adrian.bertoni@dpe.com.ar

FOLIO 197

FOLIO 121

De: "Ogden, David" <dogden@rwgroup.com>
Fecha: Jueves, 22 de Agosto de 2013 12:40
Para: <adrian.bertoni@dpe.com.ar>
CC: <JuanP@dpe.tierradelfuego>; <Manuel@dpe.tierradelfuego>; "Tecmasa" <tecmasa@tecmasa.com.ar>; "Leandro Garcia" <leandrogarcia@tecmasa.com.ar>; "Mariano Alvarez - TECMASA" <marianoalvarez@tecmasa.com.ar>; "Powell, Kevin" <kpowell@rwgroup.com>
Asunto: RE: RB211 Ushuaia

Mr Bertoni,

Thank you for your e mail.

As per my previous correspondence, I can confirm that Rolls Wood Group are able to provide DPE with an exchange RB211 -24G unit. The engine we would provide is currently undergoing repair/rework, following which it will require to be built and tested.

We are reviewing all the material requirements at the moment, so we can provide you with a firm delivery schedule in due course. However, I would anticipate that the final test of the engine will be around mid-October, therefore would expect you would see it in Ushuaia late October, or early November. We will endeavour to improve on this if possible, but would suggest you use this timescale for planning purposes at the present time.

I trust the above is of assistance, and will be in touch again shortly with further details, and our formal proposal.

In the meantime, please do not hesitate to contact me should you have any further questions.

Dave Ogden
RB211 Senior Project Engineer
Direct: +44 (0) 1224 797153
Mobile: +44 (0) 7917 772347
Email: dogden@rwgroup.com
www.rwgroup.com

Rolls Wood Group
Repair & Overhaul Expertise
RB211 Facility, Kirkhill Drive, Kirkhill Industrial Estate, Dyce, Aberdeen, AB21 0EU, United Kingdom.

From: adrian.bertoni@dpe.com.ar [mailto:adrian.bertoni@dpe.com.ar]
Sent: 20 August 2013 15:18
To: Ogden, David
Subject: Fw: RB211 Ushuaia

Direct: +44 (0) 1224 797153
From: Adrián Bertoni
Sent: Monday, August 19, 2013 12:42 PM
To: dogden@rwgroup.com
Cc: Juan Pablo Marini ; Manuel Miranda ; Adrián Bertoni

ING. ADRIAN BERTONI
Director
Dirección Provincial de Energía

23/08/2013

From: Adrián Bertoni

TRADUCION LIBRE

Sr. Bertoni,

Gracias por su correo electrónico usted.

Según mi correspondencia anterior, puedo confirmar que Rolls Wood Group son capaces de proporcionar DPE con un intercambio de la unidad RB211-24G. El motor se encuentra actualmente en la reparación / repetición del trabajo, tras lo cual será construido y probado.

Estamos revisando todos los requisitos materiales en el momento, por lo que podemos ofrecerle con un horario de entrega firme en su debido momento. Sin embargo, yo anticipo que la prueba final de que el motor será a mediados de octubre, por lo tanto, cabe esperar que se vería en Ushuaia a fines de octubre o principios de noviembre. Haremos todo lo posible para mejorar en esto si es posible, pero le sugerimos que utilice esta escala de tiempo para la planificación en el tiempo presente.

Confío en que la anterior es de la asistencia, y pondré en contacto de nuevo en breve con más detalles, y nuestra propuesta formal.

Mientras tanto, por favor no dude en ponerse en contacto conmigo si tiene alguna duda

ING. ADRIAN BERTONI
Director
Dirección Provincial de [illegible]

Tierra del Fuego, Antártida e Islas del Atlántico Sur
FOLIO 199

FOLIO 122

Poder Legislativo
FOLIO 122

Subject: RB211 Ushuaia

Dear Mr. Owens, thanks for your quick response. In order to continue the analysis for the maintenance of our RB211 engine, I'd appreciate to estimate as soon as possible, how long your engine would be available for exchange. (Item 4 of our previous mail)
This information is important for planning the commissioning of various electrical equipments our thermal plant.
Thank you for your cooperation.

Ing. Adrian Bertoni
Director
DPE

your engine would be available for exchange. (Item 4 of our previous mail)

any use or disclosure of this email or any

23/08/2013

PROVINCIA DE TIERRA DEL FUEGO,
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

FOLIO 200

FOLIO 124

Nota DPE 2134/13
Ushuaia, 26/08/13

Legislativo FOLIO 124

Sr.
Vice Gobernador
de la Provincia de Tierra del Fuego
Don Roberto Crocianelli

En mi carácter de Presidente de la Dirección Provincial de Energía, elevo a vuestra consideración el proyecto de acto administrativo correspondiente a la contratación directa del asunto "sobre reparación mayor Rolls Royce RB211" que se tramita mediante EXP interno DPE 426/2012.

Atento al desarrollo del mismo, se observa la obtención de dos cotizaciones de empresas autorizadas por el fabricante para la realización de los trabajos, los cuales en un principio permitía posibles opciones:

1) La primera opción seria optar por una reparación del equipamiento propiedad de la DPE, enviándolo al exterior para su reparación, y el regreso del mismo ya reparado, con un tiempo de implementación de cuatro meses aproximadamente, lo que debe efectuarse necesariamente en temporada estival a fin de no resentir el servicio eléctrico de la ciudad, máximo teniendo en cuenta el aumento en época invernal.

2) Reparación del equipamiento propiedad de la D.P.E., enviándolo al exterior para su reparación manteniendo el mismo tiempo de la opción anterior pero realizando el alquiler de las partes a reparar a los efectos de no sacar de servicio la maquina Roll Royce RB 2011. Toda esta operación tendría un costo de entre U$S 500.000 y U$S 600.000, dependiendo del tiempo de reparación en el exterior, y puesta en marcha. Cabe destacar que el costo de alquiler no puede ser rendido al FEDEI por lo que debe ser afrontado en su totalidad por la D.P.E.

3) La Tercera opción es el intercambio de equipo (adquisición de uno reparado entregando el actual como intercambio) lo que reduce los tiempos a solo 6 días de operación.

Ambas empresas presentan ofertas que al momento pueden resumirse de la siguiente manera:

TRANS CANADA TURBINES tiene disponibilidad inmediata de un equipo para intercambio con una propuesta económica de TRES MILLONES DOSCIENTOS DIECIOCHO MIL CUATROCIENTOS VEINTISEIS DOLARES (U$D 3.218.426,00) con un recupero posterior de entre CIEN MIL y QUININTOS MIL DOLARES (U$D 100.000 a 500.000) de acuerdo al estado de la máquina que se entrega.

ROLSS WOOD GROUP manifiesta la posibilidad de ofrecer una maquina de intercambio a principios de Noviembre próximo, con un valor final de TRES MILLONES CIENTO CUARENTA MIL DOLARES (U$D 3.140.000,00)

Con respecto a la comparación de las dos cotizaciones cabe destacar que la oferta presentada por TRANS CANADA TURBINES, con respecto a la ofertada por Rolls Wood Group, tiene en cuenta un valor residual de entre U$S 100.000 y U$S 500.000, lo cual dependerá de las inspecciones a realizarse en los talleres de TRANS CANADA TURBINES por personal especializado de la D.P.E. una vez arribado los equipos a dichos talleres, mientras que en la cotización de Rolls Wood Group está incluido el valor residual del equipamiento de la D.P.E.

Lasserre N°218 - (V9410DGF) Ushuaia - Tierra del Fuego - TE/FAX: (02901) 422-291/295 421-725/269
e-mail: dpe-tdf@speedy.com.ar
http://www.dpe.com.ar

PROVINCIA DE TIERRA DEL FUEGO,
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

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En las actuales circunstancias (temporada invernal y exceso de horas del equipo) descriptas por el Departamento Generación y la Dirección mediante notas 2076/13 y 2092/13, se considera conveniente la contratación directa de la empresa TRANS CANADA TURBINES para la realización del intercambio de equipos.

Para mayor fundamentación, se transcribe la nota emitida por el Departamento Generación a la Dirección, en fecha 15/08/13: ***"Debido a las demoras que viene sufriendo el tramite de contratación originalmente iniciado en el año 2011, se informa que teniendo en cuenta los valores actuales de la demanda energética de la ciudad de Ushuaia, se considera que el parque generador actualmente disponible ya no tendría la capacidad suficiente para suministrar la totalidad de la potencia instantánea en forma confiable y durante el periodo de aproximadamente cuatro meses que comprendería la reparación del GG.***
En función de lo expuesto, para poder considerar la opción de reparación de nuestro equipo se debería aplicar un plan de contingencia que implique una reducción de la demanda mediante cortes rotativos al sector residencial y reducción de la demanda en el sector industrial....
Para concluir se considera que la opción de intercambio es la que podría resultar más conveniente ya que mediante dicha alternativa se reduciría la indisponibilidad de la máquina por mantenimiento a un máximo de quince días aproximadamente"..

Se transcribe también nota de la Dirección a ésta Presidencia en fecha 16/08/13 indicando: ***"se reitera la necesidad de efectuar de manera urgente la reparación del turbogenerador TG7 atento a la cantidad de horas de funcionamiento, lo cual determina una muy baja confiabilidad en la operación del mismo, lo que podría ocasionar una falla grave y el consiguiente perjuicio en la prestación del servicio eléctrico de la ciudad de Ushuaia"***

Por otra parte, teniendo en cuenta que la financiación proveniente del FEDEI se encuentra inmovilizada en pesos de curso legal, y la oferta debe cancelarse en dólares estadounidenses, la rapidez que pueda imprimirse a la operación, redundará en beneficio económico para ésta Dirección.

Para ello, y de acuerdo al dictamen legal DPE 29/2013, debería emitirse un Decreto Provincial, autorizando a la Dirección Provincial de Energía a llevar a cabo la contratación mediante el Articulo 9 Inciso c) de la Ley Nacional 13064 autorizando además la siguiente forma de pago:

a) 50% de la oferta, equivalente a la suma de DOLARES ESTADOUNIDENSES UN MILLON SEISCIENTOS NUEVE MIL DOSCIENTOS TRECE (U$D 1.609.213,00) al momento de la firma del contrato.
b) 40% de la oferta, equivalente a la suma de DOLARES ESTADOUNIDENSES UN MILLON DOSCIENTOS OCHENTA Y SIETE MIL TRES CIENTOS SETENTA CON 40/00 (U$D 1.287.370,40) previo al embarque del bien adquirido y contra verificación por parte del personal de la DPE.
c) 10% de la oferta, equivalente a la suma de DOLARES ESTADOUNIDENSES TRESCIENTOS VEINTIUN MIL OCHOCIENTOS CUARENTA Y DOS CON 60/00 (U$D 321.842,60) al momento de la puesta en marcha del bien adquirido.

Por lo expuesto y en caso de acuerdo se solicita la emisión del Decreto correspondiente fin de proceder con la contratación.

Sin otro particular, saluda atte.

JUAN CARLOS SALDIVIA
Presidente
Dirección Provincial de Energía

asserre N°218 - (V9410DGF) Ushuaia - Tierra del Fuego - TE/FAX: (02901) 422-291/295 421-725/269
e-mail: dpe-tdf@speedy.com.ar
http://www.dpe.com.ar

NOTARIAL CERTIFICATE

CANADA)
PROVINCE OF ALBERTA)
TO WIT:)

I, Daniel J.B. Simonelli, a Notary Public for the Province of Alberta, by royal authority duly appointed, residing at the City of Calgary, in the Province of Alberta, do certify that the paper writing hereto annexed is a true copy of the TransCanada Turbines Certificate of Authorization from Rolls-Royce Power Engineering, the said copy having been compared by me with the original documents, an act whereof being requested I have granted under my notarial form and seal of office to serve and avail as occasion shall or may require.

IN TESTIMONY WHEREOF I have hereunto subscribed my name and affixed my seal of office at Airdrie, Alberta, this 31st day of July, 2013.

Notary Public in and for the Province of Alberta
Daniel J.B. Simonelli
Barrister and Solicitor

My Commission Expires at the Pleasure of
HER MAJESTY THE QUEEN

THE DEPARTMENT OF FOREIGN AFFAIRS AND INTERNATIONAL TRADE CANADA HAS DULY AUTHENTICATED THE FOREGOING SIGNATURE FOR OR:

LE MINISTÈRE DES AFFAIRES ÉTRANGÈRES ET DU COMMERCE INTERNATIONAL CANADA A DÛMENT AUTHENTIQUÉ LA SIGNATURE QUI PRÉCÈDE POUR:

AUTHORIZED OFFICER FOR THE DEPUTY MINISTER OF FOREIGN AFFAIRS BY:

Tina Wahal

AUTHORIZED OFFICER FOR SOUS-MINISTRE DES AFFAIRES ÉTRANGÈRES PAR

OTTAWA-CANADA

ES COPIA FIEL DEL ORIGINAL

Patricia Valencia
Jefe Dpto. Administrativo
Dirección Provincial de Tauegia

Maintenance, Repair and Overhaul Centre

This is to certify that:

TransCanada Turbines

is authorized to perform maintenance, repair and overhaul services
on the following Engines and Modules:

Rolls-Royce Avon – All Industrial Models
Rolls-Royce RB211-22B, 24A, 24B, 24C, 24G, 24G DLE, 24GT, 24GT DLE

December 22, 2008 through December 31, 2013

N. E Taylor, Head of Repair and Overhaul
Rolls-Royce Power Engineering

Rolls-Royce

AGGIO

SERIE A 4530539

TAL FEDERAL
Nro. 7130

REPÚBLICA ARGENTINA

MINISTERIO *de*
RELACIONES EXTERIORES
COMERCIO INTERNACIONAL Y CULTO

230

FOLIO 120

Sello ovalado cruzado

En virtud de las facultades conferidas por el Art. 226 del Reglamento Consular (Decreto 8714/1963):

TIPO DE DOCUMENTO: CERTIFICATE

CANTIDAD DE FOJAS QUE INTEGRAN EL DOCUMENTO: 2

POR CORRESPONDERSE CON LA OBRANTE EN LOS REGISTROS DE ESTA REPRESENTACION CONSULAR SE LEGALIZA LA FIRMA DE: WISHAK, TINA

CARGO/CALIDAD EN LA QUE ACTÚA: AUTHENTICATION OFFICER, DEPARTMENT OF FOREIGN AFFAIRS AND INTERNATIONAL TRADE

FECHA OBRANTE EN EL SELLO: 31/7/2013

N° (SI OBRA EN SELLO): N/A

PERSONAS INTERVINIENTES:

RECURRENTE: TRANSCANADA TURBINES

REPRESENTACION CONSULAR ARGENTINA QUE INTERVIENE: Consulado General de la Republica en TORONTO

FECHA: 02/08/2013

Sello ovalado cruzado

CONSULADO GENERAL DE LA REPÚBLICA ARGENTINA TORONTO

Sello y Firma del funcionario
Héctor Dellepiane
Cónsul General

N° DE ORDEN: CTORO 3526/2013

N° ARANCEL: 6.4.3

DERECHOS PERCIBIDOS: CAD 66.00

Art. 229 del Reglamento Consular (Decreto N° 8714/1963 modificado por el Decreto N° 1629/2001): "Los documentos extranjeros autenticados en la forma establecida en el presente Reglamento harán fe en territorio nacional, sin necesidad de su posterior legalización ante otra autoridad argentina."

Número de orden: 3527/13
Número de Arancel: 6.9.10
Derecho percibido
en Dls. Can $44.00

ES COPIA FIEL DEL ORIGINAL

Patricia Valencia
Jefe Dpto. Administrativo
Dirección Provincial de Energía

TRADUCCIÓN PÚBLICA----------

[Página 1]----------

----------**ACTA NOTARIAL**----------

[En la esquina superior derecha aparece un sello en español que lee:] Consulado General – Toronto – FOLIO 1 ----------

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CANADÁ ----------

PROVINCIA DE ALBERTA ----------

A SABER:----------

Yo, Daniel J. B. Simonelli, "Escribano" (*Notary Public*) de la Provincia de Alberta, debidamente nombrado por Autoridad Real, con domicilio en la Ciudad de Calgary, en la Provincia de Alberta, certifico que el escrito que se adjunta a la presente es copia fiel del Certificado de Autorización otorgado por Rolls-Royce Power Engineering a TransCanada Turbines. Dicha copia ha sido comparada por mí con los documentos originales y, habiéndoseme solicitado un acta que certifique tal situación, la otorgo por este medio bajo mi rúbrica y sello notarial a los fines pertinentes. ----------

EN TESTIMONIO DE LO CUAL estampo en la presente mi firma y sello oficial, en Airdrie, Alberta, a los 31 días del mes de julio de 2013.----------

[Aparece una firma ilegible] – [Aparece un sello en relieve que lee:] DANIEL J. B. SIMONELLI – "ESCRIBANO" (*Notary Public*) – PROVINCIA DE ALBERTA ----------

"Escribano" (*Notary Public*) de y para la Provincia de Alberta – Daniel J. B. Simonelli – Abogado y Notario----------

Mi autorización para ejercer el cargo vence: a discreción de SU MAJESTAD LA REINA ----------

[Aparece un sello que lee:] EL DEPARTAMENTO DE RELACIONES EXTERIORES Y COMERCIO INTERNACIONAL DE CANADÁ HA AUTENTICADO DEBIDAMENTE LA FIRMA QUE ANTECEDE: [Aparece una firma ilegible] – [Aparece texto en otro idioma] – AUTENTICADO EN

ES COPIA FIEL DEL ORIGINAL

Patricia Valencia
Jefe Dpto. Administrativo
Dirección Provincial de Energía

NOMBRE DEL VICEMINISTRO DE RELACIONES EXTERIORES POR: [Aparece una firma ilegible] /Tina Wishak – [Aparece texto en otro idioma] – OTTAWA-CANADÁ – [Aparece un sello redondo que lee:] Departamento de Relaciones Exteriores y Comercio Internacional – [Aparece texto en otro idioma]----------

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[Página 2 – Anverso]----------

[En la esquina superior derecha aparece un sello en español que lee:] Consulado General – Toronto – FOLIO 2----------

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----------*Centro de Mantenimiento, Reparación y Reacondicionamiento*----------

----------El presente certifica que:----------

----------TransCanada Turbines----------

se encuentra autorizada para realizar servicios de mantenimiento, reparación y reacondicionamiento en los siguientes Motores y Módulos:----------

----------**Rolls-Royce Avon - Todos los modelos industriales**----------

----------**Rolls-Royce RB211-22B, 24A, 24B, 24C, 24G, 24G DLE, 24GT, 24GT DLE**--------

----------Desde el 22 de diciembre de 2008 hasta el 31 de diciembre de 2013----------

[Aparece una firma ilegible] N. E. Taylor – Jefe de Reparación y Reacondicionamiento – Rolls-Royce Power Engineering----------

----------[Aparece un emblema] **Rolls-Royce**----------

[En la esquina inferior izquierda aparece una firma ilegible y un sello en relieve que lee:] DANIEL J. B. SIMONELLI – "ESCRIBANO" (*Notary Public*) – PROVINCIA DE ALBERTA----------

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[Pagina 2 – Reverso]----------

[Aparece texto en español]----------

ES COPIA FIEL DEL ORIGINAL

Patricia Valencia
Jefe Dpto. Administrativo
Dirección Provincial de Energía

RA PÚBLICA
GLÉS
CAPITAL FEDERAL
C.B.A. Nro. 7130

FOLIO 233

FOLIO 131

FOLIO 131

[Página 3]

SERIE: A 4530539

REPÚBLICA ARGENTINA – MINISTERIO DE RELACIONES EXTERIORES, COMERCIO INTERNACIONAL Y CULTO

En virtud de las facultades conferidas por el Art. 226 del Reglamento Consular (Decreto 8714/1963): -

TIPO DE DOCUMENTO: CERTIFICADO

CANTIDAD DE FOJAS QUE INTEGRAN EL DOCUMENTO: 2

POR CORRESPONDERSE CON EL OBRANTE EN LOS REGISTROS DE ESTA REPRESENTACIÓN CONSULAR SE LEGALIZA LA FIRMA DE: WISHAK, TINA

CARGO/CALIDAD EN LA QUE ACTÚA: FUNCIONARIA DE AUTENTICACIONES, DEPARTAMENTO DE RELACIONES EXTERIORES Y COMERCIO INTERNACIONAL

[Sigue texto en español]

LO QUE ANTECEDE ES TRADUCCIÓN FIEL AL ESPAÑOL [EN PÁGINAS 1 A 3 SIN SUS REVERSOS] DEL ORIGINAL EN INGLÉS QUE HE TENIDO ANTE MÍ. EN BUENOS AIRES, A LOS 9 DÍAS DEL MES DE SEPTIEMBRE DE 2013.

COLEGIO DE TRADUCTORES PUBLICOS
DE LA CIUDAD DE BUENOS AIRES
Corresponde a la Legalización
Nº 56353 13
FRANCO MAGGIORINI

MARÍA VICTORIA PIAGGIO
TRADUCTORA PÚBLICA
INGLÉS
MAT. Tº XIX Fº 065 CAPITAL FEDERAL
INSCRIP. C.T.P.C.B.A. Nro. 7130

ES COPIA FIEL DEL ORIGINAL

Patricia Valencia
Jefe Dpto. Administrativo
Dirección Provincial de Energía

PROVINCIA DE TIERRA DEL FUEGO.
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

335 / 13

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

FOLIO 330

USHUAIA, 30 SET. 2013

FOLIO 132

FOLIO 132

VISTO el Expediente Letra E N° 426/2012 del Registro de la Dirección Provincial de Energía mediante el cual tramita la Reparación Mayor de la Turbina Marca Rolls Royce RB211 instalada en la ciudad de Ushuaia; y

CONSIDERANDO:

Que mediante Decreto Provincial N° 1986/2013 se autoriza la contratación directa con la firma TransCanada Turbines Ltd. por la suma de DÓLARES ESTADOUNIDENSES TRES MILLONES DOSCIENTOS DIECIOCHO MIL CUATROCIENTOS VEINTISEIS (U$S 3.218.426,00), de acuerdo surge de su artículo 1°, equivalente a PESOS ($ 18.254.912,27), según cotización Pesos/Dólar del día 30/08/13 publicada por el Banco de la Nación argentina de ($ 5,6720).

Que se ha celebrado entre las partes con fecha 06 de septiembre de 2013, el pertinente contrato para el suministro de una turbina a gas industrial RB211-24G reacondicionada a cero (0) horas y servicios de instalación y puesta en marcha en la Central Termoeléctrica Ushuaia.

Que de acuerdo artículo 2°, del decreto citado precedentemente, se autoriza a esta Dirección Provincial de Energía a efectuar la cancelación anticipada del noventa por ciento (90%) del valor total de la contratación equivalente a la suma de DÓLARES ESTADOUNIDENSES DOS MILLONES OCHOCIENTOS NOVENTA Y SEIS MIL QUINIENTOS OCHENTA Y TRES CON 40/100 (U$S 2.896.583,40).

Que el porcentaje de pago será distribuido y cancelado en un cincuenta por ciento (50%) del valor del contrato cumplidas las formalidades contractuales establecidas conforme obra en las presentes actuaciones - fs. 221 a 293 -, por un monto total de DÓLARES ESTADOUNIDENSES UN MILLÓN SEISCIENTOS NUEVE MIL DOSCIENTOS TRECE (U$S 1.609.213,00), el cuarenta por ciento (40%) contra despacho del bien a adquirir por un total de DÓLARES ESTADOUNIDENSES UN MILLÓN DOSCIENTOS OCHENTA Y SIETE MIL TRESCIENTOS SETENTA CON 40/100 (U$S 1.287.370,40), conforme Acta de Constatación - fs. 305 a 308 - y el porcentaje del diez por ciento (10%) por DÓLARES ESTADOUNIDENSES TRESCIENTOS VEINTIÚN MIL OCHOCIENTOS CUARENTA Y DOS CON 60/100 (U$S 321.842,60) restante, una vez finalizados los trabajos de instalación y puesta en marcha por parte de la empresa contratada a tal fin.

Que con fecha 27 de septiembre de 2013 - fs. 310 a 314 - se ha procedido a suscribir la Enmienda N° 1 del Contrato Original de fecha 06 de septiembre de 2013, en virtud de haber consignado un error al expresar de manera discriminada el valor total del contrato, lo cual no modifica en lo absoluto el valor presupuestado, autorizado y contratado.

Que esta Dirección Provincial de Energía, cuenta con la Declaración Jurada Anticipada de Importación emitida por la AFIP (DJAI -URGENTE), a efecto de poder realizar las transferencias de divisas al exterior a través del Banco de la Provincia de Tierra del Fuego al Banco HSBC Bank Canada.

Que la firma TransCanada Turbines Ltd., ha presentado la INVOICE N° 1001432 de fecha 18 de septiembre de 2013 por la suma total de DÓLARES ESTADOUNIDENSES TRES MILLONES DOSCIENTOS DIECIOCHO MIL CUATROCIENTOS VEINTISEIS (U$S 3.218.426,00).

