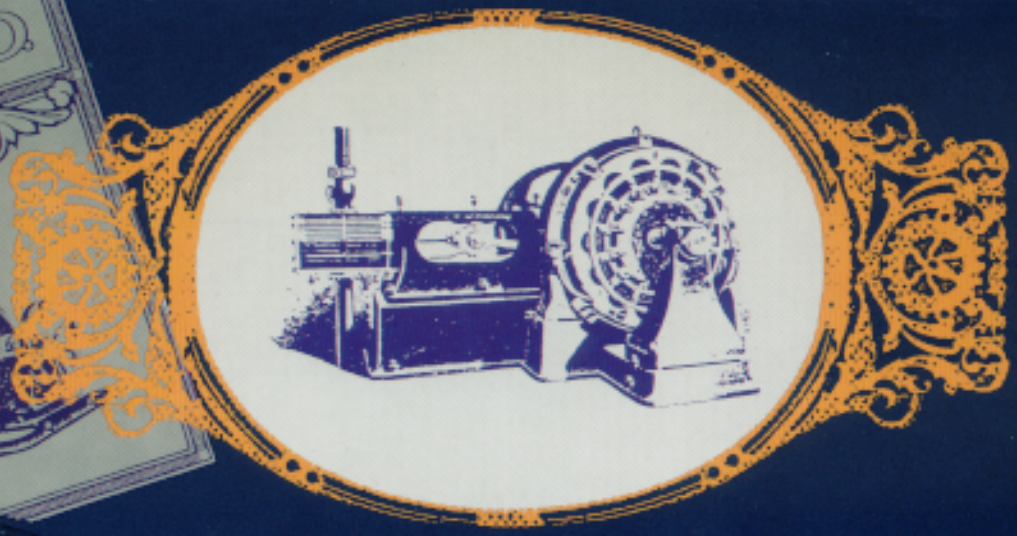
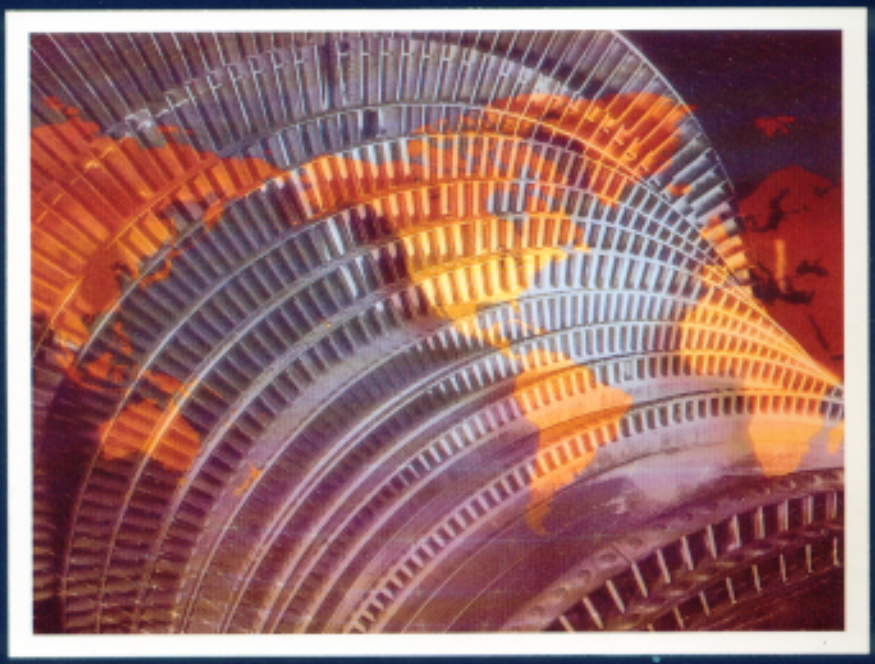
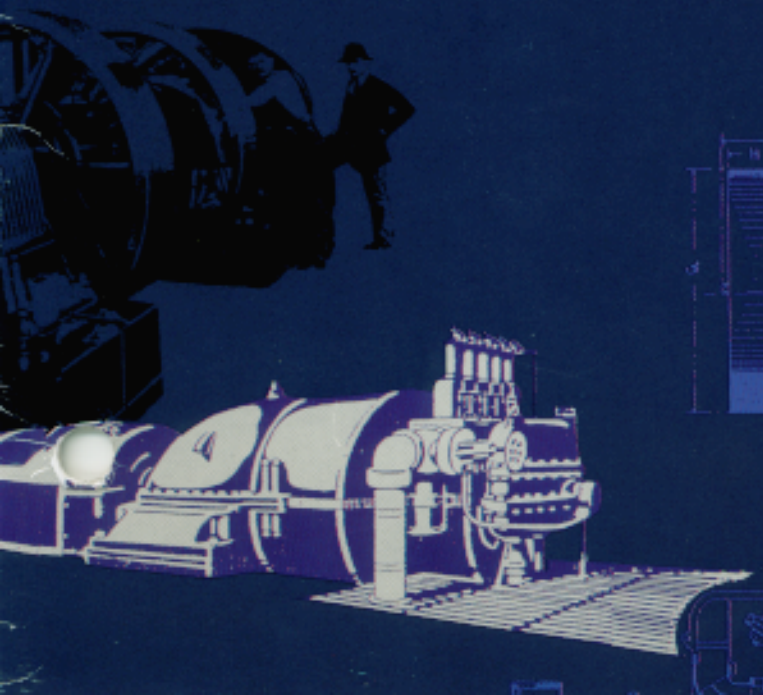
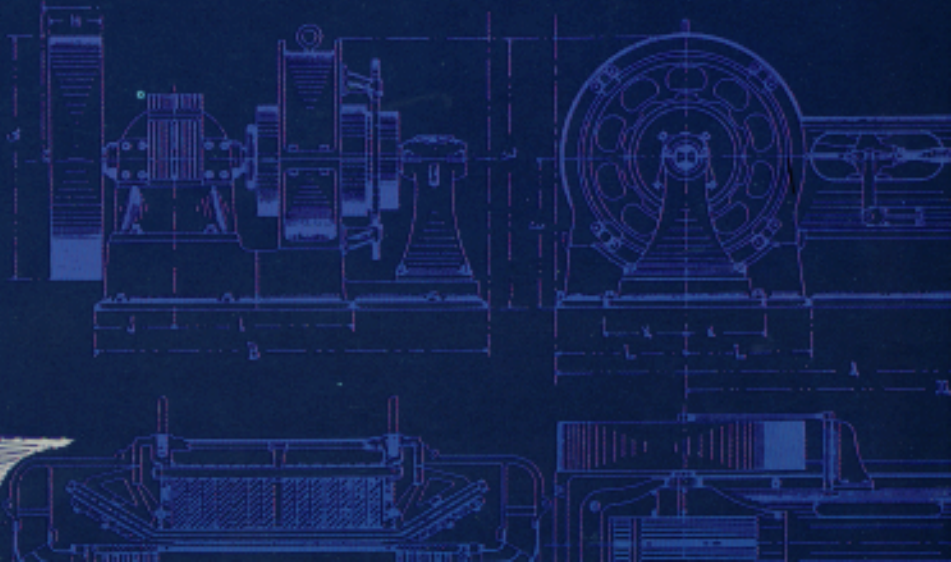




