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1.1 概述及设计条件

Preface 前言

Introduction 简介

Siemens Energy is pleased to have the opportunity to submit this proposal for Gas Turbine Package(s) on a component delivery basis.

西门子能源对于有机会提交关于西门子燃气轮机的方案表示非常高兴。

A standardized component delivery project involves engineering, procurement and manufacturing of the equipment, and its supply according to the terms of delivery (Incoterm code and named destinations) as stated in the commercial part of the supply contract.

标准的部件交付项目涉及设备设计、采购和制造以及根据供货合同商务部分所述的交付条件（国际贸易术语解释通则和指定目的地）供应设备。

On-site service related to the supplied equipment and executed by designated Contractor is typically offered in addition, such as technical field assistance during erection and commissioning phase or training for personnel on the main components.

通常由指定的承包商提供设备相关的现场服务，并在安装和调试期间提供现场技术援助以及对人员提供关于主要部件方面的培训。

The Gas Turbine is designed to provide safe, highly reliable, efficient and low cost electricity. It is

西门子燃气轮机设计旨在提供安全、高度可靠、高效及低成本的电力。机组是

– An economical power generating system, based on a pre-engineered reference design,
– 基于预制件参考设计、经济合算的发电系统，
– Flexible in design and scope to meet Purchaser's project and site specific requirements,
– 设计灵活和范围满足买方项目和现场的具体要求，
– Focused on the core equipment and suits the demands of the power plant.
– 关注核心设备，并符合电厂的需求。

The design features of the main components have been carefully considered, resulting in an optimum balance between capital cost, plant performance as well as operation and maintenance benefits.

已充分考虑到主要部件的设计特点，从而实现资本成本、设备性能以及运行和维护效益之间的最佳平衡

Brief Scope of Supply 供货范围概要

The core of the Gas Turbine Package consists of the well-proven and reliable

燃气轮机组的核心包括经过认证、可靠的

– Gas Turbine
– 燃气轮机
– Auxiliary and mechanical systems,
– 辅助设备和机械系统
– Electrical equipment (SEE/SFC),
– 电气设备(励磁和启动)
– Control system.
– 控制系统

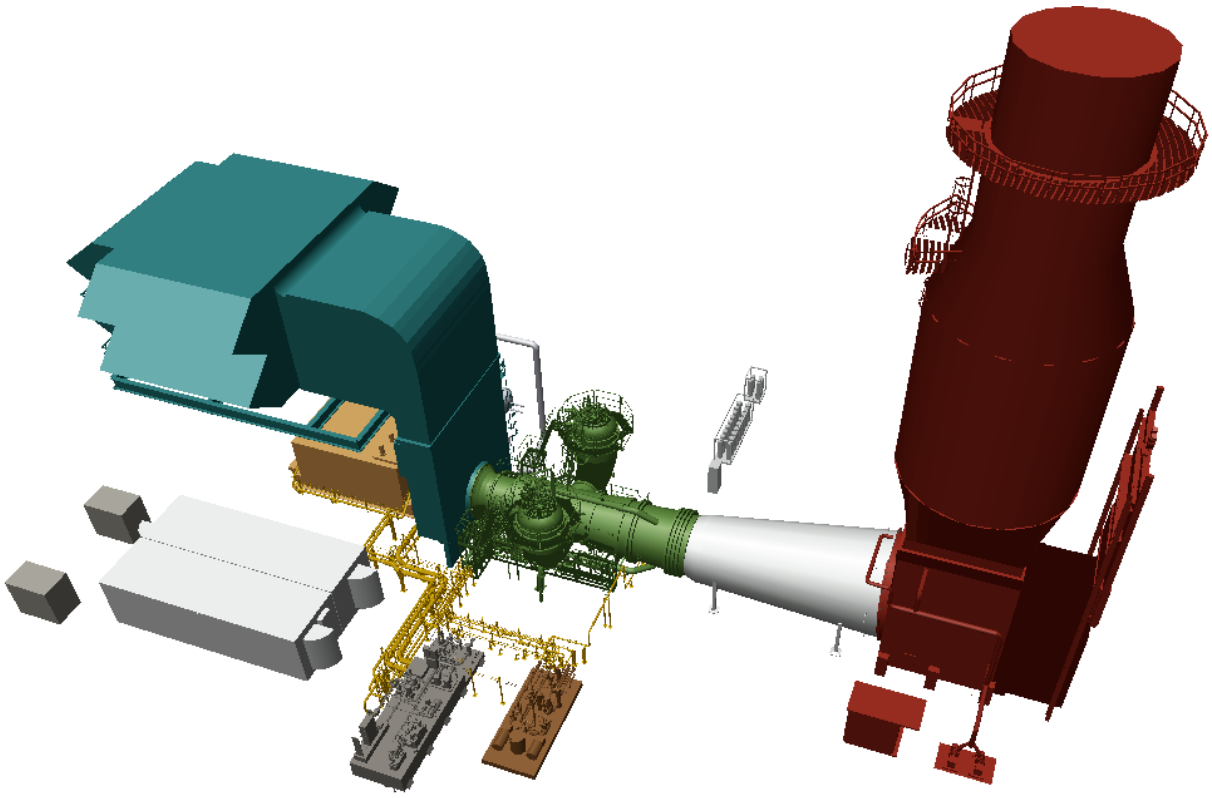
A detailed description of the main components and offered scope of supply and services is given in the following sections.

下列章节详细说明主要部件和所提供的供货与服务范围。

Arrangement of Equipment 设备布置

The following figure shows a typical arrangement of the gas turbine package SGT5-PAC 2000E for operation with natural gas as main fuel.

下图显示了西门子 SGT5-PAC 2000E 燃机的典型布置，采用天然气作为主要燃料。



The view is for explanation only and not binding regarding offered scope of supply and for execution. Kindly refer to section "Scope of Supply and Services, Terminal Points"within this offer, which shall prevail in case of difference.

该图仅作参考，而不与供货范围和项目执行关联。该项目的特定供货范畴见投标方案的后续章节。

Design Conditions 设计条件

General 概述

The design conditions taken into consideration for Supplier's scope are listed in the following. Purchaser shall ensure the mentioned parameters.

下文列出供应商范围应考虑到的设计条件。买方应确保满足所述参数。

Any deviation to these design conditions could result in consequences to Supplier's obligations (e.g. performance guarantee, equipment warranty, operation, maintenance, life time, project schedule, price) that shall be determined by Supplier. Nevertheless all resulting consequences from these deviations are in responsibility of Purchaser.

供应商对与这些设计条件的任何偏差（如履约担保、设备保修、运行、维护、使用寿命、时间表、价格）负责，而供应商的这些责任应由供应商确定。但买方应承担这些偏差所产生的所有后果。

Descriptions in referenced documents herein, as well as in annexes to this section, shall be understood as design conditions to be considered as well. Further design requirements as stated in section "Clarifications" shall also be ensured by the Purchaser.

文中参考文件中的说明应理解为待考虑的设计条件。买方也应确保“澄清”章节所述的进一步设计要求。

Site and Environment 现场环境

Parameter 参数	Design condition 设计条件	
Project name 项目名称		
Site location 现场位置		
Plant layout 场地布局	Purchaser's indoor arrangement of Supplier's equipment shall be in accordance to Supplier's standard. Please refer to layout drawings provided in section "Attached Documents" for details. 买方对供应商所供设备的室内布局应符合供应商标准。请参阅“随附文件”章节中的布局图纸，了解设备布局详情。	
Foundation 基础	The documents defining foundation design requirements, like equipment loads imposed on foundation for different load cases (e.g. operation, electrical fault, and earthquake), anchorage design details and boundary conditions for Purchaser's foundation will be submitted by Supplier during project execution phase, and requirements shall be fulfilled by Purchaser. 供应商将于工程实施阶段提交这些文件，文件中定义基础设计要求，诸如不同负荷工况（如运行、电气故障、地震）下施加在基础上的设备负荷、买方基础的锚固设计详情和边界条件。	
Forces and moments	Purchaser shall comply with the permissible forces and moments at main piping connections of Supplier's scope. Detailed information is provided by Supplier during project execution phase. 买方应符合供应商范围主要管道接头处的容许力和力矩。供应商在项目实施阶段提供详细信息。欲了解蒸汽轮机部件的初步资料，请参阅附件“力和力矩”。	
Site level 现场海拔	Above sea level 海平面以上	~10 m
Indoor ambient air, temperature 室内环境温度	Minimum 最低	5 °C
	Maximum 最高	45 °C
Outdoor ambient air, temperature 室外环境温度	Minimum 最低	-14.9 °C
	Maximum 最高	38.7 °C
Outdoor ambient air, rel. humidity 室外环境相对湿度	Minimum 最小	56 %
	Maximum 最大	68 %
Outdoor ambient air, abs. humidity 室外环境绝对湿度	Maximum 最大	25 g/m3

Plant Operation 电厂运行

Parameter 参数	Design condition 设计条件	
Plant operation and maintenance, general 电厂运行和维护，概述	Operation and maintenance of Supplier's scope shall be executed according the operation and maintenance concepts provided by Supplier during project execution phase. For further details including start-up issues please refer to section "Operational Concept". 供应商范围内的运行和维护应依据供应商于项目实施阶段所提供的运行和维护概念进行。	
Plant operation regime, main fuel 电厂运行制度	Fuel type 燃料类型	Natural Gas 天然气
	Start-up capable 起机	Yes 是
	Shutdown capable 停机	Yes 是
	Load regime 负荷制度	Base load 额定负荷
	Maximum 最大运行小时数	8000
	Maximum 最大起停数	40starst/年

Electrical Conditions 电气条件

Parameter 参数	**Design condition 设计条件**	
Grid frequency 电网频率	Nominal 标称频率	50 Hz
Grid frequency range, gas turbine 电网频率范围，燃机	Continuous operation 持续运行	47.5-51.5 Hz
	Limited operation 限制运行	47.0-47.5 Hz
	Limited operation 限制运行	51.5-52.0 Hz
	Limited operation is permitted for maximum 20 seconds per occurrence (triggering grid disconnection) and maximum 30 minutes accumulated. 处于限制运行频率时，每次允许运行最长 20 秒（触发脱网），累积运行最长 30 分钟。	
Power factor, gas turbine generator 功率系数，燃机发电机	Lagging 滞后	0.85
Voltage levels 电压等级	Power supply shall be provided to Supplier's terminal points at voltage levels and limits as defined in section "Gas Turbine Electrical System" and shown at the single line diagram provided within section "Attached Documents". 应向供应商连接点供电，电压等级和极限如〝燃气轮机/蒸汽轮机电气设备〞章节所述及〝随附文件〞章节提供的单线图所示。 Allowable generator voltage level deviations in case of simultaneous grid frequency deviations is based on IEC 60034-3. 若有电网同步频率偏差，可允许的发电机电压等级基于 IEC 60034-3.	

Grid Code Conditions 电网导则条件

Parameter 参数	**Design condition 设计条件**
General capability 一般能力	The operational requirements of the grid code will be executed by the gas turbine solely. In principle, the gas turbine can be operated according to the grid code requirements; however restrictions need to be applied, resulting from physical and technical design limitations of turbine and/or generator. Main capabilities, restrictions and conditions are described afterwards. 并网导则的运行要求仅通过燃气轮机实现。原则上，透平机组根据并网导则要求运行；但因燃气轮机和/或发电机的结构和技术设计的局限性，会限制透平机组的运行。主要能力、限制条件和情况在下文所述。
Primary frequency response (PFR) 一次频率响应（PFR）能力	PFR operation has been considered, conditioned upon: PFR 在下列条件下运行： – The gas turbine is heat-soaked. – 燃气轮机暖机状态下。 – The gas turbine is operated on fuel gas only. – 燃气轮机仅依靠燃气运行。 – The gas turbine load gradient for PFR operation is limited. – 燃机负荷变化梯度在 PFR 时受限制 – The gas turbine load range for PFR operation is limited. – 燃机负荷变化范围在 PFR 时受限制 – Emission guarantees are excluded during PFR operation. – PFR 运行时并不保证排放保证值。
Secondary frequency response (SFR) 二次频率响应（SFR）能力	SFR operation has been considered, conditioned upon: SFR 在下列条件下运行： – The gas turbine is heat-soaked. – 燃气轮机暖机状态下。 – The gas turbine is operated on fuel gas only. – 燃气轮机仅依靠燃气运行。 – The gas turbine is operated with load gradient as below. – 燃机只允许在一定负荷变化率内运行 – The summed load gradient for PFR and SFR operation is limited. – PFR 和 SFR 的总梯度受到限制 – The gas turbine load range for SFR operation is limited. – 燃机负荷变化范围在 SFR 时受限制 – Emission guarantees are excluded during SFR operation. – SFR 运行时并不保证排放保证值。

Parameter 参数	Design condition 设计条件
Grid sustaining 电网维持	Grid sustaining will be fulfilled in principle. Nevertheless there might be operational restrictions, e.g. under high ambient conditions, due to mechanical limitations of the gas turbine. 原则上实现电网维持。但因燃气轮机机械局限性会有运行限制，例如在高环境条件下，限制运行。
Grid faults 电网故障	Fault clearance times larger than 150 ms are excluded. A grid decoupling relay shall be provided by Purchaser, to ensure a decoupling of the generator from the grid within 150 ms in case of grid faults. Auto re-closing is excluded. 不含时间在 150 ms 以上的故障消除。买方应提供电网解耦继电器，确保在电网发生故障时发电机可在 150 ms 内与电网解耦。不含自动重合闸。
Load rejection capability 甩负荷能力	Load rejection to house load (i.e. to power supply of Supplier's auxiliaries) has been considered. 考虑自带厂用电（即供应商辅助设备电源供应）运行的甩负荷。
Island operation capability 孤岛运行能力	Island operation at house load (i.e. at power supply of Supplier's auxiliaries) has been considered. 应考虑自带厂用电运行（即供应商辅助设备电源供应）。 Emission guarantees are excluded during island operation. 不保证排放保证值。
Peak load capability 峰值负荷能力	Peak load (i.e. load operation beyond base load) is not provided. 峰值负荷未提供。

