

COMPONENT INSPECTION CYCLE AND DESIGNED LIFETIME

ROLL-IN / ROLL-OUT CYCLE, REFURBISHMENT CYCLES AND DESIGNED SERVICE LIFE OF THE OFFERED CAPITAL PARTS

Hot gas path capital parts and gas turbine rotor for the Siemens SGT5-2000E / V94.2 (Si3D) gas turbine unit, Phu My 2.1 Ext. Thermal Power Plant

Document No.: UNEW-GENCO3-PM21-LIFE-001, Rev. 02

Bid: Supply of capital and major spare parts for the Phu My 2.1 Ext. Thermal Power Plant, Phu My Thermal Power Company, EVNGENCO3

Scope: All 55 offered capital part line items, being the hot gas path parts of Items 1 to 27 of Attachment 1 to the Bidding Documents, together with the gas turbine rotor of the unit

Maintenance basis: Siemens 33MAC maintenance concept, Si3D hot gas path configuration

Date: 13 August 2026

1. Purpose

The Bidding Documents require the Bidder to provide documents stating the inspection and assessment cycle, referred to as the roll-in / roll-out cycle, and the designed lifetime of the offered goods. This document is issued in response to that requirement. It states, for every offered capital part line item, the inspection at which the item is accessed, whether the item is removed from the machine or assessed in place, the interval at which it is removed, the number of refurbishment cycles for which it is designed, the scope of work carried out at each cycle, the designed service life, the governing life limiting mechanism and the criterion on which the item is replaced rather than refurbished. The gas turbine rotor of the unit is stated on the same basis.

The values stated are the design values held by UNEW, Inc. as the designer and manufacturer of the offered parts. They are design values of the offered goods, stated for the maintenance configuration identified in Section 5 and for the machine configuration, operating duty and site environment recorded in Section 4 of document UNEW-GENCO3-PM21-TEC-001.

2. Reference Documents

Document	Title	Content used in this document
UNEW-GENCO3-PM21-TEC-001, Rev. 01	Technical characteristics analysis and comparison of the offered parts	Item schedule, part numbers, materials, coating systems, operating condition and working environment of every offered item
UNEW-PL-001, Rev. 00	UNEW Part List with installation location on the machine	Installation location and drawing item location number of every offered item
UNEW-CAT-001, Rev. 00	UNEW General Product Catalogue, Gas Turbine Capital Parts	Position, function, cooling arrangement, coating and manufacturing route of every offered item
UNEW-MATL-001, Rev. 00	UNEW Material Composition Schedule, Turbine and Compressor Blading	Material grades, maximum service temperatures and stage allocation

3. Definitions

The following terms are used throughout this document with the meanings given below.

Term	Meaning as used in this document
Equivalent Operating Hour (EOH)	The maintenance life counter of this engine class, combining the fired operating hours of the unit with the effect of starts, trips, load cycling, firing temperature and fuel type in accordance with the counting convention applied to the unit by the Owner. All intervals and lifetimes in this document are expressed in EOH on that basis
Roll-out	The removal of the service exposed set from the machine at a scheduled outage for inspection, assessment, refurbishment or replacement
Roll-in	The installation of a serviceable new or refurbished set in the machine, following shop inspection, repair, coating renewal and technical acceptance of that set
Roll-in / roll-out cycle	One complete loop of removal, inspection and assessment, refurbishment and reinstallation. The cycle is expressed as the interval in EOH at which it occurs
Assessed in place	The item is inspected in the machine, by borescope through the designated inspection ports or visually with the casing or combustion chamber open, and is not removed
Refurbishment cycle	One shop refurbishment of the item, carried out at a roll-out, restoring the item to a condition certified fit for a further interval
Non destructive examination cycle	One scheduled non destructive examination of the item at a roll-out, comprising visual, dimensional and fluorescent penetrant examination against the acceptance criteria of the governing procedure, carried out in place of a shop refurbishment. It may be performed at site with the row removed. Restoration work is carried out only where a finding requires it and is then reported separately
Designed lifetime	The nominal design and scheduled replacement planning point in EOH, inclusive of the refurbishment cycles stated, after which the item is replaced. It is not an automatic release to run limit
Replacement criterion	The finding at a roll-out on which the item is scrapped and replaced rather than refurbished and returned to service

4. Maintenance Concept and Inspection Intervals of the Unit

The offered parts are designed to the maintenance concept of the Siemens SGT5-2000E / V94.2 engine class in the Si3D configuration. The inspection events, the interval of each and the access afforded to the offered parts at each are stated below. The intervals are those of the unit; the roll-out interval of each individual item is stated in Section 7.

