Vericor ASE8

Outlook

- ASE8 now out of production
- Displaced by gas-powered diesel engines and microturbines
- Fuel consumption and emissions too high for modern environment

Orientation

Description. The ASE8 is a single-shaft, open-cycle, centrifugal-flow aviation-derivative industrial and marine gas turbine machine in the 500- to 550-kW class.

Sponsor. The IE831/ASE8 was privately developed. The ASE8 traces its history back to the (then) AiResearch Manufacturing Company of Arizona, a division of (then) Garrett Corporation.

Power Class. The approximate power output of the ASE8 is 525 kW (704 hp).

Status. The ASE8 is no longer in production.

Total Produced. As of 2003, more than 500 ASE8 gas turbines were in use worldwide in industries such as oil and gas, food processing, telecommunications, and hospitals, as well as in industrial and offshore power generation applications. At that time, more than 40 ASE8 gas turbines were operating in the Middle East.

Application. Applications of the ASE8 are electrical generation, including small-scale cogeneration, CHP schemes, and marine auxiliary power generation. The machine is available for mechanical load drives (including duty as compressor and pump drivers) on special order.

Price Range. The ASE8's price, in current U.S. dollars, is about $460,000 for a basic gas turbine-based electric power-generating package. For the ASE8 in a mechanical drive package, the cost is estimated at $380,000.

For electrical generation, the genset prices cover a basic electric power skid-mounted generator package including one simple-cycle (open-cycle) single-fuel gas turbine, an air-cooled electric generator, a skid and enclosure, an air intake with basic filter and silencer, an exhaust stack, a basic starter and controls, and a conventional combustion system.

For mechanical drive gas turbines, the price covers a natural-gas-fired, skid-mounted, simple-cycle (open-cycle) gas turbine prime mover (without driven equipment) with gearbox, skid, enclosure, inlet and exhaust ducts, and exhaust silencer; a conventional combustion system; fire protection and starting systems; standard engine controls; and the basic auxiliaries needed for an operational installation.

Competition. In the electrical generation and mechanical load drive arenas, the ASE8 competes with the UTC Pratt & Whitney Power Systems ST6L-721. Machine models whose power output is slightly above or below that of the ASE8 include those from Daihatsu and Kawasaki Heavy Industries (KHI).

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Contractors

Prime

Vericor Power Systems Inc	http://www.vericor.com, 3625 Brookside Pkwy, Suite 500, Alpharetta, GA 30022 United States, Tel: + 1 (770) 569-8800, Fax: + 1 (770) 569-7524, Prime
Shinko Engineering Co Ltd, (Toyohashi Plant)	http://www.shinko-zoki.co.jp/en/index.html, 150 Azo-Motoyashiki, Sannya-cho, Toyohashi, Aichi Prefecture, Japan, Tel: + 81 532 41 2121, Fax: + 81 532412179, Licensee

Subcontractor

Coen Co Inc	http://www.coen.com, 1510 Rollins Rd, Burlingame, CA 94010-2306 United States, Tel: + 1 (650) 697-0440, Fax: + 1 (650) 686-5655 (Specialized Combustor)
UTC Aerospace Systems, Engine Components	http://utcaerospacesystems.com, 811 Fourth St, PO Box 65100, West Des Moines, IA 50265-0100 United States, Tel: + 1 (515) 274-1561, Fax: + 1 (515) 271-7201 (Exciter)
Unison Industries	http://www.unisonindustries.com, 7575 Baymeadows Way, Jacksonville, FL 32256 United States, Tel: + 1 (904) 739-4000, Fax: + 1 (904) 739-4093 (Exciter)
Wood Group Fuel Systems	http://www.woodgroupgts.com/Pages/default.aspx, 66 Prospect Hill Rd, East Windsor, CT 06088 United States, Tel: + 1 (860) 292-3115, Fax: + 1 (860) 292-1305 (Fuel Nozzle)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Services; Companies, Contractors, Force Structures & Budgets) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Dimensions.

	Metric Units	U.S. Units
Length	4.27 m	14.0 ft
Width	4.29 m	14.1 ft
Height	2.59 m	8.5 ft

Performance.

SIMPLE-CYCLE PERFORMANCE

	Metric Units	U.S. Units
Output	487 kW	653 shp
Heat Rate	17,676 kJ/kWh	16,754 Btu/kW-h
Thermal Efficiency	20.4%	20.4%
Fuel Flow (LHV)	180 kg/h	397 lb/h
Heating Value (LHV)	47,786 kJ/kg	20,548 Btu/lb
Fuel Pressure Required (a)	250/300 psig	1,723/2,068 kPA
Exhaust Gas Flow	3.56 kg/s	7.8 lb/s
Exhaust Gas Temperature	489°C	913°F

(a) Minimum/maximum.

