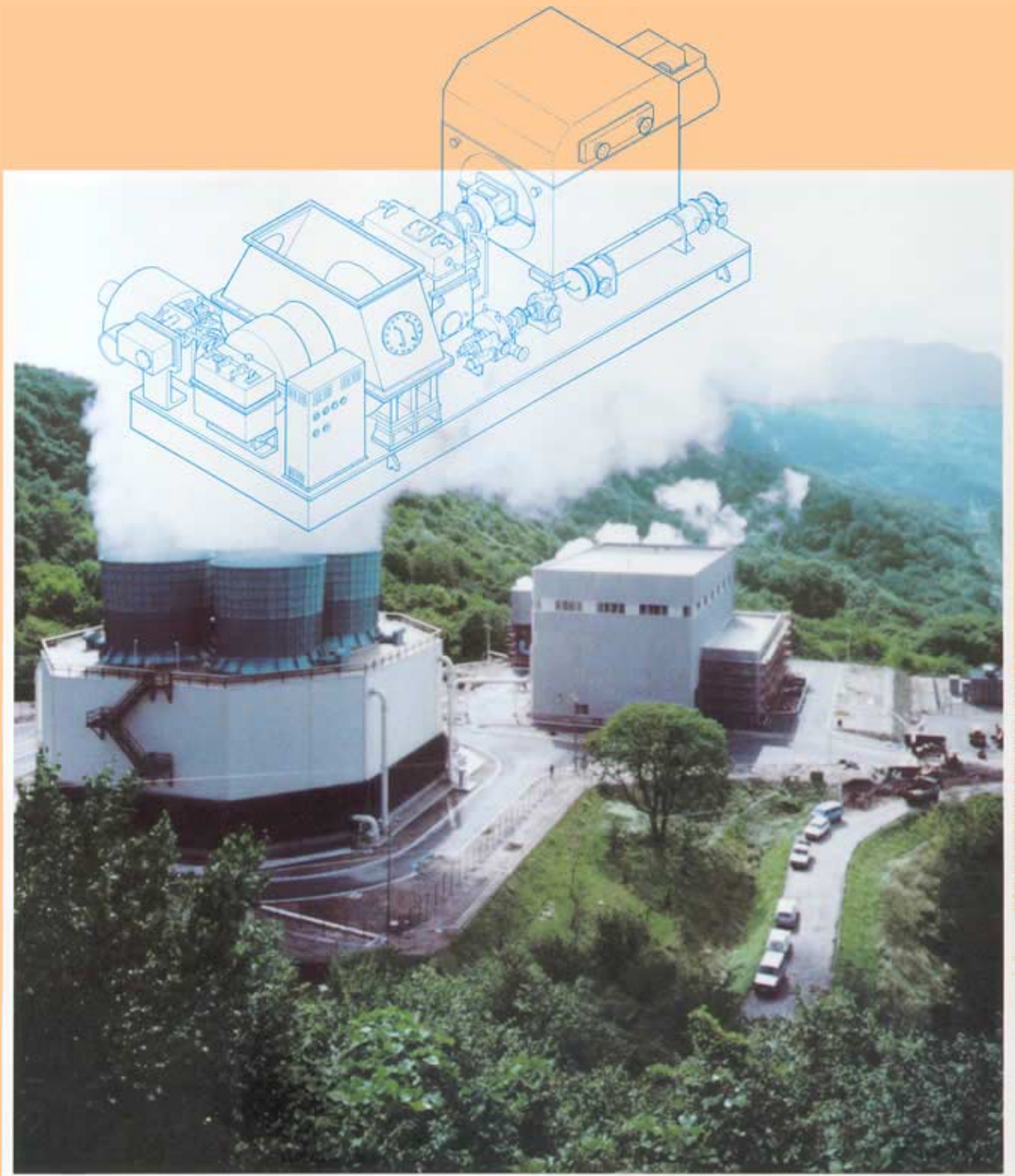
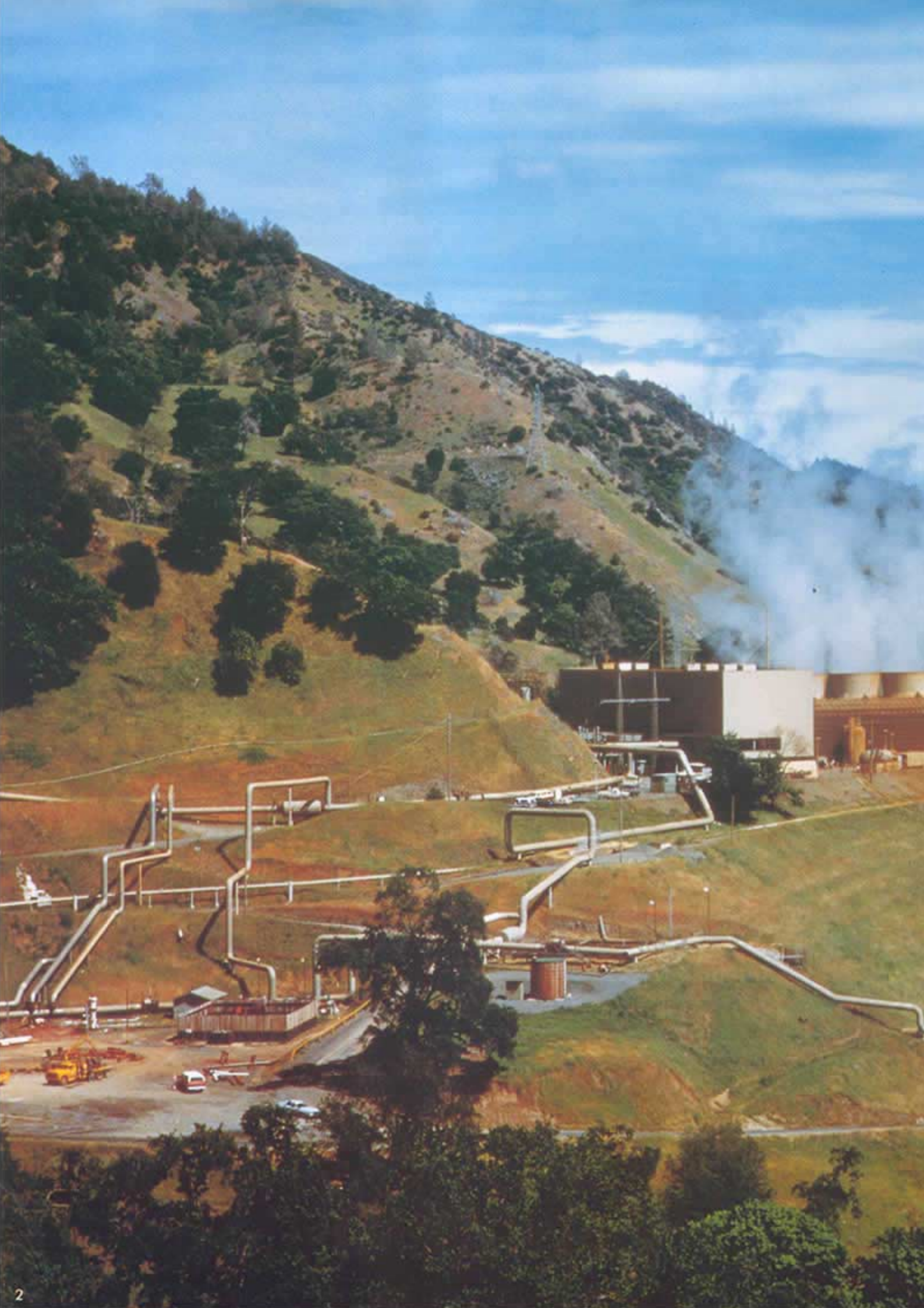