Que con fecha 18 de septiembre de 2013, se ha procedido a la transferencia de fondos de afectación específica depositados por el C.F.E.E. en el Banco de la Nación Argentina, provenientes del F.E.D.E.I., de la cta. cte. N° 053520034/16 a la cta. cte. del Banco de la Provincia de Tierra del Fuego de afectación Específica (CUT PAGADORA) N° 1-17-0677-3 mediante Libramiento de Pago DPE N° 244/2013 por la suma total de PESOS DIECIOCHO MILLONES TRESCIENTOS SETENTA Y CUATRO MIL CUATROCIENTOS ($ 18.374.400,00) equivalente a la suma de DÓLARES ESTADOUNIDENSE TRES MILLONES DOSCIENTOS MIL (U$S 3.200.000,00) según cotización Pesos/Dólar publicado por el Banco de la Nación Argentina de fecha 17/09/13 ($ 5,7420).

Que corresponde hacer frente al pago de los compromisos contractuales asumidos entre las partes, conforme lo dispuesto en el artículo 3° del Decreto Provincial N° 1986/2013 el cual se transcribe: *"... Autorizar a la Dirección Provincial de Energía a hacer frente a la cancelación de los valores indicados en el artículo 2° ajustando los mismos a la conversión*

Dirección Provincial de Energía

ES COPIA FIEL DEL ORIGINAL

///...2.-

Laura Paredes
Jefe División Administración
Dirección Provincial de Energía

PROVINCIA DE TIERRA DEL FUEGO,
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

FOLIO 331

FOLIO 133

FOLIO 133

...///2.-

Dólar/Pesos conforme cotización del Banco de la Nación Argentina a la fecha del cierre del día anterior a la fecha efectiva de pago.

Que la presente contratación se encuadra en los alcances de la Ley de Obras Públicas 13.064.

Que se cuenta con presupuesto.

Que ha tomado intervención el órgano de control de fs. 215 a 220 mediante Acta de Constatación N° 071/13 - Auditoría Obras Públicas (Control Previo - DPE) sin observaciones que formular, realizando requerimientos al respecto.

Que las erogaciones existentes serán afrontadas con fondos provenientes del F.E.D.E.I., de acuerdo a normativa aplicable por el Consejo Federal de la Energía Eléctrica (C.F.E.E.).

Que el suscripto se encuentra facultado para dictar la presente en virtud de lo establecido por Ley Territorial N° 117 - Artículo 11° y Decreto Provincial N° 1986/2013.

Por ello:

EL PRESIDENTE DE LA
DIRECCIÓN PROVINCIAL DE ENERGÍA
R E S U E L V E:

ARTÍCULO 1° Aprobar la cancelación parcial de la INVOICE N° 1001432 de fecha 18 de septiembre de 2013 por DÓLARES ESTADOUNIDENSES TRES MILLONES DOSCIENTOS DIECIOCHO MIL CUATROCIENTOS VEINTISEIS (U$S 3.218.426,00), conforme se dispone en los artículo 2° 3° y 4° de la presente resolución, ello conforme lo establecido por Decreto Provincial N° 1986/2013, los cuales serán condicionados conforme cumplimiento de Contrato de fecha 06 de septiembre de 2013, cláusula TERCERA.

ARTÍCULO 2° Aprobar el pago parcial equivalente al cincuenta por ciento (50%) de la INVOICE N° 1001432 por un monto total de DÓLARES ESTADOUNIDENSES UN MILLÓN SEISCIENTOS NUEVE MIL DOSCIENTOS TRECE (U$S 1.609.213,00), conforme Cláusula TERCERA de contrato Punto a).

ARTÍCULO 3° Aprobar el pago parcial equivalente al cuarenta por ciento (40%) de la INVOICE N° 1001432 por un monto total DÓLARES ESTADOUNIDENSES UN MILLÓN DOSCIENTOS OCHENTA Y SIETE MIL TRESCIENTOS SETENTA CON 40/100 (U$S 1.287.370,40), de acuerdo Cláusula TERCERA de contrato Punto b).

ARTÍCULO 4° Aprobar el pago parcial equivalente al el diez por ciento (10%) de la INVOICE N° 1001432 por DÓLARES ESTADOUNIDENSES TRESCIENTOS VEINTIÚN MIL OCHOCIENTOS CUARENTA Y DOS CON 60/100 (U$S 321.842,60), conforme Cláusula TERCERA de contrato Punto c).

ARTÍCULO 5° Autorizar al Departamento Administrativo a efectivizar las transferencias bancarias a través del Banco de la Provincia de Tierra del Fuego, cuenta corriente (CUT PAGADORA) N° 1-71-0677-3 conforme lo dispuesto en los artículos 2°, 3° y 4°, de acuerdo a lo resuelto en el artículo 3° del Decreto Provincial N° 1986/2013.

ARTÍCULO 6° Imputar en 112.06.15.105 - Dirección Provincial de Energía - Inciso 4 - Partida Principal 3 - Partida Parcial 1 - (F.E.D.E.I.).

ARTÍCULO 7° Comunicar, dar al Boletín Oficial de la Provincia y archivar.

RESOLUCIÓN D.P.E. N° 335 / 13 .-

ES COPIA FIEL DEL ORIGINAL

Laura Paredes
Jefe División Administración
Dirección Provincial de Energía

Juan Carlos Saldivia
Presidente
Dirección provincial de energía

PROVINCIA DE TIERRA DEL FUEGO,
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

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FOLIO 134

ANEXO 4

Lasserre N°218 - (V9410DGF) Ushuaia - Tierra del Fuego - TE/FAX: (02901) 422-291/295 421-725/269
e-mail: dpe-tdf@speedy.com.ar
http://www.dpe.com.ar

Maintenance, Repair and Overhaul Centre

This is to certify that:

TransCanada Turbines

is authorized to perform maintenance, repair and overhaul services
on the following Engines and Modules:

Rolls-Royce Avon – All Industrial Models

Rolls-Royce RB211-22B, 24A, 24B, 24C, 24G, 24G DLE, 24GT, 24GT DLE

December 22, 2008 through December 31, 2013

N. E Taylor, Head of Repair and Overhaul
Rolls-Royce Power Engineering

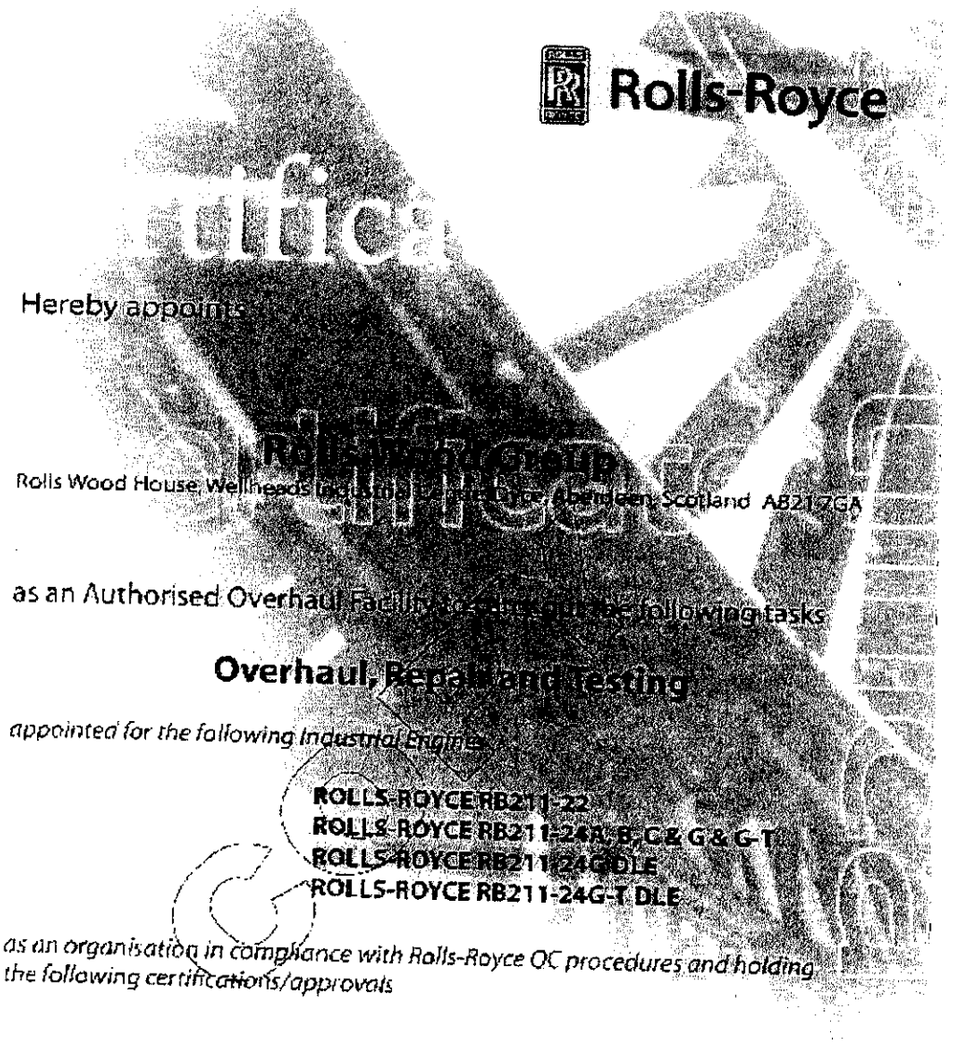
Rolls-Royce

Ing. Carlos Bertoni
Director
Dirección Provincial de Energía

Tierra del Fuego, Antártida e Islas del Atlántico Sur
FOLIO 3

FOLIO 135

FOLIO 135



Rolls-Royce

Certificate

Hereby appoints

Rolls-Royce Group

Rolls Wood House, Wellheads Industrial Estate, Dyce, Aberdeen, Scotland AB21 7GA

as an Authorised Overhaul Facility to carry out the following tasks

Overhaul, Repair and Testing

appointed for the following Industrial Engines

ROLLS-ROYCE RB211-22
ROLLS-ROYCE RB211-24A, B, C & G & G-T
ROLLS-ROYCE RB211-24GDLE
ROLLS-ROYCE RB211-24G-T DLE

as an organisation in compliance with Rolls-Royce QC procedures and holding the following certifications/approvals

BS EN ISO 9001 : 2000

This authorisation shall remain in effect until cancelled, suspended or revoked

Date approved

March, 2006

Approval

Robert B. Thomas
Parts, Repair & Overhaul Director

DPE Argentina draft RB211 Contract 030707

Ing. ADRIAN BERTONI
Director
Dirección Provincial de Energía

PROVINCIA DE TIERRA DEL FUEGO,
ANTÁRTIDA E ISLAS DEL ATLÁNTICO SUR

REPÚBLICA ARGENTINA

DIRECCIÓN PROVINCIAL DE ENERGÍA

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ANEXO 5

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DEPARTAMENTO GENERACION

TURBOGRUPO TG-7

Potencia:	28337 Kw (38000 Hp)
Combustible:	Dual (Gas Natural y Gasoil)
Generador de gases:	ROLLS-ROYCE RB211 24G Phase II
Numero de serie:	1780-559
Turbina de Potencia:	ROLLS-ROYCE RT62A
Numero de serie:	1040RT
Generador:	PEEBLES ELECTRICAL MACHINES
Numero de serie:	GOX262480

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e-mail: dpe-tdf@speedy.com.ar
http://www.dpe.com.ar

Rolls-Royce

Sección 1

Descripción e información técnica

Su nuevo paquete de turbina de gas 6562 incluye un generador de gas RB211-24G y una turbina generadora RT62. Consulte los datos de esta sección y los planos de montaje para conocer los datos del equipo y los parámetros de funcionamiento.

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1.1 Generalidades

Esta sección proporciona descripciones y especificaciones del equipo Rolls-Royce 6562. Este paquete incluye un GG (generador de gas) Rolls-Royce RB211-24G PH (dual fual) ma turbina generadora RT62.

Los sistemas de soporte y equipo incluyen un sistema de aire, un sistema de gas combustible del GG, un sistema de limpieza del GG, un sistema de motor de arranque hidráulico del GG, un sistema de aceite lubricante del GG, un sistema aceite lubricante de la turbina generadora y un acoplamiento flexible.

Un UCP (panel de control de la unidad) controla el equipo y los sistemas de soporte. Las señales de comando transmitidas por el UCP encienden el GG, aumentan o disminuyen su velocidad e inician las detenciones controladas. Los sistemas de detención y de alarma automática funcionan por medio del UCP para proteger el equipo en caso de condiciones anormales de operación como exceso de velocidad o vibración y condiciones extremas de temperatura y de presión del aceite. Consulte los documentos de control para obtener información sobre el sistema de control.

Las piezas de Rolls-Royce Energy Systems Inc. se fabrican y ensamblan con el sistema convencional de medidas de los Estados Unidos. Estos valores aparecen convertidos al sistema métrico en este manual.

1.1.1 Lista de abreviaturas

En esta sección se utilizan abreviaturas para ciertas palabras y frases. Utilice la siguiente lista como guía:

- GG = generador de gas
- HP = alta presión
- IP = presión intermedia
- N2 = velocidad de la turbina generadora
- UCP = panel de control de la unidad

1.1.2 Lista de dibujos

Al leer esta sección, consulte los siguientes dibujos en los *Volumen 3, - Manuales de Dibujos* para obtener información adicional:

- Diagrama de aire RT62-48-UK62
- Cojinetes RT62-3-6
- Protector de acoplamiento RT62-18-UK34
- Diagrama de aceite lubricante GG RT62-46-UK206
- Tobera de entrada y difusor RT62-4-10
- Diagrama de instrumentación y control de combustible RT62-37-UK37
- Diagrama principal del aceite lubricante UK62-46-UK204

1.1.3 Lista de normas de ingeniería

Cuando lea esta sección, consulte las siguientes Normas de ingeniería, en el *Apéndice 2*, para obtener información adicional:

- SD-123 Tensión de sujetadores roscados

1.2 Generador de gas

El GG industrial RB211-24G PH 11s un motor de dos bobinas (rotores) de alta proporción de presión. Los gases del escape impulsan la turbina generadora. El aire derivado de los compresores del GG tiene varias funciones tales como enfriar el borde de la turbina generadora y sellar el aire.

El GG tiene un compresor IP de siete fases, un compresor HP de seis fases, un turbina HP de una sola fase y una turbina IP también de una sola fase. Los ejes IP y HP son independientes mecánicamente y cada uno funciona a su propia velocidad óptima.

El aire fluye por el GG desde el compresor IP al compresor HP. Cierta cantidad de aire se desvía del GG por un tubo para enfriar los componentes de alta temperatura. El resto del aire ingresa a la cámara de combustión anular, donde se inyecta el combustible y se enciende la mezcla. Los gases calientes de alta energía salen hacia la turbina HP. Las turbinas HP e IP convierten la energía del gas en caballos de fuerza del eje.

Un motor de arranque aparte impulsa al GG a una velocidad que se mantiene automáticamente cuando se produce un corte de energía.

1.3 Turbina generadora

La turbina generadora RT62A es una turbina de impulso y reacción de dos fases. Convierte energía de los gases del GG en caballos de fuerza del eje.

Los gases del escape del GG ingresan a los difusores de entrada de la turbina. Los difusores de entrada guían los gases hacia los álabes de la tobera de la primera fase. Los álabes de la tobera causan que los gases golpeen las aspas de la turbina de la primera fase en el mejor ángulo. De las aspas de la turbina de la primera fase, los gases encuentran los álabes de la tobera de la segunda fase. Estos álabes hacen que los gases golpeen las aspas de la turbina de la segunda fase en el mejor ángulo. Después de pasar por las aspas de la turbina de la segunda fase, los gases fluyen entre los difusores de escape internos y externos hacia una cubierta aislada y por una chimenea de escape a la atmósfera.

El UCP permite el monitoreo de la velocidad de la turbina por medio de dos dispositivos captadores de velocidad (que muestran la velocidad N3) empotrados en la cubierta exterior de la caja de cojinetes. La información de estos dispositivos captadores de velocidad se transmite por una tarjeta FT-100 al UCP, el cual utiliza la velocidad N3 y los datos de otras señales para controlar la velocidad de la turbina mediante el ajuste del flujo de combustible al GG.

1.4 Información técnica

Generador de gas

Fabricante	Rolls-Royce, Ltd.
Modelo	RB211-24G PH 11
Dirección de la rotación	En el sentido del reloj, orientada hacia el extremo de la entrada
Sistema de combustible	Gas natural
Velocidad de marcha en vacío	Se establece durante la comisión, se utiliza para calentar el motor y se alcanza cuando se enciende la luz indicadora del panel de control.
Límites de temperatura de escape del GG para el funcionamiento	
Disparo	20°C (36°F) sobre los límites máximos de funcionamiento
Alta vibración de la entrada del GG	
Alarma	3,5 mm/seg (0,138 in/seg) sobre los niveles normales iniciales de funcionamiento
Detención	25 mm/seg (0,984 in/seg) sobre los niveles normales iniciales de funcionamiento
Alta vibración del centro del GG	
Alarma	3,5 mm/seg (0,138 in/seg) sobre los niveles normales iniciales de funcionamiento
Detención	25 mm/seg (0,984 in/seg) sobre los niveles normales iniciales de funcionamiento
Alta vibración de la turbina del GG	
Alarma	3,5 mm/seg (0,138 in/seg) sobre los niveles normales iniciales de funcionamiento
Detención	25 mm/seg (0,984 in/seg) sobre los niveles normales iniciales de funcionamiento
Aceite lubricante	Aceite sintético. Consulte el diagrama de aceite lubricante para el GG y el *Manual de Mantenimiento RB211-24G Industrial de Rolls-Royce*.

Consulte el Manual de Mantenimiento RB211-24G Industrial de Rolls-Royce para obtener información acerca de los siguiente artículos:

Motor de arranque del GG

Bombas principales y auxiliares de aceite lubricante del GG

Filtros de aceite lubricante y elementos para el GG

Consulte el diagrama de aceite lubricante del GG para obtener información sobre el refrigerador de aceite lubricante.

Turbina generadora

Fabricante	Rolls-Royce Energy Systems Inc.
Modelo	RT62A
Número de serie	1040
Fases	Dos
Tipo	Impulso y reacción
Dirección de la rotación	En el sentido del reloj, orientada hacia el extremo del eje
Caballos de fuerza (certificado por ISO)	28 337 Kw (38,000 hpP)
Velocidades de régimen	
Calentamiento	Establecido en la comisión y señalado por un diodo en el panel de control.
Normal	4,800 rpm
Continuo maximo	5,040 rpm
Rango de control	4,650 to 5,040 rpm
Desconexión por exceso de velocidad	
Primario	5,375 rpm
Respaldo	5,375 rpm
Presión de la entrada (certificado por ISO	4,02 kg/cm2 (57,16 psi)
Temperatura del escape (certificado por ISO)	498°C (928°F)
Alta vibración de los extremos del disco y del acoplamiento	
Alarma	60 micrones (2,5 mils)
Detención	90 micrones (3,5 mils)
Altas temperaturas del segmento del cojinete	
Alarma	120°C (250°F)
Detención	130°C (265°F)
Baja presión del suministro de aceite	
Alarma	117 kPa (17 psi)
Detención	76 kPa (12 psi)
Alta temperatura del suministro de aceite	
Alarma	65°C (150°F)
Detencion	68°C (155°F)
Intersticio de los cojinetes	
Chumacera (extremo del disco)	0,33 a 0,38 mm (0,013 a 0,015 in)
Cojinete de empuje (axial)	0,25 a 0,76 mm (0,01 a 0,03 in.)
Chumacera (extremo del acoplamiento)	0,33 a 0,25 mm (0,013 a 0,01 in)
Franqueo vertical entre la punta del rotor y el sello alveolar	
Primera fase	1,77 a 3,3 mm (0,07 a 0,13 in)
Segunda fase	1,77 a 3,3 mm (0,07 a 0,13 in)
Diámetros del rotor	
Chumacera (extremo del disco)	203 mm (8 in)
Chumacera (extremo del acoplamiento)	178 mm (7,00 in)
Sello de laberinto de la caja de cojinetes	508 mm (20,0 in)
Talla de interferencia en el collarín de empuje (diámetro)	0,064 a 0,102 mm (0,0025 a 0,0040 in)
Configuración del manómetro de aire de sello	
Calentamiento	175 a 200 mm (6,89 a 7,87 in) H_2O
Con carga (WC)	175 a 200 mm (6,89 a 7,87 in) H_2O

Sistema de aceite lubricante de la turbina generadora

Consulte el diagrama principal de aceite lubricante de la turbina generadora RT62-46-UK204

Consulte el sistema de aceite lubricante proporcionado por RRPE-IPS.

Sistema de aire

Consulte el diagrama de aire para lo siguiente:

Sistema de toma de aire

Acoplamiento

Número de repuesto Rolls-Royce Energy Systems Inc.	UK474-005-050
Fabricante	Bibby Turboflex, Ltd.
Tipo	Diafragma seco
Montaje de centros	Centro poligonal
Ahusamiento del extremo del eje (extremo de la turbina)	0.50 in por pie en el diámetro
Interferencia del diámetro (extremo de la turbina)	0.077 mm (0.003 in)

Requisitos de torsión

Generador de gas: Consulte el *Manual de Mantenimiento RB211-24G Industrial de Rolls-Royce.*

Turbina generadora: Consulte los planos de montaje y el apartado SD-123.

Capacidades

Depósito de aceite lubricante del GG	662,45 litros (175 US galones)
Depósito de aceite de la turbina generadora	Proporcionado por RRPE-IPS