Gas Turbine Load Gradients 燃机负荷梯度

Parameter 参数	Design condition 设计条件	
General 概述	Load gradients are valid per gas turbine between an initial load step after grid connection and97% of rated power (i.e. base load performance corrected to base reference conditions). 负荷梯度在并网后初始负荷阶段到 97%额定出力（如额定负荷效率修正至基础参考条件后）之间适用。 At other load ranges the load change gradient is restricted. 在其他负荷范围时，限制负荷变化梯度。	
Loading after grid connection 并网后载荷	Normal 正常	11 MW/min
	Fast 快速	15 MW/min
Unloading until grid disconnection 在电网断开前卸荷	Normal 正常	11 MW/min

Design Life 设计寿命

Parameter 参数	Design condition 设计条件
Design life, gas turbine 设计寿命，燃机	Supplier will use such design criteria to enable an operation of: 供应商将采用此设计标准，使燃气轮机运行。 - 100,000 Equivalent Operating Hours (EOH) or - 100,000 个等效运行小时数（EOH）或 - 3,000 starts, - 3,000 次启动， whichever occurs first. 以先发生的为准。
Design life, general 设计寿命，概述	Each is assuming that the operation and maintenance of the gas turbine will be in accordance with the requirements of the operation regime as proposed by the Supplier herein and in compliance with the operation and maintenance manuals provided by the Supplier and proper maintenance according to good engineering and construction practices where the Contract is silent. 每种情况应假定：燃气轮机的运行和维护符合供应商提出的运行制度的要求和供应商提供的运行和维护手册，并根据合同默认的关于设计和建造的良好做法进行正确维护。 It is understood that there will be, e.g. due to operational requirements or due to safety reasons, components or parts thereof (including but not limited to the hot gas path parts) as well as parts subject to normal wear and tear which have shorter material life spans, thereby requiring replacement on a more frequent basis. 这可理解为：因运行要求或安全原因，部件或此文所述部件（包括但不限于热气路部件）以及部件会受到正常磨损，从而缩短了材料的使用寿命，因此要求频繁地更换部件或部件。 Nothing in this Contract or in any applicable law shall be construed to use design criteria for a longer plant operation period than stated in this clause or to expand the warranty period. 本合同或任何适用法律中未提及的内容应采用设计标准进行解释，以获得比本条款规定期限更长的设备运行期限或延长保修期。 Note: After an extensive inspection and examination of the gas turbine (not within Supplier's scope) a life time extension may be possible. 注意：燃气轮机经过全面的检验和检查（供应商范围不含此）后，有可能延长其使用寿命。

Logging of Operating Hours and Starts 运行小时数和起动次数日志

Parameter 参数	Design condition 设计条件
General 概述	Purchaser kindly note that project-specific adaptation and implementation of following calculation formulas and weighting factors will be done by Supplier during project detail engineering phase, depending on provided scope of supply and considering permitted gas turbine operating modes. 请买方注意：供应商将在项目详细设计期间，根据所提供的供货范围并考虑到容许的燃气轮机工作模式，针对具体项目修改并采用下列计算公式。 Some typical weighting factors can be provided upfront on request. 如有要求，可以提供一些典型的权重因数

Parameter 参数	Design condition 设计条件
Gas turbine, equivalent operating hours (EOH) 燃机，等效运行小时数	$t_{EOH} = \sum_{x=1}^{N_{S1}} F_{S1} + \sum_{y=1}^{N_{S2}} F_{S2} + \sum_{i=1}^{n} t_{Dyn,i} + \sum_{j=1}^{m} (F_{O,j} \times F_{F,j} \times F_{W,j} \times \Delta t_j)\, t_{EOH}$ $= \sum_{x=1}^{N_{S1}} F_{S1} + \sum_{y=1}^{N_{S2}} F_{S2} + \sum_{i=1}^{n} t_{Dyn,i} + \sum_{j=1}^{m} (F_{O,j} \times F_{F,j} \times F_{W,j} \times \Delta t_j)$ $F_W = 1 + 0.45 \times \frac{\dot{m}_{Water/Steam}}{\dot{m}_{Fuel}} F_W = 1 + 0.45 \times \frac{\dot{m}_{Water/Steam}}{\dot{m}_{Fuel}}$ tEOH Equivalent operating hours tEOH 等效运行小时数 tDyn Equivalent hours due to fast temperature changes tDyn 因温度快速变化的等效小时数 Δt Operating time between two data points Δt 两个数据点之间的工作时间 NS1 Number of all starts NS1 所有启动的次数 NS2 Number of fast starts (if permitted) NS2 快速启动的次数（若允许） n Number of rapid temperature changes n 温度快速变化的次数 m Number of data points recorded during operation m 运行期间记录的数据点数量 FS1 Weighting factor for all starts FS1 所有启动采用的权重因数 FS2 Weighting factor for fast starts (if permitted) FS2 快速启动（若允许）采用的权重因数， FO Weighting factor for operation FO 运行采用的权重因数， FF Weighting factor for fuel (depending on fuel type and composition) FF 燃料权重因数（基于燃料类型和成分） FW Weighting factor for water or steam (if applicable) FW 注水或蒸汽采用的权重因数(如适用)

Fuels and Media 燃料与介质

GENERAL 概述

Basically, the fuel characteristics shall be according to the generic requirements stated in section "Media for Gas Turbine". In case of contradictions between the section "Media for Gas Turbine" and the data in the tables below, the latter shall prevail.

燃料特点基本上应符合“燃气轮机介质”章节规定的要求。若下表所列数据和“燃气轮机介质”章节的数据有出入，应以下表中的数据为准。

For detailed requirements concerning other operating media, please refer also to section "Requirements on Media".

了解关于燃气轮机和蒸汽轮机介质的详细要求，同样参阅“介质要求”章节。

NATURAL GAS 天然气

Except otherwise explicitly mentioned, the terms "natural gas" or "NG" within this offer mean always the natural gas provided at Supplier's terminal point(s)-14A , which shall already be conditioned as required for satisfactory gas turbine operation (i.e., cleaned, pressure regulated, pre-heated, as applicable for the specific project and defined within this offer).

除非另有明确规定，本文件中的术语“天然气”系指位于供应商连接点 14A（燃气模块入口处）的天然气，已具备满足燃气轮机运行所需的条件（即，干净的、已调节压力、预热、适用于本文件定义的具体项目）

Parameter 参数	Design condition 设计条件	
Composition and properties 天然气组分和特性	Fuel composition and properties shall be within the limits as defined in section "Media for Gas Turbine". 燃料气组分应在〝燃气轮机介质〞章节定义的范围内。 Nevertheless the impact of the total sulphur content in fuel gas has to be considered by Purchaser (e.g. relevant for HRSG design). 但买方须考虑到燃料气中的总硫分的影响。（如对余热锅炉（HRSG）设计的影响）	
Lower Wobbe Index (LWI) 低位华白数 （LWI）	Design 设计值	48.2 MJ/m3 STP
	Permissible range 允许范围	47.3-49.2 MJ/m3 STP
Pressure 压力	Minimum, operational 最小，运行	22.12 bar(g) at 20 °C fuel temperature
	Maximum, operational 最大，运行	31 bar(g)
	Maximum, design limit 最大，设计限值	31 bar(g)
Temperature 温度	Minimum 最低	15 °C 且 露点 +28k
	Within this design range, fuel gas temperature shall be controllable over the complete load range. Temperature and dew point control shall be supplied by Purchaser. Set point will be supplied by gas turbine control system. 在本设计范围内，燃料气温度应控制在全部负荷范围内。买方应实施温度和露点控制。燃气轮机控制系统将提供设定值。	
Mass flow 质量流量	Maximum 最大	12.90 kg/s
	Correctly installed and proper working natural gas flow measurement system according to requirements stated in section "Specification of Natural Gas Flow Measurement"has to be ensured by Purchaser for performance tests. 买方须确保依据〝天然气流量测定规范〞章节规定的要求正确安装并运行天然气流量测定系统，以便实施性能测试。	

CLOSED COOLING WATER 闭式冷却水

Parameter 参数	Design condition 设计条件	
Quality 质量	Please refer to section "Cooling Water Quality". 请参阅〝冷却水质规范〞章节。	
Pressure 压力	Minimum 最低水压	8 bar(g)
	Operation 工作水压	10 bar(g)
	Maximum 最高水压	12 bar(g)
Temperature 温度	Design 设计温度	28 °C
	Maximum 最高温度	38 °C

FURTHER MEDIA 其他介质

Parameter 参数	Design condition 设计条件
Lube oil 润滑油	Please refer to section "Media for Gas Turbine". 请参阅〝燃气轮机轮机介质〞章节。
Hydraulic / control fluid 控制油	Please refer to section "Media for Gas Turbine". 请参阅〝燃气轮机轮机介质〞章节。
Instrument / compressed air 仪用空气	Please refer to section "Media for Gas Turbine". 请参阅〝燃气轮机轮机介质〞章节。
GT compressor washing water 燃机压气机水洗水	Please refer to section "Media for Gas Turbine". 请参阅〝燃气轮机轮机介质〞章节。
GT compressor washing agent 燃机压气机水洗清洁剂	Only cleaning agents approved by Supplier shall be used. 仅可采用供应商许可的清洗剂。

Gas Turbine Package 燃气轮机机组

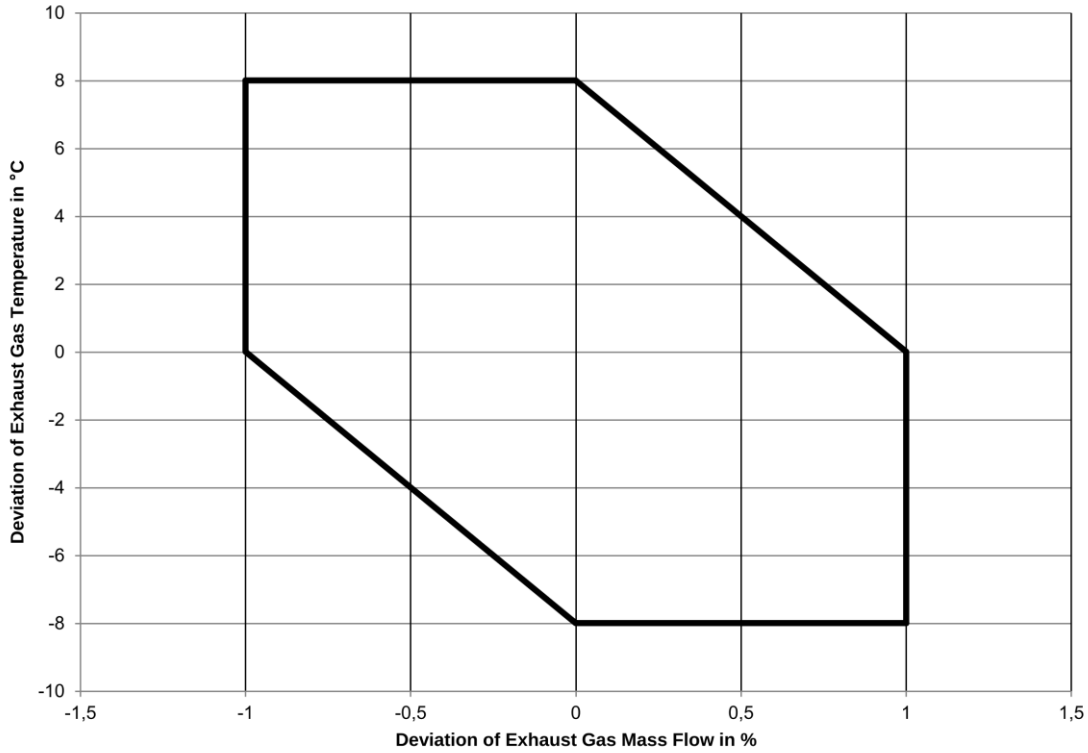
EXHAUST GAS SYSTEM 排气系统

Parameter 参数	Design condition
Exhaust gas, parameter 排气，参数	Please refer to annex "Exhaust Gas Parameter Tolerances" which determines the range, where the exhaust parameters of the gas turbine at base load conditions are expected to be and have to be considered by the Purchaser concerning the HRSG. Additionally it has to be considered by Purchaser that exhaust gas temperature might be 15 K higher at part load operation. During special operations (e.g. trip, purging) exhaust parameters might differ in general. 请参阅附件“排气参数公差”，这部分定义燃气轮机在基本负荷条件下的预期排放参数范围以及买方须考虑在内的关于余热锅炉的排气参数。另外买方须考虑到：在部分负荷运行时排气温度可能在 15K 以上。在特殊运行期间（如跳闸、换气），排气参数通常可能会有所不同。.
Exhaust gas, emissions 排气，排放	Continuous emission monitoring system (Purchaser's scope) shall be correctly installed and proper working, including interface to Supplier's gas turbine control system, at start of gas turbine commissioning for tuning of the gas turbine. The CEMS must be in accordance with EN 14181 QAL1 (please refer also to section "Continuous Emission Monitoring System"). Detailed requirements will be provided by Supplier during project execution. 应配备正确安装且正常工作的连续排放监测系统（买方范围），包括供应商范围界面，以便开始对燃气轮机进行调试，从而对燃气轮机进行（良好）的调整。烟气排放连续监测系统（CEMS）须符合 EN14181 QAL1 规定（同样请参阅章节连续排放监测系统）。供应商将在项目执行期间提供详细的要求。

Annex: Exhaust Gas Tolerances 附件：排气参数公差

Power output, efficiency and exhaust gas parameters of a gas turbine have a certain relation and impact on each other. The diagram determines the range, where the exhaust parameters of the gas turbine are expected to be.

燃气轮机的输出功率、效率和排气参数之间有一定的关系且相互影响。下列图表确定燃气轮机预期排放参数的范围。



Bild_Std 1 Tolerances of gas turbine exhaust gas parameters

图：燃气轮机排气参数公差

Example: 例如：

In case the mass flow is 0.5 % higher than the reference value, then very probably the pressure ratio will be higher as well. For a given turbine inlet temperature this will lead to a lower exhaust temperature.

若质量流超过参考值 0.5%，则压力比也极有可能会提高。若给定透平进气温度，这将使排气温度降低。

1.2 介质要求

Media for Gas Turbine

燃气轮机的介质

Supplier's requirements on working media for the gas turbine are described in the following documents provided below:

供应商对于燃气轮机的工作介质的要求在下列文件中叙述：

Fuels, Air, and Water

燃料，空气，水

GENERAL

基本要求：

In the open gas turbine cycle, large amounts of the working fluids air, fuel and water are passed through the machine (in contrast to the steam cycle, in which the same working fluid is "only" circulated).