ELLIOTT

Turbine-Generators
...The Tradition Continues





Experience

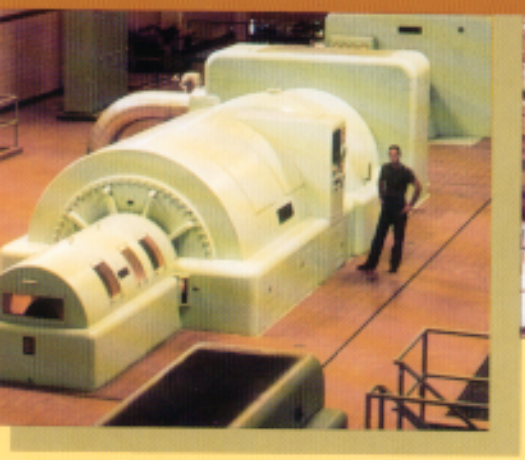
Our roots go back to 1892 and an enterprising young engineer named William S. Elliott. Elliott Company was incorporated in 1910, and in 1914 we moved to our present location in Jeannette, Pennsylvania.

With over 75 years experience in designing, manufacturing and servicing turbine-generators, Elliott has compiled an impressive record of reliability. Hundreds of Elliott turbine-generators are in service throughout the world, reliably producing electric power on both a continuous and standby basis.

Elliott's turbine-generator product line incorporates the experience gained from millions of operating hours. Our technology has steadily advanced in response to market requirements. Changes have been evolutionary, not revolutionary, in nature. For example, Elliott has dedicated considerable resources to develop high efficiency turbine blading and other performance related enhancements to remain consistent with increasing energy costs. Our control systems include a digital governor with the capability of operating the turbine-generator locally or from a remote location. If required, we can also interface with the plant's distributed control system (DCS).

