

Special Purpose Steam Turbines

Specification

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

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Machines

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 07/2014) of PETROBRAS N-2627 REV. B 07/2014. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

This Standard is based on API [STD 612:2005](#) (Sixth Edition).

1 Scope

1.1 This Standard establishes the minimum conditions required for Special Purpose Steam Turbines, and their auxiliary equipment or systems, to be supplied in accordance with API [STD 612:2005](#) (Sixth Edition).

1.2 The requirements of this Standard are additions to, or modifications of the API [STD 612:2005](#), which is an integral part of this Standard.

1.3 Special purpose steam turbines and auxiliary equipment shall be in accordance with API [STD 612:2005](#), plus the following changes, as noted in parenthesis for each clause, according to the definitions stated below. The information of each clause shall be read as follows, whenever starting with:

- **Addition:** continuation of that particular API [STD 612:2005](#) paragraph;
- **Modification:** replacement of part of that affected API [STD 612:2005](#) paragraph;
- **Substitution:** replacement of that API [STD 612:2005](#) paragraph in its entirety;
- **New:** insertion of a requirement not found in API [STD 612:2005](#);
- **Exclusion:** removal of that particular API [STD 612:2005](#) paragraph;
- **Comment:** clarification or interpretation on that API [STD 612:2005](#) paragraph.

1.4 Except for new clauses, item numbers referred in parentheses in this Standard are the same API [STD 612:2005](#), 6th edition paragraph ones.

1.5 All deviations from the requirements in this Standard and/or API [STD 612:2005](#), must be clearly identified in the proposal and submitted to PETROBRAS for approval. Any requirement exception or deviation from any of the listed documents not clearly mentioned in tender will be considered by PETROBRAS as full compliance with the material requisition.

1.6 All deviations from the contracted design or scope of supply made by vendor during time of drawings and documents review shall be clearly mentioned in the particular document to be approved.

1.7 Vendor's compliance with the requirements of these specifications does not exempt him from the responsibility of supplying equipment and accessories suitable for the specified service conditions.

1.8 This Standard applies to design starting from its issue date.

1.9 This Standard only contains Technical Requirements.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[NR-13](#) - Caldeiras e Vasos de Pressão;

[NR-26](#) - Sinalização e Segurança;

PETROBRAS [N-553](#) - Centrifugal Pumps For Petroleum, Petrochemical And Natural Gas Industries;

PETROBRAS [N-2648](#) - General Purpose Steam Turbines;

ISO [4406](#) - Hydraulic Fluid Power - Fluids - Method for Coding the Level of Contamination by Solid Particles Second Edition;

ISO [1940-1](#) - Mechanical Vibration - Balance Quality Requirements For Rotors In A Constant (Rigid) State - Part 1: Specification And Verification Of Balance Tolerances;

ISO [10441](#) - Petroleum, Petrochemical and Natural Gas Industries - Flexible Couplings for Mechanical Power Transmission - Special-Purpose Applications;

ISO [13709](#) - Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries;

API [RP 687](#) - Rotor Repair First Edition;

API [STD 611](#) - General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services Fifth Edition;

API [STD 612:2005](#) - Petroleum, Petrochemical, and Natural Gas Industries - Steam Turbines - Special-purpose Applications;

API [STD 613](#) - Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services Fifth Edition;

API [STD 614](#) - Lubrication, Shaft-Sealing and Oil-control Systems and Auxiliaries Fifth Edition;

API [STD 670](#) - Machinery Protection Systems;

API [STD 671](#) - Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services;

API [STD 682](#) - Pumps - Shaft Sealing Systems for Centrifugal and Rotary Pumps;

ASME [B 16.5](#) - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard;

ASME [PTC 6](#) - Steam Turbines;

ASME - BPVC [Section VIII](#) - Rules for Construction of Pressure Vessels;

[TEMA](#) - Standards of the Tubular Exchanger Manufacturers Association.

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

unit responsibility - Substitution (3.47 of API STD 612:2005)

refers to the technical responsibility for coordinating the general arrangement of the whole train to be supplied (driver and driven equipment-including gears, clutches and couplings, as applicable to each case), as well as power, torque and speed requirements, direction of rotation, and so forth; for analyzing noise, lateral and torsional vibration data; for designing, laying out and supplying piping and appurtenances, controls and instrumentation, cooling, heating, lubrication and sealing systems and for supervising and coordinating all required tests and material reports, preparation for shipment, shipment and field assembly, pre-commissioning, commissioning, start up, pre operation and field acceptance test of all equipment within the scope of this Standard, as required by the contracted scope of supply. For mechanical drive applications, driven equipment Vendor shall assume unit responsibility for the whole train as stated in respective applicable API standards and PETROBRAS supplementary specifications. For electrical drive applications, turbine Vendor shall assume unit responsibility for the whole train as stated in respective applicable API standards and PETROBRAS supplementary specifications.

4 Dimensions (Substitution - Section 4 of API STD 612:2005)

Unless otherwise specified in Data Sheet, drawings and maintenance dimensions shall be in SI units, except pressure unit shall be in kgf/cm².

5 Basic Design - General (Section 6 and 6.1 of API STD 612:2005)

5.1 Comment (6.1.2 of API STD 612:2005)

Usually, steam turbine supplier/manufacturer is not considered by PETROBRAS as the main equipment vendor (mostly assigned to the supplier of driven equipment) and thus the scope of responsibility defined in 3.1 of this Standard will only apply to those orders where steam turbine manufacturer is referred to as the vendor. When referred to as supplier of manufacturer, its scope of responsibility will be considered as agreed and stated on the contract with main equipment vendor.

5.2 Addition (6.1.6 of API STD 612:2005)

Unless otherwise specified, turbines shall be designed to enable a further upgrade in order to deliver 110 percent of originally rated power (within originally specified range of speeds) under originally specified steam conditions.

5.3 Addition (6.1.10 of API STD 612:2005)

Turbine supplier/equipment vendor is required to inform on the data sheets during proposal stage the minimum space required for equipment disassembly and the heaviest maintenance weight.

5.4 Addition (6.1.11 of API STD 612:2005)

Turbine components that are very similar among each other (such as wheels, shafts, seals and seal glands, sleeves, nozzle rings, stationary blades and casings) shall be indelibly identified with the order of assembly and to which sub-set they belong (e.g.: stage/wheel number, coupling end, etc). Lifting lugs or eyebolts shall be provided for any equipment or component that weighs more than 30 kg (66 lb).

5.5 Addition (6.1.13 of API STD 612:2005)

Number of tubes shall be established according to velocity criterion.

5.6 Substitution (6.1.15 of API STD 612:2005)

Unless otherwise specified, the whole train furnished by the vendor (driven, driver, gear and auxiliary equipment) shall conform to the maximum allowable sound pressure level of 85 dB(A), slow-response, measured at 1 m (3.28 ft) from the equipment surfaces. Bidder/vendor shall inform in his proposal the expected maximum sound pressure and sound power level data per octave band for the quoted equipment and including copies of noise level test certificates performed on similar equipment.

5.7 New (6.1.21)

Turbine supplier/vendor shall provide a study concerning cleaning likelihood, whether or not the setup of a special arrangement is required and shall list any additional measures that PETROBRAS should implement in order to enable the cleaning to be performed. Performance parameters and limitations, including any required precautions, shall be mutually agreed upon by PETROBRAS and turbine supplier/vendor.

5.8 New (6.1.22)

Only well-proven machinery, sturdy designs shall be proposed. Prototypes or undersized equipment (e.g., equipment or components that, in order to comply with specified transient service conditions, might come to operate at design limit) are not acceptable. Refurbished equipment or parts are not acceptable.

6 Rotor Dynamics (Section 9 of API STD 612:2005)**6.1 Lateral Analysis (9.2 of API STD 612:2005)****6.1.1 Modification (9.2.3 of API STD 612:2005)**

Replace the first paragraph by: Before carrying out the damped unbalance response analysis, the vendor shall conduct an undamped analysis to identify the undamped critical speeds and determine their mode shapes located in the range from zero to trip speed, as well as the next mode occurring above the trip speed. The results of the undamped response analysis shall be furnished. The presentation of the results shall include:

6.1.2 Addition [9.2.4 b) of API STD 612:2005]

The clearance ranges to be used in the analysis shall be:

- a) minimum bearing clearance and maximum preload, calculated using maximum pad, minimum bearing and maximum shaft radius;
- b) average bearing clearance and preload, calculated using mean pad, bearing and shaft radius;
- c) maximum bearing clearance and minimum preload, calculated using minimum pad, maximum bearing and minimum shaft radius.

These calculated coefficients for the speed range, shall be presented in the damped unbalance response analysis report. Bearing circumferential temperature profile shall also be included.

6.1.3 Addition [9.2.4 c) of API STD 612:2005]

The pad inertia, deformation, and thermal effects due to convection and pad conduction shall also be included. Pad pivot stiffness (for tilting pad bearings) shall be included also;

6.1.4 Substitution (9.2.5 of API STD 612:2005)

When applicable, the effects of other equipment in the train shall be included in the damped unbalanced response analysis (i.e., a train lateral analysis shall be performed). For machinery trains with rigid couplings, the complete analysis shall always be considered as a mandatory requirement.

6.1.5 Modification (9.2.6 of API STD 612:2005)

Replace the first paragraph by: A separate damped unbalance response analysis shall be conducted for each critical speed in the range from zero to trip speed, as well as the next mode occurring above the trip speed. Unbalance shall analytically be placed at the locations that have been determined by the undamped analysis to affect the particular mode most adversely. For the translatory (symmetric) modes, the unbalance shall be based on the sum of the journal static loads and shall be applied at the location of maximum displacement. For conical (asymmetric) modes, an unbalance shall be added at the location of maximum displacement nearest to each journal bearing. These unbalances shall be 180 degrees out of phase and of a magnitude based on the static load on the adjacent bearing. Figure 2 of API STD 612:2005 shows the typical mode shapes and indicate the location and definition of U for each of the shapes. The magnitude of the unbalances shall be 4 times the value of U as calculated by equation 1 in 9.2.6 of API STD 612:2005.

6.1.6 Substitution [9.2.7.a) of API STD 612:2005]

Identification of the frequency of each critical speed in the range from zero to trip speed, as well as the next mode occurring above the trip speed.

6.1.7 Addition [9.2.7.b) of API STD 612:2005]

These Bodé plots shall show the major-axis and the X-Y vibration probes with the same orientation as assembled in the machine.

6.1.8 Addition [9.2.7.c) of API STD 612:2005]

Mode shape plots for X-Y probe orientation shall also be presented.

6.1.9 Addition (9.2.8 of API STD 612:2005)

If the chosen location of the unbalance does not excite the critical(s) of concern, the unbalance shall be placed in the plane(s) that would excite the critical most adversely.

6.1.10 Addition [9.2.9.a) of API STD 612:2005]

Regarding unbalance response analysis, even though amplification factor calculations for a given rotor may indicate critically damped response and then no separation margin would be required, critical speeds within the range of operating speeds are not automatically acceptable. Before the conclusion on accepting such nonconformance, a complete decision sequence shall be followed in order to verify all possibilities. As a result, critical speeds within the operating speed range will only be accepted if the Vendor can demonstrate that all efforts to remove the critical speed from the operating speed range have been exhausted.

6.1.11 Modification (9.2.10 of API STD 612:2005)

Delete last sentence, the item shall read: The calculated unbalanced peak to peak amplitudes (see 9.2.7 of API STD 612:2005) shall be multiplied using the correction factor calculated from equation 4 in 9.2.10 of API STD 612:2005 or by equation below, whichever is greater.

$$CF_{OR} = \frac{A_1}{A_{OR}}$$

Where:

A_{OR} = peak to peak amplitude at the probe location for the operational range, in microns (mils) peak to peak, using the unbalance defined in 6.1.5 of this Standard;
 CF_{OR} = is limited to 6.

6.1.12 New (9.2.12)

If the analysis indicates that the SMs still cannot be met or that a non-critically damped response peak falls within the operating speed range and the purchaser and vendor have agreed that all practical design efforts have been exhausted, then acceptable amplitudes shall be mutually agreed upon by the purchaser and the vendor, subject to the requirements of 9.3.3 of API STD 612:2005.

6.2 Unbalanced rotor response verification test (9.3 of API STD 612:2005)**6.2.1 Modification (9.3.1 of API STD 612:2005)**

Replace the first sentence by: An unbalance response test shall be performed as part of the mechanical running test (see 16.3.3 of API STD 612:2005) or at high speed balancing machine, and the results shall be used to verify the analytical model. In this case, a specific rotordynamic model, for high speed bench support stiffness shall be provided prior to the test.

When using high speed balancing machine, for unbalance response test, the contract bearings shall be used.

6.2.2 Substitution [9.3.1.c) of API STD 612:2005]

If the chosen location of the unbalance does not excite the critical(s) of concern, the unbalance shall be placed in the plane(s) that would excite the critical most adversely.

6.2.3 Substitution [9.3.1. d) of API STD 612:2005]

The machine shall then be brought up to the operating speed nearest the critical of concern. If, during the acceleration, the vibration reaches 2 times the allowable vibration level calculated in 6.4.1 of this Standard, the machine shall be stopped and the following decision criterion shall be applied:

- for machines operating above the first critical speed, if the limit of 2 times is reached above the minimum operational speed, no additional test is necessary.
- if the limit is reached below the minimum operational speed, or for machines operating below their first critical speed, less unbalance weight shall be used and the test shall be repeated.
- if the unbalance mass does not change the vibration in more than 2,5 μm (0,1 mil), then more unbalance shall be used (heavier weight shall be added) and the test shall be repeated.

The vibration amplitudes and phase shall be recorded using the same procedure used for 9.3.1 a) of API [STD 612:2005](#).

6.2.4 Addition [9.3.1.e) of API [STD 612:2005](#)]

It is practical to store the residual unbalance vibration measurements recorded in the step at 9.3.1 a) of API [STD 612:2005](#), and by use of computer code perform the vectorial subtraction called for in this paragraph at each appropriate speed. This makes the comparison of the test results with the computer analysis of 9.2.8 of API [STD 612:2005](#) and 6.1.9 of this Standard quite practical. It is necessary for probe orientation be the same for the analysis and the machine for the vectorial subtraction to be valid. This vectorial subtraction for all sensors shall be given to the purchaser as a part of the test report.

6.2.5 New [9.3.2.c) of API [STD 612:2005](#)]

The predicted amplification factors shall not deviate from the actual test-stand values by more than +/- 20 %.

6.3 Torsional Analysis (9.5 of API [STD 612:2005](#))

6.3.1 Substitution (9.5.1 of API [STD 612:2005](#))

The vendor having train responsibility shall perform a torsional vibration analysis of the complete coupled train and shall be responsible for directing the modifications necessary to meet the requirements of 9.5.2, 9.5.3, 9.5.5 and 9.5.6 of API [STD 612:2005](#) and 6.3.2 of this Standard.

6.3.2 Substitution (9.5.4 of API [STD 612:2005](#))

Torsional frequencies at two or more times running speeds, including blade pass frequencies, shall be avoided.

6.4 Vibration and Balancing (9.6 of API [STD 612:2005](#))

6.4.1 Modification (9.6.8 of API [STD 612:2005](#))

Replace the second paragraph by: At any speed greater than the maximum continuous speed, up to and including the trip speed of the driver, the vibration level increase shall not exceed the following value or 12.7 μm (0,5 mil) above the maximum overall value recorded at the maximum continuous speed, whichever is less:

In SI units:

$$A = 25,4 \times \sqrt{\frac{12\,000}{n}} \quad (7)$$

In USC units:

$$A = \sqrt{\frac{12\,000}{n}}$$

Where:

A is the amplitude of unfiltered vibration, measured in μm (mil) peak to peak;
N is the maximum continuous speed, measured in revolutions per minute.

6.4.2 New (9.6.11)

The electrical or mechanical runout, measured in V blocks, shall not exceed a maximum of 25 % of the test level calculated by Equation 7 in 6.4.1 of this Standard or 6.3 µm (0,25 mil), whichever is greater. During the factory test, running at low speed (generally between 300 - 500 rpm), the measured runout levels shall not exceed the calculated level (as above) by more than 20 %. If the runout, at any probe, exceeds this limit, the runout shall be rechecked after the completion of the test, in V blocks. The runout may be vectorially subtracted from the vibration signal measured during the factory acceptance test.

Where shaft treatment such as metalized aluminum bands have been applied to reduce electrical runout, surface variations (noise) may cause a high frequency noise component which does not have an applicable vector. The nature of the noise is always additive. In this case, the noise shall be mathematically subtracted.

6.5 Level I Stability Analysis - New (9.7)

6.5.1 A stability analysis shall be performed on all Special purpose Steam Turbines except those rotors whose maximum continuous speed is below the first critical speed in accordance with 9.2.3 of API STD 612:2005 and 6.1.1 of this Standard, as calculated on rigid supports. For this analysis, the machine admission and exhaust conditions shall be at either the rated condition or another operating point unless the vendor and purchaser agree upon another operating point.

NOTE Level I analysis was developed to fulfill two purposes: first, it provides an initial screening to identify rotors that do not require a more detailed study. The approach as developed is conservative and not intended as an indication of an unstable rotor. Second, the Level I analysis specifies a standardized procedure applied to all manufacturers.

6.5.2 The model used in the Level I analysis shall include the items listed in 9.2.4 of API STD 612:2005 and 6.1.2 and 6.1.3 of this Standard together with the effects of squeeze film dampers where used.

6.5.3 All components shall be analyzed using the mean values of oil inlet temperature and the extremes of the operating limits for clearance to produce the minimum log decrement.

6.5.4 When tilting pad journal bearings are used, the analysis shall be performed with full pad dynamic coefficients. Analysis done with synchronously reduced tilt pad coefficients is not acceptable.

6.5.5 The anticipated cross coupling, Q_A , present in the rotor is defined by the following procedure:

$$q_A = \frac{HP \times B_t \times C}{D_1 \times H_1 \times N}$$

Where:

q_A is calculated for each stage of the QA is equal to the sum of q_A for all stages;
 B_t equal to 1,5.

Symbols:

C = 9,55 (63);
 D_t = blade pitch diameter, mm (in.);
 H_t = effective blade height, mm (in.);
 HP = rated power per stage; Nm/sec. (HP);

N = operating speed, rpm;

Q_A = anticipated cross coupling for the rotor, KN/mm (Klbf/in.) defined as:

$$Q_A = \sum_{i=1}^n q_{Ai}$$

Q_O = minimum cross coupling needed to achieve a log decremente qual to zero for either minimum or maximum component clearance;

q_A = cross coupling for each stage, KN/mm (Klbf/in.);

S = number of stages;

δ_A = minimum log decrement at the anticipated cross coupling for either minimum or maximum component clearance;

δ_b = basic log decrement of the rotor and support system only;

δ_f = log decrement of the complete rotor support system from the level II analysis.

6.5.6 An analysis shall be performed with a varying amount of cross coupling introduced at the rotor mid-span.

6.5.7 The applied cross coupling shall extend from zero to the minimum of:

- a level equal to 10 times the anticipated cross coupling, Q_A ;
- the amount of the applied cross coupling required to produce a zero log decrement, Q_O . This value can be reached by extrapolation or linear interpolation between two adjacent points on the curve.

6.5.8 A plot of the calculated log decrement, δ_f , for the first forward mode shall be prepared for the minimum and maximum component clearances, combined with the two extremes of oil temperature and pressure (minimum pressure x maximum oil temperature and minimum temperature x maximum oil pressure). Each curve shall contain a minimum of five calculated stability points. The ordinate (y-axis) shall be the log decrement. The abscissa (x-axis) shall be the applied cross coupling with the range defined in 6.5.7 of this Standard. A typical plot is presented in Figure below. Q_O and δ_A are identified as the minimum values from either component clearance curves.

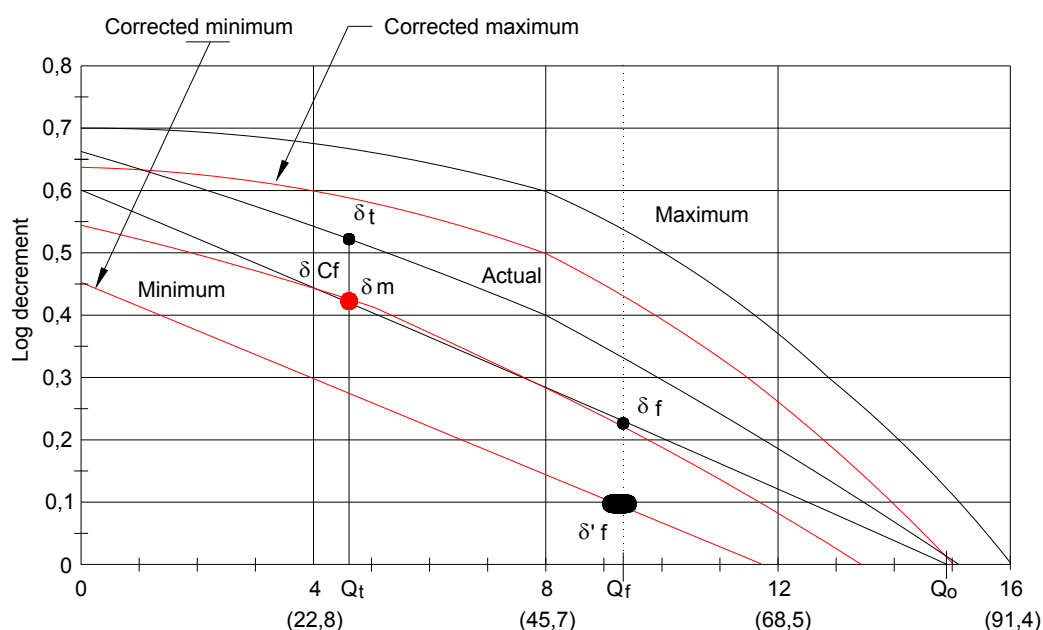


Figure 1 - Typical of Applied Cross-Coupled Stiffness vs. Log Dcrement

6.5.9 Level I Screening Criteria

If $\delta_a < 0,2$, then a Level II stability analysis shall be performed. Otherwise, the stability is acceptable and no further analyses are required.

6.5.10 Level II Stability Analysis

6.5.10.1 A Level II analysis, which reflects the actual operating behavior of the rotor, shall be performed as required by 6.5.9 of this Standard.

6.5.10.2 The Level II analysis shall include the dynamic effects from all sources that contribute to the overall stability of the rotating assembly as appropriate. These dynamic effects shall replace the anticipated cross coupling, QA. These sources may include, but are not limited to, the following:

- a) labyrinth seals;
- b) balance piston;
- c) blade flow;
- d) shrink fits;
- e) shaft material hysteresis;
- f) bearings.

NOTE It is recognized that methods may not be available at present to accurately model the destabilizing effects from all sources listed above. The vendor shall state how the sources are handled in the analysis.

6.5.10.3 The Level II analysis shall be calculated for the operating conditions defined in 6.5.1 of this Standard extrapolated to maximum continuous speed. The modeling requirements of 6.5.2, 6.5.4 of this Standard and the contribution of steam forces on bearings and other components. The component dynamic characteristics shall be calculated at the extremes of the allowable operating limits of clearance and oil inlet temperature to produce the minimum log decrement.

6.5.10.4 The frequency and log decrement of the first forward damped mode shall be calculated for the following conditions (except for double overhung machines where the first two forward modes must be considered):

- a) rotor and support system only (basic log decrement, $\delta_{\square b}$);
- b) for the addition of each group of destabilizing effects utilized in the analysis;
- c) complete model including all destabilizing forces (final log decrement, $\delta_{\square f}$).

6.5.10.5 Acceptance Criteria

The Level II stability analysis shall indicate that the machine, as calculated in 6.5.10.1 through 6.5.10.3 of this Standard, shall have a final log decrement, δ_f , greater than 0,2.

6.5.10.6 A stability test, to measure damping ratio (and to determine the corresponding log decrement), shall be performed if one of the following conditions is satisfied:

- a) the machine fails to meet the criteria specified in 6.5.10.5 of this Standard;
- b) the test has been specified in turbine data sheet.

7 Bearings, Bearing Housings and Seals - Bearing Housing (Section 10 and 10.3 of API STD 612:2005)

7.1 Addition (10.3.2 of API STD 612:2005)

Buffer injection ports shall be provided.

Although provisions for buffer injection are required, the use of buffer gas to prevent labyrinth oil leakage are not automatically approved.

7.2 Substitution (10.3.5 of API STD 612:2005)

Thrust and radial bearings shall be fitted with 2 radial vibration probes in each bearing housing, 3 axial-position probes at the thrust end of each machine, (2 connected to vibration monitor; 1 just wired) and a one-event-per-revolution (key-phasor) probe in each machine, installed in accordance with API STD 670.

7.3 New (10.3.7)

Thrust and radial bearing shall be fitted with bearing-metal temperature sensors installed in accordance with API STD 670. Minimum configuration and requirements shall be as follows:

- a) 2 pairs of embedded sensors shall be placed in the thrust pads (1 pair per side-active and inactive);
- b) 1 pair of embedded sensors shall be placed in each radial bearing;
- c) sensors shall be located in maximum temperature areas of respective bearings or pads;
- d) 2 levels of alarm shall be provided;
- e) local thermometers shall be provided on each bearing housing oil outlet.

