

行政院所屬各機關出國人員出國報告書

(出國類別：實習) C09401683

新營加壓站 SOLAR 第 C 台氣渦輪發動機送  
返原廠翻修測試工程

出國人員：服務機關：中國石油公司天然氣事業部  
職 稱：一般工程師  
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出國地點：美國  
出國日期：94 年 03 月 17 日至 94 年 03 月 27 日  
報告日期：94 年 06 月 27 日

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## 一前言：

新營加壓站於民國八十六年設置，其設置目的在於因應民營電廠商轉後，天然氣用氣量大增，原有管線供氣壓力將不足以滿足北部用戶用量之需，液化天然氣自永安廠以最高供氣壓力  $65 \text{ kg/cm}^2$  出廠後，經 30" 長途輸氣管線送出至岡山隔離站，以 26" 長途輸氣管線往北輸送至南配勢氣站，途經各配氣站用戶用氣後，輸氣管線之輸氣壓力逐漸減低至新竹配氣站時已無法達到最低  $40 \text{ kg/cm}^2$  之要求，因此在長途輸氣管線途中需增設若干中繼加壓站以維持輸氣壓力，而新營加壓站是天然氣自永安廠出廠後第一個中繼加壓站。

目前新營加壓站配置四部燃氣渦輪加壓機組，每台天然氣壓縮機的容量為  $120000 \text{ KS}^3$ ，操作壓力為進口壓力  $40 \text{ kg/cm}^2$  (最少)，出口壓力  $65 \text{ kg/cm}^2$  (最高)。

其中編號 C 台機組於民國八十九年 6 月 21 日於啟動半小時後即跳俾 4 秒後隨即有振動警報(軸承#1, #2, #3)，操作人員試圖重新啟動皆無法啟動，民國八十九年 11 月 9 日請原廠技師到現場

檢查，經由內視鏡檢視，發現發動機的壓縮段葉片毀損，無法啟動，在原廠技師協助下將發動機下架裝箱待送修；但因中油公司組織調整，供氣中心原屬台營總處改隸新成立之天然氣事業部管線處，故送修事宜延宕到民國九十二年7月日與原廠 SOLAR 公司簽定拆檢合約，並於民國九十三年1月14日將發動機以船運方式送達美國德州 DeSoto SOLAR 翻修工廠，進行拆檢工程確定故障原因，中油公司派本人與顧問漢翔公司楊瑞林於民國九十三年四月二十五日前往美國德州 DeSoto SOLAR 公司翻修工廠，見證發動機拆檢過程，並聽取故障原因分析，完整報告如（C09301871）「新營加壓站第 C 台天然氣氣渦輪增壓壓縮機故障送回原廠拆檢工程」，

中油公司派本人與顧問漢翔公司羅伯昌於民國九十四年三月十七日前往美國德州 DeSoto SOLAR 公司翻修工廠，見證發動機組裝及測試過程，並進行性能試驗，回國後就整個過程加以整理成冊完成此一報告。

## 二、氣渦輪發動機簡介

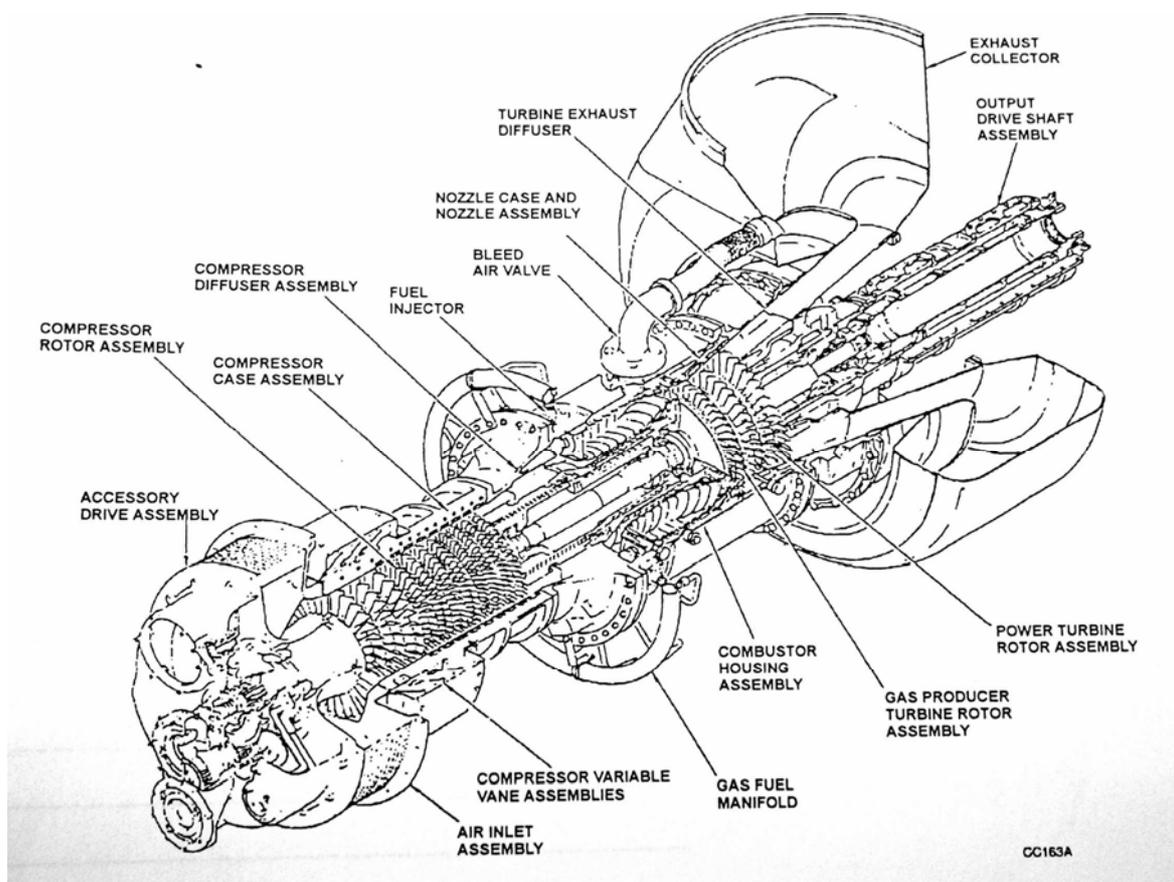


圖 2.1 SOLAR 氣渦輪機 CENTAUR 50 型剖面圖

CENTAUR 50 型氣渦輪發動機由前端開始為附件機匣、進氣道，氣體壓縮段、擴散段、燃燒段、渦輪噴嘴及渦輪，後端接上動力渦輪將動力傳送給壓縮機，為天然氣增壓。

## a、附件機匣



圖 2.2 附件機匣

包含啟動器、滑油泵、液壓泵，由主軸帶動一組齒輪組所驅動，啟動器由天然氣所帶動其構造具有一個噴嘴，噴出高速天然氣推動一組渦輪，此渦輪經由短軸帶動齒輪，使主齒輪驅動引擎的主軸，帶動壓縮段工作；滑油泵提供機組潤滑所需，液壓泵提供液壓驅動洩氣閥工作。

b、氣體壓縮段

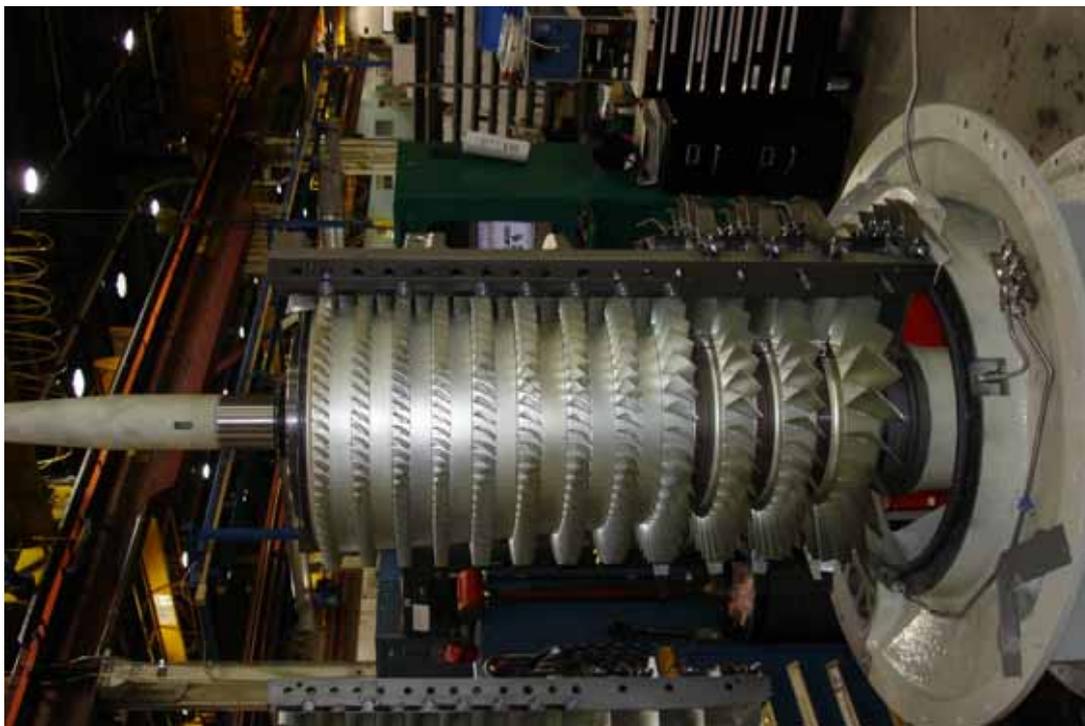


圖 2.3 壓縮段剖面圖



圖 2.4 壓縮段轉子及轉子葉片

此型發動機為軸流式壓縮，共有十一級壓縮，一到二級定葉片為可變葉片進氣閥，啟動時由啟動器帶動空氣，由進氣道進入，經由壓縮段一級一級的壓縮後速度提高，接近音速然後進入擴散段。



圖 2.5 可變葉片進氣閥

### c、擴散段

此段位於壓縮段及燃燒段之間，其作用在於將經壓縮後的高流速空氣轉變為低流速氣流，不致造成引擎熄火。



圖 2.6 擴散段

#### d、燃燒段



圖 2.7 燃燒筒外觀

包含燃燒筒、燃料噴嘴及點火器、洩氣閥，燃料由燃料噴嘴噴入燃燒筒內與空氣流充分混合後，點火器點火，使混合氣爆炸產生推力，此推力再經由渦輪噴嘴推動渦輪，帶動主軸轉動，使壓縮段得以繼續運轉；燃燒筒上的小孔具有將空氣流集中，使火焰不會擴散外，並可保護燃燒筒及外殼不被高溫火焰所燒毀，洩氣閥為當危急時排空高壓氣體防止引擎產生 surge。

e、渦輪噴嘴及渦輪



圖 2.6 渦輪



圖 2.7 渦輪噴嘴

燃燒段的高溫高壓氣體經由渦輪噴嘴導流後，以固定的方向噴向渦輪，將能量轉變為機械能帶動前方的壓縮器，高速氣流則往後噴射。

## f、動力渦輪



圖 2.8 動力渦輪及軸

由前方所噴射出的高速氣流，藉由動力渦輪噴嘴及動力渦輪，將動能轉變為機械能帶動連軸器，驅動後方的天然氣增壓壓縮機，最後廢氣由排煙道排出。



圖 2.9 動力渦輪及尾錐管

### 三、翻修測試過程

出國參與 C 台氣渦輪發動機翻修測試工程工作日報表

日期	工 作 內 容	備 註
94. 03. 17	1. 下午從高雄搭機到中正機場，轉華航 CI0006 班機到洛杉磯，再由洛杉磯轉美國國內線班機到達拉斯，抵達時間為當地時間 94. 03. 17 PM 21：30，總共花了將近 25 小時。	
94. 03. 18	上午 07:00 到 SOLAR 公司發動機準備組裝，壓縮段葉片已事先組裝在軸上，並做過動平衡測試。組裝由壓縮段開始，依序為擴散段、燃燒段、渦輪噴嘴、渦輪、動力渦輪及附件機匣，等試俾台測試後再裝啟動器及滑油泵，今日組裝到燃燒段。	
94. 03. 19	1. 工作人員加班繼續組裝。	
94. 03. 20	1. 星期假日工廠休息	
94. 03. 21	1. 發動機組裝完成並裝上測試台上，下午開始測試，測試項目參看測試程序第 16 頁。 2 測試發動機特性後熱停機於 PT 軸上加配重改善振動，再次啟動測試但發現軸卡住無法啟動，詢問測試工程師，他認為等冷機後再	

	測試，我方認為需拆開檢查，SOLAR 同意明日下午測試台拆開引擎檢查。	
94. 03. 22	1 發動機下測試台重新拆卸檢查。 2 拆卸程序與組裝程序剛好倒反，拆卸到燃燒段時發現有一支燃氣噴嘴有積碳現象，向 SOLAR 反應，翻修經理答應處理。	
94. 03. 23	1. 發動機經拆開檢查後發現第二及第三級軸封太密合，經研磨及更換蜂巢結構後重新組合。 2 下午發動機上測試台重新測試，測試完成後發現七點鐘位置燃氣噴嘴未更換，要求 SOLAR 更新並再一次測試，經更新噴嘴後再一次測試。	
94. 03. 24	1. 早上檢視昨天的測試報告，一切測試項目皆符合規範。 2. 下午 SOLAR 公司安排參觀 Mabank 系統翻修工廠。	
94. 03. 25	1. 發動機已連夜打包完成，早上到廠檢視發動機包裝序號及運抵地是否正確。 2. 下午一點到機場搭機返國。	