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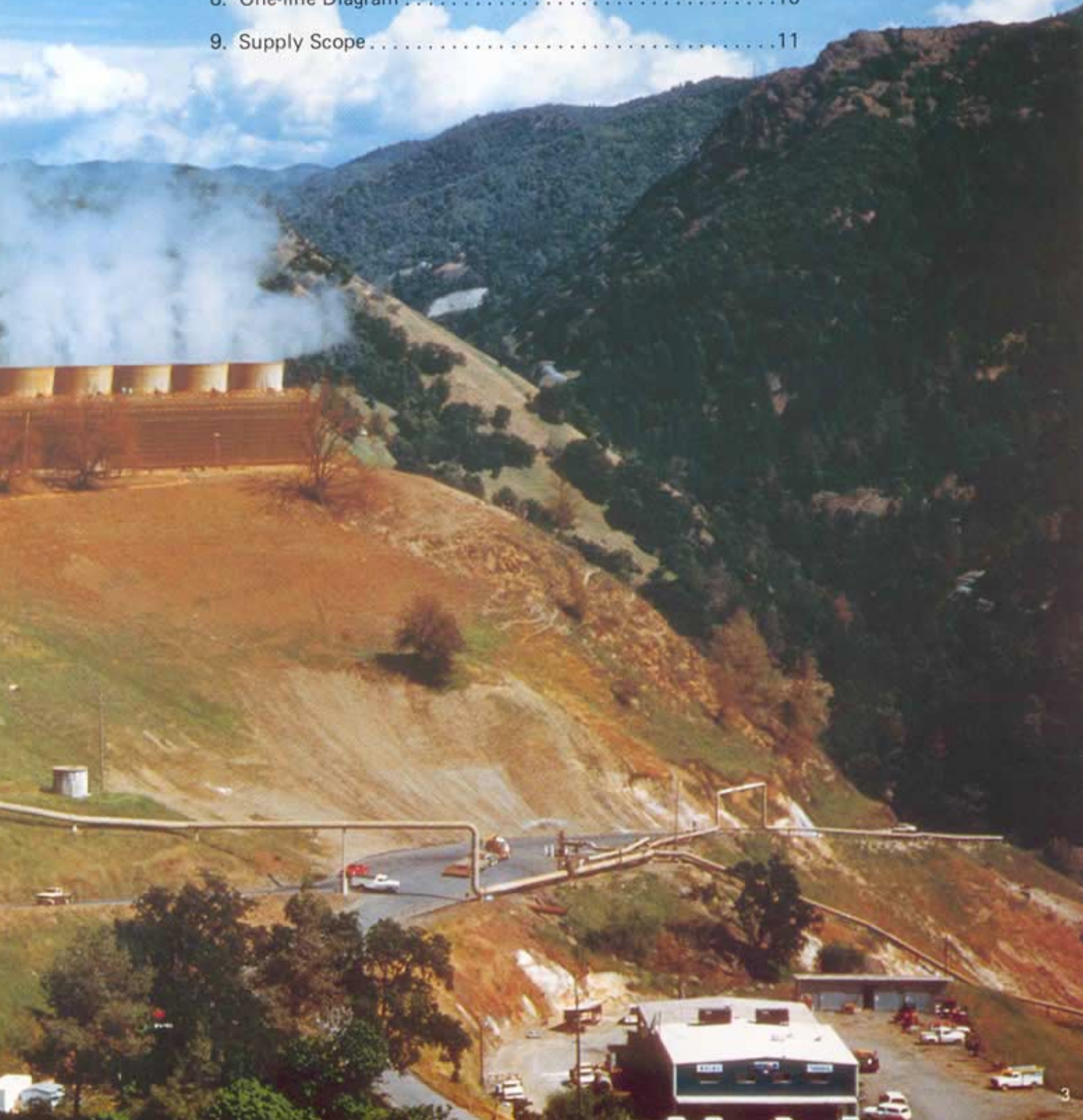
## GEOTHERMAL PORTABLE TURBINE GENERATOR