We offer a 50-50 power range capability (50 KW – 50 MW) using proven components, state-of-the-art technology, and most importantly, the experience to provide the right turbine-generator to meet your project requirements. When you purchase an Elliott turbine-generator, you know all the various components are designed and integrated to provide high reliability, high efficiency and reduced installation time.

This results in fewer problems during installation and start-up, as well as reduced operation and maintenance costs throughout the life of the equipment. Worldwide manufacturing and service facilities also allow Elliott to meet your project schedule and service needs.



Circa 1950's – Two 7.5 MW turbine-generators in a coal-fired midwestern U.S. municipal power plant.

Circa 1960's – Two 27.5 MW turbine-generators with 22-inch last stage blades in a northern California utility geothermal power plant.

Circa 1970's – Single-stage turbine-generator for applications up to approximately 2000 kw, Elliott's single-stage YR turbine provides reliable, economical service in both continuous and standby service. There are nearly 35,000 of these units in operation worldwide.

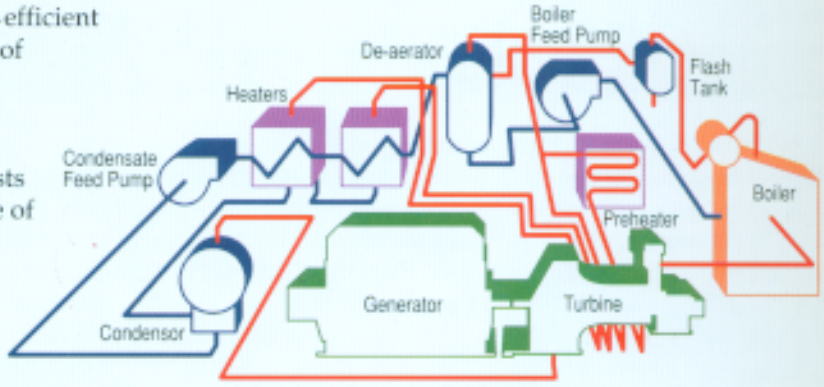
Cogeneration Overview

The Public Utilities Policy Regulatory Act (PURPA) stimulated a resurgence of interest in cogeneration ... a proven, energy-efficient technology. Cogeneration is the simultaneous production of electric power and useful thermal energy (steam). It has taken on a much broader meaning in today's energy-conscious United States. To an energy intensive industry, cogeneration provides a method of reducing operating costs and improving profitability through the more efficient use of energy. To a project developer, cogeneration represents a viable business opportunity with a high rate of return on investment.

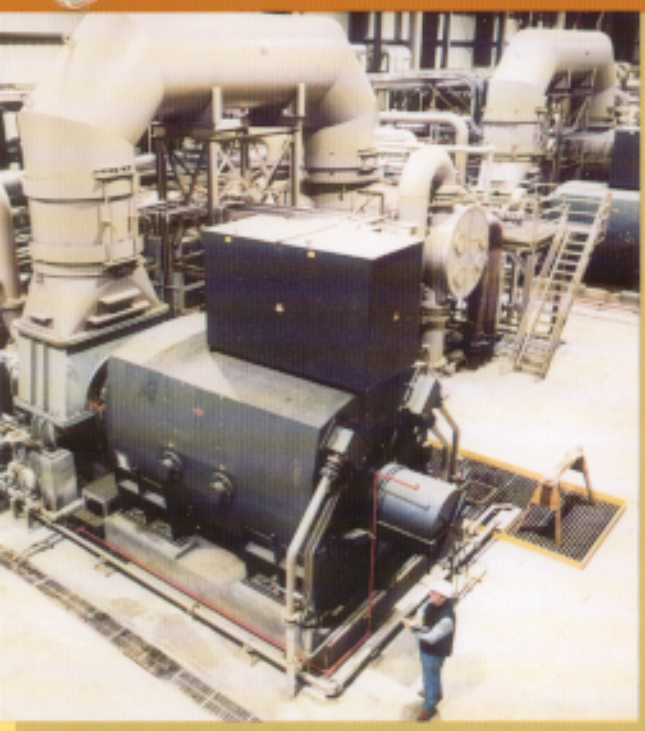
Cogeneration has also been encouraged by a number of other factors including:

- Environmental concerns
- Availability of waste fuels
- An abundance of natural gas
- Federal Energy Regulatory Commission (FERC) policies

It has bred a new class of independent power producers and the supplementing of utility-generated electric power.



One of the major pieces of equipment in a cogeneration facility is the turbine-generator. It is directly involved in the conversion of steam energy into electric power. Long before PURPA rekindled interest in cogeneration, Elliott turbine-generators were already in service saving energy... and saving money.