Peso aproximado de los componentes: consulte los bosquejos

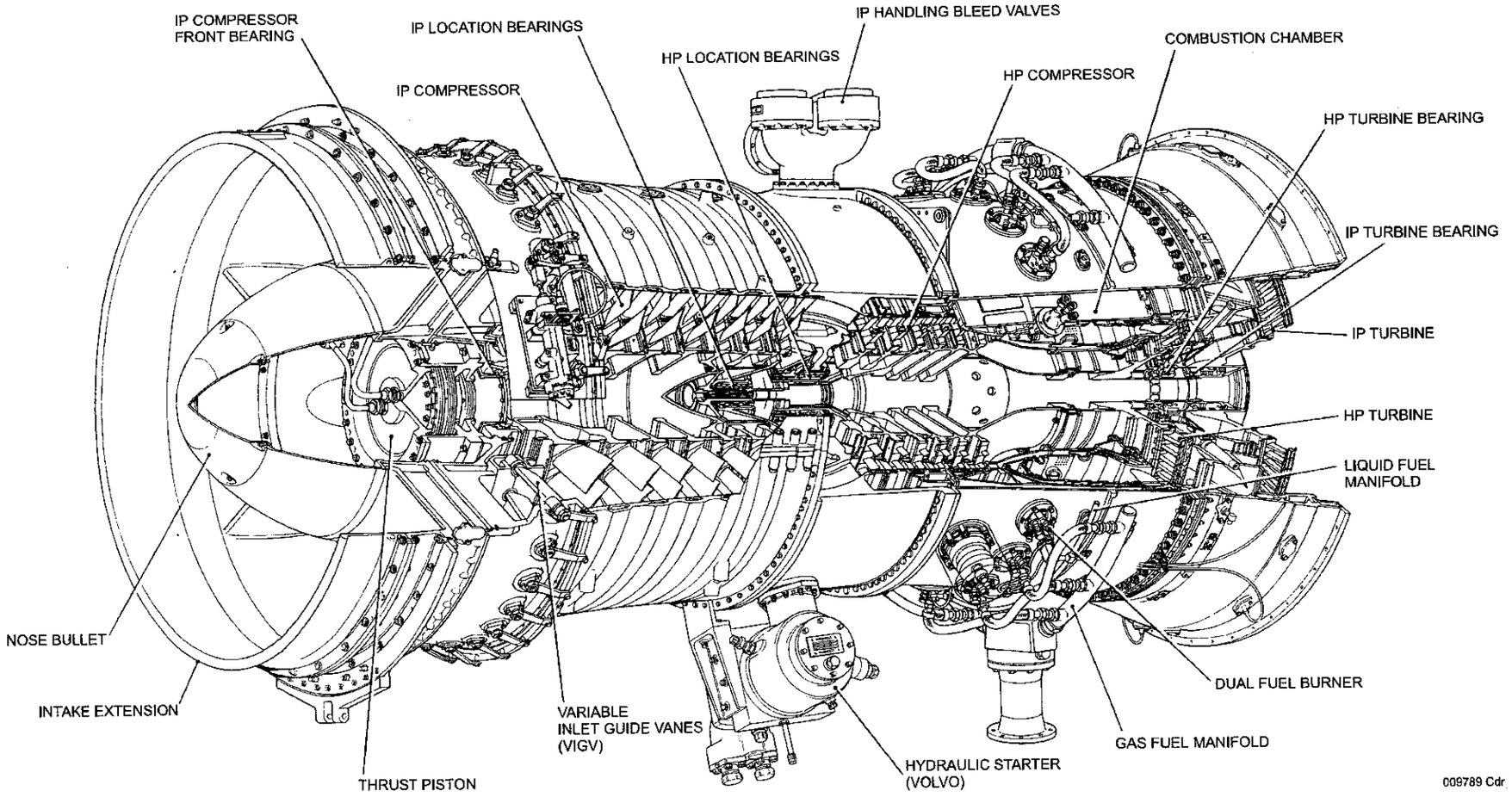

FIG 5 GAS GENERATOR - PICTORIAL CUTAWAY - DUAL FUEL

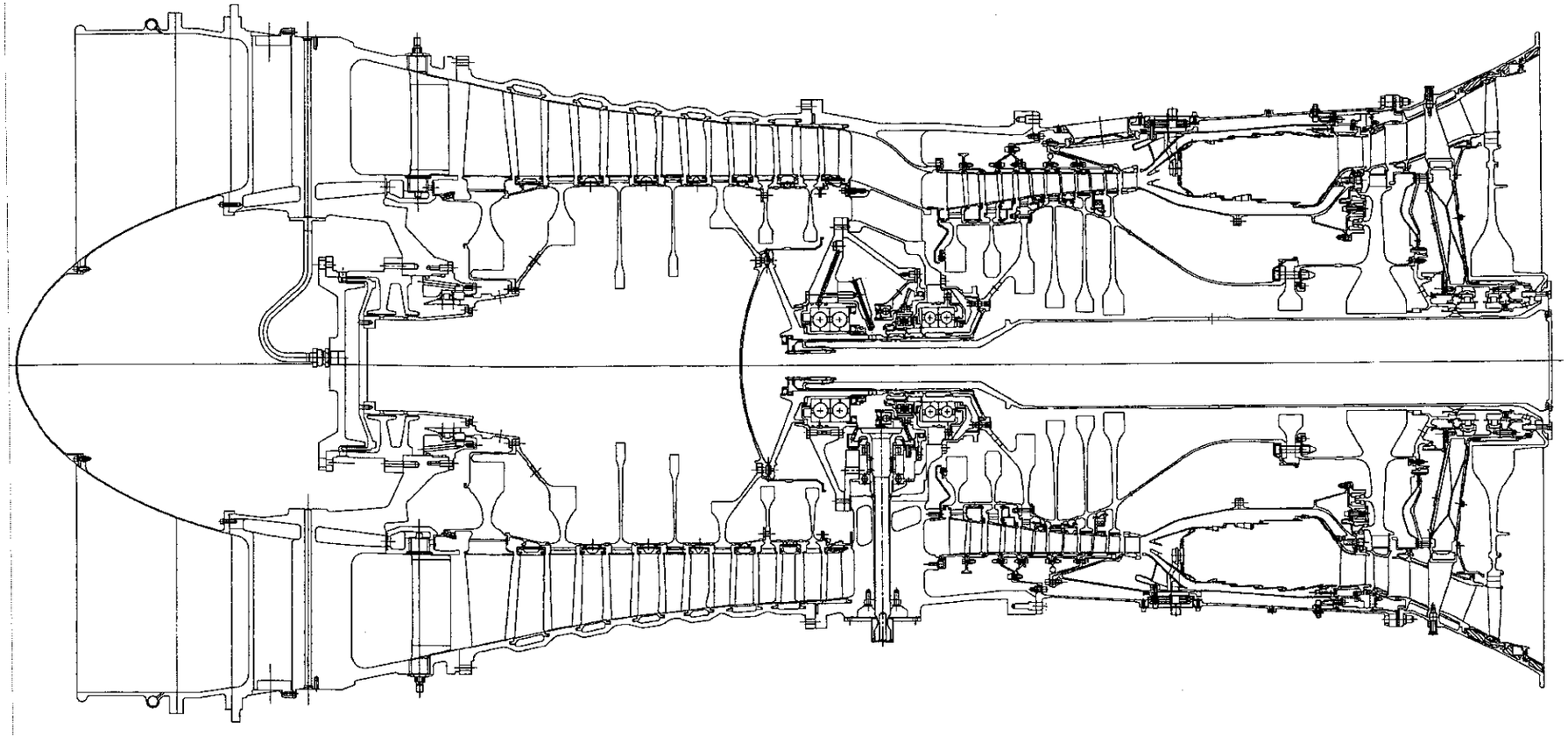

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FIG 3 SECTION THROUGH GAS GENERATOR

GENERAL DESCRIPTION

1 INTRODUCTION

(Refer to Fig 1).

The RR Industrial RB211 gas generator is a two spool high pressure ratio engine having a seven stage intermediate pressure compressor and a six stage high pressure compressor. Fuel is supplied to an annular combustion chamber and the resultant gases drive two independent single stage turbines coupled to the compressors through co-axial shafts. The two rotors of the gas generator are mechanically independent and run at their own optimum speeds.

The gas generator is an assembly of the following five major modules which can be removed as separate units:

Air intake module	(Module 01)
Intermediate pressure compressor module	(Module 02)
Intermediate casing module	(Module 03)
High pressure system module	(Module 04)
Intermediate pressure turbine module	(Module 05)

NOTE The term 'Intermediate' has been retained from the aero engine terminology. The 'fan' which is the LP stage in the aero engine is removed in the industrial version.

The modules are pre-balanced to provide complete interchangeability enabling major unit changes to be carried out on site and reducing downtime caused by unserviceable components.

Vibration is suppressed by the use of a squeeze film damping arrangement on the outer races of the roller bearings which provides a high pressure film of oil between the bearings and the bearing housing.

2 IDENTITY OF GAS GENERATOR FOLLOWING MODULE CHANGE

(Refer to Fig 2).

(1) There have been instances where RB211's have had module changes which have resulted in confusion as to the true identity of the gas generator

(2) **Refer to Fig 2**, the Gas Generator Serial Number appears twice on the gas generator carcass. The locations are on the battery plate of the 06 module (underneath the 02 module) which constitutes the Master and again (as a duplicate) on the 01 module (the air intake casing).

(3) Therefore it should be emphasised that:-

THE NUMBER ON THE 06 MODULE, BATTERY PLATE IS THE MASTER GAS GENERATOR SERIAL NUMBER.

(4) The problem has arisen when the 01 module has been exchanged or replaced. The duplicate gas generator number has been left on the 01 module, which has been fitted to another gas generator, thereby giving it two serial numbers.

(5) The purpose of the duplicate gas generator serial number on the 01 module is for ease of visibility. This serial number can be viewed through the gas generator MVP bag whilst being transported and additionally the need to crawl underneath the gas generator, when installed to view the number on the battery plate is eliminated.

(6) Whenever an 01 module is replaced / exchanged on an RB211, the duplicate Gas Generator Serial number plate must first be removed from the 01 module and attached to the replacement, having first checked that the number tallies with the number on the battery plate.

NOTE **Refer to Fig 2**, the serial number plate for the 01 module is to be found on the starboard side of the gas generator at 3 o'clock, above the small module number plate which must remain with the 01 module.

3 GAS GENERATOR

(Refer to Fig 3).

3.1 Air Intake Module (01)

The air intake casing is an aluminium alloy casting comprising an inner and outer casing separated by six integral hollow vanes. The inner casing provides a housing for the IP rotor front bearing.

The front of the outer casing is strengthened to take the gas generator front mounting which is bolted to it and the rear of the casing houses a single stage of variable inlet guide vanes which are operated by an external mechanism.

3.2 IP Compressor Module (02)

The IP compressor is a seven stage axial flow compressor consisting of a rotor drum fitted with seven stages of blades and driven by a single stage turbine. The rotor is located in a split aluminium case containing six stages of stator vanes. The single stage of outlet guide vanes is housed in the forward end of the intermediate case. The first stage stator vanes and rotor blades have been redesigned for the industrial gas generator to provide a robust front end to the compressor.

3.3 Intermediate Casing Module (03)

The intermediate casing is machined from an aluminium alloy casting and provides housing for both IP and HP rotor system bearing assemblies and starter drive gearing. The bearing layout employed eliminates the need for inter-shaft bearings.

3.4 HP System Module (04)

The HP compressor is a six stage axial flow compressor consisting of a rotor drum and six stages of blades driven by a single stage turbine. The drum consists of three sections, the front section comprising stages one and two and the rear section comprising stages four, five and six are secured to the front and rear faces of the stage three disc respectively. The compressor case consists of six separate outer case assemblies and five stages of stator vanes which have their inner roots located in five separate split shroud rings.

A stub shaft, secured to the front of the third stage hub is supported by the compressor location bearing. An extension from the rear of the stage six disc connects to an extension on the front face of the turbine disc to provide the drive for the compressor.

The combustion section consists of an annular liner assembly supported between concentric inner and outer air cases that direct compressor air to the combustion chamber. The whole assembly is enclosed within an outer case assembly which provides the location for the 18 fuel burners, HP NGV's and the HP turbine disc.

3.5 Intermediate Pressure Turbine Module (05)

This module comprises the IP turbine and the turbine case which houses the IP nozzle guide vanes and the HP and IP turbine roller bearing support assembly. The IP turbine rotor is connected to the IP compressor by a shaft passing through the HP compressor rotor and turbine.

4 GAS FLOW

Air flowing through the intake flare enters the air intake casing and is compressed via, the IP and HP compressors prior to entering the combustion section. Fuel is introduced into the combustion chamber where it mixes with the air stream, is ignited and burned. The resultant increase in temperature expands and accelerates the gas stream rearwards through the turbine sections. Each turbine system extracts energy from the gas stream to drive its respective compressor system.

Air, tapped from both the IP and HP compressors cools the turbine blades and hot areas of the gas generator and pressurizes the seals to prevent oil and gas leakage. IP and/or HP delivery air can be tapped from the appropriate casing to provide power turbine rotor cooling and seal pressurization.

5 CONTROL (GAS FUELLED)

(Refer to Fig 4).

The gas generator fuel control system consists basically of two units, a gas fuel control system, comprising a hydraulic or electrically actuated gas metering valve, and a Digital Control System (DCS) containing the necessary programme for speed governing and temperature and pressure control. The gas metering valve regulates the gas fuel flow to the burners, and is operated by the hydraulic or electrical actuator in response to signals from the DCS.

The DCS compares monitored values of:

(1) Intake temperature

(2) IP compressor speed

(3) HP compressor speed

(4) Power turbine speed

(5) HP compressor sixth stage pressure

(6) Power turbine entry temperature

-with their preset datum values and the differences produce corresponding control output signals which are proportional to the fuel flow adjustment required. The output of each control loop is fed to a low signal selector which selects the signal demanding the lowest fuel flow and transmits it to the hydraulic or electrical actuator to adjust the position of the gas valve and thus regulate the fuel flow. Under normal running conditions the power turbine governor control loop demands the lowest fuel flow to the gas generator and this is the primary governor, with the other governors maintaining the gas generator within safe operating limits when the power turbine speed is increased in response to an increase in load output demand.

To prevent stalling under conditions of rapid increase in load when on power turbine governor control, an acceleration control is provided by allowing the fuel flow to increase at a rate controlled by the rate of increase in compressor delivery pressure.

When rapid deceleration is required to cope with a sudden reduction in load, flame-out, owing to under- fuelling, is avoided by the provision of a deceleration control which allows the fuel flow to decrease to a value controlled by the decrease in compressor delivery pressure.

A high speed shut-off cock in the gas fuel line will close and shut-off the fuel to the gas generator within 100 milliseconds.

6 CONTROL (LIQUID FUELLED) - (LIQUID ONLY UNITS)

The liquid fuel system is similar to that used for the gas fuel engine and consists of the two basic units, the fuel control system and the DCS. The DCS is exactly that used for the gas fuelled engine whilst the fuel control has two additional items to that for the gas unit. There is a HP fuel inlet filter and a servo dump valve which spills excess fuel back to the fuel cooler.

7 CONTROL (DUAL FUELLED)

(Refer to Fig 5).

The gas generator fuel control system for a dual fuelled installation comprises two fuel controlled systems as described in paras 4 and 5 and a common DCS, similar to that previously described. The DCS is capable of controlling the gas generator using liquid fuel, gas fuel or a mixture of both. The control system has an automatic change-over facility.

PREFACE

1 HEALTH AND SAFETY

1.1 Procedures Before Gas Generator Operation

(1) It is a requirement that users of this Publication be familiar with and observe local Health and Safety Regulations and requirements that may affect the publication contents.

(2) It is essential that the work detailed in this Manual is only carried out by trained and competent personnel.

(3) This manual and other related manuals in the RB211 set must be read before installation or operation of the RB211 gas generator. **Refer to Support Documentation Chart** for detail of related manuals.

1.2 Rolls-Royce and the Revision of Manuals, Bulletins and Associated Documentation

(1) Rolls-Royce distributes updates for manuals, service bulletins, turbo bulletins and service information letters to the nominated address of the manual holder. These documents can contain information regarding the safe operation of the equipment and it is in the interests of both the operator/owner and Rolls-Royce to ensure that these documents are received and acted on as necessary.

(2) Rolls-Royce may not be aware of changes in the operator's/owner's organisation or changes in ownership of equipment. It is the responsibility of the equipment operator/owner to ensure that any changes in manual holder and/or address, or any changes in equipment ownership are reported to Rolls-Royce.

(3) Rolls-Royce will not be held responsible for any consequences resulting from the lack of receipt of this documentation where such changes have not been advised to Rolls-Royce in writing.

1.3 Compressor And Turbine Blade Containment Shields

(1) Several operators have requested that RRPEplc clarify the need for retaining compressor and turbine containment shields on RB211 gas generators housed in module enclosures. The containment shields may cause a hindrance during maintenance procedures which can result in increased gas generator down time.

(2) The following procedure details when containment shields can be removed and when they must be retained.

(3) The turbine casing will contain the release of any single IP or HP turbine rotor blade and the probability of an uncontained multiple turbine blade failure is considered to be 'extremely remote'. Therefore the turbine (hot end) containment shield may be removed if the operator so desires. Any equipment located on the shield will need to be suitably relocated. This work should be undertaken in conjunction with the Original Equipment Manufacturer (OEM).

(4) Although extremely unlikely, the IP compressor casing may not contain a failed IP compressor Stage 1 blade. It is therefore recommended that the compressor casing (cold end) containment shield remain in place unless a comparable containment arrangement is installed.

(5) The Industrial RB211 gas generator has been designed and manufactured to high levels of integrity, consistent with its aero equivalent.

(6) These recommendations are issued, based upon a safety review of the 5.7 million hours operational experience of the Industrial RB211, up to January 1996 during which there have been no primary uncontained turbine failures.

2 INFORMATION NOTE

This Manual and all others in the suite quote "Contact Technical Support" when encountering various situations which may occur during the operation of the gas generator

Please refer to the details given below to contact your nearest Technical Support organisation regarding any issues concerning information in any of the Manuals or for any other reason.

Communication

If you have any queries all communication should be addressed to:-

Technical Support Department
Rolls-Royce Power Engineering plc
Ansty
COVENTRY
CV7 9JR

Telephone : 024 76623283 or 76624392
Fax : 024 76624017

Or North American Region Operators:-

Technical Support Department
Rolls-Royce (Canada) Limited
9904 Cote de Liesse Road
Lachine
Quebec
CANADA
H8T 1A1

Telephone : 514 636 0964
Fax : 514 631 1849

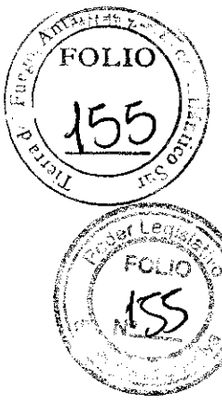
Or Far Eastern Region Operators:-

Technical Support Department
Rolls-Royce Pte. Limited
2, Gul Circle,
Singapore,
629550

Telephone : 65 863 - 3631
Fax : 65 862 - 1662

3 ABBREVIATIONS

abs	absolute
amps	ampere
brg	bearing
chu	centigrade heat unit (pound calorie)
deg	degree (temperature)
Δ (delta)	differential
ECS	engine control system
EGT	exhaust gas temperature
ESD	emergency shut down
freq conv	frequency convertor
GG	gas generator
g	gauge
HP	high pressure
HSSOC	high speed shut-off cock



HT	high tension
hyd	hydraulic
IP	intermediate pressure
IPT	intermediate pressure turbine
ISA	international standard atmosphere
kg	kilogramme
kJ	kilojoule
LH	left-hand
LOC	lubricating oil console
LP	low pressure
LT	low tension
MCD	magnetic chip detector
mg	milligramme
MOP	motor operated potentiometer
NGV	nozzle guide vane
Nm	newton metre
No.	number
NRV	non return valve
OFPU	oil flow protection unit
osc	oscillator
Pa	Pascal (SI unit of pressure)
P/SW	pressure switch
PT	power turbine
QDM	quantitative debris monitor
RH	right-hand
RVDT	rotary variable differential transformer
SSD	system shut down
VIGV(IGV)	variable inlet guide vane

Chapter 1

GENERAL DESCRIPTION

CHAPTER CONTENTS

ILLUSTRATIONS

2 PERIODIC MAINTENANCE OPERATIONS AND INSPECTIONS TABLE

2.1 Whenever the Gas Generator is Stopped

Item	Nature of Operation/Inspection
Gas generator exterior inspection	Generally visually inspect exterior of the gas generator for any fault. **Refer to Para 3**
Manual bearing Magnetic Chip Detectors (MCDs) (If fitted, alternative to QDM system)	If manual bearing chip detectors are fitted, then they are to be examined on an opportunity basis whenever the gas generator is stopped. **Refer to Para 4**.
Dual fuel liquid manifolds	Inspect for contact/touching of liquid fuel manifolds with other GG external features. **Refer to Para 3**
Gas fuel feed pipes	Inspect for damage. **Refer to Para 3**.

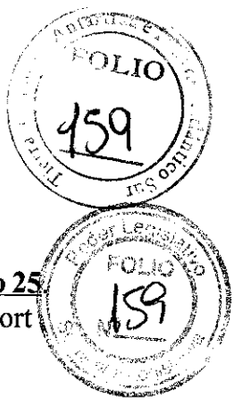
2.2 Daily

Item	Nature of Operation/Inspection
Fill in log sheet.	**Refer to Table 5** for list of recommended parameters regarding the checks to be accomplished. (Supplied for reference)
Tedeco quantitative debris monitor (QDM) system (If fitted)	If the Tedeco QDM on-line debris monitor is fitted, record the reading daily on the log sheet and monitor the trend by plotting counts/hours. **Refer to Para 5**.

2.3 Every Crank/Soak Wash

NOTE The interval between crank/soak washes is a non-specific value that will differ for each individual installation, being based upon gas generator utilisation, the degree and nature of airborne contamination and the efficiency of the air filtration of the plant. The guidelines for the intervals between each crank/soak wash are given in Chapter 8. Contact Technical Support for further information.

Item	Nature of Operation/Inspection
Carry out crank/soak wash	**Refer to Chapter 8**
Intake, VIGVs first stage rotor blade	Hand clean and inspect the intake flare, air intake casing struts, VIGVs and first stage rotor blades. Visually check the VIGVs for cracks. (Pre Mod 1165). Check the intake/flare flex seal for security. **Refer to Para 8**. Examine the flare and glass fibre intake alignment. **Refer to Para 8.**
Drain valves	Check the valves are clear and flowing following crank/soak wash. Remove, clean and test if necessary. **Refer to Para 28**
Gas feed pipes (Dual fuel gas generators only)	Check for tightness. **Refer to Para 6**.



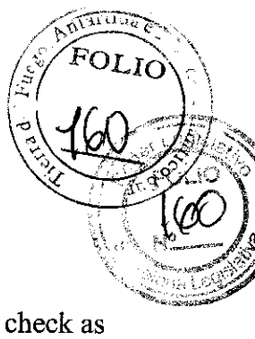
2.4 Every 4000 Hours or Annually, Whichever Occurs Sooner

Item	Nature of Operation/Inspection
Internal examination	Examine the internal features using a borescope. **Refer to Paras 12 to 25.** Any cracks or signs of distress should be reported to Technical Support and may require more frequent inspection.
Gas feed pipe (Dual fuel gas generators only.	Disconnect/remove and inspect for carbon. **Refer to Para 6**.
VIGV operating mechanism	Check for freedom of movement and security of linkages.
LVDT maintenance	Lubricate/inspect Rose bearing rod ends. Lubricate carriers. Clean electrical connections. **Refer to Para 30.**

WARNING THE ELECTRICAL DISCHARGE FROM THE HIGH ENERGY IGNITION UNITS IS LETHAL. THEREFORE THE LOW TENSION (LT) SUPPLY TO THE UNIT MUST BE DISCONNECTED AND TWO MINUTES ALLOWED TO ELAPSE BEFORE ATTEMPTING TO DISCONNECT THE HIGH TENSION (HT) CONNECTOR

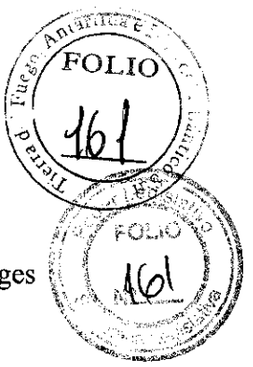
CAUTION IN ALL CASES A DRY MOTORING CYCLE MUST BE CARRIED OUT IMMEDIATELY PRIOR TO FUNCTION TESTING IGNITERS, HIGH ENERGY IGNITION UNITS OR THEIR RELATED CIRCUITS

Ignition system	Check plugs for discharge. **Refer to Para 26**.
Hydraulic starter motor and gearbox (Volvo) (if fitted)	Remove and examine magnetic drain plug. **Refer to Para 7**.
Starting bleed valve control (if fitted - gas generatorswith one starting bleed valve only)	Clean and inspect. **Refer to Para 10**.
Vibration Monitoring System	Check tightness and condition of mountings. Check calibration of vibration indicator/do a shaker table test on the accelerometers. **Refer to Para 29**.



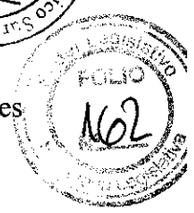
2.5 Every 8000 Hours or Annually, Whichever Occurs Sooner

Item	Nature of Operation/Inspection
BOV control solenoid	Remove for cleaning, inspection and test. **Refer to Para 11**.
Pressure switches solenoids, heaters, thermostats and all electrical equipment mounted off engine.	Carry out manufacturers recommendations and/or functional check as appropriate. **Refer to Volume 1A, Maintenance Manual and Parts Catalogue - Off Engine Parts**.
Tedeco (QDM) System (if fitted)	Check calibration of Tedeco quantitative debris monitor system. **Refer to Para 5**.
Scavenge line filter baskets	Clean the filter baskets located in the installation scavenge pipework, L2, L3 and L4. **Refer to Volume 1A, Maintenance Manual and Parts Catalogue - Off Engine Parts**. Contact Technical Support if baskets are excessively contaminated.
Fuel filter (Liquid fuel only)	Fit new filter element. **Refer to Para 27**.
Fuel shut-off valves	Consider change out/overhaul of critical valves. Refer to Technical Support.
HP3 air filter	Remove for inspection and cleaning.**Refer to Para 9**
Vibration detection system	Functional check. **Refer to Para 29**.
L5 vent pressures	Check the pressure annually for possible blockage to the L5 pipework. **Refer to Para 31**
Re-rubber Mod 1117 OGVs	Operators in high ambient climates **(Refer to Fig 53)** are advised to re-rubber their OGVs after every 8000 hours operation. **Refer to Para 32** Alternatively rework to Mod 1190 standard
Inspection of the IP compressor. Mod 1117 embodied (High ambient areas - **refer to Fig 53**)	Remove the top half of the IP compressor casing and inspect all stages of compressor inner shrouds, OGV ring etc. **Refer to Para 33**.



2.6 Every 16,000 Hours

Item	Nature of Operation/Inspection
Inspection of the IP compressor Mod 1190 embodied (High ambient areas - **refer to Fig 53**)	Remove the top half of the IP compressor casing and inspect all stages of compressor, inner shrouds, OGV ring etc. **Refer to Para 33**.



2.7 Every 24,000 Hours

Item	Nature of Operation/Inspection
Inspection of the IP compressor Mod 1144/ 1159/1205/1249 embodied(High ambient areas - **refer to Fig 53**)	Remove the top half of the IP compressor casing and inspect all stages of compressor, inner shrouds, OGV ring etc. **Refer to Para 33**.
Inspection of the IP compressor Mod 1117, 1190/1144/1159/1205 1249 embodied (NORMAL ambient areas - **refer to Fig 53**)	Remove the top half of the IP compressor casing and inspect all stages of compressor, inner shrouds, OGV ring etc. **Refer to Para 33**.

WARNINGS

1 WARNINGS

WARNING 1 IGNITION SYSTEM

BEFORE COMMENCING ANY EXAMINATION OF THE GAS GENERATOR IGNITION SYSTEM, ENSURE THAT THE LOW TENSION LEAD IS FIRST DISCONNECTED FROM THE SUPPLY TO THE HIGH ENERGY IGNITION UNIT, AS THE HIGH VOLTAGE ASSOCIATED WITH THE IGNITION PLUGS MAY PROVE LETHAL. ALLOW TWO MINUTES TO ELAPSE BETWEEN DISCONNECTION AND THE CHECKING OF ANY COMPONENT.

