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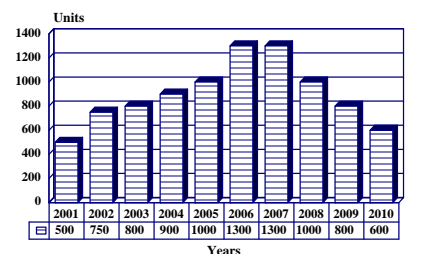
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Honeywell Microturbines – Archived 6/2002

Outlook

- Deregulation of the worldwide power utility market has opened wide-ranging opportunities for small power generation machines
- Honeywell already producing the Parallon 75 in large quantities
- Competing technologies, particularly fuel cells, should erode market for microturbines in the long term

10 Year Unit Production Forecast
2001 - 2010



Orientation

Description. The Parallon 75 TurboGenerator Power System is a small microturbine-based turbogenerator power system developing about 75 kW. In this report, the name “Parallon 75” refers to the “Parallon 75 TurboGenerator Power System.”

Sponsor. The Parallon 75 was privately developed by the prime manufacturer.

Contractors/Manufacturers. The prime manufacturer is Honeywell Power Systems Inc, Albuquerque, New Mexico, USA. This business entity was formerly known as AlliedSignal Power Systems Incorporated. In this report, the name “Honeywell” refers solely to Honeywell Power Systems Inc.

The machine is produced at Honeywell’s facility in Albuquerque, New Mexico, USA.

Associates/Licensees/Packagers. Recent and current major firms allied with Honeywell on the Parallon 75 program include the following:

Manufacturing Partners/Suppliers

- Hitachi Ltd, Tokyo, Japan.
- Ishikawajima-Harima Heavy Industries Co Ltd, Tokyo, Japan.

Major Distributors

- Amandla-Honeywell Power Systems, Midrand, Gauteng, South Africa.
- Electricité de France (EdF), Paris France.
- New Energy Ventures, Los Angeles, California, USA.
- Tokyo Boeki Ltd, Tokyo, Japan.

Power Class. The current power output of the Parallon 75 is 75 kW (see **Performance** subsection of the **Technical Data** section below for output performance parameters). Under a contract from the US Department of Energy awarded in July 2000, the power output will grow to 350 kW.

Status. The Parallon 75 is in series production.

Total Produced. As of 2001, an estimated 550 Parallon 75 systems had been built and shipped.

Application. Electrical power generation, most notably for distributed generation.

Price Range. Estimated in 2001 US dollars at \$45,000-\$55,000, or \$550-650 per kW for early-production units. The price is expected to drop as high-production volume is attained.

Competition. At about 75 kW, competition to the Parallon 75 comes from other microturbines such as the Turbec AB T100 CHP system.

Technical Data

General. The turbine, compressor and permanent magnet generator are located on a single shaft (the only moving part in the core). Compliant air-foil bearings support the shaft on a thin film of air. Shaft speed is about 85,000 rpm. An inverter reduces the generator frequency of about 1,200 Hz to either 50 Hz or 60 Hz.

Design Features. The Parallon 75 has the following design features:

Intake. Radial air intake.

Compressor. Single-stage radial compressor. Compression ratio is about 3.8:1.

Dimensions. The approximate dimensions and weights of the Parallon 75 are as follows (weight does not include optional gas compressor, transformer and battery):

	<u>Metric Units</u>	<u>English Units</u>
Length	2,334 mm	92 inches
Width	1,219 mm	48 inches
Height	2,163 mm	85 inches ⁴
Weight	1,295 kg	2,850 pounds

Performance. The approximate output performance parameters of the Parallon 75 for electrical generation are as follows (at ISO conditions). For cogeneration, an optional package can produce approximately 90 kW thermal (307,170 Btu/hr) of hot water.

Application =

Elec Generation	<u>Metric Units</u>	<u>English Units</u>
Maximum Power Output	75 kW	100 shp
Mass Flow	0.69 kg/sec	91.2 lb/min
Fuel Consumption	9.5 Therms/hr	950,000 Btu/hr
Fuel Pressure	5.17-5.86 bar(g)	75-85 psig
Fuel Flow, Natural Gas	26.6 cu. m/hr	940 cu ft /hr
Fuel Flow, Diesel Fuel	28.7 liters/hr	7.6 US gal/hr
EGT	243°C	470°F
Noise Level	65 dBa @ 10 meters	65 dBa @ 32.8 feet

Variants/Upgrades

As of 2001, no variants, upgrades, or models of the Parallon 75 were known or were reported to be in development. It should be noted, however, that the 75 kW units can be bunched for a total output of up to 600 kW.

Honeywell's next-generation Parallon unit will generate approximately 350 kW.

Program Review

Background. The Parallon 75 (also referred to as the TurboGenerator™) is a microturbine-equipped system intended for on-site power generation. The unit is self-contained, and is completely automatic and operates unattended. The entire system is designed with

“plug and play” technology. The unit is low cost, fuel efficient, low in emissions, and almost maintenance free. By virtue of the gas turbine design, rotating parts are kept to a minimum as opposed to standard reciprocating engines. In addition, it does not require a

gear box. The complete unit weighs approximately one-third that of a comparably rated diesel genset, and is considerably quieter in operation.

The system can burn natural gas, diesel and kerosene fuels, and has already run on underground landfill gas.

