭火剂钢瓶：防风雨的灭火剂钢瓶柜用于放置二氧化碳灭火剂钢瓶，设置用于维修的门。手动拉杆连接在上面，用缆线连接，用于破碎柜子外壁上的手拉式报警箱的玻璃。

CO2 Isolation Valves, Pressure Switches, and Software. Two (2) 3-way bypass valves with limit switches for off-skid installation; two (2) pressure switches; and the software to control the off-skid CO_2 isolation valves are supplied as part of the Turbine Fire and Gas Detection and Control System.
二氧化碳隔离阀、压力开关和软件。 橇外安装的两个三通旁通阀带位置开关，两个压力开关，并提供控制二氧化碳隔离阀的软件，作为燃气轮机火灾与气体探测与控制系统的一部分。

Equipment Handling System
设备移动系统

An equipment handling system is provided, consisting of:
提供一个设备处理系统，包括：

- Two external trolley beam extensions (one 9-ft and one 10-ft long) with support A-frame for turbine handling.
- One external (10-ft long) trolley beam extension with support A-frame for package component handling.

- One 6-ton and two 4-ton movable chain-fall hoists, trolleys and lift attachments (shackles and lift strap) for turbine and package component handling.
- 两个外部吊重伸长梁（一个长 9 英尺，另一个长 10 英尺），带 A 型框架支架，用于燃气轮机移动
- 一个外部吊重伸长梁（长 10 英尺），带 A 型框架支架，用于设备组件移动
- 一个 6 吨、两个 4 吨的可移动起吊葫芦、吊运车和提升附属工具（带销 U 形钩和提升带），用于燃气轮机及设备组件处理

The trolley beam extensions allow turbine removal through the side of the enclosure. One end of each beam extension attaches to an inside trolley rail; the other end is supported by the floor standing A-frame. The gas turbine can then be removed through the enclosure side and placed on a truck bed or cart.
借助于吊重伸长梁，可以在消防隔音罩结构一侧移动燃气轮机。每根伸长梁的一端与一个机组内部吊运轨道相连，另一端架在支撑在地面上的 A 型框架上。 这时，可以从消防隔音罩一侧移动燃气轮机，将其放在货车或平板车上。

CUSTOMER SERVICES
售后服务

Field Verification Test. Concurrent with the start-up and commissioning, Solar will perform a site performance verification test of the turbine-generator set following the “Site Test Procedure for Solar PG Generator Sets”. This test is based on recorded data taken from the package instrumentation.
现场验证试验： 在启动和试运行的同时，Solar 公司将按照“Solar 公司 PG 发电机组现场试验程序”对燃气轮机发电机组进行现场性能验证试验。 试验所用的数据来自于设备仪表上记录的数据。

The field verification test confirms the factory engine performance. The results of the field test shall be considered to be a demonstration of the contractual site performance guarantees for:
现场验证试验证实工厂发动机的性能参数。现场试验的结果应视为证实了合同中规定的现场性能保证值：

- Gas Turbine Full Load Output Power
- Gas Turbine Heat Rate
- 燃气轮机满负荷输出功率
- 燃气轮机热耗值

To ensure accurate gas turbine engine performance measurements, the following conditions must be met:
为了确保准备测量燃气轮机的性能，必须满足下述条件：

- The Test shall be performed within 30 days of initial startup, and before accumulating 400 hours of operation
- A detergent wash shall be performed before testing
- Before the start of the test period, the gas turbine engine must have operated between 90% and 100% load for a minimum of 4 hours
- 必须在首次启动之后的 30 天之内且工作时间累计不超过 400 小时之前进行试验
- 在试验之前，用清洁剂清洗
- 在试验周期开始之前，燃气轮机必须至少已经以 90％－100％负荷运行 4 小时。

The customer must provide the following:
用户必须提供下述：

- The gas turbine generator set must be completely installed and ready for operation
- The Solar representative shall have free, uninterrupted access to the site for one visit to complete the test procedure
- The capability to operate at 100% load
- A laboratory analysis of the fuel that includes the Lower Heating Value

- 燃气燃气轮机发电机组必须完全安装好，并做好运行准备。
- Solar 公司的代表可以在不受干扰的情况下自由进入现场进行考察，以便完成试验程序。
- 保证发电机组能满负荷运行。
- 需要提供实验室分析报告，包括燃料低热值。

Site Training. Concurrently with the start-up and commissioning at the customer's site, Solar will provide basic hands-on training to familiarize the primary operators with the operation and maintenance of the Solar turbine-generator set. The training includes the following topics:
现场培训： 在用户现场启动和初运行的同时，Solar 公司将提供基本的实习培训，帮助主操作员熟悉 Solar 燃气轮机发电机组的操作与维修。 培新内容包括下述：

- Package Overview
- Package Operation
- Scheduled Maintenance
- Basic Troubleshooting
- Safe Package Operation

- 成套设备纵览
- 成套设备操作
- 计划性维修
- 基本故障检修
- 设备安全操作

Students will be capable of performing basic package operations and maintenance at the end of commissioning.
在试运行结束时，学员将能够进行基本的设备操作与维修。

SERVICE PARTS
售后服务配件

Start-up / Commissioning Consumable Parts with Hand Tool kit. This start-up set includes parts that are most commonly consumed during the normal equipment start-up and commissioning process. It also includes a standard hand tool kit for remote or international sites where SAE hand tools are not available. The complete set is shipped to the customer site to be on hand at the time of start-up in order to provide for the immediate on-site availability of these parts, helping to minimize delays in the commissioning process. The parts included in this set are:

启动/试运行用的消耗件（带手工工具箱）：启动消耗件包括正常设备启动和初运行期间最经常消耗的零部件。 也包括一个标准的手工工具箱，用在没有 SAE 手工工具可用的远距离项目现场或国际项目现场。 向用户现场运输完整的维修件，以便用户在启动时可以立即在现场获得这些零部件，这有助于将初运行过程的延误减小到最低。 这些零部件包括：

One (1) spare hydraulic fitting kit
一个备用液压接头工具箱

One (1) set of lube-oil and fuel filtration elements for each package
为每个设备提供一套润滑油和燃料过滤元件
One (1) SAE hand tool kit
一个 SAE 手工工具箱
An assortment of gaskets, o-rings, other sealing media, and miscellaneous electrical components
各类垫圈、O 形环、其它密封介质和其它电气部件。

Operation Consumable Parts - 2 Years. A two-year supply of consumable parts routinely used during the operation and maintenance of the turbomachinery is supplied with this service parts set. The set includes lube oil and fuel filtration elements to support two (2) years of scheduled maintenance, as well as consumable items such as gaskets, o-rings, and other sealing media used to facilitate minor and routine operational maintenance tasks.

操作消耗件－2 年： 在提供维修件的同时，也提供燃气轮机械日常操作与维护期间用的消耗件，供给期限为 2 年。 操作消耗件包括能供 2 年计划维修使用的润滑油和燃料过滤元件，已经垫圈、O 形环等各种消耗件，和各种小维修任务和日常操作维修任务所用的其它密封介质。

(Optional) 5-Day Power Generation Principles and Applications, Customized. The PG Principles and Applications course reviews basic electricity principles to enhance the participants' ability to operate and adjust the major elements of a turbine-driven electric power generation package. Specific details of the generator, voltage regulator, automatic synchronization system, speed control systems, VAR/Power factor controller, and combined generator control module system are discussed in class. Laboratory activities permit students to practice adjustment and testing of some of the primary control devices found on Solar's power generation packages.

（可选的）为期 5 天的发电原理及应用课程，为用户定制的。发电原理及应用课程综述了基本的发电原理，帮助参与者提高操作和调整燃气轮机驱动的发电设备的主要组件的能力。 在课堂上会讨论发电机、电压调节器、自动同步系统、速度控制系统、无功功率/功率因数控制器和组合发电机控制模组系统的具体内容。 实验室的活动允许学员练习调整和测试 Solar 发电设备上的一些主要控制装置。

The Operation and Routine Maintenance course or equivalent experience are pre-requisites for this course that focuses specifically on power generation principles and applications.

操作与日常维修课程或同等经验是学习这一专门讲述发电原理及应用的课程的前提。

A student workbook is supplied on the first day of class; and a Certificate of Completion is awarded to participants at the successful completion of each course.

上课的第一天，为每个学员发一本工作薄；学员每成功完成一门课程，会颁发一本结课证书。

This course is custom tailored based on a needs assessment discussion between the Customer and Solar, it takes into account the customer's specific package configuration, and utilizes standard course content along with the use of the customer's package drawings and set points, as well as other particular information unique to their application. The course is limited to 10 participants per session.