SYSTEM SAFETY - ENSURE THAT ELECTRICAL CIRCUITS, FUEL, LUBRICATING OIL, HYDRAULIC OIL AND FIRE EXTINGUISHING SYSTEMS ARE ISOLATED AND SAFE IN ACCORDANCE WITH LOCAL ORDERS AND MAINTENANCE MANUAL INSTRUCTIONS BEFORE COMMENCING ANY WORK ON THE EQUIPMENT. LIVE FUNCTION TESTING MUST ONLY BE UNDERTAKEN BY AN AUTHORISED COMPETENT PERSON.

IGNITER/HIGH ENERGY IGNITION UNIT FUNCTION TESTING-IN ALL CASES A DRY MOTORING CYCLE MUST BE CARRIED OUT IMMEDIATELY PRIOR TO FUNCTION TESTING IGNITERS, HIGH ENERGY IGNITION UNITS OR THEIR RELATED CIRCUITS.

WARNING 2 VITON SEALS EXPOSED TO HIGH TEMPERATURE

WHEN DISASSEMBLING COMPONENTS WHICH CONTAIN PARTS MANUFACTURED FROM VITON THAT HAVE BEEN EXPOSED TO TEMPERATURES IN THE REGION OF 400 DEG C (750 DEG F) OR HIGHER THE VITON DECOMPOSES CHEMICALLY. ONE OF THE BY-PRODUCTS IS HYDROFLUORIC ACID WHICH IS HIGHLY CORROSIVE AND ALMOST IMPOSSIBLE TO REMOVE ONCE IT HAS CONTAMINATED THE SKIN.

THE FOLLOWING PRECAUTIONS SHOULD BE ADHERED TO:-

SHOULD YOU BE REQUIRED TO INSPECT AND/OR REPLACE ANY OVERHEATED COMPONENT MANUFACTURED FROM VITON UNDER NO CIRCUMSTANCES PERMIT THE MATERIAL TO COME INTO CONTACT WITH BARE SKIN.

IF ANY ACID CONTAMINATION HAS TAKEN PLACE THE AFFECTED AREA SHOULD BE DE-CONTAMINATED BEFORE WORK COMMENCES.

ANY SKIN CONTAMINATION MUST BE TREATED WITH HYDROFLUORIC ACID BURN JELLY AS SOON AS POSSIBLE AND MEDICAL ADVICE SOUGHT.

WARNING 3 PX 24 (ARDROX 3691) INHIBITING FLUID VAPOUR HAZARD.

OWING TO A POSSIBLE HEALTH HAZARD, CARE SHOULD BE TAKEN NOT TO INHALE PX24 INHIBITING FLUID VAPOUR, OR EQUIVALENT WHEN INHIBITING GAS GENERATORS. THIS COULD OCCUR WHEN A GAS GENERATOR IS AT REST OR ON BARRING BUT IT IS OF PARTICULAR CONCERN WHEN USING AEROSOLS IN A CONFINED SPACE. WHEN INHIBITING WITH PX24 INHIBITING FLUID, UNDER THESE CONDITIONS A DRY GAUZE FACE AND NOSE MASK SHOULD BE WORN AS A PRECAUTIONARY MEASURE. A FINE MIST OF PX24 INHIBITING FLUID OR EQUIVALENT IN THE ATMOSPHERE COULD BE READILY IGNITED (FLASH POINT 41 DEG C (110 DEG F) (MINIMUM) OPEN CUP), THEREFORE ALL SOURCES OF IGNITION IN THE PROXIMITY SHOULD BE EXTINGUISHED BEFORE INHIBITING IS CARRIED OUT.

WARNING 4 SYNTHETIC LUBRICATING OIL HAZARD

THE SYNTHETIC OIL USED IN THIS ENGINE CONTAINS ADDITIVES WHICH, AFTER PROLONGED SKIN CONTACT CAN BE TOXIC THROUGH ABSORPTION. PERSONAL PROTECTIVE EQUIPMENT IS TO BE USED TO MINIMISE CONTACT. ANY OIL SPILT SHOULD BE CONTAINED/WIPED AND DISPOSED OF IN AN APPROVED MANNER.

WARNING 5 LUBRICATING OIL TEMPERATURE AND PRESSURE

WHEN THE GAS GENERATOR SYSTEM IS OPERATING, THE OIL REACHES HIGH TEMPERATURE AND PRESSURE. THEREFORE THE LUBRICATING AND HYDRAULIC SYSTEM MUST BE SHUT DOWN AND THE TEMPERATURE AND PRESSURE BE ALLOWED TO DECAY BEFORE ANY WORK IS DONE ON ANY PART OF THE OIL SYSTEM.

IN OPERATION THE OIL PRESSURE IS CONTAINED WITHIN THE SYSTEM. THE RISK OF A LEAK, HOWEVER SLIGHT COULD RELEASE HOT OIL AT HIGH PRESSURE.

IT IS THEREFORE RECOMMENDED THAT PERSONNEL MAINTAIN A SAFE DISTANCE FROM THE GAS GENERATOR AND LUBRICATION SYSTEM WHILST THEY ARE OPERATING.

PERSONNEL MUST NOT STAND OR APPLY ANY UNDUE LOAD TO THE OIL SYSTEM PIPEWORK WHEN CARRYING OUT MAINTENANCE AS THIS COULD CAUSE LEAKAGE.

WARNING 6 SAFE LIFTING OF COMPONENTS

APPROPRIATE LIFTING EQUIPMENT MUST BE USED FOR ALL HEAVY ITEMS.

WARNING 7 SITE REGULATIONS

BEFORE WORKING ON ANY PART OF THE GENERATING SET, PERSONNEL MUST ENSURE THAT ALL CURRENT SITE REGULATIONS ARE COMPLIED WITH. PERSONNEL MUST ALSO OBTAIN PERMISSION FROM THE ENGINEER IN CHARGE BEFORE ENTERING ANY OF THE EQUIPMENT ENCLOSURES.

WARNING 8 ELECTRICAL SYSTEM ISOLATION

PRIOR TO ANY ELECTRICAL MAINTENANCE (EG CHANGING LIGHT BULBS) WITHIN THE GAS GENERATOR PACKAGE IT IS IMPERATIVE THAT THE APPROPRIATE FUSES ARE REMOVED OR THE APPROPRIATE SYSTEM SWITCHED OFF AT THE CONTROL PANEL, THEREBY ISOLATING THE ELECTRICAL SYSTEM WHICH REQUIRES MAINTENANCE.

WARNING 9 PERSONNEL ENTRY INTO GAS GENERATOR ENCLOSURE/ TURBINE HALL

A FAILURE OF THE GAS GENERATOR, PRIMARILY WHEN STARTING, OR WHEN OPERATING AT LOAD, MAY NOT BE CONTAINED IN THE GAS GENERATOR CASINGS. THERE IS A RISK OF INJURY OR POSSIBLY DEATH TO PERSONNEL ENTERING THE GAS GENERATOR ENCLOSURE/TURBINE HALL WHILE THE GAS GENERATOR IS OPERATING. IT IS RECOMMENDED THAT PERSONNEL DO NOT ENTER THE GAS GENERATOR ENCLOSURE/TURBINE HALL WHEN THE GAS GENERATOR IS RUNNING.

PERSONNEL WHO DO GO INTO THE GAS GENERATOR ENCLOSURE/TURBINE HALL MUST ONLY DO SO WHEN:-

(A) THE GAS GENERATOR IS NOT RUNNING

(B) THE GAS GENERATOR IS AT STABLE IDLE

IN ADDITION IT IS RECOMMENDED THAT PERSONNEL DO NOT GO INTO THE GAS GENERATOR ENCLOSURE/TURBINE HALL WHEN:-

(1) FAULT FINDING PROCEDURES ARE REQUIRED.

(2) ALARMS OR TRIPS HAVE OPERATED WHICH INDICATE A DANGER IN THE ENCLOSURE/TURBINE HALL.

(3) IT IS THOUGHT THE INTEGRITY OF THE GAS GENERATOR IS SUSPECT

IF IT IS NECESSARY TO GO INTO THE GAS GENERATOR ENCLOSURE/TURBINE HALL WHILE THE GAS GENERATOR IS OPERATING, THE PROCEDURES THAT FOLLOW MUST BE OBEYED.

(1) SUITABLE EAR PROTECTION/PPE MUST BE WORN.

(2) A 'PERMIT TO WORK' SYSTEM MUST BE INSTALLED AND USED.

WARNING 10 PERSONNEL ENTRY INTO AIR INTAKE PLENUM

PERSONNEL ARE NOT TO ENTER THE AIR INTAKE PLENUM AREA WHILST THE GAS GENERATOR IS RUNNING.

WARNING 11 PERSONNEL ENTRY INTO GAS GENERATOR ENCLOSURE/ TURBINE HALL DURING STARTER MOTOR OPERATION

NO PERSONNEL ARE TO BE ALLOWED INTO THE GAS GENERATOR ENCLOSURE/TURBINE HALL DURING STARTER MOTOR OPERATION.

WARNING 12 REMOVING MCD'S WHILE RUNNING

IT IS RECOMMENDED THAT THE PRACTICE OF REMOVING MAGNETIC CHIP DETECTORS (MCD'S) WITH THE GAS GENERATOR RUNNING IS DISCONTINUED.

MCD'S SHOULD ONLY BE REMOVED WITH THE GAS GENERATOR SHUT DOWN AND OPERATIVES WEARING APPROPRIATE PROTECTIVE CLOTHING.

NOTE Quantitive Debris Monitors (QDM's) which electronically 'count' debris particles, are available for RB211 gas generators. Use of QDM's precludes the need for manual removal of MCD's. Rolls-Royce Power Engineering plc will supply details of these units on request.

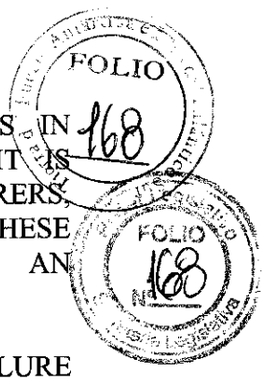
WARNING 13 TIME EXPIRED COMPONENTS

ROLLS-ROYCE POWER ENGINEERING plc (RRPEplc) ARE CONCERNED WITH THE GROWING TRADE IN LIFE EXPIRED COMPONENTS AND COMPONENTS MANUFACTURED WITHOUT RRPEplc APPROVAL. THE MANUFACTURE OF COMPONENTS BY SUPPLIERS APPROVED BY RRPEplc IS SUBJECT TO RRPEplc QUALITY ASSURANCE CONTROLS TO ENSURE THAT COMPONENTS SOLD TO THE CUSTOMER MEET THE RRPEplc SPECIFICATION. THE ORIGINAL DESIGN OF THE COMPONENT WILL HAVE BEEN BASED ON YEARS OF OPERATING EXPERIENCE OF THE GAS GENERATORS, THE USE OF APPROPRIATE MATERIALS AND THE REQUIREMENT FOR SAFE OPERATION.

COMPONENTS MANUFACTURED WITHOUT RRPEplc APPROVAL MAY BE INFERIOR IN QUALITY TO THAT OF THE ORIGINAL. EXTERNAL APPEARANCE MAY BE SIMILAR BUT METALLURGICAL DIFFERENCES AND CONSEQUENT LIFE, MAY NOT BE TO THE RRPEplc DESIGN INTENT. IT IS NOT POSSIBLE TO PREDICT LIVES FOR THESE COMPONENTS BUT A CONSIDERABLE REDUCTION COMPARED TO GENUINE PARTS COULD BE EXPECTED.

THE USE OF THESE COMPONENTS, COULD RESULT IN SUBSTANTIAL REPAIR COST AFTER PREMATURE FAILURE, OR THE POSSIBILITY OF SERIOUS INJURY OR EVEN LOSS OF LIFE OF OPERATING PERSONNEL.

A SIMILAR SITUATION EXISTS WITH THE REUSE OF LIFE EXPIRED COMPONENTS SUCH AS TURBINE AND COMPRESSOR BLADES AND DISCS WHEREAS RRPEplc



APPROVED REPAIR FACILITIES HAVE PROCEDURES IN PLACE COVERING LIFE EXPIRED COMPONENTS. IT IS SUSPECTED THAT CERTAIN NON APPROVED REPAIRERS, POSSIBLY UNWITTINGLY, HAVE BEEN RETURNING THESE COMPONENTS, COSMETICALLY REFURBISHED TO AN UNSUSPECTING MARKET.

RRPEplc ACCEPTS NO RESPONSIBILITY FOR ANY FAILURE OR DAMAGE DUE TO FITMENT OF LIFE EXPIRED COMPONENTS OR COMPONENTS OBTAINED FROM A NON RRPEplc APPROVED SOURCE.

IN ORDER TO PROTECT AGAINST THE POSSIBLE USE OF LIFE EXPIRED OR NON-RRPEplc APPROVED COMPONENTS, THE OPERATOR CAN:-

(1) ENSURE THAT ALL GAS GENERATORS AND POWER TURBINES ARE SERVICED, REPAIRED AND OVERHAULED BY RRPEplc APPROVED PERSONNEL AND REPAIR FACILITIES.

(2) ENSURE THAT WHERE NEW OR REPLACEMENT COMPONENTS ARE FITTED, THEY ARE GENUINE RRPEplc PARTS AND THAT THEY ALL CARRY RRPEplc PART NUMBERS IN LOCATIONS AND IN THE MANNER AS PRESCRIBED BY RRPEplc (INFORMATION ON THIS WILL BE SUPPLIED TO RECOGNISED OWNER/OPERATORS.

(3) INSTRUCT THE OVERHAUL BASE TO DEFACE ANY LIFE EXPIRED COMPONENTS IN SUCH A WAY AS TO MAKE COSMETIC REFURBISHMENT IMPOSSIBLE, EG A NOTCH CUT OR GROUND INTO THE LEADING EDGE OF A BLADE AEROFOIL.

Rolls-Royce	Rolls-Royce Energy Systems Inc. Mount Vernon, Ohio	TC-54-5	
		Revision	4
ENGINEERING STANDARD		Rev. Date	06/14/01
IN-SERVICE INSPECTION REQUIREMENTS COBERRA 6000 GENERATOR SET		Issued	10/3/96
		Page 1 of 8	

1.0 SCOPE:

1.1 This standard provides a general guideline to in-service maintenance requirements for the Rolls-Royce Energy Systems, Inc, (RRESI) COBERRA 6000 package driving a generator set.

1.2 Periodic and elapsed operating hour checks/inspections for all subsystems are defined.

1.3 Recommended maintenance actions are listed for gas generator, power turbine, gearbox, generator set, and pertinent subsystems.

1.4 Inspection Data Record form and Maintenance task checkoff sheets are provided for the units listed in para. 1.3. These forms are available on the PC network under: g:\cu00\forms\tc54-5.

2.0 PURPOSE:

2.1 To document in-service inspection requirements for standard maintenance records and Aftermarket Field Service applications.

3.0 APPLICABLE DOCUMENTS AND SPECIFICATIONS:

3.1 Job-specific drawings with Bills of Material.

3.2 Job-specific maintenance manuals.

3.2.1 Detailed procedures may be found in appropriate manufacturer's maintenance manuals.

4.0 REQUIREMENTS:

4.1 Maintenance checkoff sheets per paragraph 1.4.

4.2 Maintenance, measurement, and cleaning tools as required.

5.0 STATEMENT OF WORK:

5.1 Conduct daily and weekly, and elapsed operating hour inspections.

5.1.1 For maintenance actions over 100K operating hours, contact the OEM for instructions based upon actions taken at 100K hours. For the power turbine, a visual inspection should be conducted at 125K hours and a rotor removal inspection (similar to 100K hour inspection) conducted at 150K hours assuming no part replacements at 100K hours.

5.1.2 Elapsed operating hours are established using "Base Ratings." A unit operated at "Peak Ratings" will reduce the elapsed hours for inspection by four (4) times.

5.2 Fill in and initial Inspection Data Record form.

5.3 For inspection checkoff requirements by elapsed operating hours, refer to the COBERRA 6000 Generator Set Maintenance Sheets.

5.3.1 Use forms per paragraph 1.4. Comment as required for permanent record and initial Inspection Checkoff Sheets.

PERIODIC INSPECTION LIST

TASK	DAILY	WEEKLY (ANY SHUTDOWN)
Check all temperature controller(s) maintain proper system operating temperature(s).	X	
Check all pressure controller(s) maintain proper system operating pressure(s).	X	
Inspect all relief valves for leakage during operation.	X	
Inspect all systems for leaks.	X	
Check all valve packing for leaks.	X	
Check all operating fluid levels. Maintain proper operating level.	X	
Inspect all operating parameters for normal operation.	X	
Check starter settings and filters.		X
Inspect all L/O relief valves for security.		X
Inspect all L/O cooler(s) for leaks and cleanliness. Check motor security.		X
Inspect all L/O cooler(s) fan blades for nicks, cracks, bent blades and security.		X
Inspect AC/DC pre/post L/O pump and motor. Megger motor and record readings.		X
Inspect L/O system strainer for foreign material. Change if required.		X
Inspect fuel vent valve and shutoff valve.		X
Inspect fuel system strainer.		X
Check fuel control assembly for secureness and cleanliness.		X
Check fuel supply pressure regulator(s) for proper operation.		X
Check GG magnetic chip detectors.		X
Check all hoses for condition and leaks.		X
Check all air inlet systems for cleanliness and obstruction of filters. Change if required.		X
Inspect all piping and fittings for leaks.		X

OPERATING HOUR INSPECTION LIST

RB211 Gas Generator TASK	ELAPSED OPERATING HOURS 4K	8K	12K	16K	20K	25K
Check the Quantitative Debris Monitor.	X					
Check external pipework and electrical leads for security of locking devices, wear, cracks, dents, distortion and air or exhaust leaks.	X					
Check the Air Intake Flare, V.I.G.s, and visible compressor blades for dirt/damage.	X					
Carry out an acidity test on the Lubrication Oil.	X					
Inspect and clean H.P.3 air filter.	X					
The Blow Off Valve (B.O.V.) Control Solenoid to be inspected and cleaned.	X					
Check V.I.G.V. operating mechanism for freedom of movement.	X					
Check settings on Airflow Control System.	X					
Renew Ignitor Plugs and check for discharge.	X					
Check that the Flexible Joint Seal is secure.	X					
Remove Hydraulic Starter Motor/Gearbox drain plug and examine for debris. (If Hydraulic Starter is fitted).	X					
Fit new fuel filter if Dual Fuel unit.	X					
Check all Drain Valves.	X					
Check the L.O.C. Flow Meter	X					
Inspect Gas Generator internally using a Boroscope.		X				
Clean Scavenge Baskets fitted to L2, L3, and L4 Scavenge lines.		X				
Carry out Insulation and D.C. resistance checks on engine mounted electrical components.		X				
Functionally check the Vibration Detection System.		X				
Check the calibration of Magnetic Detection System (Q.D.M).		X				
Functionally check fuel system.		X				
Remove Gas Generator for hot end refurbishment.						X

NOTE: The RB211 Gas Generator Tasks were generally revised.

OPERATING HOUR INSPECTION LIST

Power Turbine TASK	ELAPSED OPERATING HOURS							
	500	2K	4K	8K	24K	32K	48K - 50K	80K - 100K
Take L/O sample for analysis.		X						
On startup, perform vibration analysis.		X						
Check unit foundation bolts/nuts and general condition.			X					
Conduct the seal air system static check.			X					
Check alignment.				X				
Inspect main drive coupling.				X				
Check blade tip clearance.				X				
Borescope inspection.				X				
Evaluate vibration data. Remove and inspect bearings if necessary.					X			
Inspect seal air system.					X			
Remove and inspect bearings if not previously done. Replace as necessary.							X	
Visually inspect vibration probes. Replace as necessary.							X	
Visually inspect speed pickups. Replace as necessary.							X	
* Remove turbine rotor for complete inspection.							1	2

* **NOTES:**

1 **For COBERRA 6X61 Packages substitute the starred task with the following: Remove duct (D) 2nd turbine (T) modules for complete inspection at every 48K - 50K elapsed operating hours.**

2 **For all other Power Turbine models, including the RT56 and RT62 Power Turbines, task should be carried out at every 80K - 100K elapsed operating hours.**

OPERATING HOUR INSPECTION LIST

Gearbox TASK	ELAPSED OPERATING HOURS							
	500	2K	4K	8K	24K	32K	48K - 50K	80K - 100K
On startup, perform vibration analysis.		X						
Check unit foundation bolts/nuts and general condition.			X					
Check gear contact pattern.				X				
Evaluate vibration data. Remove and inspect bearings if necessary.					X			
Perform major overhaul.						X		
Review with Manufacturer for recommendations for full inspection, overhaul or renewal. Expect to remove the gear.								X

OPERATING HOUR INSPECTION LIST

Generator TASK	ELAPSED OPERATING HOURS							
	500	2K	4K	8K	24K	32K	48K - 50K	80K - 100K
Check insulation resistance of rotor windings.		X						
Check exciter diodes for damage.		X						
On startup, perform vibration analysis.		X						
Check all piping and fittings for tightness.			X					
Check bearing oil seals for leaks.			X					
Check air inlet seals and ensure no oil is penetrating into the generator.			X					
Check cooling system and ensure no liquids are carrying over into the generator.			X					
Check generator heaters for proper operation.			X					
Check shaft earthing bushing.			X					
Prior to shutdown - conduct performance analysis.				X				
Check alignment.				X				

Generator TASK	ELAPSED OPERATING HOURS							
	500	2K	4K	8K	24K	32K	48K - 50K	80K - 100K
Evaluate vibration data. Remove and inspect bearings if necessary.					X			
Check the air gap pressure at the intermediate seal.					X			
Inspect and remove excess deposits of oil and dust from stator and winding.					X			
Remove and inspect bearings if not previously done. Replace as necessary.							X	
Visually inspect vibration probes. Replace as necessary.							X	
Review with Manufacturer for recommendations for full inspection, overhaul or renewal.								X

OPERATING HOUR INSPECTION LIST

Control System TASK	ELAPSED OPERATING HOURS					
	500	2K	4K	8K	24K	32K
Check battery/UPS condition.		X				
Check the fuel control system.			X			
Check the speed monitors (if applicable).			X			
Check the overspeed (simulate).			X			
Electrically check the proximeter probes and vibration monitoring system.			X			
Inspect for loose connections in the panel or junction boxes.			X			
Clean and inspect the panel air filters.			X			
Check all indicator lights.			X			
Calibrate and test the annunciator system.				X		
Check and calibrate all Unit Control Panel cards.				X		
Perform complete system overview.					X	

OPERATING HOUR INSPECTION LIST

Systems TASK	ELAPSED OPERATING HOURS					
	500	2K	4K	8K	24K	32K
Check all air filters for damage and proper fit to the support frame.		X				
Ensure that all conduit runs and junction boxes are drained of water and are corrosion free.		X				
Ensure all grounding straps are properly connected and are corrosion free.		X				
Lubricate all door hinges and limit switch arms as required to ensure free movement.		X				
Check the inlet systems for degradation and moisture buildup.			X			
Check all joints on the inlet systems for evidence of air or dust leakage.			X			
Check all indicator lights.			X			
Check function of all fire shutters.			X			
Check operation of fire and gas detection system. Ensure cylinder heads removed from extinquishent.			X			
Inspect and lubricate (as required) all motors and valves.			X			
Check all motors with meggers.			X			
Check all systems hoses and fittings for degradation and tightness.			X			
Check starter system filters/strainers.			X			
Before and after shutdown, check starter system settings.			X			
Check calibration of the GG L/O temperature control valve.			X			
Check calibration of the main L/O temperature control valve.			X			
Check the coolers for fouling.			X			
Check all level controllers.			X			
Check position of all control valves.			X			
Clean the interior of the enclosure(s).			X			
Inspect the enclosure for leakage.			X			
Inspect the exhaust thermal insulation for damage, burning, oil soaking and general overall condition.			X			
Change or clean all filters, prefilters and strainers regardless of • P reading.				X		
Check and calibrate all temperature gauges.				X		

Systems TASK	ELAPSED OPERATING HOURS					
	500	2K	4K	8K	24K	32K
Check and calibrate all pressure gauges.				X		
Check all pressure switch settings.				X		
Check all temperature switch settings.				X		
Check function of all pressure and temperature transmitters.				X		
Check condition of all solenoids.				X		
Check and calibrate all switch gear settings and MCC settings.				X		
Check the temperature, amperage, speed and resistance of all motors.				X		
Check all relief valve settings.				X		
Perform complete system overview.					X	
Overhaul all systems.						X