在燃机开放循环中，大量工作流体（空气，燃料和水）通过机体（对于蒸汽循环来说，其中工作流体仅循环）

Ideally, these working fluids are "pure", i.e., they contain no elements which can be harmful to the gas turbine or exhaust system and/or release harmful compounds to the environment.

理想情况下这些工作流体是纯净的，例如不含有任何有害于燃机排放系统的元素或释放对环境有害的物质

This ideal situation does not occur in practice, and impurities can enter the gas turbine in the following ways:

这种理想状况在实际运行中不会出现，杂质能通过以下途径进入燃机:

Contamination of 污染物

- intake air 进气空气
- the fuel 燃料
- the washing water 冲洗水.

Contamination of these working fluids can have the effects listed in section " Effects of Impurities and Requisite Countermeasures". Gas turbines can only be operated with normal maintenance intervals if limits for impurities are complied with and monitored as specified.

工作流体的污染造成的影响会列在"杂质影响和必要措施"部分。如果遵循规范要求并对杂质限制进行检测，则燃机能够在正常的维护周期内运行。

Furthermore, specified physical parameters of the working media must be complied with during operation of the gas turbine. Physical properties which characterize the fuel include,

for example, not only chemical composition, but also lower heating value, density, viscosity, flash point, dew point (in the case of fuel gases). Limits (gradients, extrema) dictated by the systems engineering design apply to each of these properties in addition.

此外，在燃机运行中也必须遵守介质规定的物理参数。描述燃料的物质特征不仅包括了化学成分，还包含了地热值，密度，粘性，燃点，露点（如果是燃料气）。此外，系统工程设计中描述的限制（梯度，极值）也应用于这些特征。

ORIGIN OF GAS TURBINE POLLUTANTS 燃机污染物来源

Pollutants can contaminate the fuel and the intake air in the following ways:

污染物会以如下方式污染燃料和进气空气

Pollutant **污染物**	**Origin of Fuel Contamination** **燃料污染物来源**	**Origin of Intake Air Contamination** **空气污染物来源**
Na	- Seawater used as ballast in empty tankers (in fuels stored in tanks / piping which were not flushed prior to fuel addition)空油管中冲洗残留海水（存储于油罐/管道中的燃料在加油前未冲洗）	- Aerosols at coastal locations 沿海地区的盐雾 - Leaching of salts contained in dust removed by filters 在过滤灰尘时的盐残留
K	- Minor constituent of seawater (K/Na approx. 1:28) 少量存在于海水 - Dominant in plant matter (coal-derived fuels) 显著存在于电厂物质中（煤源燃料 ）	- Dust of mineral origin, (clay, feldspar) 矿中灰尘（泥土，长石）
Pb	- Tetraethyl- and tetramethyl-lead as fuel additives (in fuels stored in tanks / piping which were not flushed prior to fuel addition; these compounds are water-insoluble) 四乙基和四甲基的附加物（存储于油罐/管道中的燃料在加油前未冲洗，这些物质不溶于水的）	- Automotive exhaust 汽车尾气
V	- Rock formations from which crude oil was extracted, present as water-insoluble vanadium porphyrin complex 原油萃取的岩层，以不溶于水的钒化合物呈现	

DEFINITIONS 定义

Term **术语**	**Definition** **定义**
Ash 灰烬	Designation for mineral residues produced by incineration of organic substances 定义为有机物质焚化后的矿物残留
Sediment 矿物质	Designation for loose solid mineral matter produced by of physical, chemical or, to a lesser extent, biogenic weathering of all types rock that is already present. For this application: Inorganic contaminants (sand) entrained into liquid fuels (crude oil, residual oil, etc.) during pumping, transport, or storage. 指定由已经存在的所有类型岩石的物理，化学或较小程度的生物风化产生的松散固体矿物质。 对于此应用：在泵送，运输或储存过程中，无机污染物（沙子） 夹带在液体燃料（原油，残油等）中。
Dust 灰尘	Designation for dispersed solid matter in gases, arising from mechanical processes or stirred up by gas flow. For this application: The term “dust” is used to denote all solid particles with a grain size less than 200 µm.

	定义为气体中的散布固体，通过机加工产生或气体流动产生。“尘”的定义泛指固体颗粒尺寸小于 200 μm

EFFECTS OF IMPURITIES AND REQUISITE COUNTERMEASURES

杂质影响以及必要措施

No. 序号	Constituent or Parameter 杂质	Effects 影响	Measures / Remarks 措施
1	Vanadium (V) 钒	- Hot corrosion 热腐蚀	- Adjustment of the operating hours meter if limit is slightly exceeded – 如果轻微超限，调整运行小时计数
2	Lead (Pb) 铅	- Hot corrosion 热腐蚀	- Strict compliance with limit – 严格遵守限制
3	Alkali metals (Na, K) 碱性金属（钠，钾）	- Hot corrosion (alkali sulfate corrosion) 热腐蚀（碱性硫酸盐腐蚀）	- Fuel washing 燃料冲洗 - Intake air filtering (prevent leaching of salts retained in filter during rainy weather)进气空气过滤（防止雨天含盐成分浸入） - Water demineralization 水去矿化 - Adjustment of the operating hours meter if limit is slightly exceeded 如果轻微超限，调整运行小时计数
4	Calcium (Ca)钙	Formation of hard deposits on blades which cannot be removed by washing with water; if these deposits flake off, downstream items may be damaged by 叶片上残留的不能用水冲洗一处的结垢，下游部件有可能收到破坏 → Risk of erosion 具有腐蚀风险	– Fuel washing 燃料冲洗
5	Chlorine (Cl), 氯 Fluorine (F)氟	Formation of HCl, Cl_2, or HF HF HCl, Cl_2, or HF 形式存在的 - Accelerated corrosion activity with austenitic materials (acid corrosion)燃烧介质导致的加速腐蚀（酸腐蚀） - Hot corrosion 热腐蚀	– Fuel washing (gases) 燃料冲洗
6	Sulfur (S)硫	- Nearly complete conversion to SO_X 几乎完全转化为 SO_X - Compounds such as Na_2SO_4, K_2SO_4 and $Na_3FE(SO_4)_3$ are also corrosive, as their melting points lie within the GT temperature range (alkali sulfate corrosion) Na_2SO_4, K_2SO_4 $Na_3FE(SO_4)_3$ Na_2SO_4, K_2SO_4 and $Na_3FE(SO_4)_3$ 也具有腐蚀性，其熔点在燃机温度范围	- Comply with applicable national emissions guidelines 遵守国家排放规范 - Measures stipulated as a function of concentration 采用浓度控制的措施

No. 序号	Constituent or Parameter 杂质	Effects 影响	Measures / Remarks 措施
7	Water 水	Two phase conditions 两个阶段条件	Heating to temperatures of at least 15 K above water dew point 至少加热到水露点 15k 以上
8	Dust, sediments 粉尘，沉淀物	- Clogging of filters 阻塞过滤网 - Erosion 腐蚀 - Formation of deposits 形成杂质、结垢 - Hot and acid corrosion 热腐蚀和酸性腐蚀	Cleaning of fuel and intake air (filtering, centrifuging, electrostatic precipitation)清洗燃料和进气空气（过滤，离心处理，静电沉淀）

LIMITS FOR CHEMICAL IMPURITIES IN FUELS AND INTAKE AIR 燃料和进气空气中化学杂质的限制

If the levels of fuel impurities are no higher than the following limits, the gas turbine can be operated without restriction of the permissible output or shortening of the specified maintenance intervals.

如果燃料杂质等级不超过如下限制，则燃机可以在不限制输出或缩短维护周期的情况下运行

As a matter of principle, the total entrainment of all impurities with the process media air, fuel, and H_2O is the determining factor for damage to the gas turbine and its individual component parts. The total mass flow rate of a given pollutant may therefore be the sum of the individual mass flows. 原则上，空气，燃料和水中夹杂的杂质是对燃机和其部件造成损害的决定性因素。污染物的总流量率因此可以认为是各个流量的总和。

Limits for chemical contaminants (fuel weighting factor f = 1):化学污染物限制(燃料权重 f = 1)

Pollutant 污染物		Test [7] 测试	Unit 单位	Compressor Inlet Air [1] 压缩空气进气
Dust (fuel gas), Sediments (EL fuel oil)	Total 总计 d ≤ 2 µm 2 < d ≤ 10 µm d > 10 µm	DIN EN 12622 VDI 2066 (1994) ASTM D 2709 & 6304	ppm(wt) =mg/kg	≤ 0.08 ≤ 0.06 ≤ 0.02 0
Vanadium (V) [2] 钒		DIN 51790 ASTM D 3605	ppm(wt)	≤ 0.001
Lead (Pb) [3] 铅		DIN 51790 ASTM D 3605	ppm(wt)	≤ 0.002
Sodium+potassium (Na+K) [4] 钠和钾		EPC method DIN 51790 ASTM D 3605	ppm(wt)	≤ 0.001
Calcium (Ca)钙		ASTM D 3605	ppm(wt)	≤ 0.02
Ash 灰烬		ASTM D 482	ppm(wt)	--
Fuel-bound nitrogen 燃料氮(N) [5]		ASTM D 4629	ppm(wt)	--
Sulfur (S) 硫 [5]		ASTM D 129 ASTM D 1072 ASTM D 6228	ppm(wt)	--

Remark 1 Dust contaminants in compressor intake air and in fuel (Downstream of filter, empirical values): If the stipulated values are exceeded, the permissible limits for fuel impurities shall be lowered by that amount contained in the intake air to ensure that the total mass flow of any given contaminant (compressor intake air + fuel) does not exceed the prescribed limit. The total mass flow rate of a given pollutant is therefore the sum of the individual mass flows (max. 3: air, fuel, H_2O,others).

1) 压气机进气空气和燃料中的微粒杂质: 如果超过控制值，燃料中的杂质允许限制应低于进气空气中的含量， 以确保进气空气和燃料中的总含量不超过上述限制。污染物的总流量率因此可以认为是各个流量的总和（空气，燃料，水，其他）。

Remark 2 Vanadium: Refer to “Specification Fuel Gas” if limit is violated.

2) 钒:如果超标的话参照“燃料气规范”

Remark 3 Lead: No violations of this limit whatsoever are permissible.

3) 铅: 无论任何情况都不能超出这个限制

*Remark 4 Sodium and potassium:*The standard limit of 0.5 ppm(wt) shall apply to the sum of sodium and potassium, based on the fraction present in fuel at a lower heating value of 42 MJ/kg. At coastal and industrial sites, this limit shall be reduced to 0.3 ppm(wt), provided that no air analysis has been performed.

4) 钠和钾: 0.5ppm(wt)的标准限制指钠和钾的总量，在燃料中微量存在并且燃料热值较低，为 42MJ/kg. 在沿海和工业地区，如果没有进行过空气分析，则限制应降为 0.3ppm(wt)。

Remark 5 Sulfur, fuel-bound nitrogen: Limits absolutely must be complied with in the case of gaseous and liquid fuels. Actions to be taken in the event that limits are exceeded are described in greater detail in documents "Specification Fuel Gas / Specification Fuel Oil".

5）硫，燃料氮，FBN: 燃料为气体和液体燃料必须遵循此限制。如果限制超过具体燃料规范中的描述，则需要采取措施。

REQUIREMENTS FOR COMPRESSOR INTAKE AIR 压缩机进气空气要求

The compressor intake air filters shall be designed such that the following limits for dust concentration in the compressor intake air are not exceeded:

压气机进气滤网设计，必须保证以下出压气机进气空气中的灰尘浓度限制。

Intake Air Constituent 进气空气成分	**Unit 单位**	**Limit 限制**	**Remarks 注释**
Dust, total 灰尘，总共	ppm(wt)	≤ 0.08	Absolute filter mesh size 10 µm 绝对过滤器网格尺寸 10 µm
Dust, 2 < d < 10 µm 灰尘, 2 < d < 10 µm	ppm(wt)	≤ 0.02	Absolute filter mesh size 10 µm 绝对过滤器网格尺寸 10 µm

Due to the sensitivity of the cooling air system, the plant must never be operated without intake air filters.

由于冷却空气系统的敏感性，在没有进气滤网的情况下电厂绝不能运行。

Corrosive air impurities such as salts, which can enter the turbine when air laden with seawater droplets or dust particles containing salts is ingested, must be separated out to the greatest extent possible (cf. section “Limits for Chemical Impurities in Fuels and Intake Air”).

腐蚀性空气中的杂质，如盐，在空气中充满海水沫或含有盐分的灰尘颗粒时会被带入燃机，因此必须尽最大可能除去这些杂质（“燃料和进气空气中化学杂质的限制”部分）

This must be ensured with suitable filter equipment (droplet separator if necessary) and timely cleaning of filters. Particularly in environments in which salt-laden dust collects in the filters due to inadequate filter cleaning during extended periods of dry weather, subsequent higher humidity or precipitation can lead to dissolution of the salts, entraining them into the turbine in very high concentrations.

这必须通过合适的过滤设备（如必要分离器）得到保障，并需要及时清理过滤器。特别是在由于在长时间干燥气候下所引起的不适当的过滤器清洗，会造成带盐灰尘聚集于过滤器，更高湿度或沉淀会导致盐溶解，并以非常高的浓度被带入燃机。

The topics Temperature Ranges/Humidity and Compressor Cleaning are dealt with elsewhere in greater detail.温度/湿度范围和压缩机清洁在其他地方更详细地讨论。

REQUIREMENTS FOR WASHING WATER 洗涤水要求

The following water qualities are specified for washing the compressor:

冲洗压气机的水质要求

Operation 运行	Operating Mode 运行模式	Water Quality (De-ionized water) 水质（去离子水）
Compressor cleaning 压气机清洗	Offline washing 离线水洗	x
Compressor cleaning 压气机清洗	Online washing 在线水洗	x

Remark: An increase in conductivity of up to 0.8 µS/cm is tolerable in the case of compressor cleaning, provided it is caused by air ingress (CO2) and not by other factors (entrainment of salt, etc.)
在压缩机水洗的情况下，如果电导率的增加是由空气进入(CO2)导致的，且非其它因素（夹带盐等），那么允许电导率增至 0.8 µS/cm。

UNITS AND CONVERSIONS

Gas turbine data are usually given on the basis of mass (.../kg).In the gas industry, by contrast, data are customarily stated on the basis of volume (.../m^3). It is therefore necessary to convert the data of the fuel gas analysis. The following data are used for this conversion.