處長（副處長）：

經理：

製表：吳建儀

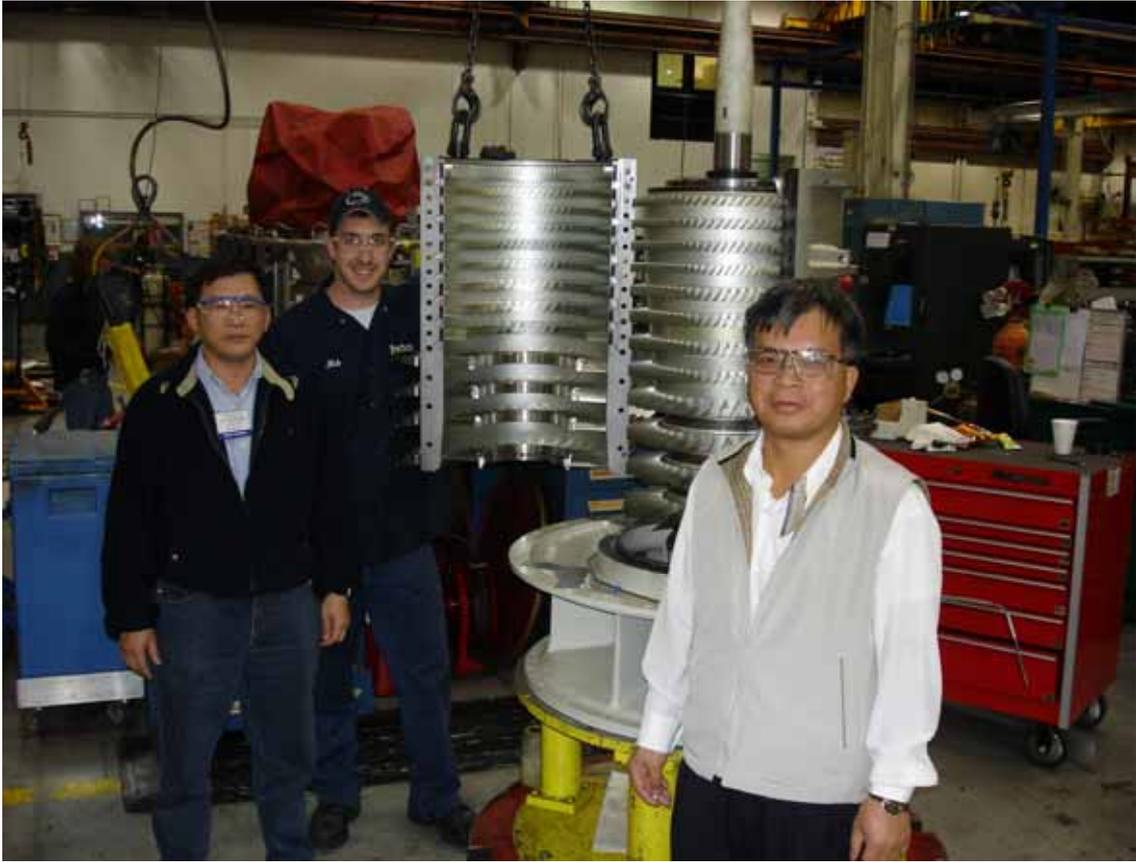


圖 3.1 組裝壓縮段



圖 3.2 組裝到擴散段



圖 3.3 正在組裝固定螺桿



圖 3.4 組裝至燃燒段



圖 3.5 發動機組裝完成



圖 3.6 試俾台進行測試



圖 3.7 發動機下測試台再次拆解檢查



圖 3.8 軸封蜂巢結構有新的磨擦痕跡箭頭所指處



圖 3.9 發動機測試完後準備裝箱



圖 3.10 名牌註明發動機序號及託修公司

#### 四、測試數據分析

測試工作是在 SOLAR 公司 DeSoto 翻修工廠所設置的試俾台進行試俾，整個測試工作由測試工程師主導，測試準則依照 SOLAR 公司的作業程序進行。

首先發動機啟動，暖車後，進行可變進氣葉片調整，現場有一領班進行調整，控制室監看發動機出力數據，角度調到 4<sup>0</sup> 時出力最佳，調整好後螺絲鎖固，進行其他項目測試；翻修後發動機主要的測試項目為：馬力、耗油量、軸承滑油溫度、振動及尾管溫度（T5）及排氣污染物分析等。

第一次測試做完所有項目，熱停機以便進行動力渦輪軸配重平衡，當平衡配重螺絲鎖固後，再次啟動，發現軸心鎖死無法啟動，發動機下測試台經重新拆開檢查後，發現第二及第三級軸封太密合，經研磨及更換蜂巢結構後重新組合，在拆檢的過程中發現 7 點鐘方向噴嘴有結焦現象，可能燃氣不潔或噴嘴有小孔堵塞，但其他噴嘴無此現象應為此噴嘴有小孔堵塞（噴嘴前端為花灑狀有多個小孔組成）。

組裝後再次進行測試，按照原程序再測試一次，發現馬力輸出比第一次差，幾未達到標準值，耗油量高一些，檢視工作單發現結焦的噴嘴僅清潔並未更新，當下要求測試工程師拆下7號噴嘴，拆下的噴嘴仍有結焦現象，SOLAR 廠方立即更換新品，裝上後進行第三次測試，測試結果馬力及耗油量明顯改善，從表 4.1~4.2 紅線所標示的數據看來，當測試進行一段時間馬力明顯下降可以查覺有異，測試時運轉一段時間馬力值下降，經拆開後燃料噴嘴有積碳現象此為堵塞造成，表 4.3、表 4.4 亦有相同現象，表 4.4 值比正常值低，待更新燃料噴嘴後，測試值如表 4.5 馬力值達 5648Hp 比正常值 5480Hp 高，耗油量為 8855 BTU/Hp-Hr 比最大容許值 9004 BTU/Hp-Hr 低，由馬力、耗油量、振動值、軸承滑油溫度、T5 排氣溫度等皆達到要求因此判定翻修的發動機測試合乎測試標準。

# 表 4.1 測試報告

## Solar Turbines

A Caterpillar Company

### ENGINE DATA REPORT

Model	5702	Date	21-Mar-05
Equipment	CENTAUR 50	Time	16:25:06

	<b>Gas Producer</b>	<b>Power Turbine</b>
Serial Number	0505H	TUG95-H3820
Part Number	EH5702-59-G	E136820-1105-80
Production Order Number	DPR283652	DPR284702
Purpose of Test	OVERHAUL	OVERHAUL
Test Specification	ES1843	
Test Engineer	KEN JONES	Data Pt. 4
TQA Review	LINDA ANGUS	
Test Technician	B. AUSTIN	

AvgOnOff	1
HighLowOut	1
Samples	20

### RUN INFORMATION

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	80.4	°F	NPT_100	16500	rpm
RH	23.6	%			
P_BARO	28.87	"Hg	#_SHAFTS	2	
ENGCON	5702		STD_TEMP	59.0	°F
IGV_ANGL	4.0	deg	T1_0_AVG	80.4	°F

### ENGINE OUTPUT

%NGP	101.99		CORR % NGP	100.02	
NGP	15305	rpm	CORR_NGP	15004	rpm
%NPT	99.35		CORR % NPT	98.45	
NPT	16393	rpm	CORR_NPT	16245	rpm
TRIT	1950.2	°F	CORRTRIT	1858.2	°F
HP	5440	Hp	CORR_HP	5667	Hp
WA	37.7	pps	CORR_WA	40.2	pps
SFCMBTU	49.5	MMBtu/Hr	CORR_SFC	87.33	Btu/Hp-hr
T6_I_AVG	1431.7	°F	CORR_T5	1355.0	°F
T7_I_AVG	1031.5	°F	CORR_T7	961.5	°F
			BASE T5	1349	°F
T2_CORR	626.8	°F	T5_T3W	0.7829	
			P2_P1	10.2	ratio

### FUEL: NATURAL GAS OR LIQUID

FUELTYPE	1	NATURAL GAS	F_NG_1	50.13	cfm
T_UQ	79.3	°F	F_NG_2	50.18	cfm
			P_NG_1	234.0	psig
WF_MASS1	2389.9	pph	P_NG_2	232.7	psig
WF_MASS2	2381.1	pph	T_NG_1	53.3	°F
%WF_DELTA	0.37	%	T_NG_2	52.9	°F
WF_AVG	2385.5	pph	SG_NGAS	0.5860	
HHV	1002	Btu/scf			
LHV	20463	Btu/lb			

表 4.2 測試報告

1st Pull Load

# Solar Turbines

A Caterpillar Company

## ENGINE DATA REPORT

Model: 5702 Date: 21-Mar-05  
 Equipment: CENTAUR 50 Time: 16:33:37

	<b>Gas Producer</b>	<b>Power Turbine</b>	
Serial Number	0505H	TUG95-H3820	
Part Number	EH5702-59-G	E136520-1165-80	
Production Order Number	DPR283652	DPR284702	
Purpose of Test	OVERHAUL	OVERHAUL	
Test Specification	ES1843		
Test Engineer	KEN JONES	Data Pt.	5
TQA Review	LINDA ANGUS		
Test Technician	B. AUSTIN	AvgOnOff	1
		High/LowOut	1
		Samples	20

### RUN INFORMATION

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	81.0	*F	NPT_100	16500	rpm
RH	23.5	%			
P_BARO	28.87	"Hg	#_SHAFTS	2	
ENGCON	5702		STD_TEMP	81.0	*F
IGV_ANGL	4.0	deg	T1_0_AVG	81.0	*F

### ENGINE OUTPUT

%NGP	98.33		CORR % NGP	98.47	
NGP	14750	rpm	CORR_NGP	14770	rpm
%NPT	97.33		CORR % NPT	98.46	
NPT	16068	rpm	CORR_NPT	16246	rpm
TRIT	1851.8	*F	CORR_TRIT	1849.5	*F
HP	4536	Hp	CORR_HP	4958	Hp
WA	35.6	pps	CORR_WA	37.1	pps
SFCMBTU	44.9	MMBtu/Hr	CORR_SFC	5061	Btu/Hp-hr
T5_1_AVG	1347.5	*F	CORR_T5	1348.3	*F
T7_1_AVG	966.0	*F	CORR_T7	979.4	*F
			BASE T5	1349	*F
T2_CORR	641.9	*F	T5_T5W	0.7829	
			P2_P1	9.4	ratio

### FUEL: NATURAL GAS OR LIQUID

FUELTYPE	1	NATURAL GAS	F_NG_1	44.34	cfm
T_LIQ	79.7	*F	F_NG_2	44.33	cfm
			P_NG_1	235.2	psig
WF_MASS1	2100.7	pph	P_NG_2	234.4	psig
WF_MASS2	2092.1	pph	T_NG_1	53.8	*F
%WF_DELTA	0.41	%	T_NG_2	53.5	*F
WF_AVG	2096.4	pph	SG_NGAS	0.5860	
HHV	1003	Btu/scf			
LHV	20462	Btu/lb			

表 4.3 測試報告

#1  
CORR. PERF.