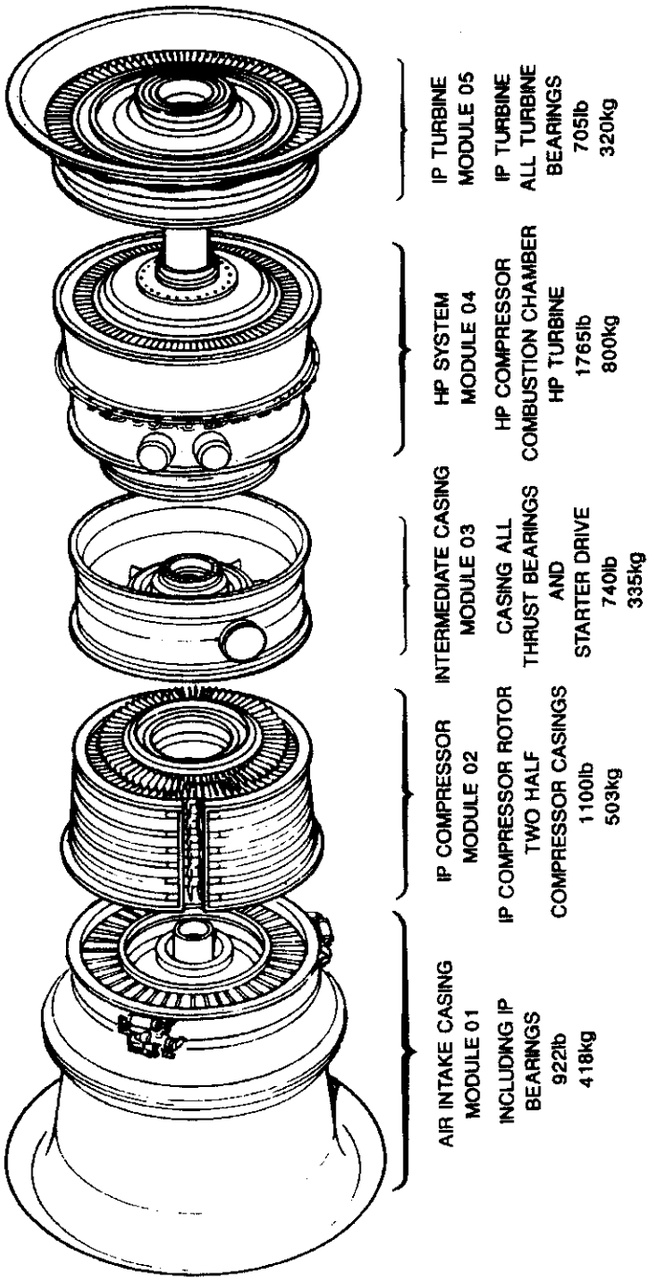
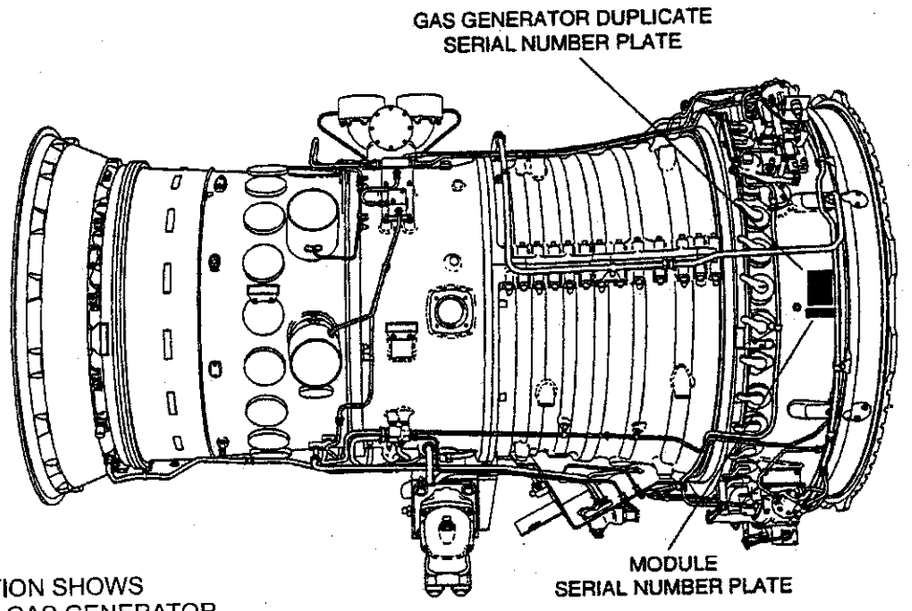
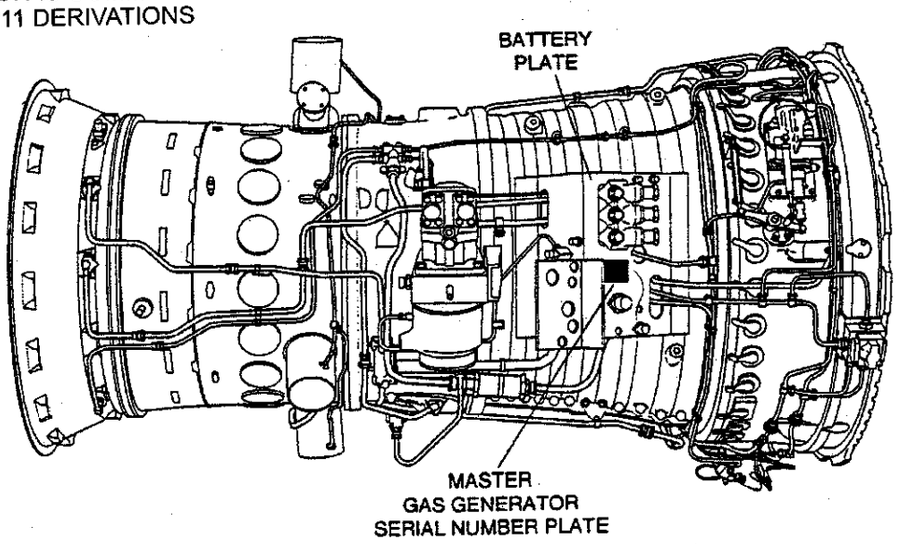


FIG 1 MODULE BREAKDOWN



NOTE
ILLUSTRATION SHOWS RB211-24G GAS GENERATOR, BUT SERIAL NUMBER PLATE INFORMATION IS COMMON TO ALL RB211 DERIVATIONS

VIEW ON STARBOARD SIDE OF GAS GENERATOR



VIEW ON UNDERSIDE OF GAS GENERATOR

009422 Cdr

FIG 2 LOCATIONS OF SERIAL NUMBER PLATES ON THE GAS GENERATOR

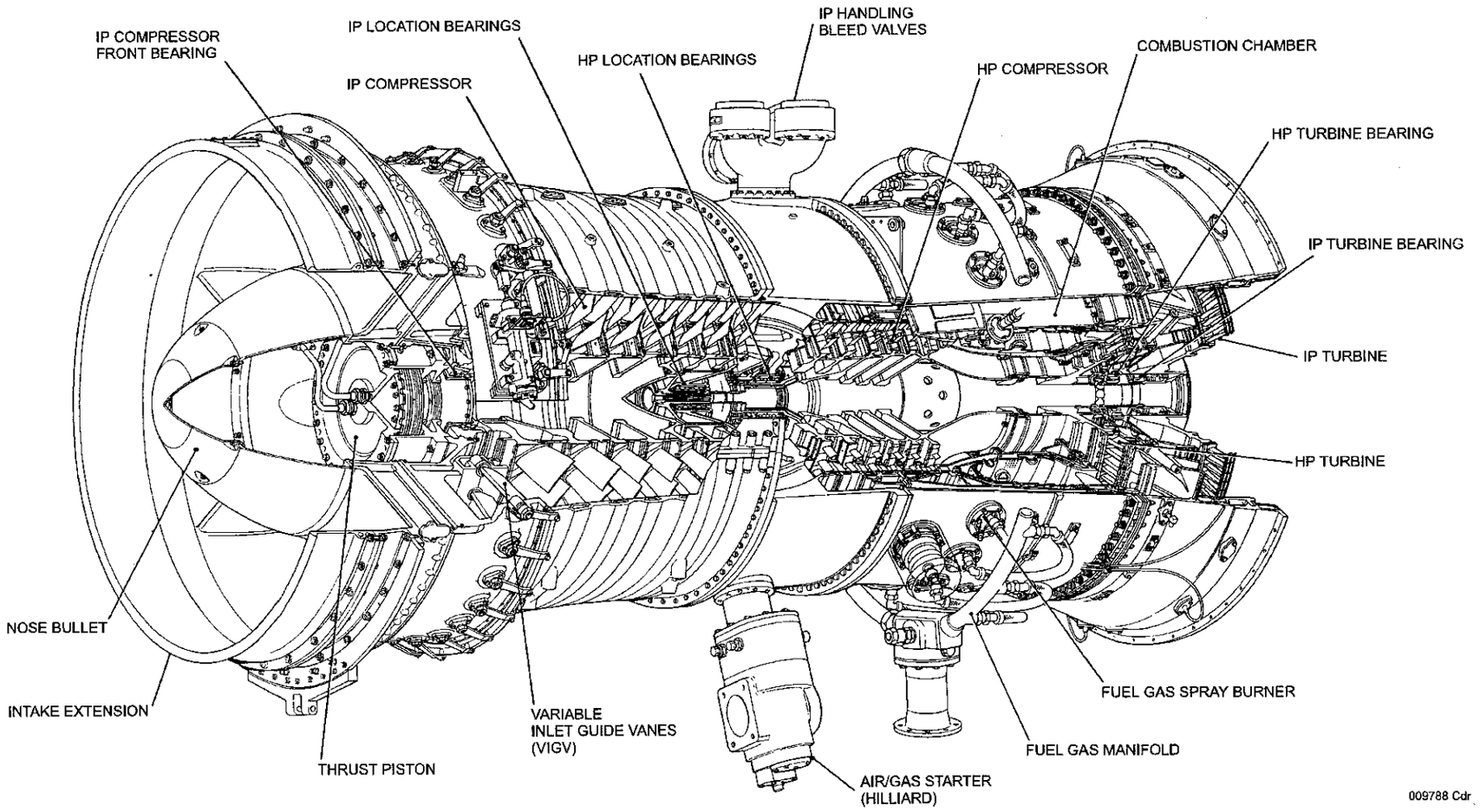
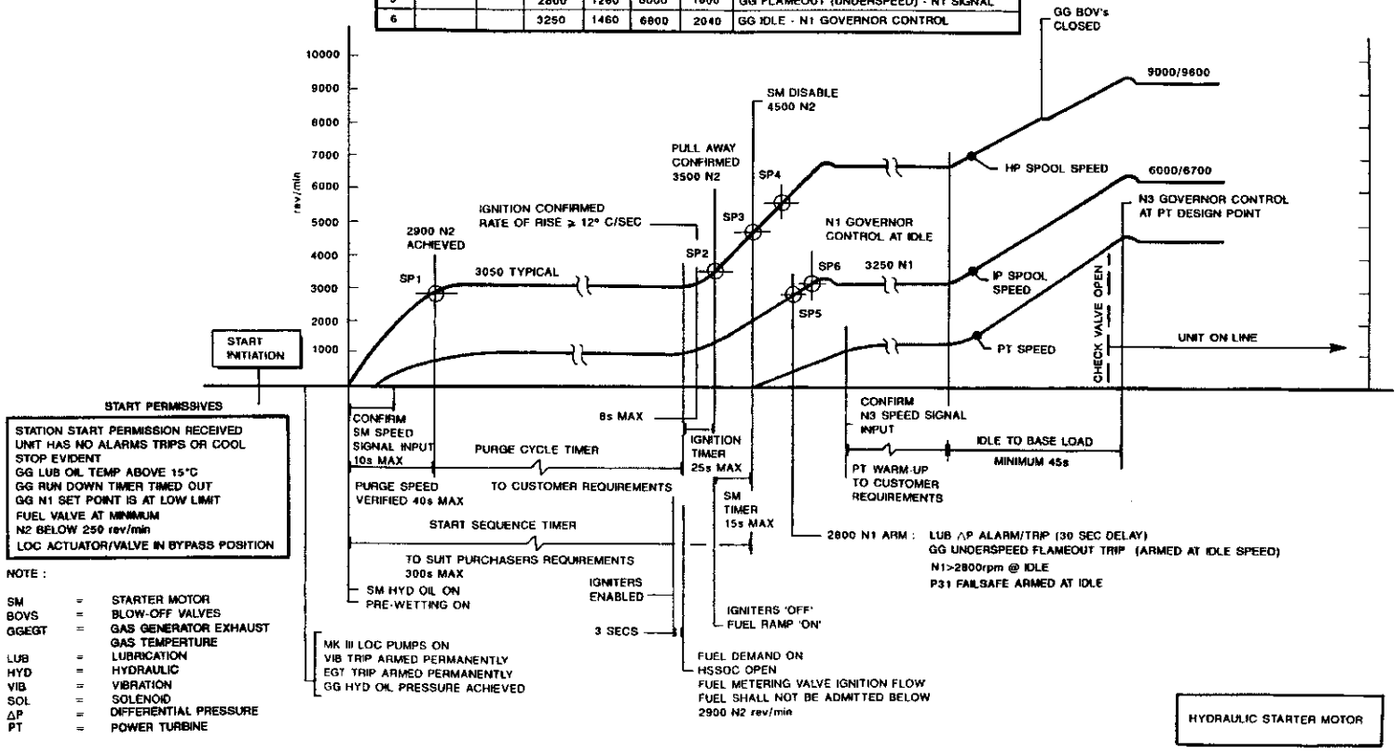


FIG 4 GAS GENERATOR - PICTORIAL CUTAWAY - GASEOUS FUEL

SPEED POINTS AND EQUIVALENT SPEED PROBE FREQUENCIES							
	Ns		N1		N2		
SP	rev/min	Hz	rev/min	Hz	rev/min	Hz	
1	2585	1336			2900	870	MIN PURGE SPEED ACHIEVED/VERIFIED
2	3182	1644			3500	1050	PULL AWAY CONFIRMED-N2 SIGNAL
3	4473	2312			4500	1350	STARTER DISABLE SPEED-Ns SIGNAL
4	4970	2568			5000	1500	STARTER OVERSPEED TRIP - Ns SIGNAL
5			2800	1260	6000	1800	GG FLAMEOUT (UNDERSPEED) - N1 SIGNAL
6			3250	1460	6800	2040	GG IDLE - N1 GOVERNOR CONTROL



NOTE :

SM	=	STARTER MOTOR
BOVS	=	BLOW-OFF VALVES
GGEGT	=	GAS GENERATOR EXHAUST GAS TEMPERTURE
LUB	=	LUBRICATION
HYD	=	HYDRAULIC
VIB	=	VIBRATION
SOL	=	SOLENOID
ΔP	=	DIFFERENTIAL PRESSURE
PT	=	POWER TURBINE

009421 Cdr

FIG 2 TYPICAL START SEQUENCE HYDRAULIC STARTER MOTOR

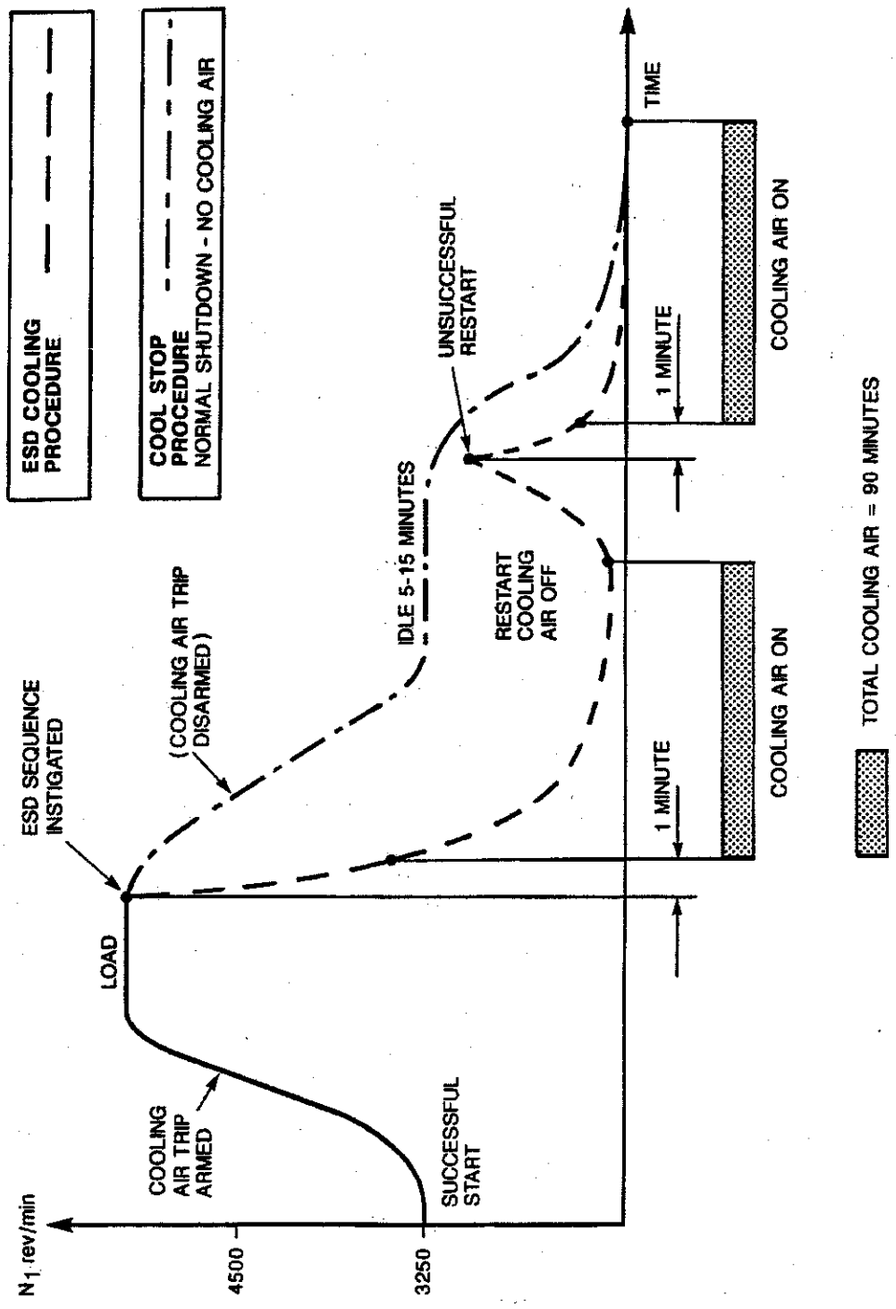


FIG 4 RB211 05 MODULE 'COOL STOP' PROCEDURE AND COOLING AIR SEQUENCE

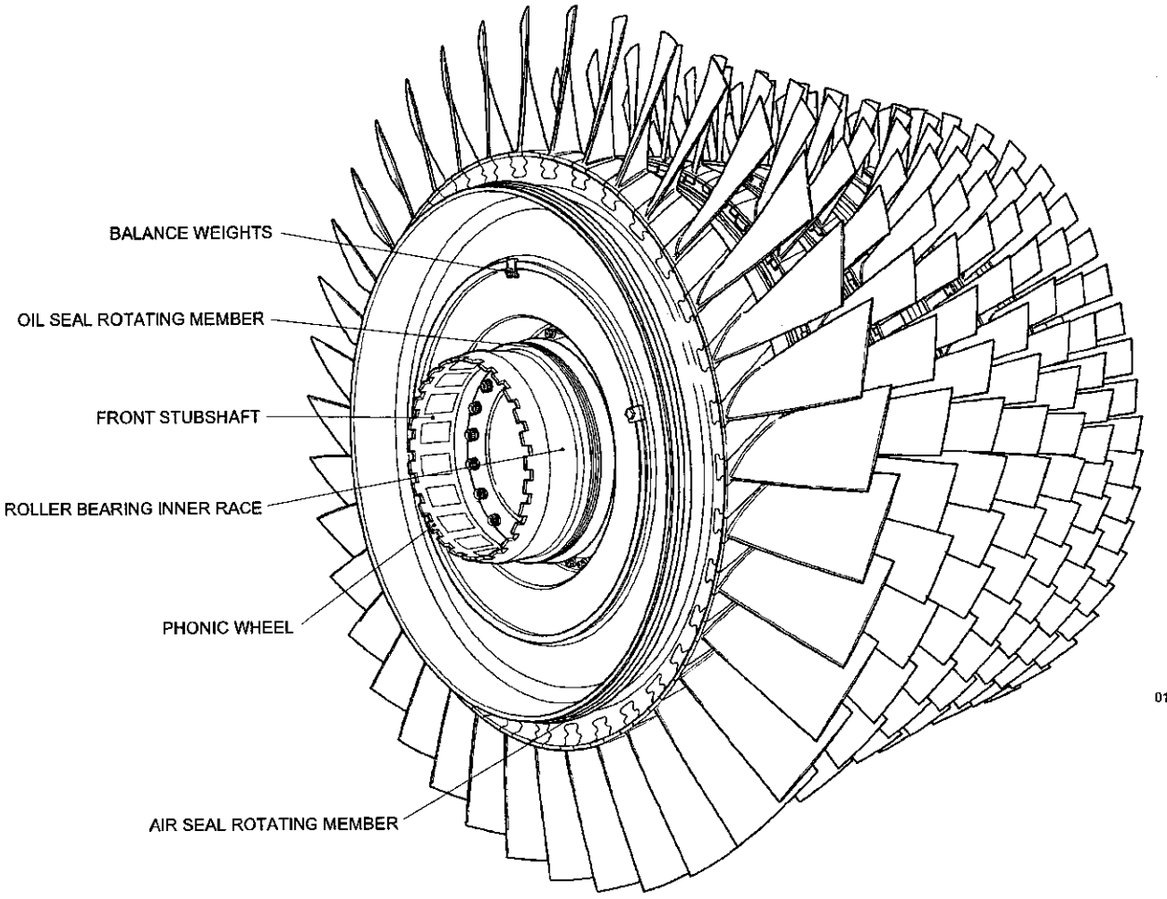


FIG 8 IP COMPRESSOR ROTOR

FOLIO 183

DEPARTAMENTO GENERACION

TURBOGRUPOS TG-5 y TG-6

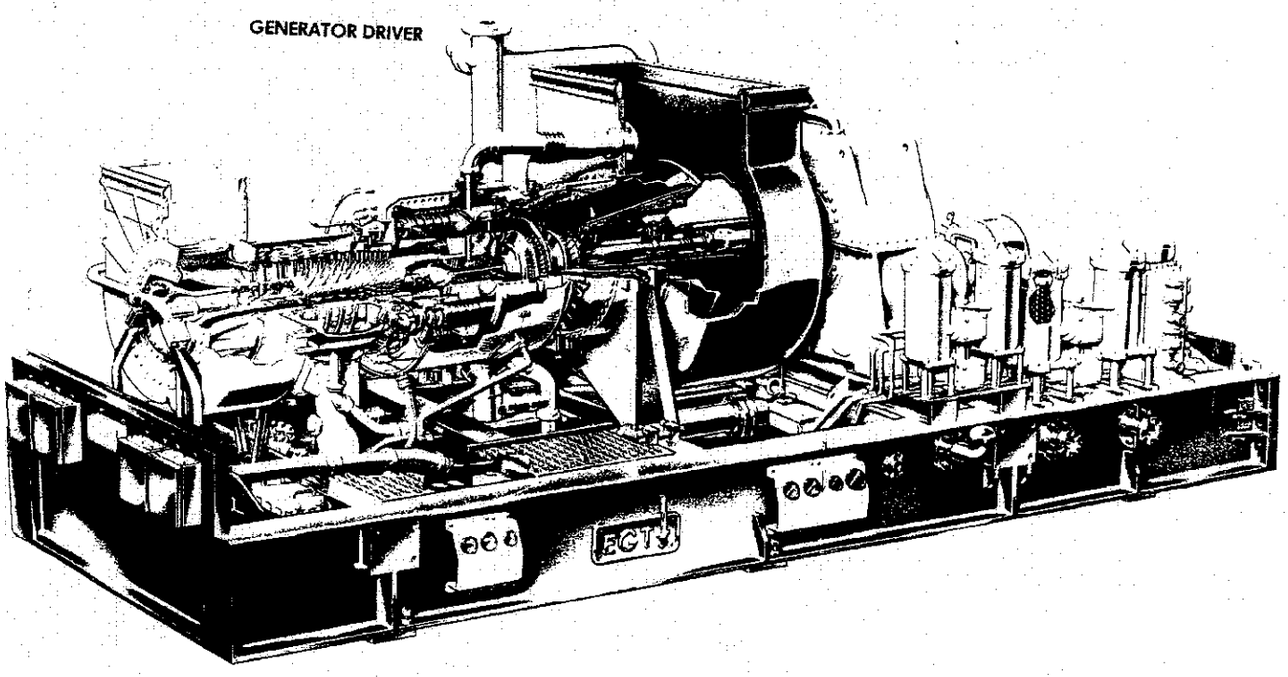
Potencia:	2 x 6540 Kw (8770 Hp)
Combustible:	Dual (Gas Natural y Gasoil)
Generador de gases:	EGT Tornado
Numero de serie:	RT213 y RT212
Turbina de Potencia:	EGT Tornado
Numero de serie:	RT211 y RT212
Generador:	ALSTOM
Numero de serie:	L41210001 y L41210002

Lasserre N°218 - (V9410DGF) Ushuaia - Tierra del Fuego - TE/FAX: (02901) 422-291/295 421-725/269
e-mail: dpe-tdf@speedy.com.ar
http://www.dpe.com.ar