8 Controls and Instrumentation (Section 12 of API STD 612:2005)

8.1 General - Addition (12.1 of API STD 612:2005)

Turbine control and operation shall be according PETROBRAS Automation Control Specification issued for each specific job.

8.2 Turbine Governing System - Addition (12.2 and 12.2.6 of API STD 612:2005)

One additional spare sensor (wired, but not connected) shall be supplied. PETROBRAS will use spare sensor for speed monitoring, speed governing or overspeed detection purposes.

8.3 Other Alarms and Shutdowns (12.4 of API STD 612:2005)

8.3.1 Modification (12.4.7 b of API STD 612:2005)

Testing of shutdown devices while in operation will only be considered when recommended by turbine supplier/vendor and equipment protection is not suspended during simulation. Self analyzing systems that will detect faulty transmitters or microprocessor fault and automatically trip the equipment (instead of transferring control and protection to redundant systems) shall not be used.

8.3.2 Modification (12.4.8 of API STD 612:2005)

Replace the first sentence by: The alarm/shutdown system shall incorporate an event recorder to record the order of occurrence of alarms and shutdowns.

9 Accessories (Section 15 of of API STD 612:2005)**9.1 Couplings and Guards - Substitution (15.1 and 15.1.2 of API STD 612:2005)**

Unless otherwise specified, couplings shall be of non-lubricated, flexible stainless steel disk type. Couplings, couplings to shaft junctures, and guards shall conform to API STD 671 or ISO 10441.

9.2 Mounting Plates (15.3 of API STD 612:2005)**9.2.1 General - Modification (15.3.1 and 15.3.1.3 of API STD 612:2005)**

Replace the first sentence by: Alignment positioning screws shall be provided, regardless of the weight of any drive train component, to facilitate longitudinal, transverse, horizontal and vertical adjustments.

9.2.2 Baseplates - Modification (15.3.2 and 15.3.2.5 of API STD 612:2005)

Replace the second sentence by: The baseplate shall be designed for grouting, it shall be provided with at least one grout hole having a clear area of at least 0,01 m² (20 in²) and no dimension less than 75 mm (3 in) in each bulkhead section.

9.3 Insulation and jacketing (15.7 of API STD 612:2005)**9.3.1 Substitution (15.7.1 of API STD 612:2005)**

Unless otherwise specified, the turbines shall be supplied with removable blanket-type insulation extending over all portions of the casing that may reach a normal operating temperature of 60 °C (140 °F) or higher. The blanket shall consist of insulating material encapsulated in a high-temperature fabric with protective wire mesh. Jacket fasteners, wire mesh, and fittings shall be made of stainless steel.

9.3.2 Substitution (15.7.2 of API STD 612:2005)

The insulation shall maintain a surface temperature of not more than 60 °C (140 °F) under normal operating conditions. Jackets and insulation shall be designed to minimize possible damage during removal and replacement.

9.3.3 Comment (15.7.2 of API STD 612:2005)

It is recognized that some components are batch quantity produced for stock and, therefore, witnessed or observed inspection/testing may not be entirely accomplished as specified. Nevertheless, turbine supplier/vendor shall make available to PETROBRAS all inspection and testing data for further review and shall include copies of such certificates and reports in equipment data-books, as per vendor's data requirements section of the inquiry documents.

10 Inspection, Testing, and Preparation for Shipment (Section 16 of API STD 612:2005)

10.1 General - Addition (16.1 and 16.1.6 of API STD 612:2005)

Calibration schedules of the equipment to be used for inspection and testing shall be duly recorded for PETROBRAS' review. As a minimum, the accuracy and/or resolution of the equipment to be used for inspection and testing shall be 5x, i.e., five times finer than the tolerance of what is to be measured. Likewise, standards and calibrating devices are to be 5x more accurate than the equipment to be calibrated.

10.2 Inspection - Mechanical Inspection (16.2 and 16.2.3 of API STD 612:2005)

10.2.1 Substitution (16.2.3.4 of API STD 612:2005)

Except for austenitic stainless steels, the hardness of parts, welds, and heat-affected zones, shall be verified as being within the allowable values by testing of the parts, welds, or heat-affected zones. Other testing may be specified on the data sheets. The method, extent, documentation, and witnessing of the testing shall be mutually agreed upon by the purchaser and the turbine supplier/vendor.

10.2.2 New (16.2.3.5)

Hydrodynamic bearings shall be inspected during manufacturing and testing. The actual contact area among each journal and its corresponding bearing, checked by blueing, shall be at least 70 % of the design contact area.

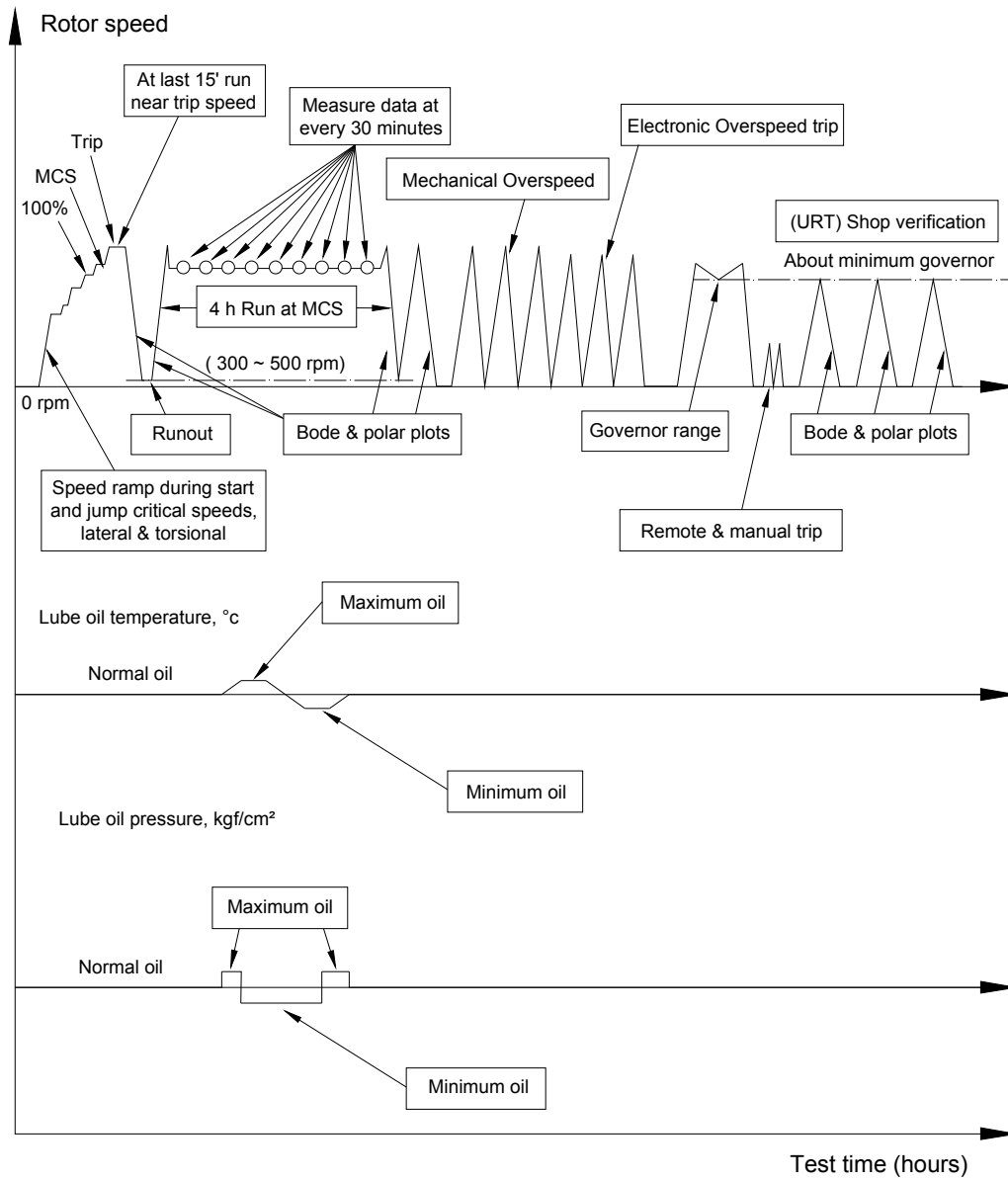


Figure 2 - Mechanical Running Test Sequence

10.3 Testing (16.3 of API STD 612:2005)**10.3.1 Addition (16.3.1.1 of API STD 612:2005)**

The MRT and URT schedules shall follow the figure below (or as specified on the data sheets, whichever is applicable) and the following notes and paragraphs.

- a) Real Time Analyzer (FFT) must be fully available for PETROBRAS use during all tests, as specified on the data sheets:
 - All vibration and phase signals to be available for connection;
 - All cables to be identified;
- b) all Real-Time data (vibration, speed, phase signals, etc.) to be recorded during the whole MRT and URT;
- c) tape or Disc recording to be submitted to PETROBRAS;
- d) the following data shall be available, recorded and printed (or plotted):
 - all vibration and phase signals shall be recorded during the whole test;
 - unfiltered & Filtered vibration amplitude and phase angle versus speed diagrams (Bodé and Polar Plots);
 - orbits (if available);
 - frequency spectra taken during relevant phenomena (surge, choke, etc.);
 - “waterfall” plots for rotor startup and coastdown;
 - data table for the whole test (instant values of all measured variables printed in columns versus elapsed test time on lines);
 - trend plot for the whole test (graphs with all measured variables shown in several trend lines, versus elapsed test time).

10.3.2 Casing Pressure Hydro Tests (16.3.2 of API STD 612:2005)**10.3.2.1 New (16.3.2.1.4)**

Vises or any other devices for clamp pressing of nozzle flanges shall not be used during hydrostatic tests.

10.3.2.2 New (16.3.2.1.5)

PTFE tape or any threaded compounds shall not be used in order to help prevent leakage of threaded plugs and connections during hydrostatic tests.

10.3.3 Mechanical Running Test (16.3.3 of API STD 612:2005)**10.3.3.1 Addition (16.3.3.1.h of API STD 612:2005)**

An additional Real-time Analyzer (RTA), connected with the Vendor's monitoring system, shall be fully available for PETROBRAS use (PETROBRAS own analysis) during all tests. PETROBRAS may, under its discretion, use its own data acquisition equipment, Vendor's additional analyzer, or both. All vibration and phase signals shall be available for connection. All cables shall be identified. ADRE™¹⁾ system is preferred for data collecting and monitoring. If Vendor uses another system, then visualization (or translation into ADRE™ files) software shall be included as well. All files regarding recorded tests, successful or not, shall be copied to a CD and given to PETROBRAS.

¹⁾ ADRE™ is an example of a suitable product available commercially. This information is given for the convenience of users of this Standard and does not constitute an endorsement by PETROBRAS of this products.

10.3.3.2 Substitution (16.3.3.3.f of API STD 612:2005)

Synchronous vibration amplitude and phase angle versus speed for acceleration and deceleration shall be plotted before and after the 4 hour run. Both the synchronous (one per revolution) and overall vibration levels shall be plotted. These data shall also be furnished in polar form. The speed range covered by these plots shall be from 400 to trip speed.

10.3.3.3 Substitution (16.3.3.3.g of API STD 612:2005)

Lube-oil inlet pressures and temperatures shall be varied through the range permitted in the turbine operating manual, after the first hour during the 4 hour run. The following cases shall be verified during the 4 hour test (at least half an hour in each case):

- HI Lube oil pressure & HI Lube oil temperature;
- HI Lube oil pressure & LO Lube oil temperature;
- LO Lube oil pressure & HI Lube oil temperature;
- LO Lube oil pressure & LO Lube oil temperature.

The readings shall be taken at least at the end of each case period.

10.3.3.4 Substitution [16.3.3.4 a) of API STD 612:2005]

All bearings shall be removed and inspected by turbine supplier/vendor or, when specified, by PETROBRAS and reassembled after the mechanical running test is completed. Whether they are inspected by PETROBRAS or not, an inspection report shall be included in the documentation. Unless otherwise specified, shaft end seals shall be removed for inspection following a successful running test.

1.3.3.5 New (16.3.3.5)

During MRT the highest bearing surface metal temperature shall not exceed 95 °C (203 °F) at maximum continuous speed.

10.3.4 Optional Tests and Inspections (16.3.4 of API STD 612:2005)**10.3.4.1 Addition (16.3.4.7 of API STD 612:2005)**

When spare rotor(s) and stator(s) components (e.g., diaphragms, bearings, seals) are ordered, the dimensional inspection report shall be provided.

10.3.4.2 Substitution (16.3.4.10 of API STD 612:2005)

The turbine governing system shall be tested together with control panel at factory or during commissioning at site.

10.3.5 Stability Test - New (16.3.5)

The purpose of this entire new item is to provide the minimum requirements for the execution of a Factory Stability Test (FST), in order to measure the real stability margin of the machine, identifying the sister modes (forward and backward) and their respective log decrements. The log decrement shall be measured at least in two different operational conditions, in order to plot the measured real applied cross-coupled stiffness vs. Log decrement and the extrapolated produced curve, to the minimum log decrement at worst design conditions (see 6.5.8 of this Standard).

The presentation of the results shall include a plot of applied cross-coupled stiffness vs. Log decrement, showing the measured values and the expected values for similar conditions.

Equipment shall be tested in accordance with 10.3.5.1 through 10.3.5.5 of this Standard.

10.3.5.1 Methods & Procedures - New (16.3.5.1)

The manufacturer shall specify in the FST procedure which kind of excitation is intended to be applied, which measurement devices to be used during the FST and how the test execution sequence has been planned. The type and direction of the excitation shall be fully described as well, including whether it would be directional (horizontal or vertical) or circular (forward or backward). It is PETROBRAS understanding that there are several methods to apply excitation and to measure the required data, as below.

10.3.5.1.1 Excitation Methods - New (16.3.5.1.1)

Impact exciters such as a hammer, bearing casing exciter or an Active Magnetic Bearing (AMB) exciter shall be used to excite the rotor. The excitation using an AMB could also be an impact or a sine sweep (blocking type or conventional).

10.3.5.1.2 Measurement Techniques - New (16.3.5.1.2)

The measurement techniques can be applied in the frequency domain or in time domain. In any of the methods, the approach to estimate the forward and backward modes and respective log decrements shall be using multiple degrees of freedom (MDOF). The method employed shall provide acceptable results even in case of the following difficulties or abnormalities (but not limited to):

- a) rotor system anisotropy;
- b) slightly damped systems (the method must render an acceptable damping ratio estimation);
- c) limitations on the number of input and output locations;
- d) noise and /or internal sources of excitations, such as rotor unbalance.

Due to the close modes in the rotating systems, the Single-Degree of Freedom (SDOF) technique is not acceptable. The methods that lead to the best results are the PEM (Predicted Error Method) for frequency domain and MOBAR (Multiple Output Backward Auto Regression) for time domain.

Any other applicable methodology, rendering acceptable results even in case of above mentioned system characteristics, such methodology shall be fully described (type of load, application of load, measurement techniques, interpretation of results, definition of model order, etc) and demonstrated (list of experience with similar designs, results and comparison with actual data). Methodologies shall be submitted to PETROBRAS for review and approval.

10.3.5.2 Definitions - New (16.3.5.2)

The stability of the machine shall be measured in two different operational conditions as defined in 10.3.5.2.1 and 10.3.5.2.2.

10.3.5.2.1 Base Stability - New (16.3.5.2.1)

The Base Stability is defined as the measured stability with the machine running with zero internal cross-coupling. This can be most closely achieved with the rotor running on High Speed Balance Machine or running during the Mechanical Running Test, which may be done at HSB or at Test Bed during Mechanical Running Test (MRT) or Performance Test (if ASME [PTC-6](#) test will be performed).

The Base stability shall be measured at maximum continuous speed - MCS - and at Steam turbine Performance test speed (if Performance test speed is different than MCS). The procedure for applying the excitation shall be according 10.3.5.5 of this Standard.

10.3.5.2.2 At Steam Turbine Performance Test - New (16.3.5.2.2)

The stability measurement at Steam turbine Performance Test is the measurement of the log decrement of the machine for a specific cross-coupling, calculated taking in account the pressure and speed during the test, for one chosen point. The Performance Test shall be according to ASME [PTC-6](#) and PETROBRAS supplementary specifications.

The procedure shall consider the following premises:

- a) the turbine shall reach the maximum working pressure (as feasible at the test bed operating conditions). The manufacturer and PETROBRAS may define other points, depending on similarity of test conditions with actual ones;
- b) there shall be a delay, waiting for system stabilization (pressures, temperatures, flow rates, bearing temperatures and shaft centerline);
- c) the test conditions shall be chosen by manufacturer such that estimated cross-coupling be at least, 20 % of the cross-coupling calculated according to 6.5.10.4 c) of this Standard. For boundary conditions where such margin cannot be accomplished, the test point shall be the highest feasible.

10.3.5.3 Preparation for the Test - New (16.3.5.3)**10.3.5.3.1 New - (16.3.5.3.1)**

When an active magnetic bearing is used for the excitation, its assembly on the shaft shall not significantly change the rotor response characteristics. The manufacturer shall submit for PETROBRAS approval the proposed device and the expected changes in the rotor response prior to the test.

The equipment measured unfiltered vibration, during the mechanical running and performance tests, with the assembled device, before applying any load, shall not exceed the limits of 6.4.1 of this Standard.

The manufacturer shall send a procedure informing how the AMB will be adjusted/calibrated and how the applied force will be measured. Prior to the tests, the accuracy of input force measurements shall be verified. The manufacturer shall submit the AMB calibration report for PETROBRAS review

10.3.5.3.2 New (16.3.5.3.2)

The manufacturer shall present, prior to the test, the calculated log decrement for the forward and backward modes at actual test conditions (Qt), such as bearing clearance, preload and test speed (for ASME [PTC-6](#) test, the test speed may be different from maximum continuous speed).

10.3.5.3.3 New (16.3.5.3.3)

The data collect system shall consists as a minimum of an Oscilloscope, a Real Time Analyzer and a data recorder (analog or digital) with capability of continuously collecting all probes data and input signals. The sampling rate of the system shall be enough to identify the excitation frequencies and the results.

10.3.5.3.4 New (16.3.5.3.4)

The manufacturer shall present in the lateral vibration report, the expected orbits for both modes (forward and backward) at MCS, from zero to the maximum expected cross-coupling (0 %, 50 %, 100 %) for the average clearance case. The definition of excitation direction shall be based in those orbits.

10.3.5.3.5 Determining the Excitation Frequencies When Using Sine Sweep Method - New (16.3.5.3.5)

To identify the actual forward and backward frequencies, a preliminary sine sweep excitation covering the frequency range, given by rotordynamic analysis, shall be performed. The frequency interval of each sine sweep shall be less or equal to 0,25 Hz.

10.3.5.4 Signal Quality - New (16.3.5.4)**10.3.5.4.1 New (16.3.5.4.1)**

In order to have good response when applying the excitation, the ratio between signal to noise (SNR) shall be at least two. The amplitude of excitation shall be controlled in order to not exceed an agreed amount of bearing clearances for safety and linearity concerns.

10.3.5.4.2 New (16.3.5.4.2)

If the manufacturer decides to apply filtering to eliminate the synchronous response, the type of filter shall be informed to PETROBRAS. The design of the filter shall not influence the signal components of interest.

10.3.5.4.3 New (16.3.5.4.3)

Any measured point (forward and backward) shall be calculated from an average of at least five readings. These five readings shall be in the range of:

$$\bar{\delta}_m - 0,03 \leq \bar{\delta}_i \leq \bar{\delta}_m + 0,03$$

Where:

$$\bar{\delta}_m = \frac{\bar{\delta}_1 + \bar{\delta}_2 + \bar{\delta}_3 + \bar{\delta}_4 + \bar{\delta}_5}{5}$$

If any value falls outside the above defined range, it shall be discarded and measured again.

The average value (δ_m) will be used to compare with the predicted values.

10.3.5.5 Acceptance Criteria - New (16.3.5.5)

10.3.5.5.1 Model Verification - New (16.3.5.5.1)

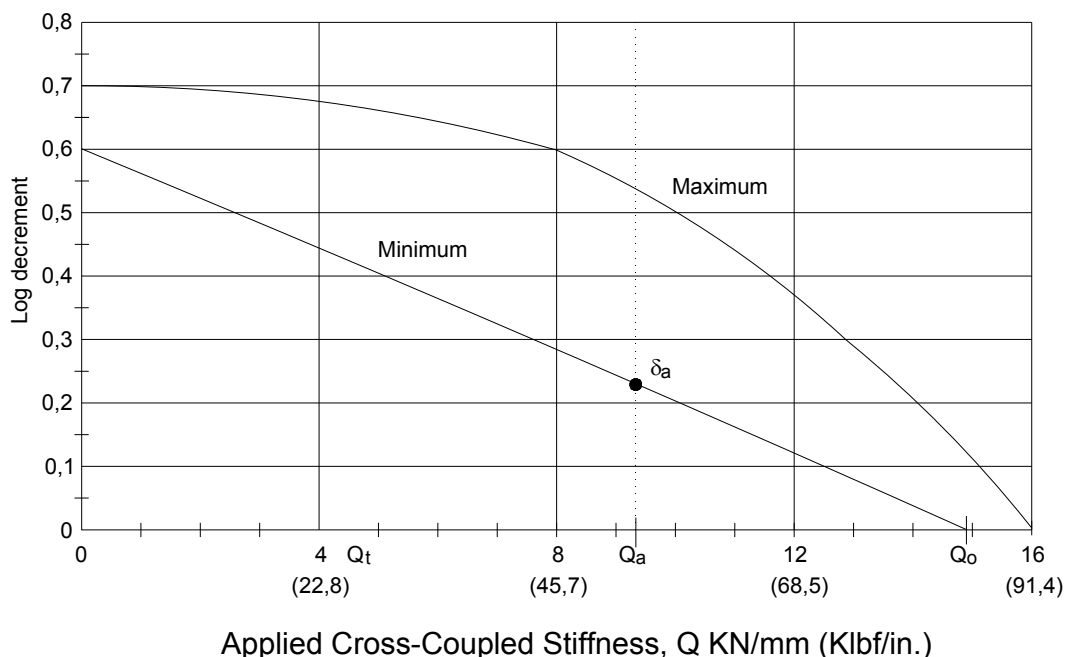
If the measured value is above the predicted one, no correction in the model is necessary.
The vendor shall correct the model if it fails to meet the following criteria:

Any expected log decrement for the forward mode, for both cases (base stability and performance test conditions), calculated according 10.3.5.3.2, shall be inside the range of the measured log decrement ($\delta_m \pm 0,03$).

10.3.5.5.2 New (16.3.5.5.2)

The highest difference between the expected value and the measured log decrement (δ_m) for each case (base stability and performance test conditions) will be the correction factor (δ_{cf}) to be applied to the calculated log decrement (δ_f) for the worst condition (see 6.5.8 of this Standard) at maximum continuous speed.

The equipment acceptance criteria shall have a final corrected log decrement ($\delta'f$), at worst condition (see 6.5.8 of this Standard) greater than 0,05.



Where:

- Q_t : calculated cross-coupled stiffness at test conditions (see 10.3.5.3.2 of this Standard);
- Q_o : calculated cross-coupled stiffness at maximum continuous speed, design pressure and worst conditions (see 6.5.8 of this Standard).

NOTE The example in the curve above is only illustrative; no curve shape correction will be applied.

Figure 3 - Typical Plot of Applied Cross-Coupled Stiffness vs Log Decrement

10.3.5.5.3 New (16.3.5.5.3)

If the equipment fails to meet the above criteria, the necessity of additional tests and/or machine modifications shall be agreed upon manufacturer and PETROBRAS.

10.4 Preparation for Shipment (16.4 of API STD 612:2005)**10.4.1 Addition (16.4.2 of API STD 612:2005)**

Turbine supplier/vendor shall specify the products to be used in preparation of the equipment components, the methods of removal and reapplication, and inform the date of application. Such data shall be summarized in two tags to be securely affixed to each main equipment and on the outside of each crate.

10.4.2 Addition [16.4.3 i) of API STD 612:2005]

Spare parts shall also be identified and tagged (or indelibly stamped with respective serial or part numbers) as applicable to each case.

10.4.3 Addition [16.4.3 j) of API STD 612:2005]

Export boxing shall be considered, unless otherwise specified. PETROBRAS will specify whether vertical or horizontal storage shall be considered. Neither TFE nor PTFE shall be used between the rotor and the cradle at the support areas.

11 Vendor's Information - Proposals - Technical Data [Substitution - 17.2 and 17.2.3 j) of API STD 612:2005]

Unless otherwise specified, running designs, with successful experience of continuous and satisfactory operation under similar conditions (at least as severe as those specified on the data sheets) shall be demonstrated, at least 25 of same model and 15 of same size, with a minimum service time of 25,000 hours.

To demonstrate successful experience with complete equipment or capital components, such as blades, bearings, etc., bidders shall provide parametric diagrams or charts (*Experience Diagrams*) where plotted scattered points show former designs and proposed design, as per the following generic example (see Figure 4 of this Standard).