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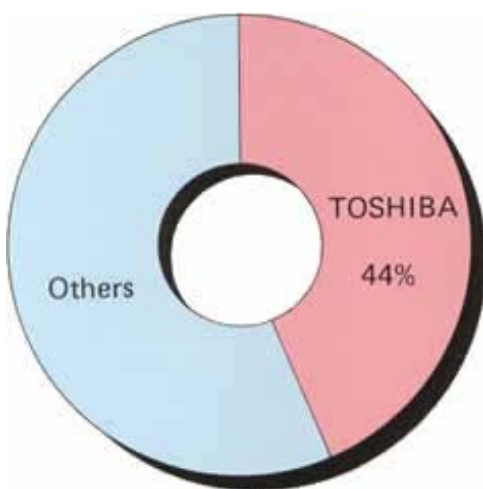
## 1. General

Recently, a unit capacity of geothermal power plant has been increasing more and more because of economical reason. While demand for small size geothermal power plant has also expanded. Small size geothermal power plant is generally used for the following purposes:

- Experimental unit as a pilot plant for large size plant installation scheduled in future
- Satisfaction of electricity demand in limited area
- Power source during construction
- Auxiliary or emergency power source for main geothermal generating plant
- Simplification steam transmission lines as a wellhead unit, because geothermal wells are scattered in geothermal field

Toshiba has a standardized series of portable small size geothermal turbine and generator set, which satisfy various requirements of clients. This portable type turbine and generator set is supported by our extensive experience of geothermal units. Special consideration is given to easy transportation, easy operation including start and stop, maintainability, high efficiency and high reliability. Toshiba portable type turbine and generator set is completely assembled on a common base then shipped to the site. Therefore installation and adjustment work at site can be minimized. Toshiba is always trying to meet any requirement of geothermal power generation from the clients based on our high engineering capability and abundant experience.

## Toshiba in the Geothermal Field



**Abundant Experience**  
**2451 MW 44 Units**

**High Technology and Engineering**

- **High Efficiency**
- **High Reliability**
- **Good Maintainability**

## 2. Applicable Operating Range

Toshiba Geothermal Portable Turbine Generator can be used in wide operating range shown in the table below.

Frame	Type-TPO	Type-TPB	Type-TPC
•Turbine type	Back pressure/ condensing	Back pressure	Condensing
•Type	Single stage curtis with reduction gear	Multistage rateau with reduction gear	Multistage reteau with reduction gear
•Power range	500-2000kW	2000-9000kW	2000-9000kW
•Steam condition Throttle press	3-10 kg/cm <sup>2</sup> g	3-10 kg/cm <sup>2</sup> g	3-10 kg/cm <sup>2</sup> g
•Speed	50Hz 6200 / 1500RPM 60Hz 7400 / 1800RPM	50Hz 6000 / 1500RPM 60Hz 6000 / 1800RPM	50Hz 5000 / 1500RPM 60Hz 5000 / 1800RPM
•No of stage	1 stage	Max. 6 stages	Max. 6 stages
•Oil cooler	Water or air	Water or air	Water or air
•Application	Power source for construction and start For blackout	Power generation and power for auxiliaries	Power generation and Power for auxiliaries

