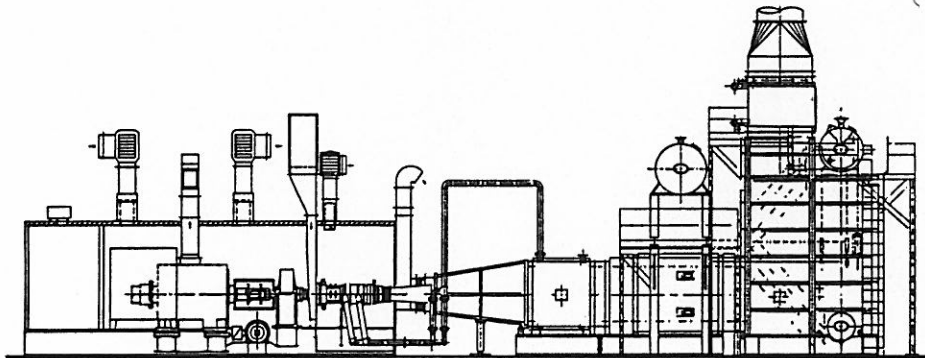


CHENG CYCLE SERIES 7-COGEN PRODUCT DESCRIPTION

Contents

	<u>Page</u>
1. Summary	2
2. Standard Plant Layout	5
3. Scope of Supply Alternative 1 - Equipment Modules	11
4. Scope of Supply Alternative 2 - Installed Power Island	19
5. Scope of Supply Alternative 3 - Turnkey Plant	20
6. Series 7 Interface Conditions and Requirements	21
7. Series 7 Performance	23
8. Options	25



INTERNATIONAL POWER TECHNOLOGY

2800 West Bayshore Road

Palo Alto, CA 94303

(415) 858-1611

1. SUMMARY

Introduction:

International Power Technology (IPT) is an integrated energy company providing a wide range of products and services to those involved in cogeneration and power generation. IPT supplies cogeneration systems which utilize its patented Cheng Cycle technology.

The Cheng Cycle is a unique, advanced power generation technology developed and patented by IPT. In essence, it is a heat engine cycle which combines and optimizes the Brayton (combustion gas turbine) and Rankine (steam turbine) cycles using a single gas turbine as prime mover. Controlled injection of superheated steam into the gas turbine combustor region provides additional mass flow. The result is a dramatic increase in power output and generating efficiency. Power output is increased by as much as 60% over that of a conventional simple cycle system, and generating efficiency is increased by as much as 40%.

In cogeneration, Cheng Cycle systems benefit from the ability to economically follow fluctuating thermal loads. Steam not needed for process is superheated and injected into the gas turbine, thus increasing power output and generating efficiency. In addition, the use of a supplemental burner allows peak electrical production while continuing to follow process steam loads. This additional electrical output can be used for peak shaving operation or for capacity sales to an electric utility. The benefits of operating flexibility and additional electrical capacity are gained without the use of steam turbines and associated auxiliaries. The system remains mechanically simple and reliable.

Series 7-Cogen Overview:

IPT's Cheng Cycle Series 7-Cogen (Series 7) is a gas turbine based, pre-engineered modular cogeneration plant capable of producing up to 5.6 megawatts of electrical power and up to 45,000 pounds per hour of process steam. The customer is typically either an industrial, institutional or commercial energy user who plans to cogenerate steam and electricity for its own use, or a developer who is financing a cogeneration project.

Scope of Supply Alternatives:

IPT offers the Series 7 in three ways:

Alternative One - Equipment modules including all major equipment items and balance-of-plant (BOP) systems required for operation. These are shipped FOB to the construction site for installation by others.

Alternative Two - A complete, installed power island consisting of the Alternative One equipment modules plus installation and construction. Interconnection and interfacing of the power island with existing systems (steam, electric, water, fuel and waste) is not included.

Alternative Three - A complete, turnkey plant including the Alternative Two power island plus all necessary interfacing and interconnect with existing systems.

These three options allow IPT and the customer to tailor IPT's participation in a project to fit specific needs and preferences. This approach is particularly useful for projects which have significant non-cogeneration plant related activities such as construction of new facilities or enhancement/ refurbishment of existing energy systems. It can also be useful when the cogeneration plant is being placed in an existing building or when integration of the cogeneration system with existing systems is particularly complex. In these situations IPT could do the entire project, or IPT's scope could be limited to that part of the cogeneration project which can utilize the standardized Series 7 equipment modules or power island.