CHP PERFORMANCE

	Metric Units	U.S. Units
Output	506 kW	678 shp
Fuel Flow (LHV)	180 kg/h	397 lb/h
	8.7 x 10^6 kJ/kWh	8.2 MMBtu/h
Heat Rate (LHV)	17,008 kJ/kWh	16,122 Btu/kW-h

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	CHP PERFORMANCE	
	Metric Units	**U.S. Units**
Efficiency	21.2%	21.2%
Exhaust Flow	3.6 kg/s	7.9 lb/s
Exhaust Gas Temperature	491°C	916°F
Fuel Gas Pressure	14.06 kg/cm²	200 psig
ASE8 Steam Generation		
Unfired	2,045 kgh	4,500 lb/h
Fired to 1,600°F/812°C	4,545 kgh	10,000 lb/h
Duct Burner Fuel Flow (LHV)	5.7x10^6 kJ/h	5.4 MMBtu/h
Fired to 2,200°F/1,204°C	7,273 kgh	16,000 lb/h
Duct Burner Fuel Flow (LHV)	12.1x10^6 kJ/h	11.5 MMBtu/h

	VPS1 MECHANICAL DRIVE	
	Metric Units	**U.S. Units**
Output	513 kW	688 shp
Heat Rate (LHV)	16,792 kJ/kWh	15,917 Btu/kW-h
Thermal Efficiency	21.4%	21.4%
Fuel Flow	180 kgh	397 lb/h
Heating Value (LHV)	47,786 kJ/kg	20,548 Btu/lb
Fuel Pressure Required (a)	250/300 psig	1,723/2,068 kPA
Exhaust Gas Flow	3.54 kg/s	7.8 lb/s
Exhaust Gas Temperature	489°C	913°F

Design Features

Intake. Screened annular type. Intake can be rotated 90°.

Compressor. Two-stage centrifugal compressor with two radial impellers provides a pressure ratio of approximately 10.5:1. The radial compressors are machined from high-strength forged titanium billets, and provide improved resistance to foreign object damage and contaminant buildup on the blades. Casings are cast iron. Engine rotor speed is 41,730 rpm.

Combustor. The single offset cannular combustor uses a dual-orifice fuel nozzle. A dual-fuel option is available, with automatic switchover. Combustor is designed for easy maintenance and replacement in the field. All combustor material is Haynes 188.

In 1997, AlliedSignal began to offer a dry-low emissions combustion system for the ASE8/IE831-1000 (see **Program Review**, below).

Turbine. A three-stage uncooled axial turbine drives the compressor section. Shaft, discs, blades, and vane are of IN738; casings are ductile cast iron. Marinized variants use aluminized coatings to reduce corrosion of hot-end components.

Gearbox. The heavy-duty gearbox is driven by an extension of the compressor rotor shaft and provides output speeds of 3,600, 1,800, or 1,500 rpm, depending on the application. The gearbox also contains the drive pads for the starter, oil, and fuel systems.

Bearings. One tapered land thrust and 10 fluid film journal bearings (seven journals in gearbox).

Controls. Honeywell supplies a wide range of controls for the ASE8, including speed, oil pressure, and temperature sensors; engine monitoring units; and automatic startup and shutdown systems. Automatic dual-fuel switchover available.

Accessories. AC electric start. DC electric start or pneumatic start options.

Operational Characteristics. The IE831/ASE8's dry low emissions (DLE) system produces NOx levels well below 30 ppm and is available on new units or can be retrofitted onto previous IE831 models. It consists of a gas nozzle system using two separate gas flows, one for a pilot burner and one for a main burner. Gas is injected through holes in the vanes. The optional dry low NOx combustor is only available for use with natural gas fuel.

The IE831-1000/ASE8's low turbine inlet temperature and relatively low pressure ratio make it an excellent choice for situations requiring industrial heat. Heat recovery steam generating superheated or saturated steam can be provided at a rate of approximately 4,000 lb/hr (1,814 kg/hr). This model can also produce hot water for space heating or other heating needs.

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Variants/Upgrades

Throughout its history, the ASE8 has been variously referred to as the Series 831, Model 831, IE831, and 831. Among the more important marine power applications for the engine has been the naval surface combatant. The former U.S. Navy Patrol, Hydrofoil, Missile (PHM) boats each utilized an IM831 for onboard electric power generation. Additionally, ASE8 engines have been considered to power auxiliary generators aboard a number of new U.S. Navy mine countermeasures vehicles and non-U.S. surface combatants.