Inspection	Interval	Scope and access to the offered parts
Minor / Combustion Inspection (CI)	Approximately 8,000 EOH	Combustion system inspection, comprising the ceramic tiles, the hybrid burners and the fuel equipment. The turbine vanes and blades and the compressor blading are assessed in place, by borescope through the designated inspection ports and visually through the walk-in combustion chambers. No offered capital part is removed at this event
Hot Gas Path Inspection (HGPI)	33,000 EOH	Turbine vane rows 1 to 4 and turbine blade rows 1 to 4 are rolled out for shop inspection, assessment and, where applicable, refurbishment and coating renewal. The accessible rotor wheel areas, blade slots, dovetail and fir tree interfaces, stator carrier and casing interfaces are reviewed with the blading removed. Compressor blade rows 1 to 16 are assessed in place over the full flow path and are not removed



Inspection	Interval	Scope and access to the offered parts
Major Inspection (MI)	66,000 EOH, being every second Hot Gas Path Inspection	Full inspection of the rotor, the casings and the flow path in addition to the hot gas path scope. The rotor is withdrawn from the casing. The compressor blading is accessed and assessed in place; individual compressor blades are removed only where an inspection finding requires it
Rotor and Casing Inspection and Evaluation (RCIE)	At the Major Inspection, and non destructive examination of the rotor components at 3,000 starts	The disc stack, the blade root slots, the tie and coupling features and the casings are examined and evaluated for remaining life. The evaluation is normally planned in consultation with the engine designer approximately two years ahead of the Major Inspection falling in the range of 123,000 to 133,000 EOH

5. Applicable Maintenance Configuration

The intervals and lifetimes stated in this document depend on the maintenance configuration of the unit. Three configurations are current on this engine class. The values of Sections 7 and 8 are stated on the 33MAC basis, which corresponds to the Si3D hot gas path configuration operating principally on natural gas in continuous or intermediate duty. The values of one configuration must not be applied to a unit in another configuration without verification of the installed hardware, coatings, cooling arrangement, firing temperature and maintenance records.

Configuration	Hot Gas Path Inspection interval	Major Inspection interval	Application and component life planning points
25MAC	25,000 EOH	50,000 EOH	Units that have not received the hot gas path upgrade. The component lifetimes of Section 8 do not apply to a unit in this configuration and must not be assumed for it
33MAC	33,000 EOH	66,000 EOH	Upgraded and coated hot gas path in the Si3D configuration, operating principally on natural gas in continuous or intermediate duty. This is the basis of Sections 7 and 8 of this document and is the basis on which the offered parts are supplied
41MAC	Up to 41,000 EOH	Up to 82,000 EOH	Extended interval configuration. Where the installed hardware, coatings, cooling arrangement, firing temperature and maintenance records confirm this configuration, the planning points become approximately 82,000 EOH for the turbine blades of rows 1 and 2 and approximately 123,000 EOH for the eligible rear rows and vanes

The unit at Phu My 2.1 Ext. is in the Si3D configuration and UNEW accordingly applies the 33MAC concept as the planning basis of this document. Where the Owner advises that a different maintenance configuration is approved for the unit, UNEW will restate the intervals and lifetimes of Sections 7 and 8 on that basis and will confirm the result to the Owner in writing before manufacture.

6. Equivalent Operating Hour Convention

The lifetimes stated in this document are expressed in Equivalent Operating Hours counted on the convention applied to the unit by the Owner, comprising the fired operating hours together with the equivalent hours charged for each normal start, each fast start and each trip and for the operating severity factors of the unit. UNEW does not substitute a counting convention of its own. Where the Owner advises the convention applied at Phu My 2.1 Ext., UNEW will confirm the stated intervals and lifetimes against that convention in writing before manufacture, and will record the resulting figures in the order specific documentation.



The parts are individually serialised and are recorded against the delivery documentation, so that the accumulated EOH of every installed item can be tracked by the Owner from installation to each successive roll-out and against the designed lifetime stated in Section 8.

7. Roll-In / Roll-Out Cycle by Item

Item numbers are those of the offered schedule in document UNEW-GENCO3-PM21-TEC-001, Rev. 01. Part numbers, PB numbers and drawing item location numbers for each item are given in that document and in UNEW-PL-001, Rev. 00. The complete item schedule of the offered line items is given in Annex A to this document.

No.	Component group and offered items	Access at Combustion Inspection	Access at Hot Gas Path / Major Inspection	Roll-out interval	Condition on roll-in
1	Turbine vanes, row 1 — items 1 to 3	Assessed in place, borescope and visual	Rolled out. Removed complete as a row set	33,000 EOH	At the first roll-out the row is refurbished, recoated and certified to the governing drawing, with the throat area re-measured and recorded for the complete row, and a serviceable row is rolled in. At the second roll-out the row has reached its designed lifetime and is replaced
2	Turbine vanes, row 2 — items 4 to 6	Assessed in place, borescope and visual	Rolled out. Removed complete as a row set	33,000 EOH	Refurbished, recoated and certified to the governing drawing, with throat area re-measured and recorded for the complete row
3	Turbine vanes, row 3 — items 7 to 9	Assessed in place, borescope and visual	Rolled out. Removed complete as a row set	33,000 EOH	Refurbished on a condition basis and certified to the governing drawing, coating per drawing, throat area re-measured and recorded
4	Turbine vanes, row 4 — items 10 to 12	Assessed in place, borescope and visual	Rolled out. Removed complete as a row set	33,000 EOH	Subject to non destructive examination against the acceptance criteria of the governing procedure, which may be carried out at site with the row removed. Returned to service where the examination is satisfactory, with the throat area re-measured and recorded for the complete row. Restoration is carried out in the shop only where a finding requires it
5	Turbine blades, row 1 — items 13 to 15	Assessed in place, borescope	Rolled out. Removed complete as a wheel set with locking and weighted blades	33,000 EOH	At the first roll-out the set is refurbished and recoated and a serviceable set is rolled in. At the second roll-out the set has reached its designed lifetime and is replaced
6	Turbine blades, row 2 — items 16 to 18	Assessed in place, borescope	Rolled out. Removed complete as a wheel set with locking and weighted blades	33,000 EOH	At the first roll-out the set is refurbished and recoated and a serviceable set is rolled in. At the second roll-out the set has reached its designed lifetime and is replaced