Packaging and Design Philosophy:

The system described in this document is the product of years of experience in the design, construction, and operation of Cheng Cycle cogeneration systems. With four Series 7 units in operation (three of which are operated by IPT), and two more units under construction, IPT's base of experience is unmatched by any other supplier of similarly sized cogeneration systems. This depth of actual design, construction, and operating experience has resulted in a truly unique system which combines the benefits of Cheng Cycle technology with low cost installation and proven reliable design.

Experience has shown that to ensure a successful cogeneration project, the major equipment and all auxiliary systems and components must be designed and built as an integrated system. In addition, there are numerous advantages to having a single source bear responsibility for all critical systems and components. For this reason, **IPT offers a complete system rather than individual pieces of equipment.** Some of the benefits of this are:

- **Highest reliability and operability** is achieved because the design of all systems and components reflects IPT's experience with actual operating plants, and because all subsystems and components are designed from the ground up to operate together as an integrated system
- **Engineering and design costs are dramatically reduced** because each plant is based on a fully developed standard design
- **Project management is greatly simplified** because IPT is responsible for all critical systems and components
- **Installation and startup costs are significantly reduced** because each plant is based on a fully developed modular design, and the same experienced design, manufacturing, and construction (if Alternative 2 or 3 is chosen) team is used on each project
- **Enhanced customer service and support** is possible because all Series 7 plants share a common design basis

A unique modular approach has been used in the design of the Series 7. All major components and systems are factory assembled in skid-mounted modules to the greatest extent possible. This yields many benefits:

- **Field fabrication and erection costs and time are minimized**
- **Quality is maximized** because module fabrication and assembly is performed under shop rather than field conditions by an experienced, competent team
- **Highest operability and maintainability are achieved** because plant layout and design is thoroughly thought out in advance, with the design of each module reflecting actual operating experience
- **Space constraints can be easily accommodated** with minimal redesign by changing the placement of individual modules. Modules are designed to minimize field interconnection

requirements

- **Site specific operating requirements are easily accommodated** (e.g. fuel gas compression, water quality) through configuration changes to individual modules

Scope of Supply Summary:

As mentioned above, IPT supplies the Series 7 in the following three ways:

Alternative One - Pre-packaged Equipment Modules Under Alternative One, IPT supplies pre-packaged equipment modules which are delivered FOB to the cogeneration plant site for installation by others. Included in Alternative One are:

- Allison 501 KH gas turbine generating set designed for Cheng Cycle operation
- Matched heat recovery steam generator (HRSG) with supplemental firing capability.
- Distributed digital control system with performance monitoring and economic optimization functions
- Balance of Plant (BOP) prefabricated equipment modules for water treatment, air compression, fuel treatment, and electrical equipment
- Project management and startup, and training services
- Interconnecting piping spools and wiring shipped loose

Alternative Two - Installed Power Island This second Alternative provides additional construction and installation services required for a completely installed, operational cogeneration power island. Included are:

- All equipment and services included in Alternative One
- Power island interconnecting piping and wiring, including routing of all inputs and outputs to a single point on the plant boundary
- Power island foundations
- All field construction and installation services required for the power island

Alternative Three - Turnkey Cogeneration Plant As a third alternative, IPT can provide the additional engineering and construction services required to interconnect and interface the power island provided under Alternative Two with existing facilities and electric and gas utilities. The result is a fully operational, turnkey cogeneration plant. Typically included are:

- All equipment and services included in Alternative Two
- Connection of the power island steam, electrical, water, fuel, and waste interfaces with existing site systems
- Electric and gas utility interconnects
- Enclosure of the cogeneration plant in a building

Many projects also involve enhancement or refurbishment of existing energy facilities. IPT can provide these services or recommend a suitable engineer/constructor with which IPT has had good working experience. Also, a broad range of equipment and service options are available to allow tailoring of the Series 7 to match project specific requirements. These are described in the Options section of this document.

2. PLANT LAYOUT

Standard designs have been developed for both the Series 7 equipment modules and the installed power island. The standard designs incorporate the plant layout shown on the following pages. The equipment shown is described in the Scope of Supply section of this document. (Note: equipment shown with dashed lines is optional).