Most common design parameters (among others) to be plotted for experience diagrams should be according the Table 1.

Table 1 - Experience Parameters

Type of equipment/component	Most common set of parameters
Blades	Power per stage and peripheral speed, Stress X speed, Goodman & Campbell
Bearings	Specific load and peripheral speed
Turbines	Power, RPM, inlet pressure, inlet temperature, steam flow

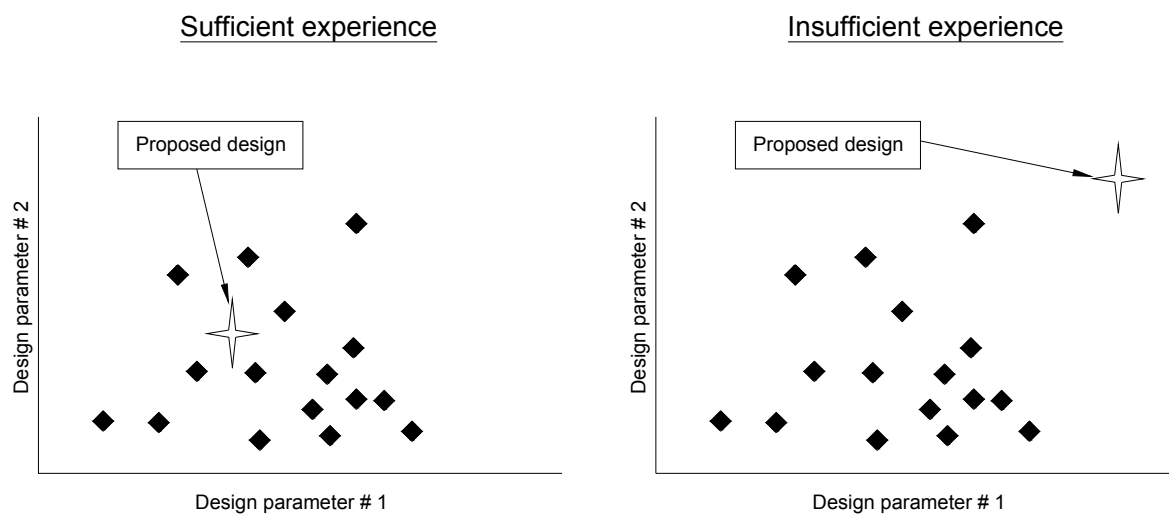



Figure 4 - Experience Diagrams


12 Annexes

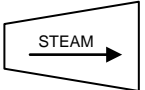
This Standard contains the following data sheets:


- a) Annex A - Special Purpose Steam Turbine (Annex A of API [STD 612:2005](#));
- b) Annex B - Vendor Drawing and Data Requirements (Annex J of API [STD 612:2005](#)).


[illegible]


		DATA SHEET				No.				REV.										
										SHEET 02 of 22										
		TITLE: SPECIAL PURPOSE STEAM TURBINE																		
01	APPLICABLE TO: <input checked="" type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS PURCHASED <input type="checkbox"/> AS BUILT																			
02	FOR: _____ LOCATION: _____																			
03	UNIT: _____																			
04	SERVICE: _____ UNITS REQ'D: _____																			
05	TURBINE TYPE _____ ITEM N° _____																			
06	MANUFACTURER: _____ MODEL: _____																			
07	DRIVEN EQUIPMENT: _____ ITEM N° _____																			
08	MANUFACTURER: _____ MODEL: _____																			
09	TRANSMISSION EQUIP.: _____ ITEM N° _____																			
10	MANUFACTURER: _____ MODEL: _____																			
11	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> PERFORMANCE																			
12	OPERATING POINTS	SHAFT		INLET			INDUCTION/EXTRACTION			EXHAUST										
13		POWER	SPEED	FLOW	PRESSURE	TEMP	FLOW	PRESSURE	TEMP	PRESSURE	TEMP	ENTHALPY								
14		kW	RPM	kg/h	kgf/cm ² g	°C (TT)	kg/h	kgf/cm ² g	°C (TT)	kgf/cm ² g mm Hg abs	°C (TT)	KJ /kg								
15		@ DRIVEN EQ. RATED																		
16	@ DRIVEN EQ. NORMAL																			
17	@ DRIVEN EQ. MINIMUM																			
18	TURBINE (API STD 612) RATED																			
19	<input checked="" type="checkbox"/> STEAM RATE, kg/kW-h: NORMAL RATED INDUCTION <input type="radio"/> UNCONTROLLED <input type="radio"/> CONTROLLED BY: _____																			
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21	<input checked="" type="checkbox"/> POTENTIAL MAXIMUM POWER, kW: WITH MINOR MODIFICATIONS: WITH MAJOR MODIFICATIONS:																			
22	STEAM CONDITIONS	INLET			<input type="checkbox"/> INDUCTION <input type="checkbox"/> EXTRACTION			<input type="checkbox"/> INDUCTION <input type="checkbox"/> EXTRACTION			EXHAUST									
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24		kg/h	kgf/cm ² g	°C	kg/h	kgf/cm ² g	°C	kg/h	kgf/cm ² g	°C	kgf/cm ² g mm Hg abs	°C								
25		MINIMUM																		
26	NORMAL																			
27	MAXIMUM / DESIGN																			
28	<input checked="" type="checkbox"/> INSTALLATION CONDITIONS AND SITE DATA																			
29	AREA CLASSIFICATION: <input checked="" type="checkbox"/> IEC: ZONE: GROUP: TEMP. CLASS: <input type="radio"/> NEC: CLASS: --- GROUP: --- DIVISION: ---																			
30	TURBINE: <input type="radio"/> GRADE (NOTE 1) <input checked="" type="checkbox"/> CONCRETE BASE <input checked="" type="checkbox"/> LOS ON GRADE <input checked="" type="checkbox"/> OUTDOOR <input type="radio"/> INDOOR <input checked="" type="checkbox"/> SHELTERED <input type="radio"/> UNSHELTERED																			
31	<input type="radio"/> MEZZANINE <input type="radio"/> ON SKID MODULE <input type="radio"/> COS ON GRADE <input type="radio"/> HEATED <input checked="" type="checkbox"/> UNHEATED <input checked="" type="checkbox"/> UNDER ROOF <input checked="" type="checkbox"/> PARTIAL SIDES																			
32	MAIN CONDENSER: <input type="radio"/> GRADE <input type="radio"/> UNDER TURBINE <input type="radio"/> ASIDE TURBINE <input type="radio"/> WINTERIZATION <input checked="" type="checkbox"/> TROPICALIZATION																			
33	ELEVATION, m: BAR. PR., mbar: AMBIENT TEMPERATURE, °C						<table border="1"> <tr> <td>DESIGN</td> <td>NORMAL</td> <td>MAXIMUM</td> <td>MINIMUM</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>						DESIGN	NORMAL	MAXIMUM	MINIMUM				
DESIGN	NORMAL	MAXIMUM	MINIMUM																	
34	UNUSUAL CONDITIONS: <input checked="" type="checkbox"/> DUST <input checked="" type="checkbox"/> FUMES <input type="radio"/> OTHER DRY BULB																			
35	AVERAGE AIR HUMIDITY, MAX.: % SUMMER WET BULB:																			
36	<input type="radio"/> ELECTRIC POWER FOR INSTRUMENTS																			
37	<input type="radio"/> AC: VOLTAGE: FREQ., Hz: PHASES:						<input type="radio"/> AC: VOLTAGE: FREQ., Hz: PHASES:													
38	<input type="radio"/> DC: VOLTAGE: WIRES:						<input type="radio"/> AC: VOLTAGE: FREQ., Hz: PHASES:													
39	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> UTILITIES																			
40	<u>HEATING STEAM</u>	MINIMUM	NORMAL	MAXIMUM	<u>STEAM FOR AUX. TURBINES & EJECTORS</u>				MINIMUM	NORMAL	MAXIMUM									
41	INLET PRESSURE, kgf/cm ² g:				INLET PRESSURE, kgf/cm ² g:															
42	TEMPERATURE, °C:				TEMPERATURE, °C:															
43	OUTLET PRESSURE, kgf/cm ² g:				OUTLET PRESSURE, kgf/cm ² g:															
44	<input checked="" type="checkbox"/> TOTAL CONSUMPTION, kg/h:				<input checked="" type="checkbox"/> TOTAL CONSUMPTION, kg/h:															
45	<u>INSTRUMENT AIR, DEOILED:</u> <input checked="" type="checkbox"/> YES	MINIMUM	NORMAL	MAXIMUM	<u>SERVICE AIR, DEOILED:</u> <input checked="" type="checkbox"/> NO				MINIMUM	NORMAL	MAXIMUM									
46	PRESSURE, kgf/cm ² g:				PRESSURE, kgf/cm ² g:															
47	TEMPERATURE, °C :				TEMPERATURE, °C :															
48	DEW POINT, °C:				DEW POINT, °C:															
49	<input checked="" type="checkbox"/> TOTAL CONSUMPTION, Nm ³ /h:				<input checked="" type="checkbox"/> TOTAL CONSUMPTION, Nm ³ /h:															
50	<u>COOLING WATER INLET</u>	MINIMUM	NORMAL	MAXIMUM available	<u>COOLING WATER OUTLET</u>				MINIMUM	NORMAL	MAXIMUM allowable									
51	PRESSURE, kgf/cm ² g:				PRESSURE, kgf/cm ² g:															
52	TEMPERATURE, °C :				RETURN TEMPERATURE, °C :															
53	CIRCUIT: <input checked="" type="radio"/> OPEN <input type="radio"/> CLOSED				WATER TYPE : <input checked="" type="radio"/> COOLING TOWER <input type="radio"/> FOR MACHINERY															
54	<input checked="" type="checkbox"/> TOTAL CONSUMPTION, m ³ /h:				FOULING FACTOR, m ² .°C.h / kcal:															

	DATA SHEET					No.		REV.	
								SHEET 3 of 22	
	TITLE: SPECIAL PURPOSE STEAM TURBINE								

01	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> CONSTRUCTION FEATURES									
02	<u>GOVERNING SPECIFICATIONS:</u>					<u>DESIGN CRITERIA & GUIDANCE SPECIFICATIONS: SEE MATERIAL REQ.</u>				
03	<input checked="" type="checkbox"/> SPECIAL PURPOSE STEAM TURBINES	API STD 612	PETROBRAS-N-2627	<input type="radio"/>						
04	<input checked="" type="checkbox"/> SPECIAL PURPOSE COUPLINGS	API STD 671		<input type="radio"/>						
05	<input checked="" type="checkbox"/> STEAM CONDENSERS [WHEN APPLICABLE]	HEI, TEMA	NR-13	<input type="radio"/>						
06	<input checked="" type="checkbox"/> CENTRIFUGAL PUMPS [IF APPLICABLE]	ISO 13709	PETROBRAS-N-553	<input type="radio"/>						
07	<input checked="" type="checkbox"/> GENERAL PURPOSE STEAM TURBINES	API STD 611	PETROBRAS-N-2648	<input type="radio"/>						
08	<input checked="" type="checkbox"/> OIL SYSTEMS	API STD 614	CH. <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3	<input type="radio"/>						
09	<input checked="" type="checkbox"/> OIL COOLERS	TEMA C	NR-13	<input type="radio"/>						
10	<input checked="" type="checkbox"/> ALL PRESSURE CONTAINING EQUIPMENT	ASME SEC. VIII	NR-13	<input type="radio"/>						
11	<input checked="" type="checkbox"/> SPECIAL PURPOSE GEAR UNITS [IF APPL.]	API STD 613		<input type="radio"/>						
12	<u>TURBINE TYPE</u>			<u>ROTATION</u> (VIEWED FROM INLET END)						
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15	<input type="radio"/> OTHER									
16	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> CASINGS, NOZZLES & DIAPHRAGMS									
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19	INDUCTION SECTION	EXTRACT. SEC.					EXHAUST CASING		OTHER	
20	OTHER									
21	<input type="checkbox"/> MAX. OPERATING TEMPERATURES, °C:					<input type="radio"/> WELDED NOZZLE RING		NOZZLE RING, %	ADM	
22	INLET SECTION	EXHAUST SEC.					<input type="checkbox"/> DIAPHRAGM BLADE ATTACHMENT:			
23	INDUCTION SECTION	EXTRACT. SEC.					<input type="checkbox"/> INTEGRALLY CAST		<input type="checkbox"/> WELDED	
24	<input type="radio"/> DESIGN METAL TEMP.					<input type="checkbox"/> OTHER				
25	<input type="radio"/> RELIEF VALVE SETTING, kgf/cm ² g					<input type="checkbox"/> DIAPHRAGM AXIAL LOCATION:				
26	INLET SECTION	EXHAUST SEC.					<input type="checkbox"/> INDIVIDUALLY		<input type="checkbox"/> STACKED	
27	INDUCTION SECTION	EXTRACT. SEC.								
28	OTHER									
29	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> CASING CONNECTIONS									
30		DESIGN		# RATING		FLANGED	MATING FLANGE	MAXIMUM	MINIMUM	FLOW
31	CONNECTION	APPROVAL		AND	POSITION	OR	& GASKET BY	STEAM FLOW	STEAM FLOW	VELOCITY
32		REQUIRED	SIZE	FACING		STUDDED	VENDOR (NOTE 4)	kg/h	kg/h	m/s
33	INLET	YES				FLANGED	YES			
34	EXHAUST	YES				FLANGED	YES			
35	EXTRACTION									
36	INDUCTION									
37	<input checked="" type="checkbox"/> ALLOWABLE PIPING FORCES AND MOMENTS									
38	POSITION	INLET		EXHAUST		EXTRACTION		INDUCTION		
39		FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	FORCE	MOMENT	
40		N	N.m	N	N.m	N	N.m	N	N.m	
41	AXIAL									
42	VERTICAL									
43	HORIZONTAL 90°									
44	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> MATERIALS - CASINGS & APPURTENANCES									
45	<input type="radio"/> STEAM CONTAMINANTS:					<input type="radio"/> STEAM PATH COMPONENTS HARDNESS LESS THAN Rc 22 REQUIRED				
46	<input type="checkbox"/> HIGH PRESSURE CASING					<input type="checkbox"/> HP DIAPHRAGMS				
47	<input type="checkbox"/> MID PRESSURE CASING					<input type="checkbox"/> LP DIAPHRAGMS				
48	<input type="checkbox"/> EXHAUST CASING					<input type="checkbox"/> DIAPHRAGM NOZZLES				
49	<input type="checkbox"/> STEAM CHEST					<input type="checkbox"/> BLADE CARRIERS				
50	<input type="checkbox"/> NOZZLE RINGS					<input type="checkbox"/> OTHER				
51	<u>NOTES:</u>									
52										
53										
54										


		DATA SHEET				No.		REV.	
								SHEET 04 of 22	
		TITLE: SPECIAL PURPOSE STEAM TURBINE							
<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> CONSTRUCTION FEATURES, CONTINUED									
01		<input checked="" type="checkbox"/> RUNNING SPEEDS, rpm				<input checked="" type="checkbox"/> SHAFT			
02		MAX CONTINUOUS: TRIP: MAX. ALLOWABLE: MAX. TIP SPEEDS, m/s: @ RATED SPEED: (REGARDING BLADES / BUCKETS) @ MCS:				<input type="checkbox"/> SHAFT TYPE <input type="checkbox"/> INTEGRAL WHEELS <input type="checkbox"/> BUILT-UP <input type="checkbox"/> COMBINATION			
03						<input type="checkbox"/> DOUBLE EXTENDED <input type="checkbox"/> No. OF STAGES <input type="checkbox"/> FINAL STAGE BLADE LENGTH, mm <input type="checkbox"/> MAX. BLADE LENGTH, mm <input type="checkbox"/> SHAFT MATERIAL <input type="checkbox"/> MAX. YIELD STRENGTH, N/mm ² : <input type="checkbox"/> SHAFT HARDNESS, [BHN] [Rc]: <input type="checkbox"/> MAX. TORQUE CAPABILITY, [N.m] <input type="checkbox"/> MATERIAL AT SEALS / PACKINGS: <input type="checkbox"/> HARDNESS, [BHN] [Rc]: <input type="checkbox"/> HARDENING PROCESS: <input type="checkbox"/> Cr PLATING <input type="checkbox"/> NITRIDING <input type="checkbox"/> SPRAY: <input type="checkbox"/> WITH SLEEVES			
04		<input checked="" type="checkbox"/> LATERAL CRITICAL SPEEDS, rpm							
05		<u>FIRST CRITICAL:</u> DAMPED: UNDAMPED: MODE SHAPE: MODE SHAPE:							
06		<u>SECOND CRITICAL:</u> DAMPED: UNDAMPED: MODE SHAPE: MODE SHAPE:							
07		<u>THIRD CRITICAL:</u> DAMPED: UNDAMPED: MODE SHAPE: MODE SHAPE:							
08		<u>FOURTH CRITICAL:</u> DAMPED: UNDAMPED: MODE SHAPE: MODE SHAPE:							
09		<input checked="" type="checkbox"/> ROTORDYNAMICS							
10		<input checked="" type="checkbox"/> LATERAL ANALYSIS REQUIRED (NOTE 2) <input type="checkbox"/> STABILITY ANALYSIS [IF APPLICABLE]				<input type="checkbox"/> SHAFT ENDS <input type="radio"/> CYLINDRICAL (STRAIGHT)			
11		<input checked="" type="checkbox"/> TORSIONAL ANALYSIS REQUIRED <input checked="" type="checkbox"/> CRITICAL <input checked="" type="checkbox"/> TRANSIENT				<input type="radio"/> TAPERED TAPER ∠: <input type="checkbox"/> mm/m			
12		<input checked="" type="checkbox"/> LATERAL CRITICAL SPEED BASIS:				<input type="radio"/> KEYED <input type="checkbox"/> SINGLE <input type="checkbox"/> DOUBLE <input type="checkbox"/>			
13		<input checked="" type="checkbox"/> DAMPED UNB. RESP. ANALYSIS <input checked="" type="checkbox"/> SHOP VERIFICATION TEST [URT 1&2]				<input type="radio"/> HYDRAULIC FIT <input type="radio"/> INTEGRAL FLANGE			
14		<input type="checkbox"/> SHOP STABILITY TEST [IF APPL.] <input type="checkbox"/> OTHER TYPE:				<input type="checkbox"/> SHAFT DIAMETERS, mm:			
15		<input type="checkbox"/> ALLOWABLE VIBRATION LEVELS [Pk-Pk] μ m:				<input type="checkbox"/> @ BEARINGS: <input type="checkbox"/> @ COUPLING:			
16		<input type="checkbox"/> ALLOWABLE VIBRATION LEVELS [rms] mm/s:				<input type="checkbox"/> @ WHEELS:			
17		<input type="checkbox"/> TURBINE ROTOR INERTIA [GD ²], kg.m ²				<input type="checkbox"/> FIELD BALANCING PROVISIONS:			
18		<input checked="" type="checkbox"/> TORSIONAL CRITICAL SPEEDS				<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> LOCATION:			
19		FIRST CRITICAL, rpm:				<input type="checkbox"/> DESCRIPTION OF FIELD BALANCING PROVISIONS:			
20		SECOND CRITICAL, rpm:							
21		THIRD CRITICAL, rpm:							
22		FOURTH CRITICAL, rpm:							
23		<input type="checkbox"/> BLADING:				STAGE # 1 STAGE # 2 STAGE # 3 STAGE # 4 STAGE # 5 STAGE # 6 STAGE # 7			
24		<input type="checkbox"/> WHEEL MATERIAL							
25		<input type="checkbox"/> BLADE MATERIAL							
26		<input type="checkbox"/> BLADE ROOT TYPE							
27		<input type="checkbox"/> CLOSURE PIECE TYPE							
28		<input type="checkbox"/> TIE WIRE/SHROUD MATERIAL							
29		<input type="checkbox"/> SHROUD ATTACHMENT							
30		<input type="checkbox"/> PITCH DIAMETER, mm							
31		<input type="checkbox"/> BLADE HEIGHT, mm							
32		<input type="checkbox"/> BLADE QUANTITY							
33		<input type="checkbox"/> BLADE TYPE							
34		<input type="checkbox"/> SHAFT SEALS:				INLET INTERMEDIATE #1 INTERMEDIATE #2 EXHAUST			
35		SURFACE SPEED, m/s				<input checked="" type="checkbox"/> CASING END SEALS:			
36		MAX. SEAL PRESSURE, kgf/cm ² g				TYPE: <input type="radio"/> LABYRINTH			
37		DIFF. PRESSURE PER SEAL, kgf/cm ²				<input type="checkbox"/> OTHER:			
38		STEAM LEAKAGE, kg/h				MATERIAL:			
39		AIR LEAKAGE, Std m ³ /h				<input checked="" type="checkbox"/> INTERSTAGE SEALS:			
40		DIAMETER, mm				TYPE: <input type="radio"/> LABYRINTH			
41		NUMBER OF RINGS PER SEAL				<input type="checkbox"/> OTHER:			
42		STATIONARY SEALS / LABYRINTH TYPE:				MATERIAL:			
43		ROTATING SEALS / LABYRINTH TYPE:				NOTES:			
44		MATERIAL							

	DATA SHEET			No.		REV.	
						SHEET 5 of 22	
	TITLE: SPECIAL PURPOSE STEAM TURBINE						
01	<input checked="" type="checkbox"/> <input type="checkbox"/> CONSTRUCTION FEATURES, CONTINUED						
02	BEARINGS AND BEARING HOUSINGS						
03	RADIAL	INLET END	EXHAUST END	THRUST	ACTIVE	INACTIVE	
04	TYPE:			TYPE:	TILTING PAD	TILTING PAD	
05	MANUFACTURER:			MANUFACTURER:			
06	LENGTH, mm:			UNIT LOADING, MAX., kgf/cm ² :			
07	SHAFT DIAMETER, mm:			UNIT LOAD, ULTIMATE, kgf/cm ² :			
08	UNIT LOAD, ACTUAL/ALLOWABLE			AREA, mm ² :			
09	BASE MATERIAL:			No. OF PADS:			
10	BABBITT THICKNESS, mm:			PIVOT: CENTER/OFFSET, %			
11	No. OF PADS:			PAD BASE MATERIAL:			
12	LOAD, BETWEEN PADS / ON PAD:			LUBRICATION:	<input type="radio"/> FLOODED	<input checked="" type="radio"/> DIRECT	
13	PIVOT, CENTER / OFFSET, %:			THRUST COLLAR:	<input checked="" type="radio"/> INTEGRAL	<input type="radio"/> REPLACEABLE	
14	SPAN BETWEEN BEARINGS, mm:			MATERIAL:			
15	<input checked="" type="checkbox"/> <input type="checkbox"/> BEARING TEMPERATURE DEVICES			<input checked="" type="checkbox"/> <input type="checkbox"/> VIBRATION DETECTORS, CONTINUED			
16	<input type="radio"/> THERMISTORS:			<input type="radio"/> VELOCITY TRANSDUCERS:			
17	TYPE: <input type="checkbox"/> POS TEMP COEFFICIENT <input type="checkbox"/> NEG TEMP COEFFICIENT			<input type="checkbox"/> TYPE: <input type="radio"/> REQUIRED <input type="radio"/> NOT REQUIRED			
18	TEMP SWITCH & INDICATOR BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			No. REQ'D:			
19	<input type="radio"/> THERMOCOUPLES: TYPE: <input type="radio"/> J <input type="radio"/> K <input type="radio"/> FIRST <input type="radio"/> SECOND OPTION			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
20	SELECTOR SWITCH & INDICATOR BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			No. @ EACH SHAFT BEARING: TOTAL NUMBER:			
21	<input type="radio"/> RESISTANCE TEMPERATURE DETECTORS: <input type="radio"/> FIRST <input type="radio"/> SECOND OPTION			OSCILLATOR-DETECTORS SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
22	RESISTANCE MATERIAL PLATINUM R, Ω: 100			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
23	SELECTOR SWITCH & INDICATOR BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			MONITOR & DISPLAY SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
24	<input type="radio"/> LOCATION-JOURNAL BEARINGS			<input type="radio"/> LOCATION: <input type="checkbox"/> ENCLOSURE			
25	No.: TWO <input type="checkbox"/> EACH PAD <input type="checkbox"/> EVERY OTHER <input type="radio"/> PER BEARING			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
26	OTHER:			<input type="checkbox"/> SCALE RANGE: <input type="radio"/> ALARM: <input type="checkbox"/> SET, mm/s:			
27	<input type="radio"/> LOCATION-THRUST BEARING [ACTIVE SIDE]			<input type="checkbox"/> TIME DELAY, s: <input type="radio"/> DANGER: <input type="checkbox"/> SET, mm/s:			
28	No.: TWO <input type="checkbox"/> EACH PAD <input type="checkbox"/> EVERY OTHER <input type="radio"/> PER BEARING			<input type="radio"/> SHUTDOWN: <input type="checkbox"/> SET, mm/s:			
29	<input type="radio"/> LOCATION-THRUST BEARING [INACTIVE SIDE]			<input type="radio"/> ACCELEROMETERS: <input type="radio"/> REQUIRED <input type="radio"/> NOT REQUIRED			
30	No.: TWO <input type="checkbox"/> EACH PAD <input type="checkbox"/> EVERY OTHER <input type="radio"/> PER BEARING			<input type="checkbox"/> TYPE: No. REQ'D:			
31	OTHER:			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
32	MONITOR & DISPLAY SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			No. @ EACH SHAFT BEARING: TOTAL NUMBER:			
33	<input type="radio"/> LOCATION <input type="checkbox"/> ENCLOSURE			OSCILLATOR-DETECTORS SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
34	<input type="radio"/> MFR.: <input type="radio"/> MODEL:			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
35	<input type="checkbox"/> SCALE RANGE: <input type="radio"/> ALARM: <input type="radio"/> SET, °C:			MONITOR & DISPLAY SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
36	<input type="checkbox"/> TIME DELAY, s: <input type="radio"/> DANGER: <input type="radio"/> SET, °C:			<input type="radio"/> LOCATION: <input type="checkbox"/> ENCLOSURE			
37	<input checked="" type="checkbox"/> <input type="checkbox"/> PHASE INDICATORS [N]			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
38	<input type="radio"/> KEY PHASOR(S) ARE REQUIRED FOR EVERY DIFFERENT SHAFT SPEED			<input type="checkbox"/> SCALE RANGE: <input type="radio"/> ALARM: <input type="checkbox"/> SET, mm/s ² :			
39	<input type="checkbox"/> DRIVEN EQ. <input type="checkbox"/> GEAR [IF APPL.] <input type="checkbox"/> TURBINE <input type="checkbox"/>			<input type="checkbox"/> TIME DELAY, s: <input type="radio"/> DANGER: <input type="checkbox"/> SET, mm/s ² :			
40	<input checked="" type="checkbox"/> <input type="checkbox"/> RADIAL VIBRATION DETECTORS (NOTE 9)			<input checked="" type="checkbox"/> <input type="checkbox"/> AXIAL POSITION DETECTORS (NOTE 9)			
41	<input type="radio"/> AMPLITUDE SENSORS:			<input type="radio"/> SHAFT DISPLACEMENT SENSORS:			
42	<input type="radio"/> TYPE: <input type="radio"/> ALWAYS REQUIRED			<input type="radio"/> TYPE: <input type="radio"/> ALWAYS REQUIRED			
43	<input type="radio"/> MFR.: No. REQ'D:			<input type="radio"/> MFR.: No. REQ'D:			
44	No. @ EACH SHAFT BEARING: TOTAL NUMBER:			No. @ EACH THRUST BEARING: TOTAL NUMBER:			
45	OSCILLATOR-DETECTORS SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			OSCILLATOR-DETECTORS SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
46	<input type="radio"/> MFR.: <input type="radio"/> MODEL:			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
47	MONITOR & DISPLAY SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			MONITOR & DISPLAY SUPPLIED BY: <input type="radio"/> PURCHASER <input type="radio"/> VENDOR/MFR			
48	<input type="radio"/> LOCATION <input type="checkbox"/> ENCLOSURE			<input type="radio"/> LOCATION: <input type="checkbox"/> ENCLOSURE			
49	<input type="radio"/> MFR.: <input type="radio"/> MODEL:			<input type="radio"/> MFR.: <input type="radio"/> MODEL:			
50	<input type="checkbox"/> SCALE RANGE: <input type="radio"/> ALARM: <input type="checkbox"/> SET, μm:			<input type="checkbox"/> SCALE RANGE: <input type="radio"/> ALARM: <input type="checkbox"/> SET, μm:			
51	<input type="checkbox"/> TIME DELAY, s: <input type="radio"/> DANGER: <input type="checkbox"/> SET, μm:			<input type="checkbox"/> TIME DELAY, s: <input type="radio"/> DANGER: <input type="checkbox"/> SET, μm:			
52	<input type="radio"/> SHUTDOWN: <input type="checkbox"/> SET, μm:			<input type="radio"/> SHUTDOWN: <input type="checkbox"/> SET, μm:			
53							
54							