燃气轮机数据常基于质量单位(.../KG)，而天然气行业数据通常以体积单位表示(.../M^3). 因此，需要对燃料气的数据进行换算。以下数值可用于换算。

The designation "m^3_N" is used to denote standard cubic meter (m^3), i.e., a cubic meter at standard temperature (T_N) and pressure (p_N), where p_N = 1.01325 bar, and T_N = 273.15 K = 0 °C

单位符号 m^3_N 用于表示标准立方米(m^3)，即标准温度(T_N)以及标准压力下(p_N)一立方米，其中：

p_N = 1.01325 bar,

T_N = 273.15 K = 0 °C

Conversion of heating value:　　热值换算：

- Lower Heating Value [kJ/m^3_{STP}] / density [kg/m^3_{STP}] = Lower Heating Value [kJ/kg].
- 低热值[kJ/m^3_{STP}] / 密度 [kg/m^3_{STP}] = 低热值[kJ/kg].

Conversion of relative density 相对密度换算:

Instead of density, the gas industry often states relative density. Relative density is the ratio of the gas density to that of air. Relative density is therefore dimensionless.

天然气行业通常以相对密度代替密度表示。相对密度是气体密度与空气密度的比值。因此相对密度是无量纲量。

- The density of air at standard pressure and temperature is 1.293 kg/m^3.
- 标准压力及温度下的空气密度为 1.293 kg/m^3。
- Relative density x 1.293 kg/m^3 = gas density [kg/m3].

- 相对密度 x 1.293 kg/m^3 = 气体密度[kg/m3]

Specification Fuel Gas 天然气规范

GENERAL 综述

Only those fuels which are stipulated by Siemens in the supply contract are permissible for operation of gas turbines. Operation with fuels other than those stipulated there is not permitted. An unequivocal evaluation of fuel gas can only be performed if data corresponding to section "Checklist for Fuel Gas" are available. Limits and standards listed there apply to such assessments. If no limits are listed, the situation must be coordinated with Siemens on a case-to-case basis.

只有西门子能源供应合同中规定的燃料才能用于燃气轮机的运行。使用其他不匹配的燃料是不允许的。对燃料的评估，要求提供“燃料检查清单”中所列的相关信息。所列范围和标准适用于这样的评估。若无相应的范围或限制，则需与西门子针对项目具体情况商议。

CONSTITUENTS AND PROPERTIES 污染物与性能

The fuel gas must meet the following typical requirements if it is to be used in gas turbines equipped with standard fuel gas systems. The permissible gradients for changes in fuel gas pressure, temperature and lower heating value stipulated in section "Requirements".

针对配备标准燃气系统的燃气轮机，天然气必须满足以下典型要求。 具体要求部分规定的燃气压力，温度和低热值变化的允许梯度。

Handling of fuels shall be subject to all regulations stipulated in the Operating Manual and Product Manual.

燃料的处理应遵守操作手册和产品手册中规定的所有规定。

The following data must be determined as defined in the respective ASTM, ISO or DIN standard.

以下参数必须依照以下 ASTM, ISO 或 DIN 标准测试

Tabelle_Std 1 Gas Constituents and Properties of Fuel Gas at Flange 14A

天然气成分值适用于法兰接口 14A

Gas Constituents **燃料成分**	**Unit** **单位**	**Limit** **限制**

Gas Constituents 燃料成分	Unit 单位	Limit 限制
CH_4 甲烷	Vol.%	⩾ 80
C_2H_2 乙炔	Vol.%	⩽ 0.1 2.4)
C_2H_6 乙烷	Vol.%	⩽ 15
C_nH_m 碳氢化合物	Vol.%	⩽ 10 sum of C_nH_m with n ⩾ 2,excluding C_2H_6 除了乙烷之外，二阶以上的碳氢化合物总和 2.5) cf. condensation point 关于露点温度（“燃气要求”章节） 3.4)
H_2 氢气	Vol.%	⩽ 1.0 2.4, 2.5)
CO 一氧化碳	Vol.%	normally not a constituent of fuel gas 通常不是燃气的成分 2.2)
H_2O 水	Vol.%	cf. condensation point 关于露点温度（“燃气要求”章节） 3.4)
N_2 + Ar + CO_2 C 氮气+氩气+二氧化碳	Vol.%	⩽ 20
O_2 氧气	Vol.%	⩽ 0.1
Fuel bound nitrogen (FBN) 燃料氮	Vol.%	2.7)
Others 其他	Vol.%	2.2)

Tabelle_Std 2 Contaminants of Fuel Gas at Flange 14A 天然气污染物 适用于 14A

Gas Contaminants 燃料污染物	Unit 单位	Limit 限制

Gas Contaminants 燃料污染物	Unit 单位	Limit 限制
Chemical 化学物质	Refer also to document "Requirements / Fuels, Air and Water", section "Limits for Chemical Contaminants in Fuels, Compressor Intake Air, and in Injection Water" 另请参阅文档“燃料，空气和水”中“燃料中的化学污染物，压缩机进气和注入水中的限制”部分	
Dust 粉尘 2.1, 2.3) d ≤ 2 µm 2 < d ≤10 µm	ppm(wt) = mg/kg	≤ 20 ≤ 18.5 ≤ 1.5
Na + K 钠+钾 2.1)	ppm(wt)	≤ 0.5 (with Fuel Factor 燃料系数 f=1.0) ≤ 1.0 (with Fuel Factor 燃料系数 f=1.5)
Ca 钙 2.1)	ppm(wt)	≤ 10.0
V 钒 2.1)	ppm(wt)	≤ 0.5
Pb 铅 2.1)	ppm(wt)	≤ 1.0
H_2S 硫化氢 2.6)	ppm(vol)	≤ 10
Total sulfur 总硫 2.1, 2.6)	ppm(wt)	≤ 20

Any deviations from the parameters stipulated above must be discussed with Siemens.

必须与西门子讨论与上述规定值的所有偏差。

1) Permissible limits must be corrected using the equation: X_{corr} = LHV (MJ/kg / 42 MJ/kg) x X_{spec}
允许的限制条件必须使用所列的公式修正

2) To be specified.
将详细说明

3) To ensure the required degree of purity after filtration, an appropriate filter unit shall be provided upstream of the terminal point of supply of the gas turbine fuel gas system (MBP). Care must be taken to ensure that entrainment of particles caused by corrosion of the inner walls of the lines downstream of the filtration unit and/or residual soiling in the piping is not possible.
为了确保过滤后达到要求的纯度，在燃气轮机燃气供气系统（MBP）终端接口上游 应装有一个合适的过滤单元。必须小心确保由于过滤单元下游线路内壁腐蚀和/或管道残留物引起的夹带颗粒不会发生。

4) Gases with hydrogen (H_2) content greater than 1.0 Vol% and/or acetylene (C_2H_2) content greater than 0.1 Vol% shall only be combusted in diffusion mode. If such fuels were combusted in premix mode, this would involve the risk of reactions occurring in the premix piping which could completely destroy the burners.

– 气体含氢气（H2）含量大于 1vol%，和/或乙炔含量大于 0.1vol%只能在扩散模式下燃烧。如果这些燃料在预混模式下燃烧，会导致在预混管道发生反应的风险，这会完全损害燃烧器。

5) In the case of fuels with increased hydrocarbon (C_nH_m, n = 2) content and/or hydrogen content, there is a risk of greater combustion instability even in diffusion mode; this is due to formation of condensation and/or higher flame velocity.

– 当在燃料中有较高的高阶碳氢化合物(C_nH_m, n = 2)含量和/或氢气含量的情况下，即使在扩散模式下，燃烧也有不稳定的风险；这是由于凝结的形成和/或高火焰速度引起的

6) Sulfur and hydrogen sulfide: 硫和硫化氢

Elemental sulfur is not permissible. Sulfur content as referred to in this document defines the sum of sulfur derived from the sulfur-containing compounds occurring in the fuel gas (mercaptans (R-SH), hydrogen sulfide (H_2S), odorizing agents (e.g. THT), carbonyl sulfide (COS), and others). With a total sulfur content >20 mg/kg, provision for preheating of the fuel gas to at least 60°C (with an operational tolerance of ±10 K) must be made (cf. section “Natural Gas Requirements”). At higher sulfur contents, additional operating restrictions and adaptations to the fuel gas system are required. Such requirements must be clarified on a case-to-case basis with Siemens Energy.

– 基本上硫是不被允许的。硫的含量依照于这个文档定义的由燃气中含硫混合物（硫醇（R-SH, 硫化氢（H2S），添加剂（如 THT），硫化羰（COS）和其他物质）中推导出的总硫含量。当总的硫含量大于 20mg/kg, 燃气预加热至少到 60°C 的规定必须被采用（比较“燃气需求”部分）。在高硫含量的情况下，对于燃气系统额外的操作限制和调整是需要的。这些需求必须在具体情况下和西门子能源进行澄清

Gas turbines and their auxiliary systems can be operated without restrictions under the parameters defined as before, provided the partial pressure of hydrogen sulfide (H_2S) remains below 0.003 bar(abs). At a system pressure of 30 bar(abs) and 100 ppm(mol) H_2S, 3 mbar H_2S corresponds to a total sulfur content of approximately 200 mg/kg. This is in line with the materials requirements defined in standard NACE MR1075-2003. The partial pressure of hydrogen sulfide is calculated from the product of the mole fraction and system pressure as follows:

燃气轮机和相应的辅机系统可以在以上规定的参数下进行正常工作，提供的硫化氢分压持续低于 0.003bar（绝对压力）。在系统压力 30bar（绝对压力）和 100ppm（mol）H2S，3mbarH2S 相当于总硫含量接近 200mg/kg。这是和标准 NACE MR1075-2003 中定义的材料需求是一致的。硫化氢的分压是通过摩尔分数和系统压力计算出来的

$$P_{partial}\,[H_2S] = P_{total} \times H_2S$$

$P_{partial}\,[H_2S]$ = maximum partial pressure of hydrogen sulfide 最大硫化氢分压

P_{total} = maximum system pressure 最大系统压力

H_2S = molar fraction of hydrogen sulfide.硫化氢摩尔分数

To protect the turbine and hot gas path parts, the sulfur content must not exceed 2000 mg/kg, provided no lower limits are specified in restrictions imposed by the authorities, contractual stipulations and/or items not included in the Siemens Energy scope of supply (HRSG, catalytic reactors). At corresponding sulfur concentrations, additional adaptations to the gas turbine operating modes are required; hence each such application must be coordinated with Siemens Energy.

为了保护涡轮和热气体通道,硫含量不得超过 2000 毫克/公斤,但没有提供低的限制，按当局限制规定,合同规定和/或项目不包括在西门子能源供货范围(如余热锅炉，催化反应器)。在相应的硫浓度下,燃气轮机的运行模式必须进行额外的调整,因此每一个这样的情况必须与西门子能源相协调。

Emissions are determined by the mass fraction of total sulfur (S) yielded by the ultimate analysis of natural gas composition. Sulfur compounds are limited, inter alia, by emissions regulations of the respective countries (conversion of S to SO_X).

排放是由总硫的质量含量决定的，是通过天然气成分分析得到的。硫化合物是被限制的,尤其,由各自国家的排放规定(SO_X 转换)。

7) Fuel bound nitrogen (FBN), for example, from the gas constituents NH_3, N_2H_4, is not chemically bound as strongly as molecular nitrogen. Under the conditions prevailing during combustion, fuel bound nitrogen is usually readily released, that is, $NO_{X,\ Fuel}$ forms largely independent of temperature. As a matter of principle, formation of NO_X from fuel bound nitrogen cannot be controlled by injection of water or steam.
   – 燃料氮(FBN),例如,从气体成分 NH3、N2H4,不是化学和分子氮一样强烈。在一定的条件下的燃烧期间,燃料氮通常是容易释放,也就是说,氮氧化物、燃料形式很大程度上独立于温度。作为一个原则问题,形成氮氧化物燃料氮不能由注入水或蒸汽来控制。

NATURAL GAS REQUIREMENTS 天然气要求

This document defines the properties and conditions of the fuel gas that must be satisfied at the terminal point of supply of the gas turbine supplier. Fulfillment of these requirements must be assured by equipment which is not included in the gas turbine manufacturer′s scope of supply and by separate agreements with the operator.

本节定义了燃气轮机供应商的供应终端的燃气的性能和边界条件。为满足这些条件的相关设备不包括在本供货范围内，客户需满足此要求。

Properties **特性**	**Conditions** **条件**	**Limits** **限值**
Pressure 压力 [3.1)]		
Design Value 设计值		
Tolerance 误差	at 0 – 15 % of the max. fuel flow 0 – 15 % 最大流量	± 5.0 % of design value ± 5.0 % 设计值
	at 15 – 100 % of the max. fuel flow 15 – 100 %最大流量	± 2.5 % of design value ± 2.5 %设计值
Change Rate 变化率		dp/dt ≤ 0.2 bar/s
Temperature 温度 [3.2)]		
Permissible Range 允许范围	LHV, min 35.0 MJ/kg (最小) LHV, max 50.0 MJ/kg (最大)	5 °C to 60 °C
	LHV, min 40.0 MJ/kg (最小) LHV, max 50.0 MJ/kg (最大)	5 °C to 120 °C
Condensation Point 露点 [3.4)]		min. 10 K above dew point of the gas mixture 在混合气体的露点之上至少 10 K
		min. 15 K above the dew point of water 在混合气体的露点之上至少 15 K
Tolerance 误差		± 10 K from startup and/or design value 基于启动 和/或 设计价值
Change Rate 变化率		dT/dt ≤ 1 K/s
Lower Heating Value 低热值(LHV)[3.3)]		
Design Range 设计范围	0 %– 100 % output 0 %– 100 % 出力	LHV, min 35.0 MJ/kg LHV, max 50.0 MJ/kg (100 % methane)
Design Value 设计值		[3.3)]

Properties **特性**	**Conditions** **条件**	**Limits** **限值**
Tolerance 误差		± 5.0 % of design value ± 5.0 % of 设计值
Change Rate 变化率		dLHV/dt ≤ 0.1 %/s
Lower Wobbe Index (LWI)[3.5)]	[3.2)]	
Permissible Range 允许范围		LWI, min 40.3 MJ/m^3_{STP} LWI, max 51.0 MJ/m^3_{STP}
Design Value 设计值		[3.5)]
Tolerance 误差		± 5 % of design value
Change Rate 变化率		dLWI/dt ≤ 0.1 %/s
Contaminants 污染物		
Chemical 化学污染	Refer also to document "Requirements / Fuels, Air and Water", section "Limits for Chemical Contaminants in Fuels, Compressor Intake Air, and in Injection Water" 另请参阅文档“燃料，空气和水”中“燃料中的化学污染物，压缩机进气和注入水中的限制”部分	