IE831. The IE831 was an early version in this gas turbine family; it was rated at 400 to 690 hp.

ASE8. The ASE8 (formerly IE831-1000) is the current offering of the IE831 in the power generation and mechanical drive arenas. It is rated at 525 kW/704 shp for electrical power generation, with an efficiency of 21 to 22 percent. The machine's pressure ratio is about 10.5:1.

IM831-800. The IM831-800 is the previous production model, rated at 518 to 548 kW continuous duty. It replaced the earlier IE831 model.

ME831-800. The ME831-800 is a variant of the IE831 adapted for marine duty.

Fluid Coupling Option. For electrical generation and other non-surge applications, the Series 831/ASE8 machine can be supplied with a standard direct-coupled gearbox connection. However, Voith has offered a special fluid coupling to adapt the engine to pipeline pumping and compression duties where variations in load are encountered. Under a NATO contract, at least 20 fluid-coupled units were ordered for use as emergency pumpers. Those portable units were envisioned as capable of being installed on pipelines that transfer aviation or other critical fluids in the event of a pipeline malfunction or main pump system breakdown. Units are equipped with bypass lines and all required hardware for rapid installation.

Cheng Cycle. The Cheng Cycle is a patented thermodynamic power cycle of International Power Technology. It combines Brayton and Rankine cycles, utilizing the exhaust mass flow to produce superheated steam that is then re-injected into the gas turbine, greatly increasing the power output.

VOC Reduction. AlliedSignal/Honeywell's VOC (volatile organic compound) technology can help reduce fuel emissions and fuel costs, and can meet electrical and thermal requirements at a given power plant. The VOC technology has destruction efficiencies that can be well above the current U.S. standard.

VOC reduction technology has been installed at the Tempo Plastics facility in Visalia, California. The polystyrene producer has realized a 96 percent reduction in VOC while saving 25 percent in energy costs since the system was installed in 1993.

Packagers. The IE/IM831 and the follow-on ASE8 have been packaged by a number of original equipment manufacturers (OEMs) for generation and mechanical drive applications. The companies mate the gas turbine to driven equipment of their own design per customer specifications, with the packaged units including accessories and controls. A brief discussion of the major packagers follows:

Comercio e Industria Induco. Brazil's efforts toward wider use of alcohol-based fuels were seen as possibly opening new niches for the 831. Developments in the combustion of alcohol fuels impacted the sales potential in this region through the late 1980s and 1990s.

Hibiya Engineering. Among the more recent packagers of the IE/IM831, Hibiya of Japan is believed to have sold machines to commercial establishments in Japan and the Middle East. The units are thought to have been generation sets, designated HGT 625, installed as standby/baseload systems.

Kongsberg Vapenfabrikk. Kongsberg Vapenfabrikk (now a part of Dresser-Rand) has been successful in marketing the KG831 series for generation applications; the firm has sold many units to U.S. and overseas customers. Some have been installed as standby generators for businesses, while a number are in use on offshore platforms.

North American Energy Systems. In 1996, AlliedSignal signed an agreement with North American Energy Systems to package the IE831 into a portable enclosure.

Shinko Engineering. Shinko has operated in the Japanese emergency/standby market with the IE/IM831, recording sales of just over 100 units. The package, designated GX625, has also been offered for customers in the Middle East. The firm has also provided gas turbine generation sets for the Japanese Navy's Hatsuyuki and Hatakaze class ships.

Stewart & Stevenson. This Houston-based firm, now a part of General Electric Co (USA), was one of the most active packagers of gas turbine machines, of all

sizes. In the 60-Hz generator-set market, its packages used the IE831 as its smallest offering, at 515 kW (base). Aside from small gensets powered by the IE/IM831, the Houston-based entity also offered a twin version as the IM2-831-1600, rated at 1,000 kW. In 1998, Stewart & Stevenson International completed the sale of its gas turbine division to General Electric.

Triveni Engineering & Industries. In December 1998, AlliedSignal concluded a deal with Triveni Engineering & Industries of Bangalore, India, for the marketing, sale, and packaging of gas turbines in that market. The first contract awarded under that arrangement was the December 1999 sale of two ASE8s for a hotel in India.

Triveni deals in the small gas and steam turbine and high-speed gearbox markets in India.