No.	Component group and offered items	Access at Combustion Inspection	Access at Hot Gas Path / Major Inspection	Roll-out interval	Condition on roll-in
7	Turbine blades, row 3 — items 19 to 21	Assessed in place, borescope	Rolled out. Removed complete as a wheel set with locking and weighted blades	33,000 EOH	Subject to non destructive examination against the acceptance criteria of the governing procedure, which may be carried out at site with the row removed. Returned to service where the examination is satisfactory, with the moment weight re-verified and the distribution chart re-issued for the complete wheel set. Restoration is carried out in the shop only where a finding requires it. Where the row 3 configuration of the unit is confirmed as stated in the note to Section 8, the row is instead refurbished at the first roll-out and replaced at the second
8	Turbine blades, row 4 — items 22 and 23	Assessed in place, borescope	Rolled out. Removed complete as a wheel set with locking and closing blades	33,000 EOH	Subject to non destructive examination against the acceptance criteria of the governing procedure, which may be carried out at site with the row removed. Returned to service where the examination is satisfactory, with the moment weight re-verified and the distribution chart re-issued for the complete wheel set. Restoration is carried out in the shop only where a finding requires it
9	Compressor blades, stages 1 to 4 — items 24 to 31	Assessed in place, borescope through the compressor inspection ports and from the inlet plenum with the inlet guide vanes open	Assessed in place over the full flow path with the casing open. Not rolled out at a scheduled interval	No scheduled roll-out. Rolled out only on an inspection finding, or at the end of the designed lifetime	Where cleaning, blending within the drawing limit or re-peening is carried out, the blade is returned to service in the machine in the same outage
10	Compressor blades, stages 5 to 10 — items 32 to 43	Assessed in place, borescope through the compressor inspection ports	Assessed in place over the full flow path with the casing open. Not rolled out at a scheduled interval	No scheduled roll-out. Rolled out only on an inspection finding, or at the end of the designed lifetime	Where cleaning or blending within the drawing limit is carried out, the blade is returned to service in the machine in the same outage
11	Compressor blades, stages 11 to 16 — items 44 to 55	Assessed in place, borescope through the compressor inspection ports	Assessed in place over the full flow path with the casing open. Not rolled out at a scheduled interval	No scheduled roll-out. Rolled out only on an inspection finding, or at the end of the designed lifetime	Where cleaning or blending within the drawing limit is carried out, the blade is returned to service in the machine in the same outage



No.	Component group and offered items	Access at Combustion Inspection	Access at Hot Gas Path / Major Inspection	Roll-out interval	Condition on roll-in
12	Gas turbine rotor, compressor and turbine disc stack	Not accessed	Blade root slots, dovetail and fir tree interfaces and accessible wheel surfaces inspected in place with the blading removed at the Hot Gas Path Inspection. At the Major Inspection the rotor is withdrawn from the casing and a Rotor and Casing Inspection and Evaluation is carried out	Withdrawn at the Major Inspection, at 66,000 EOH. Non destructive examination of the rotor components at 3,000 starts	Returned to service following the Rotor and Casing Inspection and Evaluation, with the blade root slots, the dovetail and fir tree interfaces, the tie and coupling features and the wheel surfaces recorded

Note on item 12: the gas turbine rotor is stated in this document because the roll-out cycle of the turbine vanes and blades and the designed lifetime of the compressor blading are set by reference to it, and the Owner requires the two to be read together. UNEW, Inc. designs, manufactures and supplies gas turbine rotors and rotor components for this engine class and will quote on the Owner's requirement.

8. Designed Lifetime by Item

The designed lifetime stated is the nominal design and scheduled replacement planning point, inclusive of the refurbishment cycles stated in the same row, on the 33MAC basis of Section 5. It is not an automatic release to run limit. The disposition of any item at any roll-out is determined by the condition assessment carried out at that roll-out against the replacement criterion stated.