这一课程是在用户与 Solar 公司之间进行需求评估讨论的基础上定制的，考虑了用户的具体设备配置，利用标准课程内容，使用了用户的设备图纸和设定值，以及用户应用方面的一些独特信息。 该课程每期限定 10 位参与者。

The customer is responsible for contacting their local sales office to assess and discuss course content, location and schedules.

用户负责联系当地的销售办事处，让其评估和讨论课程内容，授课地点和计划。

The customer also needs to confirm the booking and reservation for the customized class at least 60 days in advance, coordinating with the local Solar sales office; or directly with Solar's Technical Training department by phone or fax to the Registrar located in San Diego, CA:

用户还需要与当地的 Solar 公司销售办事处协调，提前 60 天确认课程的预定和保留；或者直接联系 Solar 公司的技术培训部，可以给位于加利福尼亚州圣地亚哥的注册主管打电话或发传真。

Tel: (++1) 858-715-2060

电话: (++1) 858-715-2060

Fax: (++1) 858-715-2080

传真: (++1) 858-715-2080

The dates reserved are subject to rescheduling to mutually acceptable dates based on project progress, instructor availability and other factors.

根据项目进展、指导人员是否有时间和其它因素，预定的日期可能重新安排，以便确定相互都能接受的日期。

All registrations will be acknowledged upon receipt, then confirmed by the Registrar 30 days prior to the course date. Solar Turbines does not provide compensation for nonrefundable travel plans, including airline tickets, it is therefore recommended that the customer not commit to nonrefundable transportation arrangements until receipt of the 30-day confirmation.

注册主管在收到注册信息时，会向所有注册者发出感谢信，并且会在开课日期 30 天之前确认所有注册。Solar 燃气轮机公司不为不退费的行程计划（包括飞机票）提供补偿，因此，建议用户在收到提前 30 天的确认之前，不要安排不可退费的行程。

The course can be conducted at the San Diego training facility which would include a factory site visit of Solar's main packaging operations, located adjacent to the training facilities in San Diego. Arrangements can be made to conduct the training at alternate Solar training sites or at the Customer's location.

可以在圣地亚哥的培训设施内授课，这样可以参观圣地亚哥培训设施附近的工厂现场的主要 Solar 设备的操作。 培训可以安排在 Solar 公司的培训现场或用户处。

All course materials and presentations are in English unless otherwise arranged
除非另有安排，课程用的所有材料和讲课的语言为英语。

SCOPE CLARIFICATIONS AND EXCLUSIONS

供货范围澄清及分界

BASIC PACKAGE
基本设备

The Customer is responsible for any and all civil works, including anchor bolts, above and below ground. The Customer is also responsible for the unloading, positioning, and installation of all equipment provided by Solar.
客户负责所有的土建工程，包括地上和地下的固定螺栓。客户也应负责 Solar 公司提供的所有设备的卸货、定位及安装。

The Customer must provide site power, external cabling to and from specified limits of supply (as defined in Solar's proposal), electrical assembly, local interconnections, external wiring, and electrical utilities necessary for construction, installation, and testing.
客户必须提供为规定供应的设备（Solar 公司的建议书中有所规定）提供现场动力和外部电缆、电气组件、局部互联管、外部配线以及施工、安装和试验所必需的电气设施。

Solar is not responsible for distribution of water during construction; HRSG make-up water tanks, deaerators, and water treatment plants; external piping to and from limits of supply (as defined in Solar's proposal); and mechanical assembly of interconnect piping; and water utilities necessary for construction, installation and testing. The Customer is also responsible for all potable water supplies, drainage and sewage systems.
Solar 公司不负责施工期间的供水；HRSG（余热锅炉）补水箱、除氧器和水处理设备；规定供应的外部管道（Solar 公司的建议书中有所规定）；互联管道的机械组件；施工、安装和试验必需的供水设施。 用户还要负责所有饮用水供给系统、排水系统和污水处理系统。

Site facilities, such as maintenance structures, offices, sanitary facilities, storage rooms, etc. are the Customer's responsibility. The Customer must also provide all external lighting, lightning arrestors, and earthing.
客户负责现场的设施，如维护结构、办公室、卫生设备和储存室等。 客户也必须提供所有外部照明、避雷器和接地。

The Customer is responsible for all site preparation, waste removal, preparation of site access roads, and site permits and licenses (e.g. construction, air, fire, and working permits). All working visas, approvals and requirements of local authorities, taxes, duties, fees and custom clearance levied in the country of installation must be supplied by the Customer.
客户负责所有现场准备、废料清除、现场便道准备、现场出入证及许可证（即施工、空气、用火和工作许可证）。 客户必需提供设备安装所在地方的当局要求的所有工作许可、批准和设备安装所在国征收的税、关税、规费和海关许可证。

START SYSTEM
启动系统

Direct Drive AC Start Motor. The direct drive AC start motor's variable frequency drive (VFD) controller requires installation in a clean and dry environment by the Customer.
交流电直接驱动电动机：客户需要将直接驱动式交流电起动电动机的变频驱动控制器安装在清洁干燥的环境中。

FUEL SYSTEM
燃料系统

The Customer must supply all fuels and interconnection fuel piping for the installation, testing, and operation of the gas turbine generator set at the required package skid edge pressures, temperatures and flows as defined by Solar. All fuels must meet the requirements of Solar Specification ES 9-98.
客户必须为燃气轮机发电机组的安装、试验和操作提供所有燃料和燃料管道，在 Solar 公司要求的到设备边缘压力、温度和定义的燃料流量状态下进行发电机组的安装、试验和操作。所有燃料必须满足 Solar 公司的 ES 9-98 规范的要求。

Liquid Fuel. An off-skid means for disposal of liquid fuel waste and a supply of clean, dry, compressed air is required and shall be supplied by the Customer. The quality of the air must meet the requirements of Solar Specification ES 2201.
液体燃料：要求客户提供橇外安装的液体燃料废料处理装置，提供清洁、干燥的压缩空气。空气的质量必须满足 Solar 公司的 ES 2201 规范的要求。

Low BTU Fuel System. Solar will provide a package gas fuel system suitable for low caloric value fuels with a Wobbe index in the range of 800 or less. The fuel system requires parallel fuel valves system and dual (independent)or single (synchronous) control. For conventional Combustion engine only.
低热值燃料系统：Solar 公司将提供适用于低热值燃料的设备气体燃料系统，华白数不大于 800。燃料系统需要平行的燃料阀系统和双重（独立的）或单重（同步的）控制。仅适用于常规燃烧系统。

Block and Bleed Off-Skid Module with Leak Detection. The interconnect piping and wiring between the off-skid module and the turbine package are not part of the scope of supply. The installation of the off-skid block and bleed module is to be performed by the customer upstream of the turbine package gas fuel system.

橇外装的燃料隔离和泄放模块（带泄露检测装置） 橇外装模块与燃气轮机设备之接的联接管道和配线不在供货范围之内。 客户负责在燃气轮机设备的气体燃料系统的上游安装橇外装燃料隔离和泄放模块。

Liquid Fuel Boost System. A Customer-supplied liquid fuel boost system is required to increase the pressure of the fuel supply at the generator package skid edge to the required pressure for the application.
液体燃料加压系统：需要客户提供一个液体燃料加压系统，将到达发电机设备边缘的燃料供给压力增加至需要的应用压力。

Liquid Fuel Filter Skid. The installation, plumbing, and connections of the liquid fuel filter skid must take place at the operating site and are not part of Solar's standard offering.
液体燃料过滤撬：液体燃料过滤撬的安装、管道连接必须在操作现场进行，它们不是 Solar 公司标准供货的一部分。

LUBE OIL SYSTEM
润滑油系统

Lube Oil Vent Separator. A separator support structure, and the interconnect piping between the package flanges and the lube oil vent separator must be supplied by the Customer.
润滑油排气油气分离器： 用户必须提供设备法兰与润滑油通气孔分离器之间的分离器支撑结构和连接管道。

Lube Oil Cooler. The Customer must supply all interconnect piping between the generator set skid edge flanges and the lube oil cooler. The Customer is also responsible for providing the cooling media.
润滑油冷却器： 客户必须提供发电机组橇装边缘法兰与润滑油冷却器之间的所有互联管道。客户也应负责提供冷却介质。

Lube Oil. The Customer must supply all lube oil required for the operation of the turbine-generator set. All lube oil must meet the requirements of Solar Specification ES 9-224.
润滑油： 客户必须提供操作燃气轮机发电机组所用的所有润滑油。润滑油必须满足 Solar 公司的 ES 9-224 规范的要求。