### 3. Approximate Steam Consumption

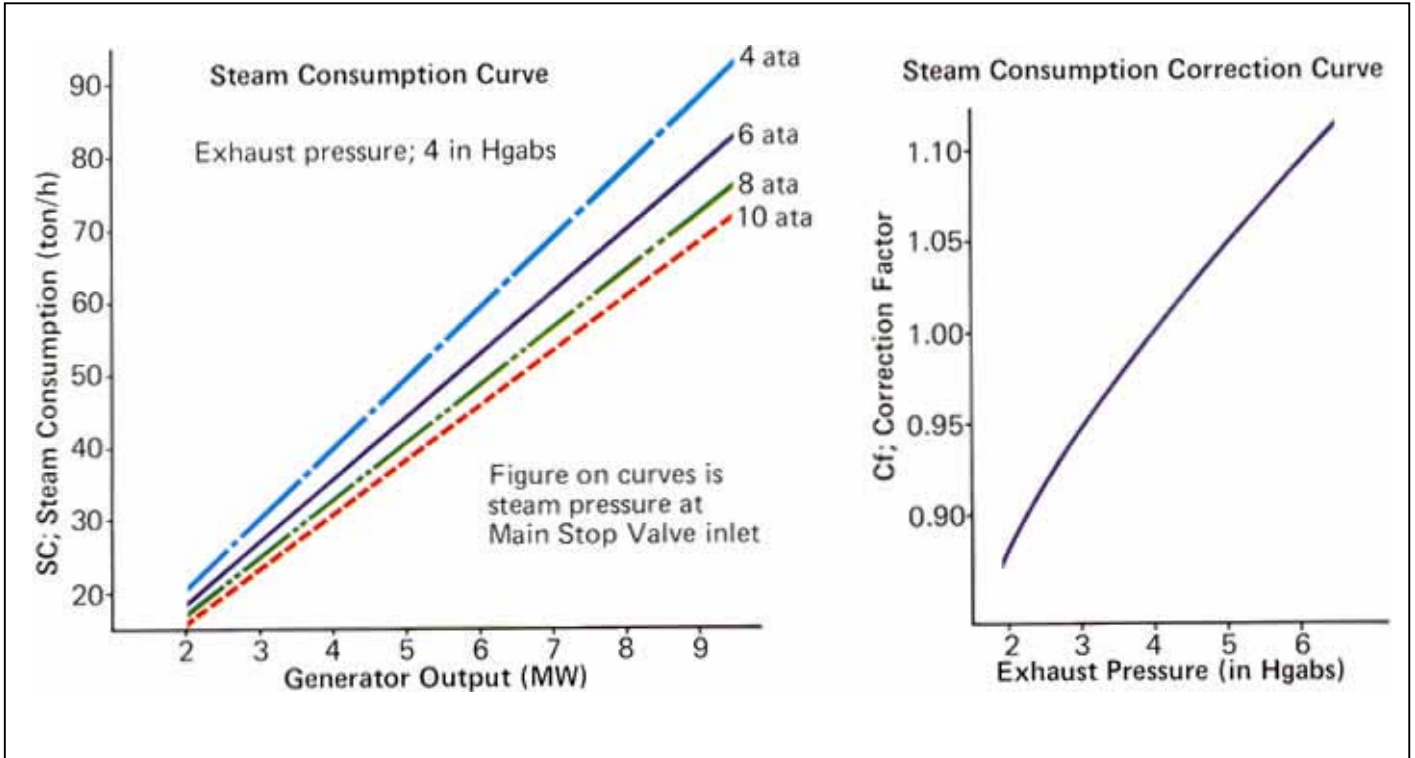
$$SC = SCo \times Cf$$

Where, SC; Steam consumption (TON/H)

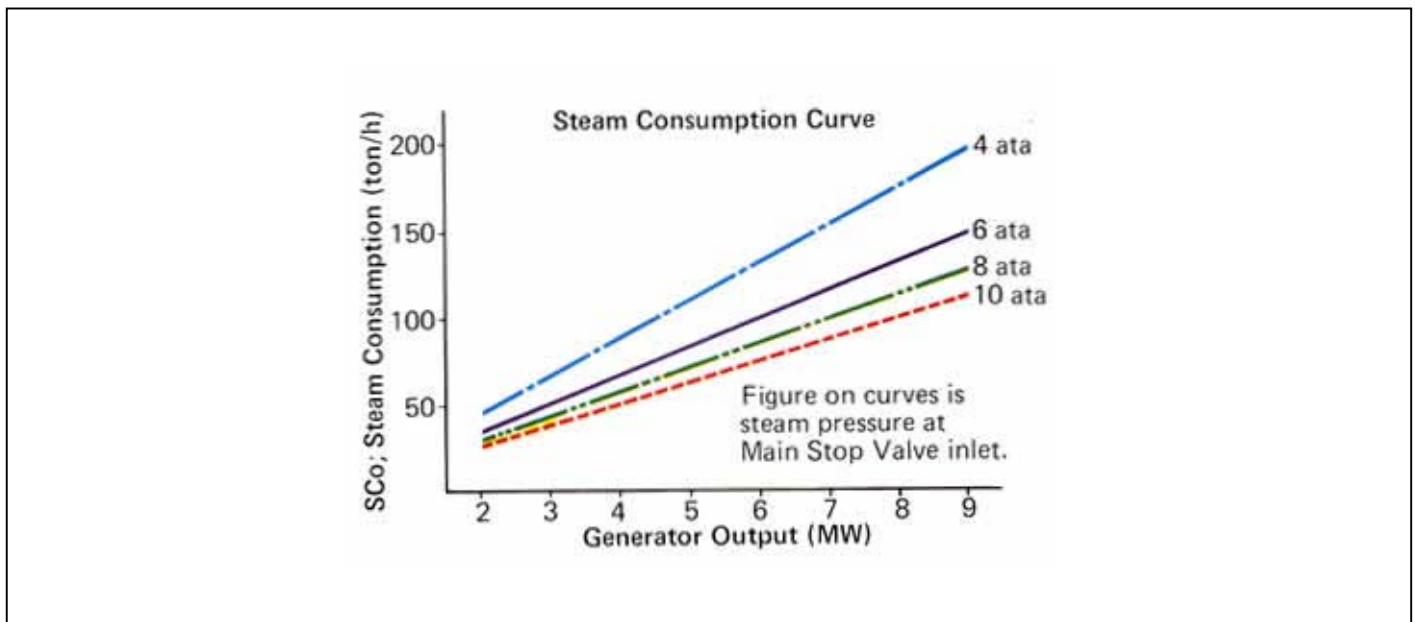
SCo; Basic steam consumption (TON/H)