VOC Pollution Control. In 1998, AlliedSignal began marketing the IE831-1000 package as one suitable for VOC destruction in industrial and oil & gas applications. It was marketed as a low-polluting solution that also provided cost savings. The first such application was at the Tempo Plastics facility in Visalia, California (producer of expanded polystyrene). The system reportedly has yielded a 96-97 percent reduction in the facility's VOC emissions while saving 25 percent in energy costs.

In the system, the turbine package is attached to a reaction chamber and combustor, where the VOC/air combination is compressed to a pressure of 120 psi.

Program Review

Background. The ASE8 was introduced in the mid-1960s as the AlliedSignal Garrett IE831. It incorporated much of the same technology found in Garrett's aircraft propulsion engines of the same era, notably the TPE331. The IM831, as the small industrial engine was later designated, was adapted to many electric power and mechanical drive applications, including marine auxiliary power generation and standby electric power generation. It is used in compression and lift modules for platforms and oil field service, and in water injection pumps and fuel pumps.

The IE831/ASE8 quickly became popular in the small generator market, especially in the standby/emergency power segment. Its compact, low-noise/emissions capabilities, coupled with simplified sitting requirements, make it very adaptable to this market. The packaged genset is also available in a quick-start configuration with 10-second capability.

Among the more notable installations, 29 sets were installed on the Alyeska Pipeline driving Electric Machinery 500-kVA generators. Those units are equipped for remote, fully automatic operation, and are fitted with weatherproof enclosures. The Delco battery starting systems are equipped with La Marche battery chargers.

Model IM831/ASE8s also established a significant presence in various cogeneration applications around the world. As an example, an IM831 supplied by Kongsberg to a German brick and tile plant has produced thermal efficiencies of 90 percent.

In 1983 and 1984, International Power Technology conducted an evaluation of an IM831 gas turbine equipped with a heat recovery steam generator (HRSG). The IM831 produced essentially the same power output as the simple-cycle machine (500 kW) but at a greatly increased thermal efficiency of 27 percent – 5 full percentage points higher than the simple-cycle machine. IPT officials indicated at that time that an optimized Cheng Cycle IM831 set could produce a power output of 1.1 MW at thermal efficiencies of 34 percent.

Stewart & Stevenson sold two IE831 units to support a 1-MW cogeneration system that supplies steam and electricity for the Queen Mary Hotel/Spruce Goose exhibit complex in Long Beach, California. Subsequently, the Spruce Goose was sold to an aviation museum in Oregon when the original museum owners declared bankruptcy. Currently, Evolution Hospitality operates the *Queen Mary*, but the status of the gas turbines is unclear.

Marine Applications

The Model IM831 has been used aboard various naval combatants and light force ships for onboard electrical generation. As part of a general shift toward using gas turbines as ship's service turbo generators (SSTG) in the U.S. Navy, the 235- to 240-ton PHM class boats utilized the Series 831. Six PHMs were built between July 1977 and November 1982. Each vessel used twin 548-kW ME831-800 machines to power its twin generators. In 1993 and early 1994, the vessels were taken out of U.S. service due to high operating costs and limited utility.

This application was followed by an experimental program inaugurated in September 1982 when Garrett received a contract to supply four IM831 gensets for a trial retrofit aboard two 44-ton MSB class ships. Each vessel was equipped with two ME831-800 generator sets to power magnetic sweeps. The experiment

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appears to have been unsuccessful, since the period from 1990 to 1992 saw the U.S. Navy take all the MSB class craft out of service.

In parallel with the U.S. Navy's adoption of gas turbine SSTGs, the Japanese Maritime Self-Defense Force built 11 3,800-ton Hatsuyuki class destroyers, each equipped with three Shinko Engineering-supplied CX625 ship's service generators. These destroyers were launched from November 1980 through October 1985 and were decommissioned from 2010 onward.

The Hatsuyuki class was followed by two 6,400-ton Hatakaze class destroyers that were equipped with three Japanese-built IM831 SSTGs. These destroyers were launched in November 1984 and January 1987, respectively, and remain in active service.

Company Realignments.

The ASE8 was originally produced by the Garrett division of AlliedSignal. In 1994, this division was merged with the Lycoming Turbine Engine division (purchased from Textron) to become AlliedSignal Aerospace. In 1999, AlliedSignal/Honeywell formed a joint venture with MTU Aero Engines called Vericor Power Systems LLC to manage its marine and industrial gas turbine products. In June 2002, MTU acquired full ownership of Vericor, which became a wholly owned subsidiary of the German company.