CONTROL SYSTEM
控制系统

Auxilliary Desktop Computer and Monitor. The Customer must supply the wiring from the generator set package to the auxiliary desktop computer.
辅助台式电脑和监视器： 客户必须提供从发电机组设备到辅助台式电脑的配线。

English and Chnese display labels. Package and offskid auxiliary display to be in both English and Chinese language.
英文与中文显示标记： 设备和橇外安装辅助显示器均使用英文和中文。

Ethernet Supervisory Interface. The Customer is responsible for providing the hardware and software interfaces to the system.
Ethernet 通讯界面：客户负责提供系统的硬件与软件界面。

Chinese/English Language Display. Chinese display capability on TT4000 display systems.
中文/英文显示： TT4000 显示系统能够显示中文。

Heat Recovery Interface. The turbine control does not provide control of the diverter valve, duct burner or other components in the heat recovery system.
余热回收界面： 燃气轮机控制不包括对烟气三通阀、管道燃烧器或其它余热回收系统的其它构件的控制。

GENERATOR CONTROL AND MONITORING
发电机控制与监测

Sync Check and Generator Protective Relays. Utility grade approved generator protection relays are not provided, and must be supplied by the Customer.
同期检查与发电机保护继电器： 公用电网等级的发电机保护继电器不在供货范围之内，必须由客户提供。

Motorized Voltage Adjust. An additional raise / lower switch is not provided to adjust the voltage set point from a remote location.
调压器控制：不提供从远端位置调整电压设定值的升压/减压开关。

ACCESSORY EQUIPMENT
附属设备

Compressed Air for Self-Cleaning Filter. The Customer must provide compressed air for use in the self-cleaning turbine air inlet filter, and the interconnect piping between the compressed air source and the self-cleaning filter.
自清洗过滤器用的压缩空气：客户必须提供压缩空气，供自清洗燃气轮机进气过滤器以及压缩空气源和自清洗过滤器之间的互联管使用。

MISCELLANEOUS
其它杂项

CD-ROM Operation and Maintenance Instruction Manuals. The CD-ROM manual set requires a computer provided by the Customer with the following minimum requirements:
存储在 CD-ROM（只读存储光盘）上的操作与维修说明书：CD-ROM（只读存储光盘）说明书要求客户提供一台电脑，电脑的配置应满足下述最低要求：

- Processor: 486 mHz or better
- Operating System: Windows® 3.1, 95 or higher or NT®, UNIX® or Macintosh®
- RAM: 16 MB or better
- Available hard disk space: 9 MB or more
- CD-ROM reader drive speed: 2X or faster
- Software: Netscape Navigator™ Version 4.0 or higher or Internet Explorer™ 4.0 or higher

- 处理器： 486 mHz 或更好
- 操作系统：Windows® 3.1, 95 或更高或 NT®, UNIX® 或 Macintosh® RAM: 16 MB 或更好
- 可用的硬盘空间: 9 MB 或更多
- CD-ROM 阅读器的驱动速度：2X 或更快
- 软件： Netscape Navigator™ 版本 4.0 或更高或 Internet Explorer™ 4.0 或更高

Hydrostatic Testing. All hardware assemblies (fuel gas piping) to be leak tested with helium prior to assembly in package.
静水压试验：所有硬件组件（燃料系统）在装配到设备内之前，用氦气检查是否泄露。

Radiographic (X-Ray). All hydrogen wetted components to receive 100% X-Ray inspection for porosity of casting and integrity of weld.
放射线（X 射线）： 所有氢气接触的部件要用 100％的 X 射线检查铸造的孔隙率和焊接的完整性。

AIR INLET SYSTEM
进气系统

All components supplied with the air inlet system must be supported by the Customer, independently from the turbine package enclosure.
客户必须支撑与进气系统一起提供的所有组件，它们的支撑与燃气轮机设备消防隔音罩结构的支撑相互独立。

EXHAUST SYSTEM
排气系统

For projects where ducting is supplied by the Customer and not Solar, it must be ensured that the components supplied by others are capable of handling high temperature gases on the order of 1000ºF (540ºC). Specific exhaust flow rate and temperature data is included with the performance data in this proposal.
对于由客户提供而不是 Solar 公司提供的管道，必须确保其它供应方提供的组件能够耐受 1000°F (540°C) 的高温气体。本技术附件给出了排气流量和温度性能数据。

Exhaust Ducting. All exhaust ducting must be supported by the Customer independent of the enclosure to maintain loads on engine exhaust within the limits set by Solar's Mechanical Installation drawing. The Customer must also supply personnel protection, insulation and/or lagging.
排气管道：客户必须提供所有排气管道的支撑，独立于消防隔音罩结构，以使发动机排气管道的负荷在 Solar 公司的机械装置图纸规定的限度之内。客户也必须提供人身保护、隔热和/或外套。

ENCLOSURE
消防隔音罩

Exterior Connections. Connections for oil tank vent line, ventilation fan wiring, CO2 fire suppression systems, and turbine air inlet and exhaust are terminated outside of the enclosure. All electrical wiring and mechanical piping external to the generator set package to these connections must be supplied by the Customer.
外部连接管： 油箱通气管、通风机布线、二氧化碳灭火系统、燃气轮机进气与排气管的连接管的终端位于消防隔音罩结构外部。 客户必须提供与这些连接管相连的发电机组设备外部的所有电气配线和机械管道。

Operation Consumable Spare Parts. The turbine combustion air inlet elements are not included in this set. Insurance parts and other non-consumable items are not included in the price for operational consumables and can be quoted separately upon request from the customer after completion of project engineering and bill of material finalization.
运行易损备件：不包括燃气轮机燃烧空气进口过滤器芯。保险零件和其它非消耗零件不包含在工作性消耗件的价格之内，在项目设计完成和材料清单最终确定之后，客户要求报价时，可单独报价。

Utility List

公共工程清单

The following project utility requirements are preliminary and subject to change after receipt of order.
下面的项目设备要求是初步要求，在收到订单之后，可以更改。

ELECTRICAL SYSTEM
电气系统

3-Phase AC Power Rating
Unless otherwise noted, all 3-Phase AC power is rated as follows:

Voltage / Frequency	380 VAC / 50 Hertz

三相交流电额定功率
除非另作说明，所有三相交流电的额定功率如下：

电压/频率	380 VAC / 50 Hz

1-Phase AC Power Rating
Unless otherwise noted, all 1-Phase AC power is rated as follows:

Voltage / Frequency	220 VAC / 50-60 Hertz

单相交流电额定功率
除非另作说明，所有单相交流电的额定功率如下：

电压/频率	220 VAC / 50-60 Hz

GENERATOR

Space Heater Power	1 to 3 kW, 1-Phase

发电机

空间加热器的功率	1 至 3 kW、单相

START SYSTEM
启动系统

Starter Motor

Type	AC Motor with Variable Frequency Drive
Motor Power	93 kW (125 hp) ea of 2 motors, 3-Phase
VFD Rating, Input Current (max)	570 Amps
Space Heater Power	200 W, 1-Phase
Additional Start System Requirements	See Solar Publication PIL 149

起动电动机

类型	交流电机，带变频驱动装置
电机功率	93 kW (125 hp)，2 台电机，3 相
变频驱动装置的额定输入电流（最大值）	570 A
空间加热器的功率	200 W，单相
额外的启动系统要求	见 Solar 公司的出版物 PIL 149

DUAL FUEL SYSTEM

双燃料系统

Natural Gas Fuel Requirements (See skid edge presure requirments for COG),

Gas Fuel Supply Pressure (ISO) (i)	338 psig (2330 kPag)
as Fuel Supply Pressure (min/max)	255 to 382 psig (1758 to 2634 kPag) at 130 to -40°F (54 to -40°C) Ambient
Gas Fuel Supply Pressure (design max)	500 psig (3448 kPag)
Gas Fuel Flow Demand Rate (max)	3225 SCFM (86 Nm^3/min)
Gas Fuel Supply Temperature (min/max) (ii)	-40 to 200°F (-40 to 93°C)
Fuel Quality	See Solar Specification ES 9-98

天然气燃料要求（见焦炉煤气机组边界压力要求）

气体燃料供给压力 (ISO) (i)	338 psig (2330 kPag)
燃料供给压力 (最小值/最大值)	255 至 382 psig (1758 至 2634 kPag) at 130 to -40°F (54 to -40°C) Ambient
气体燃料供给压力 (设计最大值)	500 psig (3448 kPag)
气体燃料流量需求 (最大值)	3225 SCFM (86 Nm^3/min)
气体燃料供给温度(最小值/最大值) (ii)	-40 至 200°F (-40 至 93°C)
燃气质量	见 Solar 公司的 ES 9-98 规范