No.	Component group and offered items	Refurbishment or examination cycles	Designed lifetime	Intervals to lifetime	Governing life limiting mechanism	Replacement criterion at roll-out
1	Turbine vanes, row 1 — items 1 to 3	One (1), at approximately 33,000 EOH	66,000 EOH	Two (2)	Thermal mechanical fatigue of the platforms under start and stop cycling, accumulated cooling passage degradation, oxidation and type I hot corrosion of the airfoil. This row carries the highest gas temperature and the most severe platform loading of the vane rows	Platform or airfoil cracking beyond the weld repair limit of the drawing, wall thickness below the drawing minimum, cooling passage degradation beyond the acceptance criteria, base metal loss or airfoil distortion, or throat area outside the drawing band after restoration



No.	Component group and offered items	Refurbishment or examination cycles	Designed lifetime	Intervals to lifetime	Governing life limiting mechanism	Replacement criterion at roll-out
2	Turbine vanes, row 2 — items 4 to 6	Two (2), at approximately 33,000 and 66,000 EOH	100,000 EOH	Three (3)	Thermal mechanical fatigue of the platforms under start and stop cycling, accumulated cooling passage degradation, oxidation and type I hot corrosion of the airfoil	Platform or airfoil cracking beyond the weld repair limit of the drawing, wall thickness below the drawing minimum, cooling passage degradation beyond the acceptance criteria, base metal loss or airfoil distortion, or throat area outside the drawing band after restoration
3	Turbine vanes, row 3 — items 7 to 9	Two (2), on a condition basis	100,000 EOH	Three (3)	Low temperature hot corrosion, deposit formation and aerodynamic loading into the exhaust diffuser	Cracking beyond the weld repair limit, wall thickness below the drawing minimum, or throat area outside the drawing band after restoration
4	Turbine vanes, row 4 — items 10 to 12	Two (2) non destructive examinations, at approximately 33,000 and 66,000 EOH, which may be carried out at site	100,000 EOH	Three (3)	Low temperature hot corrosion, deposit formation and aerodynamic loading into the exhaust diffuser	Cracking beyond the weld repair limit, wall thickness below the drawing minimum, or throat area outside the drawing band after restoration
5	Turbine blades, rows 1 and 2 — items 13 to 18	One (1), at approximately 33,000 EOH	66,000 EOH	Two (2)	Creep under combined thermal and centrifugal load, low and high cycle fatigue, oxidation of the internal cooling passages and type I hot corrosion. These rows carry the highest thermal and mechanical loading of the machine	Creep elongation beyond the drawing limit, internal oxidation of the cooling passages, wall thickness below the drawing minimum, cracking extending into the fir tree root, insufficient tip material for a further weld build-up, or failure to meet the metallurgical acceptance criteria after rejuvenation heat treatment
6	Turbine blades, row 3 — items 19 to 21	Two (2) non destructive examinations, at approximately 33,000 and 66,000 EOH, which may be carried out at site	100,000 EOH	Three (3)	High centrifugal and vibratory loading, shroud contact loading, fatigue and deposit formation	Shroud wear beyond the restoration limit, cracking extending into the fir tree root, natural frequency outside the drawing band after repair, or moment weight outside the classification band



No.	Component group and offered items	Refurbishment or examination cycles	Designed lifetime	Intervals to lifetime	Governing life limiting mechanism	Replacement criterion at roll-out
7	Turbine blades, row 4 — items 22 and 23	Two (2) non destructive examinations, at approximately 33,000 and 66,000 EOH, which may be carried out at site	100,000 EOH	Three (3)	High centrifugal and vibratory loading, shroud contact loading, fatigue and deposit formation	Shroud wear beyond the restoration limit, cracking extending into the fir tree root, natural frequency outside the drawing band after repair, or moment weight outside the classification band
8	Compressor blades, stages 1 to 4 — items 24 to 31	None scheduled. In-situ cleaning, blending and re-peening within the drawing limits	100,000 EOH minimum, matched to the service life of the compressor rotor set	Three (3) or more, without roll-out	Pitting corrosion from salt bearing and humid intake air initiating high cycle fatigue, and particulate and droplet erosion of the leading edge	Pitting or erosion beyond the blend limit of the drawing, cracking at the dovetail root or in the airfoil, natural frequency outside the drawing band, or blade untwist beyond the drawing limit
9	Compressor blades, stages 5 to 10 — items 32 to 43	None scheduled. In-situ cleaning and blending within the drawing limits	100,000 EOH minimum, matched to the service life of the compressor rotor set	Three (3) or more, without roll-out	Corrosion from carry over of salt and moisture, fouling and deposit formation, high cycle fatigue	Corrosion pitting beyond the blend limit of the drawing, cracking at the dovetail root or in the airfoil, or natural frequency outside the drawing band
10	Compressor blades, stages 11 to 16 — items 44 to 55	None scheduled. In-situ cleaning and blending within the drawing limits	100,000 EOH minimum, matched to the service life of the compressor rotor set	Three (3) or more, without roll-out	Elevated temperature strength duty at compressor discharge condition, fouling and deposit formation, high cycle fatigue	Cracking at the dovetail root or in the airfoil, material degradation on metallurgical assessment, or natural frequency outside the drawing band
11	Gas turbine rotor, compressor and turbine disc stack	Not applicable. Rotor and Casing Inspection and Evaluation at the Major Inspection	100,000 EOH first design service life, extendable by a further 66,000 EOH to 166,000 EOH following evaluation. A further extension to 200,000 EOH in total may be considered where the evaluation supports it	Three (3) to the first design service life	Low cycle fatigue of the disc bores and of the blade root slots under start and stop cycling, creep of the turbine discs, fretting at the blade root and tie interfaces	Indications at the disc bore, at the blade root slots or at the tie and coupling features beyond the acceptance criteria of the non destructive examination procedure, or disc growth beyond the drawing limit