The Parallon 75 has an availability/uptime exceeding 95 percent, and it is Honeywell's goal to raise that figure to 98 percent.

In terms of applications, the turbogenerator power system is a compact power source designed to be used for distributed generation, peak shaving, standby power, off-grid power generation, portable power, cogeneration, and uninterruptible power supply (UPS).

Allied Firms. The following firms have been working with Honeywell on the Parallon 75 systems:

IHI and Hitachi. In July 2000, Honeywell announced that it had formed alliances with IHI and Hitachi to support Honeywell's turbogenerator business in Japan and around the world. The two companies would

develop cobranded cogeneration products for use with the Parallon turbogenerator systems. Those products would include hot water heaters, boilers, absorption chillers and steam boilers, and will address the Combined Heat, Power, and Chilling markets in Japan and around the world.

The two firms are also expected to work with Honeywell to codevelop improvements to the Parallon turbogenerator product line. The recuperated models are expected to be the choice for baseload applications.

Distributors. Honeywell identifies the distributors on the Parallon 75 as follows (firms are headquartered in the USA unless otherwise noted): PSEG Energy Technologies, Unicom Distributed Energy, Mercury Electric Corp (in Canada), EdF (in France), Thermax Ltd (in India), Tokyo Boeki (in Japan), NewEnergy, Transcontinental, and Amandla Energy Ventures (in South Africa).

Funding

No US government funding specifically pertaining to the Honeywell Parallon 75 has been identified.

Recent Contracts

No major identifiable US government military contracts specifically pertaining to the Honeywell Parallon 75 gas turbine machine have been awarded or received in the recent past. However, in July 2000, the US Energy Department (DoE) awarded Honeywell Power Systems nearly \$10 million for R&D work oriented to a large-scale advanced microturbine for on-site power generation.

Recent Sales Activity

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Tokyo Boeki	N/A	Jul 2000 – 100 Parallon 75 machines for delivery in 2000.

Timetable

Among the major events in the Honeywell Parallon 75 system are the following:

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jun	1997	AlliedSignal forms Power Systems Business
May	1998	AlliedSignal Power Systems announces intent to move turbocharger business to Albuquerque, New Mexico
Late	1998	AlliedSignal completes factory test program
Mar	1999	Tokyo Boeki named as exclusive distributor in Japan
		AlliedSignal and EdF enter agreement for distribution in Europe/North Africa
Late	1999	Commercial availability of Parallon 75 systems announced
Dec	1999	AlliedSignal and Honeywell merge; AlliedSignal adopts the Honeywell name
May	2000	Parallon 75 system connected with utility grid in South Africa
Jun	2000	Honeywell announces delivery of 40 Parallon 75 systems to Mercury Electric Corp
Jul	2000	Tokyo Boeki orders 100 Parallon 75 systems

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
		IHI and Hitachi intent to ally with Honeywell Power announced
Oct	2000	Honeywell receives US DoE contract for next-generation Parallon unit
		General Electric agrees to buy Honeywell for \$45 billion
		Honeywell begins work on 350 kW next-generation Parallon unit
Thru	2010	Continued production of Parallon 75 systems

Worldwide Distribution

As of 2001, an estimated 550 Parallon 75 systems machines had been fabricated and delivered. The units are known to be operational in **Canada, Japan, South Africa**, and the **US**.

Forecast Rationale

The Honeywell Power Systems Parallon 75 is a refinement and further development of earlier work done by AlliedSignal not only in small aviation and industrial gas turbine engines but also in turbochargers.

The Parallon 75 is considerably more versatile than conventional generators because it can generate electricity with liquid or gaseous fuels, including alternative fuels such as flare gas and landfill gas. The 75 kW system was designed to help small-to-mid-sized facilities reduce their energy bills, improve power quality, minimize the risk of power outages, and circumvent unreliable utility power generation.

Honeywell's next move is the 350 kW Parallon unit, being partially funded by the US Department of Energy. That machine is being designed to bring highly reliable, energy-efficient, low-cost power to large-scale commercial and industrial customers. Both the 75 kW and 350 kW should benefit from Honeywell Power Systems' long-standing leadership and prominence in high-performance small gas turbines and turbochargers, as well as the overall reputation and large installed base

of Honeywell (here referring to the former AlliedSignal) aero engines and industrial engines and machines. Of even further benefit is the acquisition of Honeywell by the General Electric Company (USA), giving a customer base of almost unparalleled breadth.

The distributed generation arena is set to grow almost geometrically in the next few years. At this point in time, we are projecting that total production of microturbines (including some miniturbines that function more like a microturbine) will grow from about 2,000 units in 2001 to about 7,500 units in 2006 and 2007, then dipping as other power sources, most notably fuel cells, begin to "make their mark" in the electrical generation arena.

In our forecast period that includes the decade extending through the year 2010, we project that Honeywell Power Systems will build almost 9,000 Parallon 75 systems. Its chief rival in the microturbine-based power generation arena is projected to be Capstone.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

<u>Engine</u>	<u>(Application)</u>	<u>Thru 2000</u>	<u>High Confidence</u>			<u>Good Confidence</u>			<u>Speculative</u>			<u>Total 2001-2010</u>	
			<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>		<u>2010</u>
HONEYWELL POWER SYSTEMS PARALLON 75	GENERATION	550	500	750	800	900	1000	1300	1300	1000	800	600	8950