# Solar Turbines

A Caterpillar Company

## ENGINE DATA REPORT

Model 5702 Date 23-Mar-05  
Equipment CENTAUR 50 Time 15:52:16

	<b>Gas Producer</b>	<b>Power Turbine</b>
Serial Number	0505H	TUG95-H382D
Part Number	EH5702-69-G	E136520-1105-80
Production Order Number	RW0037750	DPR2847C2
Purpose of Test	OVERHAUL	OVERHAUL
Test Specification	ES 843	
Test Engineer	KEN JONES	Data Pt: 14
TQA Review	LINDA ANGUS	
Test Technician	B. AUSTIN	AvgOnOff 1
		HighLowOut 1
		Samples 20

### RUN INFORMATION

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	67.2	°F	NPT_100	16500	rpm
RH	44.5	%			
P_BARO	29.22	" Hg	#_SHAFTS	2	
ENGCON	5732		STD_TEMP	59.0	°F
IGV_ANGL	4.0	deg	T1_D_AVG	67.2	°F

### ENGINE OUTPUT

%NGP	100.96		CORR % NGP	100.18	
NGP	15145	rpm	CORR_NGP	15027	rpm
%NPT	98.41		CORR % NPT	98.70	
NPT	16230	rpm	CORR_NPT	16285	rpm
TRIT	1894.0	°F	CORRTRIT	1859.1	°F
HP	5382	Hp	CORR_HP	5637	Hp
WA	38.5	pps	CORR_WA	40.1	pps
SFCMBTJ	53.0	MMBtu/Hr	CORR_SFC	8872	Btu/Hp-hr
T5_1_AVG	1393.6	°F	CORR_T5	1365.0	°F
T7_1_AVG	996.4	°F	CORR_T7	964.5	°F
			BASE T5	1358	°F
T2_CORR	626.8	°F	T5_T3W	0.7869	
			P2_P1	10.2	ratio

### FUEL: NATURAL GAS OR LIQUID

FUELTYPE	1	NATURAL GAS	F_NG_1	59.97	cfm
T_LIQ	67.7	°F	F_NG_2	60.21	cfm
			P_NG_1	190.1	psig
WF_MASS1	2400.2	pph	P_NG_2	188.6	psig
WF_MASS2	2393.9	pph	T_NG_1	44.3	°F
%WF_DELTA	0.26	%	T_NG_2	44.0	°F
WF_AVG	2397.1	pph	SG_NGAS	0.5900	
HHV	1007	Btu/scf			
LHV	20448	Btu/lb			

表 4.4 測試報告

Full Load  
#1

**Solar Turbines**

A Caterpillar Company

**ENGINE DATA REPORT**

Model 5702 Date 23-Mar-06  
Equipment CENTAUR 50 Time 15:08:17

	<b>Gas Producer</b>	<b>Power Turbine</b>
Serial Number	0505H	TUG95-H3820
Part Number	EH-5702-59-G	E136520-1105-80
Production Order Number	RW0037750	DPR284702
Purpose of Test	OVERHAUL	OVERHAUL
Test Specification	ES1843	
Test Engineer	KEN JONES	Data Pt. 16
TQA Review	LINDA ANGUS	
Test Technician	B. AUSTIN	
		AvgOrOf
		HighLowOut
		Samples 20

**RUN INFORMATION**

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	67.3	*F	NPT_100	16500	rpm
RH	47.1	%			
P_BARO	29.22	" Hg	#_SHAFTS	2	
ENGCON	5702		STD_TEMP	67.3	*F
IGV_ANGLE	4.0	deg	T1_C_AVG	67.3	*F

**ENGINE OUTPUT**

%NGP	99.38		CORR % NGP	99.41	
NGP	14910	rpm	CORR_NGP	14911	rpm
%NPT	97.86		CORR % NPT	99.01	
NPT	6143	rpm	CORR_NPT	16336	rpm
TRT	1854.4	*F	CORRTRIT	1854.5	*F
HP	5057	Hp	CORR_HP	5344	Hp
WA	37.6	pps	CORR_WA	38.8	pps
SFCMBTJ	48.1	MMBtu/Hr	CORR_SFC	9006	Btu/hp-hr
T5_1_AVG	1355.9	*F	CORR_T5	1356.7	*F
T7_1_AVG	977.6	*F	CORR_T7	970.3	*F
			BASE T5	1353	*F
T2_CORR	532.0	*C	T5_T3W	0.7849	
			P2_P1	9.9	ratio

**FUEL: NATURAL GAS OR LIQUID**

FUELTYPE	1		NATURAL GAS		
T_LIQ	66.4	*F	F_NG_1	56.80	cfm
			F_NG_2	57.06	cfm
WF_MASS1	2277.2	pph	P_NG_1	190.7	psig
WF_MASS2	2274.6	pph	P_NG_2	189.4	psig
%WF_DELTA	0.12	%	T_NG_1	44.8	*C
WF_AVG	2275.9	pph	T_NG_2	44.5	*C
			SG_NGAS	0.5900	
HHV	1007	Btu/scf			
LHV	20449	Btu/lb			

表 4.5 測試報告

# Solar Turbines

A Caterpillar Company

## ENGINE DATA REPORT

Model 5702 Date 23-Mar-05  
 Equipment CENTAUR 50 Time 18:05:06

	Gas Producer	Power Turbine
Serial Number	0605H	TUG95-H3820
Part Number	EHS702-59-G	E136520-1105-80
Production Order Number	RW0037750	DPK284702
Purpose of Test	OVERHAUL	OVERHAUL
Test Specification	ES1843	
Test Engineer	KEN JONES	Data Pt. 21
TQA Review	LUNDA ANGLUS	
Test Technician	B. AUSTIN	
		AvgOnOff 1
		HighLowOut 1
		Samples 20

### RUN INFORMATION

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	63.2	*F	NPT_100	16500	rpm
RH	49.2	%			
P_BARO	29.18	*Hg	#SHAFTS	2	
ENGCON	5702		STD_TEMP	59.0	*F
IGV_ANGL	4.0	deg	T1_0_AVG	63.2	*F

### ENGINE OUTPUT

%NGP	100.66		CORR % NGP	100.23	
NGP	15100	rpm	CORR_NGP	15035	rpm
%NPT	97.38		CORR % NPT	98.05	
NPT	16057	rpm	CORR_NPT	16178	rpm
TRIT	1877.4	*F	CORRTRIT	1859.8	*F
HP	5358	Hp	CORR_HP	5648	Hp
WA	38.8	pps	CORR_WA	40.1	pps
SFCMBTU	50.0	MMBtu/hr	CORR_SFC	8855	Btu/Hp-hr
T5_1_AVG	1379.4	*F	CORR_T5	1364.9	*F
T7_1_AVG	983.3	*F	CORR_T7	963.4	*F
			BASE T5	1357	*F
T2_CORR	628.0	*F	T5_T3W	0.7866	
			P2_P1	10.2	ratio

### FUEL: NATURAL GAS OR LIQUID

FUELTYPE	1	NATURAL GAS	F_NG_1	59.50	cfm
T_LIQ	68.4	*F	F_NG_2	59.71	cfm
			P_NG_1	190.6	psig
WF_MASS1	2386.5	pph	P_NG_2	189.1	psig
WF_MASS2	2379.8	pph	T_NG_1	44.2	*F
%WF_DELTA	0.28	%	T_NG_2	43.9	*F
WF_AVG	2383.1	pph	SG_NGAS	0.5900	
HHV	1005	Btu/act			
LHV	20414	Btu/lb			

## 五、結語

噴射發動機原理簡單，但是構造精密，先進的材質國內尚無此技術製造，因此維修皆需靠國外原廠協助，此行能夠到 SOLAR 公司翻修工廠參與發動機組裝及測試，對於今後操作保養氣渦輪發動機工作實獲益良多。

附錄一、測試報告

**Solar Turbines**  
A Caterpillar Company

Solar Turbines Incorporated

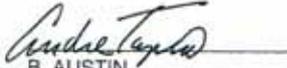
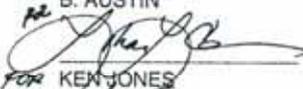
215 Centre Park Blvd.  
DeSoto, Texas 75115

## Two Shaft Gas Turbine Certified Test Report

Date of Test : 23-Mar-05  
Equipment Tested : CENTAUR 50  
Model Type : 5702

	<u>Gas Producer</u>	<u>Power Turbine</u>
Serial Number	: 0505H	TUG95-H3820
Part Number	: EH5702-59-G	E136520-1105-80
Purpose of Test	: OVERHAUL	OVERHAUL
Test Specification	: ES1843	ES1843

### Approvals

Test Technician	:  B. AUSTIN	: 03/23/05 Date
Test Engineer	:  for KEN JONES	: March 24, 2005 Date
Product Engineer	:  LINDA ANGUS	: 3/24/05 Date

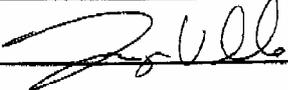
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CPC (Chinese Petroleum Corporation ) Repaired C50 Engine Test Report

**Test Record Sheet**

**Test Data for Repaired Two Shaft C50 Gas Turbine(Gas Producer  
Serial No.: 0505H, Power Turbine Serial No. TUG95-H3820) for CPC**

**Test by: Solar Turbines Incorporated Desoto, Texas**

**Witness by:  / Robert [unclear] / Wu, Chien. I**  
**Tony Valle - Project Manger Centaur 50 / AZOL / CPC**

**Date: March 23, 2005**

# **Solar Turbines**

*A Caterpillar Company*

## **OVERHAUL ASSEMBLY DATA**

**ASSEMBLY PART NUMBER:                   EH5702-59-G / E136520-1105-80**

**ASSEMBLY SERIAL NUMBER:                0505H / TUG95-H3820**

**SOLAR PROJECT NUMBER:                 RW0037750 / DPR284702**

**LIFE LIMITED COMPONENT STATUS**

**ACCEPTANCE CRITERIA**

**PERFORMANCE DATA**

**VIBRATION SIGNATURES**

## LIFE LIMITED COMPONENT STATUS

### FIRST STAGE TURBINE DISC ASSEMBLY:

PART NUMBER:	E136331-1403
SERIAL NUMBER:	DAG95-H3870
REMAINING SERVICE LIFE:	129,500 HOURS

### SECOND STAGE TURBINE DISC ASSEMBLY:

PART NUMBER:	E136361-600
SERIAL NUMBER:	DAG95-H3871
REMAINING SERVICE LIFE:	129,500 HOURS

### THIRD STAGE TURBINE DISC ASSEMBLY:

PART NUMBER:	E136524-300
SERIAL NUMBER:	DAAOO-H4071
REMAINING SERVICE LIFE:	90,000 HOURS

**TEST SUMMARY  
GAS FUEL**

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Solar Turbines - Desoto, Texas  
 Two-Shaft Gas Turbine Certified Test Report  
 Corrected to Sea Level, No Duct Losses, 60% Rel. Humidity and Match Temp.

**Equipment Summary**

Date	23-Mar-05	Time	18:05:06	Model	5702
GP S/N	0505H	GP P.O.	RW0037750	CS Curve	CS27156
PT S/N	TUG95-H3820	PT P.O.	DPR284702	Test Spec	ES1843
Match Temp.	59	Fuel Type	Gas	Data Pt.	21

**Corrected Performance Summary**

Parameter Name	Units	Results	Min	Max
Corrected NGP	%	100.2	99.7	100.3
Corrected NPT	%	98.0	98	100
Corrected HP	HP	5648	5509	
Corrected SFC	BTU/HP HR	8855		9019
Corrected TRIT	DEG F	1859.8	1830	1860

**Engine Parameters**

Parameter Name	Units	Results	Min	Max
Air Inlet Temp	DEG F	63.2		
Corrected T5	DEG F	1364.9		
T5 Base	DEG F	1357.2		
T5/T3	RATIO	0.7866	0.7727	0.8377
Compensator P/N		120902-12		
T5 Delta	DEG F	24.1		150
Final IGV Angle	DEGREES	4.0	2	8
Corr Mass Flow	PPS	40.1		41.8
PCD	PSIG	129.1		
PTC	PSIG	N/A	N/A	N/A
PPTBLEED	PSIG	N/A	N/A	N/A
T2 Spread	DEG F	3.5		10.0
Corr_T7	DEG F	963.4	935	
P2_P1	RATIO	10.2	9.8	
T7 Delta	DEG F	4.0		20

Test Technician

  
 B. AUSTIN

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Solar Turbines - Desoto, Texas  
 Two-Shaft Gas Turbine Certified Test Report  
 Corrected to Sea Level, No Duct Losses, 60% Rel. Humidity and Match Temp.

**Equipment Summary**

Date	23-Mar-05	Time	18:05:06	Model	5702
GP S/N	0505H	GP P.O.	RW0037750	CS Curve	CS27158
PT S/N	TUG95-H3820	PT P.O.	DPR284702	Test Spec	ES1843
Match Temp.	59	FuelType	Gas	Data Pt.	21

**Lube System Parameters**

Location	Pressure		Flow		Min	Max
Brg 1	57.8	PSIG	6.0	GPM	5.6	7.6
Brg 2 & 3	45.7	PSIG	29.8	GPM	25.9	32.9
Brg 4 & 5	54.6	PSIG	27.9	GPM	24.9	30.1
Lube Oil Temp			130.8	DEG F	110	155
Lube Oil Press Limits					45.0	65.0
GP Thrust Brg Temp			189.2	DEG F		230.0
PT Thrust Brg Temp			198.4	DEG F		230.0
Tank Vent Pressure			0.9	IN H2O		5.7

**CENTAUR 50  
 DATA TAG INFO**

Model No.	CENTAUR 50
Version	5702
I.D. No.	EH5702-59-G
Turbine S/N	0505H
Power	5672 HP ISO Dry
Turbine RPM	15000
Output RPM	16500
Base T5 Gas	1357
Liquid	N/A
T5 Comp	120902-12
T5 Setpoint	1400
Vane Angle	4.0

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**TEST DATA  
GAS FUEL**

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# Solar Turbines

A Caterpillar Company

## ENGINE DATA REPORT

Model 5702 Date 23-Mar-05  
 Equipment CENTAUR 50 Time 18:05:06

	Gas Producer	Power Turbine	
Serial Number	0506H	TUG95-H3820	
Part Number	EHS702-59-G	E136520-1105-80	
Production Order Number	RW0037750	DFR284702	
Purpose of Test	OVERHAUL	OVERHAUL	
Test Specification	ES1843		
Test Engineer	KEN JONES	Data Pt.	21
TQA Review	LINDA ANGUS		
Test Technician	B. AUSTIN	AvgOnOff	1
		HighLowOut	1
		Samples	20

### RUN INFORMATION

FUELTYPE	1		NGP_100	15000	rpm
T_AMB	63.2	*F	NPT_100	16500	rpm
RH	49.2	%			
P_BARO	29.18	*Hg	#SHAFTS	2	
ENGCON	5702		STD_TEMP	59.0	*F
IGV_ANGLE	4.0	deg	T1_0_AVG	63.2	*F