Circa 1980's – Three 18.9 MW turbine-generators in a wood-fired northern California power plant. (Largest independent wood-fired power plant in the United States.)
Photograph courtesy of Zurn/NEPCO.

Applications

Elliott turbine-generators are available to produce reliable electric power for a variety of PURPA cogeneration projects and independent power producers.

Energy- intensive industries and grass roots project developers that can benefit from the installation of a turbine-generator include:

- Chemical and petrochemical
- Combined cycle
- Distilleries
- Educational facilities
- Food processing
- Geothermal
  - *Direct steam*
  - *Single/double flash*
  - *Binary cycle*
- Government facilities
  - *Hospitals*
  - *Prisons*
  - *Military installations*
- Primary metals
- Refineries
- Waste-to-energy
  - *Biomass (agricultural waste, wood waste, etc.)*
  - *Culm (waste coal)*
  - *Land fill gas*
  - *Municipal solid waste*
  - *Petroleum coke/pitch*

Whether your project is going to use a conventional fossil fuel, a waste fuel, or a geothermal resource, Elliott is prepared to help you select the right turbine-generator for your application. We'll also be glad to provide the information you need for proper economic analysis through the various stages of project development from feasibility through final design.

POWER, "Elliott Style": The Elliott Turbine-Generator

Our complete product line includes single valve single stage (SVSS), single valve multistage (SVMS) and multivalve multistage (MVMS) turbines utilizing a building block approach of blading, diaphragms, inlet, exhaust and bearing casings. This approach allows us to accommodate condensing and non-condensing exhaust conditions and single or multiple controlled and uncontrolled extraction and/or induction requirements. Both direct connected and geared units are available. Baseplates are used whenever practical in order to reduce on-site installation time.

In order to provide high reliability, high efficiency and reduced installation time, each Elliott turbine-generator is designed and manufactured as an integrated system. The turbine, generator, gear (where required), couplings, baseplate or soleplates, oil system, controls and instrumentation are designed to your specific needs. Auxiliary control panels, synchronizing and generator protection equipment, condensers, and other accessories are also available.

Your Elliott turbine-generator will include the generator designed to your requirements. Because Elliott is not committed to one manufacturer, we have the flexibility to furnish the right generator for your application...from several manufacturers worldwide. As a result of our experience working with these manufacturers, we coordinate this part of the system with minimal involvement on your part.

The Elliott turbine-generator is an engineered state-of-the-art system which provides cost effectiveness, reliability, high quality, and field-proven components. Each *POWER, "Elliott Style"* system includes:

1. Turbine – The turbine is the first step in converting steam energy into electric power. Turbine blading, made of stainless steel, is the rugged impulse type of blading. The steam chest is normally cast with high grade alloy steel selected to meet the steam pressure and temperature requirements of the application. The turbine rotor is of forged construction and is speed balanced whenever possible for smooth operation. The rotor is supported by tilt pad journal bearings. Positive axial rotor position is maintained by a double-acting Kingsbury type thrust bearing. The turbine features Labyrinth type shaft end and interstage seals. The governor valves of multivalve turbines are bar operated for precise flow control. Controlled extraction and induction governor valves can be either bar operated or grid type depending on the operating pressure.