Liquid Fuel Requirements

Liquid Fuel Supply Temperature (min)	*Whichever is greatest:* -30°F (-34°C), **or** 12 centistokes maximum viscosity, **or** 20°F (-6.7°C) above pour point, **or** 10°F (-12.2°C) above cloud point.
Liquid Fuel Supply Temperature (max)	*Whichever is least:* 160°F (71°C), **or** 1 centistoke minimum viscosity.
Fuel Quality	See Solar Specification ES 9-98

液体燃料要求

液体燃料供给温度（最小值）	取两者中的较大者： -30°F (-34°C)或 12 厘司 最大粘度，或 比流点高20°F (-6.7°C) ，或 比浊点高 10°F (-12.2°C) 。
液体燃料供给温度（最大值）	取两者中的较小者： 160°F (71°C)，或 1 厘司最小粘度。
燃料质量	见 Solar 公司的 ES 9-98 规范

Natural Gas and Liquid Fuel Pilot Air Valves

Air Supply Pressure (min/max)	100 to 200 psig (690 to 1379 kPag)
Air Flow Demand Rate (max)	70 SCFM (1.9 Nm^3/min)
Air Consumption per Start	6 SCF (0.17 Nm^3)
Pilot Vent Back Pressure (max)	5 psig (34 kPag)

天然气与液体燃料导向空气阀

空气供给压力（最小值/最大值）	100 至 200 psig (690 至 1379 kPag)
空气流量需求率（最大值）	70 SCFM (1.9 Nm^3/min)
每次启动的空气消耗	6 SCF (0.17 Nm^3)
导向气孔的反压（最大值）	5 psig (34 kPag)

Liquid Fuel Pump

Type	AC Motor with Variable Frequency Drive
Motor Power	18.6 kW (25 hp), 3-Phase
VFD Rating, Input Current (max)	47 Amps
Space Heater	None
Liquid Fuel Flow Demand Rate (max)	28 gpm (106 L/min)

液体燃料泵

类型	交流电机，带变频驱动装置
电机功率	18.6 kW (25 hp), 三相
变频驱动装置的额定输入电流（最大值）	47A
空间加热器	无
液体燃料流量需求率（最大值）	28 gpm (106 L/min)

Liquid Fuel Purge Pump

Type	AC Motor with Variable Frequency Drive
Motor Power	2.2 kW (3 hp), 3-Phase
VFD Rating, Input Current (max)	10.8 Amps
Space Heater	None
Water Supply Source	Customer De-Ionized Water Supply
Water Flow Demand Rate (max)	9 gpm (34 L/min)
Water Supply Temperature (min/max)	50 to 120°F (10 to 50°C)
Water Quality	See Solar Specification ES 9-98

液体燃料净化泵

类型	交流电机，带变频驱动装置
电机功率	2.2 kW (3 hp), 三相
变频驱动装置的额定输入电流（最大值）	10.8 A
空间加热器	无
供水水源	用户的去离子水供给
水流量需求率（最大值）	9 gpm (34 L/min)
供水温度（最小值/最大值）	50 至 120°F (10 至 50°C)
水质	见 Solar 公司的 ES 9-98 规范

Air Assist

Air Supply Source	Customer Service Air
Air Supply Pressure (min/max)	100 to 200 psig (690 to 1379 kPag)
Air Flow Demand Rate (max)	165 SCFM (4.4 Nm^3/min)
Air Supply Temperature (min/max)	-20 to 200°F (-29 to 93°C)
Air Quality	See Solar Specification ES 2201

空气供给

空气供给来源	客户服务空气
空气供给压力（最小值/最大值）	100 至 200 psig (690 至 1379 kPag)
空气流量需求率（最大值）	165 SCFM (4.4 Nm^3/min)
空气供给温度（最小值/最大值）	-20 至 200°F (-29 至 93°C)
空气质量	见 Solar 公司的 ES 2201 规范

(Customer provides) Liquid Fuel Boost Pump

Type	AC Motor-Driven
Motor Power	0.75 kW (1 hp), 3-Phase
Liquid Fuel Supply Discharge Pressure	20 foot (6096 mm) wet lift to 25 psig (172 kPag)
Space Heater Power	1-Phase, Max 200 Watts

（客户提供） 液体燃料增压泵

类型	交流电动机驱动

电机功率	0.75 kW (1 hp), 三相
液体燃料供给排放压力	20 inch(6096 mm) 湿扬程至 25 psig (172 kPag)
空间加热器的功率	单相, 最大值 200W

LUBE OIL SYSTEM
润滑油系统

Pre-Post Lube Oil Pump

Type	AC Motor-Driven
Motor Power	5.6 kW (7.5 hp), 3-Phase
Space Heater Power	25 W, 1-Phase
Lube Oil Quality	See Solar Specification ES 9-224

预－后润滑油泵

类型	交流电动机驱动
电机功率	5.6 kW (7.5 hp), 三相
空间加热器的功率	25 W, 单相
润滑油的质量	见 Solar 公司的 ES 9-224 规范

Backup Lube Oil Pump

Type	120 VDC Motor-Driven
Motor Power	0.75 kW (1 hp)
Space Heater	None

备用润滑油泵

类型	120 伏直流电机驱动
电机功率	0.75 kW (1 hp)
空间加热器	无

Lube Oil Tank Heater

Motor Power	20 kW (27 hp), 3-Phase

润滑油箱加热器

电机功率	20 kW (27 hp), 三相

Water / Oil Cooler

Type	Shell (Oil) & Tube (Water)
Water Supply Flowrate	98.7 gpm (374 L/min)
Water Supply Pressure	150 psig (1034 kPa)
Water Supply Temperature	85°F (29°C)

水/油冷却器

类型	壳 (油) 和管 (水)
供水流量	98.7 gpm (374 L/min)
供水压力	150 psig (1034 kPa)
供水温度	85°F (29°C)

Auxiliary Desktop Display

Phase / Amperage	1-Phase at 20 Amps

辅助台式显示器

相/安培	单相、 20 A

Printer / Logger

Voltage / Phase / Frequency	240 VAC / 1-Phase / 50-60 Hertz

打印机/记录器

电压/相/频率	240 伏交流电 / 单相/ 50-60 Hz

Battery

Type	120 VDC, Valve-Regulated Lead Acid
Rating	160 Ampere-Hours

蓄电池

类型	120 伏直流电、阀调节酸铅
额定值	160 安培－小时

Charger

Type	Wall-Mount
Charger Input Power	4 kW (5.5 kVA), 1-Phase
Charger Output Current	20 Amps DC

充电器

类型	挂墙式
充电器的输入功率	4 kW (5.5 kVA), 单相
充电器的输出电流	20 A、直流

Note:
The unit 24 VDC control system includes a converter to reduce the 120 VDC supply to 24 VDC.
注意：
设备的 24 伏直流电控制系统包含一个转换器，将 120 伏直流电降低为 24 伏直流电。

Portable Engine Cleaning System

Tank Capacity	26 US gallons (98 liters)
Water Quality	Refer to Solar Specification ES9-98, Para. 5.5
Air Supply (Clean and Dry Shop Air)	85 psig to 100 psig (586.1 kPag to 689.5 kPag)
On-Crank Airflow	5.3 scfm (8.51 Nm³/hr)
On-Line Airflow	3.5 scfm (5.63 Nm³/hr)

便携式发动机清洗系统

罐的容量	26 美国加仑 (98 升)
水质	参考 Solar 公司 ES9-98 规范，节号 5.5
空气供给 (清洁干燥的工厂用空气)	85 psig 至 100 psig (586.1 kPag 至 689.5 kPag)
曲柄上的气流	5.3 scfm (8.51 Nm³/hr)
管线上的气流	3.5 scfm (5.63 Nm³/hr)

Package Enclosure

Type	Complete Package Enclosure
Sound Attenuation	Average 85 dBA at 3ft (1m) from the enclosure, at a height of 5 ft (1.5 m), when installed in a free-field

设备消防隔音罩结构

类型	全部设备的消防隔音罩结构
消音	当安装在自由场地内时，离消防隔音罩结构 3 英尺（1 米）的上方 5 英尺（1.5 米）处平均为 85 dBA

Enclosure Ventilation Fan

Type	AC Motor-Driven
Motor Power	22.4 kW (30 hp), 3-Phase
Space Heater	None

消防隔音罩结构的通风机

类型	交流电动机驱动
电机功率	22.4 kW (30 hp), 三相
空间加热器	无

Enclosure Lights

Type	AC, Incandescent
Power	1000 W (200 W per fixture), 1-Phase
消防隔音罩结构用的灯	
类型	交流、白炽灯
功率	1000 W (200 W 每个灯具), 单相