Legend: 图例
T = Temperature 温度; LHV = Lower Heating Value 地位热值; LWI = Lower Wobbe Index 低华白指数; t = Time 时间; p = Pressure 压力；

Remark 3.1: The required fuel gas pressure at the terminal point of supply of the GT fuel gas system (MBP) is dependent on the fuel gas composition, its temperature and density as well as the ambient conditions (air temperature and elevation of the power plant site).
3.1：燃气轮机燃气供应系统(MBP)的终端所需的燃料气体压力是依赖于燃气成分、温度和密度,以及环境条件(空气温度和海拔的电厂网站)。
Project-specific parameters are used by Siemens for determination of the required fuel gas pressure (refer to the foregoing) and entered in the List of Control Settings for Open- and Closed-loop Control Equipment (SREL) if a contract is awarded. This pressure is required for various items in the fuel gas system.
在项目执行过程中，具体项目的的参数会被西门子用来决定所需的燃气压力，并输入到开环和闭环控制设备的控制设定值中。这个压力在燃气系统的各个方面的设计中都会被用到。
The fuel gas pressure determined at this time is the "design value" and applies to all gas turbine operating conditions. In other words, it is selected such that operation of the gas turbine at limit output is guaranteed even under the least favorable conditions. The specified tolerances apply to this pressure.
现在确定的燃气压力是“设计值”并适用于所有燃气轮机操作条件。换句话说,即使在最差的工况下，保证燃机最大出力也能达到。指定的公差适用于这个压力。

In general, the maximum fuel gas pressure is calculated on the basis of the following parameters for the maximum volume flow rate of fuel:

– Lowest ambient temperature (with allowance for the permissible limit load)
– Maximum water injection (e.g., for NOx control)
– Minimum lower heating value (LHV)
– Maximum fuel gas temperature

一般来说,最大的燃气压力是在基于以下参数的最大燃料体积流率的基础上计算的:

- 最低环境温度（容许极限载荷)
- 最大注水(如。氮氧化物控制)
- 最低低热值(低热值)
- 最大的燃气温度。

Allowance is not made for the pressure drop of items not included in the gas turbine fuel gas system manufacturer's scope of supply (e.g., gas pressure control station and fuel gas fine filter). An appropriate correction factor must therefore be generated and applied to specify the requisite fuel gas pressure, e.g., at the power plant's terminal point of supply.

上述对燃气压力的要求不适用于那些不包含在燃气轮机燃气系统制造商的供货范围(如气体压力控制站和燃气细滤器)。因此,当在规定非燃气轮机供应终端的其它终端的燃气压力时，必须加上一个适当的校正因子,如在电厂供应的终点。

If the requisite gas pressure cannot be ensured by the gas supplier, a gas pressure boosting station (gas compressor) must be provided. In such cases it is imperative that only absolutely lube-oil-free gas compressors are used, i.e., all components of the gas compressor in contact with the fuel gas (e.g., pistons of a reciprocating compressor) shall not require oil for lubrication. This requires the use of suitable materials (e.g., PTFE piston rings).

如果气体供应商无法保证必要的气体压力, 必须提供气体压力增加站(气体压缩机)。在这种情况下,必须确保使用无润滑油的天然气压缩机,即气体压缩机的中与天燃气接触的所有组件 (例如活塞的往复压缩机)不能使用油润滑。这需要使用合适的材料(如：聚四氟乙烯活塞环)。

Remark 3.2: In the event of changes in the operating temperature with fuel gas preheating that exceed 30 K compared to the temperature setting made during commissioning, it must be expected that emissions will increase to such an extent that adaptation of the hardware or settings is required. In the least favorable case, emissions limits (imposed by authorities or stipulated in the contract)can no longer be complied with, consequently it may be necessary to restrict the permissible output of the GT (e.g., max. 80 % rated GT output).

3.2 如果燃气预热后的燃气温度变化,超过调试期间设定好的温度30 k，这必须认识到排放将增加到一定程度以致于某些硬件或设置需要调整。在最差的情况下排放限制(按合同规定)再也不能被遵守,其后果可能需要限制燃机的最大出力(如。最大80%额定GT输出)。

Without exception, fuel preheating to more than 60°C shall be clarified with Siemens Energy on a project-specific basis, as the permissible lower heating value in such cases is restricted. A special design fuel gas system is required if the range of permissible limits is extended; additional effort (costs, deadline adjustments) must be clarified with Siemens Energy.

无一例外，基于具体项目，当燃料预热超过 60°C 应当与西门子能源进行澄清,在这种情况下允许的低发热值是被限制的。如果超出容许极限范围，就需要特殊设计燃气系统,额外的努力(成本、期限调整)必须与西门子能源澄清。

The specified rate of gas temperature change shall not be exceeded, either during operation or in the event of a fault (outage of the fuel preheating system).

在发动机运行或在发生故障(燃气预热系统的停机)时，气体温度变化率不能超过规定值。

Remark 3.3: A "design value" must be selected between the minimum lower heating value of 35000 kJ/kg and the maximum lower heating value of 50035 kJ/kg (in line with the respective fuel gas analysis,the tolerance stated shall apply to this value). Siemens must be consulted if the lower heating value determined for the fuel gas to be used lies outside the permissible range.

3.3 设计值必须选择在最低低热值 35000 kJ /kg 和最大的低热值 50035kJ/kg(符合相关的燃料气体分析、公差规定适用于这个值)。若所使用的燃气的低热值是在允许的范围之外，必须咨询西门子。

Remark 3.4: The operating temperature of the fuel gas shall be controlled in line with the temperature limits specified in remark 3.2 of this document to ensure that no liquid and/or solid condensates (higher hydrocarbons, water,sulfur,...) form. Observe temperature limits stipulated in remark 2.6.
3.4 燃气的工作温度应控制在符合指定的温度限制在注 3.2,以确保没有液体和/或固体冷凝物(更高的碳氢化合物、水、硫、…)的形式。温度限制参照 “燃气成分和性质” 规定的部分 2.6。

Remark 3.5: The lower Wobbe Index (LWI) is calculated from the product of the lower heating value LHV_m[MJ/kg] and the square root of the density of the fuel gas ρ_{fuel} and air ρ_{air} at standard temperature and pressure [0 °C,1.013 bar]

3.5 低华白指数越是从低热值和在标准温度和压力(0°C,1.013 bar)下的燃气和空气相对密度的平方根计算得出。

(i)$LHV_v = LHV_m \cdot \rho_{fuel} LHV_v = LHV_m \cdot \rho_{fuel}$

(ii)$LWI = \frac{LHV_v}{\sqrt{\frac{\rho_{fuel}}{\rho_{air}}}} = LHV_m \cdot \sqrt{\rho_{fuel}} \cdot \sqrt{\rho_{air}} LWI = \frac{LHV_v}{\sqrt{\frac{\rho_{fuel}}{\rho_{air}}}} = LHV_m \cdot \sqrt{\rho_{fuel}} \cdot \sqrt{\rho_{air}}$

This definition of LWI is based on ISO 6976. With the standard fuel gas system (flange A14), fuel gases with lower Wobbe index levels in the range from 37 –51 MJ/m^3[0 °C, 1.013 bar] may be used.For each gas in this range, a maximum tolerance of ± 5 % is permissible for LWI. Such requirements must be clarified on a project-specific basis with Siemens.低华白指数的这个定义是基于 ISO 6976。在标准燃气系统前提下，终端 14A 处的 华白指数的范围是 37 –51 mj / m3(0°C,1.013 bar)。对于在这个区间内每种气体, ±5%的最大公差对于低华白指数是允许的。在一个特定项目基础上的所有应用，必须咨询西门子。

CHECKLIST FOR FUEL GAS 天然气成分表

To ensure unequivocal assessment of fuel analysis data, figures must be entered in the associated checklist by the customer and made available to Siemens:为确保正确评估燃料分析数据，客户必须在相关检查表中填入数据并提供给西门子：

Gas Constituents **燃气成分**	**Unit** [1)] **单位**	**Method** **测试方法**	**Value** **值**

Gas Constituents **燃气成分**	**Unit** [1)] **单位**	**Method** **测试方法**	**Value** **值**
CH_4	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_2H_2	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_2H_6	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_3H_6	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_3H_8	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_4H_8	Vol.%	ASTM D 1945 / ISO 6974, 6975	
n C_4H_{10}	Vol.%	ASTM D 1945 / ISO 6974, 6975	
i C_4H_{10}	Vol.%	ASTM D 1945 / ISO 6974, 6975	
n C_5H_{12}	Vol.%	ASTM D 1945 / ISO 6974, 6975	
i C_5H_{12}	Vol.%	ASTM D 1945 / ISO 6974, 6975	
C_6	Vol.%	ASTM D 1945 / ISO 6974, 6975	
$C_7(+)$	Vol.%	ASTM D 1945 / ISO 6974, 6975	
H_2	Vol.%	ASTM D 1945 / ISO 6974, 6975	
CO	Vol.%	ASTM D 1945 / ISO 6974, 6975	
CO_2	Vol.%	ASTM D 1945 / ISO 6974, 6975	
H_2O	Vol.%	ASTM D 1945 / ISO 6974, 6975	
N_2	Vol.%	ASTM D 1945 / ISO 6974, 6975	
O_2	Vol.%	ASTM D 1945 / ISO 6974, 6975	
Ar	Vol.%	ASTM D 1945 / ISO 6974, 6975	
Other	Vol.%		
Properties 性能			
Heating value 热值	MJ/kg	ASTM D 3588 / ISO 6976	
Wobbe index 华白数	MJ/m^3	ASTM D 3588 / ISO 6976	
Specific density 密度	kg/m^3	ASTM D 3588 / ISO 6976	

Gas Constituents 燃气成分	Unit [1)] 单位	Method 测试方法	Value 值
Temperature 温度	°C		
Condensation point 露点	°C	ASTM D 1142 / ISO 6327 (water) -/ ISO 23874 (hydrocarbons)	
Contaminants 污染物			
Dust 粉尘	Mass %	VDI 2066 (1994) ASTM D 2709 & 6304	
Alkali metals 碱性金属 (Na + K)	ppm(wt)	ASTM D 3605 / DIN 51790	
Other metals 其他金属 (V,...)	ppm(wt)	ASTM D 3605 / DIN 51790	
NH_3	ppm(vol)	ASTM D 5504 / ISO 19739	
H_2S	ppm(vol)	ASTM D 5504 / ISO 19739	
Total sulfur 总硫	ppm(wt)	ASTM D 3246 / ISO 6326	
Other specific Characteristics 其他特性			
* other ISO units are permitted 其他 ISO 单位亦适用			

Specification Lube Oil 说明书：润滑油

INTRODUCTION 介绍

This specification describes the requirements imposed on turbine oils used for lubricating Siemens turbine-generators. Only turbine oils approved by Siemens shall be used. An up-to-date list of approved turbine oils can be requested from Siemens.

本说明书描述了用于润滑西门子涡轮发电机的透平油的相关要求。只能使用经西门子能源批准的透平油。可从西门子能源处获得经批准的透平油的最新列表。

TYPE OF TURBINE OIL

For the purposes of this specification, turbine oil is defined as a mineral oil or synthetic oil with additives which enhance corrosion protection and degradation resistance. Turbine oils used for gearbox lubrication may also contain additives which increase load carrying capacity and reduce wear.

本说明书的目的，透平油是一种含有添加剂的矿物油或合成润滑油，以增强腐蚀保护和抗降解能力。用于齿轮箱润滑的透平油还可以包含增加负载能力和减少磨损的添加剂。

As a rule, turbine oil is a paraffin-base mineral oil comprising a mixture of saturated hydrocarbons. Because of the numerous chemical constituents involved, it is not possible to state a defined composition. The physical properties of the oil are the selection criteria used for choosing a turbine oil. The additives shall not have any adverse effect on the materials used in the oil system. Additives shall not contain any organometallic compounds (e.g., organic zinc compounds).

作为规定，透平油是一种含有饱和烃的混合物的石蜡基矿物油。由于大量的化学成分，不可能确切地阐述其组成。油的物理性质是选择一个透平油的标准。所使用的添加剂应对油系统中使用的材料没有任何不利影响。并且所使用的添加剂中不包含有机金属化合物（例如，有机锌化合物）。

GENERAL REQUIREMENTS 一般要求

- Viscosity 粘度

  The required viscosity grade is specified within the following tables for physical and chemical properties. The viscosity grade is dependent on the gas turbine model and project-specific requirements. Prior approval from the Siemens engineering departments is required if oils with other viscosity grades are to be used.

  所需的粘度等级在下表中列出了物理和化学性质。 粘度等级取决于燃气轮机型号和项目特定要求。 如果要使用其他粘度等级的油，则需要事先获得西门子工程部门的批准。

- Thermal stability 热稳定性

  Turbine oil with **normal** thermal stability: The turbine oil must be capable of withstanding temperatures of **max.110 °C** in machine components (e.g., bearings, clutch,gearbox) and up to 80 °C in the oil tank with no negative impact on the properties of the oil.

  高热稳定性的透平油: 透平油必须能够承受温度高达 110°C 机器部件（例如，轴承，离合器，变速箱）和 80°C 油箱油且对机油性质无负面影响。

- Compatibility 兼容性

  The fluids must be capable of mixing with residues (max. 4 vol. %) of another similarly based product (mineral or synthetic) with no negative impact on the properties of the oil.

  透平油必须能够掺混其他相似产品（矿物或合成气）的残留液体（最大容量为 4 VOL.%），而对润滑油本身的性能无负面影响。

- Physiological properties 生化特性

  By nature, the turbine oil must not be hazardous to the health of the persons working with it, provided the necessary hygienic precautions are taken.