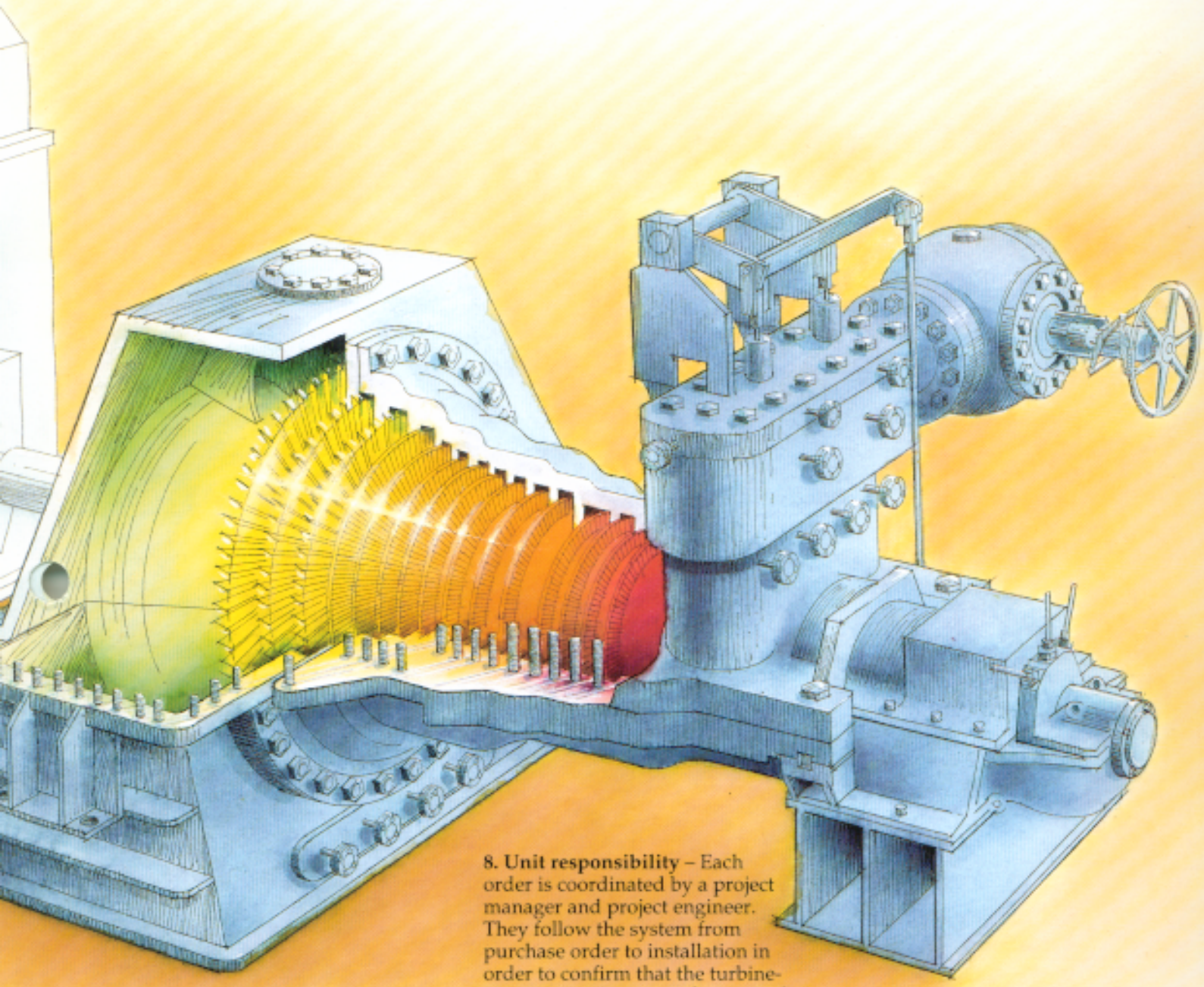
2. Generator – The generator takes the turbine's mechanical energy and converts it into electric power. Both two- and four-pole designs are available with open drip-proof, weather protected and totally enclosed air-to-water cooled (TEWAC) enclosures. The stator and rotor are provided with Class F insulation. The generator shaft is forged and supported by spherically seated split sleeve journal bearings. Synchronous generators utilize brushless excitation for enhanced reliability. The voltage regulator is automatic for ease of operation.

3. Oil system – The oil system is sized for ample capacity to operate through transients of the lube and/or control system. Each oil system features a three-minute retention time oil reservoir, two full capacity centrifugal oil pumps and one motor driven emergency pump, twin filters, and single or twin coolers.

4. User-friendly control – The control system features a user-configurable digital governor which provides the versatility required for speed or pressure control. The system can load limit the generator as well as automatically synchronize with other units.

5. Protection system – The safety and availability of the equipment depend on the protection devices built into the system. Every turbine-generator has a mechanical overspeed trip which closes the main stop valve when activated. Other protective devices available include temperature and vibration monitoring, electrical overspeed trip, and oil system monitoring.

6. Testing – Each component of the turbine-generator is factory tested to confirm that it meets industry standards. In addition to hydrostatic casing and rotor heat indication tests, the turbine is no-load tested to verify its mechanical integrity. The generator is checked for mechanical, insulation, and electrical soundness.



7. Packaging – Components to be designed for your system include couplings, sealing and leakoff system, turning gear, reduction gear, baseplates, non-return valves, generator protection, condensers, and more.

8. Unit responsibility – Each order is coordinated by a project manager and project engineer. They follow the system from purchase order to installation in order to confirm that the turbine-generator arrives complete, tested, and ready for installation.

9. Quality – Elliott's "do it right the first time" policy has minimized errors and enhanced reliability from purchase order to unit operation. "Built to last" is one of the key design concepts of the Elliott turbine-generator.