Continuation of any item beyond the designed lifetime stated above requires a unit specific lifetime extension inspection and a documented residual life assessment and engineering disposition. Rear turbine rows found satisfactory at 100,000 EOH may be considered for one further interval of up to approximately 33,000 EOH only on that basis. The values stated for the row 3 turbine blades apply to the row 3 configuration of the unit as offered. Where the row 3 configuration or upgrade



standard installed in the unit is confirmed to be otherwise, the row 3 turbine blades are stated on the same basis as rows 1 and 2, being one refurbishment cycle and a designed lifetime of 66,000 EOH over two intervals, and UNEW will confirm the applicable basis to the Owner in writing before manufacture.

9. Scope of Work at Each Roll-Out

The following scope is carried out on the item at each roll-out. The complete scope is recorded item by item and serial number by serial number, and the records are issued to the Owner with the returned parts.

No.	Component group	Work carried out at each roll-out
1	Turbine vanes, rows 1 and 2	Receipt inspection and serial number verification; coating strip; fluorescent penetrant inspection; cooling passage inspection and cleaning; dimensional and coordinate measurement against the governing drawing; weld repair of the platforms, the airfoil and the trailing edge within the drawing limits; restoration of the sealing and carrier interfaces; throat area restoration and measurement; MCrAlY overlay coating reapplication under Nadcap accredited process control; coating thickness, adhesion and metallographic verification; final dimensional and throat area record
2	Turbine vanes, row 3	Receipt inspection and serial number verification; coating strip where the drawing requires it; fluorescent penetrant inspection; dimensional and coordinate measurement; weld repair within the drawing limits; restoration of the sealing and carrier interfaces; throat area restoration and measurement; coating reapplication per drawing; final dimensional and throat area record
3	Turbine vanes, row 4	Receipt inspection and serial number verification; visual examination of the airfoil, the platforms and the sealing and carrier interfaces; fluorescent penetrant inspection to the governing procedure; dimensional and coordinate measurement and throat area measurement against the governing drawing; assessment of the findings against the acceptance criteria; issue of the examination record and of the throat area record for the complete row. The examination may be carried out at site with the row removed, in which case a site examination report is issued in place of a shop record. No coating strip and no scheduled shop restoration is carried out. Where a finding exceeds the acceptance criteria the vane is returned to the shop for weld repair, throat area restoration and coating per drawing on a condition basis, and that work is recorded separately
4	Turbine blades, rows 1 and 2	Receipt inspection and serial number verification; thermal barrier and bond coat strip; fluorescent penetrant inspection; internal cooling passage inspection and cleaning; dimensional and coordinate measurement against the governing drawing; tip weld build-up and crack repair within the drawing limits; rejuvenation heat treatment with metallurgical verification of the gamma prime structure; internal aluminide diffusion coating restoration; MCrAlY bond coat and, where the drawing requires it, yttria stabilised zirconia thermal barrier coating reapplication under Nadcap accredited process control; airflow test where the drawing specifies it; natural frequency check; moment weight measurement, re-classification and issue of the distribution chart for the complete wheel set
5	Turbine blades, rows 3 and 4	Receipt inspection and serial number verification; visual examination of the airfoil, the tip shroud, the contact faces and the fir tree root; fluorescent penetrant inspection to the governing procedure; dimensional and coordinate measurement against the governing drawing; natural frequency check; moment weight verification and re-issue of the distribution chart for the complete wheel set; assessment of the findings against the acceptance criteria and issue of the examination record. The examination may be carried out at site with the row removed, in which case a site examination report is issued in place of a shop record. No scheduled shop restoration is carried out. Where a finding exceeds the acceptance criteria the blade is returned to the shop for tip shroud and contact face restoration, crack repair and coating per drawing on a condition basis, and that work is recorded separately

No.	Component group	Work carried out at each roll-out
6	Compressor blades, stages 1 to 16	No scheduled shop refurbishment and no coating is applied to the compressor blading. At each inspection the blading is examined in place over the leading edges, the trailing edges, the airfoil surfaces, the tips, the visible root and platform areas and the surrounding flow path, and the flow path is reviewed for deposits, corrosion marks, contact marks, abnormal rub and loose material. Cleaning, blending of minor leading edge damage within the blend limit of the drawing and, for the titanium stages, re-peening of the blended area are carried out in the machine and recorded. Where a finding exceeds the drawing limit the affected blade is rolled out and replaced
7	Gas turbine rotor, compressor and turbine disc stack	No shop refurbishment at the Hot Gas Path Inspection. At each Hot Gas Path Inspection, with the blading removed, the accessible rotor wheel areas, the blade slots, the locking areas, the dovetail and fir tree interfaces and the surrounding wheel surfaces are reviewed and recorded, and the stator carrier, casing grooves, seal locations and locating surfaces are checked before close-out. At the Major Inspection the rotor is withdrawn and a Rotor and Casing Inspection and Evaluation is carried out, comprising non destructive examination of the disc bores, the blade root slots and the tie and coupling features, dimensional recording of the disc stack, and evaluation of the remaining life of the rotor. Non destructive examination of the rotor components is carried out at 3,000 starts