Cf; Correction factor

#### Type-TPC



#### Type-TPB



## 4. Special Features of TSB's Geothermal Portable Turbine Generator

Toshiba geothermal portable turbine generator unit have the following special features.

### (1) High efficiency and high reliability

Toshiba portable steam turbines are of impulse type, multi-stage nozzles and blades and low steam consumption. The impulse design features sturdy and simple construction. This construction minimized damages from foreign materials and less susceptible to deterioration of performance due to increased leakage caused by packing rules. The nozzle diaphragm consists of web with an inner and an outer ring of sufficient strength, and the nozzle partitions are rugged and efficient cross section. The blades also have a rugged and efficient cross section, and are strongly fixed to a solid type rotor wheel.

### (2) Extensive experience in the geothermal power plant field

Toshiba has many years of experience in the geothermal power plant field. Currently, Toshiba's share of the aggregate power output of the units installed worldwide is almost 44%. Based on this accumulated experience we have acquired a level of technical expertise with respect to design, material selection, operation and maintenance.

### (3) Easy transportation and easy erection

Simplicity of construction ensures Toshiba portable turbine generator unit highly compact and easy to handle. Therefore the equipment can be installed at various sites and operated successfully. Moreover turbine, generator and their necessary auxiliary equipments are completely assembled on a common base in Toshiba's work. So transportation to site is very simple.

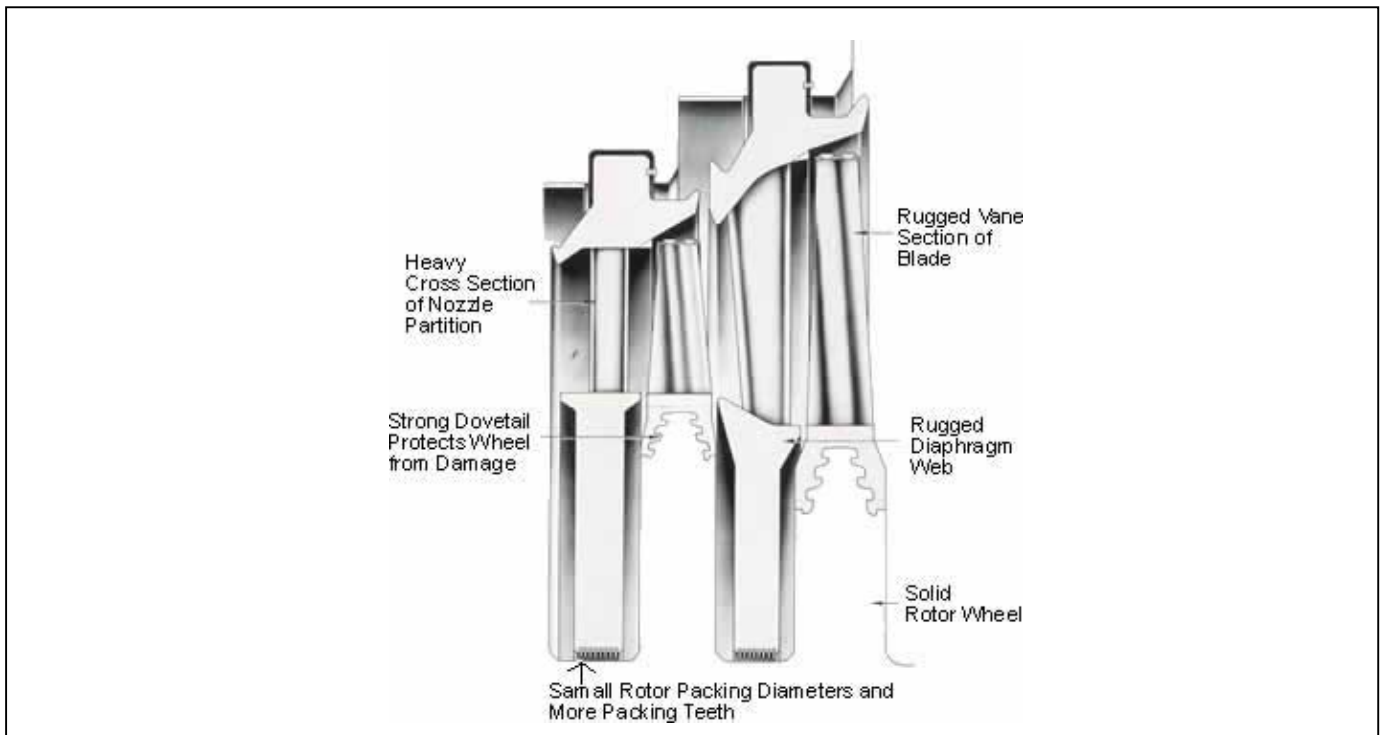
### (4) No power source for start

Toshiba portable turbine generator can be started without any auxiliary power source except a battery for instrumentation. The unit has steam turbine driven oil pump and mechanical-hydraulic control system. Therefore the unit can be installed without considering any electric network of the area.