Your Elliott Turbine-Generator combines today's design with yesterday's experience to meet the demanding applications of tomorrow.

Total Capabilities

Design

In designing your turbine-generator, Elliott applies state-of-the-art analytical procedures in the areas of thermodynamics, blade design, rotor dynamics, bearing flexibility and torsional analysis.

Elliott's CAD capabilities have been recently upgraded with the purchase of an Anvil-5000 system with individual workstations. Used in conjunction with Elliott-developed routines, such as blade mainline/streamline prediction programs, airfoil generation/stacking programs and blade-to-blade boundary layer analyses, aerodynamic engineers can economically develop state-of-the-art turbine blading with predictable performance over a wide range of applications.

Manufacture

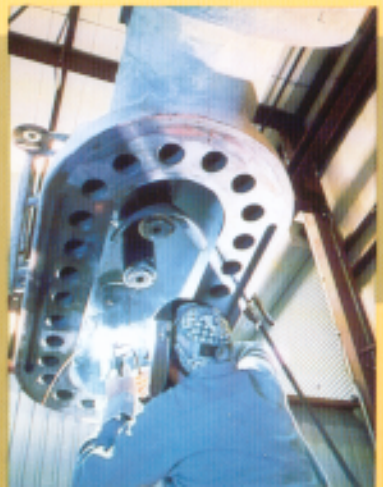
Elliott has the capability of manufacturing turbines in the United States, the Federal Republic of Germany, Japan and Mexico. At each production facility, skilled workers use the most modern equipment and tooling for machining, heat treating, assembly, inspection and shipping. Regardless of which facility is used to manufacture your turbine, Elliott's proven design standards and quality control procedures are used.

Prior to shipment, the components of each turbine-generator go through a rigorous series of inspections and tests including individual testing of the assembled turbine, generator and gear (where required) in order to meet two standards ... yours and ours.

Service

Elliott service is there when you need it ... anytime and anywhere in the world. Our service engineers and representatives are available to assist with turbine-generator installation, start-up, trouble shooting, maintenance and, if necessary, repair. Elliott service can also provide the crews to install your turbine-generator, and qualified individuals to train operating and maintenance personnel. Parts orders are computer processed by Elliott service from our regional offices to our headquarters in Jeannette, Pennsylvania.

Elliott-authorized repair shops, located in the United States, Canada and Europe, are manned by highly skilled and experienced personnel. Our repair capabilities include unique techniques such as submerged arc weld repair of solid rotor turbine disks. We can perform at speed rotor balancing in our Jeannette, Pennsylvania facility and also have a portable balancing machine capable of handling turbine rotors on site as large as 200,000 pounds and 12.5 feet in diameter.



Turbine-Generator Types

The turbine-generator for your project will be selected from one of the following basic types:

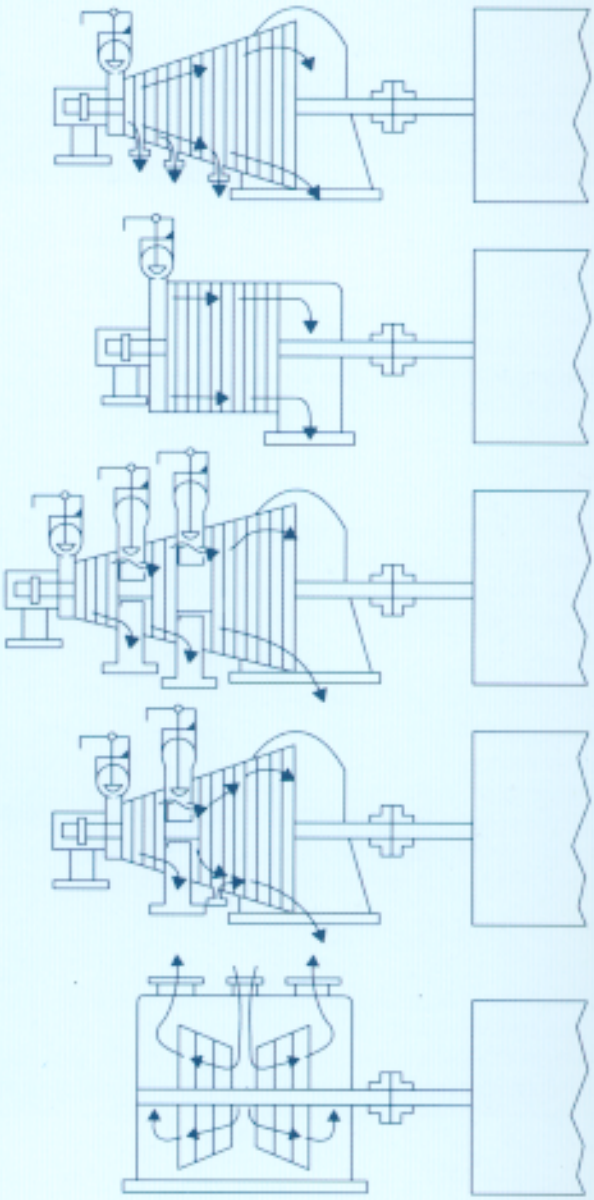
Condensing - provides the traditional approach for converting the energy contained in the steam into electric power. Regenerative feedwater heating is commonly used to improve the efficiency of the fuel-to-electric power conversion process.