### ENGINE OUTPUT

%NGP	100.66		CORR % NGP	100.23	
NGP	15100	rpm	CORR_NGP	15035	rpm
%NPT	97.38		CORR % NPT	98.05	
NPT	16057	rpm	CORR_NPT	15178	rpm
TRT	1877.4	*F	CORRTRT	1859.8	*F
HP	5358	Hp	CORR_HP	5648	Hp
WA	38.8	pps	CORR_WA	40.1	pps
SFCMBTU	50.0	MMBtu/hr	CORR_SFC	8855	Btu/Hp-hr
T5_1_AVG	1379.4	*F	CORR_T5	1364.9	*F
T7_1_AVG	983.3	*F	CORR_T7	963.4	*F
			BASE T5	1357	*F
T2_CORR	628.0	*F	T5_T3W	0.7866	
			P2_P1	10.2	ratio

### FUEL: NATURAL GAS OR LIQUID

FUELTYPE	1	NATURAL GAS	F_NG_1	59.50	cfm
T_NG	68.4	*F	F_NG_2	59.71	cfm
			P_NG_1	190.6	psig
WF_MASS1	2386.5	pph	P_NG_2	189.1	psig
WF_MASS2	2379.8	pph	T_NG_1	44.2	*F
%WF_DELTA	0.28	%	T_NG_2	43.9	*F
WF_AVG	2383.1	pph	SG_NGAS	0.5900	
HHV	1005	Btu/scf			
LHV	20414	Btu/lb			

### ENGINE DATA REPORT

Serial Number	Gas Producer	Power Turbine	Data Pt.	21
Part Number	EH5702-59-G	TUG95-H3820	Date	23-Mar-05
Solar P.O.	RW0037750	E136520-1105-60	Time	18:05:06
		DPR284702		

#### LUBE OIL

DPSUMP	0.88	*H <sub>2</sub> O	TPKG_OIL	130.8	*F
P_BRG#1	57.8	psi	F_BRG#1	6.0	gpm
P_BRG#2	45.7	psi	F_BRG#2	29.8	gpm
P_BRG#3	N/A	psi	F_BRG#3	N/A	gpm
P_BRG#4	54.6	psi	F_BRG#4	27.9	gpm
P_BRG#5	N/A	psi	F_BRG#5	N/A	gpm

#### COMPRESSOR INLET

TV	62.4	*F	P_AMB	14.33	psia
T1_0_1	63.4	*F	P1_0_1	-4.20	*H <sub>2</sub> O
T1_0_2	63.1	*F	P1_0_2	-4.18	*H <sub>2</sub> O
T1_0_3	63.3	*F	P1_0_3	-3.98	*H <sub>2</sub> O
T1_0_4	63.1	*F	P1_0_4	-4.19	*H <sub>2</sub> O
T1_0_AVG	63.2	*F	P1_0_AVG	-3.98	*H <sub>2</sub> O
T1_0_SPR	0.3	*F	P1_0_SPR	0.22	*H <sub>2</sub> O
Delta T1-TV	0.81	*F	P0_AVG	-5.25	*H <sub>2</sub> O
PV_PLNM	-0.43	*H <sub>2</sub> O			
P1_PKG#1	-78.39	*H <sub>2</sub> O	DPV_ST_1	-35.20	*H <sub>2</sub> O
P1_PKG#2	-78.79	*H <sub>2</sub> O	DPV_ST_2	-35.84	*H <sub>2</sub> O
P1_PKG#3	-75.82	*H <sub>2</sub> O	DPV_ST_3	-35.71	*H <sub>2</sub> O
P1_PKG_AVG	-77.67	*H <sub>2</sub> O	DPV_ST_4	-35.57	*H <sub>2</sub> O
P1_PKG_SPR	2.97	*H <sub>2</sub> O	DPV_AVG	-35.56	*H <sub>2</sub> O
			DPV_SPR	0.63	*H <sub>2</sub> O

#### COMPRESSOR DISCHARGE

T2_0_1	635.1	*F	PCD	129.1	psi
T2_0_2	638.6	*F	PTC	103.0	psi
T2_0_3	636.2	*F			
T2_0_AVG	636.6	*F	P2_P1	10.2	Ratio
T2_0_SPR	3.5	*F			

#### TURBINE TEMPERATURES

T5_1_1	1383.6	*F	T5_1_DEL	24.1	*F
T5_1_2	1367.2	*F	T5_1_SPR	39.7	*F
T5_1_3	1356.3	*F			
T5_1_4	1394.9	*F	T5_1_MAX	1394.9	*F
T5_1_5	1392.2	*F	T5_1_MIN	1356.3	*F
T5_1_6	1375.4	*F	T5_1_AVG	1379.4	*F

### ENGINE DATA REPORT

Serial Number	0505H	Gas Producer	TUG95-H3820	Power Turbine		Data Pt.	21
Part Number	EH5702-59-G		E136520-1105-80			Date	23-Mar-05
Solar P.O.	RW0037750		DPR284702			Time	18:05:06

#### EXHAUST TEMPERATURES AND PRESSURES

T7_1_1	983.9	*F	T7_1_8	980.3	*F
T7_1_2	982.9	*F	T7_1_9	982.9	*F
T7_1_3	983.4	*F	T7_1_10	984.5	*F
T7_1_4	983.4	*F	T7_1_11	985.5	*F
T7_1_5	983.9	*F	T7_1_12	983.9	*F
T7_1_6	983.9	*F	T7_1_13	985.5	*F
T7_1_7	983.9	*F	T7_1_14	979.3	*F
P7_1_1	8.46	*H <sub>2</sub> O	T7_1_AVG	983.3	*F
P7_1_2	6.76	*H <sub>2</sub> O	T7_1_MAX	985.5	*F
P7_1_3	7.32	*H <sub>2</sub> O	T7_1_MIN	979.3	*F
P7_1_4	6.53	*H <sub>2</sub> O	T7_1_SPR	6.2	*F
P7_AVG	7.27	*H <sub>2</sub> O	T7_1_DELTA	4.0	*F
P7_SPR	1.93	*H <sub>2</sub> O			

#### DYNAMOMETER PARAMETERS

F1_DVNO	998.13	lbt	TGPTBRG1	189.2	*F
PH2Osupply	150.57	psig	TGPTBRG2	182.6	*F
FOYNOIL	37.88	psig	TPITBRG1	198.4	*F
FDYNFWD	11.12	gpm	TPITBRG2	171.9	*F
FDYNAFT	10.03	gpm	PPBLEED	N/A	psig
TDYNH2oIN	73.00	*F	<b>EMISSION PARAMETERS</b>		
TDYNH2oOUT	165.30	*F	ISO_NOX	N/A	PPMV

#### PERFORMANCE PARAMETERS

Cyc. Eff.	28.74	%	NOX	N/A	PPMV
ETA COMP	0.8387		CO	N/A	PPMV
ETA TOA	0.8753		HC	N/A	PPMV
WQ10C	664.70		O2	N/A	%
WQ31CC	140.64		CO2	N/A	%
WQ51EC	423.25				
HEAT BAL.	0.9809	ratio			
GB_EFF	0.96				
GEN_EFF	0.955				

# FULL LOAD EMISSIONS SUMMARY

Solar Turbines - Desoto, Texas  
Gas Turbine Certified Test Report  
Corrected to Sea Level, No Duct Losses, 60% Rel. Humidity

## EQUIPMENT SUMMARY

Date	23-Mar-05	Time	18:21:59	Model	5702
GP S/N	0505H	GP P.O.	RW0037750	Test Spec	ES1843
PT S/N	TUG95-H3820	PT P.O.	DPR284702	Data Pt.	23
Match Temp	62	FuelType	Gas		

## FULL LOAD PERFORMANCE SUMMARY

Parameter Name	Units	Results
Corrected NGP	%	99.7
Match Speed	RPM	14962.3
Corrected NPT	%	98.8
Corrected HP	HP	5482.8
Corrected SFC	Btu/HpHr	8923.6
Corrected TRIT	Deg F	1850.0
Corrected T7	Deg F	961.8
T1 Average	Deg F	61.9

## FULL LOAD EMISSIONS SUMMARY

Parameter Name	Units	Results
ISO_NOX	ppmv	94.2
NOX	ppmv 15% O <sub>2</sub> Corr.	93.7
CO	ppmv 15% O <sub>2</sub> Corr.	3.6
HC	ppmv 15% O <sub>2</sub> Corr.	1.0
O2	%	15.58
CO2	%	3.08

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## VIBRATION PLOTS

CATERPILLAR CONFIDENTIAL, YELLOW

# Solar Turbines

A Caterpillar Company

## VIBRATION LIMITS

LOCATION	OVERALL LIMIT	ROTOR FREQUENCY LIMIT	NOTES
Accessory Drive Vert.	0.28 in/sec (RMS)	0.14 in/sec (RMS)	(1) (3)
GP Forward Horiz.	0.28 in/sec (RMS)	0.17 in/sec (RMS)	(1) (3)
GP Forward Vert.	0.28 in/sec (RMS)	0.17 in/sec (RMS)	(1) (3)
GP Aft Vert.	0.28 in/sec (RMS)	0.17 in/sec (RMS)	(1) (3)
PT Vertical	0.40 in/sec (RMS)	0.33 in/sec (RMS)	(1) (3)
Bearing #1	3.5 mils (P-P)	2.0 mils (P-P)	(1) (2) (3)
Bearing #2	3.5 mils (P-P)	2.0 mils (P-P)	(1) (2) (3)
Bearing #3	2.5 mils (P-P)	2.0 mils (P-P)	(1) (2) (3)
Bearing #4	1.6 mils (P-P)	1.15 mils (P-P)	(1) (2) (3)
Bearing #5	1.6 mils (P-P)	1.15 mils (P-P)	(1) (2) (3)

- (1) All readings are valid between 15 to 2000 Hz.
- (2) Vibration limits at frequencies other than running speed are limited to 0.4 mils (P-P).
- (3) All OVERALL LEVELS or GLOBAL LEVELS are displayed in RMS. For Proximity Probes, the GLOBAL LEVEL can be converted to (P-P) with the following formula:

$$\text{VIBRATION (P-P)} = \text{VIBRATION (RMS)} \times 2 \times 1.41$$

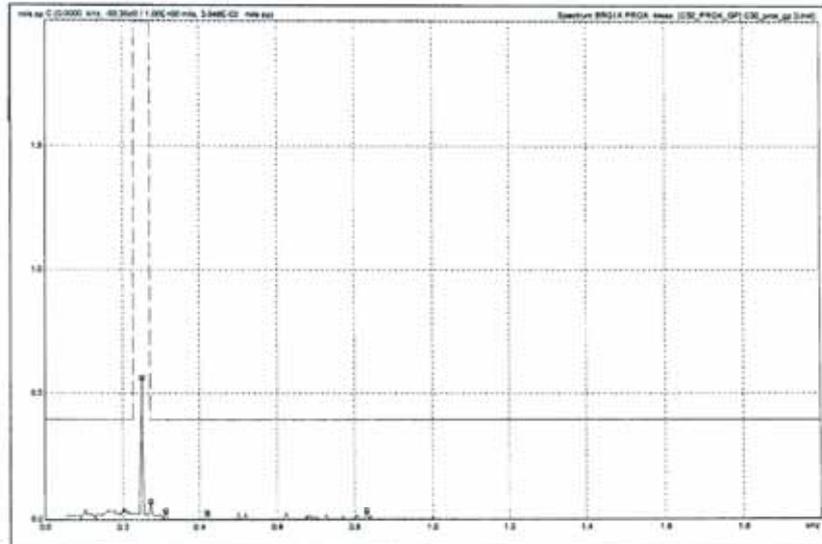
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRG1X PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -13.40 dB; 2.14E-01 mls  
 ----- : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50\C50\_PROX\_GPAE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.83 dB; 4.92E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.25000	-14.00	564.3E-03	100.00
2	P	0.27250	-32.49	67.15E-03	11.90
3	P	0.31250	-38.69	32.89E-03	5.83
4	P	0.83000	-38.82	32.40E-03	5.74
5	P	0.42000	-41.32	24.29E-03	4.30

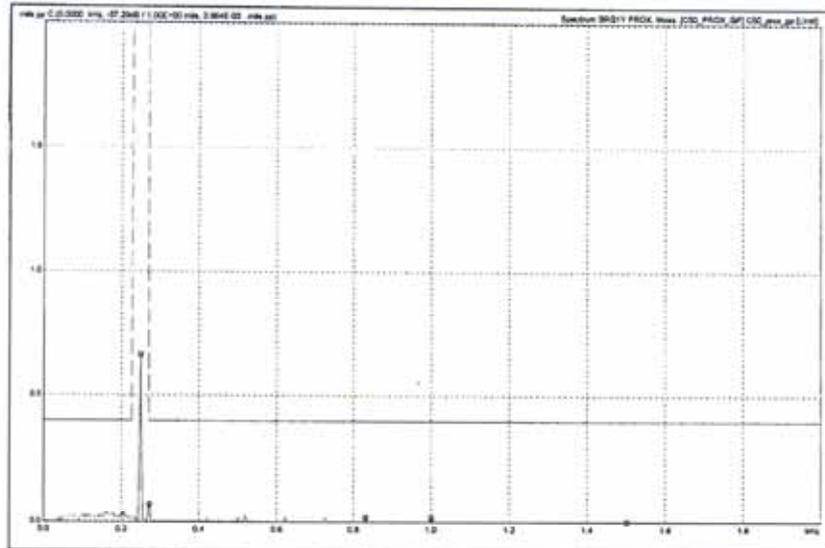
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CATERPILLAR CONFIDENTIAL, YELLOW

# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



Signals List:

— : Spectrum BRG1Y PROX  
 Global Level : From 0.0025 kHz To 2 kHz -12.27 dB; 2.43E-01 mls  
 - - - : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50\C50\_PROX\_GPAE2]  
 Global Level : From 0.0025 kHz To 2 kHz 13.83 dB; 4.92E+00 mls  
 Comments :

Peak List :

Nb	Type	kHz	dB	mls pp	%
1	P	0.25000	-12.60	663.0E-03	100.00
2	P	0.27250	-32.29	68.71E-03	10.36
3	P	0.83000	-43.53	18.84E-03	2.84
4	P	1.00000	-44.97	15.96E-03	2.41
5	P	1.50000	-52.33	6.839E-03	1.03

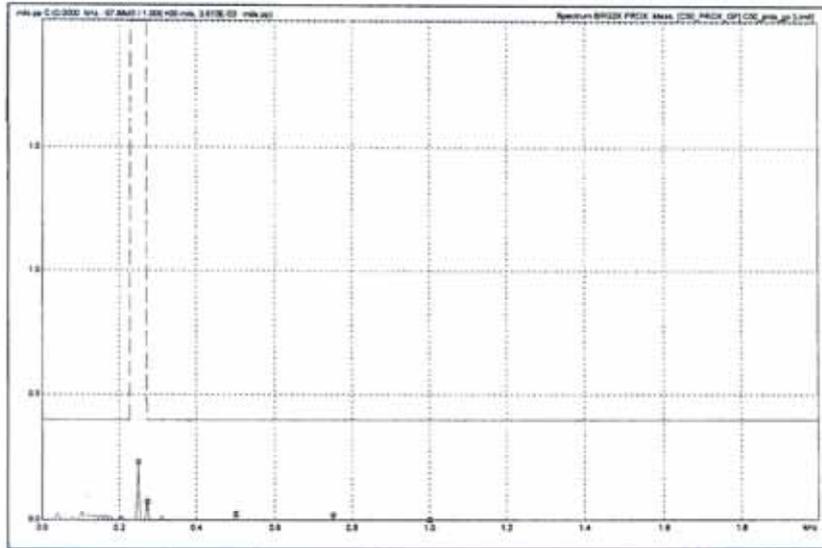
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRG2K PROX  
 Global Level : From 0.0025 kHz To 2 kHz -20.64 dB; 9.29E-02 mls  
 - - - - - : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50\C50\_PROX\_GPAE2]  
 Global Level : From 0.0025 kHz To 2 kHz 13.83 dB; 4.92E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.25000	-21.86	228.3E-03	100.00
2	P	0.27250	-32.19	69.50E-03	30.44
3	P	0.50000	-41.71	23.23E-03	10.18
4	P	0.75000	-44.51	16.83E-03	7.37
5	P	1.00000	-49.09	9.932E-03	4.35

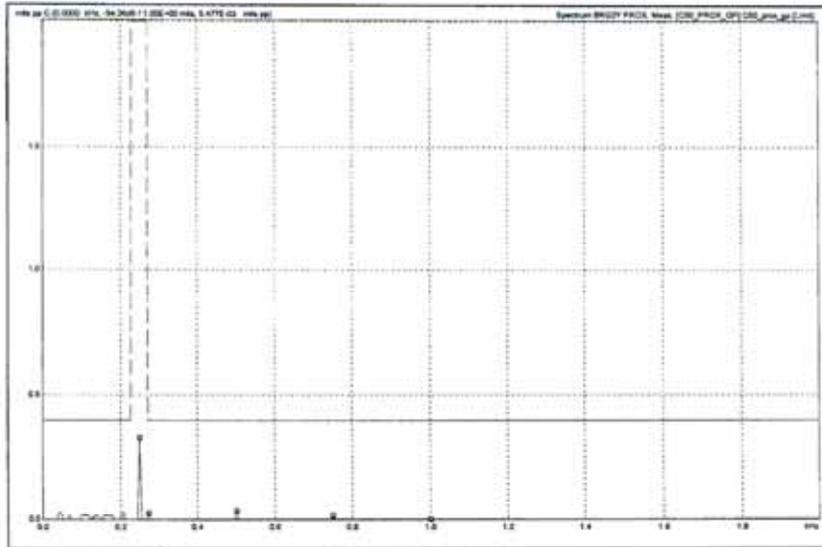
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CATERPILLAR CONFIDENTIAL, YELLOW

# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRGZY PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -18.15 dB; 1.24E-01 mls  
 ----- : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50\C50\_PROX\_GP.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.83 dB; 4.92E+00 mls  
 Comments :

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.25000	-18.64	330.8E-03	100.00
2	P	0.50000	-39.05	31.55E-03	9.54
3	P	0.27250	-41.14	24.80E-03	7.50
4	P	0.75000	-45.88	14.37E-03	4.34
5	P	1.00000	-49.92	9.026E-03	2.73

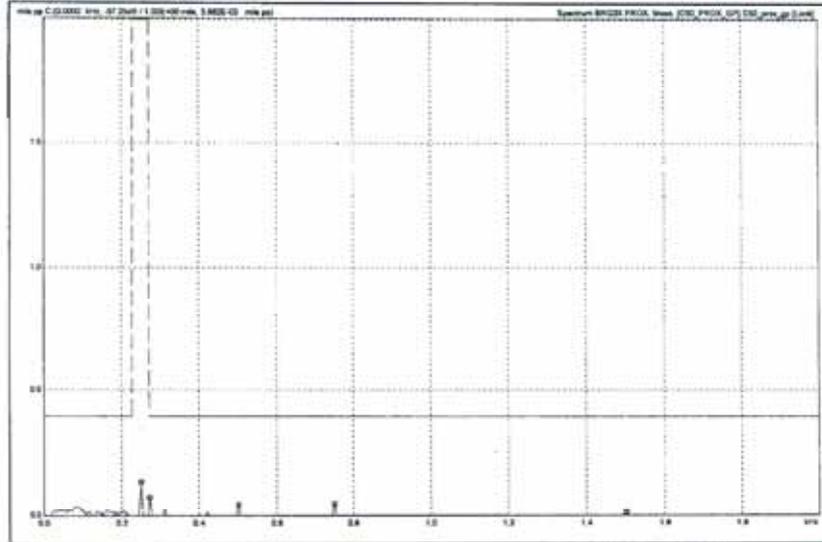
Created on 3/23/2005 6:14 PM

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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRG3X PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -22.13 dB; 7.82E-02 mls  
 ----- : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50\C50\_PROX\_GPAE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.83 dB; 4.92E+00 mls  
 Comments :

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.25000	-26.36	136.0E-03	100.00
2	P	0.27250	-31.68	73.71E-03	54.20
3	P	0.75000	-35.49	47.54E-03	34.96
4	P	0.50000	-35.81	45.82E-03	33.69
5	P	1.50000	-47.35	12.13E-03	8.92

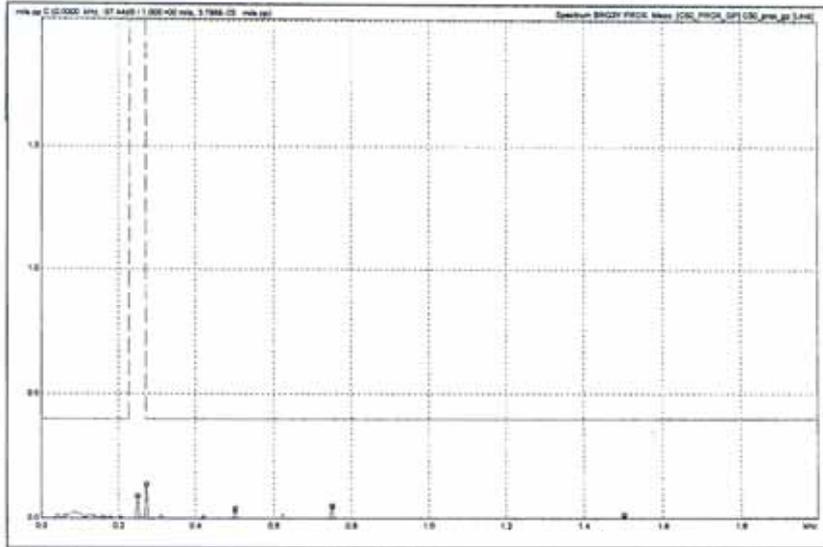
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

— : Spectrum BRG3Y PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -22.52 dB; 7.49E-02 mls  
 — — — : Meas. [C50\_PROX\_GP] C50\_prox\_gp [Limit]  
 [C:\MASKS\C50VC50\_PROX\_GP.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.83 dB; 4.92E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.27250	-26.35	136.1E-03	100.00
2	P	0.25000	-30.07	88.72E-03	65.19
3	P	0.75000	-35.08	49.83E-03	36.61
4	P	0.50000	-37.65	37.07E-03	27.24
5	P	1.50000	-47.61	11.78E-03	8.66

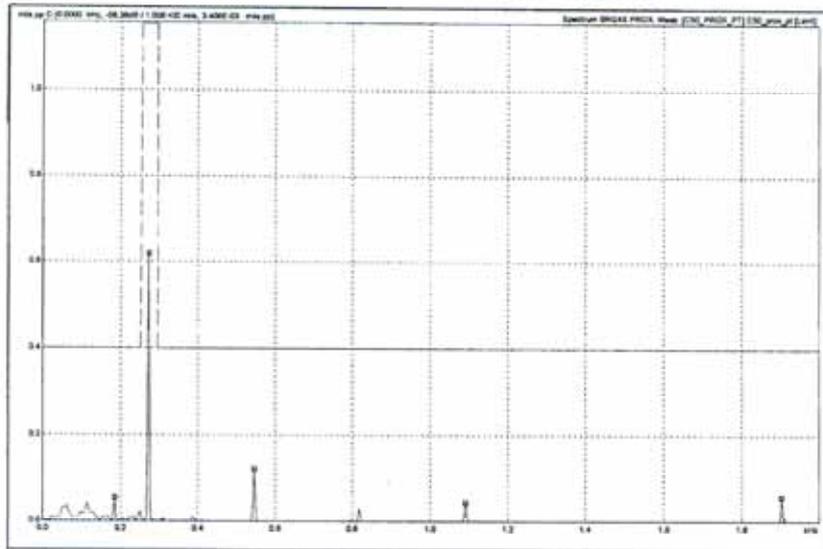
Created on 3/23/2005 6:14 PM

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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signal List:**

----- : Spectrum BRG4K PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -12.69 dB; 2.32E-01 mls  
 ----- : Meas [C50\_PROX\_PT] C50\_prox\_pt [Limit]  
 [C:\MASKS\C50\C50\_PROX\_PT\_AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 12.66 dB; 4.30E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.27250	-13.19	619.5E-03	100.00
2	P	0.54500	-27.39	120.8E-03	19.50
3	P	1.90250	-34.24	54.89E-03	8.86
4	P	0.18500	-34.39	53.95E-03	8.71
5	P	1.09000	-36.67	41.50E-03	6.70

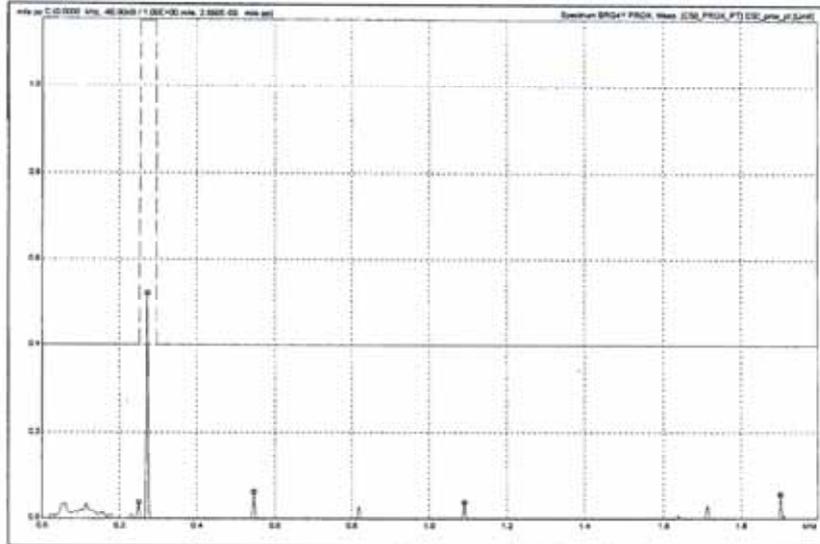
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRG4Y PRDX  
 Global Level : From 0.0025 kHz To 2 kHz: -14.23 dB; 1.94E-01 mls  
 ----- : Meas. [C50\_PRODX\_PT] C50\_prox\_pt [Limit]  
 [C:\MASKS\C50\C50\_PRODX\_PT.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 12.66 dB; 4.30E+00 mls  
 Comments :

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.27250	-14.70	520.6E-03	100.00
2	P	0.54500	-33.28	61.31E-03	11.78
3	P	1.90250	-34.13	55.59E-03	10.68
4	P	1.09000	-37.91	35.98E-03	6.91
5	P	0.25000	-37.95	35.81E-03	6.88