### (5) Option for the various site conditions

Toshiba portable turbine generator unit can overcome any kind of purpose for unit use and site condition. For example, the type of oil cooler can be selected from two types-air cooled oil cooler and water cooled oil cooler-depending on the site condition.

## 5. Turbine Construction

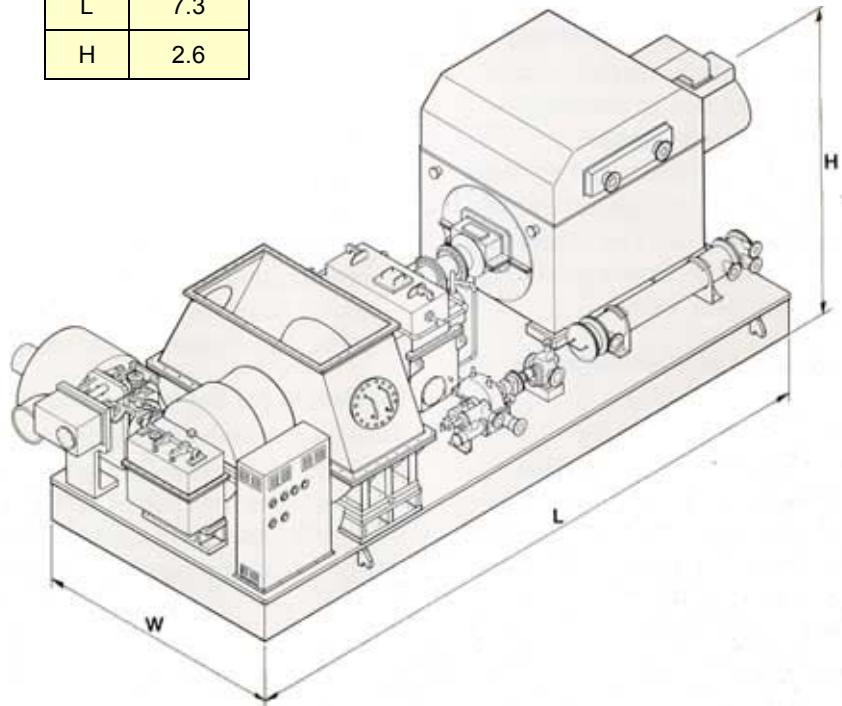


## 6. Mechanical Outline

### Type-TPC

Weight	Unit: Ton
Turbine	17.0
Reduction Gear	2.5
Generator	13.3
Common Base and Others	12.5
<b>Total</b>	<b>45.3</b>

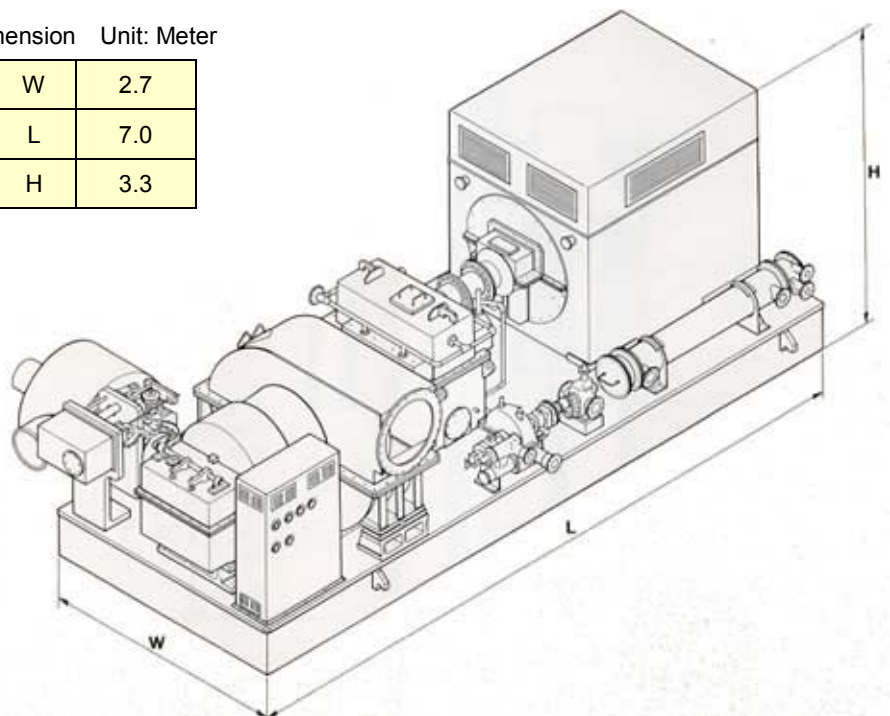
Dimension	Unit: Meter
W	2.7
L	7.3
H	2.6



### Type-TPB

Weight	Unit: Ton
Turbine	15.0
Reduction Gear	2.5
Generator	13.0
Common Base and Others	12.3
<b>Total</b>	<b>42.8</b>