SECTION 2

PERFORMANCE

第二部分

出力性能表

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer: *Liheng Iron & Steel*	Model: TITAN 130-20501 Axial
Job ID: CN10-0004	Package Type: GSC 50 Hz
Run By: Bob Chen / Date Run: 18-Jan-11	Match: STANDARD
Engine Performance Code: REV. 3.48 / Engine Performance Data: REV. 0.3	Fuel System: DUAL
	Fuel Type: CHOICE GAS

DATA FOR MINIMUM PERFORMANCE

Elevation	metres	400
Inlet Loss	mm H2O	100.0
Exhaust Loss	mm H2O	250.0
Engine Inlet Temperature	deg C	14.0
Relative Humidity	%	50.0
Gearbox Efficiency		0.9850
Generator Efficiency		0.9800
Based On 1.0 Power Factor		
Specified Load*	kW	FULL
Net Output Power*	kW	13928
Fuel Flow	kcal/sec IT	9802.86
Heat Rate*	kcal/kW-hr	2534
Therm Eff*	%	33.935
Engine Exhaust Flow	kg/hr	170557
Exhaust Temperature	deg C	500

Fuel Gas Composition (Volume Percent)

Methane (CH4)	28.00
Carbon Monoxide (CO)	7.00
Carbon Dioxide (CO2)	3.20
Hydrogen (H2)	58.00
Nitrogen (N2)	3.00
Oxygen (O2)	0.80
Sulfur Dioxide (SO2)	0.0001

Fuel Gas Properties

LHV (kcal/Nm3)	4097.1	Specific Gravity	0.3496	Wobbe Index at 60F	737.3

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Notes
Gas composition to be specified per actual oven operation

SECTION 3

RESPONSE TO CUSTOMER SPECIFICATIONS

第三部分

对客户具体问题的答复

1 供货范围包括增加的两台滑油冷却器。

2 没有提供空气中的杂质分析报告，尤其是碱金属的含量。设计联络会后需要做现场空气质量检测。燃机空气过滤系统或许需要修改。

SECTION 4

PRICING AND COMMERCIAL CONSIDERATIONS

第四部分

定价及商业考虑

PRICING
报价
$ for four (4),Titan 130 Power Generation Set, 15.0 MW (ISO) as described in Section 1 of this proposal, ex-work price.
本建议书的第一部分中描述的四套 15 MW(ISO)的 Titan 130 发电机组报价 美元，出厂价格。

Notes:
注：

- Prices do not include sales, duties, use, excise tax value added, import or royalty taxes.
- Prices are in US Dollars
- This proposal pricing is valid until June 30th, 2009
- 报价不包含销售税、关税、使用税、特许增值税、进口税或专利税。
- 报价以美元表示。
- 本报价有效期至 2011 年 1 月 31 日。

Cost Adder
附加

CIP Qingdao Port(four units).....USD
海运加保险到天津港(四台) .....USD

Commissioning and Start-up assistance ..... per daily rate
调试和安装指导 ..... 人民币，按照实际发生天数收费

Recommended Spare Parts.....See attachment
推荐配件清单..... 见附件

Payment Terms
支付条款

- 15% of the Order price upon receipt of Order or financial commitment
- 35% of the Order price 90 days after Order
- 35% of the Order price at commencement of engine assemblies
- 15% of the Order price upon readiness for shipment to be paid by wire transfer prior to shipment or against a commercial Letter of Credit to be opened by the buyer at least 30 days prior to shipment date
- 收到订单或财务承诺时，支付订单价的 15%
- 订单 90 天之后，支付订单价的 35%
- 发动机组件开始装配时，支付订单价的 35%
- 当准备装运时，在装运之前电汇订单价的 15%，或者在装运日期至少提前 30 天收到买方开具的商业信用证时电汇订单价的 15%。

All payments except the final payment shall be due net 30 days from the date of a valid invoice. Any amount not paid when due shall be subject to a late payment charge equal to one and one-half percent (1.5%) of the delinquent amount per month, pro-rated on a daily basis for each day that such amount remains unpaid.
除了最终付款之外的所有付款应在有效发货单的日期算起的 30 天内支付。任何到期未支付的金额应支付滞纳金，每月的滞纳金数额等于拖欠款的 1.5%，将拖欠金额按天数分配，按日计算滞纳金。

Delivery
交货

Equipment can be made available, Ex-Works, seller's designated facility (or facilities) (Incoterms 2000) in 9-11 Months after Receipt of Purchase Order and Financial Commitment.
收到订购单和财务承诺 9-11 个月之后，在工厂、卖方指定的设施（国际贸易术语解释通则 2000）内交货。

Terms and Conditions
条款

Solar Standard Terms and Conditions (form 3047b) apply. (See Appendix)
采用 Solar 公司的标准条款（表 3047b）。 （见附录）

Warranty
质量保证

Warranty

The goods are warranted against defects in workmanship in material used in their manufacture during the Warranty Period. The Warranty Period commences upon the delivery of the goods, on a unit-by-unit basis, in accordance with the applicable delivery term, and expires on the earlier of (i) the date which is twenty four (24) months after delivery in accordance with the applicable delivery term or such date Seller would have delivered but for delays caused by others (e.g., where Seller cannot deliver to site because the site is not ready due to delays by others); or (ii) the date which is twelve (12) months after the unit is first placed into service, or would be capable of being placed into service but for any cause beyond the reasonable control of Seller.
在质量保证期内，质量保证涵盖人工和材料的缺陷。质量保证期起始时间是设备交货后，以每台为基础，根据相关的交货条款，以先发生者为准（1）根据相应的交货条款交货后24个月，或索拉应该交货但被他人的原因延迟（例如其它人原因造成的现场条件无法接受设备，造成索拉无法交货）；或（2）设备第一次投入使用后12个月，或能够投入服务但被超出卖方可控的原因造成的延误。

Solar's complete standard warranty is stated in its Terms and Conditions of Sale (Form 3047b, Rev 3/09).
索拉公司的全面质量保证描述在 Form 3047b,Rev3/09 上。

SECTION 5

AVAILABLE SERVICES AND AGREEMENTS

(not included in Bid)

Not offered in this proposal. More information about this service is included in section 8. Customer is encouraged to discuss this service with Solar's sales person.

AVAILABLE SERVICES

TOTAL SUPPORT CAPABILITIES

Solar Turbines Incorporated, as the Original Equipment Manufacturer (OEM) solution provider, stands behind each of our customers with uncompromising commitment to the success of their turbomachinery installations throughout the equipment's entire life-cycle. Solar maintains its own worldwide Customer Services organization, which offers a direct single-point contact to meet customer needs for the complete turbomachinery system throughout its operational life. This may include responsibility for installation assistance, start-up/commissioning service, asset management, contract maintenance programs, technical training, service parts, package refurbishment and overhaul services.

Solar's Worldwide Service Network

Location	Service Parts Center	Turbine Overhaul Center	Turbine Repair Center	Package Refurbishment	Exchange Engines	Compressor Overhaul/ Repair
Anchorage, Alaska	Yes	—	—	Yes	Yes	—
Bandung, Indonesia	—	Yes	Yes	—	—	Yes
Caracas, Venezuela	PA	—	—	—	—	—
DeSoto, Texas	—	Yes	—	—	Yes	—
Dubai, UAE	PA	—	—	—	—	—
Dublin, Ireland	PA	—	Yes	—	—	—
Edmonton, Canada	Yes	Yes	Yes	Yes	Yes	Yes
Esbjerg, Denmark	—	—	Yes	—	—	—
Gosselies, Belgium	Yes	Yes	Yes	—	Yes	Yes
Jakarta, Indonesia	PA	Yes	—	—	—	—
Kuala Lumpur	PA	Yes	Yes	—	—	Yes
Lagos, Nigeria	—	—	Yes	—	—	—
Mabank, Texas	—	—	Yes	Yes	—	Yes
Melbourne, Australia	Yes	Yes	Yes	Yes	Yes	—
New Orleans, Louisiana	Yes	—	—	—	Yes	Yes
Ontario, California	Yes	—	—	—	—	—
Perth, Australia	—	—	—	—	—	Yes
San Diego, California	PA	—	—	—	—	—
Singapore	Yes	—	—	—	Yes	—
Tijuana, Mexico	—	—	—	Yes	—	—
Tokyo, Japan	—	—	—	—	Yes	—
Veracruz, Mexico	—	Yes	Yes	—	—	Yes
Villahermosa, Mexico	—	Yes	Yes	—	—	—

PA = Parts Administrator only

INSTALLATION AND COMMISSIONING

In general, the customer's contractor or Solar's Construction Service organization is responsible for the installation of the turbine generator package and its related equipment, depending on project complexity, customer preference and experience. It is not uncommon for Solar's Customer Services/Field Service organization to become involved at various times throughout the installation phase (as opposed to being involved only in the Start-up / Commissioning phase) of the project. Customers and contractors may experience difficulties to some degree and require advice and assistance regarding such areas as interpretation of drawings and installation instructions, identification of support equipment, additions or deletions of hardware, and re-sizing or re-routing of lines or wires. Complex projects have realized a

considerable reduction in installation time by assigning a designated Solar Field Service Representative (FSR) on a continuous basis throughout the installation.