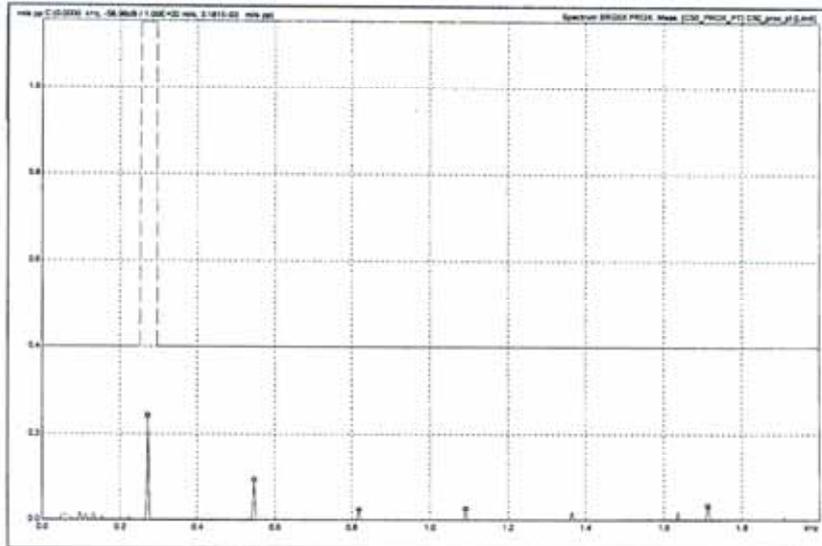
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRGSX PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -20.19 dB; 9.79E-02 mls  
 ----- : Meas. [C50\_PROX\_PT] C50\_prox\_pt [Limit]  
 [C:\MASKS\C50\C50\_PROX\_PT.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 12.66 dB; 4.30E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.27250	-21.29	243.8E-03	100.00
2	P	0.54500	-29.61	93.54E-03	38.37
3	P	1.71500	-38.58	33.31E-03	13.66
4	P	1.09000	-40.21	27.61E-03	11.32
5	P	0.81750	-40.96	25.32E-03	10.39

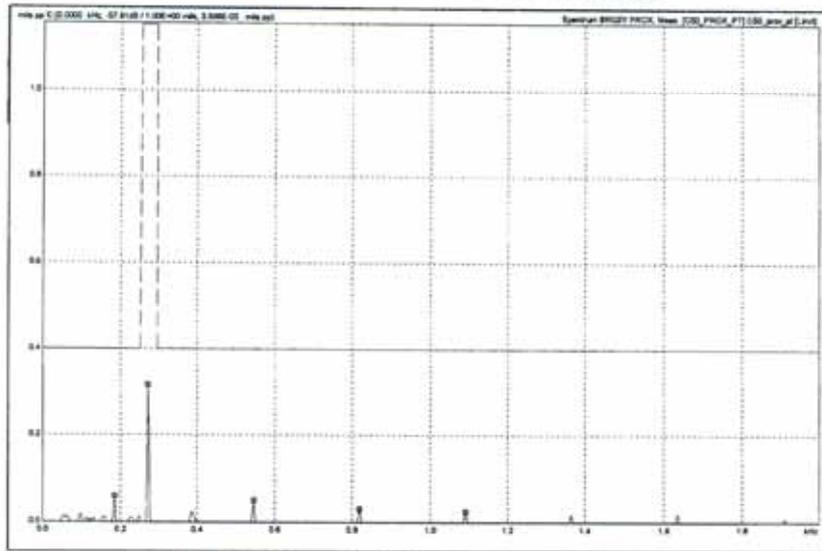
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum BRGSY PROX  
 Global Level : From 0.0025 kHz To 2 kHz: -18.46 dB; 1.19E-01 mls  
 --- : Meas. [C50\_PROX\_PT] C50\_prox\_pt [Limit]  
 [C:\MASKS\C50\C50\_PROX\_PT.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 12.66 dB; 4.30E+00 mls  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	mls pp	%
1	P	0.27250	-19.05	315.5E-03	100.00
2	P	0.18500	-33.78	57.88E-03	18.35
3	P	0.54500	-35.46	47.70E-03	15.12
4	P	0.81750	-39.18	31.08E-03	9.85
5	P	1.09000	-41.17	24.72E-03	7.84

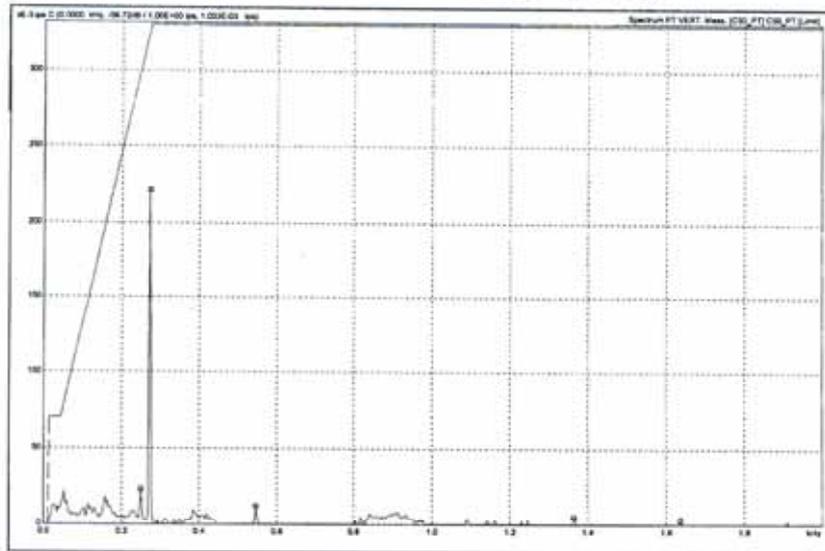
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



Signals List:

—: Spectrum PT VERT.  
 Global Level : From 0.0025 kHz To 2 kHz: -12.43 dB; 2.39E-01 ips  
 —: Meas [C50\_PT] C50\_PT [Limit]  
 [C:\MASKS\C50\C50\_PT.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 19.00 dB; 8.91E+00 ips  
 Comments :

Peak List :

Nb	Type	kHz	dB	ips	%
1	P	0.27250	-13.12	220.9E-03	100.00
2	P	0.25000	-32.84	22.81E-03	10.33
3	P	0.54500	-38.69	11.63E-03	5.26
4	P	1.36500	-46.44	4.766E-03	2.16
5	P	1.63750	-50.78	2.892E-03	1.31

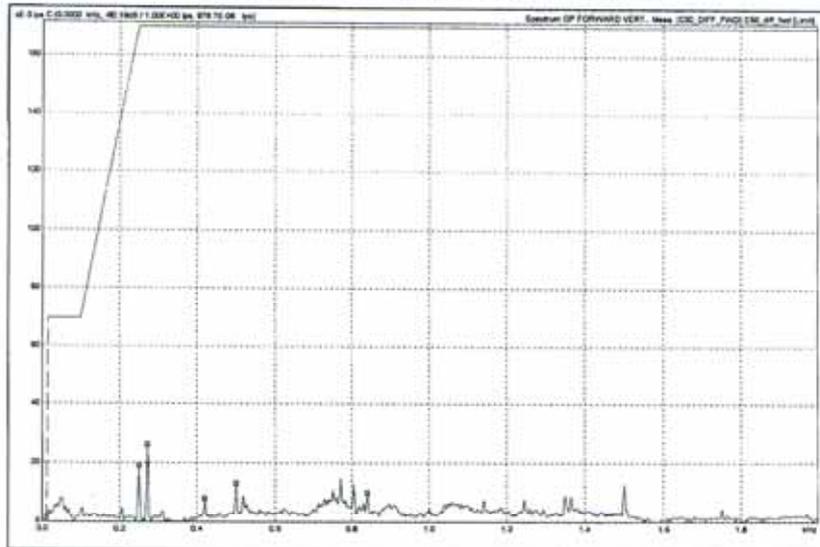
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

— : Spectrum GP FORWARD VERT.  
 Global Level : From 0.0025 kHz To 2 kHz: -21.58 dB; 8.34E-02 ips  
 - - - : Meas. [C50\_DIFF\_FWD] C50\_diff\_fwd [Limit]  
 [C:\MASKS\C50\C50\_DIFF\_FWD.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.29 dB; 4.62E+00 ips  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	ips	%
1	P	0.27250	-31.65	26.16E-03	100.00
2	P	0.25000	-34.35	19.17E-03	73.28
3	P	0.50000	-37.83	12.84E-03	49.08
4	P	0.84000	-40.32	9.641E-03	36.85
5	P	0.42000	-42.25	7.720E-03	29.51

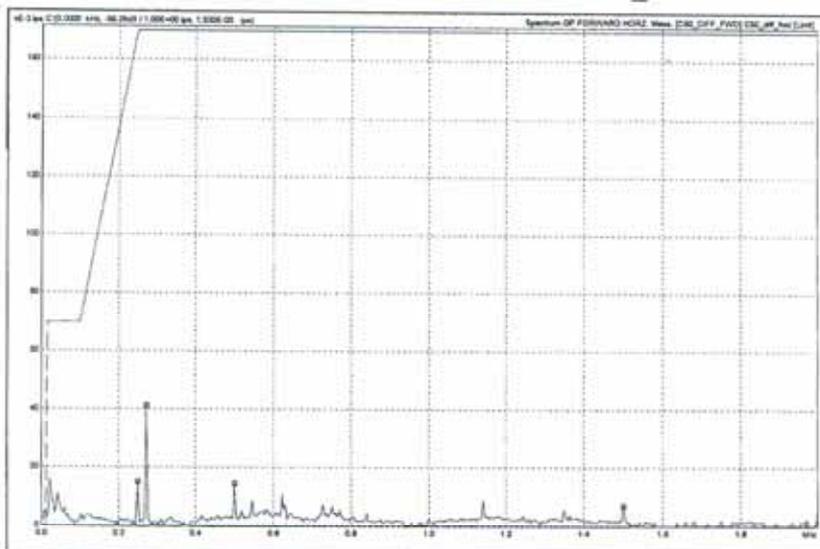
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum GP FORWARD HORIZ.  
 Global Level : From 0.0025 kHz To 2 kHz: -22.49 dB; 7.51E-02 ips  
 - - - - - : Meas. [C50\_DIFF\_FWD] C50\_diff\_fwd [Limit]  
 [C:\MASKS\C50\_DIFF\_FWD.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.29 dB; 4.62E+00 ips  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	ips	%
1	P	0.27250	-27.69	41.27E-03	100.00
2	P	0.25000	-36.49	14.98E-03	36.30
3	P	0.50000	-36.85	14.38E-03	34.84
4	P	1.50000	-43.50	6.685E-03	16.20

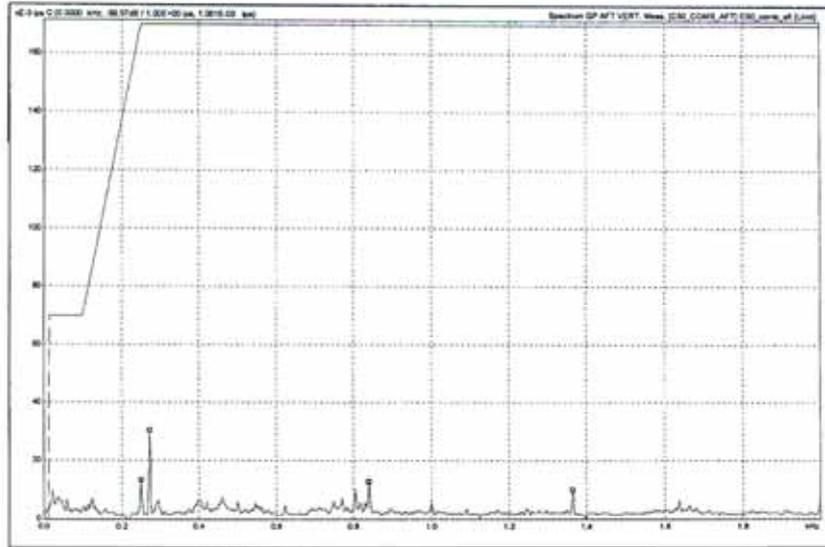
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



Signals List:

— : Spectrum GP AFT VERT.  
 Global Level : From 0.0025 kHz To 2 kHz: -22.64 dB; 7.38E-02 ips  
 — : Meas. [C50\_COMB\_AFT] C50\_comb\_eit [Lim]  
 [C:\MASKS\C50\C50\_CDMB\_AFT AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 13.29 dB; 4.62E+00 ips  
 Comments :

Peak List :

Nb	Type	kHz	dB	ips	%
1	P	0.27250	-30.32	30.49E-03	100.00
2	P	0.25000	-37.51	13.32E-03	43.69
3	P	0.84000	-37.87	12.78E-03	41.92
4	P	1.36500	-40.09	9.900E-03	32.47