Related News

Skid-Mounted ASE8 Units For Sale on Secondhand Market – Eight skid-mounted, natural-gas-fueled electric generator units rated at 557-kVA output per unit are currently for sale on the secondhand market. Each skid unit contains an ASE8-1000 Vericor gas turbine with water injection system and FADEC control; a 30-hp AC starter motor; a 4160-V, 99-amp U.S. Electrical Motors induction generator rated at 598 kVA; a 4160-V, 99-amp vacuum contactor; a motor control center; and a PLC control center. (SGE, 8/16)

Funding

The ASE8 marketer-distributor is Vericor Power Systems, Alpharetta, Georgia. Vericor is a wholly owned subsidiary of MTU Aero Engines. The engine is manufactured and serviced at Vericor's facility in New Orleans, Louisiana.

Contracts/Orders & Options

No recent contract data for the ASE8 gas turbine is available.

Timetable

Month	Year	Major Development
	1961	Series 831 development begins
	1962	First prototype built
	1963	First production unit in operation
Late	1982	Garrett announces work on IE831-1600
Jun	1987	Stewart & Stevenson becomes exclusive distributor
Late	1996	North American Energy Services becomes packager
Jun	1999	AlliedSignal, Honeywell merge; Honeywell International adopted as name
May	2005	Vericor partners with SAE of Canada for assembly and testing
Mar	2006	Vericor and TUBA of Germany sign service agreement
Mar	2007	International Coil Ltd (ICL) signs an agreement to distribute Vericor's VPS series industrial gas turbine gensets in India

Worldwide Distribution/Inventories

Country	Year of Installation	Total
Argentina	1980 (2), 1981 (1)	3
Australia	1977 (1), 1979 (4)	5
Germany	Unknown	1
India	2000	2
Iran	1977	5
Italy	1978 (1), 1989 (1)	2
Japan	1973 (4), 1975 (6), 1977 (2), 1978 (8), 1979 (1), 1984 (9), 1985 (18), 1986 (6), 1987 (3), 1988 (3), 1995 (3), Unknown (30)	93
Pakistan	1980	1
Saudi Arabia	1977 (4), 1978 (1), 1979 (5), 1980 (3), 1981 (3)	16
U.K.	1976 (1), 1977 (4), 1978 (1)	6
U.S.	1974 (2), 1975 (9), 1976 (9), 1977 (36), 1978 (18), 1979 (26), 1980 (10), 1981 (21), 1982 (14), 1983 (8), 1984 (2), 1985 (3), 1986 (4), 1987 (2), 1997 (1), 1998 (3)	168
TOTAL		**302**

About 500 ASE8 series machines of all marks and variants have been built. Of these, 302 have been identified. The balance includes units sold to hotels, hospitals, and other buildings requiring emergency power provisions. These are almost impossible to track since the emergency generator for such facilities is usually far down the contract suppliers list. A number of ASE8 units have also been supplied as skid-mounted generators used for mobile applications. We know of eight such units because they are currently up for sale on the secondhand market. Finally, some units were purchased by government departments or corporate enterprises for experimental purposes.

Forecast Rationale

The majority of the ASE8 family of small gas turbines were sold to the United States and Japan. Vericor claims to have supplied ASE8s to 12 countries, 11 of which have been identified. They also claim that 40 ASE8s were sold to the Middle East, but the identified clients in that region only account for 22. It can therefore be assumed that one Middle Eastern country has 18 ASE8s of uncertain age in its inventory. It also appears that the last ASE8s were delivered in the early years of this century and that this machine is now out of production.

An examination of maritime uses of the ASE8 as a shipboard generator suggests that the installations have not been successful. The U.S. Navy used a twin-pack ASE8 as the SSTG on the PHM class patrol craft. This installation was described as "a voracious consumer of fuel" and "seriously fuel-hungry." The U.S. Navy had already standardized on the more economical and higher output Rolls-Royce 501K-17 and 501K-34 for its SSTG needs and was quick to abandon use of the ASE8. The Japanese Hatsuyuki class destroyers have long been rumored to suffer from severe onboard power-generation deficiencies. Much weight is given to these rumors by the fact that they use three ASE8 SSTGs that together deliver less power than a single 501K-17. The Japanese have now shifted to the IM800, a license-built version of the 501K-17.

Overall, it appears that the ASE8 has fallen victim to a double-pronged assault from the development of much more efficient microturbine technology and diesels that run on natural gas. It appears probable that Vericor decided to concentrate on the ASE40 and ASE50, because they are built to comply with environmental and fuel emission regulations and are more efficient, generating more horsepower. At best, the ASE8 could be built-to-order if a pressing need arose. This seems improbable and is an insufficient basis to justify a forecast. Unless there is a substantive change in this situation, this report will be archived next year.

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