Since the amount of time required for installation assistance can vary significantly depending upon customers and contractors, as well as size and complexity of the job, it is generally desirable and necessary to quote at the standard daily rate for the estimated number of days required. A flat fee or lump sum is appropriate only for large complex projects where planning reflects the use of FSRs continuously during installation. Fixed price quotations for a large project can be supplied upon request.

Installation Supervision. Solar's Technical Representative will provide the supervisory assistance necessary or requested for the installation and interconnection of Solar's turbomachinery and its support systems with either the site process equipment, the power distribution equipment, and other turbine package related ancillary equipment, heat recovery equipment, and emissions reduction systems.

Solar's Technical Representative normally acts in an advisory or consulting capacity. Labor, material, fabrication and installation tools, lifting equipment, etc., should be furnished by the customer, customer's representative (contractor) or Solar's Construction Services organization as applicable.

Commissioning Assistance. Solar's Technical Representative can provide the supervisory assistance and guidance necessary to ensure that the equipment has been properly installed, interconnected with other equipment, calibrated and is operated in accordance with Solar's specifications and good engineering practices. This can improve equipment reliability and help reduce the potential for subsequent operational problems due to poor installation or operating practices. The equipment will also be tested statically and operationally to the customer's satisfaction at the completion of the commissioning phase.

ENGINE OVERHAUL, EXCHANGE, AND REPAIR

Solar offers comprehensive overhaul and repair support for its entire gas turbine product line. A Solar gas turbine major overhaul consists of a complete refurbishment of the gas turbine in order to ensure that performance can be restored to Solar’s current production standards for mechanical configuration and aerothermal performance. As part of the overhaul program, Solar offers an exchange fleet with major assemblies and entire engines available to keep customer downtime to a minimum.

CONSTRUCTION SERVICES

To complement the supply of turbomachinery packages and offer complete and/or partial installation services to its customers, Solar maintains a Construction Services organization. This allows Solar to act as a single source for the supply of turbomachinery and ancillary equipment and design applications of this equipment into complete Engineer, Procure, and Construct (EPC) installations. Construction Services offers a wide range of services and equipment to Solar's customers in order to ensure that essential expertise is applied to each phase of a project.

Single point responsibility allows Construction Services to manage your entire project scope. This can drastically simplify design, development and construction, thus minimizing the chances for error. Construction Services has amassed significant knowledge and expertise in the areas most needed by our customers. Our professional staff knows your application fully - from gas compression to power generation both onshore and offshore and can provide a full range of services such as:

- Proposal Preparation
- Design and Engineering
- Material Procurement

- Fabrication
- Onsite Construction
- Quality Control
- Scheduling
- Budget Control
- Shipping
- Commissioning

AVAILABLE AGREEMENTS

EXTENDED SERVICE AGREEMENTS

In order to better serve our customers, Solar Customer Services, offers Extended Services Agreement. Extended Service Agreement (ESA) enhances the machine availability, reduces equipment life cycle cost and offers planned regular, predictive, and proactive maintenance service to the customer. ESA absorbs the risk of equipment failure and as an option offers availability guarantees. The following briefly describes the ESA options currently available. Table 1 below shows in greater detail the coverage provided by each offering. The shaded cells highlight the coverage's that differ from Level I.

Level I (Long Term Service Agreement) provides for overhauls and repairs as required. The term for Level I can be from 5-15 years. Renewal is available at the price of current agreement with set escalations.

Level II (Term Service Agreement), as in Level I, provides for overhauls and repairs as required. However, only one-way freight is covered. This agreement is only for the first five-year term. Thereafter, renewal is on a negotiated basis.

Level III (Service Agreement) includes a maximum of one (1) overhaul only but covers all engine repairs as necessary. In addition, unscheduled inspections are limited to two per year. Level III is available for a five-year term only. Thereafter, renewal is on a negotiated basis.

Beneficial Use Service Agreement (BUSA), as in Level I, provides for overhauls and repairs as required. Customer will pay CMP and a small portion of the overhaul on monthly basis. At the time of the overhaul, the cost of overhaul will be covered by calculating the number of hours of operation accumulated on the engine multiplied by the fired hour rate agreed upon by at the time of the signing of the contract. Two-way freight is covered. The term for this agreement can be from 5-15 years.

Table 1. Long Term Service (ESA) Agreements Scope of Services Comparison

	ESA Level I	ESA Level II	ESA Level III	BUSA
Renewable at current price	Yes	No	No	Yes
Turbine scheduled inspections	Yes	Yes	Yes	Yes
Turbine unscheduled inspections	Yes	Yes	Limited	Yes
Turbine overhaul / repair as needed	Yes	Yes	One / Term	Yes
Exchange program	Yes	Yes	Yes	Yes
Parts (turbine, driven equipment, package)	Yes	Yes	Yes	Yes
Freight	Two-way	One-way	One-way	Two-way
Availability guarantee (%)	95 + 1	95 + 1	95	95 + 1
Wear and tear warranty	Yes	Yes	No	Yes
Performance guarantee	Turbine-Gen Set Package	Turbine-Gen Set Package	No	Turbine-Gen Set Package
Term (years)	5 to 15	First 5 only	5	5 to 15

CONTRACT MANAGEMENT SERVICES

Years of experience have proven that Solar Turbines Incorporated not only manufactures top of the line turbomachinery systems, but also provides high quality long-term Contract Management Services to turbomachinery users. Solar provides complete operation and maintenance services to customers in the Power Generation industry around the world, and our service contracts are designed to meet the often unique requirements that owners face in developing cost-effective operation and maintenance strategies for their assets.

For more than twenty years we have been providing Contract Management Services ranging in scope from single-unit gas turbine to single-point responsibility for multiple gas turbine fleets. With a worldwide network of professional and skilled managers, engineers, operators and technicians, Solar is positioned to support operation and maintenance needs in all types of facilities. Headquartered in San Diego, California and operating out of our worldwide field offices, we are able to provide consistent, proven, and specialized care to each service contract customer.

Solar can provide Contract Management Services for all turbomachinery and balance of plant equipment, including Solar's and other manufacturers' equipment, providing customers a single-point responsibility asset management solution. Solar's Contract Management Services are offered in a number of generic formats. In addition, service elements can be combined into a customized service agreement. The following types of services are offered.

Full-Service Operation & Maintenance consists of turbomachinery and balance-of-plant operations and maintenance services, including Solar's after-market products, services, and parts. This provides the highest level of service. Full-Service agreements may also incorporate plant performance guarantees.

Operation & Maintenance Management consists of turbomachinery and limited balance of plant equipment maintenance and repair. Solar supplies the personnel necessary to develop and implement a long-term preventive and predictive maintenance program. This includes parts and spares inventory management, coordination with outside contractors when necessary, normal daily maintenance and major maintenance inspections.

Maintenance Management consists of turbine maintenance and replacement parts, as well as a range of technical staff at the customer's location. Our personnel can be used to supplement the customer's workforce and enhance existing skill levels as necessary on either a long or short-term basis.

Technical Services Management consists of providing an operations and maintenance consultant on a full-time basis at the customer's facilities or at a remote location where remote monitoring of onsite equipment is available over a data link.

Technical Education Services and Training consists of the development of personnel. Agreements can optimize this investment for our customers through programs designed to meet customer personnel training objectives. The main programs include standard or customer tailored classroom training, on-the-job training, and vocational skills development programs.

CONTRACT POWER AND LEASING SERVICES

Solar also maintains a Contract Power organization dedicated to providing numerous financing options. All or part of a project can be financed, offered under a lease agreement, or installed on a service tariff with a performance contract.