EUROPEAN GAS TURBINES

TORNADO GAS TURBINE

Level 1 Training

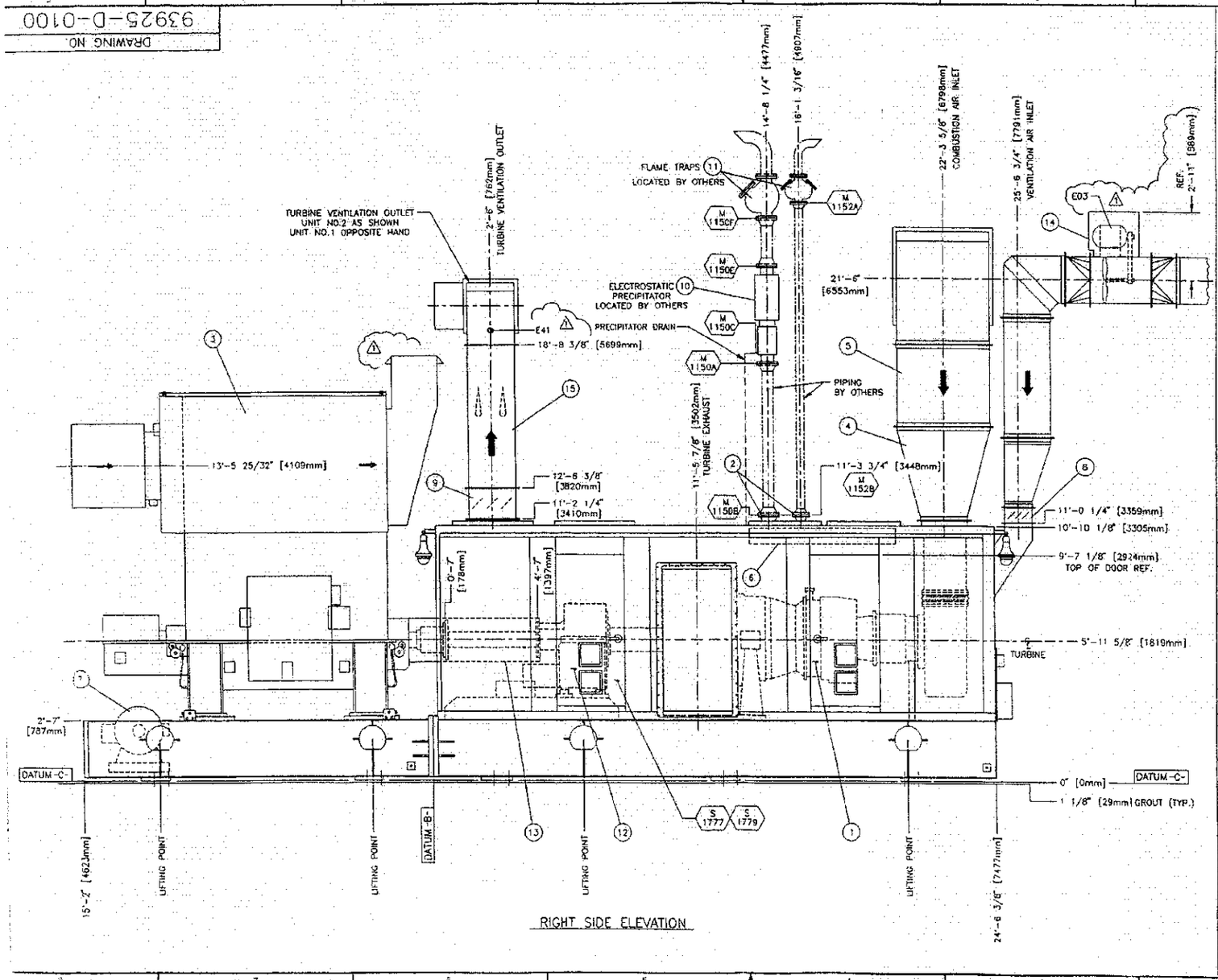


GEC ALSTHOM

European Gas Turbine Services Limited
Freeman Road, North Hykeham, Lincoln, LN6 9AP England
Telephone 0522 500100. Telex 56231 EGT G. Fax 0522 50 [illegible]
Registered Office: P.O. Box [illegible] Thorngate House [illegible]

EGT

DRAWING NO. 93925-D-0100



RIGHT SIDE ELEVATION

NOTES:

1. SEE DWG. 93925-D-0100 SHT. 1, ITEM 2 FOR THE LIST OF ALL DRAWINGS AND SHEET NOS. IN THE INSTALLATION DRAWING SERIES.
2. FOR A LIST OF CUSTOMERS MECHANICAL CONNECTIONS, SEE SHEET 5B.
3. FOR A LIST OF CUSTOMERS ELECTRICAL CONNECTIONS, SEE DWG. SHEET 5A.
4. UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE ± 1/4" [6.4mm].
5. UNLESS OTHERWISE NOTED, ALL TAIL DIMENSIONS ARE TO BE FROM DATUMS "A", "B", & "C".
6. NO EXTERNAL LOADINGS ACCEPTABLE ON TOP OF TURBINE ENCLOSURE AND GENERATOR CONNECTIONS.

ITEM	DESCRIPTION/WEIGHT
1.	EGT TORNADO GAS TURBINE.
2.	LUBE OIL AND SEAL AIR BREATHERS.
3.	GEC GENERATOR (TOP REMOVAL):
	HEAT EXCH: 7,275 LBS. [3300 kg]
	STATOR: 18,740 LBS. [8500 kg]
	ROTOR: 16,047 LBS. [7279 kg]
4.	TURBINE AIR INLET TRANSITION: 1000 LBS. [454 kg]
5.	INLET DUCT EXT: 1000 LBS. [454 kg]
6.	TROLLEY BEAM.
7.	ELECTRO/HYDRAULIC START PUMP.
8.	ACOUSTIC ENCLOSURE INLET VENT DAMPER: 120 LBS. [54kg]
9.	ACOUSTIC ENCLOSURE EXHAUST VENT DAMPER: 140 LBS. [64kg]
10.	ELECTROSTATIC PRECIPITATOR: SHT. 7B
11.	FLAME TRAPS: SHT. 7C
12.	ALLENS GEARBOX.
13.	MAIN DRIVE COUPLING & GUARD.
14.	VENT FAN: 575 LBS. [261kg]
15.	VENTILATION OUTLET SILENCER: 515 LBS. [234kg]
16.	INLET AIR SILENCER: 1305 LBS. [592kg] (SEE SHT. 2A)
17.	INLET AIR FLEX JOINT: 225 LBS. [102kg]

REV. NO.	DATE	D.C.R. NO. & COMMENT	
		DRAWN	CHECKED / APPROVED
3			
2			
CP	06 MAR 95	REVISED PER DCR# 024	
9MAR	J.D.	WAS 8/3/95 Rev 8 was 93	

Provincia de Tierra del Fuego, Antartida e Islas del Atlantico Sur

DRAWN	J.D.	02 DEC 94
CHECKED	KKW	16 DEC 94
APPROVED	MTS	16 DEC 94

EUROPEAN GAS TURBINES

GEC ALSTHOM EGT

GENERAL ARRANGEMENT, DUCTING, PIPING, & MAINT. ACCESS

DWG. REF. / NEXT ASSEMBLY

SCALE: 1/2" = 1'

DRAWING NO. 93925-D-0100 SHEET 2B

REV. 2

TURBINE

1. Introduction

References in the following text are to Diagram RT8A in Section 8 unless otherwise stated.

The turbine is constructed in two main sections, the Gas Generator and the Power Turbine. The gas generator section comprises the air inlet casing, compressor stator casing, gas generator rotor, centre casing, combustion system, compressor turbine stator and compressor turbine rotor assemblies, together with their related details.

The power turbine section comprises the power turbine stator, exhaust collector and power turbine rotor assembly, from which the drive is transmitted to the driven machinery.

2. Air Inlet Casing

The air inlet casing assembly comprises an external casing approximately rectangular in shape and a circular internal casing which incorporates the gas generator rotor front bearing housing. This casing is called the Bearing Support Housing and is designed and shaped to provide a smooth and uninterrupted path to the gas generator for incoming air.

The external casing is manufactured in three parts and is bolted together along the vertical and horizontal machined faces. The open end of the casing terminates in a rectangular machined flange, to which is bolted the air inlet ducting.

3. Bearing Support Member

The bearing support member is manufactured in two halves, which are machined, dowelled, and bolted together along their horizontal flanges. Eight radially disposed support vanes join the forward and rear faces.The support vanes are aerodynamically shaped and positioned so that they offer the minimum resistance to air flow. 'Sermetel' corrosion resistant coating is applied for protection.

4. Inlet Bearing Housing Assembly

The inlet bearing housing is flanged at its forward end and secured by setscrews to the front flange of the bearing support member. It is split horizontally, and machined to accept the thin wall white metal journal bearing and the forward and reverse thrust bearings. Lubrication is provided via pipes to the journal and thrust bearings through drilled oilways, and air is piped to internal passageways to pressurise the labyrinth seal, preventing oil from the bearing passing into the gas generator. A fairing covers the housing which smooths the passage of air into the gas generator.

5. Compressor Stator Casing

The stator casing is split horizontally, and also midway along its length, to permit the inspection of the front end of the compressor with the minimum of dismantling. The

casing is protected with 'Sermetel' corrosion resistant coating. It has machined flanges at either end, is bolted at its forward face to the bearing support member, and the rear end is spigotted and bolted to the centre casing.

The first five rows of inlet guide vanes are adjustable for ease of control, the remaining eleven stages of stator vanes, and one stage of exit guide vanes being retained by dovetail roots.

The front and rear sections of the stator casing, where they are bolted together at the vertical joint, form an annulus from which air is bled for pressurising the labyrinth seals for both the compressor and power turbines.

The pick up probe for the gas generator speed indication is mounted on the casing of the auxiliary gearbox.

6. Gas Generator Rotor Assembly

The gas generator rotor assembly is made up of a fifteen stage compressor rotor and a two stage compressor turbine, with their relative seals on a common shaft. The inlet stub shaft, fitted to the forward end of the rotor assembly, is machined to form a seat for the oil sealing ring, a flange for the thrust bearing, and a journal for the front bearing and front labyrinth seal.

The rotor blades, which are located in circumferential dovetail grooves, are sandwiched between the inlet stub shaft, fourteen rotor discs, and the intermediate shaft. The number of blades in each of the fifteen stages are as follows:

> Stage number 1 - 19 blades, stage 2 - 27 blades, stages 3 and 4 - 37 blades, stages 5, 6 and 7 - 49 blades, stages 8,9 and 10 - 59 blades and stages 11 to 15 inclusive - 69 blades.

To prevent the blades from moving circumferentially in their grooves, four equally spaced blades in each stage are located by means of dowels inserted between the rotor discs on assembly.

The fourteen rotor discs are clamped between the inlet stub shaft and the intermediate shaft. A throughbolt inserted from the intermediate shaft end is screwed into the inlet stub shaft and when tightened to the required torque setting, ensures a rigid assembly.

The first five stages of compressor blades are protected with 'Sermetel' corrosion resistant coating.

The inner member of the compressor turbine stub shaft labyrinth seal, the centre bearing journal, and the inner member of the centre housing labyrinth seal, are integral with the compressor turbine stub shaft, which is also machined on its rear face in the form of a 'Hirth Coupling'. It is spigotted and bolted to the rear face of the intermediate shaft.

The two-stage axial flow compressor turbine is directly coupled to the gas generator rotor stub shaft and features air cooled blading in the first stage rotor and stator to

reduce metal temperature to conservative levels, ensuring long life. In addition 'Sermetel' coating is used on the first stage compressor turbine stator and rotor blading. Ports are incorporated to permit borescope examination of the blades.

The compressor turbine rotor consists of two discs which are accurately located relative to the stub shaft and each other by means of 'Hirth Couplings' machined on their faces and secured by a waisted throughbolt.

Each disc is fitted with seventy nine shrouded rotor blades and attachment is by means of extended firtree type roots. The blades are retained in their slots by sealing plates which are in turn held in position by locking strips. In order to provide a greater contact area, the slots are machined in the disc at an angle of twenty five degrees. Both rotor discs, where their toothed faces meet are reduced in diameter and machined to form the inner member of the shroud seal.

7. Centre Casing and Compressor Turbine Bearing Support

The cylindrical centre pressure casing is split vertically to permit easy access to the flame tubes and transition ducts without disturbing either the gas generator or compressor turbine.

The pressure casing backplate is mounted between the rear of the compressor stator and the bearing support. This directs the compressed air supply to the flame tubes, and provides the mounting for the eight fuel burners. Access is provided for borescope examination by removing blanking plugs.

The bearing housing is also cylindrical in design and split horizontally. Top and bottom sections house the top and bottom halves of the compressor turbine journal bearing insert and labyrinth seals.

Four equidistant support arms ensure rigidity and alignment under all conditions. Three of the support arms are internally drilled, providing respectively a buffer air inlet, secondary air breather, and oil supply to the central journal bearing.

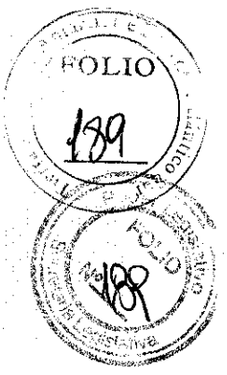
Two vertical but offset drillings accommodate, at the top, a primary breather outlet pipe and at the bottom, an oil drain pipe. Internal passageways are provided for bearing lubrication and labyrinth seal pressurising air.

The complete assembly is located between the rear of the compressor stator and front face of the compressor turbine stator, and is protected by a 'Sermetel' corrosion resistant coating.

8. Combustion System

The combustion system employs eight tubular flame tubes symmetrically positioned in a cylindrical pressure chamber; they are of the reverse flow type equally spaced on the forward face of the pressure casing and parallel to the axis of the turbine. Two of the flame tubes have igniter ports and all are interconnected by cross-light tubing to simplify ignition. Two self contained high energy ignition systems are provided.

The flame tubes are so disposed in the centre pressure casing that air from the gas generator flows to the head of each flame tube. A bracket at the front end of the flame



tube is drilled and bolted to the pressure casing back plate, and the rear end is secured in the centre casing by support rings. The end of the flame tube protrudes into the transition duct which directs the hot gas flow to the compressor turbine stator.

Mounted on the front flange of the flame tube is the swirler, which imparts a rapid swirling motion to the incoming air to ensure a thorough integration of air and fuel. A duplex burner bolted to the pressure casing back plate provides either gas or liquid fuel for combustion, and is readily accessible for removal and cleaning. A series of holes in the flame tube permit the entry of air for cooling and stabilization of the flame.

9. Interduct

The interduct casing joins the gas generator section of the turbine to the power turbine section. The outer lagged casing is dowelled and bolted at its forward end to the second stage compressor turbine stator and at the rear end, mounted in the same manner to the power turbine outer casing. The interduct casing houses a double cone of heat resisting steel, the gases passing between the walls of the double cone being directed from the compressor turbine outlet to the power turbine inlet.

The twin shaft turbine incorporates an inner interduct dome which is dowelled and bolted to the front face of the power turbine first stage stator.

10. Power Turbine Stators

The two stage power turbine stator assemblies are built from segments, each with four blades for the first stage and three blades for the second stage. The stators are carried in full rings attached to the power turbine support structure to maintain concentricity of rotor and stator.

The first stage stator assembly consists of fifteen segments forming an outer ring, each segment holding four blades, around an inner diaphragm. The outer ring forms the rotor shroud and the inner ends of each segment are grooved and secured to the periphery of the diaphragm by stator pins, locked in position by retaining strips. Sealing strips between segments are held in position by countersunk head rivets. The centre of the diaphragm is blanked off by a disc called a shroud shield.

The second stage stator assembly has the same construction as the first stage but consists of nineteen segments each containing three stator blades.

11. Power Turbine Rotor

The power turbine rotor assembly consists of two rotor discs attached to a common shaft. Accurate location is ensured by means of Hirth Couplings machined on the rear face of the first stage disc, front and rear faces of the second stage disc, and the end face of the output shaft. Both discs are reduced in diameter at their mating faces and machined to form the inner member of the power turbine shroud seal.

Each of the two rotor discs carries seventy three blades which are retained in firtree roots and held in position by peening both sides of the disc. Unlike the compressor turbine blades they are unshrouded and the slots are machined parallel to the axis of the shaft.

The rotor discs are cooled by air from the compressor interstage bleed.

The pick up unit for the power turbine speed indication is fitted on the PT bearing housing support, so arranged that the probe is in line with an integral toothed gear on the rotor shaft.

12. Power Turbine Diffuser and Support

The support structure is in the form of two machined rings with eight radial support arms to provide a rigid mounting for the power turbine bearing housing assembly. To prevent heat radiation, both the external casing of the duct, and area surrounding the bearing support member are heavily lagged.

The bearing housing is manufactured in two sections - a top and bottom half. The two halves are dowelled and bolted together to form a cylindrical housing which is flange mounted to the front of the support member. It is drilled internally to provide oilways, and machined to accept the outer members of the labyrinth seal, the front and rear journal bearings, the thrust bearing assembly, and the oil sealing ring.

13. Frame

The frame, or underbase, carries the turbine and auxiliary gearbox. The driven equipment and main gearbox (where fitted) are mounted on a separate underbase at the exhaust end of the turbine. Both underbases are bolted together and have adjustment screws to assist in obtaining the correct alignment at site. The auxiliary gearbox is mounted on the underbase at the air intake end of the turbine and on some applications this unit drives the main lubricating oil pump and liquid fuel pump. Power take off positions are also available for optional pumps if required. The lubricating oil tank is secured within the underbase.

Provision is made for fitting vertically mounted AC and DC motor driven lubricating oil pumps on the tank top to suit particular requirements.

The front support is pad mounted at the forward end of the turbine; it is in the form of a double trunnion thus permitting free axial expansion or contraction which takes place due to changes in temperature. The rear turbine support is taken from the centre line of the power turbine casing via bosses which locate in the cradle of the rear support, mounted on pads at the rear end of the underbase.

Drainpipe assemblies carry oil back to the tank from the gas generator rotor front bearing, centre bearing, and power turbine bearing assemblies.

Four lifting extensions are supplied with each turbine. These are bolted to the underbase, and the chains used in lifting, fit round the extensions, which are used only during initial installation on site, or subsequent turbine/underbase re-siting.

SINGLE SHAFT ENGINE DATA

Gas Temperature Safety Device

	-	High Temperature Max Warning	See data plate
		High Temperature Max Shutdown	See data plate
	-	Engine Hot	See Section RT-6G5B
Interduct	-	Deviation Warning (One or more non-adj. T/C's)	Dependent on T.Max
Interduct	-	Deviation Shutdown (Adjacent T/C's)	See Section RT-6G5B

Speed

Compressor	-	At normal rating	11,053 rpm approx.
Turbine			
Power Turbine	-		11,053 rpm
Output Shaft	-		1,500 rpm
Overspeed	-	Shutdown	10.0% above rated speed
Droop	-	No load to full load	Set nominally to 4% ± 1/4% of rated speed

Turbine Vibration

Warning Level	65 m (2.6 MIL)
Shutdown Level	90 m (3.5 MIL)

NOTE : If warning level is exceeded regularly during steady running it should be investigated. The shutdown level prevents continuous operation at levels that could lead to long term damage to bearings.

Lubricating Oil

Normal Operating Pressure			2.06 bar (30 lb/in^2)
Safety Devices Pressure Switch Settings:-			
Main Rail Pressure low	-	Warning (PS.3)	1.72 bar (25 lb/in^2)
Main Rail Pressure low	-	Shutdown (PS.1)	1.38 bar (20 lb/in^2)
Hot Bearing Pressure low	-	Warning (PS.19)	1.72 bar (25 lb/in^2)
Hot Bearing Pressure low	-	Shutdown (PS.4)	1.38 bar (20 lb/in^2)

Temperature	-	Start Permissive [TS 4]	20°C (68°F)
		High Temperature - Warning [TS 1]	66°C (151°F)
		High Temperature - Shutdown [TS 2]	74°C (165°F)

Specifications

Lubricating Oil	-	See recommended specifications, Section RT-5B
Fuel Gas	-	Dry natural gas as agreed by R.G.T.
Distilate Fuel	-	To BS.2869 Class A
		Other Fuels as agreed by R.G.T.

TORNADO POWER UNIT DATA PLATE INSTRUCTIONS

SALES ORDER N°.

CUSTOMER.

EUROPEAN GAS TURBINES

POWER UNIT DATA PLATE SERIAL N°. [redacted]
MUST BE QUOTED IN ALL CORRESPONDENCE.
GAS GEN. N°. RT– POWER TURBINE N°. RT–

RUNNING TEMPERATURE: –	GAS FUEL			
MAXIMUM CONTINUOUS =	1025	°C /	1877	°F
WARNING =	1040	°C /	1904	°F
SHUTDOWN =	1055	°C /	1931	°F

RUNNING TEMPERATURE: –	LIQUID FUEL			
MAXIMUM CONTINUOUS =	1023	°C /	1873	°F
WARNING =	1038	°C /	1900	°F
SHUTDOWN =	1053	°C /	1927	°F

SEE CONTRACT DATA PLATE FOR FURTHER DATA

GEC ALSTHOM

COMPILED.
TEST ENGINEER. DBHackney DATE. 25-8-93

ENGRAVED & FITTED.
SIGNED. JMagney DATE. 26-8-93

GAS TURBINE TRAINING NOTES

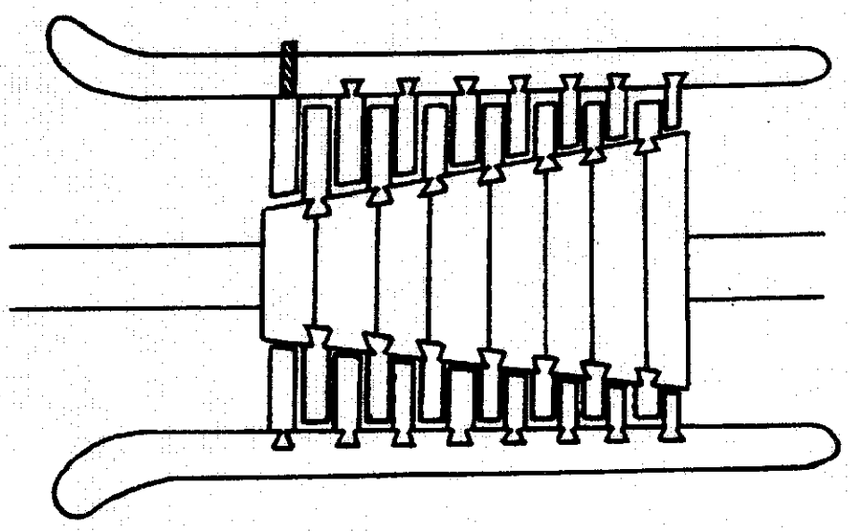
Section 3 – Gas Turbine Components

Introductory

The three basic components of the simple open cycle gas turbine are the compressor, the combustion system comprising one or more combustion chambers, and the turbine.

The Compressor

The axial flow compressor consists of a rotor drum with rings of blades mounted around its periphery. The rotor rotates in a stationary or stator casing carrying circumferential rings of stator blades, so positioned that they are in the gaps between the rings of rotor blades. At the compressor inlet is a row of stationary blades, inlet guide vanes, which guide the air flow smoothly on to the first row of rotor blades whilst at the outlet, there is one or more rows of outlet guide vanes which smooth the air flow and direct it to the combustion system with minimum flow disturbance.



Section 3 – Figure 1 – Axial Flow Compressor

Section 3 – Figure 1 – Axial Flow Compressor

The rotor drum is built up from separate discs pulled together by one or more pretensioned through bolts. Each disc is grooved so that when the discs are assembled, the recesses in the adjacent faces form a dovetailed housing into which fit the dovetail roots of the rotor blades. The stator casing has circumferential dovetailed recesses into which fit the roots of the stator blades. The stator casing is horizontally split to allow inspection and cleaning of the rotor blades and to give access to the bearings and bearing housings.

Air flows axially through the compressor, the rotor blades accelerating and slightly increasing its pressure whilst in the stator blades the velocity of air flow is decreased with a resulting increase in pressure. Blade length decreases from the compressor inlet to the outlet as pressure increases. A ring of rotor blades followed by a ring of stator blades is defined as one stage of the compressor and axial flow compressors of twelve to fifteen stages are used on the Ruston units.

The axial flow compressor is more susceptible to mechanical damage than the more robust centrifugal unit and great care must be taken at all times to avoid damage to the blading, the use of the correct rotor stands and storage boxes being essential whenever the rotor is removed from the engine.

The performance of axial flow compressors falls off rapidly if the surfaces of the blading become fouled with dirt from the atmosphere and, at sites where fouling is possible, equipment is fitted to allow the compressor to be cleaned. Great care should be taken to ensure that there are no oil leaks into the air entering the compressor. Although high efficiency inlet air filters are fitted there will always be a small quantity of atmospheric dust of small particle size that will pass through these. These particles are normally dry and only a very small proportion deposits on the compressor blading. If, however, the rotor and stator blades are moist with oil, these particles will adhere and rapidly cause excessive blade fouling and deterioration in engine performance.