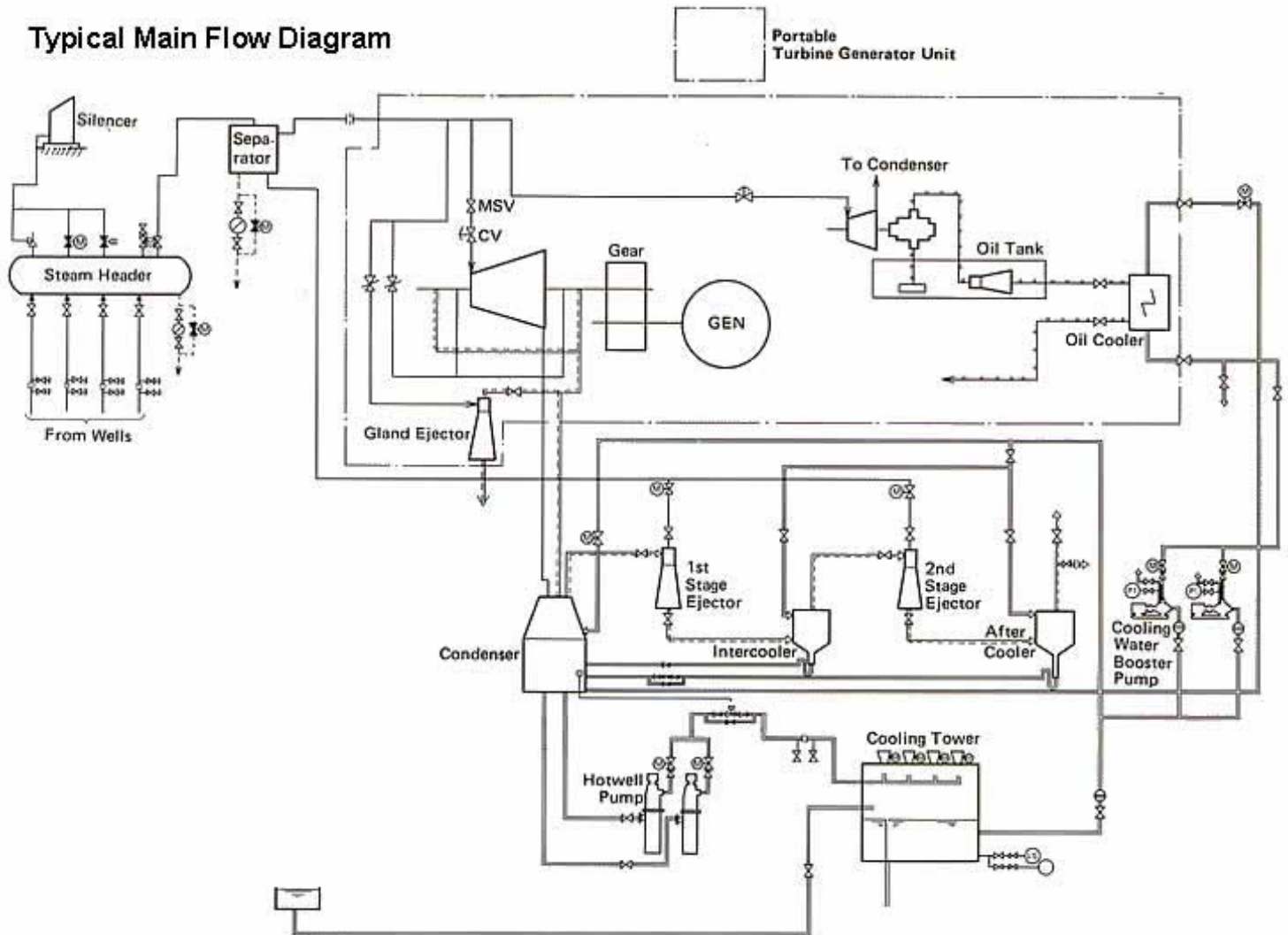
Dimension	Unit: Meter
W	2.7
L	7.0
H	3.3



## 7. Main Flow Diagram

Typical main flow diagram of the portable turbine generator with low-level type condenser and water-cooled oil cooler is as follows.