Equipment Financing. What equipment to utilize represents only part of the decision process in a gas turbine acquisition process. Other decisions, such as when to proceed and whether to buy or lease, can be equally important. Cash to purchase assets is often scarce, even for the biggest of companies. As a

result, equipment acquisition is often delayed well past the time it is needed. Solar offers leasing, and conditional sales contracts, as well as trade financing options for our gas turbines and related equipment. Financing can be arranged for just the gas turbine package, or it can be structured to include an entire Engineering, Procurement, and Construction project. Lease financing benefits may include the following:

- Help you obtain equipment when you need it as opposed to when you have funding available on your Capital Plan.
- Provide an alternative source of financing. You can retain your existing lines of credit for core business projects.
- Preserve and strengthen financial ratios by structuring as "off-balance sheet".
- Offer a hedge against inflation. You get the benefit of the equipment today, but pay for the use with tomorrow's earnings.
- Conserve working capital. Payment for the use of the equipment is spread over the term of the lease.
- May provide a tax-deductible business expense, reducing tax liabilities.
- The high residual value the team of Solar and Caterpillar Financial Services is able to place on Solar-manufactured equipment can result in low monthly payments during the lease term.
- Minimize equipment disposal problems for the user at the end of the finance term.

Some Questions To Help Determine if Leasing is a Good Option for Your Company:

- Are your capital acquisition programs delayed due to capital budget constraints?
- Do you have capital tied up in equipment, which you would prefer to have available for core business uses (inventory, accounts receivable, capacity expansion)?
- Do you have a preference for on or off balance sheet financing?

Solar Turbines Incorporated and Caterpillar Financial Services together provide the following lease products:

Energy Service Contract. The Bottom Line - Solar's exclusive Energy Service Contract saves you money and allows you to concentrate on other things - like running your core business. Through this contract, Solar will provide turnkey installation of a plant consistent with your operating requirements, provide lease financing, and operate and maintain the equipment for the contract term.

Finance Lease. In this type of lease structure, the total of all payments represents the full value of the equipment. The lessee usually has the end-of-lease option to purchase the equipment for $1.00, a percentage of the original equipment price, or a specified dollar amount.

Operating Lease. The lessor retains ownership of the equipment but takes a substantial residual position, thereby lowering the lessee's monthly rental payments. Operating leases may qualify as "off-balance sheet" financing for the lessee. The lessee usually has the option to purchase the equipment for fair market value at the end of the lease term.

Synthetic Lease. A lease structured to qualify as an operating lease for financial reporting purposes, however, the lessee is considered the tax owner of the equipment. In certain applications this structure can allow the lessee to obtain off-balance sheet book status but claim accelerated depreciation benefits for tax purposes.

Municipal Lease. A type of lease available to municipalities, state and local government entities at low interest rates.

Federal Government Lease. Leasing to U.S. Federal Government entities. This product is similar to leases offered to commercial customers with a few exceptions. Further, Federal Government leases can

be structured as either true leases or conditional sales contracts for tax purposes, and as either operating leases or capital leases for accounting purposes.

Additional Financing Options for Turbine Buyers Located Outside the USA

In addition to Lease Financing solutions, Solar can also assist in arranging financing through a group of large global banks with whom Solar has established a corporate relationship. The financing for purchasers located in emerging markets is often supported by the Export-Import Bank of the United States (Exim). Advantages to an Exim supported loan include:

- Provides commercial and political risk coverage making attractive financing possible in emerging markets where it would otherwise be difficult and expensive.
- With support from Exim, longer term financing of up to ten years is available
- With support from Exim, lower interest rates are available based on a fractional spread over the London Interbank Offered Rate (LIBOR).
- Experts from the global bank, Exim and Solar can assist the purchaser in applying for an arranging the financing to meet individual project requirements.

SECTION 6

SOLAR EXPERIENCE

SOLAR TURBINES INCORPORATED

Solar Turbines Incorporated is a San Diego, CA based company whose business is the design, manufacture, installation and servicing of proven lines of gas turbine-driven generator sets, mechanical-drive packages and centrifugal natural gas compressor sets. Since 1981, Solar has been a wholly owned subsidiary of Caterpillar Incorporated. Caterpillar Inc., primarily known as the world's largest manufacturer of construction and mining equipment, diesel and natural gas engines, and industrial gas turbines, was actively engaged in gas turbine development 25 years prior to Solar's acquisition. Both Caterpillar and Solar are committed to providing turbomachinery products designed as the industry standard.

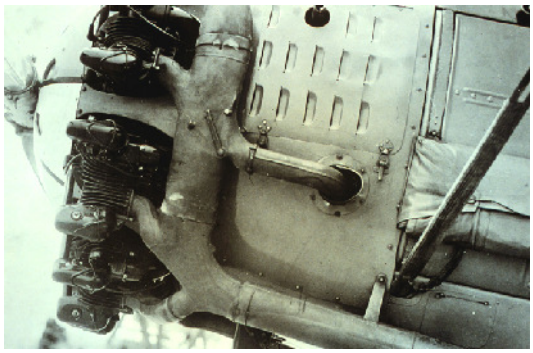
Solar's current axial-flow industrial gas turbine product line consists of:

Family and Model	Generator Set (kWe)
Saturn 20	1210
Centaur 40	3515
Centaur 50	4600
Mercury 50	4600
Taurus 60	5500
Taurus 70	7520
Mars 90	9450
Mars 100	10 690
Titan 130	14 250

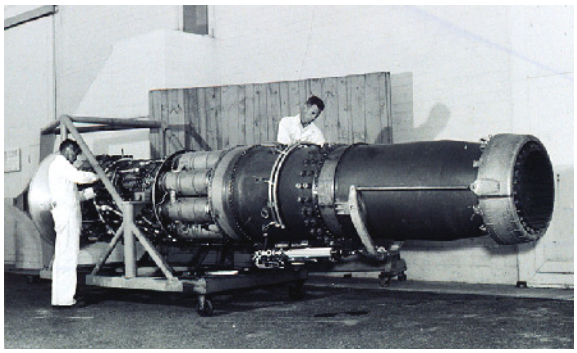
SOLAR TURBINES HISTORY

Solar was founded in 1927 as a manufacturer of all-metal airplanes. In the 1930's, the company entered the aircraft components business and manufactured the first stainless steel manifolds for aircraft engines. Shortly thereafter, the company became a major supplier of manifolds, exhaust stacks and heat exchangers for military and commercial aircraft. This early background in the manufacture of aircraft engine components, combined with achievements in high temperature metallurgy, resulted in Solar's participation in the first U.S. jet engine programs beginning in 1944. The first successful jet engine afterburner was designed and built by Solar.

Stainless Steel Manifold



Jet Engine Afterburner



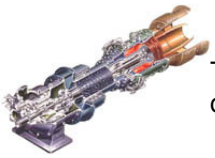
This experience led to the development of turbine engines and gas compressors for industrial applications, which became the mainstay of the power systems presently designed, manufactured, packaged, modularized and serviced for our customers worldwide. In less than two decades, Solar Turbines Incorporated became the world's leading manufacturer of industrial gas turbines and power packages.

Solar's first radial gas turbine (the original Mars gas turbine), introduced in 1948, was a 60-hp engine used as an auxiliary power unit for aircraft and to power portable fire pumps primarily for the United States Navy. Since then, Solar has built more than 10,400 units of radial design, including the Spartan gas turbine used in a 225-kW generator set, the original Titan engine used for many different applications, including a start engine for the Centaur 40 gas turbine, and the Gemini engine originally developed as a portable 10- kW generator set for the U.S. Army.

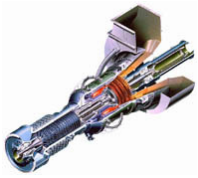
The evolution in Solar's product line led to the introduction of axial-flow gas turbines in 1948.

1948 The ***Jupiter****, Solar*'s first axial-flow turbine.

1957 The *Saturn, Solar*'s first industrial turbine engine. Originally designed for naval shipboard power generation and propulsion applications, the *Saturn* turbine engine was applied as an industrial prime mover for electrical power generation, as well as in gas compression, pumping, and other mechanical-drive applications.

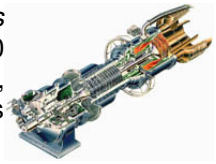
1969  The ***Centaur* 40** industrial gas turbine features rugged construction, conservative firing temperatures and long-life sleeve bearings.

1976 The ***Mars*** turbine, a development from *Centaur* turbine experience, is a rugged, heavy-duty engine designed for continuous-duty industrial service under the most severe conditions, is the most efficient industrial gas turbine in its power class.