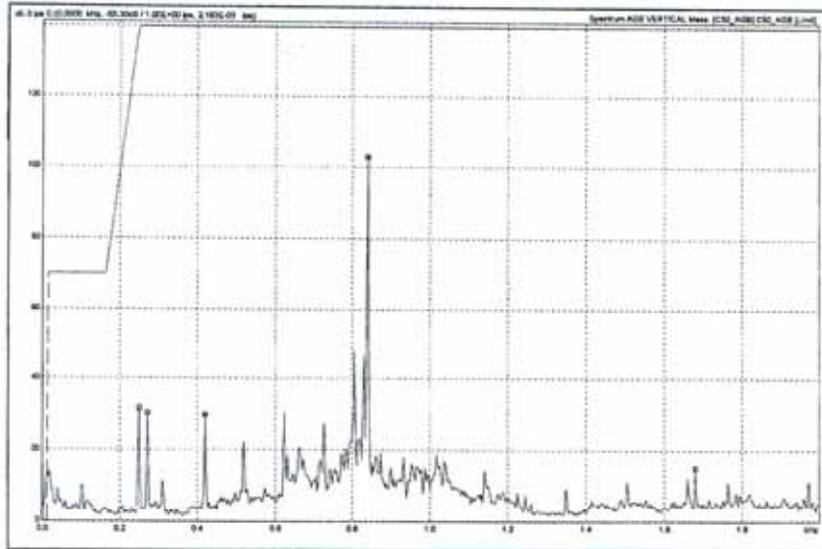
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# Solar Turbines

A Caterpillar Company

## GPSN 0505H PTSN TUG95-H3820\_2



**Signals List:**

----- : Spectrum AGB VERTICAL  
 Global Level : From 0.0025 kHz To 2 kHz: -12.47 dB; 2.38E-01 ips  
 ----- : Meas. [C50\_AGB] C50\_AGB [Link]  
 [C:\MASKS\C50\C50\_AGB.AE2]  
 Global Level : From 0.0025 kHz To 2 kHz: 11.59 dB; 3.80E+00 ips  
**Comments :**

**Peak List :**

Nb	Type	kHz	dB	ips	%
1	P	0.84000	-19.74	103.1E-03	100.00
2	P	0.25000	-29.99	31.67E-03	30.72
3	P	0.27250	-30.31	30.52E-03	29.60
4	P	0.42000	-30.49	29.90E-03	29.00
5	P	1.68000	-36.41	15.12E-03	14.67

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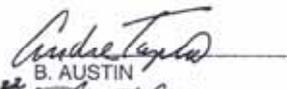
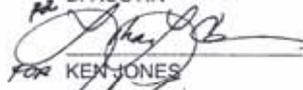
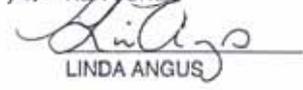
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## Two Shaft Gas Turbine Certified Test Report

Date of Test : 23-Mar-05  
Equipment Tested : CENTAUR 50  
Model Type : 5702

	<u>Gas Producer</u>	<u>Power Turbine</u>
Serial Number :	0505H	TUG95-H3820
Part Number :	EH5702-59-G	E136520-1105-80
Purpose of Test :	OVERHAUL	OVERHAUL
Test Specification :	ES1843	ES1843

### Approvals

Test Technician :	 B. AUSTIN	03/23/05 Date
Test Engineer :	 FOR KEN JONES	March 24, 2005 Date
Product Engineer :	 LINDA ANGUS	3/24/05 Date

附錄二、測試方法依據

**Solar Turbines**  
A Caterpillar Company

Solar Turbines Incorporated

215 Centre Park Blvd.  
Desoto, TX 75115  
(972) 228-5500  
Fax: (972) 228-6180

**CERTIFICATE OF CALIBRATION  
FOR  
Test Cell 4**

Systems Calibrated:

RTD  
THERMOCOUPLE  
LOW PRESSURE  
HIGH PRESSURE  
VIBRATION  
LOADCELL  
FLOWMETER  
SPEED PICKUP  
KISTLER

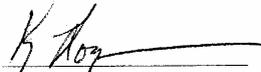
CALIBRATION DATE: February-2005

RECAL DATE: 31-May-2005

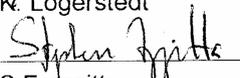
We hereby certify the above mentioned items have been calibrated using standards traceable to. The NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) of the United States of America.

This calibration is :  As Found  As Left

Calibration preformed by:

  
K. Logerstedt

Test Engineer:

  
S. Frazzitta

**Table 6. Performance, and Emissions Test Sequence<sup>(1)</sup>**

Run Number	Purpose of Run	Load	Reference Notes
1	Idle, No Load	0	2
2	Corrected Performance	At Maximum Corrected TRIT	2, 3, 4, 5
3	Mechanical Full Load Performance, and Emissions	100%	5, 6, 7
4	Emissions	80%	7, 8

**NOTES:**

- (1) The engine shall demonstrate performance in accordance with Section 4.3.2. Performance evaluation will be based on the CS or PT tables specified in Table 1 for the appropriate match temperature and fuel. Dual fuel units will have their speed and temperature matched on gas fuel. The liquid fuel criteria applies only to dual fuel machines with the match set on gas fuel. Special instructions are required for liquid fuel only.
- (2) Record performance data (corrected to 59°F, 60% relative humidity, sea level, and zero inlet and exhaust duct losses) and all operating parameters measured by instrumentation listed in Table 2. Do not record emissions data.
- (3) Engine trimming (guide vane adjustment) is based on corrected TRIT and NP using gas fuel. See the Engine Build Instruction for initial variable vane settings. Use the actuator lever turnbuckle to adjust the IGV open setting within the open limits shown in Table 1. Each time the open setting is changed, readjust the stop nut on the actuator rod to set the closed position on the first stage vane ring graphic plate to "C" (-29). Note: The -35, and -24 marks (or "C" marks) on the IGV and second stage rings respectively are incidental to this rigging and may be misaligned by up to 1/4 of an inch. The variable vane system will operate between the established full open and full closed mechanical stops when controlled by the servo. The servo actuator linkage must be rigged beyond these limits to assure full travel. IGV angle reporting shall be in accordance with Section 5.1.1.

Handwritten notes and circled numbers:

- 220
- 590
- 80°
- 29
- 67
- TS SP: 12
- 119
- 121
- 110
- 12

Table 6. Performance, and Emissions Test Sequence (continued)

**NOTES (continued)**

- (4) At inlet temperatures (cool days) which permit operation at actual TRIT below 1985°F: set corrected NGP per Table 1 and adjust inlet guide vanes to bring corrected TRIT as close to 1885°F as practical within the limits shown in Table 1.

At inlet temperatures (warm days) which do not allow 1885°F corrected TRIT at 100% corrected NGP, set maximum allowable corrected NGP (maximum NGP is 102% actual), and set NPT to the appropriate speed per the CS or PT table. Adjust the inlet guide vanes to get TRIT within the range of the corrected performance CS or PT table.

With the engine thermally stabilized, record performance data per note 2 and all operating parameters measured by instrumentation listed in Table 2. Guide vanes shall be open against their mechanical stops and bleed valve full closed for performance tests. Do not record emissions data. T5/TRIT compensator selection (for engines with compensating resistors) and Base T5 are determined from this point. (The ratio of T5/TRIT is for compensation selection only, see Table 9). Record "Base T5" and the T5/TRIT compensator part number (to be stamped on the engine name plate in accordance with Section 5.1.1.).

- (5) Thermally Stabilized - If the engine is cool or cold (engine has not run in the last 3 hours), run 1 hour continuous with the last 45 minutes at specified TRIT and speeds per CS or PT table. If the engine is warm (been running 1 hour of last 3-hour clock time), run a minimum of 20 minutes at specified TRIT and speeds per CS or PT table. Oil supply temperature must be at 110°F to 155°F (C32 oil only) for a minimum of 20 minutes prior to taking data.

- (6) Mechanical full load is when the engine is operating at Base T5 determined in Run 2. With the engine thermally stabilized, and the NPT set to the appropriate speed per the PT table record performance data (based on the inlet temperature (T1), corrected to 60% relative humidity, sea level, and zero inlet and exhaust duct losses), emissions data and all operating parameters measured by instrumentation listed in Table 2.

The actual load obtained in Run 3 establishes the 100% load point for emissions. Partial loads are determined as a fraction of this load.

- (7) Run 4 is strictly an emissions run and should not be taken if the ACS does not require an 80% emissions point.

- (8) With the engine thermally stabilized with 80% of the load determined in Run 3, record mechanical performance and emissions data (if required by engine ACS). Data is required on both fuels for dual fuel units.



39.0	136130-600	0.00	68.00 ASSEMBLE	T5700 COMP/STATOR CASE ASSY.	\$10,995.60	\$0.00
40.0	127370-400	36.00	0.00 REWORK	AF-CE VANE IGV COATED	\$0.00	\$0.00
41.0	U127370-400	-36.00	0.00 REWORK	AF-CE VANE IGV COATED,CORE	\$0.00	\$0.00
42.0	136969-100	1.00	0.00 RUB DAMAGE	RING,INNER,STATOR,VARIABLE	\$5,749.47	\$0.00
43.0	127370-501	36.00	0.00 REWORK	AF-STG.1 GUIDE VANE (COATED)	\$0.00	\$0.00
44.0	U127370-501	-36.00	0.00 REWORK	AF-STG.1 GUIDE VANE (CTD),CORE	\$0.00	\$0.00
45.0	136078-101	1.00	0.00 RUB DAMAGE	INNER RING	\$7,938.69	\$0.00
46.0	197052-3	36.00	0.00 REWORK	VANE, STATOR STG. 2 COATED	\$11,424.67	\$0.00
47.0	U197052-3	-36.00	0.00 REWORK	Vane 2nd Stage,CORE	\$0.00	(\$9,984.60)
48.0	136079-101	1.00	0.00 WORN	INNER RING	\$8,848.27	\$0.00
49.0	136103-302	2.00	0.00 CLEAN AND INSPECT	STG. 3 CTD STATOR ASSY.	\$6,741.61	\$0.00
50.0	136104-302	2.00	0.00 CLEAN AND INSPECT	STG. 4 CTD STATOR ASSY.	\$6,741.61	\$0.00
51.0	136105-302	2.00	0.00 CLEAN AND INSPECT	STG. 5 CTD STATOR ASSY.	\$6,985.00	\$0.00
52.0	136106-302	2.00	0.00 CLEAN AND INSPECT	STG. 6 CTD STATOR ASSY.	\$6,985.00	\$0.00
53.0	136107-302	2.00	0.00 CLEAN AND INSPECT	STG. 7 CTD STATOR ASSY.	\$6,985.00	\$0.00
54.0	136108-302	2.00	0.00 CLEAN AND INSPECT	CF-S STG. 8 CTD STATOR ASSY.	\$6,741.61	\$0.00
55.0	136109-302	2.00	0.00 CLEAN AND INSPECT	STG. 9 CTD STATOR ASSY.	\$6,741.61	\$0.00
56.0	136110-302	2.00	0.00 CLEAN AND INSPECT	STG. 10 CTD STATOR ASSY.	\$6,741.61	\$0.00
57.0	136111-302	2.00	0.00 CLEAN AND INSPECT	STG. 11 CTD STATOR ASSY.	\$8,160.85	\$0.00
58.0	136053-1	108.00	0.00 REWORK	CA-ARM,ACTUATING VANE	\$957.10	\$0.00
59.0	U136053-1	-108.00	0.00 REWORK	CA-ARM,ACTUATING VANE, CORE	\$0.00	\$0.00
60.0	136126-302	0.00	15.00 RUB DAMAGE	LABOR	\$2,425.50	\$0.00
61.0	136968-407	1.00	0.00 REQUIRED	RC-ROTOR ASSY, CPRSR (H), MISC.	\$0.00	\$0.00
62.0	136968-207	0.00	30.00 REBLADE	RC-ROTOR ASSY, CPRSR (H)	\$4,851.00	\$0.00
63.0	191147-1	0.00	15.00 GRIND	CONE,ROTOR COMPRESSOR	\$2,425.50	\$0.00
64.0	128002-1	1.00	0.00 WORN	5" LABYRINTH SLEEVE	\$542.29	\$0.00
65.0	128003-1	1.00	0.00 WORN	LABYRINTH SLEEVE	\$2,229.41	\$0.00
66.0	136839-102	0.00	6.00 CLEAN	RC-DISK ASSY, CPRSR, STG. 1	\$970.20	\$0.00
67.0	117993-200	0.00	6.00 CLEAN AND INSPECT	DISC ASSY, CPRSR, STG. 2	\$970.20	\$0.00
68.0	117994-200	0.00	8.00 REBLADE	RC-DISC ASSY, CPRSR, STG. 3	\$1,293.60	\$0.00
69.0	134592-7	38.00	0.00 FOREIGN OBJECT DAMAGE	3RD STG COMP. BLADE	\$14,176.87	\$0.00
70.0	136064-200	0.00	8.00 REBLADE	RC-DISC ASSY, CPRSR, STG. 4	\$1,293.60	\$0.00
71.0	907876C6	60.00	0.00 FOREIGN OBJECT DAMAGE	RC-STG 4 BLADE	\$11,091.15	\$0.00
72.0	907878C2	1.00	0.00 RUB DAMAGE	TT-SPACER #4, ROTOR CPRSR.	\$1,515.35	\$0.00
73.0	136065-200	0.00	8.00 REBLADE	RC-DISC ASSY, CPRSR, STG. 5	\$1,293.60	\$0.00
74.0	907876D6A	63.00	0.00 FOREIGN OBJECT DAMAGE	RC-STG 5 BLADE	\$11,645.71	\$0.00
75.0	951252C1	1.00	0.00 FOREIGN OBJECT DAMAGE	SPACER,COMPRESSOR,COATED	\$1,791.46	\$0.00
76.0	136066-300	0.00	8.00 REBLADE	RC-DISC ASSY, CPRSR, STG. 6	\$1,293.60	\$0.00
77.0	907880C2	1.00	0.00 FOREIGN OBJECT DAMAGE	TT-SPACER #6, ROTOR CPRSR.	\$567.95	\$0.00
78.0	136067-300	1.00	0.00 FOREIGN OBJECT DAMAGE	RC-DISC ASSY, CPRSR, STG. 7	\$30,420.47	\$0.00
79.0	136068-301	1.00	0.00 FOREIGN OBJECT DAMAGE	RC-DISC ASSY, CPRSR, STG. 8	\$23,264.10	\$0.00
80.0	136069-301	1.00	0.00 FOREIGN OBJECT DAMAGE	RC-DISC ASSY, CPRSR, STG. 9	\$19,283.07	\$0.00
81.0	136070-401	1.00	0.00 REBLADE	RC-DISC ASSY, CPRSR, STG.10	\$17,914.60	\$0.00
82.0	194062-203	1.00	0.00 FOREIGN OBJECT DAMAGE	RC-HUB ASSY-AFT, CPRSR.	\$28,613.59	\$0.00
83.0	180054-1	1.00	0.00 WORN	RC-SEAL, LABYRINTH	\$4,725.81	\$0.00
84.0	909067C2	0.00	2.00 CLEAN AND INSPECT	RC-BOLT,CENTER-CPRSR	\$323.40	\$0.00
85.0	909052C1	0.00	1.00 CLEAN	RC-NUT-CENTER BOLT	\$161.70	\$0.00