  就其本性而言，倘若采取了必要的卫生防护措施，透平油必须对操作工人的健康无害。

PHYSICAL AND CHEMICAL PROPERTIES OF TURBINE OILS WITH STANDARD THERMAL STABILITY 标准水平热稳定性的透平润滑油的物理特性和化学特性

Property **性能指标**	**Numeric Value** **数值**	**Unit** **单位**	**Test Method** **检测方法**	
			DIN/ISO	**ASTM**
Kinematic viscosity at 40 °C [1)] ISO VG 46 在 40°C 下的运动粘度，ISO VG 46	41.4 – 50.6	mm^2/s	DIN 51562-1 / DIN EN ISO 3104	ASTM D 445
Viscosity index 粘度指数	≥ 90	-	DIN ISO 2909	ASTM D 2270
Air release value at 50 °C 在 50 °C 下的空气释放值	≤ 4	min	DIN ISO 9120	ASTM D 3427
Neutralization number	≤ 0.30	mg KOH/g	DIN 51558-1	ASTM D 974
Water content 含水量	≤ 200	mg/kg	DIN EN ISO 12937	ASTM D 1744
Foaming at 24 °C: 在 24 °C 下的起泡情况	≤ 450 / 0	ml / ml	ISO 6247 (Seq. 1)	ASTM D 892 (Seq. 1)

Property 性能指标	Numeric Value 数值	Unit 单位	Test Method 检测方法	
			DIN/ISO	ASTM
Water release capability 水分离性	≤ 300	s	DIN 51589-1	-
Demulsibility 抗乳化性	≤ 30	min	DIN ISO 6614	ASTM D 1401
Density at 15 °C 在 15 °C 下的密度	reported 报告	-	DIN 51757	ASTM D 1298
Flash point 闪电	> 200	°C	DIN ISO 2592	ASTM D 92
Pourpoint 流点	≤ - 6	°C	DIN ISO 3016	ASTM D 97
Purity 清洁度 [2)]	≤ 20/17/14	-	ISO 4406	-
Copper strip corrosion 3 h at 100 °C, extent of corrosion 铜片腐蚀， 100 °C 下需三个小时，腐蚀等级	≤ 2	-	DIN EN ISO 2160	ASTM D 130
Corrosion protection for steel, method B 防锈特性，过程 B	Pass 通过	-	DIN ISO 7120	ASTM D 665
Aging behavior: Time to increase of neutralization number by 2.0 mg KOH/g 氧化稳定性：总酸值增加 2 mg KOH/g 所需的时间	≥ 3000	h	DIN EN ISO 4263-1	ASTM D 943

as-received condition 收货状态

[1)] The viscosity grade is specified by the responsible design department. 粘度等级由相关设计部门决定；

[2)] The purity of the oil refers to its condition upon receipt. The required purity is specified for the system in question and must be ensured through implementation of suitable measures (e.g.,filtering, separation). 清洁度指润滑油的状况。所要求的系统清洁度取决于系统设计。必须采取相应措施（如过滤、分离）来保证透平润滑油的清洁度。

Specification Hydraulic Oil 说明书：液压油

INTRODUCTION 简介

This specification describes the requirements imposed on hydraulic oils used for Supplier's hydrostatic actuators of the gas turbine.

本规格描述供应商的燃气轮机的流体静力传动装置采用的液压油的要求。

Quality, cleanliness and operating viscosity of the hydraulic oil are decisive factors for the operational reliability, economy and service life of the hydraulic system.

液压油的质量、清洁度和运行年度是液压系统运行可靠性、经济性、使用寿命的决定性因素。

Only those hydraulic oils shall be used, which have been approved by Siemens Energy before. The properties of and requirements on these oils are described below. A list of approved hydraulic oils can be provided by Supplier on request.

只可使用西门子能源预先批准的液压油。这些油的特性和要求如下所述。批准的液压油的清单可以应要求由供应商提供。

TYPE OF HYDRAULIC OIL

液压油类型

The minimum requirements which hydraulic oil must meet are stipulated in DIN 51524 Part 2.

Requirement: Grade HLP 46 hydraulic oil per DIN 51524 Grade ISO-L-HM 46 hydraulic oil per ISO 6743-4 液压油的最低要求在 DIN51524 第二部分进行规定。必须采用根据 DIN 51524 等级为 HLP 46 或根据 ISO 6743-4 等级为 ISO-L-HM 46 的液压油。

CHEMICAL COMPOSITION

For the purposes of this specification, hydraulic oil is defined as a mineral-oil-base liquid pressure medium, having additives which enhance protection against oxidation, corrosion, and wear, and exhibit good demulsification performance, i.e. resistance to emulsification.

为了本规格的目的，液压油被定义为矿物油基液体传压介质，含有添加剂增强对氧化、腐蚀、磨损的防护，展示了良好的反乳化作用性能，即乳化作用抵抗力。

The additives shall not have any adverse effect on the materials used in the hydraulic system. Additives shall not contain any organometallic compounds (e.g. organic zinc compounds). The use of hydraulic fluids that attack lead or bearing shell alloys which contain lead is not permitted even if these materials meet the requirements of the HLP specification per DIN 51524 Part 2.

添加剂不得对液压系统上采用的材料有任何负面影响。添加剂不得含有任何有机金属化合物（例如有机锌化合物）。即使根据 DIN 51524 第二部分，材料符合 HLP 规格的要求，也不允许采用腐蚀铅或含铅轴瓦合金的液压液体。

If the terms of a contract call for the use of hydraulic fluids which do not correspond to these requirements, approval must be obtained from the respective engineering departments. 如果合同条款要求使用不符合这些要求的液压油，则必须从相应的工程部门获得批准。

Thermal Stability 热稳定性

The hydraulic oil must be capable of withstanding temperatures of up to +70 °C in the hydraulic oil tank with no negative impact on the properties of the fluid. 液压油在液压油箱中必须能够耐受高达+70 °C 的温度，对液体的特性不产生负面影响。

COMPATIBILITY 兼容性

If hydraulic fluids from different manufacturers or different types from one manufacturer are mixed, sludge and deposits may form. These may cause faults in and damage to the hydraulic system. For this reason, mixing different types of hydraulic fluid is strictly forbidden. The only exception to this is the compatibility of the hydraulic fluid with residues (max.2 vol.%) of another hydraulic fluid with the same mineral base. 如果不同制造商的液压液体或来自同一制造商的不同类型的液压液体混合到一起，可能会形成沉淀物。这些可能会造成液压系统的故障和损坏。为此，混合不同类型的液压液体是严格禁止的。唯一的例外液压液体与其他相同矿物基的液压液体的剩余物（最多 2%vol.）的兼容性。

PHYSIOLOGICAL PROPERTIES 物理特性

By nature, the hydraulic oil must not be hazardous to the health of the persons working with it, provided the necessary hygienic precautions are taken. 在本质上讲，液压油不对作业的人员的安全和健康造成危害，前提是遵循正常良好行业卫生做法。

Physical and Chemical Properties of the Hydraulic Oil in the As-supplied Condition 供应条件下的物理和化学特性

Property 特性	Requirements 限值	Unit 单位	Test Method 测试方法	
			DIN / ISO	ASTM
Kinematic viscosity at 40 °C 40 °C 的运动粘度	41.4 – 50.6	mm^2/s	DIN 51562-1	ASTM D 445
Air release at 50 °C 50 °C 的空气释放	≤ 10	min	DIN 51381	ASTM D 3427
Water content 含水量	≤ 100	mg/kg	DIN 51777-1	ASTM D 6304
Foaming characteristics at 25 °C 25 °C 的泡沫特性	≤ 150/0	ml	ISO 6247	ASTM D 892 (Sequence 1)
Demulsibility 反乳化率	≤ 40	min	DIN ISO 6614	ASTM D 1401
Density at 15 °C 15 °C 的密度	≤ 900	kg/m^3	DIN 51757	ASTM D 1298
Flash point 闪点	> 185	°C	DIN EN ISO 2592	ASTM D 92
Pour point 流动点	≤ -15	°C	ISO 3016	ANSI/ASTM D 97
Minimum requirements 最小要求	Class 17/15/12 per ISO 4406 Class 6 per SAE AS4059	–	ISO 5884	–
Copper strip corrosion 铜条腐蚀	pass	–	DIN EN ISO 2160	ASTM D 130
Steel corrosion resistance 对钢腐蚀	pass	–	DIN ISO 7120	ASTM D 665
Aging: increase in neutralization number after 1000 h 1000 h 老化后中和值变化	≤ 2.0	mg KOH/g	DIN 51587	ASTM D 943

Cooling Water Quality 冷却水特性

Closed Cooling Water System 闭冷水系统

The coolers within the closed cooling water system are designed to be provided at cooling water inlet with water of a quality as defined below. 闭冷水系统中的冷却器设计配备在冷却水入口处，水质说明如下：

The closed cooling water system cycle shall be filled with demineralized water according to guideline VGB M 407 with the following quality: 根据 VGB 指导方针 M407，闭合冷却系统循环须加入去矿物质水，水质如下：

Parameter 参数	Requirement 要求
Conductivity 传导性	< 0.080 µS/cm
Silica 硅	< 0.010 mg/l
Sodium 钠	< 0.005 mg/l
Dissolved organic carbon (DOC) 溶解有机碳(DOC)	< 0.200 mg/l

That demineralized water shall be treated with carbohydrazide in a low concentration as required for corrosion protection. The properties of the demineralized water/carbohydrazide mixture shall not exceed these values: 根据要求，去矿物质水须采用低浓度碳酰肼进行处理，提高腐蚀防护能力。去矿物质水/碳酰肼混合物的特性不得超过下列的值：

Parameter 参数	Requirement 要求
Conductivity 传导性	< 30 µS/cm
pH value pH 值	7.0-9.3
Carbohydrazide 碳酰肼	1.0-5.0 mg/l

Monitoring of the aforementioned parameters should be done once a week by grab sample.

The use of other water qualities is allowed after Supplier's approval only. 上述参数的监测通过随机取样每周进行一次。只有在供应商批准的情况下，才允许采用其他水质。

Media Measurements 介质测量

Natural Gas Flow Metering System 天然气流量测量

GENERAL 概述

The natural gas flow metering system is a high precision flow measurement unit to be applied for performance testing only. Supplier's part of the flow metering system will be provided as one calibrated measuring unit plus additional parts. 天然气流量计量系统是一种高精度流量测量装置，仅适用于性能测试。 供应商的流量计量系统将作为一个校准测量单元和附加部件提供。

The objective of this document is to specify the requirements for the installation and operation of the "natural gas flow metering by means of a turbine flow meter" at fuel gas temperature ≤ 60 °C. 本文件的目的是规定在燃气温度≤60°C 时安装和运行的要求。

For further details concerning natural gas flow metering please refer also to section "Gas Turbine Package".有关天然气流量计量的更多详细信息，请参阅"燃气轮机组件"部分。

REQUIREMENTS 要求

The following requirements have to be ensured by Purchaser concerning installation and operation of the natural gas flow metering: 买方必须确保以下有关天然气流量计量安装和操作的要求：

- Responsible for the integration of the natural gas flow metering section as well as the compliance with Supplier's requirements is the Purchaser.买方负责天然气流量计量部分的整合以及确保其符合供应商的要求；
- The calibrated natural gas flow metering provided by Supplier shall be transported and installed in one piece. The flanges between the turbine flow meter and the 5 D inlet piping will be sealed after calibration and it is not allowed to disassemble the metering section after the calibration. 供应商提供的校准天然气流量计应运输和安装在一起。涡轮流量计和 5 D 入口管道之间的法兰将在校准后密封，校准后不允许拆卸计量部分。
- To protect the fuel gas flow meter section from damage (e.g. caused by foreign matter transmitted through piping or by overspeed when the line is being filled) a spool piece shall be installed instead of the fuel gas flow metering during erection & commissioning of the power plant. Only after completion of erection & commissioning and sufficient cleaning of the system, it is permitted to replace this spool piece by Supplier's fuel gas flow metering section. 为了保护燃气流量计部分免受损坏（例如：管道中的异物或管线填充时的超速），应在安装和调试期间安装一个排气管道而不是燃气流量计。只有在完成安装和调试以及系统的充分清洁后，才允许通过供应商的燃气流量计量部分更换该该段管道。
- For the natural gas flow metering system Purchaser has to provide also: 对于天然气流量计量系统，买方还必须提供
  - Support base frame with fixing material
  - 底部支撑结构以及固定材料
  - Inlet ball valve, full bore, with filling bypass
  - 入口球阀，全通径，带加注旁路
  - Outlet ball valve
  - 出口球阀