	DATA SHEET				No.		REV.	
	TITLE: <div style="text-align: center; font-weight: bold; font-size: 1.2em;">SPECIAL PURPOSE STEAM TURBINE</div>						SHEET 6 of 22	

01	<input checked="" type="checkbox"/> <input type="checkbox"/> LUBRICATION AND CONTROL OIL SYSTEMS						
02	SEE OIL SYSTEM(S) DATA SHEETS: AS ISSUED FOR THIS JOB		OIL REQUIREMENTS		CONTROL OIL	LUBE OIL	
03	SYSTEM(S) SUPPLIED BY: <input type="radio"/> TURBINE MFR. <input checked="" type="radio"/> TRAIN VENDOR		<input type="checkbox"/> NORMAL FLOW, m ³ /h <input type="checkbox"/> TRANSIENT FLOW, m ³ /h <input type="checkbox"/> PRESSURE, kgf/cm ² g <input type="checkbox"/> TEMPERATURE, °C <input type="checkbox"/> TOTAL HEAT REJECTED, [MW] [kcal/h] <input type="checkbox"/> OIL TYPE [MINERAL / SYNTHETIC] <input type="checkbox"/> VISCOSITY, [SSU @ 37,8 °C] [ISO VG] <input type="checkbox"/> FILTRATION <input type="checkbox"/>				
04	<input type="radio"/> SEPARATE SYS. FOR TURBINE ONLY <input type="radio"/> CONTROL OIL <input type="radio"/> LUBE OIL						
05	<input checked="" type="radio"/> COMMON WITH TRAIN <input type="radio"/> CONTROL OIL <input checked="" type="radio"/> LUBE OIL						
06	TRAIN VENDOR OR TURBINE MANUFACTURER TO SUPPLY:						
07	<input checked="" type="radio"/> CONTROL OIL ACCUMULATOR <input checked="" type="radio"/> CTRL.OIL FILTERS <input checked="" type="radio"/> DUAL [2X100%]						
08	<input checked="" type="radio"/> FULL 304/304L SS OIL SUPPLY HEADER PIPING, UP/DOWNSTR. FILTERS						
09	<input checked="" type="radio"/> OIL DRAIN HEADER PIPING						
10	<input checked="" type="radio"/> STAINLESS STEEL (304/304L) <input type="radio"/> CARBON ST.						
11	<input checked="" type="radio"/> SIGHT FLOW INDICATORS						
12	<input checked="" type="checkbox"/> <input type="checkbox"/> COUPLINGS AND GUARDS						
13	NOTE: SEE FIELDS ABOUT "SHAFT ENDS" ON DRIVEN & DRIVER DATA SHEETS		<input checked="" type="checkbox"/> KEYLESS HYDRAULIC FIT (IF APPLICABLE) <input type="checkbox"/> KEYED FIT <input type="checkbox"/> OTHER <input checked="" type="checkbox"/> VENDOR MOUNT HALF COUPLING <input checked="" type="checkbox"/> IDLING ADAPTER / SOLO PLATE <input checked="" type="checkbox"/> TYPE: <input checked="" type="checkbox"/> MODEL LUBRICATION REQUIREMENTS: <input checked="" type="radio"/> NON-LUBE <input type="radio"/> GREASE <input type="radio"/> CONT. OIL LUBE <input type="radio"/> OTHER SEPARATE SYSTEM: <input type="radio"/> LUBE OIL SYS. <input type="radio"/> JUST OIL FILTERS QUANTITY PER HUB: <input type="checkbox"/> kg/h OR <input type="checkbox"/> l/h END FLOAT, mm: SPACER WEIGHT, kg: HUB WEIGHT, kg:				
14	<input checked="" type="radio"/> API STD 671 DATA SHEETS: <input checked="" type="radio"/> TO BE PROVIDED <input type="checkbox"/> SEE ATTACHED						
15	COUPLING FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR						
16	COUPLING MANUFACTURER:						
17	CPLG GUARD FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR						
18	GUARD TYPE: <input checked="" type="radio"/> FULLY ENCLOSED <input type="radio"/> SEMI-OPEN						
19	GUARD MATERIALS & SAFETY <input checked="" type="radio"/> NON SPARKING <input type="radio"/> OTHER						
20	<input checked="" type="radio"/> GUARD TO FULLY RETAIN DAMAGED COUPLING IN CASE OF FAILURE						
21	COUPLING MAX O.D., mm:						
22	SPACER LENGTH, mm: (NOTE 5)						
23	<input checked="" type="checkbox"/> <input type="checkbox"/> MOUNTING PLATES						
24	BASEPLATES FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR		SOLEPLATES FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR				
25	<input checked="" type="radio"/> COMMON WITH: DRIVEN [IF FEASIBLE] <input checked="" type="radio"/> GEAR [IF APPLICABLE]		<input type="checkbox"/> THICKNESS, mm: <input type="radio"/> SUB-SOLE PLATES REQUIRED				
26	<input type="radio"/> COLUMN MOUNTING [FULLY RIGID SKID] <input checked="" type="radio"/> OTHER: (NOTE 1)		<input checked="" type="checkbox"/> LEVELING [SHOCK] BLOCKS REQUIRED				
27	<input checked="" type="radio"/> HORIZONTAL ADJUSTING SCREWS FOR EVERY COMPONENT OF TRAIN		<input checked="" type="checkbox"/> STAINLESS STEEL SHIM THICKNESS, mm				
28	<input checked="" type="radio"/> VERTICAL ADJUSTING SCREWS FOR EVERY COMPONENT OF TRAIN		DRIVER: GEAR: COMPRESSOR:				
29	<input checked="" type="radio"/> DRIP RIM <input checked="" type="radio"/> LEVELING PADS <input checked="" type="radio"/> NON-SKID DECK PLATES REQUIRED		<input type="radio"/> PRIMER FOR EPOXY GROUT REQUIRED TYPE:				
30	<input checked="" type="radio"/> SUB-SOLE PLATES REQUIRED [WHENEVER APPLICABLE]		<input checked="" type="radio"/> HOLD-DOWN BOLTS FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR				
31	<input checked="" type="checkbox"/> STAINLESS STEEL SHIM THICKNESS, mm:		<input checked="" type="radio"/> ANCHOR BOLTS FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR				
32	<input type="radio"/> PRIMER FOR EPOXY GROUT REQUIRED TYPE:		<input checked="" type="radio"/> SUITABLE FOR OPTICAL / LASER ALIGNMENT				
33	<input checked="" type="radio"/> BASE PLATE WILL BE INSTALLED ON CONCRETE FOUNDATION		<input type="checkbox"/> SINGLE SECTION <input type="checkbox"/> MULTI-SECTION				
34	<input type="radio"/> BASE PLATE WILL BE INSTALLED ON METALLIC STRUCTURE		<input checked="" type="radio"/> MACHINED MOUNTING PADS REQUIRED [WHENEVER APPLICABLE]				
35	<input checked="" type="checkbox"/> <input type="checkbox"/> GEAR UNITS:		<input checked="" type="checkbox"/> <input type="checkbox"/> CONTROLS AND INSTRUMENTATION:				
36	GEAR UNITS FURNISHED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TRAIN VENDOR		INSTRUMENTS & CONTROLS SHALL BE ACCORDING TO PURCHASER'S SPECS.				
37	SEE GEAR UNIT(S) DATA SHEETS No.:		SEE SPEC(S) & DATA SHEETS No.:				
38	<input checked="" type="checkbox"/> <input type="checkbox"/> PROTECTIVE DEVICES:						
39	PROTECTIVE DEVICES	EXHAUST RELIEF VALVE	EXTRACT. /INDUCT. RELIEF VALVES	SENTINEL WARNING VALVE	VACUUM BREAKER	NON-RETURN VALVES	OTHER THERMAL RELIEF VALVES
40							
41	MOUNTING LOCATION						
42	SET RELIEF PRESSURE, kgf/cm ² g						
43	CAPACITY, kg/h [OF STEAM]						
44	VALVE MANUFACTURER						
45	VALVE TYPE						
46	VALVE SIZE / # RATING						
47	FLANGE FACING	RF					
48	FURNISHED BY:	TURBINE MFR.	TURBINE MFR.	NOT REQUIRED	TURBINE MFR.	TURBINE MFR.	TURBINE MFR.
49	QUANTITY:						
50	NOTES:						
51							
52							
53							
54							


		DATA SHEET			No.		REV.		
								SHEET 7 of 22	
		TITLE: SPECIAL PURPOSE STEAM TURBINE							
01	<input checked="" type="checkbox"/> <input type="checkbox"/> TRIP AND THROTTLE VALVES								
02	ARR. TYPE: <input type="radio"/> TRIP <input type="radio"/> TRIP & THROTTLE <input type="radio"/> DUPLICATE T / T & T				<input type="checkbox"/> INLET STRAINERS				
03	PROVIDED BY: <input type="radio"/> PURCHASER <input checked="" type="radio"/> TURBINE VENDOR				PERM. STR. OPENING SIZE, [mm] [mesh] MATERIAL				
04	VALVE MANUFACTURER: MODEL:				TEMPORARY STARTUP STR., [mm] [mesh] MATERIAL				
05					<input checked="" type="checkbox"/> STRAINERS TO FOLLOW PETROBRAS STD.				
06	LOCATION:	<input checked="" type="checkbox"/> MAIN INLET		<input type="checkbox"/> INDUCTION		VALVE INTERNALS			
07	VALVE SIZE	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/> STEM MATERIAL: HARDNESS, Rc:			
08	# RATING	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/> STEM HARDENING BY: HARDNESS, Rc:			
09	FACING	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/> Cr PLATING <input type="checkbox"/> NITRIDING <input type="checkbox"/> SPRAY:			
10	ACTION	<input type="checkbox"/> PULL TO SEAT <input type="checkbox"/> PUSH TO SEAT		<input type="checkbox"/> PULL TO SEAT <input type="checkbox"/> PUSH TO SEAT		<input type="checkbox"/> PLUG MATERIAL: HARDNESS, Rc:			
11	RESET	<input type="checkbox"/> MANUAL <input type="checkbox"/> HYDRAULIC		<input type="checkbox"/> MANUAL <input type="checkbox"/> HYDRAULIC		<input type="checkbox"/> SEAT MATERIAL: HARDNESS, Rc:			
12	TRIP	<input checked="" type="checkbox"/> LOCAL MANUAL <input type="checkbox"/> REMOTE		<input type="checkbox"/> LOCAL MANUAL <input type="checkbox"/> REMOTE					
13	EXERCISER	<input checked="" type="checkbox"/> LOCAL MANUAL <input type="checkbox"/> REMOTE		<input type="checkbox"/> LOCAL MANUAL <input type="checkbox"/> REMOTE		<input type="checkbox"/> PACKING MATERIAL: LEAK OFF, kg/h:			
14		<input type="checkbox"/> FULLY OIL OPERATED		<input type="checkbox"/> FULLY OIL OPERATED		<input checked="" type="checkbox"/> VALVE SPRING SUPPORT PROVIDED BY <input checked="" type="radio"/> TURB. VENDOR <input type="radio"/> PURCHASER			
15	<input checked="" type="checkbox"/> <input type="checkbox"/> GOVERNOR-CONTROLLED VALVES								
16	LOCATION	MAIN INLET		INDUCTION		INDUCTION / EXTRACTION		INDUCTION / EXTRACTION	
17	TRIP POSITION (OPEN-CLOSED)								
18	NUMBER OF VALVES								
19	PROVIDED BY:	TURBINE MFR.		TURBINE MFR.		TURBINE MFR.		TURBINE MFR.	
20	VALVE MANUFACTURER								
21	CONNECTION SIZE								
22	# RATING								
23	FACING (RF, RTJ, OTHER)								
24	ACTION (CAM, BAR, OTHER)								
25	STEM MATERIAL								
26	STEM MATERIAL HARDNESS, Rc								
27	PACKING MATERIAL								
28	PACKING LEAK OFF, kg/h								
29									
30									
31									
32	<input checked="" type="checkbox"/> <input type="checkbox"/> TURNING DEVICES [TURBINE MFR. TO ADVISE]				<input checked="" type="checkbox"/> MISCELLANEOUS				
33	<input type="radio"/> TURNING DEVICE REQUIRED BY PETROBRAS, FOR THIS JOB <input type="radio"/> NOT REQUIRED				<input checked="" type="checkbox"/> STARTUP ASSISTANCE REQUIRED, SEE MATERIAL REQUISITION.				
34	<input type="checkbox"/> RECOMMENDED BY TURBINE AND / OR TRAIN VENDORS <input type="checkbox"/> UNNECESSARY				<input checked="" type="checkbox"/> VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION				
35	TURNING DEVICE FURNISHED BY: <input checked="" type="radio"/> TURBINE MFR. <input type="radio"/> TRAIN VENDOR				<input checked="" type="checkbox"/> VENDOR'S REVIEW & COMMENTS ON PURCHASER'S CONTROL SYSTEMS				
36	MOUNTED BY <input checked="" type="radio"/> TURBINE MFR. <input type="radio"/> TRAIN VENDOR <input type="radio"/> OTHERS				<input checked="" type="checkbox"/> VENDOR WITNESS INITIAL ALIGNMENT <input checked="" type="checkbox"/> FINAL (HOT) ALIGNMENT CHECK				
37	<input type="checkbox"/> TURN. DEV. MFR. MODEL				<input checked="" type="checkbox"/> WATER WASHING SYSTEM: <input type="radio"/> COMPLETE <input type="radio"/> PARTIAL <input checked="" type="checkbox"/> PROVISIONS ONLY				
38	<input type="checkbox"/> TYPE:				<input checked="" type="checkbox"/> STATIC CONDUCTING BRUSHES <input checked="" type="checkbox"/> SHAFT BRUSHES				
39	<input type="checkbox"/> NORMAL OPER. SPEED, rpm: MIN. FOR BEARINGS OIL FILM, rpm				<input checked="" type="checkbox"/> SHUTDOWN ACTIVATES EXHAUST VACUUM BREAKER [WHENEVER APPLICABLE]				
40	<input type="checkbox"/> MIN. FOR DRY SEALS LIFT, rpm				<input checked="" type="checkbox"/> OPTICAL ALIGNMENT FLATS REQUIRED ON TURBINE / GEAR / DRIVEN				
41	TURNING DEVICE OPERATION:				<input checked="" type="checkbox"/> EXTENT OF PROCESS PIPING BY VENDOR: WITHIN BATTERY LIMITS				
42	ENGAGEMENT <input checked="" type="radio"/> MANUAL, LOCAL <input type="radio"/> AUTOMATIC				<input checked="" type="checkbox"/> SHOP FIT-UP OF VENDOR'S PIPING				
43	<input checked="" type="radio"/> MANUAL CRANK <input checked="" type="radio"/> NO CLUTCH <input type="radio"/> WITH CLUTCH				<input checked="" type="checkbox"/> WELDING HARDNESS TESTING, AS REQUIRED				
44	INTERLOCKING AND PERMISSIVE STARTS WITH:				<input checked="" type="checkbox"/> AUXILIARY EQUIPMENT MOTORS				
45	<input checked="" type="radio"/> ZERO RPM DETECTION <input checked="" type="radio"/> DRIVEN EQUIP. BLOCKAGE								
46	<input checked="" type="radio"/> TRAIN LUBE OIL SYSTEM <input type="radio"/> JACK (OIL LIFT) SYSTEM								
47	<input checked="" type="radio"/> DRIVEN EQUIP. SEAL SYS. <input type="checkbox"/> OTHER:								
48	DISENGAGEMENT <input checked="" type="radio"/> MANUAL, LOCAL <input checked="" type="radio"/> AUTOMATIC				<input checked="" type="checkbox"/> SPECIAL TOOLS				
49	<input checked="" type="checkbox"/> DRIVER & GEARBOX DATA SHEETS: <input checked="" type="radio"/> TO BE PROVIDED <input type="checkbox"/> SEE ATTACHED				<input checked="" type="checkbox"/> ALL THOSE NOT COMMERCIALY AVAILABLE TOOLS, AS PER API STANDARDS.				
50	<input checked="" type="checkbox"/> DRIVER TYPE: <input checked="" type="radio"/> ELECTR. MOTOR <input type="radio"/> STEAM TURBINE <input type="radio"/> HYDR. MOTOR				<input checked="" type="checkbox"/> COUPLING RING AND PLUG GAUGE				
51	<input type="radio"/> PNEUM. MOTOR				<input checked="" type="checkbox"/> HYDRAULIC COUPLING MOUNTING / REMOVAL KIT				
52	LUBRICATION: <input type="checkbox"/> INDEPENDENT <input type="checkbox"/> TRAIN LOS <input type="checkbox"/> OTHER:				<input checked="" type="checkbox"/> FIELD BALANCING WEIGHTS AND THEIR MOUNTING / REMOVAL KIT				
53	OPERATOR STATION <input checked="" type="radio"/> LOCAL <input type="radio"/> REMOTE				<input checked="" type="checkbox"/> SPREADER BEAMS, AS NECESSARY				
54					<input checked="" type="checkbox"/> INSTRUMENTS & CONTROLS RECALIBRATION DEVICES				
					<input checked="" type="checkbox"/> PANELS / CONTROLLERS REPROGRAMMING HARDWARE / SOFTWARE				


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01	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> GOVERNOR AND TURBINE DUTY REQUIREMENTS									
02	GOVERNOR TYPE		NEMA CLASS <input checked="" type="checkbox"/> REQ'D <input checked="" type="checkbox"/> ACTUAL		SPEED RANGE, +/- % OF RATED		MANUFACTURER		MODEL	
03	<input type="radio"/> MECHANIC / HYDRAULIC									
04	<input checked="" type="radio"/> ELECTRONIC, WITH DIGITAL PROCESSOR		D							
05	PROCESSOR: <input type="radio"/> SIMPLEX <input checked="" type="radio"/> MULTIPROCESSOR									
06	ACTUATOR: <input type="checkbox"/> PNEUMATIC <input type="checkbox"/> HYDRAULIC MFR/MODEL:				<input checked="" type="radio"/> GOVERNOR SUPPLIED BY:		<input checked="" type="radio"/> TURBINE MFR.		<input type="radio"/> TRAIN VENDOR	
07	SPEED ADJUSTMENT: <input checked="" type="radio"/> MANUAL <input checked="" type="radio"/> MANUAL REMOTE <input checked="" type="radio"/> AUTOMATIC				<input checked="" type="radio"/> MOUNTED BY:		<input checked="" type="radio"/> TURBINE MFR.		<input type="radio"/> TRAIN VENDOR	
08	<input checked="" type="radio"/> REMOTE TRIP SIGNAL <input type="checkbox"/>									
09	TURBINE TYPE AND DUTY									
10	<input type="radio"/> SINGLE VALVE, SINGLE STAGE		<input type="checkbox"/> SINGLE VALVE, MULTISTAGE		<input type="checkbox"/> DOUBLE AUTOMATIC EXTRACTION					
11	<input type="radio"/> MULTI VALVE, MULTISTAGE		<input type="checkbox"/> SINGLE AUTO EXTRACTION		<input type="checkbox"/> SINGLE AUTOMATIC EXTRACTION / INDUCTION					
12	<input type="radio"/> OTHER				<input type="checkbox"/> DOUBLE AUTOMATIC EXTRACTION / INDUCTION					
13	DRIVEN EQUIPMENT TYPE									
14	<input type="radio"/> AXIAL / CENTRIFUGAL COMPRESSOR					<input type="radio"/> SYNCHRONOUS GENERATOR				
15	<input type="radio"/> CENTRIFUGAL PUMP					<input type="radio"/> INDUCTION GENERATOR				
16	<input type="radio"/> FAN					<input type="radio"/> OTHER				
17	MECHANICAL DRIVE SERVICE REQUIREMENTS					GENERATOR DRIVE SERVICE REQUIREMENTS				
18	<input checked="" type="radio"/> SPEED CONTROL BY					<input type="radio"/> DROOP CONTROL				
19	PROCESS VARIABLE		<input type="radio"/> PRESSURE <input checked="" type="radio"/> FLOW		<input type="radio"/> FREQUENCY CONTROL					
20	EXTRACTION		<input type="radio"/> PRESSURE <input type="radio"/> FLOW		<input type="radio"/> LOAD CONTROL					
21	INDUCTION		<input type="radio"/> PRESSURE <input type="radio"/> FLOW		<input type="radio"/> kW CONTROL					
22	TURBINE INLET		<input type="radio"/> PRESSURE <input type="radio"/> FLOW		<input type="radio"/> kW IMPORT / EXPORT CONTROL					
23	TURBINE EXHAUST		<input type="radio"/> PRESSURE <input type="radio"/> FLOW		<input type="radio"/> LOAD SHEDDING					
24						<input type="radio"/> AUTO SYNCHRONIZATION				
25	<input type="radio"/> EXTRACTION EXTERNAL CONTROL BY: <input type="radio"/> PRESSURE <input type="radio"/> FLOW					<input type="radio"/> AUTO VOLTAGE REGULATION				
26	<input type="radio"/> INDUCTION EXTERNAL CONTROL BY <input type="radio"/> PRESSURE <input type="radio"/> FLOW					<input type="radio"/> TURBINE INLET PRESSURE LIMITING				
27						<input type="radio"/> INLET PRESSURE LIMITER				
28	<input checked="" type="checkbox"/> MINIMUM INPUT / OUTPUT REQUIREMENTS (BIDDER/VENDOR TO INCLUDE ADDITIONAL ITEMS, AS NECESSARY)									
29	DISCRETE INPUTS					DISCRETE OUTPUTS				
30	<input checked="" type="radio"/> START OR RESET					<input type="radio"/> INLET PRESSURE LIMITER				
31	<input checked="" type="radio"/> NORMAL STOP					<input checked="" type="radio"/> COMMON SHUTDOWN				
32	<input checked="" type="radio"/> EMERGENCY TRIP					<input checked="" type="radio"/> COMMON ALARM				
33	<input checked="" type="radio"/> INCREASE SPEED					<input checked="" type="radio"/> OVERSPEED TRIP RPM				
34	<input checked="" type="radio"/> DECREASE SPEED					<input checked="" type="radio"/> REMOTE SPEED SET POINT ENABLED				
35	<input checked="" type="radio"/> ENABLE / DISABLE REMOTE SPEED SET POINT					<input type="radio"/> PRESSURE CONTROL ENABLED				
36	<input checked="" type="radio"/> RAMP TO MINIMUM CONTINUOUS SPEED					<input type="radio"/> FLOW CONTROL ENABLED				
37	<input checked="" type="radio"/> OVERSPEED TEST ENABLE					<input type="radio"/> EXTRACTION CONTROL ENABLED				
38	<input type="radio"/> ENABLE PRESSURE CONTROL					<input type="radio"/> INDUCTION CONTROL ENABLED				
39	<input type="radio"/> ENABLE EXTRACTION CONTROL					<input checked="" type="radio"/> SPEED PICKUP ALARM				
40	<input checked="" type="radio"/> REMOTE ALARM CLEAR / ACKNOWLEDGEMENT					<input type="radio"/> OTHER				
41	<input type="radio"/> ENABLE AUTO SYNCHRONIZATION									
42	<input type="radio"/> CASCADE INCREASE / DECREASE									
43	<input type="radio"/> OTHER									
44	ANALOG INPUTS (4 - 20 mA)					ANALOG OUTPUTS (4 - 20 mA)				
45	<input checked="" type="radio"/> REMOTE SET POINT		<input type="radio"/> PROCESS PRESSURE		<input checked="" type="radio"/> SPEED		<input checked="" type="radio"/> SPEED SET POINT			
46	<input type="radio"/> EXTRACTION		<input type="radio"/> PRESSURE <input type="radio"/> FLOW		<input checked="" type="radio"/> REMOTE SPEED SET POINT					
47	<input type="radio"/> kW IND. LOAD		<input type="radio"/> kW IMPORT / EXPORT		<input type="radio"/> EXTRACTION PRESSURE SET POINT		<input type="radio"/> EXTRACTION PRESSURE			
48	<input type="radio"/> OTHER				<input type="radio"/> PROCESS PRESSURE		<input checked="" type="radio"/> ACTUATOR POSITION			
49					<input type="radio"/> kW		<input type="radio"/> kW IMPORT / EXPORT			
50	NOTES:									
51										
52										
53										
54										