86.0	907776C2	0.00	2.00	CLEAN AND INSPECT	RC-STUD,CENTER CPRSR TO TURBIN	\$323.40	\$0.00
87.0	909055C1	0.00	1.00	REQUIRED	RC-NUT,CTR.STUD (.875-14 4SLT)	\$161.70	\$0.00
88.0	194018-1	1.00	0.00	WORN	COLLAR,THRUST	\$2,621.71	\$0.00
89.0	180008-900	1.00	0.00	REWORK	DIFF ASSY. PP,RTD'S,AXIALS.	\$127,333.37	\$0.00
90.0	U180008-900	-1.00	0.00	REWORK	DIFF ASSY. PP,RTD'S,AXIALS,CORE	\$0.00	\$0.00
91.0	192864-1	1.00	0.00	GROOVE CUT	TJ-RING SEAL	\$779.05	\$0.00
92.0	194087-300	0.00	2.00	CLEAN AND INSPECT	HOUSING,#3 BEARING ASSY	\$323.40	\$0.00
93.0	192863-101	0.00	3.00	REWORK	#2 TILT PAD BRG ASSY.	\$485.10	\$0.00
94.0	180502-100	0.00	1.00	REBUILD, TEST	BEARING,THRUST,TILTPAD,TURBINE	\$161.70	\$0.00
95.0	180319-1	1.00	0.00	REQUIRED	EB-AFT THRUST WASHER.	\$1,485.13	\$0.00
96.0	136165-3	1.00	0.00	REWORK	PV-BRACKET MTG.PROX PROBE	\$199.95	\$0.00
97.0	U136165-3	-1.00	0.00	REWORK	BRACKET,PROXIMITY PROBE,CORE	\$0.00	(\$158.19)
98.0	136201-2	1.00	0.00	REWORK	END CAP,#3 BEARING	\$2,279.91	\$0.00
99.0	U136201-2	-1.00	0.00	REWORK	CAP,BEARING,CORE	\$0.00	(\$1,469.47)
100.0	192053-101	0.00	1.00	CLEAN AND FLUSH	TUBE,OIL TRANSFER	\$161.70	\$0.00
101.0	136176-103	0.00	1.00	CLEAN AND FLUSH	TUBE,OIL SUPPLY,ASSY	\$161.70	\$0.00
102.0	136199-102	0.00	2.00	CLEAN,FLUSH,PAINT	RING,OIL COOLING ANNULUS	\$323.40	\$0.00
103.0	136191-1	0.00	2.00	CLEAN,FLUSH,PAINT	ADAPTER,ENGINE DRAIN	\$323.40	\$0.00
104.0	192483-101	0.00	3.00	REBUILD, TEST	#3 TILT PAD BRG ASSY.	\$485.10	\$0.00
105.0	192246-2	5.00	0.00	WORN	BRG PAD STD.	\$2,036.63	\$0.00
106.0	131738-1	0.00	2.00	CLEAN & PAINT	ADAPTER,INSTRUMENTATION	\$323.40	\$0.00
107.0	129838-1	1.00	0.00	CLEAN AND INSPECT	ADAPTER,INSTRUMENTATION	\$283.74	\$0.00
108.0	136183-8	0.00	1.00	CLEAN AND INSPECT	EB-RING BRG. CLAMP & OIL XFR	\$161.70	\$0.00
109.0	136230-206	1.00	0.00	REWORK	EB-COMB ASSY H	\$140,413.71	\$0.00
110.0	U136230-206	-1.00	0.00	REWORK	COMBUSTOR,CORE	\$0.00	(\$112,537.80)
111.0	136269-102	1.00	0.00	REWORK	TJ-MANIFOLD GAS	\$2,938.11	\$0.00
112.0	U136269-102	-1.00	0.00	REWORK	MANIFOLD,FUEL,GAS,CORE	\$0.00	(\$1,955.69)
113.0	136231-300	0.00	3.00	CLEAN & PAINT	HOUSING,COMBUSTOR	\$485.10	\$0.00
114.0	196614-200	1.00	0.00	REWORK	COMBUSTOR LINER ASSY	\$0.00	\$0.00
115.0	U196614-200	-1.00	0.00	REWORK	LINER,COMBUSTOR,CORE	\$0.00	(\$87,489.14)
116.0	136234-200	1.00	0.00	REQUIRED	INSULATION BLANKET COMB	\$428.07	\$0.00
117.0	136263-103	12.00	0.00	REWORK	CS-E INJ.ASSY-GAS H ENG	\$21,027.89	\$0.00
118.0	U136263-103	-12.00	0.00	REWORK	INJECTOR,FUEL,CORE	\$0.00	(\$16,099.08)
119.0	136235-1	0.00	3.00	CLEAN AND INSPECT	PIN,SUPPORT,COMBUSTOR	\$485.10	\$0.00
120.0	25470R1	7.00	0.00	WORN	PLUG,HEXHD,0.75TUBE,CRES316	\$118.85	\$0.00
121.0	136383-301	0.00	4.00	CLEAN AND INSPECT	HSG ASSY. NOZZLE SUPPORT	\$646.80	\$0.00
122.0	136244-100	0.00	1.00	CLEAN AND INSPECT	PLUG,BORESCOPE	\$161.70	\$0.00
123.0	136408-100	0.00	3.00	REWORK	HM-PLATE,LOCK'G 1STG DIAPHRAGM	\$485.10	\$0.00
124.0	907818C3	1.00	0.00	WORN	HV-SEAL ASSY	\$986.97	\$0.00
125.0	197101-300	1.00	0.00	REWORK	AF-1ST STAGE NOZZLE ASSEMBLY	\$256,407.52	\$0.00
126.0	U197101-300	-1.00	0.00	REWORK	NOZZLE,TURBINE,CORE	\$0.00	(\$107,608.39)
127.0	192874-103	1.00	0.00	REWORK	1ST STG NOZZLE ASSEMBLY	\$87,149.33	\$0.00
128.0	U192874-103	-1.00	0.00	REWORK	NOZZLE,TURBINE,CORE	\$0.00	(\$55,170.17)
129.0	136385-100	1.00	0.00	REWORK	DIAPHRAGM,NOZZLE,TURBINE,STG 1	\$10,100.22	\$0.00
130.0	U136385-100	-1.00	0.00	REWORK	DIAPHRAGM,NOZZLE,TURBINE,CORE	\$0.00	(\$8,334.60)
131.0	136406-4	1.00	0.00	REWORK	HV-FLEX,1ST STG DIAPHRAM	\$3,260.78	\$0.00
132.0	U136406-4	-1.00	0.00	REWORK	RING,FLEX,CORE	\$0.00	(\$2,459.50)

133.0	173027-100	1.00	0.00 REWORK	PRESWIRLER ASSEMBLY	\$7,925.90	\$0.00
134.0	U173027-100	-1.00	0.00 REWORK	PRESWIRLER,DIAPHRAGM,CORE	\$0.00	(\$7,466.11)
135.0	136388-1	1.00	0.00 DISTORTED	SEAL,NOZZLE,INNER,STG 1	\$1,226.49	\$0.00
136.0	197141-1	1.00	0.00 DISTORTED	RING,PISTON	\$690.50	\$0.00
137.0	136389-1	0.00	2.00 CLEAN AND INSPECT	SHROUD,COOLING,NOZZLE,STG 1,IN	\$323.40	\$0.00
138.0	136388-1	0.00	2.00 CLEAN AND INSPECT	RING,CLAMP,NOZZLE,TURBINE,STG	\$323.40	\$0.00
139.0	136391-1	0.00	3.00 CLEAN AND INSPECT	SEAL,NOZZLE,INNER,STG 1	\$485.10	\$0.00
140.0	136410-100	0.00	16.00 MODIFY	EB-TURB NOZ ASSY STG 2	\$2,587.20	\$0.00
141.0	136420-100	0.00	6.00 MODIFY	DIAPHRAGM,STG 2-MACHINED	\$970.20	\$0.00
142.0	907818C3	1.00	0.00 WORN	HV-SEAL ASSY	\$986.97	\$0.00
143.0	194025-300	0.00	12.00 CLEAN AND INSPECT	AF-3RD STG. TURB-NOZZLE ASSY.	\$1,940.40	\$0.00
144.0	136444-2	0.00	3.00 CLEAN AND INSPECT	HV-DIAPHRAGM,STG 3-MACH12 SHAF	\$485.10	\$0.00
145.0	136443-1	1.00	0.00 WORN	DIAPHRAGM,CENTER,NOZZLE,TURBIN	\$281.75	\$0.00
146.0	136330-1402	0.00	12.00 ASSEMBLE AND BALANCE	RT-TURB ROTOR ASSY S/S CENT "H	\$1,940.40	\$0.00
147.0	907905C2	0.00	7.00 GRIND	RT-G/P SHAFT,CENTAUR	\$1,131.90	\$0.00
148.0	121444-1	1.00	0.00 WORN	SLEEVE, LAB.-REPAIR 907905C2	\$753.25	\$0.00
149.0	136380-3	0.00	2.00 CLEAN AND INSPECT	RT-BOLT,CENTER,G/P-"H" (REWORK	\$323.40	\$0.00
150.0	907911C2	1.00	0.00 DISTORTED	RT-SHIELD,G/P SHAFT	\$214.36	\$0.00
151.0	136331-1402	0.00	17.00 REBLADE	RT-DISK ASSY,GP,STG 1	\$2,748.90	\$0.00
152.0	196521-1	0.00	2.00 CLEAN AND INSPECT	RT-DISK, GP TURB. 1ST STG.	\$323.40	\$0.00
153.0	136808-204	62.00	0.00 WORN	RT-BLADE STG 1 TURBINE	\$133,506.43	\$0.00
154.0	136361-401	0.00	10.00 DEBLADE	RT-TURB DISC ASSY STG 2 2S	\$1,617.00	\$0.00
155.0	196562-1	0.00	2.00 CLEAN AND INSPECT	RT-DISK, TURBINE STG 2 (2S)(GP	\$323.40	\$0.00
156.0	136341-3	0.00	6.00 CLEAN AND INSPECT	RT-BLADE STG 2 TURB. COATED	\$970.20	\$0.00
157.0	EH5501-59-G	0.00	79.65 SERMATEL COAT	GAS PRODUCER	\$12,879.41	\$0.00
158.0	136575-102	0.00	4.00 CLEAN AND INSPECT	TORCH IGNITOR ASSY., GAS	\$646.80	\$0.00
159.0	124894-100	0.00	1.00 CLEAN AND INSPECT	TORCH TUBE ASSEMBLY	\$161.70	\$0.00
160.0	903316C1	1.00	0.00 WORN	CS-SPARK PLUG	\$17.15	\$0.00
161.0	136579-1	1.00	0.00 WORN	ORIFICE,FUEL,TORCH,GAS	\$9.65	\$0.00
162.0	136288-100	12.00	0.00 REWORK	TUBE ASSY.AIR.	\$0.00	\$730.30
163.0	U136288-100	-12.00	0.00 REWORK	LINE,AIR,CORE	\$0.00	\$0.00
					\$1,174,612.44	(\$408,669.90)

LINE NO.	DESCRIPTION	TOTAL
1)	REPLACEMENT PARTS:	\$1,174,612.44
2)	REWORK CORE CREDIT:	(\$408,669.90)
3)	OVERHAUL FEE:	\$83,589.00
SUBTOTAL:		\$849,531.54

MAXIMUM DISPO PRICE:	\$800,917.00
CPC Discount (5%):	(\$40,045.85)

**FINAL DISCOUNTED PRICE: \$760,871.15**

4)	FIELD SERVICE (Inst. & Comm.):	\$27,254.00
5)	FREIGHT (CIP Desoto to Kaoshiung):	\$13,230.00