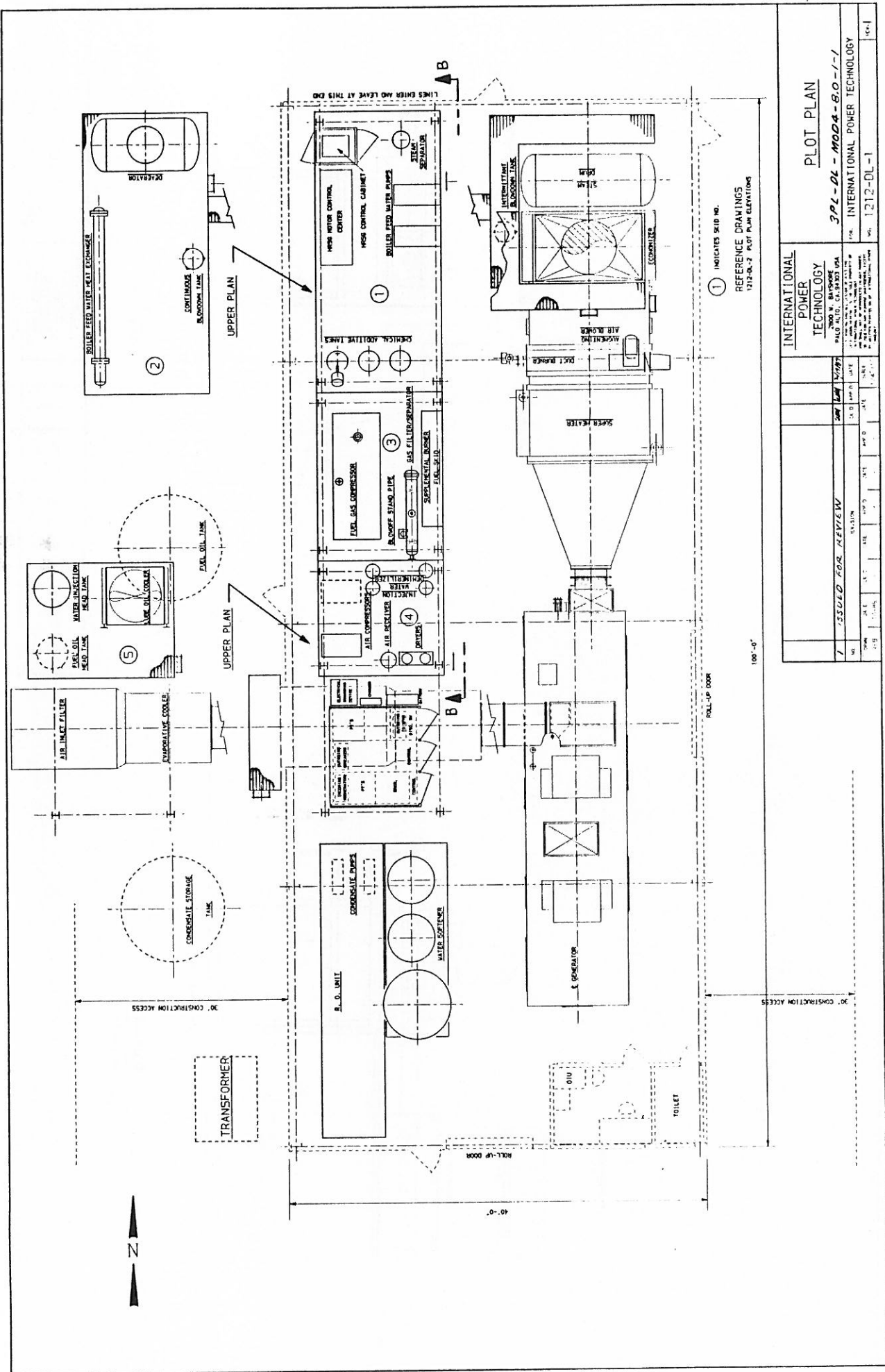
This layout:

- Minimizes field construction and installation costs
- Minimizes overall space requirements
- Provides optimum maintainability and operability of the entire plant based on actual operating experience with other Cheng Cycle plants