In addition to supplying air for the combustion process, air is ducted from the compressor to cool various components of the gas turbine (Turbine Assys), and also to pressurise the bearing housings.

N.B.

Students will rapidly appreciate that with so complex a component as an axial flow compressor the smooth flow of air through it during acceleration and load changes must be controlled very carefully, as conditions known as stall and surge can very easily result if the heat input to the machine is changed quickly.

With these facts in mind, blow off valves and/or variable incidence guide vanes are fitted.

The Combustion System

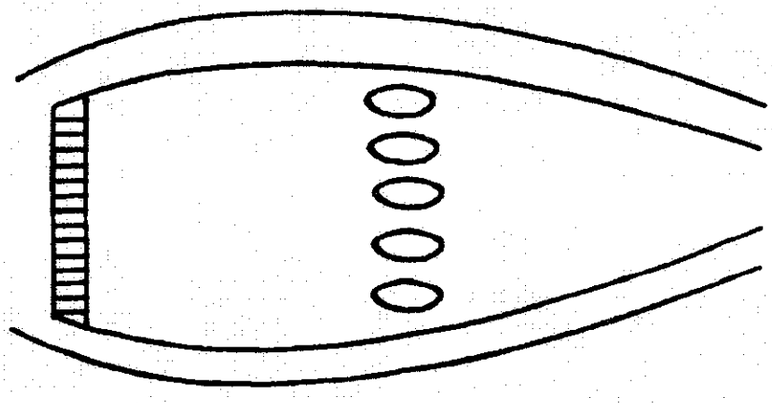
To appreciate the combustion system it is necessary first to understand some of the basic elements of combustion and to do this we must consider the fuel itself and the air in which it is burned.

All fuels used in EGT gas turbines, whether liquid or gaseous are hydro–carbons, that is, they

are compounds of hydrogen and carbon both of which are combustible elements. Air is basically a mixture of oxygen and nitrogen and the process of combustion is simply the combining of the hydrogen of the fuel with the oxygen of the air to form water vapour and the carbon of the fuel with the oxygen of the air to form carbon dioxide. During both these chemical changes heat is given out. When considering combustion from a basic point of view and under the conditions existing in a gas turbine combustion chamber it can be assumed that the nitrogen passes through the combustion zone without change.

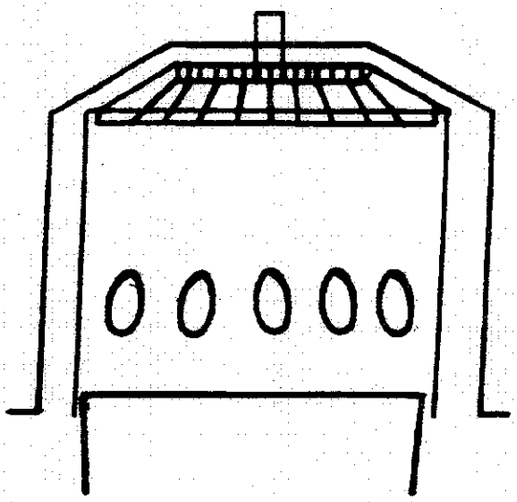
Next one must consider the actual flame temperature which, dependent on the fuel and the combustion conditions, is approximately 1500 – 1800°C for mixture strengths that can be burned remembering that with excessively rich or weak mixtures combustion is impossible.

Thus, in the gas turbine combustion chamber, we must provide a zone in which rapid combustion is possible and then, since the combustion temperatures are above the allowable turbine blading temperature, the combustion products must be diluted with air to cool them to give an acceptable gas temperature at the turbine blading. Each chamber must have a combustion zone in which the air/fuel ratio is approximately 10 – 20 to 1 followed by a dilution or cooling zone in which the combustion products are cooled to approximately 800 – 1000°C by the admission of additional air. Thus, the overall air/fuel ratio of a gas turbine is approximately 70 – 1, i.e. 70lbs of air flows through the engine for each pound of fuel burnt.



Section 3 – Figure 2 – Ideal Combustion Chamber

Reverse Flow Combustion Chamber



Section 3 – Figure 3 – Reverse Flow Combustion Chamber

The diagram shows a typical combustion chamber as used on all the EGT gas turbines with the exception of the TA.

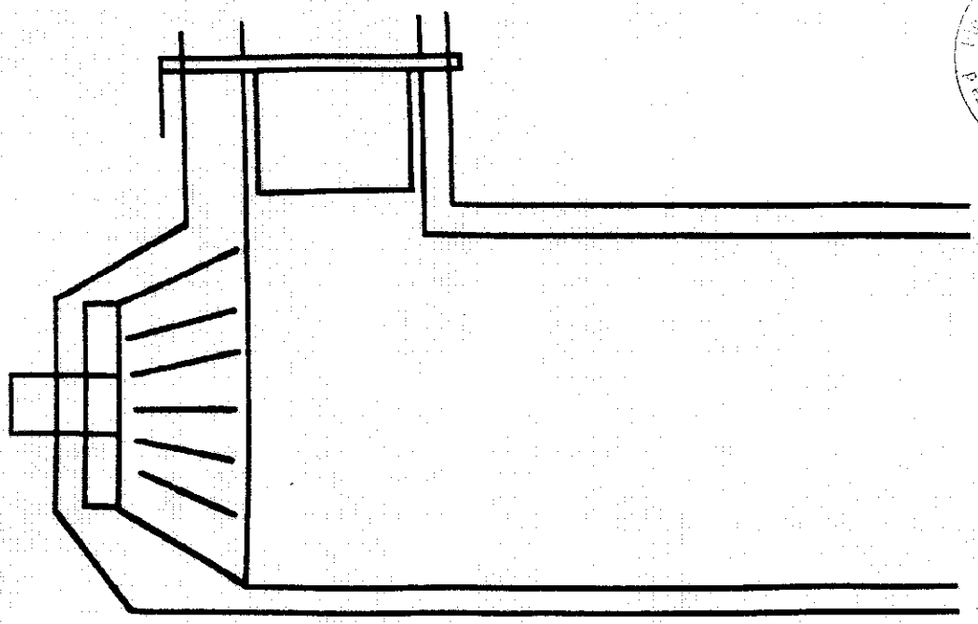
Fuel enters the chamber through the burner, the gas burner serving purely as a fuel distributor whilst the liquid fuel burner finely atomises the fuel to permit rapid combustion. Sufficient air for combustion of the fuel passes into the flame tube head through the swirl vanes whilst additional air entering through the shrouded ports in the swirler assembly provides skin cooling for the metal casing to protect it from the high combustion products and the heat radiated by the flame. The swirl given to the air ensures thorough mixing of the air and fuel and gives a region of low axial air velocity in which to establish a stable flame.

The dilution air enters through the large ports in the flame tube and, thoroughly mixing with the combustion products, reduces their temperature to a level acceptable by the turbine blades.

The flame and the hot gases are contained in an inner liner of Nimonic heat resisting alloy around the outside of which flows the air from the compressor prior to entering the flame tube. In this way the inner heat resistant casing is pressure balanced and carries only the heat loads. The air flow surrounding the flame tube cools and combustion chamber outer casing which then only carries the pressure loads and need not be fabricated from an expensive heat resisting alloy.

The Elbow Combustion Chamber

The configuration of the TA with a single side mounted combustion chamber necessitates the use of an elbow type chamber.



Section 3 – Figure 4 – Elbow Combustion Chamber

The principles of combustion are essentially the same as for the reverse flow chamber, the major difference being on the manner of introduction and mixing of the dilution air.

Burners

For liquid fuels a simple pressure jet atomising burner is used, the fuel entering tangentially into a tapering swirler chamber and being discharged through the orifice. Air flows over the discharge face of the burner for cooling and to assist in fuel atomisation. The gas burner simply carries discharge ports around its periphery.

Certain turbines supplied must have a dual fuel capability, that is, operating on gas as the primary fuel, they must be capable of switching to a secondary or standby liquid fuel should the primary fuel supply fail. On these units a dual fuel burner is fitted consisting of a standard liquid fuel burner surrounded by a concentric gas burner.

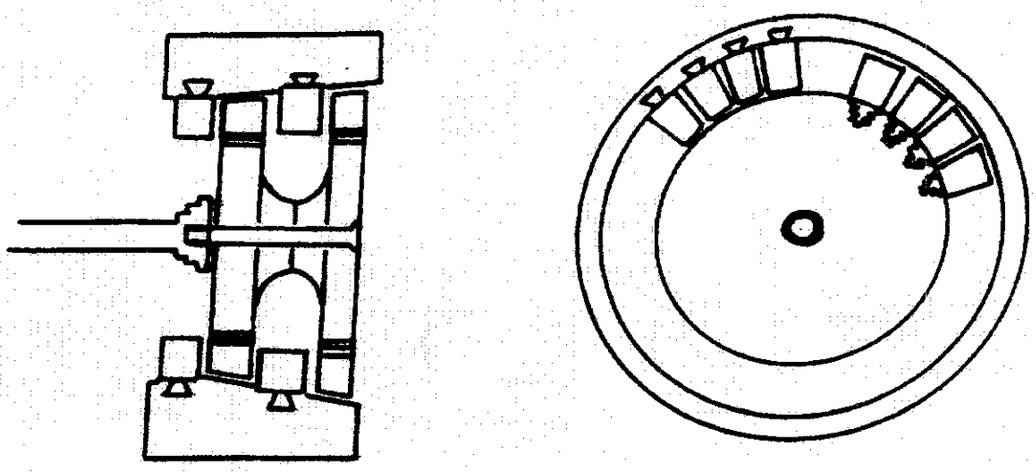
All burners, but more especially the liquid fuel pressure jet burners, must be handled carefully. Fuel leaks from a liquid burner head can give rapid fouling of the burner by carbon and completely upset the fuel distribution. This can also be upset by a scratch or light score across the burner face or orifice. If the spray pattern of the burner is incorrect, local hot spots of the swirler head and flame tube can result leading to rapid deterioration of the combustion chamber components. Fuel impingement on the lining will cause carbon build up which can result in local deformation and with some fuels will almost certainly result in combustion chamber corrosion. Droplets of liquid hydrocarbons in gaseous fuels also cause carbon deposits and corrosion.

Turbine Rotors

The third basic element in the engine is the compressor and power turbines. The turbines derive their power from the hot gases flowing from the combustion chamber.

The turbine rotor consists of one or more discs of heat resisting alloy or heat resisting steel carrying around the circumference blades manufactured from heat resisting alloy. The periphery of the disc is broached to accept the roots of the blades, the blades being retained either by opening or by locking plates.

The hot gases first flow through stator blading, the function of which is to accelerate the gas and deflect it at the angle of flow required by the rotor blading. One ring of stator blades is fitted ahead of each row of rotor blades and, as in the case of the axial compressor, one row of stator and one row of rotor blades is referred to an one turbine stage.



Section 3 – Figure 5 – Turbine Rotor & Stator

On the EGT units, the number of turbine stages range from two to four.

The turbine blades have the most arduous duty of any turbine component. Subject to a continuous flow of high temperature gas, contaminated with combustion products they must be heat and corrosion resistant. Tip clearances must be maintained within close limits, on unshrouded blades the tips of the blades are relieved to minimise damage in case of blade rub.

The turbine rotors are built up from separate discs and air bled from the engine compressor led to both the discs and, by centrifugal action, the blade roots for cooling.

On later engines, the turbine blades have extended roots to minimise heat effects. The shrouded blades are used on the compressor turbine of the more modern engines to minimise gas leakage at the tips and to increase turbine efficiency

SECTION 3
EQUIPMENT MAINTENANCE

3.1 INTRODUCTION AND MAINTENANCE CONCEPT

3.1.1 Purpose The instructions in this section constitute a guide for maintenance of the European Gas Turbines (EGT) equipment. Some maintenance information is provided in the form of EGT Work Packages. Specific maintenance material for vendor equipment is provided in Volumes III and IV of this manual.

3.1.2 On-Condition Maintenance The maintenance concept for European Gas Turbines turbine-powered packages is generally referred to as *"on-condition"* maintenance, which eliminates scheduled overhaul based on operating hours. Under the on-condition concept, turbine-driven equipment and auxiliary equipment are inspected on a regular schedule and repaired as necessary to restore the unit to operational serviceability. The extent of repairs under this concept is determined by two basic factors:

A. Correction of the primary cause of failure and/or discrepancy and any resultant secondary damage.

B. Replacement or repair of parts that do not meet established inspection criteria defined by European Gas Turbines or vendor technical manuals.

3.1.3 On-Site Maintenance On-site maintenance falls into the categories of *Preventive* maintenance (Scheduled) and *Corrective* maintenance (Unscheduled).

A. Preventive maintenance includes those scheduled maintenance actions which are performed based on operating hours, calendar time, or a combination of operating hours, calendar time, and condition monitoring.

B. Corrective maintenance includes unscheduled maintenance actions required to correct a problem. This could be an equipment failure, or a problem detected by inspection and/or condition monitoring.

3.1.4 Monitoring Some of the items monitored during operation are: gas generator speed, power turbine speed, gas generator inlet temperature, turbine compressor exhaust temperature, exhaust gas temperature, engine and driven equipment vibration, oil pressure, and oil temperature.

3.1.5 Maintenance Intervals Under the *"on-condition"* maintenance philosophy, scheduled maintenance actions requiring shutdown can be accomplished concurrently at intervals of 2,000 hours or 3 months and 8,000 hours or 12 months.

3.1.6 Boroscope Check The most significant item of these scheduled inspections is a turbine boroscope check, which provides visual information on the condition of the gas generator and hot gas path. The turbine, therefore, has incorporated a number of ports specifically located to facilitate boroscope inspections. It is standard practice to monitor the condition of internal parts and schedule on-condition maintenance intervals based on boroscope inspections.

3.1.7 Basic Maintenance Levels For support of the turbine-powered package, overall maintenance is divided into three basic levels according to shop capability. Normally, some combination of these defined maintenance levels will satisfy requirements of each customer.

3.1.8 On-Site External - Level 1 The work scopes for these tasks cover all work on the exterior of installed equipment, plus scheduled inspections, turbine compressor cleaning (water wash), gas generator/turbine change-out (when necessary), and change-out of components of driven equipment. On-site external maintenance encompasses the following two categories of maintenance tasks:

A. Preventive: Tasks which are scheduled on the basis of equipment "run" hours or calendar time.

B. Corrective: Tasks which are unscheduled and accomplished as a result of a problem.

3.1.9 Off-Site Level 2 (Medium Shop Repair) This level of maintenance includes complete tear-down and rebuild of a gas generator and/or power turbine by subassemblies. Replacement of major subassemblies is within the capability of this maintenance level.

3.1.10 Off-Site Level 3 (Extensive Shop Repair) This scope of work provides for all levels of maintenance, plus complete repair of gas generator, power turbine, or driven equipment parts. A test cell is required for a Level 3 facility.

3.1.11 Maintenance Schedule Normal maintenance of the EGT turbine-powered package during the initial 3 years of operation (at 8,000 hours per year) will require only a daily visual inspection of turbine and driven equipment exteriors and turbine compartment interior. Some of the inspections are performed at 3 month (2,000 hour) and 1 year (8,000 hour) intervals. None of these inspections or tasks require complete equipment removal or disassembly.

3.1.12 Time Required The daily inspection will require approximately one elapsed time hour by one man and can be performed with the unit operating. The scheduled maintenance tasks that are recommended at 3-month and 12-month intervals can be performed in one 8-hour shift, requiring approximately 16.0 manhours for the set of tasks on the turbine engine.

NOTE

Do not fill the turbine/generator lube oil reservoir past two-thirds full while the turbine is running. If the lube oil reservoir is overfilled, it will overflow on shutdown.

3.1.13 Required Lubricants and Fluids

A. Lubricants Tables 1.1 and 1.2 in Work Package WP 020 lists consumable lubricants that will eventually require replenishment or replacement in the turbine package. If for some reason preferred lubricants listed are not immediately available, acceptable equivalents are listed in vendor-provided instructions contained in Volumes III and VI of this manual. If no equivalents are found in vendor-provided publications, contact the original equipment manufacturer directly.

B. Fluids Demineralized water and cleaner are requires for turbine gas generator cleaning (water wash). Refer to Work Package WP 030 for water wash instructions including the requirements for water, cleaners and antifreeze.

3.1.14 Recommended Daily Checks Although daily checks are not absolutely necessary, European Gas Turbines recommends that as a minimum, the following performance parameters be recorded daily, if possible.

A. All Lube Oil Temperatures. Includes turbine lube oil and generator lube oil.

B. All Vibration Monitor Readings. Includes turbine engine and generator.

C. All Pressure Gauges Readings. Includes any pressure gauge in any system including the air filtration system.

D. All Temperature Gauge Readings. Includes the turbine intake ambient and turbine gas generator exhaust readings.

3.2 TURBINE MAINTENANCE SCHEDULE

3.2.1 Turbine On-Condition Maintenance Schedule Work Package 010, at the end of this section, contains recommended inspection checks, inspection intervals, and maintenance level codes for the EGT turbine engine.

3.2.2 References Refer to the EGT Ltd. Operating and Maintenance Manual, contained in Volume III of this manual, for the recommended maintenance practices and schedules for the EGT turbine engine.

3.3 GENERATOR MAINTENANCE SCHEDULE

3.3.1 On-Condition Maintenance Schedule Refer to the Generator Service Manual, (Operating Routine) for recommended Shift Change/Daily, Weekly, Quarterly, and Yearly or Plant Turn Around activities. The Generator Service Manual is included in Volume III of this manual.

3.4 AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

3.4.1 On-Condition Maintenance Schedule Work Package 012, at the end of this section, contains recommended inspection checks, inspection intervals, and maintenance level codes for the auxiliary equipment used on the turbine-generator unit.

3.4.2 References Refer to auxiliary equipment manufacturer documentation, contained in Volume IV of this manual, for specific corrective actions and additional details.

3.5 SPECIFIC MAINTENANCE PROCEDURES

3.5.1 Additional Procedures Locations Procedures for performing the functions described in the preventive maintenance schedules can be found in this section or in the appropriate vendor data provided in Volumes III and IV.

3.5.2 Turbine Gas Generator Cleaning Requirements The gas generator stator and rotor blades can become fouled with atmospheric pollutants resulting in a drop in power output and/or a rise in temperature for the same load. To alleviate this problem, cleaning of the gas generator stator and rotor blades is required. The frequency of cleaning depends on the operating environment. The recommended initial cleaning standard, every two to three days running, should be adjusted to accommodate turbine operations. The goal is to establish a site specific cleaning criterion based on power and temperature fluctuations correlated to site demands. Refer Work Package 030, located at the end of this section, for detailed cleaning instructions.

3.5.3 Fluid System Filter Element Inspection and replacement The fluid systems of the turbine-generator utilize similar filter assemblies and filter elements. The procedures in Work Package 020 are generally applicable to the inspection and servicing of all fluid filter assemblies of the turbine-generator system.

3.5.4 Alignment of Turbine/Generator Unit Components Alignment of the turbine-generator unit components must be checked and verified before attempting to operate the unit. Alignment of this unit includes: (1) Turbine-To-Gearbox, and (2) Gearbox-To-Generator. Verification of alignment should be performed yearly hereafter. Alignment procedures for this unit are in Work Package 040. Accurate alignment of the rotating machines is essential to achieving reliable operation, and maximizing the service life of the rotating machine bearings. Optimum radial and angular alignment exists when the rotary axis of the turbine, gearbox, and generator coincide as the unit operates at normal operating temperature and speed. Optimum axial alignment will result in no load being placed on the thrust bearings of the rotating machines during normal operating conditions.

3.6 TURBINE TROUBLESHOOTING, REPAIRS, AND ADJUSTMENTS

3.6.1 Troubleshooting EGT turbine engine troubleshooting procedures are contained in the EGT Ltd. Operating and Maintenance Manual in Volume III of this manual. Refer to the EGT drawings, located in Volume II of this manual, for details pertaining to turbine and generator support systems.

3.6.2 Repairs EGT turbine engine information is included in the EGT Ltd. Operating and Maintenance manual, contained in Volume III of this manual.

3.6.3 Adjustments Very few adjustments are needed for the turbine engine. Details pertaining to engine adjustments are contained in the EGT Ltd. Operating and Maintenance Manual, in Volume III of this manual.

3.6.4 Variable Geometry Stator Blades Adjustment To ensure satisfactory turbine control, the first rows of the gas generator stator have variable geometry stator blades installed. These are controlled by an actuator system. The alignment procedure for the variable geometry stator blades is in Work Package 050.

3.7 GENERATOR TROUBLESHOOTING, REPAIRS, AND ADJUSTMENTS

3.7.1 Troubleshooting Procedures for the Generator are included in the Service Manual provided in Volume III of this manual. Refer to the EGT drawings, in Volume II of this manual, for information on the external systems.

3.7.2 Repairs Procedures for repairing the Generator are contained in the Service Manual, provided in Volume III of this manual.

3.7.3 Adjustments Required adjustments of the generator are determined by inspection. Inspection procedures for the Generator are included in the Service Manual provided in Volume III of this manual. Other potential adjustments are the instruments used for measuring vibration and temperature within the generator. Refer to specific item vendor data for possible requirements and procedures.

3.8 AUXILIARY EQUIPMENT TROUBLESHOOTING, REPAIRS, AND ADJUSTMENTS

3.8.1 Troubleshooting Information for various external systems of the turbine-generator unit can be found in specific vendor literature, in Volumes III and IV of this manual, and the EGT drawings contained in Volume II of this manual.

3.8.2 Repair Information for repair of the subsystems and components of the unit can be found in Volume IV, Vendor Reference Material, and Volume II, EGT Drawings.

3.8.3 Adjustments The following adjustments should be made on an on-condition schedule or as needed to maintain equipment in proper working order. Refer to the specific vendor documentation, contained in Volume IV, for additional details.

A. Instruments and Indicators If a reading on the indicator is high or low and all other indications confirm proper turbine-generator operation, recalibration of suspect indicator may be in order.

B. Transducers and Probes Positioning of probes may require adjustment if indications appear to fluctuate or vary from the norm. Refer to proper vendor data contained in Volume IV of this manual. Also refer to EGT mechanical schematics (2500 series drawings) and the Instrument List (drawing xxxxx-A-2598) contained in Volume II for setpoints of electrical instrument probes.

C. Pressure and Temperature Controllers Adjustments may be required on various pressure and temperature controllers to maintain pressures and temperatures reading accuracy. Refer to EGT mechanical schematic drawings and the Instrument & Parts List contained in Volume II for setpoints and to Volumes III and IV for details of the various controllers.

D. Equipment Alignment Realignment of equipment may be necessary to compensate for normal wear. Excessive vibration or noise may indicate a problem of this kind. If vibration levels become too great, it is recommended that an alignment check be made. Settling of the unit or foundation can adversely affect machinery alignment. Refer to Volume IV for tolerances of various vendor supplied items.

E. Air Filtration System The air filtration system is designed to operate for extended periods between maintenance intervals. The air intake filter is equipped with a differential pressure monitor which will initiate a cleaning cycle when needed. A differential pressure monitors will initiate an alarm signal when differential pressure reaches the alarm set point rising. A monitor will initiate a trip signal when differential pressure reaches shut down set point rising. Maintenance of the air filtration system shall be carried out in accordance with the instructions provided by the air cleaner manufacturer, which are included in Volume IV of this manual.

F. Control System The control system is designed to require little adjustment. However, there are components associated with the control system that require regular adjustment to ensure proper operation. These are sensing switches, transducers, senders, thermocouple, and other devices employed to monitor the operation of the units, which have been covered above.

3.9 CONTROL SYSTEM TROUBLESHOOTING

3.9.1 General Troubleshooting the control system consists of checking the inputs and outputs for the faulty function and locating the modules where the inputs and outputs are handled. Some inputs and outputs are provided with indicator light-emitting diodes (LED) that indicate when inputs or outputs are present. Refer to the control system specifications, and the EGT 2100 series drawings, in Volume II of this manual for control system/operating unit interface information. Using these references and indicators, and following the steps outlined below, the technician can determine whether the fault is within the module or in the switches or transducers and relays that are connected to the module.

3.9.2 General Troubleshooting Procedures The following steps can be used as a general guide in troubleshooting the control system:

A. Determine the exact malfunction. Write down all details of the malfunction.

B. Using the system drawings and the control system technical documentation, contained in Volume II, determine what outputs could cause the malfunction. The exact module output points must be located.

C. Check to see if the output status light(s) is lit. If the output status light is not lit, check the input module. If the input module input status light is not lit, check the input to the input module.

D. Check input device and wiring for proper operation. Repair as needed.

E. Output module light for specific function is lit but still no action. Check output device and wiring for proper function. Repair as needed.

F. Each module contains a power indicator. If the power indicator on a module is not lit, refer to the wiring diagrams to find which power supply is supplying power to the module. Check output of power supply and repair/replace as needed.