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01	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> SPEED GOVERNOR & OVERSPEED PROTECTING DEVICES					
02	<u>GOVERNOR INSTALLATION REQUIREMENTS</u>					
03	LOCATION	<input type="radio"/> LOCALLY MOUNTED (AT TURBINE)	MOUNTING	<input type="checkbox"/> FLUSH MOUNT IN PANEL	<input type="checkbox"/> SURFACE MOUNT	
04		<input type="radio"/> TRAIN LOCAL CONTROL PANEL (AT SITE, NEAR TRAIN)		<input type="checkbox"/> VERTICAL RACK	<input type="checkbox"/>	
05		<input type="radio"/> TRAIN REMOTE CONTROL PANEL (IN CONTROL ROOM)		<input type="checkbox"/>	<input type="checkbox"/>	
06		<input type="checkbox"/> OTHER:		<input type="checkbox"/>	<input type="checkbox"/>	
07	ENCLOSURE	<input type="radio"/> GENERAL PURPOSE	<u>POWER SOURCE</u>	<u>SINGLE</u>	<u>DUAL</u>	
08		<input type="radio"/> AS REQUIRED BY AREA CLASSIFICATION (SEE SITE DATA)	120 V AC	<input type="radio"/>	<input type="radio"/>	
09		<input type="checkbox"/> NEMA 4 <input type="radio"/> ISA 512.4 DRY AIR PURGE TYPE: Z	220 V AC	<input type="radio"/>	<input type="radio"/>	
10		<input type="checkbox"/> NEMA 4X <input type="checkbox"/> IP 65 <input type="checkbox"/> EXPLOSION PROOF	125 V DC	<input type="radio"/>	<input type="radio"/>	
11		<input type="checkbox"/> OTHER:	24 V DC	<input type="radio"/>	<input type="radio"/>	
12	<u>GOVERNOR CONTROL PANEL:</u>			<u>OUTPUTS FROM PANEL TO GOVERNOR</u>		<u>INPUTS FROM PANEL TO GOVERNOR</u>
13		<input checked="" type="checkbox"/> REQUIRED BY PETROBRAS, WHENEVER APPLICABLE		<input checked="" type="checkbox"/> START		<input checked="" type="checkbox"/> COMMON ALARM TRIP
14	LOCATION	<input type="radio"/> TRAIN LOCAL CONTROL PANEL (AT SITE, NEAR TRAIN)		<input checked="" type="checkbox"/> TRIP		<input checked="" type="checkbox"/> TRIP LAMP
15		<input type="radio"/> TRAIN REMOTE CONTROL PANEL (IN CONTROL ROOM)		<input checked="" type="checkbox"/> INCREASE		<input checked="" type="checkbox"/> REMOTE SET POINT ENABLE LAMP
16		<input type="radio"/> OTHER:		<input checked="" type="checkbox"/> DECREASE		<input checked="" type="checkbox"/> SPEED SET POINT METER
17	ENCLOSURE	<input type="radio"/> GENERAL PURPOSE		<input checked="" type="checkbox"/> OVERSPEED TEST		<input type="checkbox"/> OTHER:
18		<input type="radio"/> AS REQUIRED BY AREA CLASSIFICATION (SEE SITE DATA)		<input checked="" type="checkbox"/> RAMP TO MINIMUM CONTINUOUS		<input type="checkbox"/>
19		<input type="checkbox"/> NEMA 4 <input type="radio"/> ISA 512.4 DRY AIR PURGE TYPE::		<input checked="" type="checkbox"/> REMOTE SET POINT ENABLE / DISABLE		<input type="checkbox"/>
20		<input type="checkbox"/> NEMA 4X <input type="checkbox"/> IP 65 <input type="checkbox"/> EXPLOSION PROOF		<input checked="" type="checkbox"/> RESET		<input type="checkbox"/>
21		<input type="checkbox"/> OTHER:		<input type="checkbox"/> OTHER:		<input type="checkbox"/>
22	<u>MISCELLANEOUS GOVERNOR DETAILS</u>					
23	GOVERNOR ACTION ON LOSS OF REMOTE SIGNAL OR SECONDARY POWER			<input checked="" type="checkbox"/> LOCKS ON LAST VALUE	<input type="radio"/> LOOP MATE	<input type="checkbox"/>
24				<input type="radio"/> GOES TO MINIMUM CONTINUOUS SPEED		
25				<input type="radio"/> GOES TO MAXIMUM CONTINUOUS SPEED		
26	EXTERNAL INTERFACE DEVICE TYPE: <input type="radio"/> PRINTER FORMAT:			<input type="radio"/> GRAPHIC DISPLAY		
27				<input checked="" type="checkbox"/> TABULAR DATA		
28				<input checked="" type="checkbox"/> TRENDING (REAL TIME)		
29				<input checked="" type="checkbox"/> HISTORICAL ARCHIVING		
30	<input type="radio"/> DCS MANUFACTURER:					
31	<input type="radio"/> DCS MODEL:					
32	<input type="radio"/> DATA TRANSMISSION: <input checked="" type="checkbox"/> SERIAL DATA LINK			<input type="checkbox"/> PROTOCOL:		
33				<input type="checkbox"/> BAUD RATE: <input type="checkbox"/> 300 <input type="checkbox"/> 1 200 <input type="checkbox"/> 2 400		
34				<input type="checkbox"/> 4 800 <input type="checkbox"/> 9 600 <input type="checkbox"/> 19 200		
35						
36	<input type="checkbox"/> MANUFACTURER: MODEL:			<input checked="" type="checkbox"/> INSTALLATION:	<input type="radio"/> DUAL	<input checked="" type="checkbox"/> TRIPLE <input type="radio"/> INSTALLED SPARE
37	<input type="checkbox"/> SPEED PICK UPS <input checked="" type="checkbox"/> QUANTITY REQUIRED: 3			<input checked="" type="checkbox"/> NUMBER OF TEETH IN SPEED SENSING SURFACE:	60	T. WHEEL
38						
39	<u>ACTUATORS</u> <input checked="" type="checkbox"/> SUPPLIED BY: <input checked="" type="checkbox"/> TURBINE VENDOR / MFR.			<input type="checkbox"/> TYPE:	<input type="checkbox"/> HYDRAULIC	<input type="checkbox"/> PNEUMATIC
40	<input type="checkbox"/> MANUFACTURER:				<input type="checkbox"/> SINGLE COIL	<input type="checkbox"/> MULTI COIL
41	<input type="checkbox"/> MODEL:				<input type="checkbox"/> OTHER:	
42	<u>TACHOMETERS</u>			<u>ELECTRONIC OVERSPEED SHUTDOWN SYSTEMS</u>		
43	LOCATION	<input type="radio"/> LOCALLY MOUNTED (AT TURBINE)		LOCATION	<input type="radio"/> TRAIN LOCAL CONTROL PANEL (AT SITE, NEAR TRAIN)	
44		<input checked="" type="checkbox"/> TRAIN LOCAL CONTROL PANEL (AT SITE, NEAR TRAIN)			<input checked="" type="checkbox"/> TRAIN REMOTE CONTROL PANEL (IN CONTROL ROOM)	
45		<input type="radio"/> TRAIN REMOTE CONTROL PANEL (IN CONTROL ROOM)				
46	<input checked="" type="checkbox"/> SUPPLIED BY:	<input checked="" type="checkbox"/> TURBINE MFR.	<input checked="" type="checkbox"/> OTHERS	<input checked="" type="checkbox"/> SUPPLIED BY:	<input checked="" type="checkbox"/> TURBINE MFR.	<input type="radio"/> OTHERS
47	<input type="checkbox"/> MANUFACTURER:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> MANUFACTURER:	<input type="checkbox"/>	<input type="checkbox"/>
48		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> MODEL:	<input type="checkbox"/>	<input type="checkbox"/>
49	<input type="checkbox"/> MODEL:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> NUMBER OF TEETH IN SPEED SENSING SURFACE:	60	T. WHEEL
50	<input type="checkbox"/> SPEED PICK UPS	<input checked="" type="checkbox"/> QUANTITY REQUIRED:		<input type="checkbox"/> SPEED PICK UPS	<input checked="" type="checkbox"/> QUANTITY REQUIRED:	3 + 1
51	<u>MECHANICAL OVERSPEED SHUTDOWN SYSTEM</u>			<input type="checkbox"/> SET POINT, rpm: <input checked="" type="checkbox"/> VOTING LOGIC: 2 out of 3		
52	<input type="radio"/> REQUIRED BY PETROBRAS, FOR THIS JOB <input checked="" type="checkbox"/> NOT REQUIRED			<input type="checkbox"/> SOLENOIDS SHALL: <input type="checkbox"/> DE-ENERGIZE TO TRIP <input type="checkbox"/> ENERGIZE TO TRIP		
53	<input type="checkbox"/> RECOMMENDED BY TURBINE / TRAIN VENDORS <input type="checkbox"/> UNNECESSARY			<input type="checkbox"/> CONTACTS SHALL BE: <input type="checkbox"/> NORMALLY OPEN <input type="checkbox"/> NORM. CLOSED		
54	<input type="checkbox"/> TYPE: <input type="checkbox"/> SET POINT, rpm			<input type="checkbox"/> VOLTAGE LEVELS:		


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01	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> GLAND SEALING AND VACUUM SYSTEM								
02	SYSTEM PER: <input type="checkbox"/> APPENDIX G-1 <input type="checkbox"/> APPENDIX G-2				<input checked="" type="checkbox"/> VACUUM SYSTEM FURNISHED BY: <input checked="" type="checkbox"/> TURBINE MFR. <input type="checkbox"/> OTHERS <input checked="" type="checkbox"/> SHIPPED LOOSE <input type="checkbox"/> SKID MOUNTED <input type="checkbox"/> <input type="checkbox"/> OTHER:				
03	<input type="checkbox"/> OTHER:								
04	<input type="checkbox"/> AVAILABLE HEADER PRESSURE, kgf/cm ² g				<input type="checkbox"/> GLAND CONDENSER SPECIFICATION:				
05	<input type="checkbox"/> AVAILABLE HEADER TEMPERATURE, °C				<input checked="" type="checkbox"/> STEAM EJECTOR <input type="checkbox"/> STEAM PRESSURE, kgf/cm ² g				
06	<input type="checkbox"/> AVAILABLE SEAL STEAM SUPPLY PRESSURE, kgf/cm ² g				<input type="checkbox"/> STEAM FLOW, kg/h				
07	<input type="checkbox"/> AVAILABLE SEAL STEAM SUPPLY TEMPERATURE, °C				<input type="checkbox"/> VACUUM PUMP SPECIFICATION:				
08	<input type="checkbox"/> SEAL STEAM PRESSURE, kgf/cm ² g <input type="checkbox"/> STEAM FLOW, kg/h				<input type="checkbox"/> CONDENSATE RECEIVER <input type="checkbox"/> LOOP SEAL HEIGHT, m:				
09	<input type="checkbox"/> SEALING STEAM RELIEF VALVE SET PRESSURE, kgf/cm ² g								
10	<input type="checkbox"/> VALVE FURNISHED BY: <input type="checkbox"/> TURBINE MFR.								
11	<input type="checkbox"/> FLOW ADJUSTING VALVES, TYPE:								
12	<input type="checkbox"/> VALVES FURNISHED BY: <input type="checkbox"/> TURBINE MFR.								
13	<input type="checkbox"/> <input type="checkbox"/> SURFACE CONDENSER								
14	DESIGN SPECIFICATIONS:				CONSTRUCTION MATERIALS				
15	<input checked="" type="checkbox"/> ASME BPVC SEC VIII <input checked="" type="checkbox"/> TEMA B <input checked="" type="checkbox"/> HEI / 9				<input type="checkbox"/> SHELL <input type="checkbox"/> <input type="checkbox"/>				
16	<input type="checkbox"/> OTHER:				<input type="checkbox"/> COOLING SHROUDS <input type="checkbox"/> <input type="checkbox"/>				
17	APPLICATION: STEAM TURBINE EXHAUST				<input type="checkbox"/> TUBE SUPPORT PLATES <input type="checkbox"/> <input type="checkbox"/>				
18	MANUFACTURER MODEL:				<input type="checkbox"/> TUBE SHEETS <input type="checkbox"/> <input type="checkbox"/>				
19	PERFORMANCE DATA:				<input type="checkbox"/> TUBE SHEETS LINING <input type="checkbox"/> <input type="checkbox"/>				
20	INLET PRESSURE, mm Hg abs		STEAM FLOW, kg/h		<input checked="" type="checkbox"/> TUBES <input checked="" type="checkbox"/> ADMIRALTY		<input type="checkbox"/>		
21	HEAT REJECTED, kcal/h		CIRC. WATER FLOW, m ³ /h		<input type="checkbox"/> WATER BOXES <input type="checkbox"/>		<input type="checkbox"/>		
22	WATER INLET TEMP., °C		WATER OUTLET TEMP., °C		<input type="checkbox"/> WATER BOXES COVERS <input type="checkbox"/>		<input type="checkbox"/>		
23	WATER Δp, [m] [kgf/cm ²]				<input type="checkbox"/> HOT WELL <input type="checkbox"/>		<input type="checkbox"/>		
24	DESIGN DATA:				<input type="checkbox"/>				
25	SURFACE AREA, m ² TOTAL:		EFFECTIVE:		<input checked="" type="checkbox"/> EXP. JOINTS REQUIRED: <input checked="" type="checkbox"/> STEAM INLET NOZZLE				
26	No. OF WATER PASSES		No. OF TUBES O.D., in. 3/4		<input checked="" type="checkbox"/> SHELL EXPANSION DEVICE <input checked="" type="checkbox"/> DIVIDED WATER BOXES <input checked="" type="checkbox"/> DAVITS INCLUDED				
27			TUBE LENGTH, m		<input checked="" type="checkbox"/> SACRIF. ANODES INCLUDED <input checked="" type="checkbox"/> EPOXY COATING				
28	DESIGN PRESSURE, kgf/cm ²		SHELL: TUBES:		CONDENSATE REMOVAL SYSTEM				
29	TEST PRESSURE, kgf/cm ²		SHELL: TUBES:		<input checked="" type="checkbox"/> TWO CENTRIFUGAL, OH ₂ , ISO 13709 PUMPS, C6 MATERIALS				
30	DESIGN TEMPERATURE, °C		SHELL: TUBES:		<input checked="" type="checkbox"/> MOTOR DRIVEN PUMP <input checked="" type="checkbox"/> TURBINE DRIVEN PUMP				
31	HOT WELL SUPPLY CAPACITY, minutes MIN:		MAX:		<input checked="" type="checkbox"/> STEAM JET AIR PUMP SYS: <input checked="" type="checkbox"/> PRIMARY EJECTOR <input checked="" type="checkbox"/> SECONDARY EJECTOR				
32	CONNECTIONS (diameters in inches)				<input checked="" type="checkbox"/> INTER/AFTER CONDENSERS				
33	STEAM INLET		WATER IN/OUT		CONDENS. OUT				
34	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> PAINTING								
35	<input checked="" type="checkbox"/> MANUFACTURER'S STANDARD <input checked="" type="checkbox"/> TO BE SUBMITTED FOR APPROVAL				<input checked="" type="checkbox"/> FINISH COLOR: SEE GENERAL NOTES				
36	<input checked="" type="checkbox"/> <input type="checkbox"/> NOISE ATTENUATION DEVICES				<input checked="" type="checkbox"/> PREPARATION FOR SHIPMENT				
37	ACOUSTIC ENCLOSURE: [BY VENDOR, IF NECESSARY] <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO				<input type="checkbox"/> DOMESTIC <input checked="" type="checkbox"/> EXPORT <input checked="" type="checkbox"/> EXPORT BOXING <input checked="" type="checkbox"/> WATERPROOF				
38	ACOUSTIC LAGGING / BLANKETS [WHEN APPLICABLE] <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO				<input checked="" type="checkbox"/> OUTDOOR STORAGE FOR: <input type="checkbox"/> 6 <input checked="" type="checkbox"/> 12 <input type="checkbox"/> MORE THAN 12 MONTHS				
39	<input checked="" type="checkbox"/> THERMAL INSULATION				<input checked="" type="checkbox"/> SPARE ROTOR ASSEMBLY PACKAGED FOR:				
40	<input checked="" type="checkbox"/> REMOVABLE, REUSABLE BLANKETS				<input type="checkbox"/> HORIZONTAL STORAGE <input type="checkbox"/> VERTICAL STORAGE				
41	<input checked="" type="checkbox"/> FOR PERSONNEL PROTECTION ON THOSE PARTS @ OP. TEMP. OF 60 °C OR HIGHER				<input checked="" type="checkbox"/> BOTH HORIZONTAL AND VERTICAL STORAGE <input checked="" type="checkbox"/> AS PER API RP 687				
42	<input checked="" type="checkbox"/> AS REQUIRED BY PROCESS CONDITIONS				<input checked="" type="checkbox"/> WRAPPED, PACKED IN STEEL CONTAINER, SEALED AND N ₂ PRESSURIZED WITH				
43	<input checked="" type="checkbox"/> SAFETY DATA SHEETS FOR ASBESTOS-FREE MATERIALS [MANDATORY]				MANOMETER, BLOCK AND SAFETY VALVES, VENT AND FILLING CONNECTIONS.				
44	<input checked="" type="checkbox"/> SPACE REQUIREMENTS, mm				<input checked="" type="checkbox"/> WEIGHTS, kg				
45	DIMENSIONS:		L	W	H	TURBINE, COMPLETE SET:			
46	<input type="checkbox"/> COMPLETE UNIT:					TURBINE: GEAR: DRIVEN: BASE:			
47	<input type="checkbox"/> LUBE OIL CONSOLE:					ROTORS: TURBINE: DRIVEN: GEAR:			
48	<input type="checkbox"/> CONTROL OIL CONSOLE:					TURBINE UPPER CASE: CONTROL OIL CONSOLE:			
49	<input type="checkbox"/> CONDENSATE REMOVAL SYSTEM:					LUBE OIL CONSOLE: TRIP AND/OR T & T VALVES:			
50	<input type="checkbox"/> GLAND SEALING CONSOLE:					CONDENSATE REMOVAL SYSTEM: GLAND SEALING CONSOLE:			
51	<input type="checkbox"/> WATER INJECTION SYSTEM CONSOLE:					MAX. FOR MAINTENANCE IDENTIFY:			
52	<input type="checkbox"/> LOCAL PANEL / GAUGE BOARD:					TOTAL SHIPPING WEIGHT: PACKAGE GRAVITY CENTER:			
53									
54									