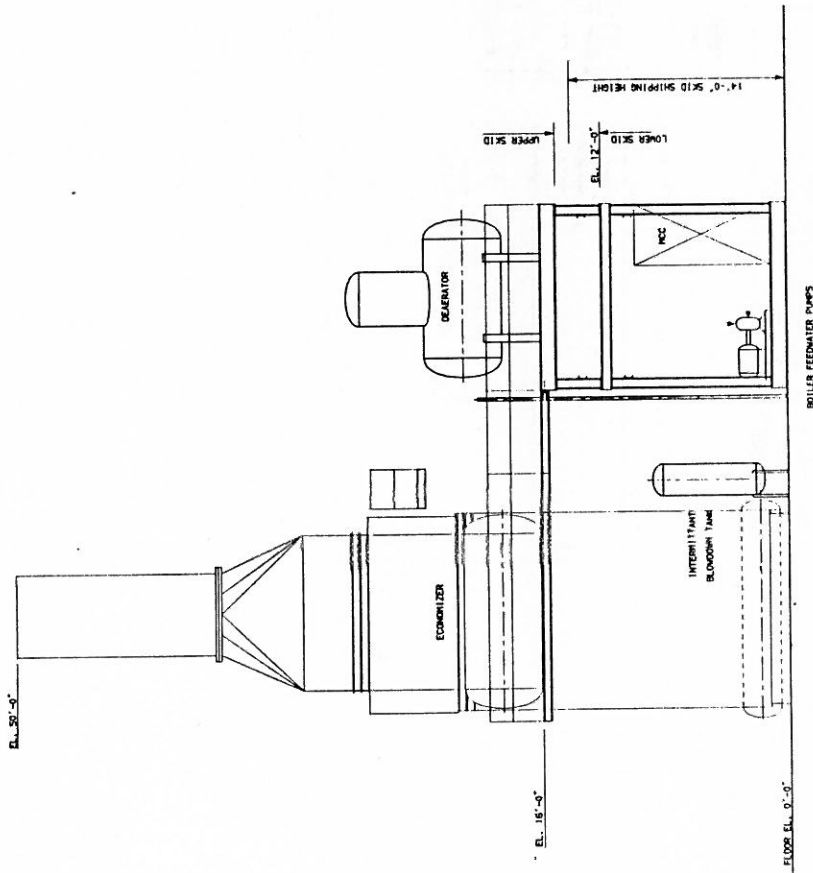
Key features of this layout include:

- All piping inputs/outputs are routed to standard interface locations on the plant boundary. This allows the power island to retain its standard design irrespective of existing site interface locations.
- Each module is configured to minimize interconnection requirements.
- Most piping and wiring is prefabricated as an integral part of the BOP equipment modules, eliminating field construction problems. A pipe and cable-tray rack is an integral part of the HRSG accessory, fuel treatment, and plant air skids. Piping not integral to the modules is delivered to the construction site as pre-fabricated spool pieces.

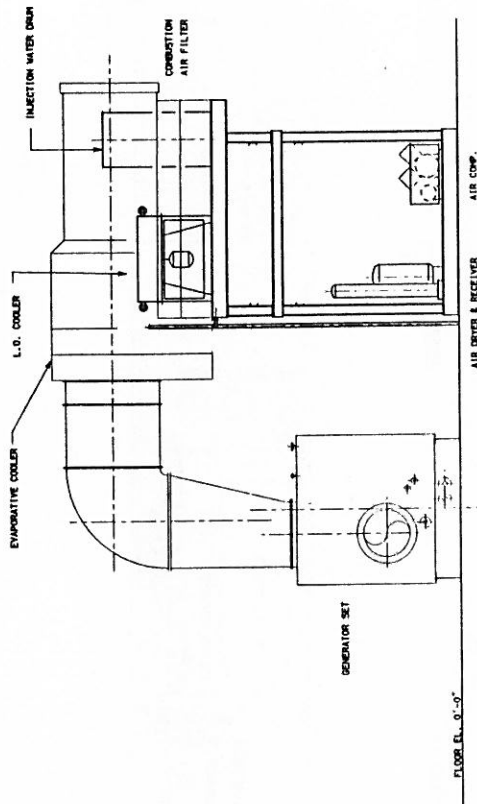
For a variety of reasons, including cost and maintainability/operability, it is desirable to use this standard layout if possible. However, in the event that insufficient space is available to accommodate the layout shown, the plant is easily reconfigured by relocating individual modules. Each module has been designed to minimize interconnections so that relocation is relatively simple.