10. Life Limiting Factors at the Site of Installation

The designed lifetimes stated above are the values for the working environment of the Phu My 2.1 Ext. site, being a tropical coastal location with high ambient humidity through the year, salt bearing marine air drawn into the compressor intake and an industrial atmosphere, and for base load and mid merit duty with daily and weekly start and stop cycles. Three factors govern.

First, for the compressor blading the governing mechanism at a coastal site is pitting corrosion initiated by carry over of salt into the compressor, which acts as an initiation site for high cycle fatigue. It is not creep. The offered blading is supplied in titanium at the wet forward stages and in 12 to 14 percent chromium martensitic stainless steel from stage 5 onward, and the titanium stages are shot peened to introduce a compressive residual stress at the surface, which are the material and process selections that address that mechanism. The lifetime stated for the compressor blading assumes that the compressor intake filtration and the offline and online washing regime of the plant are maintained in accordance with the plant procedure.

Second, for the turbine vanes the governing mechanism under daily and weekly cycling is thermal mechanical fatigue of the platforms, not creep of the airfoil. The offered vane material is a solid solution strengthened cobalt base grade carrying 29.5 percent chromium, selected for thermal fatigue and hot corrosion resistance, and the refurbishment scope of Section 9 is built around a platform weld repair programme for that reason. The row 1 vanes carry the highest gas temperature and the most severe platform loading of the vane rows, and their designed lifetime is accordingly stated over two intervals at 66,000 EOH, against three intervals at 100,000 EOH for the vanes of rows 2 to 4.

Third, for the turbine blades of rows 1 and 2 the governing mechanisms are creep under combined thermal and centrifugal load together with oxidation of the internal cooling passages, and it is these mechanisms that set the two interval lifetime stated for those rows. The offered blade material is the low carbon variant of the nickel base grade, selected to control carbide morphology and improve thermal fatigue resistance under cycling, and the internal surfaces carry an aluminide diffusion coating to resist intergranular oxidation of the cooling passages.

Where the Owner advises an operating regime, a fuel specification or a site condition materially different from that recorded in Section 4 of document UNEW-GENCO3-PM21-TEC-001, UNEW will reassess the stated intervals and lifetimes for the affected items before manufacture and will confirm the result to the Owner in writing.

11. Basis and Qualifications

The intervals and lifetimes stated in this document are engineering design values. They are stated on the following basis, and the Bidder records the following qualifications so that the values are not read beyond their intended effect.

Element	Basis or qualification
Design ownership	UNEW, Inc. is the designer and manufacturer of every item offered and holds the complete technical record for each item, comprising the governing drawings, the material specification, the coating specification, the manufacturing route, the repair procedures and the inspection criteria. The values in this document are taken from that record and can be produced for verification by the Owner
Maintenance configuration	The values are stated on the 33MAC basis identified in Section 5. They must not be applied to a unit in the 25MAC configuration, and the extended values of the 41MAC configuration apply only where the installed hardware, coatings, cooling arrangement, firing temperature and maintenance records confirm that configuration
Condition assessment governs	The designed lifetime is a nominal design and scheduled replacement planning point. It is not an automatic release to run limit. The disposition of any individual item at any roll-out is determined by the condition assessment carried out at that roll-out against the replacement criteria of Section 8, using visual and dimensional inspection, the applicable non destructive examination, the coating and cooling passage condition, the material condition and the operating and repair history of the item. An item that meets a replacement criterion is replaced irrespective of the EOH accumulated
Operating conditions assumed	The values assume operation within the machine data, the operating duty, the fuel condition and the site environment recorded in Section 4 of document UNEW-GENCO3-PM21-TEC-001, and the maintenance of the compressor intake filtration and washing regime in accordance with the plant procedure
EOH counting	The values are expressed in Equivalent Operating Hours counted on the convention applied to the unit by the Owner, as stated in Section 6. EOH, starts and calendar age are planning controls and do not replace engineering acceptance
Relationship to the warranty	The designed lifetime stated in this document is an engineering design value for the service life of the component. It is not a warranty and does not extend, replace or modify the warranty of the offered goods, which is that stated in the Bidding Documents and in the Bid
Records issued with the goods	Every capital part is individually serialised and recorded against the delivery documentation, and the certificates, dimensional records, non destructive testing results and coating records listed in Section 15 of document UNEW-GENCO3-PM21-TEC-001 are issued with the goods, so that the Owner can track the accumulated life of each installed item against the values stated in this document

12. Technical References

The maintenance concept and the inspection interval structure of the engine class described in Sections 4 and 5 are documented in the following published technical literature. The component values of Sections 7 and 8 are the design values of UNEW, Inc. as stated in Section 11.