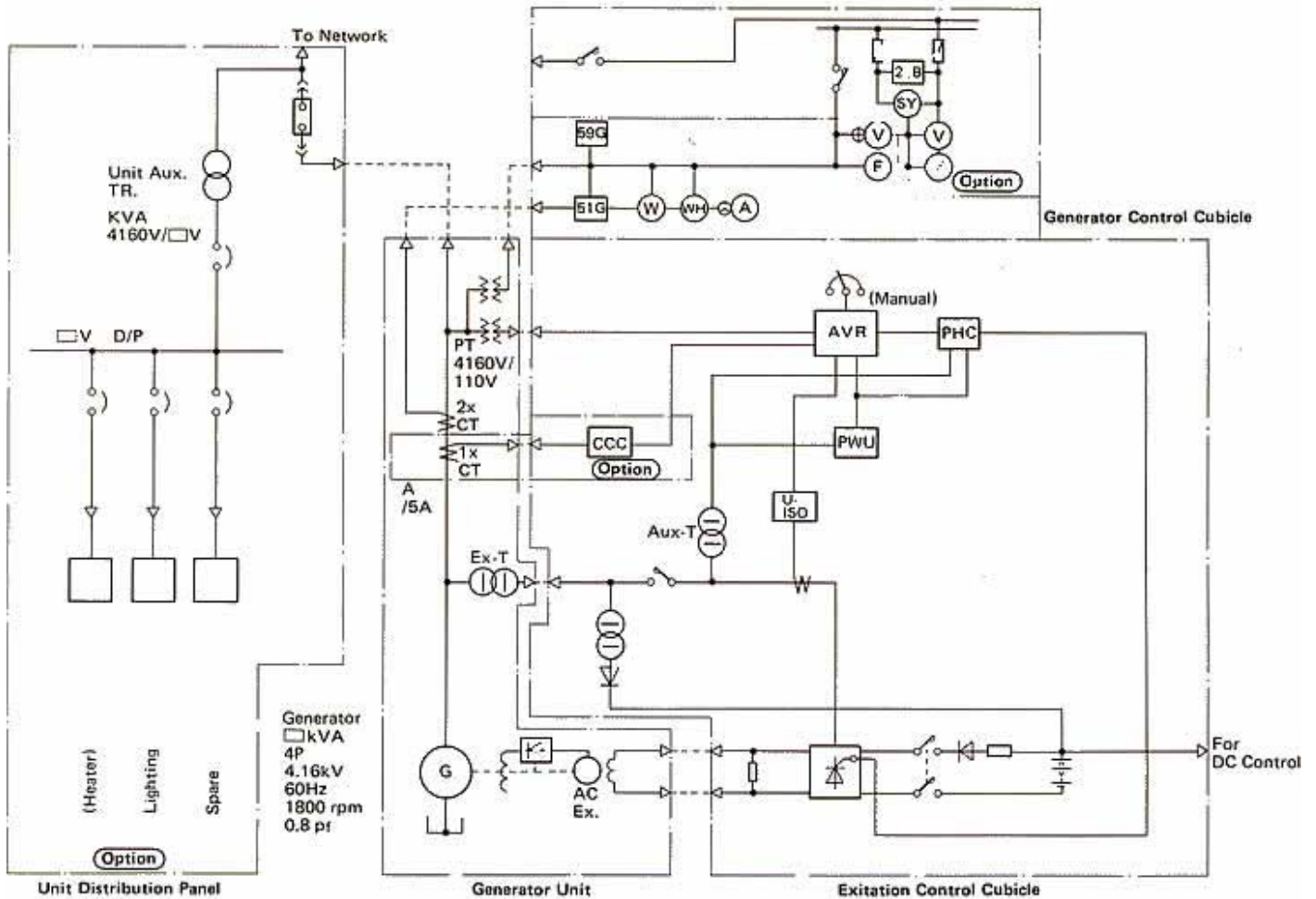
Typical Main Flow Diagram



**LEGEND:**

	Steam Pipe		Control Valve (Hydraulic)
	Water Pipe		Control Valve (Motorized)
	Gas Pipe		NRV
	Oil Pipe		Trap
	Drain Pipe		Strainer
	Connected		Butterfly Valve
	Not Connected		Motorized B/F Valve
	Gate Valve		Safety Valve
	Normal Close		Orifice
	Motorized Valve		Needle Valve

## 8. One-line Diagram



### LEGENDS:

G:	Generator	Aux-T:	Auxiliary Transformer
AC Ex.:	A.C. Exciter	59G:	Over Voltage Relay
AVR:	Automatic Voltage Regulator	51G:	Over Current Relay
PHC:	Phase Control Device	SY:	Synchrometer
PWU:	Power Unit	25B:	Synchronizing Check Relay
CCC:	Cross Current Compensator	W:	Watt Meter
U-ISO:	Isolator	WH:	Watt Hour Meter
Ex-T:	Excitation Transformer	V:	Voltage Meter
		F:	Frequency Meter

## 9. Supply Scope

### Turbine

Steam Turbine	1 Set
Reduction Gear Unit	1 Set
Speed Governer and Speeder	1 Set
Control Valve and Servomotor	1 Set
Main Stop Valve with Steam Strainer	1 Set
Emergency Governer with Hand Trip and Reset	1 Set
Bearing Oil Pressure Low Trip	1 Set
Oil Pump-Small Steam Turbine Driven	1 Set
Oil Cooler	1 Set
Oil Filter	1 Set
Oil Filter Differential Pressure Trip	1 Set
Oil Tank Integral with Common Bed for Turbine Generator	1 Set
Starting Panel and Instruments	1 Set
Gland Ejector	1 Set
1 set	

### Generator

Generator	1 Set
Exciter	1 Set
Generator Control and Synchronizing Panel	1 Set
Exciter Control Panel	1 Set
PT	1 Set
CT	1 Set

# TOSHIBA

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