		DATA SHEET		No.		REV.	
		TITLE: SPECIAL PURPOSE STEAM TURBINE				SHEET 11 of 22	
01	<input checked="" type="checkbox"/> SHOP INSPECTIONS AND FACTORY ACCEPTANCE TESTS [FAT1]						
02	INSPECTIONS & TESTS:		WITNESSED	OBSERVED	INSPECTIONS & TESTS:		WITNESSED OBSERVED
03	SHOP INSPECTION		<input checked="" type="checkbox"/>	<input type="checkbox"/>	RESIDUAL ELECTRICAL / MECH. RUNOUT [ROTOR 1]		<input checked="" type="checkbox"/> <input type="checkbox"/>
04	QC PROGRAM REVIEW [AT PIM & BEFORE TESTS]		<input checked="" type="checkbox"/>	<input type="checkbox"/>	FIT IN TEST, FIRST ROTOR [WITH REPORT]		<input checked="" type="checkbox"/> <input type="checkbox"/>
05	FINAL ASSEMBLY RECORDS REQUIRED, BOTH ROTORS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	MECHANICAL RUN TEST, FIRST ROTOR [MRT1]		<input checked="" type="checkbox"/> <input type="checkbox"/>
06	SPECIAL REQUIREMENTS FOR: (NOTE 3)		MP	PT	RT	UT	
07	TRIP AND/OR TRIP & THROTTLE VALVE		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
08	STEAM CHEST		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
09	CASING		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
10	PIPING		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
11	ROTOR SHAFT & DISCS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
12	ROTOR BLADES		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
13	STATOR VANES / DIAPHRAGMS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
14	BEARINGS / BEARING PADS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/>
15	HEAT STABILITY		<input checked="" type="checkbox"/>	<input type="checkbox"/>	MECHANICAL RUN TEST, SECOND ROTOR [MRT2]		<input checked="" type="checkbox"/> <input type="checkbox"/>
16	CLEANLINESS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	VARY LUBE PRESSURES & TEMPERATURES		<input checked="" type="checkbox"/> <input type="checkbox"/>
17	HARDNESS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	UNBALANCE RESPONSE TEST [URT2] (NOTE 6)		<input checked="" type="checkbox"/> <input type="checkbox"/>
18	HYDROSTATIC TESTS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	POLAR & BODÉ PLOTS OF VIBRATION DATA [ALL TESTS]		<input checked="" type="checkbox"/> <input type="checkbox"/>
19	BLADE SHAKER (STATIC)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	RECORD VIBRATION & OTHER DATA [ALL TESTS]		<input checked="" type="checkbox"/> <input type="checkbox"/>
20	ROTOR BALANCE		<input checked="" type="checkbox"/>	STANDARD / LOW SPEED		<input checked="" type="checkbox"/>	<input type="checkbox"/>
21			<input checked="" type="checkbox"/>	HIGH SPEED		<input checked="" type="checkbox"/>	<input type="checkbox"/>
22			<input checked="" type="checkbox"/>	LS PRIOR TO HS		<input checked="" type="checkbox"/>	<input type="checkbox"/>
23			<input checked="" type="checkbox"/>	LS RESIDUAL UNBALANCE CHECK		<input checked="" type="checkbox"/>	<input type="checkbox"/>
24	ROTOR No. 1 OVERSPEED TEST		<input checked="" type="checkbox"/>	<input type="checkbox"/>	COMPLETE UNIT TEST [STRING TEST]		<input type="checkbox"/> <input type="checkbox"/>
25	ROTOR No. 2 OVERSPEED TEST		<input checked="" type="checkbox"/>	<input type="checkbox"/>	SOUND LEVEL TEST [FOR REFERENCE] (NOTE 7)		<input checked="" type="checkbox"/> <input type="checkbox"/>
26	FINAL SURFACE INSPECTION		<input checked="" type="checkbox"/>	<input type="checkbox"/>	TORSIONAL VIBRATION MEASUREMENT		<input type="checkbox"/> <input type="checkbox"/>
27	CRATING INSPECTION		<input checked="" type="checkbox"/>	<input type="checkbox"/>			
28	CASING JOINT LEAK TEST PRESSURE		<input type="checkbox"/> BEFORE MRT2 <input checked="" type="checkbox"/> AFTER MRT2	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
29							
30	AUXILIARY EQUIPMENT TESTS & INSPECTIONS:		DYNAMIC (RUNNING) TESTS TO BE PERFORMED WITH:				
31	TRIP AND/OR TRIP & THROTTLE VALVE		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> CONTRACT COUPLING <input checked="" type="checkbox"/> IDLING ADAPTOR (IF NECESSARY)		
32	GLAND SEALING SYSTEM		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> CONTRACT PROBES <input type="checkbox"/> SHOP PROBES		
33	GLAND VACUUM SYSTEM		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> CONTRACT LUBE OIL SYSTEM <input type="checkbox"/> SHOP LUBE OIL SYSTEM		
34	RELIEF VALVES		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> CONTRACT CTRL OIL SYSTEM <input type="checkbox"/> SHOP CONTROL OIL SYSTEM		
35	CONDENSATE REMOVAL SYSTEM, INCLUDING PUMPS		<input type="checkbox"/>	<input type="checkbox"/>			
36	LUBE OIL SYSTEM		<input checked="" type="checkbox"/>	<input type="checkbox"/>			
37	CONTROL OIL SYSTEM [WHEN APPLICABLE]		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> FOR EVERY TEST, ALL VIBRATION DATA SHALL BE MEASURED		
38	HYDRAULIC COUPLING HUB INSP. [WHEN APPLICABLE]		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> FOR EVERY TEST, THE WHOLE TEST SHALL BE FULLY RECORDED		
39	COUPLING TO SHAFT FIT [ISO 10441]		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> ALL RECORDED DATA TO BE GIVEN TO PURCHASER		
40	TURNING GEAR [WHEN APPLICABLE]		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> CERTIFIED COPIES / PLOTS OF ALL TESTS DATA		
41	LIFT [JACK OIL] SYSTEM [WHEN APPLICABLE]		<input checked="" type="checkbox"/>	<input type="checkbox"/>			
42	MECH. OVERSPEED TRIP DEVICE [3 VALID READINGS]		<input type="checkbox"/>	<input type="checkbox"/>			
43	ELEC. OVERSPEED TRIP DEVICE [3 VALID READINGS]		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> ALL EQUIPMENT TO BE SUBMITTED TO ____ h ENDURANCE TEST		
44	MANUAL TRIP & MANUAL EXERCISER TESTS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> VENDOR TO SUBMIT TEST PROCEDURES & MAJOR / MINOR FAULTS LISTS		
45	GOVERNOR RESPONSE / REGULATION / STABILITY TESTS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> MTBF FOR MAJOR FAULTS, h: ____ <input type="checkbox"/> FOR MINOR FAULTS, h		
46	SPARE EQUIPMENT / PARTS TESTS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> FIELD PERFORMANCE TEST REQUIRED <input type="checkbox"/> ASME PTC 6 <input type="checkbox"/> AS AGREED		
47	NOTES:						
48							
49							
50							
51							
52							
53							
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 PETROBRAS		DATA SHEET		No.		REV.		
							SHEET 12 of 22	
		TITLE: SPECIAL PURPOSE STEAM TURBINE						
01	⊗ INSTRUMENTATION SUPPLIED WITH THE TURBINE TRAIN (NOTES 8 AND 10)							
02	PRESSURE & DIFFERENTIAL PRESSURE	LOCAL INDICATION	TRANSMITTER	TRANSMITTER WITH LOCAL	HMI & LOCAL CTRL. PANEL	REMOTE CTRL. PANEL	CONTROL ROOM (DCS)	
03	CONTROL, LUBE, OIL PUMP DISCHARGE	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
04	DOWNSTREAM OF CONTROL, LUBE, OIL FILTERS	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
05	CONTROL, LUBE, OIL DELIVERY MANIFOLDS	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
06	OIL COOLER INLET/OUTLET [OIL AND WATER SIDES]	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
07	CONTROL, LUBE, OIL FILTERS ΔP	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
08	JOURNAL BEARING INLET	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
09	THRUST BEARING INLET	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10	STEAM INLET / INDUCTION FILTER / STRAINER AND / OR ΔP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
11	STEAM CONDENSER [STEAM SIDE] INLET [IF APPLICABLE]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
12	STEAM INLET / INDUCTION / EXTRACTION / EXHAUST	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
13	STEAM CHEST	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
14	FIRST STAGE	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
15	SEALING STEAM AND GLAND CONDENSER	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
16	WATER INJECTION SYSTEM, EACH BRANCH [IF APPLICABLE]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
17	SURFACE CONDENSER CIRCULATION WATER, INLET / OUTLET	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
18		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
19		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
20	TEMPERATURE	LOCAL INDICATION	TRANSMITTER	TRANSMITTER WITH LOCAL	HMI & LOCAL CTRL. PANEL	REMOTE CTRL. PANEL	CONTROL ROOM (DCS)	
21	ENCLOSURE INTERNAL TEMPERATURE [IF APPLICABLE]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
22	STEAM DESUPERHEATER OUTLET [IF APPLICABLE]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
23	JOURNAL AND THRUST BEARINGS OIL OUTLET	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
24	OIL COOLER OUTLET [OIL AND WATER SIDES]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
25	STEAM INLET / INDUCTION / EXTRACTION / EXHAUST	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
26	STEAM CHEST	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
27	FIRST STAGE	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
28	STEAM CONDENSER [CONDENSATE & WATER SIDE] OUTLET [IF APP.]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
29	CONTROL, LUBE, OIL RESERVOIRS	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
30	TILTING SHOE THRUST BEARINGS / RADIAL BEARINGS [WHOLE TRAIN]	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
31		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
32	LEVEL	LOCAL INDICATION	TRANSMITTER	TRANSMITTER WITH LOCAL	HMI & LOCAL CTRL. PANEL	REMOTE CTRL. PANEL	CONTROL ROOM (DCS)	
33	CONTROL, LUBE, OIL RESERVOIRS	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
34	RUNDOWN / OVERHEAD OIL TANK	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
35	GLAND CONDENSER	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
36	STEAM CONDENSER HOT WELL [IF APPLICABLE]	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
37								
38								
39	SIGHT FLOW INDICATORS	ADDITIONAL INFORMATION			HMI & LOCAL CTRL. PANEL	REMOTE CTRL. PANEL	CONTROL ROOM (DCS)	
40	⊗ LUBE OIL OUTLET FROM TURBINE BEARINGS	AUXILIARY LUBE OIL PUMP RUNNING			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
41	○ LUBE OIL OUTLET FROM DRIVEN & GEAR BEARINGS	AUXILIARY CONTROL OIL PUMP RUNNING			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
42	○ LUBE OIL OUTLET FROM COUPLINGS				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
43	⊗ LUBE OIL OUTLET FROM RUNDOWN TANKS	EMERGENCY LUBE OIL PUMP RUNNING			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
44		LIFT [JACK OIL] PUMP(S) RUNNING			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
45	⊗ EVERY COOLING WATER OUTLET	WATER INJECTION SYS. PUMP(S) RUNNING			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
46	⊗ CONTROL, LUBE, OIL DOWNSTREAM RELIEF VALVES	TURNING GEAR DEVICE RUNNING			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
47	⊗ RETURN HEADER FROM CONTROL, LUBE OIL TO RESERVOIRS	ENCLOSURE VENTILATOR ON / OFF			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
48		ENCLOSURE FIRE DAMPER OPEN / CLOSED			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
49	○	AUX. CONDENSATE PUMP RUNNING [IF APPL.]			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
50	○	TEST / RESET SYSTEM			<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	
51	○				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
52	NOTES:							
53								
54								

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		SHEET 13 of 22							
		TITLE: SPECIAL PURPOSE STEAM TURBINE							
01	⊗ INSTRUMENTATION SUPPLIED WITH THE TURBINE TRAIN, CONTINUED (NOTES 8 AND 10)								
02	ALARMS AND TRIPS			SIGNALS AND / OR MAIN CONTACTS		LOCAL CONTROL PANEL [HMI] AND REMOTE CONTROL PANEL		MAIN CONTROL ROOM PANEL [DCS]	
03									
04	A = ALARM D= DANGER T = TRIP P = PERMISSIVE START								
05	O = BY OTHERS, BUT LOGIC BY VENDOR V = INSTRUMENT, SIGNALS & LOGIC BY VENDOR			P	V	O	A	D	T
06	LOW STEAM INLET / INDUCTION PRESSURE			○	⊗	○	⊗		
07	LOW STEAM INLET / INDUCTION TEMPERATURE			⊗	⊗	○	⊗		
08	HIGH STEAM EXTRACTION / EXHAUST PRESSURE [IF CONDENS.]			○	⊗	○	⊗		⊗
09	HIGH STEAM EXTRACTION / EXHAUST TEMPERATURE			○	⊗	○	⊗	⊗	
10	LOW ⊗ CONTROL ⊗ LUBE OIL PRESSURE			○	⊗	○	⊗		⊗
11	LOW ⊗ CONTROL ⊗ LUBE OIL DIFFERENTIAL PRESSURE			○	⊗	○	⊗	⊗	
12	LOW ⊗ CONTROL ⊗ LUBE OIL ACCUMULATOR / RUNDOWN TANK LEVEL			⊗	⊗	○	⊗	⊗	
13	LOW ⊗ CONTROL ⊗ LUBE OIL RESERVOIR LEVEL			⊗	⊗	○	⊗	⊗	
14	LOW ⊗ CONTROL ⊗ LUBE OIL RESERVOIR TEMPERATURE			⊗	⊗	○	⊗		
15	AUX. ⊗ CONTROL ⊗ LUBE & ⊗ EMERGENCY LUBE OIL PUMPS RUNNING			○	⊗	○	⊗		
16	HIGH ⊗ CONTROL ⊗ LUBE OIL TEMPERATURE DOWNSTREAM COOLERS			○	⊗	○	⊗	⊗	
17	HIGH ⊗ CONTROL ⊗ LUBE OIL FILTERS DIFFERENTIAL PRESSURES			○	⊗	○	⊗	⊗	
18	HIGH LUBE OIL RETURN HEADER TEMPERATURE			○	⊗	○	⊗	⊗	
19	EXCESSIVE ROTOR AXIAL DISPLACEMENT [TURBINE / DRIVEN / GEAR]			○	⊗	○	⊗		⊗
20	HIGH JOURNAL BEARING METAL TEMPERATURE [TURBINE / DRIVEN / GEAR]			○	⊗	○	⊗	⊗	
21	HIGH THRUST BEARING METAL TEMPERATURE [TURBINE / DRIVEN / GEAR]			○	⊗	○	⊗	⊗	
22	EXCESSIVE VIBRATION LEVELS [TURBINE / DRIVEN / GEAR]			○	⊗	○	⊗		⊗
23	SPEED GOVERNOR FAILURE (FAULT SIGNAL OR SECONDARY POWER SUPPLY)			○	⊗	○			
24	ZERO RPM DETECTION			○	⊗	○			
25	OVERSPEED			○	⊗	○	⊗		⊗
26	HIGH GLAND CONDENSER VACUUM PRESSURE			○	⊗	○	⊗		
27									
28									
29									
30									
31									
32									
33									
34									
35									
36	ALARMS & TRIPS BY EXTERNAL SIGNALS:						REMOTE & LOCAL PANEL		
37	HIGH OUTLET TEMPERATURE ON STEAM CONDENSER				[IF APPLICABLE]		⊗ A	⊗ T	
38	HIGH PRESSURE ON TURBINE EXHAUST / STEAM CONDENSER				[IF APPLICABLE]		⊗ A	⊗ T	
39	HIGH LEVEL ON STEAM CONDENSER				[IF APPLICABLE]		⊗ A	⊗ T	
40	EMERGENCY SHUTDOWN ⊗ WITH ⊗ WITHOUT UNIT DEPRESSURIZATION				[IF APPLICABLE]		⊗ A	⊗ T	
41	GAS DETECTION INSIDE ENCLOSURE ⊗ [20 % LEL] ⊗ [60 % LEL]				[IF APPLICABLE]		⊗ A	⊗ T	
42	CONFIRMED ⊗ NON-CONFIRMED ⊗ FIRE DETECTION INSIDE ENCLOSURE				[IF APPLICABLE]		⊗ A	⊗ T	
43	HIGH TEMPERATURE INSIDE ENCLOSURE				[IF APPLICABLE]		⊗ A	⊗ T	
44	LOW ENCLOSURE VENTILATION AIR FLOW				[IF APPLICABLE]		⊗ A	⊗ T	
45	SMOKE DETECTION INSIDE CONTROL PANEL OR CONTROL ROOM				[IF APPLICABLE]		⊗ A	⊗ T	
46									
47									
48	VIBRATION, TEMPERATURE & POSITION MONITORS ALL DRIVER & DRIVEN EQUIPMENT			COMPLETE SYSTEM, SEE DATA SHEETS	○ LOCAL PANEL	REMOTE PANEL	CONTROL ROOM		
49					⊗ LOCAL HMI				
50	ROTOR AXIAL DISPLACEMENT (NOTE 9)			⊗	⊗	⊗	⊗		
51	ROTOR VIBRATION (NOTE 9)			⊗	⊗	⊗	⊗		
52	SPEED (NOTE 9)			⊗	⊗	⊗	⊗		
53	CASING VIBRATION (NOTE 9)			○	○	○	○		
54	BEARING TEMPERATURES (NOTE 9)			⊗	⊗	⊗	⊗		

		DATA SHEET		No.		REV.		
							SHEET 14 of 22	
		TITLE: SPECIAL PURPOSE STEAM TURBINE						
01	⊗ INSTRUMENTATION SUPPLIED WITH THE TURBINE TRAIN, CONTINUED (NOTES 8 AND 10)							
02	OTHER INDICATORS		LOCAL	○ LOCAL PANEL	REMOTE PANEL	CONTROL ROOM		
03				⊗ LOCAL HMI				
04	SERVICE HOURS METER [TOTAL & PARTIAL]		○	○	○	○		
05	TURNING GEAR MOTOR DRIVER AMPERE METER [WHEN APPLICABLE]		○	○	○	○		
06	THROTTLE VALVES POSITION [% OPEN]		⊗	⊗	⊗	⊗		
07	INDUCTION VALVES POSITION [% OPEN]		⊗	⊗	⊗	⊗		
08	EXTRACTION VALVES POSITION [% OPEN]		⊗	⊗	⊗	⊗		
09	SPEED INDICATOR (TACHOMETER) & SPEED CONTROL [%]		⊗	⊗	⊗	⊗		
10	CASING EXPANSION (SLIDING SCALE / LOOSE WASHERS ON TURB. FEET)		⊗					
11								
12								
13	INDICATIONS							
14	⊗ LUBE OIL MAIN, AUXILIARY, & EMERGENCY PUMPS STARTUP		⊗ AUTOMATIC OIL HEATER SWITCHING-ON & OFF, HEATER FAILURE, OVERHEATING					
15	⊗ CONTROL OIL MAIN & AUXILIARY PUMPS STARTUP		⊗ REMOTE & LOCAL SHUTDOWN [SOLENOID TRIP]					
16	⊗ REMOTE & LOCAL STARTUP [IF APPLICABLE]		⊗ LIFT [JACK OIL] MAIN & AUXILIARY PUMPS STARTUP [IF APPLICABLE]					
17	⊗ TURNING DEVICE							
18	⊗ CONDENSATE MAIN & AUXILIARY PUMPS STARTUP							
19								
20								
21								
22								
23	PUSH BUTTONS & SWITCHES (NOTE 9)		LOCAL	○ LOCAL PANEL	REMOTE PANEL	CONTROL ROOM		
24				⊗ LOCAL HMI				
25	OIL PUMP START / STOP [ALL MAIN, STAND-BY AND EMERGENCY OIL PUMPS]			⊗	⊗	⊗		
26	OIL PUMP MAIN/STAND-BY SELECTOR [ALL OIL PUMPS]			⊗	⊗	⊗		
27	JACK OIL PUMPS START / STOP [IF APPLICABLE]			⊗	⊗	⊗		
28	ENCLOSURE VENTILATOR ON / OFF [IF APPLICABLE]			⊗	⊗	⊗		
29	ENCLOSURE FIRE DAMPER OPEN / CLOSE [IF APPLICABLE]			⊗	⊗	⊗		
30	ENCLOSURE VENTILATOR MAIN/STAND-BY SELECTOR [IF APPLICABLE]			○	○	○		
31	CONDENSATE PUMP START / STOP			○	○	○		
32	CONDENSATE PUMP MAIN/STAND-BY SELECTOR			○	○	○		
33	TURNING GEAR DEVICE START / STOP [WHEN APPLICABLE]			⊗	⊗	⊗		
34	TRAIN EMERGENCY STOP (MANUAL MECHANICAL TRIP AND PULL-OUT TYPE BUTTON)		⊗	⊗	⊗	⊗		
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38	NOTES:							
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NOTE 1 COMPRESSOR TRAIN BASEPLATE(S) WILL BE INSTALLED ON CONCRETE BASE(S).

NOTE 2 LATERAL ANALYSIS FOR DRIVER & DRIVEN SHALL BE SEPARATED, WHENEVER FLEXIBLE COUPLINGS ARE APPLIED.

NOTE 3 ITEMS NOT MARKED WITH "Ø", SHALL BE COMPLETED BY BIDDER / VENDOR, AS PER API STD 612 AND BIDDER / VENDOR'S INSPECTION & TESTING PLAN.

NOTE 4 COMPANION FLANGES SHALL BE INCLUDED IF NON-STANDARD SIZES ARE APPLIED.

NOTE 5 COUPLING MINIMUM SPACER LENGTH SHALL BE 500 mm.


NOTE 6 SEE GENERAL NOTES ON TEST REQUIREMENTS, ESPECIALLY THOSE REGARDING WHEN URT2 SHOULD BE CONSIDERED AS A MANDATORY TEST.

NOTE 7 API 615 IS DISCONTINUED. IT SHALL BE USED JUST AS A REFERENCE ON CONCEPTS, METHODS & PROCEDURES. NR-15 LIMITS SHALL ALWAYS PREVAIL.

NOTE 8 LIST PROVIDES THE MINIMUM INSTRUMENTATION REQUIRED, AS APPLICABLE, TO THE JOB. BIDDER/VENDOR TO COMMENT ON / COMPLETE AS NECESSARY.

NOTE 9 THE PUSH BUTTONS & SWITCHES COULD BE PHYSICAL OR LOGICAL (INSIDE HMI). IT IS VENDOR'S CHOICE.

NOTE 10 SOME VARIABLES BELONG TO OTHER SYSTEMS, SUCH AS LUBE AND/OR CONTROL OIL SYSTEMS, AND ARE REPEATED HERE IN THESE DATA SHEETS FOR CONSISTENCY.

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REMARKS

1 ☒ MAIN EQUIPMENT - TURBINE PERFORMANCE

1.1 ☒ TURBINES AND ACCESSORIES SHALL BE FURNISHED IN ACCORDANCE WITH API STD 612 AND RESPECTIVE PETROBRAS SUPPLEMENTARY STANDARDS AND TECHNICAL SPECIFICATIONS, AS LISTED IN RM

1.1.1 ☒ BIDDER/VENDOR SHALL FILL IN PERFORMANCE DATA AND SHALL PROVIDE PERFORMANCE CURVES (STEAM RATE, EFFICIENCY, ENTHALPY, ENTROPY AND DELIVERED POWER); REGARDING DRIVEN EQUIPMENT SPECIFIED OPERATING CONDITIONS.

1.1.2 ☒ THE TURBINE MUST BE CAPABLE TO OPERATE ALL OVER THE ENTIRE POWER, SPEED AND FLOW RANGES AS STATED ON THE PERFORMANCE CURVES.

1.1.3 ☒ HOWEVER, AUTOMATIC OPERATION OF TURBINE IS ALWAYS REQUIRED ALL OVER THE WHOLE OPERATING RANGE AND UNDER ALL SPECIFIED STEAM CONDITIONS, EXCEPT FOR WORST STEAM CONDITIONS. THEREFORE, PETROBRAS IS NOT CONSIDERING THE POSSIBILITY OF MANUALLY OPENING ANY HAND VALVES AT FIELD JUST TO COMPENSATE PERFORMANCE FLUCTUATIONS.

1.1.4 ☒ REGARDING PERFORMANCE CURVES, STEAM FLOW VERSUS POWER FIGURES SHALL BE PROVIDED FOR EACH AND EVERY HAND VALVE (IF ANY) OPENING SETTINGS, AND FOR EACH AND EVERY SPECIFIED STEAM CONDITIONS.

1.2 ☒ TURBINE EXHAUST TEMPERATURE AND PRESSURE SHALL BE LESS THAN PIPING ☒ MAX. ☐ DESIGN TEMPERATURE AND PRESSURE FOR ALL SPECIFIED OPERATING CONDITIONS, INCLUDING IDLE OR NO-LOAD OPERATION.

DOWNSTREAM PIPING SYSTEM <input checked="" type="checkbox"/> MAX. <input type="checkbox"/> DESIGN TEMPERATURE, °C:	
DOWNSTREAM PIPING <input checked="" type="checkbox"/> MAX. <input checked="" type="checkbox"/> SYSTEM DESIGN PRESSURE, kgf/cm ² g:	

1.3 ☒ WHENEVER TURBINE EXHAUST OR SEALING STEAM TEMPERATURE IS HIGHER THAN INFORMED STEAM CONDITIONS, AN AUTOMATIC DE-SUPERHEATER SYSTEM WITH TEMPERATURE CONTROL SHALL BE SUPPLIED BY TURBINE VENDOR.

1.3.1 ☒ THE USE OF DE-SUPERHEATER IS NOT EXPECTED FOR CONTINUOUS (STEADY-STATE), LOADED OPERATION. IT MAY BE CONSIDERED DURING STARTUP (NO LOAD), MOSTLY TO PROTECT TURBINE FROM EXCESSIVE PIPING FORCES & MOMENTS DURING IDLING OPERATION, AND OTHER SIMILAR TRANSIENT CONDITIONS.

1.3.2 ☒ TURBINES REQUIRING CONTINUOUS INJECTION OF WATER AT EXHAUST WILL NOT BE ACCEPTABLE.

2 ☒ MAIN EQUIPMENT - CONSTRUCTION DETAILS

2.1 ☒ BIDDER/VENDOR SHALL SPECIFY MATERIALS IN ACCORDANCE WITH INTERNATIONAL CODES (ASTM, ASME, AISI, ETC...).

2.2 ☒ SHAFTS SHALL BE PROTECTED BY CORROSION-RESISTANT MATERIAL UNDER SEALS/CARBON RINGS PACKING FOR CASING GLANDS. CHROMIUM-PLATED ELECTROLYTE DEPOSITION PROCESSES ARE PREFERRED, THERMAL SPRAY ASPERSION PROCESSES SHALL NOT BE USED.

2.3 ☒ TRIP & THROTTLE VALVE STEM HARDENING SHALL BE BY NITRIDING PROCESS.

2.4 ☒ ALL EQUIPMENT FEET TO BE PROVIDED WITH VERTICAL AND HORIZONTAL JACKSCREWS. ALIGNMENT POSITIONING SCREWS SHALL BE PROVIDED, REGARDLESS OF THE WEIGHT OF ANY TRAIN COMPONENT, TO FACILITATE LONGITUDINAL AND TRANSVERSE HORIZONTAL ADJUSTMENTS. HORIZONTAL JACKSCREWS SHALL BE SAME SIZE OR LARGER THAN THE VERTICAL SCREWS. THE LUGS HOLDING THESE JACKSCREWS SHALL BE ATTACHED TO THE MOUNTING PLATES SUCH THAT THEY DO NOT INTERFERE WITH THE INSTALLATION OR REMOVAL OF THE EQUIPMENT.

2.5 ☒ LIFTING LUGS OR EYEBOLTS SHALL BE PROVIDED FOR ANY EQUIPMENT OR COMPONENT WEIGHTING MORE THAN 30 kgf (66 lb.).

2.6 ☒ PACKAGE SHALL HAVE ALL FLANGED CONNECTIONS AT THE EDGE OF THE SKID OR BASEPLATE (BATTERY LIMITS). EVERY PIPING TERMINATION SHALL HAVE SINGLE INLET AND OUTLET FLANGED CONNECTIONS.


2.7 ☒ DRAIN LINES SHALL BE BROUGHT OUT TO THE BASEPLATE EDGE AND SHALL BE INDIVIDUALLY VALVED. DRAIN POINTS SHALL BE PROVIDED WITH SECONDARY CONTAINMENT BARRIERS AGAINST LEAKAGE.

2.7.1 ☒ VALVED DRAINS SHALL BE PROVIDED ON ALL CASINGS.

2.7.2 ☒ MULTISTAGE EQUIPMENT SHALL BE PROVIDED WITH INDIVIDUAL STAGE CASING DRAINS.