No.	Reference
1	Bohrenkämper, G., Bals, H., Wrede, U. and Umlauf, R., "Hot-Gas-Path Life Extension Options for the V94.2 Gas Turbine", Proceedings of the ASME Turbo Expo 2000, Munich, 8 to 11 May 2000, Paper 2000-GT-0178, DOI 10.1115/2000-GT-0178
2	Siemens AG, Power Generation, "Technology Evolution of the Proven Gas Turbine Models V94.2 and V84.2 for New Units and Service Retrofits", 2004
3	Siemens AG, "Lifetime Extension for Siemens Gas Turbines VX4.2 / VX4.3 / VX4.3A", Power-Gen Europe, 2006

No.	Reference
4	Siemens Energy, SGT5-2000E heavy-duty gas turbine, technical features and serviceability, product information

13. Conclusion

For every one of the 55 offered capital part line items, being the hot gas path parts of Items 1 to 27 of Attachment 1 to the Bidding Documents, and for the gas turbine rotor of the unit, this document states the inspection at which the item is accessed, whether the item is rolled out or assessed in place, the roll-out interval in Equivalent Operating Hours, the number of refurbishment cycles for which the item is designed, the scope of work carried out at each cycle, the designed service life, the governing life limiting mechanism and the criterion on which the item is replaced.

On the 33MAC maintenance concept applicable to this unit, the turbine vanes of rows 1 to 4 are rolled out at each 33,000 EOH Hot Gas Path Inspection. The row 1 vanes are designed for one refurbishment cycle and have a designed lifetime of 66,000 Equivalent Operating Hours over two intervals. The vanes of rows 2 and 3 are designed for two refurbishment cycles and have a designed lifetime of 100,000 Equivalent Operating Hours over three intervals. The row 4 vanes are designed for two non destructive examination cycles, which may be carried out at site, and have a designed lifetime of 100,000 Equivalent Operating Hours over three intervals. The turbine blades of rows 1 and 2 are rolled out at the same interval, are designed for one refurbishment cycle and have a designed lifetime of 66,000 Equivalent Operating Hours over two intervals. The turbine blades of rows 3 and 4 are rolled out at the same interval, are designed for two non destructive examination cycles, which may be carried out at site, and have a designed lifetime of 100,000 Equivalent Operating Hours over three intervals, subject for row 3 to the configuration qualification stated in the note to Section 8. The compressor blades of stages 1 to 16 are assessed in place, have no scheduled roll-out and no applied coating, and have a designed lifetime of not less than 100,000 Equivalent Operating Hours matched to the service life of the compressor rotor set. The gas turbine rotor is withdrawn at the Major Inspection at 66,000 Equivalent Operating Hours for Rotor and Casing Inspection and Evaluation and has a first design service life of 100,000 Equivalent Operating Hours, extendable by a further 66,000 Equivalent Operating Hours to 166,000 Equivalent Operating Hours following evaluation.

For and on behalf of UNEW, Inc.



Ronald Miller
Operations Director



UNEW, Inc.

2570 N. First Street, 2nd Floor, San Jose, CA 95131, United States | T: +1 408-892-2364 | info@unew.us.com

Annex A — Item Schedule of the Offered Line Items

No.	Part No.	PB No.	MBCSN / Drawing Item Location	Description
1	A2A50021940-G001	PB0000251001	MBCSN10.0101	Standard Turbine Vane Segment, Row 1.
2	A2A50021941-G002	PB0000251002	MBCSN90.0002	Joint/Lead Vane Segment, Row 1.
3	A2A50021942-G003	PB0000251003	MBCSN90.0003	Instrumented/Transition Vane Segment, Row 1.
4	A2A50024312-G001	PB0000251004	MBCSN10.0204	Standard Turbine Vane Segment, Row 2.
5	A2A50024312-G002	PB0000251005	MBCSN90.0005	Joint Vane Segment, Row 2.
6	A2A50024312-G003	PB0000251006	MBCSN10.0206	Instrumented Turbine Vane Segment, Row 2.
7	A2A5116244-G001	PB0000251007	MBCSN10.0307	Standard Turbine Vane Segment, Row 3.
8	A2A5116244-G002	PB0000251008	MBCSN90.0008	Joint Vane Segment, Row 3.
9	A2A5116244-G003	PB0000251009	MBCSN10.0309	Instrumented Turbine Vane Segment, Row 3.
10	A2A5118611-G001	PB0000251010	MBCSN10.0410	Standard Turbine Vane Segment, Row 4.
11	A2A5118611-G002	PB0000251011	MBCSN90.0011	Joint Vane Segment, Row 4.
12	A2A5118611-G003	PB0000251012	MBCSN10.0412	Instrumented Turbine Vane Segment, Row 4.
13	A2A50012458-G001	PB0000252001	MBCSN11.0113	Standard Turbine Blade, Row 1.
14	A2A50012458-G002	PB0000252002	MBCSN11.0114	Locking Turbine Blade, Row 1.
15	A2A50012458-G003	PB0000252003	MBCSN90.0015	Weighted / Balanced Segment Blade, Row 1.
16	A2A50014822-G001	PB0000252004	MBCSN11.0216	Standard Turbine Blade, Row 2.