  - Purge connection
  - 清洗接头
  - Vent line
  - 排空管道

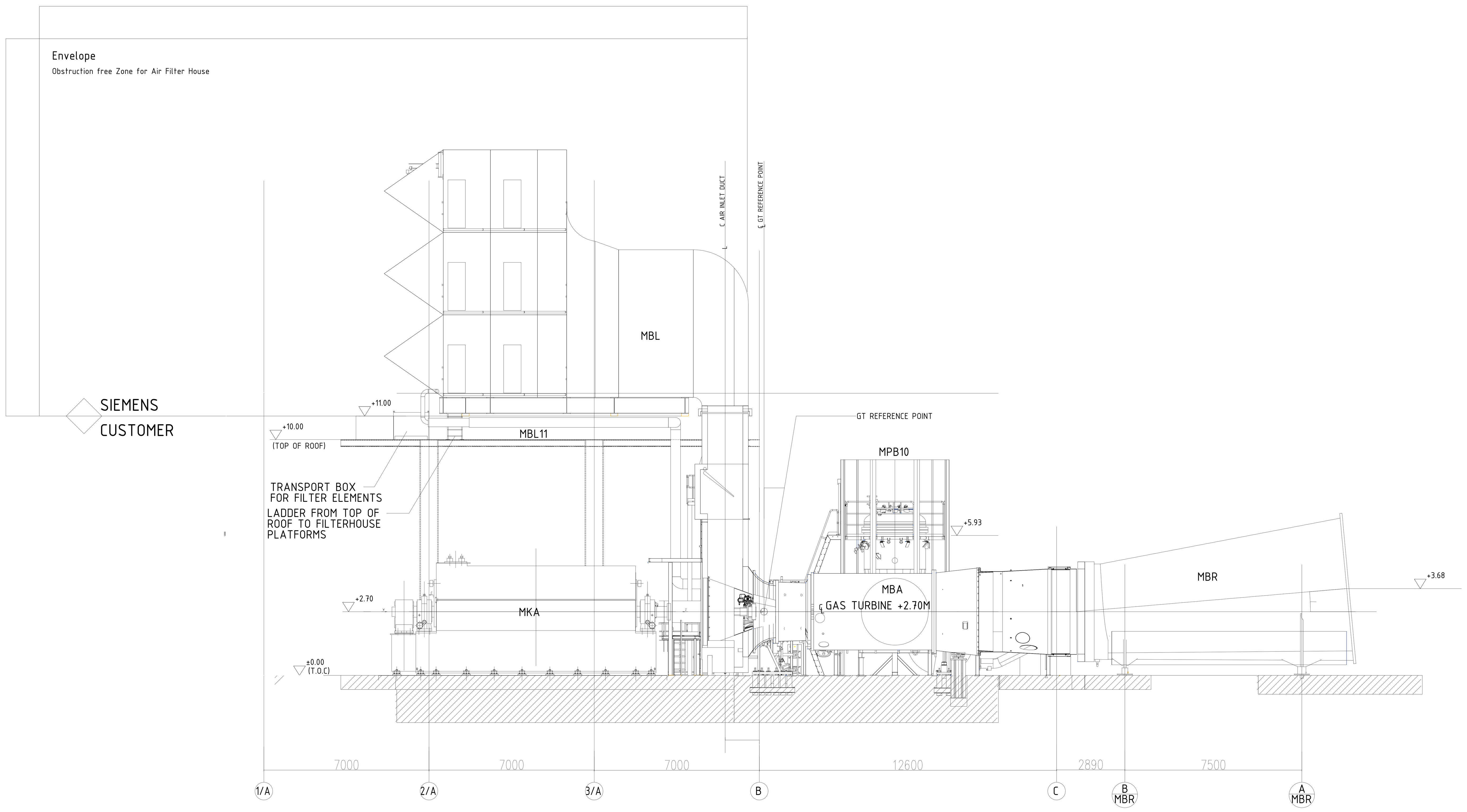
- The start-up strainer (Supplier's scope) must be installed upstream of the metering to protect the turbine flow meter. 必须在流量计的上游安装启动过滤器（供应商的范围），以保护涡轮流量计。
- The fuel gas flow metering has to be installed upstream of the performance fuel gas pre-heater. The fuel gas temperature has to be ≤ 60 °C. 燃气流量计量必须安装在高性能燃气预热器的上游。燃气温度必须≤60° C。
- The inlet pipe section upstream to the fuel gas flow metering has to be straight for at least 10 D. No flow disturbances (e.g. changes in pipe diameters or inline components like filters are allowed between the inlet to the 10D inlet flow path and the flow meter). 燃气流量计量上游的入口管段必须是直的 （至少 10 D）。没有流量扰动（例如管道直径的变化或在 10D 入口上游安装过滤器以及联组件仪表是允许的）
- Full-bore ball valves with filling bypasses must be installed by Purchaser for isolating the 21 D section of piping from the rest of the fuel supply system. It is also permissible to locate the outlet-end ball valve downstream of the final filter. 买方必须安装带有填充旁路的全通径球阀，以便将 21D 部分管道与燃料供应系统的其余部分隔离。也允许将出口端球阀定位在最终过滤器的下游。
- No changes in pipe diameter between a point 15 D upstream of the inlet ball valve of the 21 D measuring and its end are allowed. The diameter shall be determined by Supplier. 不允许 21D 长度中 15D 到其端部之间的管道直径变化。直径应由西门子确定。
- The entire fuel gas flow metering must be located at least 100 D away from the control valve, compressor and reducing station, because the pronounced acoustic vibrations in pipes can impair the accuracy of flow measurements. 整个燃气流量计量必须距离控制阀，压缩机和减压站至少 100 D 处，因为管道中明显的声振动会影响流量测量的准确性。
- A gas filter has to be installed upstream of the fuel gas flow metering to prevent fouling of the turbine flow meter during operation. 必须在燃气流量计量的上游安装气体过滤器，以防止涡轮流量计在运行期间结垢。
- Purchaser has to ensure that the fuel gas flow metering is electrically grounded. 买方必须确保燃气流量计量接地。
- Downstream to the fuel gas metering no gas shall be extracted except for operation of the gas turbine itself. Gas leakages are also not allowed. 燃气计量的下游除燃气轮机本身的运行外，不得提取气体。也不允许有气体泄漏。
- After the performance test, the fuel gas flow metering shall be de-installed by Purchaser and replaced by the spool piece, without damaging the sealing. 性能测试后，应由买方卸下燃气流量计量并更换为管道，且不能损坏密封。
- In case of doubt, Supplier's test engineer has the right to check integrity of the fuel gas flow metering system. 如有疑问，供应商的测试工程师有权检查燃气流量计量系统的完整性。

In case of any deviations to these requirements Supplier's performance test engineer shall determine the impact on the measured values and define additional corrections for determination of performance test results and comparison with legally binding values. 如果与这些要求有任何偏差，供应商的性能测试工程师应确定对测量值的影响，并定义额外的校正以确定性能测试结果并与性能保证值进行比较。

1.3 燃机岛布置图-主/俯视图

BUILDING LEGEND

BAB11	GENERATOR NEUTRAL POINT CUBICLE
BAB15/BAB16	GENERATOR CURRENT TRANSFORMER TERMINAL BOX
CYE10GH001	LOCAL FIRE ALARM PANEL
MBA	GAS TURBINE
MBL25	AIR DRYER PACKAGE
MBA30	ADVANCED COMPRESSOR CLEANING SKID
MBA51	HYDRAULIC CLEARANCE OPTIMIZATION (PART OF BASE MODULE)
MBJ01	START-UP UNIT TRANSFORMER
MBL	AIR INTAKE FILTERHOUSE AND DUCT
MBP	FUEL GAS SUPPLY SYSTEM (PART OF BASE MODULE)
MBR	EXHAUST GAS SYSTEM (DIFFUSER)
MBV	BASE MODULE, LUBE OIL
MBV50	OIL VAPOUR EXTRACTOR (PART OF BASE MODULE)
MBX	HYDRAULIC SKID (PART OF BASE MODULE)
MKA	GENERATOR FOR GAS TURBINE
MKC01	EXCITER TRANSFORMER
MKC40	SHAFT VOLTAGE AND CURRENT MEASUREMENT BOX
MPB10	NOISE PROTECTION WALLS FOR GT AND NOISE PROTECTION FOR COMBUSTION CHAMBERS
MPB15	ENCLOSURE FOR FUEL GAS SYSTEM
MPB16	ENCLOSURE FOR INTERMEDIATE SHAFT



SECTION A-A

Integration Platform-Identifier

Integration Platform-Variant

Projekt/Project	2000E	PKZ/PC	
UNID		DCC/UA Type	Inhaltskennzeichen Contents code
		Zähl-Nr. Serial no.	
Ursprung-Nr. Origin no.	erstellt mit Created with AutoCad 2010	Abtlg. Dept. CN COE	

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Spez. Specs.

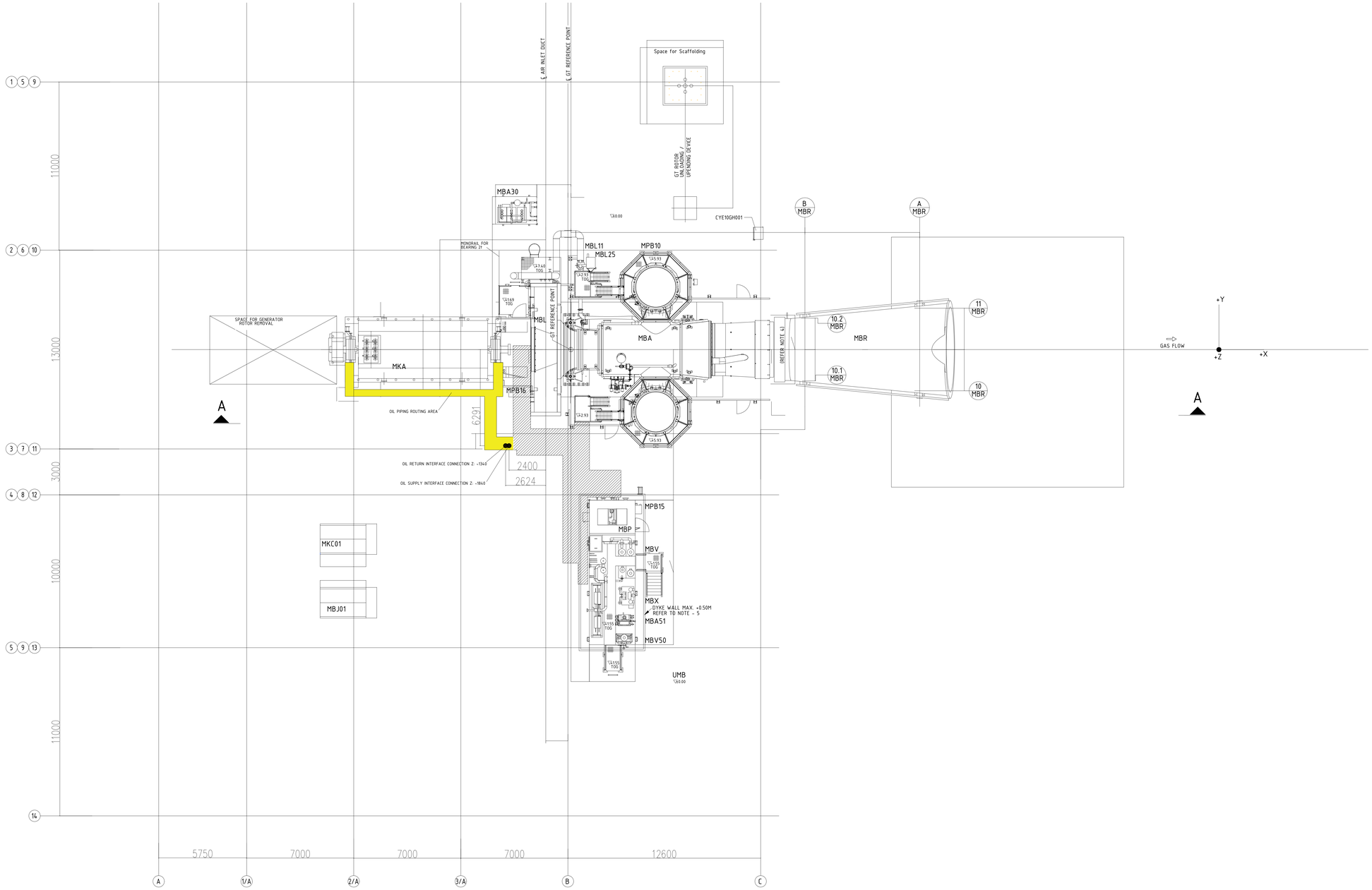
Titel/Title: GENERAL LAYOUT DRAWING

Handhabung Handling: for internal use only

Zeichnungs-Nr. Drawing no.

Index/Rev. —

Blatt-Nr. Sheet no. 1/1



PLAN VIEW

BUILDING LEGEND

BAB11	GENERATOR NEUTRAL POINT CUBICLE
BAB15/BAB16	GENERATOR CURRENT TRANSFORMER TERMINAL BOX
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MPB15	ENCLOSURE FOR FUEL GAS SYSTEM
MPB16	ENCLOSURE FOR INTERMEDIATE SHAFT

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Integration Platform-Identifier

Integration Platform-Variant

Projekt / Project	2000E
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UNID	
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Inhaltskennzeichen Contents code	
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Titel/Title: GENERAL LAYOUT DRAWING

Handhabung Handling: for internal use only

Zeichnungs-Nr. Drawing no.

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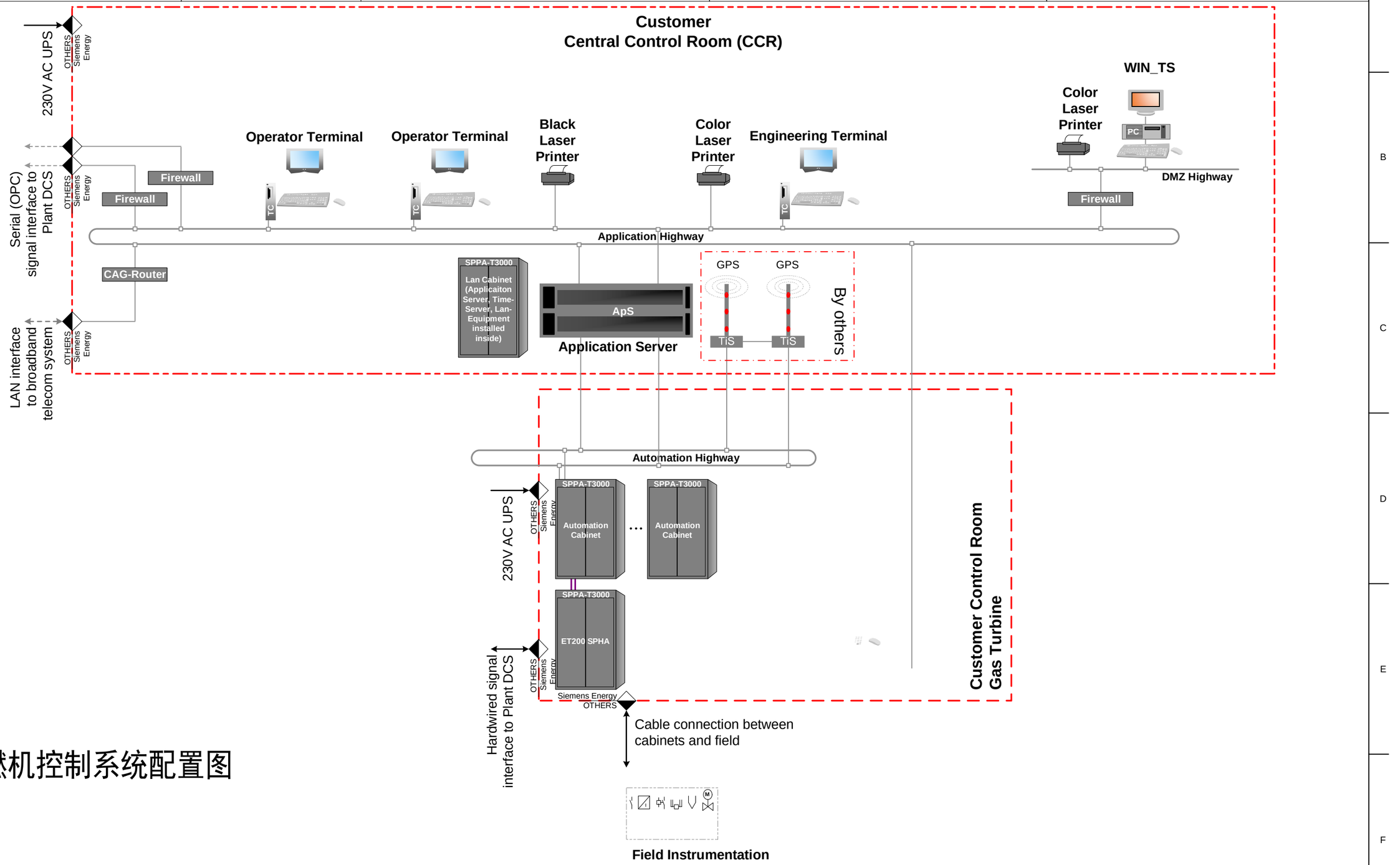
Blatt-Nr. Sheet no. 1/1