2.7.3 ☒ IF INDIVIDUAL STAGE DRAINS CANNOT BE PROVIDED DUE TO DESIGN LIMITATIONS, IT SHALL BE DEMONSTRATED DURING PROPOSAL STAGE (WITH DRAWINGS) THAT NO INNER PARTS WOULD REMAIN UNDRAINED WITH THE PROPOSED ARRANGEMENT.

2.7.4 ☒ DRAIN ARRANGEMENTS SHALL PROVIDE VISUAL ACCESS IN ORDER TO VERIFY DRAIN LEAKAGE AND TO CONFIRM WHETHER DRAINAGE OPERATION HAS BEEN ACCOMPLISHED OR NOT.

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2.8 ☒ PACKAGE SHALL HAVE ALL TERMINAL POINTS FOR ELECTRONIC CIRCUITRY GATHERED IN JUNCTION BOXES, LOCATED AT THE EDGE OF THE SKID OR BASEPLATE (BATTERY LIMITS).

3 ☒ MAIN EQUIPMENT - ROTORDYNAMICS

3.1 ☒ THE ROTORDYNAMIC MODEL (ROTOR/BEARINGS/LABYRINTHS) USED IN THE ANALYSIS SHALL BE GIVEN TO PETROBRAS, TOGETHER WITH ANY ROTORDYNAMIC REPORT FOR PETROBRAS' OWN ANALYSIS.

3.2 ☒ TURBINE BEARINGS SHALL BE HYDRODYNAMIC. BLANK FORMS FOR BEARING DATA SHEETS WILL BE SUPPLIED BY PETROBRAS DURING PROPOSAL/CLARIFICATION STAGE. DATA SHEETS SHALL BE FILLED-IN BY BIDDER/VENDOR AND SUB-SUPPLIERS (AFTER ORDER), AND INCLUDED IN EQUIPMENT DOCUMENTATION. MINIMUM REQUIRED DATA SHALL BE AS FOLLOWS:

- SHAFT DIAMETER AT BEARING, mm;
- BEARING LENGTH, mm;
- JOURNAL RADIUS, DEGREES;
- PAD BORE RADIUS, DEGREES;
- BEARING SET BORE RADIUS, DEGREES;
- BEARING CLEARANCE, mm;
- PAD CLEARANCE, mm;
- NUMBER OF PADS;
- OFF-SET FACTOR;
- PRE-LOAD FACTOR;
- PAD ARC LENGTH, DEGREES;
- BABBITT THICKNESS, mm.
- LOAD PER BEARING, N;
- PIVOT STIFFNESS;
- PAD MASS, kg.

• REGARDING THRUST BEARINGS, VENDOR SHALL ALSO INFORM:

- STEAM LOADING, kgf/cm²;
- COUPLING SPLIT LOAD, kgf/cm²;
- COUPLING FRICTION COEFFICIENT;
- COUPLING GEAR PITCH DIAMETER, mm;
- BALANCE PISTON COMPENSATION LOAD, kgf/cm²;
- ALLOWABLE END-FLOAT, mm

4 ☒ MAIN EQUIPMENT - INSPECTION AND TESTING REQUIREMENTS - FAT1

4.1 ☒ ALL EQUIPMENT (MAIN AND AUXILIARY) SHALL BE FACTORY INSPECTED AND TESTED IN ACCORDANCE WITH THE APPLICABLE DESIGN AND CONSTRUCTION SPECIFICATIONS, STANDARDS AND CODES, AS SPECIFIED.

4.1.1 ☒ BESIDES MAIN INSPECTION & TESTING REQUIREMENTS AS SPECIFIED ON THE DATA-SHEETS, PETROBRAS WILL PROVIDE IN THE INQUIRY DOCUMENTS ANY SPECIFIC INSTRUCTIONS TO THE BIDDERS COMPRISING THE TYPE OF INSPECTION ROUTINES TO BE APPLIED, DEPENDING ON POTENTIAL BIDDER/VENDOR'S (AND RESPECTIVE SUB-SUPPLIERS) QUALIFICATIONS AND HISTORICAL RECORDS OF FORMER SUPPLIES.

4.1.2 ☒ AS A RESULT, INSPECTION & TESTING EXTENT, PROCEDURES AND SCHEDULES WILL BE EVALUATED BY PETROBRAS DURING BID EVALUATION. THEY SHALL BE DISCUSSED AND MUTUALLY AGREED UPON BY PETROBRAS AND SELECTED BIDDER/VENDOR BEFORE THE PLACEMENT OF ORDER, AND LATER CONFIRMED DURING KICK-OFF AND PRE-INSPECTION MEETINGS (KOM AND PIM).

4.1.3 ☒ INSPECTION AND TESTING SHALL BE PERFORMED BY PETROBRAS OR BY THIRD PARTIES, ON BEHALF OF PETROBRAS, DURING ANY PROJECT STAGE, AT BIDDER/VENDOR'S OR SUB-SUPPLIERS FACILITIES.

4.1.4 ☒ INSPECTION AND TESTING SCHEDULES SHALL BE ISSUED BY MAIN EQUIPMENT BIDDER/VENDOR (COMPRISING SUB-SUPPLIERS' SCHEDULES AS WELL) IN ORDER THAT INSPECTION AND TESTING EVENTS ARE PERFORMED AT THE PROPER TIME DURING ALL PROJECT STAGES (PROCUREMENT OF MATERIALS, MANUFACTURING, ASSEMBLING, TESTING, PACKING, ETC.).

4.2 ☒ UPON COMPLETION OF MANUFACTURING SCHEDULE, FAT1 (FACTORY ACCEPTANCE TESTS) SHALL BE PERFORMED AS SPECIFIED, IN ACCORDANCE WITH APPLICABLE STANDARDS AND PETROBRAS SUPPLEMENTARY SPECIFICATIONS.

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4.2.1 ☒ DYNAMIC TESTS (PERFORMANCE, MECHANICAL RUN, ETC.) AND FINAL INSPECTIONS (SCOPE, PREPARATION FOR SHIPMENT, PACKING, ETC.) SHALL BE PERFORMED ONLY AFTER ALL REQUIRED DOCUMENTS (INCLUDING TEST PROCEDURES) ARE APPROVED BY PETROBRAS.

4.2.2 ☒ DYNAMIC TESTS SHALL NOT BE NOTIFIED WITHOUT THE FOLLOWING APPROVED DOCUMENTS ARE READILY AVAILABLE FOR REFERENCE AT THE TEST BED FACILITIES, DURING THE WHOLE TEST SEQUENCE:

- TEST PROCEDURES;
- MINUTES OF MEETINGS, AGREEMENTS, DRAWINGS, DATA-SHEETS & CURVES;
- ROTORDYNAMIC MODEL (LATERAL & TORSIONAL ANALYSES);
- ANY OTHER DOCUMENT FOUND RELEVANT TO PERFORM THE TESTS.

4.2.3 ☒ ALL REPORTS OF STATIC TESTS, INSPECTIONS, BALANCING, RUN-OUT, ANY OTHER CONTRACTED EXAMINATIONS AND TEST BED ARRANGEMENT & INSTRUMENT CALIBRATION RECORDS SHALL BE AVAILABLE FOR PETROBRAS REVIEW BEFORE DYNAMIC TESTS ARE ALLOWED TO START.

- RUN-OUT CHECK (PERFORMED WITH ROTOR PLACED ON V-BLOCKS) REPORTS FOR EVERY ROTOR TO BE TESTED SHALL BE COMPARED WITH MEASURED ROTOR RUN-OUT DURING RESPECTIVE MECHANICAL RUNNING TEST. THEREFORE, SLOW-ROLL RUN-OUT SHALL BE RECORDED AT ABOUT 300 ~ 500 rpm.
- BEFORE PERFORMANCE TESTS ARE PERFORMED, BIDDER/VENDOR SHALL SUBMIT ALL TEST DATA AND TARGET / GUARANTEED CONDITIONS FOR PETROBRAS REVIEW AND COMMENTS. AS AN EXAMPLE, FOR STEAM TURBINES, A TABLE COMPRISING INLET & OUTLET OPERATING CONDITIONS, AND ASME PTC 6 CORRECTION PARAMETERS SHALL BE PROVIDED.

4.3 ☒ BASIC PROCEDURE FOR FACTORY PERFORMANCE TEST:

4.3.1 ☒ PETROBRAS STRONGLY RECOMMENDS THE USE OF BACKUP TEST-BED INSTRUMENTATION, FULLY CALIBRATED, WIRED, BUT NOT CONNECTED, IN ORDER TO AVOID FURTHER DISCUSSIONS AND DELAYS DURING TESTING. ALTHOUGH IT IS NOT A MANDATORY REQUIREMENT, THE USE OF SUCH BACKUP SYSTEMS WOULD PREVENT A TEST FROM BEING ABORTED JUST BECAUSE OF INSTRUMENT OR DATA TRANSMISSION FAILURE.

4.3.2 ☒ THE PURPOSE OF THE FACTORY PERFORMANCE TEST IS TO PROVIDE AN ACCURATE DETERMINATION OF BACK PRESSURE AND CONDENSING STEAM TURBINES EFFICIENCY AT THE TURBINE VENDOR'S MANUFACTURING FACILITIES ("FACTORY"). THE EFFICIENCY AS MEASURED AT THE FACTORY TESTS SHALL NOT BE LESS THAN THE VALUE STATED IN THE TECHNICAL PROPOSAL, AFTER APPLICATION OF THE PROPER CORRECTION FACTORS.

4.3.3 ☒ THE TEST SHALL BE CONDUCTED USING FACTORY AVAILABLE STEAM, WITH INLET AND EXHAUST PRESSURES ADJUSTED TO PROVIDE AERODYNAMIC SIMILARITY WITH THE DESIGN CONDITIONS. TEST CONDITIONS SHALL RELATE TO DESIGN CONDITIONS ACCORDING TO THE FOLLOWING EQUATIONS:


$$\left(\frac{P_{adm}}{P_{exh}} \right)_{test} = \left(\frac{P_{adm}}{P_{exh}} \right)_{design}$$

$$\left(\frac{\dot{m} \sqrt{T_{adm}}}{P_{adm}} \right)_{test} = \left(\frac{\dot{m} \sqrt{T_{adm}}}{P_{adm}} \right)_{design}$$

$$\left(\frac{N}{\sqrt{T_{adm}}} \right)_{test} = \left(\frac{N}{\sqrt{T_{adm}}} \right)_{design}$$

DEFINITION OF TERMS:	DEFINITION OF SUBSCRIPTS:
P = PRESSURE	ADM = INLET
T = TEMPERATURE	EXH = EXHAUST
M = MASS FLOW	TEST = FACTORY TEST CONDITIONS
N = ROTATING SPEED	DESIGN = DESIGN CONDITIONS

4.3.4 ☒ SIMILARITY CONDITIONS SHALL APPLY TO THE STEAM TURBINE ITSELF, SO, TEST AND DESIGN INLET CONDITIONS SHALL BE CONSIDERED DOWNSTREAM OF THE INLET CONTROL VALVES.

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4.3.5 ☒ BIDDER/VENDOR SHALL DEVELOP THIS BASIC TEST PROCEDURE INTO A COMPLETE ELABORATED ONE, WHICH SHALL BE SUBMITTED TO PETROBRAS FOR APPROVAL, INDICATING EXPLICITLY THE CORRECTION FACTORS TO BE APPLIED, ESPECIALLY THOSE REGARDING THE FOLLOWING PARAMETERS, ALL OF THEM AT DESIGN AND TEST CONDITIONS:

- INLET AND EXHAUST PRESSURE
- INLET AND EXHAUST TEMPERATURE
- ROTATING SPEED.

4.3.6 ☒ TEST PROCEDURE SHALL ALSO STATE TEST AND DESIGN STEAM CONDITIONS UPSTREAM AND DOWNSTREAM OF THE CONTROL VALVES.

4.3.7 ☒ TEST DATA CALCULATIONS SHALL BE CORRECTED FOR OTHER INFLUENCING FACTORS, SUCH AS GLAND OR OTHER EXTERNAL LEAKAGES, AS WELL AS BEARING, GEAR AND DRIVEN EQUIPMENT LOSSES, AS APPLICABLE.

4.4 ☒ USUALLY, ONLY URT1(UNBALANCE RESPONSE TEST 1) IS REQUIRED, BUT URT2 WOULD ALSO BE NECESSARY IF URT1 RESULTS SHOULD NOT SUFFICE TO VALIDATE ROTORDYNAMIC MODEL.

5 ☒ MAIN EQUIPMENT - PAINTING, INSULATION, NOISE, SAFETY AND HEALTH REQUIREMENTS

5.1 ☒ EQUIPMENT SHALL BE FURNISHED WITH PAINTING COMPATIBLE WITH INDUSTRIAL CORROSIVE ATMOSPHERE (WET ENVIRONMENT, PRESENCE OF SO₂, H₂S, FUMES, ETC.).

5.2 ☒ ALL EQUIPMENT AND COMPONENTS (EXCEPT FOR STAINLESS STEEL PARTS) SHALL BE PAINTED IN ACCORDANCE WITH NR-26, WITH THE FOLLOWING COMMENTS AND / OR MODIFICATIONS:

5.2.1 ☒ ORDINARY PROCESS EQUIPMENT (PUMPS, COMPRESSORS, TURBINES, ETC.) SHALL BE PAINTED IN LIGHT GRAY 0065 OR ALUMINUM 0170 FOR HOT PARTS (OPERATING TEMPERATURES ABOVE 80 °C), AS REQUIRED.

5.2.2 ☒ ORDINARY EQUIPMENT BASE PLATES SHALL BE IN THE SAME COLOR APPLIED TO EQUIPMENT (USUALLY, LIGHT GRAY 0065). THIS IS DUE TO TECHNICAL REASONS, SINCE IT IS EASIER TO NOTICE LEAKAGES IF BASE PLATE IS PAINTED IN GRAY.

5.2.3 ☒ PAINTING SCHEMES FOR EQUIPMENT AND COMPONENTS SHALL BE AS PER THE FOLLOWING GENERIC TABLE, WHERE THE TERM HOT MEANS OPERATING TEMPERATURES ABOVE 80 °C:


ITEM / EXAMPLE	COLOR
<input checked="" type="checkbox"/> ORDINARY PROCESS COMPRESSOR COLD PARTS	LIGHT GRAY 0065
<input checked="" type="checkbox"/> ORDINARY PROCESS COMPRESSOR HOT PARTS	ALUMINUM 0170
<input checked="" type="checkbox"/> HYDROGEN-RICH COMPRESSOR (JUST THE COMPRESSOR)	<input checked="" type="checkbox"/> LIGHT GRAY 0065 <input type="checkbox"/> SAFETY-YELLOW 2586
<input checked="" type="checkbox"/> COUPLING GUARDS	SAFETY-YELLOW 2586
<input checked="" type="checkbox"/> GEARBOX	LIGHT GRAY 0065
<input checked="" type="checkbox"/> MOTORS	LIGHT GRAY 0065
<input checked="" type="checkbox"/> TURBINE COLD PARTS	LIGHT GRAY 0065
<input checked="" type="checkbox"/> TURBINE HOT PARTS	ALUMINUM 0170
<input checked="" type="checkbox"/> OIL PUMP BASEPLATE	LIGHT GRAY 0065
<input checked="" type="checkbox"/> OIL PUMP COLD BEARING HOUSING	LIGHT GRAY 0065
<input checked="" type="checkbox"/> OIL PUMP COLD PEDESTAL	LIGHT GRAY 0065
<input checked="" type="checkbox"/> OIL PUMP COLD VOLUTE	LIGHT GRAY 0065
<input checked="" type="checkbox"/> COOLING WATER PUMP (JUST THE PUMP)	PB GREEN 3355
<input checked="" type="checkbox"/> OTHER ROTATING EQUIPMENT COLD PARTS	LIGHT GRAY 0065
<input checked="" type="checkbox"/> OTHER ROTATING EQUIPMENT HOT PARTS	ALUMINUM 0170
<input checked="" type="checkbox"/> STAINLESS STEEL PARTS	NOT TO BE PAINTED
<input checked="" type="checkbox"/> TRAIN BASEPLATE	<input checked="" type="checkbox"/> LIGHT GRAY 0065 <input type="checkbox"/>

5.2.4 ☒ THE ABOVE TABLE IS JUST AN EXAMPLE, AND DOES NOT COMPRISE ALL POSSIBLE PAINTING SCHEMES. ALL OTHER CONFLICTS SHALL BE BROUGHT TO PETROBRAS ATTENTION FOR REVIEW AND DECISION.

5.2.5 ☒ WHERE REMOVABLE THERMAL INSULATION SHALL BE PROVIDED FOR PERSONNEL PROTECTION, SOME PAINTING REQUIREMENTS MAY NEED TO BE CHANGED.

5.3 ☒ ASBESTOS SHALL NOT BE USED IN THE MATERIALS AND EQUIPMENT SUPPLIED FOR THIS PROJECT.

5.4 ☒ ALL EQUIPMENT AND INSTRUMENTS OF THE PROCESS PLANT, WHICH ARE TO BE SUBJECTED TO ANY KIND OF MAINTENANCE AND OPERATION, INCLUDING BUT NOT LIMITED TO TOWERS, VESSELS, MANHOLES, COOLERS, HEATERS, VALVES, PUMPS, TURBINES, COMPRESSORS, ELECTRICAL GENERATORS AND MOTOR DRIVERS AND DEVICES, ENGINES, INSTRUMENTS, CONTROL PANELS, DISPLAYS, ETC, SHALL BE DESIGNED AND BUILT IN STRICT COMPLIANCE WITH THE BRAZILIAN LEGISLATION REGARDING WORKING CONDITIONS AND INTERFACES BETWEEN PERSONNEL AND EQUIPMENT.

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6 ☒ DRIVE TRAIN EQUIPMENT - COUPLINGS & COUPLING GUARDS:

6.1 ☒ COUPLINGS SHALL CONFORM TO API STD 671 REQUIREMENTS FOR SPECIAL-PURPOSE APPLICATIONS.

6.1.1 ☒ COUPLING MAKE SELECTION SHALL FOLLOW JOB SPECIFIC VENDORS LIST.

6.1.2 ☒ COUPLINGS SHALL BE FLEXIBLE, NON-LUBRICATED, WITH STAINLESS STEEL DISKS / DIAPHRAGMS.

6.1.3 ☒ RESIDUAL UNBALANCE ACCEPTANCE CRITERION SHALL BE IN ACCORDANCE WITH API STD. 671 OR G 1.0, AS PER ISO 1940, WHICHEVER IS MORE RESTRICTIVE.

6.1.4 ☒ COUPLING GUARDS SHALL BE FULLY-ENCLOSED, REMOVABLE, NON-SPARKING TYPE, AND SHALL EFFECTIVELY RETAIN DAMAGED COUPLING PARTS IN CASE OF FAILURE.

6.1.5 ☒ COUPLING SHALL INCORPORATE A FEATURE THAT ALLOWS TRANSMISSION OF LOAD FOR A LIMITED PERIOD, IN THE EVENT OF A COMPLETE FLEXIBLE ELEMENT FAILURE. THIS FEATURE SHALL BE CONSIDERED FOR TURBINE MAIN-DRIVE COUPLINGS TO PROVIDE AN ADDITIONAL SAFETY FACTOR TO PREVENT TURBINE OVERSPEED IN THE EVENT OF COUPLING FAILURE AND COMPLETE LOSS OF LOAD.

7 ☒ REQUIREMENTS FOR LUBE & CONTROL OIL SYSTEM:

7.1 ☒ THE SYSTEM SHALL BE COMBINED.

7.2 ☒ BASED ON EXPERIENCE WITH SEVERAL EXISTING COMBINED SYSTEMS, PETROBRAS IS CONCERNED ABOUT THE PERFORMANCE OF SOME ELECTRO-HYDRAULIC CONVERTERS AND/OR ELECTRO-HYDRAULIC SERVO VALVES, WITH HIGH RISKS OF OIL CONTAMINATION, THUS CAUSING SEVERE TURBINE CONTROL FAILURES.

7.2.1 ☒ BIDDER/VENDOR SHALL REVIEW THE ISSUE, DISCUSS WITH PETROBRAS ON THE POSSIBILITIES, AND PROPOSE A RELIABLE SOLUTION FOR CONTROL OIL SYSTEM BEFORE SUBMITTING PRICE QUOTATION. THE USE OF PNEUMATIC CONVERTERS TOGETHER WITH HYDRAULIC CONTROL VALVE SERVO CYLINDER MUST BE APPROVED BY THE PURCHASER. THE USE OF PNEUMATIC ACTUATOR ACTING DIRECT ON THE CONTROL VALVES IS NOT ACCEPTABLE. COMBINED CONVERTER/ACTUATOR WILL NOT BE AUTOMATICALLY ACCEPTABLE. THE VENDOR SHALL CLEARLY DEMONSTRATE SUCCESSFUL EXPERIENCE. A LIST OF REFERENCE (JUST WITH SIMILAR DUTIES) SHALL BE PROVIDED, INCLUDING COMBINED CONVERTER/ACTUATOR OPERATING DATA, SERVICE, CUSTOMER, YEAR OF STARTUP. THE VENDOR SHALL ALSO INFORM THE FOLLOWING DATA FOR PETROBRAS APPROVAL:

- - VISCOSITY OPERATING RANGE FOR COMBINED CONVERTER/ACTUATOR;
- - TEMPERATURE OPERATING RANGE;
- - OIL FILTRATION QUALITY;
- - CLEANLINESS FACTOR (OIL GRADE ACCORDING TO ISO 4406).

8 ☐ AUXILIARY EQUIPMENT AND SYSTEMS - TURBINE SURFACE CONDENSER SYSTEM:


8.1 ☐ BIDDER/VENDOR SHALL FURNISH A STEAM SURFACE CONDENSER, IN ACCORDANCE WITH ASME, TEMA B AND HEI / LAST EDITION REQUIREMENTS, TO BE CONNECTED TO THE STEAM TURBINE EXHAUST IN ACCORDANCE WITH THE APPLICABLE PETROBRAS STATIC EQUIPMENT DESIGN CRITERIA, AS ISSUED FOR THIS JOB.

8.1.1 ☐ THE CONDENSER SHALL BE HORIZONTAL, TWO-PASS DIVIDED, WATER BOX TYPE, WITH STEEL SHELL, TUBES SUPPORT AND HOT WELL. THE CONDENSER SHALL BE CONNECTED TO THE TURBINE EXHAUST, BY MEANS OF A STAINLESS STEEL EXPANSION JOINT TO BE SUPPLIED BY VENDOR. THE HOT WELL SHALL HAVE A STORAGE CAPACITY FOR ONE MINUTE OF STEAM FLOW.

8.1.2 ☐ THE CONDENSER SHALL BE FURNISHED WITH A TWIN ELEMENT, TWO STAGE EJECTOR WITH SURFACE TYPE INTER- AND AFTER- CONDENSERS, AND STANDARD ACCESSORIES. EITHER ELEMENT MUST HAVE SUFFICIENT CAPACITY TO OPERATE UNDER FULL LOAD CONDITIONS.

8.1.3 ☐ WATER SEALED ATMOSPHERIC RELIEF VALVE SHALL BE PROVIDED FOR THE CONDENSER. THIS RELIEF VALVE SHALL BE INSTALLED FOR TURBINE PROTECTION, AND SHALL BE SIZED FOR 180 % OF THE MAXIMUM EXHAUST FLOW.

8.1.4 ☐ THE CONDENSER SHALL BE FURNISHED WITH AN AIR METER, A VACUUM GAUGE, SEVEN THERMOMETERS AND THREE PRESSURE GAUGES. THE THERMOMETERS ARE FOR COOLING WATER INLET AND OUTLET, EXHAUST STEAM INLET, HOT WELL AND WATER OUTLET FROM THE AFTER-CONDENSER. THE THREE PRESSURE GAUGES ARE FOR CIRCULATING WATER INLET AND OUTLET, AND FOR STEAM TO EJECTORS. THE HOT WELL SHALL HAVE A LEVEL GLASS AND A LEVEL CONTROLLER.

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8.2 ☐ STEAM EJECTOR SYSTEM:

8.2.1 ☐ THE STEAM EJECTOR SYSTEM IS COMPRISED BY TWIN-ELEMENT, SINGLE NOZZLE, PRIMARY AND SECONDARY EJECTORS, WITH INTERMEDIATE AND AFTER CONDENSERS.

- THE PRIMARY EJECTORS SHALL TAKE SUCTION FROM THE MAIN CONDENSER AND DISCHARGE TO THE INTERMEDIATE CONDENSER, WHILST CONDENSATE SHALL RETURN TO THE MAIN CONDENSER STEAM SPACE VIA A DRAIN LEG.
- THE SECONDARY EJECTORS SHALL TAKE SUCTION FROM THE INTERMEDIATE CONDENSER AND DISCHARGE TO THE AFTER-CONDENSER, WHILST ANY CONDENSATE SHALL RETURN TO THE MAIN CONDENSER VIA A STEAM TRAP.
- ANY ENTRAINED AIR SHALL BE ALLOWED TO ESCAPE THROUGH AN OPEN VENT PIPE AT THE AFTER-CONDENSER.