No.	Part No.	PB No.	MBCSN / Drawing Item Location	Description
17	A2A50014822-G002	PB0000252005	MBCSN11.0217	Locking Turbine Blade, Row 2.
18	A2A50014822-G003	PB0000252006	MBCSN90.0018	Weighted / Balanced Segment Blade, Row 2.
19	A2A50113110-G001	PB0000252007	MBCSN11.0319	Standard Turbine Blade, Row 3.
20	A2A50113110-G002	PB0000252008	MBCSN11.0320	Locking Turbine Blade, Row 3.
21	A2A50113110-G003	PB0000252009	MBCSN90.0021	Weighted / Balanced Segment Blade, Row 3.
22	A2A50113110-G004	PB0000252010	MBCSN11.0422	Standard Turbine Blade, Row 4.
23	A2A50113110-G005	PB0000252011	MBCSN11.0423	Locking Blades (Master Blades / Closing Blades) , Row 4,
24	A2A2001101-G001	PB0000253001	MBCSN22.0123	Standard Compressor Blade, Row 1.
25	A2A2001101-G002	PB0000253002	MBCSN22.0124	Locking Compressor Blade, Row 1.
26	A2A2001102-G001	PB0000253003	MBCSN22.0225	Standard Compressor Blade, Row 2.
27	A2A2001102-G002	PB0000253004	MBCSN22.0226	Locking Compressor Blade, Row 2.
28	A2A2001103-G001	PB0000253005	MBCSN22.0327	Standard Compressor Blade, Row 3.
29	A2A2001103-G002	PB0000253006	MBCSN22.0328	Locking Compressor Blade, Row 3.
30	A2A2001104-G001	PB0000253007	MBCSN22.0429	Standard Compressor Blade, Row 4.
31	A2A2001104-G002	PB0000253008	MBCSN22.0430	Locking Compressor Blade, Row 4.
32	A2A2001105-G001	PB0000253009	MBCSN22.0531	Standard Compressor Blade, Row 5.
33	A2A2001105-G002	PB0000253010	MBCSN22.0532	Locking Compressor Blade, Row 5.
34	A2A2001106-G001	PB0000253011	MBCSN22.0633	Standard Compressor Blade, Row 6.
35	A2A2001106-G002	PB0000253012	MBCSN22.0634	Locking Compressor Blade, Row 6.
36	A2A2001107-G001	PB0000253013	MBCSN22.0735	Standard Compressor Blade, Row 7.
37	A2A2001107-G002	PB0000253014	MBCSN22.0736	Locking Compressor Blade, Row 7.
38	A2A2001108-G001	PB0000253015	MBCSN22.0837	Standard Compressor Blade, Row 8.
39	A2A2001108-G002	PB0000253016	MBCSN22.0838	Locking Compressor Blade, Row 8.
40	A2A2001109-G001	PB0000253017	MBCSN22.0939	Standard Compressor Blade, Row 9.
41	A2A2001109-G002	PB0000253018	MBCSN22.0940	Locking Compressor Blade, Row 9.
42	A2A2001110-G001	PB0000253019	MBCSN22.1041	Standard Compressor Blade, Row 10.
43	A2A2001110-G002	PB0000253020	MBCSN22.1042	Locking Compressor Blade, Row 10.
44	A2A2001111-G001	PB0000253021	MBCSN22.1143	Standard Compressor Blade, Row 11.
45	A2A2001111-G002	PB0000253022	MBCSN22.1144	Locking Compressor Blade, Row 11.
46	A2A2001112-G001	PB0000253023	MBCSN22.1245	Standard Compressor Blade, Row 12.
47	A2A2001112-G002	PB0000253024	MBCSN22.1246	Locking Compressor Blade, Row 12.
48	A2A2001113-G001	PB0000253025	MBCSN22.1347	Standard Compressor Blade, Row 13.
49	A2A2001113-G002	PB0000253026	MBCSN22.1348	Locking Compressor Blade, Row 13.



No.	Part No.	PB No.	MBCSN / Drawing Item Location	Description
50	A2A2001114-G001	PB0000253027	MBCSN22.1449	Standard Compressor Blade, Row 14.
51	A2A2001114-G002	PB0000253028	MBCSN22.1450	Locking Compressor Blade, Row 14.
52	A2A2001115-G001	PB0000253029	MBCSN22.1551	Standard Compressor Blade, Row 15.
53	A2A2001115-G002	PB0000253030	MBCSN22.1552	Locking Compressor Blade, Row 15.
54	A2A2001116-G001	PB0000253031	MBCSN22.1653	Standard Compressor Blade, Row 16.
55	A2A2001116-G002	PB0000253032	MBCSN22.1654	Locking Compressor Blade, Row 16.
56	Not applicable	Not applicable	Not applicable	Gas turbine rotor, compressor and turbine disc stack. see the note to Section 7.