INTERNATIONAL POWER TECHNOLOGY		PLOT PLAN	
3PL-DL-MOD4-B.O.-1-1		FOR INTERNATIONAL POWER TECHNOLOGY	
ISSUED FOR REVIEW		REV. DATE	
DATE	BY	DATE	BY



ELEVATION
(LOOKING SOUTH)
DWG. 1212-0L-1

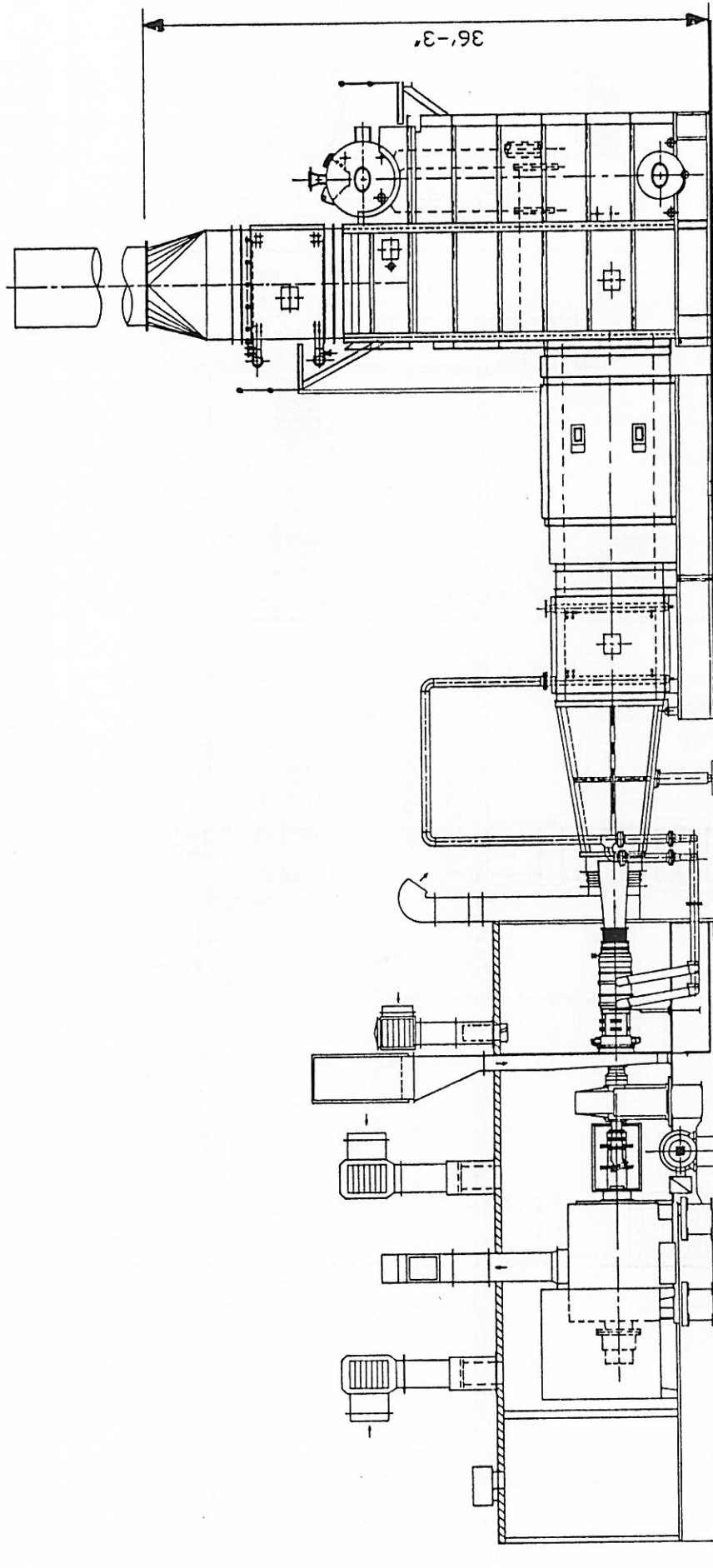


SECTION
(LOOKING SOUTH)
DWG. 1212-0L-1

INTERNATIONAL POWER TECHNOLOGY		INTERNATIONAL POWER TECHNOLOGY	
2000 N. BAYVIEW DALLAS, TEXAS 75210 USA Tel: (214) 343-1111 Fax: (214) 343-1112 www.internationalpowertech.com		PROJECT NO. 1212-0L-2	
NO.	DATE	BY	CHKD.
1	12-08-06		
REVISION		DATE	BY