8.2.2 ☐ EACH EJECTOR SHALL CONSIST OF A CAST IRON VAPOR HEAD AND CONVERGENT-DIVERGENT TAIL PIPE WITH A PARALLEL THROAT THROUGH WHICH THE AIR AND VAPOR IS COMPRESSED BY MEANS OF STEAM DISCHARGED FROM THE SINGLE STAINLESS STEEL NOZZLE. THE NOZZLE IS SCREWED INTO A MILD STEEL STEAM CHEST BOLTED TO THE VAPOR HEAD, A STEAM STRAINER BEING FITTED BEFORE EACH EJECTOR TO PROTECT THE NOZZLE.

8.2.3 ☐ EACH EJECTOR SHALL BE FITTED WITH STEAM INLET AND VAPOR INLET AND DISCHARGE VALVES TO PERMIT EXAMINATION, CLEANING OR REPAIR WITHOUT SHUTTING DOWN THE MAIN EQUIPMENT AND TO PERMIT OPERATION WITH ONLY ONE SET OF ELEMENTS IN USE.

8.2.4 ☐ THE INTERMEDIATE AND AFTER-CONDENSERS SHALL BE OF SIMILAR CONSTRUCTION AND SHALL BE OF THE SURFACE TYPE WITH TWO PASS WATER FLOW. THE BRASS TUBES SHALL BE EXPANDED INTO BRONZE TUBE PLATES, AN EXPANSION JOINT BEING PROVIDED AT THE WATER BOX END OF THE MILD STEEL SHELL.

8.2.5 ☐ THE EJECTORS, MOUNTED VERTICALLY, SHALL DISCHARGE INTO THE INLET ELBOWS WELDED INTO THE SHELLS, A MILD STEEL IMPINGEMENT BAFFLE BEING FITTED AT THE AFTER-CONDENSER INLET TO PROTECT THE TUBES FROM DIRECT STEAM IMPINGEMENT. SEMI CIRCULAR BAFFLES, POSITIONED, SHALL ENSURE THAT VAPOR AND AIR (WHILST PASSING THROUGH THE CONDENSER SHELL) HAVE THE MAXIMUM CONTACT WITH THE TUBE SURFACE.

8.3 ☐ TWO CONDENSATE PUMPS SHALL BE FURNISHED WITH THE MAIN CONDENSER. THE MAIN PUMP SHALL BE DRIVEN BY A STEAM TURBINE AND THE SPARE BY AN ELECTRIC MOTOR. THE CONDENSATE PUMPS SHALL HAVE THE FOLLOWING CHARACTERISTICS:

8.3.1 ☐ ISO 13709, LAST ED., PETROBRAS N-553 FULL COMPLIANCE, HORIZONTAL PUMPS, OH2 CONSTRUCTION (END-TOP) SHALL BE THE FIRST DESIGN OPTION. THE SUCTION AND DISCHARGE FLANGES SHALL BE ASME B 16.5 RAISED FACE.

8.3.2 ☐ VERTICAL SUSPENDED PUMPS ARE NOT AUTOMATICALLY ACCEPTABLE. BIDDER/VENDOR SHALL DEMONSTRATE THAT HORIZONTAL PUMPS ACCOMPLISHING THE MINIMUM NPSH MARGIN OF 0,6 m CANNOT BE PROVIDED.

8.3.3 ☐ ISO 13709 CONSTRUCTION MATERIALS CODE SHALL BE C-6. MECHANICAL SEALS SHALL BE IN ACCORDANCE WITH API STD 682 LAST ED. SEAL PLAN SHALL BE 11/62.

8.3.4 ☐ COUPLINGS SHALL BE NON LUBRICATED TYPE WITH FLEXIBLE STAINLESS STEEL DISC AND REMOVABLE NON SPARKING COUPLING GUARDS.

8.4 ☐ THE CONDENSATE PUMP STEAM TURBINE DRIVER SHALL HAVE THE FOLLOWING CHARACTERISTICS:

8.4.1 ☐ API STD 611 LAST ED., PETROBRAS N-2648, FULL COMPLIANCE, HORIZONTAL, BACKPRESSURE TURBINE.

8.4.2 ☐ TURBINE SEALING SHALL BE CARBON RINGS TYPE.

8.4.3 ☐ THE TURBINE SHALL BE DESIGNED TO DELIVER 110 PERCENT OF RATED POWER UNDER NORMAL STEAM CONDITIONS.


8.4.4 ☐ THE GOVERNOR SHALL BE ☐ HYDRAULIC OR ☐ ELECTRONIC.

8.4.5 ☐ TURBINE TO BE FITTED WITH REUSABLE TURBINE THERMAL INSULATION, WITH CLIPS.

9 ☒ AUXILIARY EQUIPMENT AND SYSTEMS - TURBINE WASHING SYSTEM:

9.1 ☐ WASHING (WATER-INJECTION), SYSTEMS ARE REQUIRED FOR SERVICES WHERE STEAM TENDS TO CREATE DEPOSITS, ADHERED TO TURBINE INTERNALS, PRECLUDING EQUIPMENT PERFORMANCE. VENDOR SHALL PROVIDE PROCEDURE FOR WATER WASHING IN NORMAL OPERATION. THE PROCEDURE SHALL COMPRISE:

- MAXIMUM OPERATION TIME PER YEAR.
- MINIMUM INLET STEAM TEMPERATURE.
- MINIMUM PIPING LENGTH UPSTREAM OF T&T VALVE.

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9.2 ☐ STEAM DESUPERHEATER SYSTEM, SHIPPED LOOSE, IN VENDOR SCOPE OF SUPPLY TO BE INSTALLED IN THE PIPING UPSTREAM THE STEAM TURBINE, CONSISTING OF:

- WATER CONTROL VALVE;
- TEMPERATURE CONTROL SYSTEM;
- INJECTION NOZZLE.

10 ☒ **AUXILIARY EQUIPMENT AND SYSTEMS - TURNING GEAR DEVICE:**

10.1 ☒ WHEN TURNING GEAR DEVICE IS NECESSARY, THE TYPE OF TURNING DEVICE SHALL BE AUTOMATIC WITH:

10.1.1 ☒ ELECTRIC MOTOR DRIVEN, HYDRAULIC OR PNEUMATIC.

10.1.2 ☒ PROVISIONS TO ALLOW FOR THE MANUAL BARRING OF THE MACHINERY TRAIN IN CASE OF FAILURE OR DUE TO LOSS OF POWER SUPPLY OR DRIVE FLUID TO THE TURNING DEVICE.

10.1.3 ☒ TURNING DEVICES SHALL NOT DEPEND ON ANY CLUTCH FOR THEIR OPERATION.

10.2 ☒ DETAILS OF TURNING DEVICE OPERATION, SUCH AS LOCAL / REMOTE, MANUAL OR AUTOMATIC ENGAGEMENT / DISENGAGEMENT, SHALL BE MUTUALLY AGREED UPON BY PETROBRAS / CONTACTOR AND BIDDER / VENDOR. THE FOLLOWING DESIGN FEATURES SHALL APPLY:

10.2.1 ☒ ENGAGEMENT SHALL ALWAYS BE ACCOMPLISHED BY MANUAL OPERATION (MANUAL CRANKING AND / OR LOCAL / REMOTE MANUAL COMMAND).

10.2.2 ☒ SINCE ENGAGEMENT SHALL ONLY BE POSSIBLE IF AN ADEQUATE SYSTEM LUBE-OIL PRESSURE AT ALL TRAIN BEARINGS IS FULLY ESTABLISHED AND STABLE, LUBE OIL PRESSURE SHALL BE A PERMISSIVE START CONDITION AT THE TRAIN PLC, FOR ENERGIZING POWER SUPPLY TO THE TURNING DEVICE OR FOR OPENING ITS DRIVE FLUID VALVES, AS APPLICABLE.


10.2.3 ☒ ENGAGEMENT ON SHUTDOWN BEFORE THE TRAIN HAS COME TO A FULL STOP CONDITION (DETECTION OF ZERO RPM IS REQUIRED) SHALL BE POSITIVELY PREVENTED IF THIS COULD DAMAGE THE TURNING DEVICE OR THE MACHINERY TRAIN COMPONENTS.

10.2.4 ☒ DISENGAGEMENT SHALL BE AUTOMATIC WHEN THE ROTOR ACCELERATES DURING STARTUP.

11 ☒ **CONTROLS AND INSTRUMENTATION:**

11.1 ☒ TURBINE CONTROL AND OPERATION SHALL BE ACCORDING PETROBRAS AUTOMATION CONTROL SPECIFICATION ISSUED FOR THIS SPECIFIC JOB.

[illegible]

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					SHEET 2 of 7	
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS					


THE DOCUMENTS STATED BELOW SHALL BE SUPPLIED IN ENGLISH OR BRAZILIAN PORTUGUESE (NOTES 4, 5) [REMARKS A, B, F, J]

PROPOSAL (NOTE 1)	BIDDER SHALL FURNISH	<u>4</u>	COPIES OF DATA FOR ALL ITEMS INDICATED BY AN X
REVIEW (NOTE 2) [REMARK C]	VENDOR SHALL FURNISH	<u>3</u>	COPIES AND <u> - </u> TRANSPARENCES OF DRAWINGS AND DATA INDICATED
FINAL (NOTE 3)	VENDOR SHALL FURNISH	<u>3</u>	COPIES AND <u> - </u> TRANSPARENCES OF DRAWINGS AND DATA INDICATED
	VENDOR SHALL FURNISH	<u>2</u>	INSTALLATION, OPERATING AND MAINTENANCE MANUALS. [REMARK D, E]


DISTRIBUTION RECORD	FINAL – RECEIVED FROM VENDOR _____ FINAL – DUE FROM VENDOR ^[c] _____ REVIEW – RETURNED TO VENDOR _____ REVIEW – RECEIVED FROM VENDOR _____ REVIEW – DUE FROM VENDOR ^[c] _____
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SPECIAL-PURPOSE STEAM TURBINE					
☒	☒	☒	1 - CERTIFIED DIMENSIONAL OUTLINE DRAWING AND LIST OF CONNECTIONS		
☒	☒	☒	2 - CROSS-SECTIONAL DRAWING, PART LIST AND BILL OF MATERIALS		
☒	☒	☒	3 - ROTOR ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS		
☒	☒	☒	4 - THRUST BEARING ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS		
☐	☒	☒	4a - THRUST BEARING DATA SHEET AND SIZING CALCULATIONS		
☒	☒	☒	5 - JOURNAL BEARING ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS		
☐	☒	☒	5a - JOURNAL BEARING DATA SHEET AND SIZING CALCULATIONS		
☒	☒	☒	6 - SEALS / PACKINGS / LABYRINTHS CROSS-SECTION DRAWING, ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS		
☒	☒	☒	7 - SHAFT COUPLING ALIGNMENT DIAGRAM, ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS		
☒	☒	☒	8 - GLAND SEALING AND LEAK-OFF SCHEMATICS, PART LIST AND BILL OF MATERIALS		
☐	☒	☒	9 - GLAND SEALING AND LEAK-OFF ARRANGEMENT DRAWING AND LIST OF CONNECTIONS		
☒	☒	☒	10 - GLAND SEALING AND LEAK-OFF EQUIPMENT AND COMPONENT DRAWINGS, PART LIST AND DATA SHEETS		
☒	☒	☒	11 - LUBE / CONTROL -OIL SCHEMATICS AND BILL OF MATERIALS		
☐	☒	☒	12 - LUBE / CONTROL OIL ASSEMBLY, ARRANGEMENT DRAWING, LIST OF CONNECTIONS, PART LIST AND BILL OF MATERIALS		
☐	☒	☒	13 - LUBE / CONTROL-OIL MAIN AND AUXILIARY EQUIPMENT/COMPONENT DRAWINGS, PART LIST AND DATA SHEETS		
☒	☒	☒	14 - ELECTRICAL AND INSTRUMENTATION SCHEMATICS AND BILL OF MATERIALS		
☐	☒	☒	15 - ELECTRICAL AND INSTRUMENTATION ARRANGEMENT DRAWINGS AND LIST OF CONNECTIONS		
☒	☒	☒	16 - CONTROL AND GOVERNOR SYSTEM DESCRIPTION AND SCHEMATIC (DOCUMENTATION AND DATA)		
☒	☒	☒	17 - OVERSPEED SHUTDOWN SYSTEM DESCRIPTION AND SCHEMATIC (DOCUMENTATION AND DATA)		
☒	☒	☒	18 - CURVES SHOWING STEAM FLOW VERSUS POWER		
☒	☒	☒	18a - CURVE SHOWING STEAM FLOW VERSUS THRUST BEARING LOAD		
☒	☒	☒	19 - CURVE SHOWING STEAM FLOW VERSUS FIRST-STAGE PRESSURE		
☒	☒	☒	20 - CURVES SHOWING STEAM FLOW VERSUS SPEED AND EFFICIENCY		
☒	☒	☒	21 - CURVE SHOWING STEAM FLOW VERSUS VALVE LIFT		
☒	☒	☒	22 - CURVES SHOWING EXTRACTION PERFORMANCE		
☒	☒	☒	23 - STEAM CORRECTION FACTORS AND CHARTS		
☐	☒	☒	24 - BLADING VIBRATION ANALYSIS [REMARK I]		
☐	☒	☒	25 - LATERAL CRITICAL SPEED ANALYSIS		
☐	☒	☒	26 - TORSIONAL CRITICAL SPEED ANALYSIS		
☐	☒	☒	26a - VIBRATION ANALYSIS DATA AND REPORT (MULTISTAGE TURBINE)		
☐	☒	☒	26b - DAMPED UNBALANCE RESPONSE ANALYSIS		

[illegible]

	DATA SHEET		No.		REV.	
					SHEET 4 of 7	
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS					
OIL SYSTEM						
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1 - CERTIFIED DIMENSIONAL OUTLINE DRAWING AND LIST OF CONNECTION			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2 - COMPONENTS DRAWINGS AND BILL OF MATERIALS			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3 - SYSTEM SCHEMATICS, BILL OF MATERIALS AND COMPONENTS SIZING CRITERIA			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3a - ASSEMBLY AND ARRANGEMENT DRAWINGS INCLUDING PARTS LIST			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4 - ASSEMBLY AND ARRANGEMENT DRAWINGS INCLUDING PARTS LIST			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5 - ELECTRICAL AND INSTRUMENTATION WIRING DIAGRAMS AND BILL OF MATERIALS			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5a - ELECTRICAL AND INSTRUMENTATION WIRING DIAGRAMS AND BILL OF MATERIALS			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6 - ELECTRICAL AND INSTRUMENTATION TERMINAL BOX LAYOUT AND LIST OF CONNECTIONS			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7 - CONSOLE TEST PROCEDURES			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7a - MATERIALS CERTIFICATES, TESTS PROCEDURES, REPORTS AND DATA			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7b - SPECIAL AND OPTIONAL TESTS PROCEDURES, REPORTS AND DATA			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8 - WELDING PROCEDURES, REPORTS AND DATA.			
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	9 - HYDROSTATIC TEST LOGS (PROCEDURES, REPORTS AND DATA)			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	10 - OPERATIONAL TEST LOGS (PROCEDURES, REPORTS AND DATA)			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	11 - DATA SHEETS (PROPOSAL / AS-BUILT) [REMARK I]			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12 - INSTALLATION, OPERATION AND MAINTENANCE MANUALS			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12a - FOUNDATION PLAN (WITH ANCHOR BOLTS LOCATION), WEIGHTS, STATIC / DYNAMIC LOADS AND CENTERS OF GRAVITY.			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13 - PROGRESS REPORT			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13a - QUALITY PLAN, INSPECTIONS, TESTING & NDT PROCEDURES, SCHEDULES, REPORTS AND DATA			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13b - ENGINEERING, FABRICATION AND DELIVERY SCHEDULES			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	14 - LIST OF RECOMMENDED SPARE PARTS WITH PART NUMBERS AND LIST OF INTERCHANGEABLE LIST OF RECOMMENDED SPARE PARTS WITH PART NUMBERS AND LIST OF INTERCHANGEABLE			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	15 - PRESSURE VESSEL CERTIFICATION DATA			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	16 - TECHNICAL DATA MANUAL [REMARK H]			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	17 - PRESERVATION, PACKING AND SHIPPING PROCEDURES			
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	18 - SHIPPING LIST			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19 - SYSTEM GENERAL DESCRIPTION AND CATALOGS			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20 - STANDARD / SPECIAL (DETAILED) REFERENCE LISTS			

		DATA SHEET		No.		REV.	
						SHEET 5 of 7	
		TITLE: VENDOR DRAWING AND DATA REQUIREMENTS					
MONITORING SYSTEM AND INSTRUMENTATION							
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1 - CERTIFIED GENERAL ARRANGEMENT OR OUTLINE DRAWING AND LIST OF CONNECTIONS				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2 - SECTIONAL DRAWING AND BILL OF MATERIALS (WITH PART LIST)				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2a - DESCRIPTION AND DETAILED DRAWINGS FOR THE INSTRUMENTATION OPERATION,				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2b - INSTRUMENTATION CABLE LIST WITH COMPLETE SPECIFICATION				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3 - CONTROL AND ELECTRICAL SYSTEM SCHEMATICS AND BILL OF MATERIALS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3a - ELETRONIC CARDS SCHEMATIC DRAWINGS				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4 - ELECTRICAL AND INSTRUMENTATION SYSTEM ARRANGEMENT PLANS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4a - INTERCONNECTION DIAGRAMS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5 - GROUNDING PLAN				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	6 - CALIBRATION CURVES (CERTIFIED)				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7 - ROTOR NODAL POINT ANALYSIS DATA				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8 - RECOMMENDED ALARM (ALERT) AND SHUTDOWN (DANGER) SETPOINTS				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8a - CONTROL AND SHUTDOWN / ALARM SPECIFICATION				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	9 - DATA SHEETS (ISA AND PETROBRAS) [REMARK I]				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	9a - CALCULATION SHEETS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	10 - DIMENSIONS AND DATA				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	11 - INSTALLATION MANUAL				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12 - OPERATING AND MAINTENANCE MANUAL				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12a - HARDWARE AND SOFTWARE MANUALS OF CONTROL AND SHUTDOWN / ALARM SYSTEM (INCLUDING LADDER DIAGRAM, PROGRAMING INSTRUCTION AND COMMUNICATION DRIVERS)				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13 - LIST OF RECOMMENDED SPARE PARTS WITH PART NUMBERS AND LIST OF INTERCHANGEABLE PARTS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	14 - ENGINEERING, FABRICATION AND DELIVERY SCHEDULE				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	14a - PROGRESS REPORTS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	15 - LIST OF DRAWINGS AND DOCUMENTS INDEX (STATUS AND DELIVERY SCHEDULE)				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	16 - SHIPPING LIST				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	17 - SPECIAL WEATHER PROTECTION (IF NECESSARY) AND TROPICALIZATION REQUIREMENTS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	18 - SPECIAL SYSTEM INTEGRITY PROTECTION REQUIREMENTS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	19 - LIST OF SPECIAL TOOLS				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	20 - TECHNICAL DATA MANUAL [REMARK H]				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	21 - MATERIAL SAFETY DATASHEETS				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	22 - INSTRUMENTATION VENDOR LIST AND MANUFACTURERS CATALOGUES				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23 - EMI AND RFI TEST ACCEPTANCE				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	24 - CAUSE X EFFECT DIAGRAM				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	25 - LOGIC DIAGRAM FOR START UP, ALARM AND SHUTDOWN SYSTEM				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	26 - LOOP DIAGRAMS				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	27 - PANEL HARDWARE AND SOFTWARE (DESCRIPTION OF LADDER AND BLOCK DIAGRAM, DRAWINGS, SPECIFICATION LAY-OUT, DATA SHEETS AND CABLE LIST)				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	28 - P&I DRAWINGS INCLUDING AS A MINIMUM: STEAM, SEAL GAS, ELECTRICITY, FUEL, WATER, LUBRICATION AND PROCESS GAS SYSTEM.				
NOTE 1 PROPOSAL DRAWINGS AND DATA DO NOT HAVE TO BE CERTIFIED OR AS-BUILT. NOTE 2 PURCHASER WILL INFORM IN CONTRACT, OFFICIAL DOCUMENTATION OR INDICATE IN THIS COLUMN THE DESIRED TIME FRAME FOR SUBMISSION OF MATERIALS USING THE API NOMENCLATURE. NOTE 3 BIDDER SHALL COMPLETE THIS COLUMN TO REFLECT HIS ACTUAL DISTRIBUTION SCHEDULE AND SHALL INCLUDE THIS FORM WITH HIS PROPOSAL. NOTE 4 ALL DOCUMENTS AND DRAWINGS SHALL ALSO BE PROVIDED IN MAGNETIC MEDIA (CD) AND SHALL BE ISSUED BY VENDOR. FILES SHALL BE IN ACCORDANCE WITH CONTRACT AND PETROBRAS REQUIREMENTS. NOTE 5 MANUFACTURER SHALL MERGE SIMILAR DOCUMENTS ASKED IN DIFFERENT LISTS, BUT IT SHALL BE CLEARLY STATED IN PROPOSAL, REVIEW AND FINAL PHASE WHERE ARE THE INFORMATION (ITEMS AND SUB-ITEMS).							

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				SHEET 6 of 7
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS			
REMARKS				
<p>1 Drawings, instruction books and other commercial or engineering data shall be in english or brazilian portuguese language, except for those from the brazilian market, which shall be in brazilian portuguese language. All data, drawings, hardware and equipment supplied to this specification shall use the SI system of measurements, except for ordinary piping, flanges, accessories and appurtenances, which shall be in inches.</p> <p>2 All drawings and documents (sub-suppliers documents included) shall be identified, as a minimum, with the following:</p> <ul style="list-style-type: none"> • Client's name; • Client's station; • Job location; • Purchaser's requisition number; • Purchaser's order number; • Tag number; • Service. <p>3 Revision boxes shall be provided to describe the latest revisions in full detail and an indication of revisions shall be made at revised information by such means as circled revision number.</p> <p>4 Installation, operation and maintenance manuals must be issued by equipment vendor in both Brazilian Portuguese and English, under vendor's responsibility.</p> <ul style="list-style-type: none"> • Independent (third-party) translations are not acceptable. • In case of conflicts between IOM instructions, Portuguese version shall prevail. • PETROBRAS will not take any responsibility on mistakes, actions or decisions based on, or originated from, mistranslated instructions provided by vendor. • Both languages shall be used in all Human – Machine Interfaces (HMI) computer screens installed on control panels. language selection shall be performed at any time, without requiring computer reset or disturbing any monitoring / control process being run by computer plc. • All warnings, such as caution, danger, hazardous signs and other basic safety instructions to be applied on equipment / component external surfaces, enclosures, doors, handles, levers, emergency stop buttons, etc. shall be supplied by vendor and shall be written in brazilian portuguese (primary text, in capital letters) and english (secondary text, with smaller fonts). • Ordinary / standard documentation of foreign items (main and auxiliary equipment) may be supplied in English. Whenever documents are written in languages other than English, then translations shall be provided as well. <p>5 The manuals shall be divided in three sections and shall included the topics below (minimum):</p> <p><u>Section I:</u></p> <ul style="list-style-type: none"> • All certified drawings; • Certified and illustrated part list (exploded views of internal parts); • Catalogues; • Technical specifications; • Performance curves for driven and driver equipment; • Calculation sheets; • Data sheets; • Dynamic loads for all operations conditions. <p><u>Section II:</u></p> <ul style="list-style-type: none"> • Instructions for storage and transportation; • Commissioning procedure; • Instructions for installation and operation (including auxiliaries); • Instructions for maintenance; • Maintenance procedures, including: disassembly, special tools, cleaning, inspection, repair and assembly of main equipment and auxiliaries. 				

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	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS			

Section III:

- Material certificates;
- Test certificates;
- Welding procedures;
- Quality plans;
- Electrical and electronic instrument certificates for area classification.

OBS: Vendor may be requested, at any time during service life of equipment, to provide additional information required to overcome problems related to the performance of supplied equipment.

6 All drawings shall have dimensions, tolerance and part number.

7 Foundation and baseplate drawings shall clearly show the weights and other loads at each point of support. If the equipment requires a supporting structure and where such structure is within purchaser scope of supply then vendor shall provide complete loading diagram.

8 Technical data book shall include spare parts for erection, commissioning test, start up and operation.

9 The vibration analysis data and lateral critical analysis report shall include: rotor analytical model, bearing data, seal clearance x amplitude, critical speed map, undamped rotor mode shapes, unbalance response plots, damped rotor mode shapes, rotor stability analysis. Vendor shall provide to PETROBRAS a recorded CD with vibration data (including vibration amplitude sweeping and vibration signature) and phase angle recorded during mechanical running test, including also signature and sweep diagram for all bearings (horizontal and vertical axis). A Goodman Diagram shall be provided for the highest stressed location of the rotor blade at the rated (guarantee) point. A Campbell Diagram shall be provided for the rotor blade including the blade natural frequencies operating range and potential exciting frequencies. All natural frequencies shall be at least 10 % away from exciting frequency.

10 All tests reports, data and curves shall be certified.

IR 1/1