Non-condensing - or "topping units" are utilized in classic cogeneration schemes to supply heating, or process steam at a selected pressure level while producing electric power.

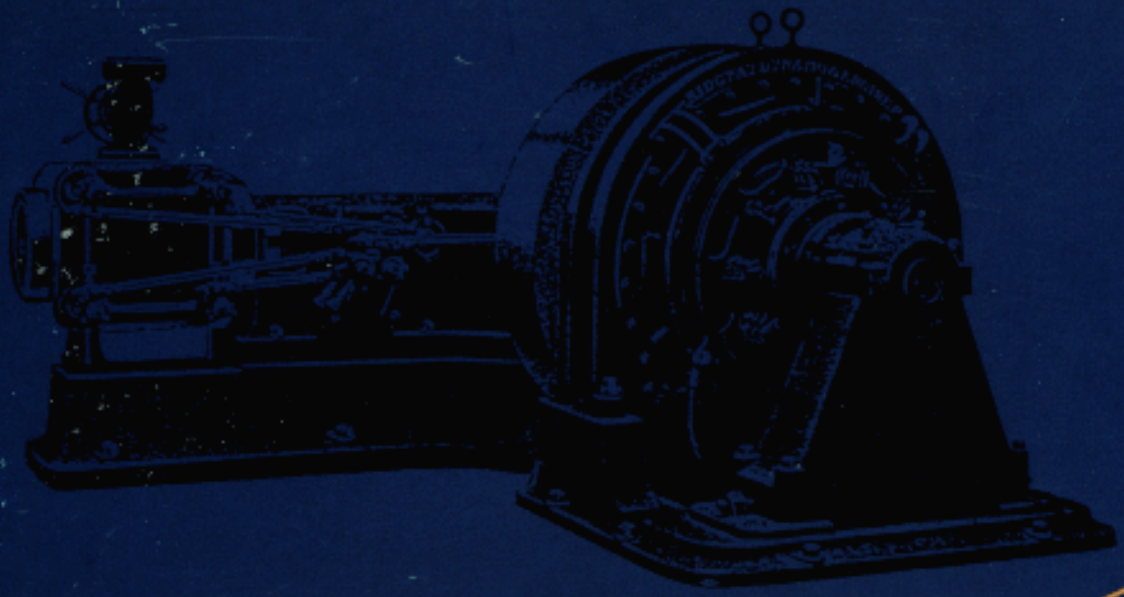
Condensing Extraction - is used to meet heating or process steam requirements at one or more pressure levels while condensing the remaining steam and producing electric power.

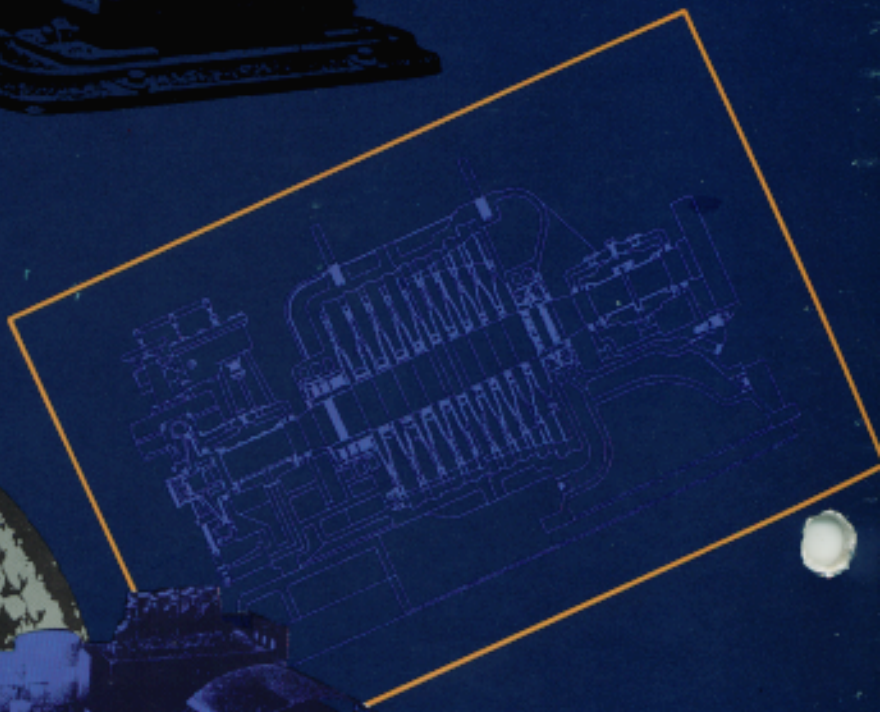
Condensing Extraction/Induction - is commonly used in combined cycle applications to improve the efficiency of the fuel-to-electric power conversion process. A portion of the steam produced by the heat recovery steam generator (HRSG) is inducted into the low pressure section of the turbine.