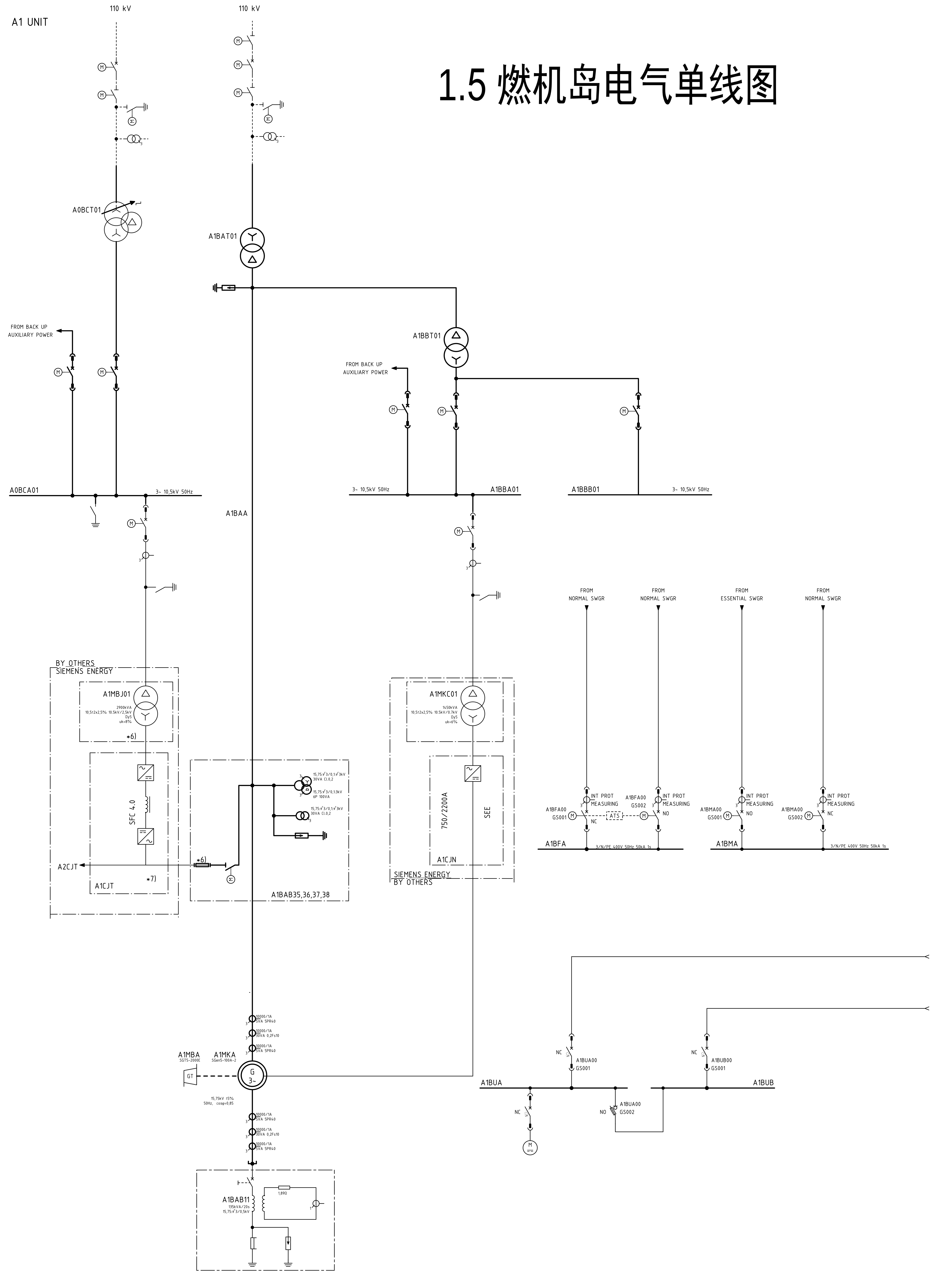
General	Legend	Remarks to terminal points	Hardwired signals between Plant DCS and TCS I&C	Signal interface between Plant DCS and TCS I&C
The information given in this interface drawing is not subject to verification and non fulfillment of it is not subject to any kind of rights or remedies of the customer whatsoever.	direct wiring bus wiring terminal point	- All terminal points are in I&C cabinets or at I&C equipment, located inside of the control room or CCR. - Further equipment for interfaces is not included. - Cabling is not included. - The VAC Power supply inside CCR not included.	- Time critical signals, protection relevant signals, operational and important process signals have to be exchanged hardwired. - The hardwired signal exchange is limited.	- The signal exchange for indication and further processing of process signals will be realized via OPC server. - The signal exchange over OPC interface is limited and one-directional.

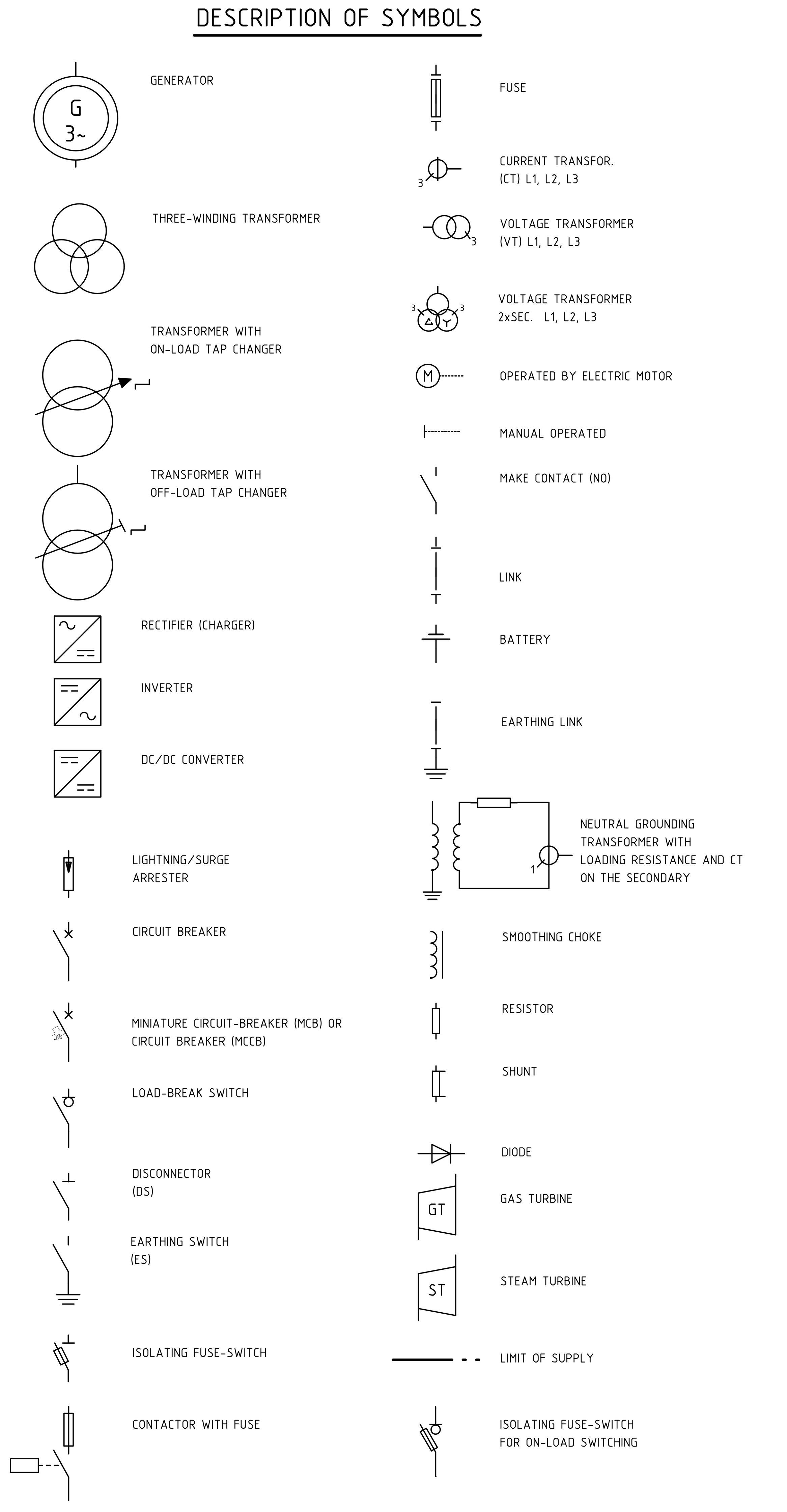


1.4 燃机控制系统配置图

				Date	2022-11-14	Simple Cycle Package CN5024 Wanhua Yantai	SIEMENS energy	I&C Overview Siemens Energy Turbine Control System	AHB	
				Drawn	S. Tang					
				Chkd.					SPPA-T3000	Page 1
Rev.	Remarks	Date	Name	DRAFT	SE GS C	Org.	Repl.f	Repl.by		1 Bl. 1

1.5 燃机岛电气单线图





REMARKS:

1) EQUIPMENT OUTSIDE SIEMENS ENERGY SCOPE OF SUPPLY IS SHOWN FOR INFORMATION ONLY THE DETAILED SCOPE IS DESCRIBED IN THE OFFER
2) CABLING TO EQUIPMENT OUTSIDE THE CONTAINERISED POWER CONTROL CENTER AND CABLES BY OTHERS
3) FOR DATA WHICH ARE RELATED TO GT RATING PLEASE SEE OFFER TEXT/DATA SHEETS
4) FOR ADDITIONAL REQUIREMENTS FOR PROTECTION SYSTEM, PLEASE REFER TO OTHERS DIAGRAMS
5) SFC FUSES WILL BE SUPPLIED BY OTHERS FOR INSTALLATION IN THE PT CUBICLES.
6) FOR OVERLOAD DURING START-UP OF GT PLEASE REFER TO OFFER SECTION 4 TECHNICAL DATA SFC TRANSFORMER
7) FOR SFC INTERCONNECTION PLEASE REFER TO SFC INERCONNECTION SCHEME

BAA	ISOLATED PHASE BUSDUCT (IPB)
BAB11	GENERATOR NEUTRAL-POINT CUBICLE
BAB40	SFC CHANGE OVER ISOLATOR CUBICLE
BAC	GENERATOR CIRCUIT BREAKER
BAT	GENERATOR TRANSFORMER
BBE	GT 10.5kV UNIT SWITCHGEAR
BBT	UNIT AUXILIARY TRANSFORMER
BFA	GT 400V LV SWITCHGEAR
BFT	LV TRANSFORMER
BMA	GT 400V LV ESSENTIAL SWGR
BTA	220V DC BATTERY
BTL	220V DC BATTERY CHARGER
BUA/BUB	GT 220V DC SWITCHGEAR
CJT	SEE/SFC CUBICLE
MBA	GAS TURBINE
MBJ	SFC TRANSFORMER
MKA	GENERATOR
MKC	SEE TRANSFORMER
UBA	POWER CONTROL CENTER (PCC)

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Projekt/Project	WANHUA	PKZ/PC	CN5024
UNID	519122897	DCC/UA Type	&EFA010
Variante/Variant		Zähl-Nr./Serial no.	700501
Ursprung-Nr./Origin no.	erstellt mit/Created with	Abtlg./Dept.	EMEA CLR ES
Inhaltskennzeichen/Contents code	/		
Titel/Title	SINGLE LINE DIAGRAM SIEMENS GASTURBINE PACKAGE SGT5-PAC 2000E SINGLE LINE DIAGRAM		
Handhabung/Handling	Restricted		
Zeichnungs-Nr./Drawing no.	CN5024-B-&EFA010-700501	Index/Rev.	/
Blatt-Nr./Sheet no.	1		

SIEMENS energy

1.6大件运输尺寸及重量
Large components transportation dimension and weight

燃机部分 Gas Turbine Part （单台机组 Single Unit）

序号 No.	部件名称 Parts name	数量 Qty.	长 x 宽 x 高 (米) L × W × H (m)	重量 (单重: 吨) Weight / unit （ton）	备注 Remarks
			包装 Packaged	包装 Packaged	
1	燃机 Gas Turbine	1	10.34 x4.12 x4.05	211	
2	燃烧桶 Silo combustor	2	7.30x3.34x4.30	27.6	
3	基础模块 Base Module	1	10.80 x3.80 x3.70	22.0	
4	Duct Lower Part 风道下部零件	1	12 x1.8 x3	9.0	
5	Duct Upper Part 风道上部零件	1	11.4 x2.1 x3	8.5	
6	进气挡板门 INTAKE DUCT FLAP	1	14x2.3x1.0	9	
7	进气道膨胀节 DUCT EXPANSION JOINT	1	10x2.3x0.5	0.8	
8	进气道中间段 DUCT INTERMEDIATE PIECE	1	11.5x1.8x3	6.5	
9	进气道过渡段 DUCT TRANSITION PIECE	1	11.5x1.9x1.7	6.5	
10	进气弯头 Air intake elbow	2	11.6 x2.4 x2.9	6.3	
11	消音器腔体 Silencer casing	1	10 x4 x1.5	15	
12	过滤房框架	2	14x2.3x1.5	12.5	

	SUPPORT STRUCTURE FILTERHOUSE				
13	洁净空气段 PLENUM	1	8.7x3.1x2.7	8.1	
14	洁净空气段 PLENUM	1	10.4x2.5x2.3	9.4	
15	洁净空气段 PLENUM	1	13.5x2.4x3	3.2	
16	透平排气扩散器 TURBINE EXHAUST MANIFOLD	1	5.6x4.2x4.7	10.5	
17	扩散段 DIFFUSER SEGMENTS	2	10.8x3.1x2.8	21	