3.9.3 Specific Troubleshooting Procedures Refer to the specific vendor documents for troubleshooting procedures for vendor supplied equipment. All vendor *Controls* data can be found in Volume IV of this manual.

3.10 AUXILIARY EQUIPMENT REMOVAL ASSOCIATED WITH TURBINE ENGINE GAS GENERATOR REMOVAL

3.10.1 Equipment Removal This section does not detail specific steps for auxiliary equipment removal. The following information is given as a general guide for auxiliary equipment removal to prepare for turbine gas generator removal. Refer to the EGT drawings, in Volume II, and the Vendor Reference Materials, in Volume IV, for details and procedures for removal and installation.

Removal procedures for the EGT turbine engine gas generator are contained in Section 6A1A of the EGT Ltd. Operating and Maintenance Manual.

The EGT Ltd. Operating and Maintenance Manual is located in Volume III of this manual.

A. Remove fuses controlling the high energy ignitors.

B. Remove lube oil feed and drain pipes. Remove enough piping as to not interfere with the gas generator removal. Install blanks to all open piping.

C. Remove fuel piping as required, leaving the fuel manifold on the engine. Install blanks to all open piping.

D. Remove cooling air pipes and breather pipes as required. Install blanks to all open piping.

WARNING

Discharge of the ignition system can be lethal to personnel. Always isolate the ignition system and allow at least 5 minutes before carrying out any form of maintenance on the ignitors.

E. Remove ignitors and leads.

F. Disconnect vibration and thermocouple leads.

G. Disconnect the variable geometry actuator and/or control connections. Secure any actuator components to prevent damage during engine removal.

H. Remove enclosure panels/doors and support members as needed.

I. Remove coupling guard and coupling. Gearbox and coupling drawings and instructions are contained in Volume III of this manual.

J. Take up weight of turbine using roll out gear jacking screws or overhead crane rigging.

3.10.2 Generator Installation and Removal Refer to the Generator instruction manual, contained in Volume III of this manual.

3.11 CONSUMABLE FLUIDS

3.11.1 Turbine-Generator Lube Oil The turbine engine requires lubricating oil conforming to BS 489:1983 with a viscosity rating of ISO/VG 46. Refer to Work Package 020 for a listing oils meeting these specifications and sources for those products.

3.11.2 Blow-Off Valve and Motor Grease Work Package 020 provides a listing of some greases approved for use on the turbine engine blow-off valves and electric motors. Refer to the EGT Ltd. Turbine Engine Manual, in Volume III of this document, for additional grease listings.

3.11.3 Review of Specifications Oil companies reserve the right to review their specifications periodically. Therefore, it is essential, and a customer responsibility, to verify, with a local oil supplier, the suitability of oils selected to meet the listed specifications.

3.12 LIST OF TEST EQUIPMENT AND CALIBRATION INSTRUMENTS

3.12.1 Calibration Equipment Refer to Table 3.2 for a listing of equipment for calibrating the control system sensing devices. Equipment listed in this table is not provided by EGT in the basic scope of supply. This list is to aid the purchaser in procuring the proper calibration equipment.

3.12.2 Equipment Usage Some of the equipment listed is not essential, but is recommended for ease of servicing. Any selected items may be purchased from EGT Gas Turbines, Inc.

CAUTION

During installation and testing, any test procedure that calls for rotating machinery to be in operation shall not be attempted without direct supervision by EGT turbine service technicians and/or representatives. Failure to comply with this notice could result in the equipment warranty being voided.

NOTE

Test and calibration equipment with specifications equal to or better than equipment listed here may be substituted. Refer to manufacturer provided publications, included in Volume IV of this manual, for equipment specifications.

TABLE 3.2 TEST AND CALIBRATION EQUIPMENT LIST

NOMENCLATURE	*PART NO.*	*SOURCE/ MANUFACTURER*
Portable Disc Drive, 24V	CT92591/01	EGT
Anti-Static Kit	CT91206/125	EGT
Potentiometer	CT4017P/69	EGT
Transducer Simulator	CT4017T/76	EGT
Decade Resistance Box	CT4017R/87	EGT
Optalign Computerized Shaft Alignment System	ALI 2.50	Proftechnik or local distributer
Dead-Weight Tester (for testing pressure switches)	23-1 (Or Equivalent)	Chandler (Or Equivalent)
Hot Oil Bath, electrically heated, with adjustable thermostatic temperature control, oil agitator, and calibrated thermometer (for testing temperature switches)	Various	Various
Digital Multimeter (two are needed)	8021B	Fluke
	177	Keithley
Power Unit	CT4017U/11	EGT
Signal Generator/Counter	CT4017G/50	EGT
Volt-Ohmmeter, 20,000 ohms/volt	260	Simpson
Oscilloscope, Dual Channel 15MHz	2213A/2215A	Tektronix
Jumpers, with insulated alligator clips	Various	Various
UV/IR Test Lamp	Model TL101	General Monitor
Portable Purge Calibrator	1400150	General Monitor
Megohm Meter, 500V-5kV	21-158	Biddle

END OF TABLE 3.2

3.13 SPECIAL MAINTENANCE TOOLS

3.13.1 Requirement There is a requirement for special tools to provide Level 1 and Level 2 maintenance activities. Tools to support turbine maintenance activities are listed in Section 7A1 of the EGT Gas Turbine Manual in Volume III of this manual.

3.13.2 Supply These tools are not supplied by European Gas Turbines, Inc. in the basic contract. Tools to remove the turbine from, and install the turbine in, the engine compartment are provided on loan from European Gas Turbines, Inc. on an as needed basis. Contact European Gas Turbines at the parts and service address provided in Section 4 of this manual to request special tools.

3.14 WORK PACKAGES

3.14.1 Table 3.3 - Work Packages Table 3.3 contains a list of the Work Packages contained in this section. The Work Packages are located immediately following this page. They are sequenced in numerical order as listed in the table.

TABLE 3.3 WORK PACKAGES

NUMBER	*DESCRIPTION*
WP 010	Turbine Engine Maintenance Schedule
WP 012	Auxiliary Equipment Maintenance Schedule
WP 020	Lube Requirements & Source Information and Liquid Systems Filter Servicing Information
WP 030	Turbine Gas Generator Cleaning Instructions
WP 040	Instructions for Alignment of Turbine-Generator Unit Components
WP 050	Variable Geometry Stator (VGS) Blades Adjustment Procedure
WP 051	Fuel Valve Actuator Setup Procedure
WP 070	Flushing Instructions (And Mechanical Connections)

END OF TABLE 3.3

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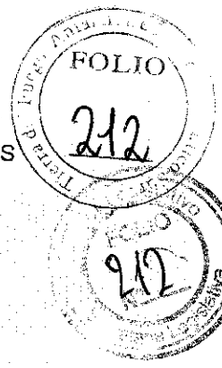
TORNADO TURBINE UNIT

WORK PACKAGE 010

TURBINE ENGINE MAINTENANCE SCHEDULE



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TURBINE ENGINE MAINTENANCE SCHEDULE

1. Turbine On-Condition Maintenance Schedule This schedule describes recommended inspection checks and intervals for the European Gas Turbine (EGT) turbine engine. Recommended maintenance level codes are also given.

2. References Refer to the EGT Ltd Turbine Engine Operation and Maintenance manual, part of Volume III of this manual, for the recommended maintenance practices and schedules for the EGT turbine engine.

3. Safety Devices The following devices should be checked by using them occasionally to shut down the turbine at the end of a running period.

   a) Stop the turbine using one of the emergency stop buttons. Reset the button when the turbine has stopped.

   b) Close the shut-off valve of the pressure gauge/pressure switch for the lube oil system pressure monitoring and then slowly bleed off the pressure at the pressure gauge/pressure switch. Check that a "Low Lube Oil Pressure" shutdown occurs when the pressure shown on the gauge reaches shutdown "setpoint". Reset valves to operational norms.

   c) Manually shut-off fuel flow to the turbine. Check that a "Flame Failure" shutdown is annunciated.

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
1.	Engine/Gas Compressor Oil Level	Daily	I	Visually check oil level in reservoir and system for oil leaks
2.	General Condition of Engine	Daily	I	Visually inspect external engine components for security and leaks

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
3.	Instrument Air Pressure	Daily	I	Visual check gauge for proper pressure.
4.	Battery Charger Output	Daily	I	Refer to manufacturer's literature for satisfactory charger output.
5.	Fuel Inlet Supply Pressure	Daily	I	Visual check gauge for proper pressure.
6.	Air Intake Differential Pressure	Daily	I	Visual check differential pressure gauge for indications of air filter blockage.
7.	Gas Generator Exhaust Gas Temperature Spread	Daily	I	Check for marked change in temperatures or abnormal temperature spread
8.	Oil Filter Differential Pressure	Daily	I	Check differential pressure on gauge and warning on CRT screen. Service as required.
9.	Water Wash Gas Generator	48/72 Hours or as determined by owner. *(see NOTE after table)*	I	Perform on-line, "Hot" water wash of gas generator. *Perform "Cold Crank" wash if necessary to recover full operating temperature.*
10.	Variable Stator System Inspection	Weekly	I	Visually inspect external parts for security of installation and leaks.

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
11.	Battery	Weekly	I	Visually inspect batteries *and top off with distilled water if necessary*. On an opportunity basis, with turbine shutdown, boost charge the batteries after electrically isolating control module.
12.	Engine Burners	First 250 Hours of Operation	I	Boroscope check for deposits or erosion.
13.	Combustion System and Compressor Turbine Blading Boroscope Check	First 500 Hours of Operation	I,II	Check for unusual erosion or deterioration of blades.
14.	Emergency Lube Oil Pump	Monthly	I	Check operation of the emergency lube oil pump motor.
15.	Water Wash Gas Generator	Monthly or as determined by owner. *(see NOTE after table)*	I	Perform "Cold Crank" water wash of gas generator.
16.	Engine Plumbing	Monthly or 700 Hours	I	Check fuel and oil plumbing line to and on engine for security, chafing, and leaks.
17.	Combustion System and Turbine Compressor Blading Boroscope Check	First 1000 Hours of Operation	I,II	Check for unusual erosion or deterioration of blades.

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
18.	Combustion System and Turbine Compressor Blading Boroscope Check	First 2000 Hours of Operation	I,II	Check for unusual erosion or deterioration of blades or combustor cans.
19.	Combustion System and Turbine Compressor Blading Boroscope Check	First 5000 Hours of Operation	I,II	Check for unusual erosion or deterioration of blades or combustor cans.
20.	Blow-Off Valves	8,000 Hours	I	Grease bearings.
21.	Guide Vane Rods	8,000 Hours	I	Replace the Variable Guide Vanes rod ends.
22.	Oil Quality	8,000 Hours	I	Test oil for oxidation and acidity.
23.	Motor Bearings	8,000 Hours	I	Grease the bearings of electric motors where applicable.
24.	Hold Down Bolts	8,000 Hours	I	Check tightness of the turbine and underbase hold down bolts.
25.	Solenoid Valves	8,000 Hours	I	Inspect all solenoid Valves. Check for leakage and correct operation.
26.	Unit Alignment	8,000 Hours	I	Check alignment of the turbine/driven unit shafts.
27.	Igniter Leads	8,000 Hours	I	Check condition and insulation of igniter lead(s).

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
28.	Combustion System	8,000 Hours	I,II	Remove pressure casing halves and examine cross light tubes, combustion chambers, and transition ducts for wear, deformation, cracking and hot spots.
29.	Turbine Compressor Blading Boroscope Check	8,000 Hours	I,II	Check for unusual erosion or deterioration of blades.
30.	"8,000 Hours" Service	16,000 hours	I,II	Perform all activities listed at 8,000 Hours above.
31.	Turbine Compressor Blading Boroscope Check	Annually	I,II	Check for unusual erosion or deterioration of blades or combustor cans.
32.	Retractable Igniter Units	Annually	I	Check for proper operation.
33.	Fuel Valves and Actuators	Annually	I	Check settings and check for wear.
34.	Electrical Leads and Cable Harness	Annually	I	Check ignition leads and thermocouple harness for burning or chafing. Replace igniter plugs.
35.	Engine Mounting Bolts	Annually	I	Check tightness of all engine mounting bolts.
36.	"8,000 Hours" Service	24,000 hours	I,II	Perform all activities listed at 8,000 Hours above.
37.	Turbine Inspection	24,000 Hours	II	Carry out a full examination of the engine core.
38.	Power Turbine Boroscope exam	24,000 Hours	I	Do boroscope inspection of power turbine.

TABLE 1 TURBINE ENGINE AND SYSTEMS ON-CONDITION MAINTENANCE INSPECTION/CHECK SCHEDULE

MAINTENANCE LEVEL CODES

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
39.	"8,000 Hours" Service	32,000 hours	I,II	Perform all activities listed at 8,000 Hours above.
40.	Turbine System Examination	40,000 Hours	III	Carry out a full examination of gas generator, power turbine, gearboxes and starting system.
	As 40,000 hours is the design life of the compressor turbine rotor blades, the compressor turbine should be returned to EGT for examination and blade replacement if the creep life is found to have been exhausted.			

END OF TABLE 1

NOTE

The gas generator stator and rotor blades can become fouled with atmospheric pollutants resulting in a drop in power output and/or a rise in temperature for the same load. To alleviate this problem, cleaning of the gas generator stator and rotor blades is required. The frequency of cleaning depends on the operating environment. The recommended initial cleaning standard, every two to three days running, should be adjusted to accommodate turbine operations. The goal is to establish a site specific cleaning criterion based on power and temperature fluctuations correlated to site demands.

END OF WORK PACKAGE

TURBINE-GENERATOR SET

WORK PACKAGE 012

AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

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1. AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

1.1 On-Condition Maintenance Schedule The schedule in Table 1.3 describes recommended inspection checks and inspection intervals for the Auxiliary Equipment used on the turbine-generator unit. Recommended maintenance level codes are also given.

1.2 References Refer to the various Auxiliary Equipment manufacturer manuals, contained in Volume IV of this manual, for specific corrective actions and additional details.

TABLE 1.3 AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

MAINTENANCE LEVEL CODE

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
1	Turbine Air Filter	Daily	I	Inspect air filter for proper operation and check differential pressure.
2	Battery Charger	Daily	I	Check for proper output. Adjust as needed.
3	Gauge Readings	Daily	I	Record readings of all gauges on unit. Compare with past readings. Investigate large deviations.
4	Oil Cooler	Daily	I	Visually inspect oil cooler for leaks and proper operation.
5	Unit Control Panel Fans	Weekly	I	Check for operation of fans and dirt accumulation. Clean as needed.
6	Battery Electrolyte (if not maintenance free)	Weekly	I	Check for proper level of electrolyte. Fill with distilled water as needed.
7	Unit General Conditions	Weekly	I	General appearance and integrity of unit.

TABLE 1.3 AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

MAINTENANCE LEVEL CODE

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
8	Flame Detectors & Heat Sensors (Fire Sensors)	30 Days or As Required by vendor or code	I	Check sensitivity and clean surfaces.
9	Turbine Air Filter	Monthly or 700 Hours	I	Initiate manual cleaning and record differential pressure gauge readings. Service as required.
10	Fluid Filters	3 Months or 2,000 Hours	I	Check for blockage; indicated by high differential pressure
11	Lube Oil System Coalescer	3 Months or 2000 Hours	I	Check differential pressure. Service as needed.
12	Strainers	6 Months or 4000 Hours	I	Remove screens and clean as needed.
13	Flame Traps & Coalescer	6 Months or 4000 Hours	I	Remove and clean with solvent.
14	Mounting/Skid/ Piping/Valves	6 Months or 4,000 Hours	I	Leaks, cracks, alignment
15	Thermocouples	6 Months or 4,000 Hours	I	Security of Connections
16	Fluid Couplings	6 Months or 4,000 Hours	I	Integrity, leaks
17	Control Panels, MCC, etc.	6 Months or 4,000 Hours	I	Check for broken or damaged components
18	Turbine Air Filters	6 Months or 4,000 Hours	I	Check for cleanliness; high differential pressure indicates dirty filter

TABLE 1.3 AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

MAINTENANCE LEVEL CODE

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
19	Lube Oil System Auxiliary and Emergency Lube Oil Pumps	6 Months or 4,000 Hours	I	Check for proper operation.
20	Fuel System Gas Regulator Valve	6 Months or 4,000 Hours	I	Examine valve pad, valve seat, diaphragms, sliding seals and O-ring seals. Repair as needed.
21	Ventilation Fan Bearings	6 Months or 4,000 Hours	I	Replenish bearing lubricant per manufacturer maintenance instructions in Volume IV.
22	Batteries & Battery Chargers (* Not Reqd. for maint. free Batteries)	6 Months or 4,000 Hours	I	*Replenish electrolyte, *check specific gravity, clean battery case. Adjust float and equalizing charge potentiometers as required.
23	Fire System Test and CO_2 Cylinders Weight	6 Months or 4,000 Hours or as required by vendor or code	I	Test all components of the fire and gas protection system. Check weight each CO_2 cylinder and compare with full weight. If cylinder is 10% underweight, have cylinder refilled.
24	Pumps	Annually	I	Check for noisy operation.
25	Lube Oil	Annually	I	Collect Sample and have analyzed. Change if needed.

TABLE 1.3 AUXILIARY EQUIPMENT MAINTENANCE SCHEDULE

MAINTENANCE LEVEL CODE

I - MINOR REPAIR II - HEAVY REPAIR III - RESTORATION

ITEM	*INSPECTION CHECK REQUIRED*	*INSPECTION FREQUENCY*	*MAINT. LEVEL*	*REMARKS*
26	Control Panel Instruments	Annually or 8,000 Hours	I, II	Calibration of all instruments
27	Electrical Sensors and Transducers	Annually or 8,000 Hours	I, II	Calibration of all sensors and transducers.
28	Turbine-to-Generator Alignment	Annually	I	Check alignment of the gearbox-to-generator. Correct alignment as needed.
29	Solenoid Valves	Annually	I	Check operation of all solenoid valves.
30	Pressure Regulators	Annually	I	Inspect and calibrate. Repair as needed.
31	Pressure Transducers	Annually	I	Check calibration. Calibrate as Needed
32	Electric Motors	Annually	I	Grease bearings.
33	Starter Motor	Annually or every 50 starts	I	Grease bearings on starter motor.
34	Gearbox	1 year after initial installation.	II	Perform a full inspection per Gearbox instruction manual.
35	Gearbox	2 years after initial installation.	II	Perform a full inspection per Gearbox instruction manual.
36	Gearbox	Every 4 years	II	Perform a full inspection per Gearbox instruction manual.

END OF TABLE 1.3

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ANEXO 6

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Ushuaia, 10 de enero 2014

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Sr. Director:

En función de lo solicitado mediante Resolución N° 317/13 de la Honorable Legislatura de la Provincia, se remite a su consideración la información relativa a:

Fondos Transferidos a la Cooperativa Eléctrica de la ciudad de Río Grande.

AÑO 2012			
Fecha de Transferencia	Importe	Origen Fondos	Destino Fondos
23/01/2012	$ 320,801.00	FCT	COMP FACT NOV 2011
23/01/2012	$ 339,145.00	FCT	COMP FACT DIC 2011
29/03/2012	$ 356,574.00	FCT	COMP FACT ENE 2012
29/03/2012	$ 203,328.88	FCT	COMP FACT 1° C FEB 2012
24/04/2012	$ 171,388.12	FCT	COMP FACT 2° C FEB 2012
24/04/2012	$ 97,829.39	FCT	COMP FACT 1° C MARZO 2012
30/05/2012	$ 269,416.61	FCT	COMP FACT 2° C MARZO 2012
30/05/2012	$ 127,134.88	FCT	COMP FACT 1° C ABRIL 2012
28/06/2012	$ 214,885.12	FCT	COMP FACT 2° C ABRIL 2012
28/06/2012	$ 165,191.73	FCT	COMP FACT MAYO 2012
20/07/2012	$ 69,146.58	FEDEI	CERT OBRA CFEE TF 07 F 06
25/07/2012	$ 15,922.95	FEDEI	CERT OBRA CFEE TF 07 F 06
31/07/2012	$ 172,788.27	FCT	COMP FACT MAYO 2012
31/07/2012	$ 188,104.33	FCT	COMP FACT 1° C JUNIO 2012
11/09/2012	$ 144,234.67	FCT	COMP FACT 2° C JUNIO 2012
11/09/2012	$ 131,485.67	FCT	COMP FACT 1° C JULIO 2012
30/10/2012	$ 210,489.94	FCT	COMP FACT 2° C JULIO 2012
30/10/2012	$ 89,321.77	FCT	COMP FACT 1° C AGO 2012
30/10/2012	$ 242,516.23	FCT	COMP FACT 2° C AGO 2012
14/12/2012	$ 296,658.54	FCT	COMP FACT SEPT 2012

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AÑO 2013			
03/01/2013	$ 323,234.82	FCT	COMP FACT OCTUBRE 2012
04/01/2013	$ 1,680,255.91	FEDEI	CERT OBRA CFEE TF 13 F 03
04/01/2013	$ 867,157.88	FEDEI	CERT OBRA CFEE TF 13 F 02
30/01/2013	$ 291,499.98	FCT	COMP FACT NOVIEMBRE 2012
09/04/2013	$ 1,294,277.42	FEDEI	CERT OBRA CFEE TF 13 F 03
09/04/2013	$ 307,153.46	FEDEI	CERT OBRA CFEE TF 13 F 02
16/04/2013	$ 388,501.00	FCT	COMP FACT DICIEMBRE 2012
16/04/2013	$ 167,925.23	FCT	COMP FACT ENERO 2013
03/06/2013	$ 346,884.07	FCT	COMP FACT FEBRERO 2013
03/06/2013	$ 221,080.57	FCT	COMP FACT MARZO 2013
04/10/2013	$ 177,909.00	FCT	COMP FACT JUNIO 2013
04/10/2013	$ 176,813.00	FCT	COMP FACT JULIO 2013
04/10/2013	$ 75,371.15	FEDEI	CERT OBRA CFEE 13 F 03
04/10/2013	$ 175,308.79	FEDEI	CERT OBRA CFEE TF 13 F 02
09/10/2013	$ 200,200.72	FEDEI	CERT OBRA CFEE TF 13 F 02
30/12/2013	$ 190,225.00	FCT	COMP FACT MAYO 2013
30/12/2013	$ 175,846.00	FCT	COMP FACT AGOSTO 2013
30/12/2013	$ 179,737.00	FCT	COMP FACT SEPTIEMBRE 2013
30/12/2013	$ 197,277.00	FCT	COMP FACT OCTUBRE 2013

Siendo:

a) FCT – Fondo Compensador de Tarifas a Usuarios Finales. El fondo se aplica directamente en la facturación realizada a los usuarios finales del servicio público de electricidad. La CERG remite en medio electrónico (CD) la consulta a la base de datos de la facturación realizada, discriminada la aplicación del FCTUF. La DPE verifica que los montos facturados se correspondan con lo indicado en la normativa vigente y los montos totales aplicados en dicho concepto. La CERG factura a la DPE el monto total aplicado. La partida que se aplica el gasto es la 5.1.8 Transferencias a Cooperativas.
b) FEDEI – Fondo Especial para el Desarrollo Eléctrico del Interior.
c) Obra TF 07 F 06 – Denominación: "Mejoras en la Red de MT de la ciudad de Río Grande. Obra realizada por la CERG durante el año 2011 y 2012. Concluyendo los trabajos (final de obra) en el mes de julio de 2012. En las fechas indicadas en el cuadro se abonan las últimas certificaciones. La DPE mediante un inspector de obra certifica los avances de obra y posteriormente rinde la obra en el Consejo Federal de Energía Eléctrica (CFEE). La CERG factura los montos certificados en la obra. La partida que se aplica el gasto es la 4.2.1 Construcciones en Bienes de Dominio Privado.

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d) Obra TF 13 F 02 – Denominación: "Electrificación Expropiación Ley N° 848 – Río Grande". Obra realizada por la CERG durante el año 2013. Concluyendo los trabajos durante el mes de Septiembre. La DPE mediante inspector de obra certifica los avances de obra y posteriormente rinde la obra en el CFEE. La CERG factura los montos certificados en la obra. La partida que se aplica el gasto es la 4.2.1 Construcciones en Bienes de Dominio Privado.
e) Obra TF 13 F 03 – Denominación: "Suministro MT Ley N° 847 y 848 – Río Grande". Obra realizada por la CERG durante el año 2013. Concluyendo los trabajos durante el mes de Septiembre. La DPE mediante inspector de obra certifica los avances de obra y posteriormente rinde la obra en el CFEE. La CERG factura los montos certificados en la obra. La partida que se aplica el gasto es la 4.2.1 Construcciones en Bienes de Dominio Privado.
f) Las obras como todos los gastos realizados por la DPE son auditados por el Tribunal de Cuentas de la Provincia. En el caso específico de los fondos nacionales, remitidos por el CFEE, FCT y FEDEI son rendidos por la DPE a dicho organismo nacional.

Ing. Fernando Martín Aras
Jefe Departamento
Planificación y Costos
Dirección Provincial de Energía

Inf. N° 05/2014

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