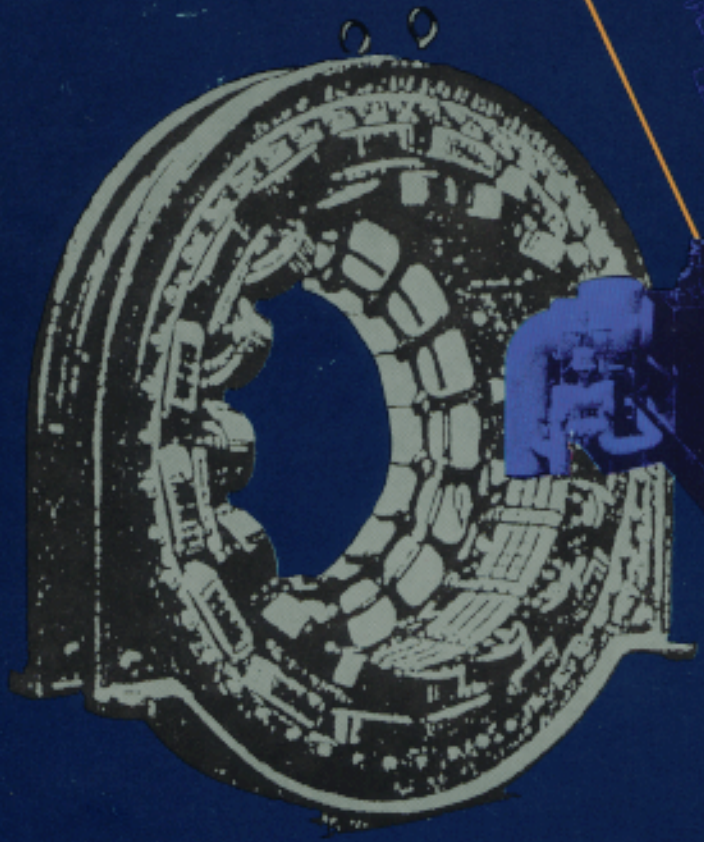
Binary Cycle - is used in liquid-dominated geothermal applications where geothermal brine cannot be passed directly through the turbine due to its chemical properties. A low boiling point hydrocarbon, such as iso-butane, is used as the working fluid in the turbine.

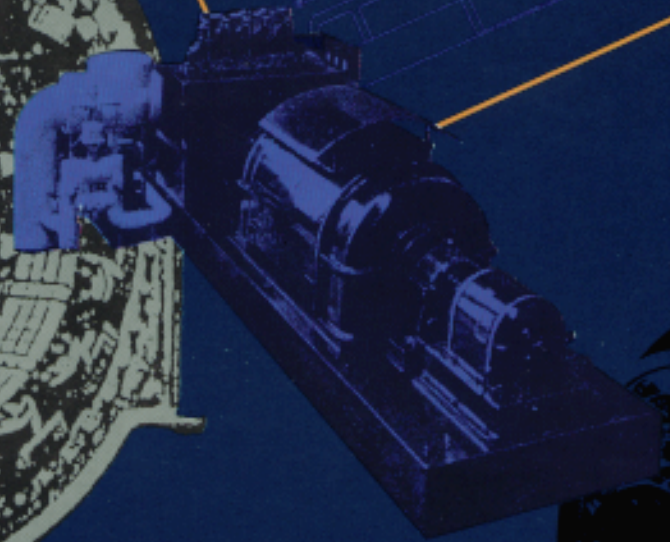


Count on ***POWER, "Elliott Style"*** to perform for you today and in the future









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