1985  The ***Centaur* 50** turbine was the next step in a planned series of uprates and has achieved its current rating by capitalizing on the *Centaur* 40 experience and the conservative use of technology and hardware developed with the *Mars* turbine.

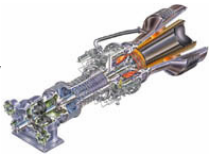
1989 The ***Taurus* 60** gas turbine evolved from the *Centaur* gas turbine. *Taurus* 60 achieves an approximate 20% power advantage over the *Centaur* 50 gas turbine by using an additional "zero" stage in the engine compressor, while operating at the same turbine inlet temperature as the *Centaur* 50 gas turbine.



A distinct advantage of the *Centaur* 40, *Centaur* 50 and *Taurus* 60 gas turbine products is the interchangeability of engines on a common "universal" turbomachinery package. The three engines are all packaged on essentially the same skid and the skid-mounted components are sized to accommodate all three engines. This feature facilitates the ability to replace the engine with a higher power unit should additional power be required in the future, assuming the driven equipment can be replaced or modified to use the additional power.

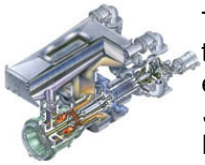
1995  The ***Taurus* 70** gas turbine evolved from the Centaur product and achieves an additional 39% power advantage over the *Taurus* 60 gas turbine by using an additional "zero-zero" stage in the engine compressor and operating at the same turbine inlet temperature as the *Mars* 100 gas turbine.

1997 The ***Titan* 130** gas turbine design consists of a linear scale-up of the proven *Taurus* 70 gas turbine and also allows for the use of many components common to the *Mars* gas turbine product line. The *Titan* 130 engine is, thus, designed to be durable and reliable for demanding



industrial applications, while offering the highest efficiencies in its class.

2004



The ***Mercury* 50** is the newest addition to *Solar*'s products and represents a technological breakthrough in recuperative gas turbine technology, with a host of environmental, operational, economic and siting advantages. It is a product of *Solar's* commitment to the US DOE's Advanced Turbine Systems (ATS) program. Features include the highest electrical efficiency for a gas turbine in its size range and an ultra-low emissions profile.

SOLAR TURBINES FACILITIES

Solar's industrial gas turbine engine and centrifugal compressor manufacturing and turbomachinery packaging facilities are the largest and most modern in the industry. More than 101,350 square meters (1,000,000 square feet) of floor space are dedicated to manufacturing and packaging gas turbines.

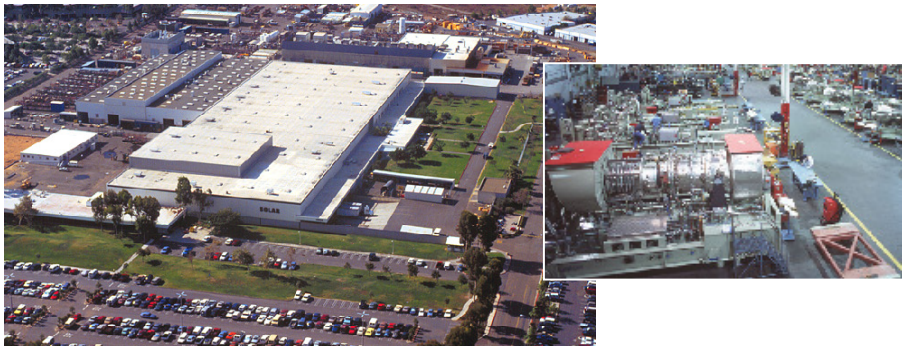
The San Diego, Harbor Drive facility accommodates general offices, engineering, development test facilities, research, field support organizations, and parts and components manufacturing. The Harbor Drive Development Testing facility began in 1945 when the company designed and constructed its first test cell specifically for testing industrial turbines. The present array of test beds and instrumentation, therefore, is based on more than 50 years of experience in this field.

Solar's Headquarters – Harbor Drive Plant

Solar's modern manufacturing assembly plant is located in the Kearny Mesa area of San Diego. All assembly and production testing of the Saturn, Centaur, Taurus, Mars and Titan turbines, centrifugal

boost compressors and turbomachinery packages is conducted at the Kearny Mesa plant facility.

Plant features include an engine assembly lines, centrifugal compressor assembly area, pre-test area, computerized production test cells consisting of enclosed cells and outside test pads, an advanced retrieval parts stacking and storage system, and dedicated space for the production of generator set, mechanical-drive package, and compressor set systems and control consoles. All turbomachinery packages are assembled on easily movable dollies and transported throughout assembly, pretest, production testing, final painting, and package finishing. The plant also includes facilities for final product crating, preparation for shipment and loading onto transport vehicles.



Solar's Manufacturing and Test Facilities - Kearny Mesa Plant

WORLD LEADER IN INDUSTRIAL GAS TURBINES

Solar Turbines Incorporated is a world leading producer of industrial gas turbines and turbomachinery packages in the 1-to-14.5 MW (1500-to-19,500 hp) range. 1-25MW officially? Solar gas turbine units are operating in 90 different countries and under varying conditions, including arctic, desert, tropical and offshore. Even in the harshest environments, Solar gas turbines continue to provide safe and reliable power.

Solar Industrial Gas Turbine Operating Experience Summary

Experience by Package	Units Sold	Estimated Hours
Compressor Sets	3,840	579,500,000
Mechanical Drives	2,520	354,900,000
Generator Sets	7,010	489,500,000
Total	**13,370**	**1,423,900,000**

Effective: 12/31/08, © Solar Turbines Incorporated

Titan 130 Industrial Gas Turbine Operating Experience Summary

Experience by Package	Units Sold	Estimated Hours
Compressor Sets	90	800,000
Mechanical Drives	70	900,000
Generator Sets	240	3,600,000
Total	**400**	**5,300,000**

Effective: 12/31/08, © Solar Turbines Incorporated

Cogeneration Experience Summary

Market	Saturn 10	Saturn 20	Centaur 40	Centaur 50	Mercury 50	Taurus 60	Taurus 70	Mars 90	Mars 100	Titan 130	Total
Airport - Gov/inst				3		3		2			**8**
Brewery - Industrial		1	1	3		5	1	1	1		**13**
Buildings - Commercial	2	1				4					**7**
Ceramics - Industrial		12		22		20	4			1	**59**
Chemical - Industrial	3	1	5	20		23	7	8	3	3	**73**
Communications - Commercial	19			5	1						**25**
District Heating - Industrial				1		2				2	**5**
Food Processing - Industrial	9	10	3	20		65	6	14	6	2	**135**
Gov Owned - Elec Power			2	5		3					**10**
Hospital - Commercial	14	14	7	7		6	1				**49**
Hotel - Commercial	1	1				2	1				**5**
Independent - Elec Power				2		4	3			2	**11**
Inv Own Baseload - Elec Power	2		3	1		6		2		3	**17**
Inv Owned Other - Elec Power	7			1			1		2	1	**12**
Landfill - Elec Power	1	1	5			1		1			**9**
Manufacturing - Industrial	4	1	7	16		21	8	4	7		**68**
Mining - Industrial			1			20		5			**26**
Municip/rea/coop - Elec Power	1	4	2	27		27	13	15	1	3	**93**
Other - Industrial	6	6	10	14		32	10	2	1		**81**
Other Facility Pwr - Gov/inst	1	1	4	1		4					**11**
Othr Facility Pwr - Commercial	15		1	4		2					**22**
Petrochemical - Industrial	2	1	5	5		10	5				**28**
Pharmaceutical - Industrial		4	6	7		11	1	1	3		**33**
Process Plant Pg						3					**3**
Pulp & Paper - Industrial	6	7	11	41		86	22	10	3	3	**189**
Refinery Pg				1		1	1			2	**5**
Research - Industrial				1					1		**2**
Textiles - Industrial	1	8	4	4		35	5	4	1		**62**
Tires/rubber - Industrial				4		6	1	2			**13**
Unavailable - Other	17	1					1				**19**
University - Gov/inst	10	4	4	9	1	21	7	1		8	**65**
Wtp/stp - Gov/inst	6		2	2		8			3		**21**
Total Cogeneration	**127**	**78**	**83**	**226**	**2**	**431**	**98**	**72**	**32**	**30**	**1179**

Appendix

The following Referenced Documentation Are Attached:

- -ES 9-224 Lube Oil Specification 润滑油技术要求
- -ES 9-98 Air, Fuel, Water Specification 空气、燃料和水质量要求
- PIL 162 Recommendation for the Sourcing, Handling, Storage and Treatment of Fuels
  PIL 162 燃料采购，处理，储藏及处理推荐办法
- Site Testing Procedure 现场实验大纲