PLLOT ELEVATIONS
3PL-0L-1004-8.0-2-1

INTERNATIONAL POWER TECHNOLOGY
NO. 1212-0L-2



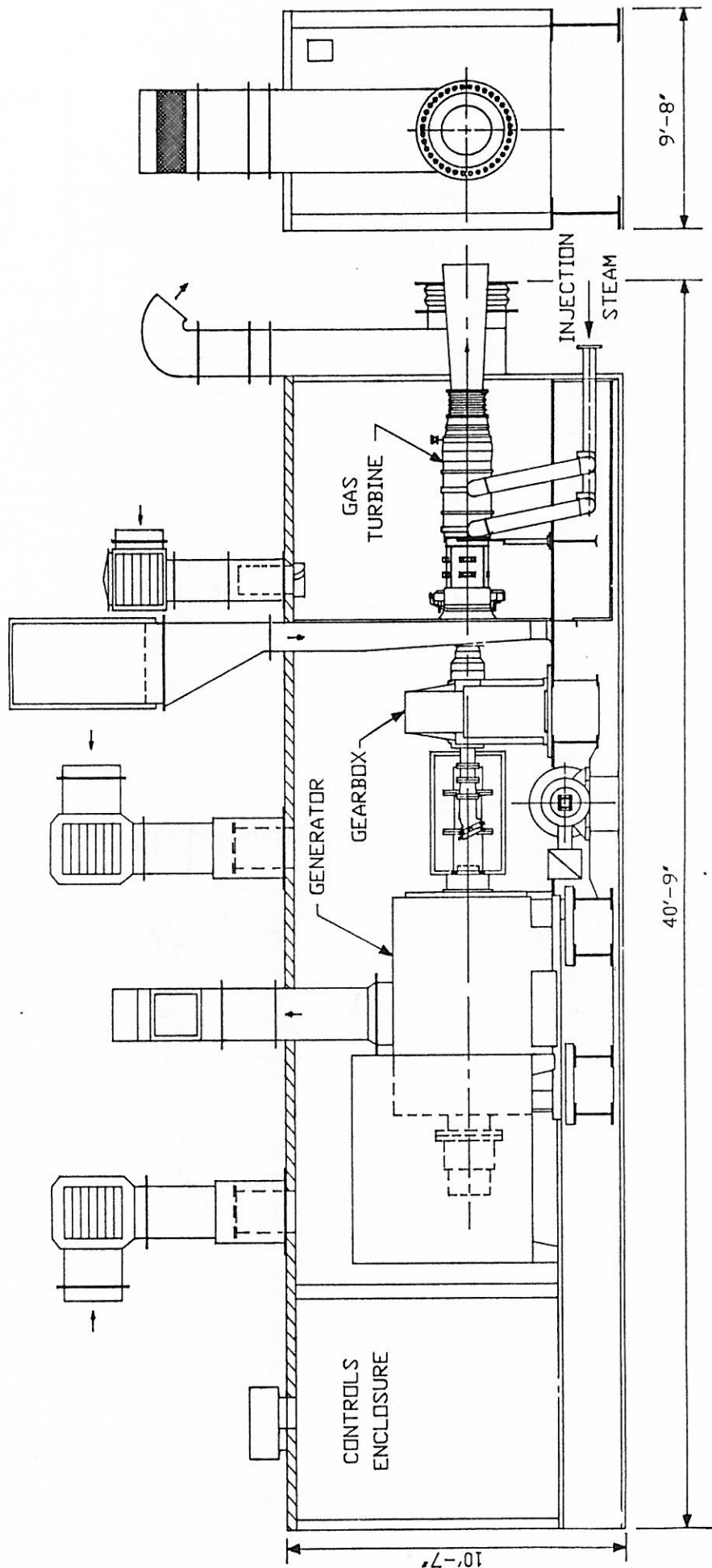
86'-6"

36'-3"

EQUIPMENT WEIGHTS		
	SHIPPING	OPERATING
TURBINE-GENERATOR SKID	85,800 LB.	94,500 L.B.
INLET FILTER/EVAP. COOLER	—	9,700
SUPERHEATER	30,000	32,800
BOILER	73,500	96,750
ECONOMIZER	25,400	28,270

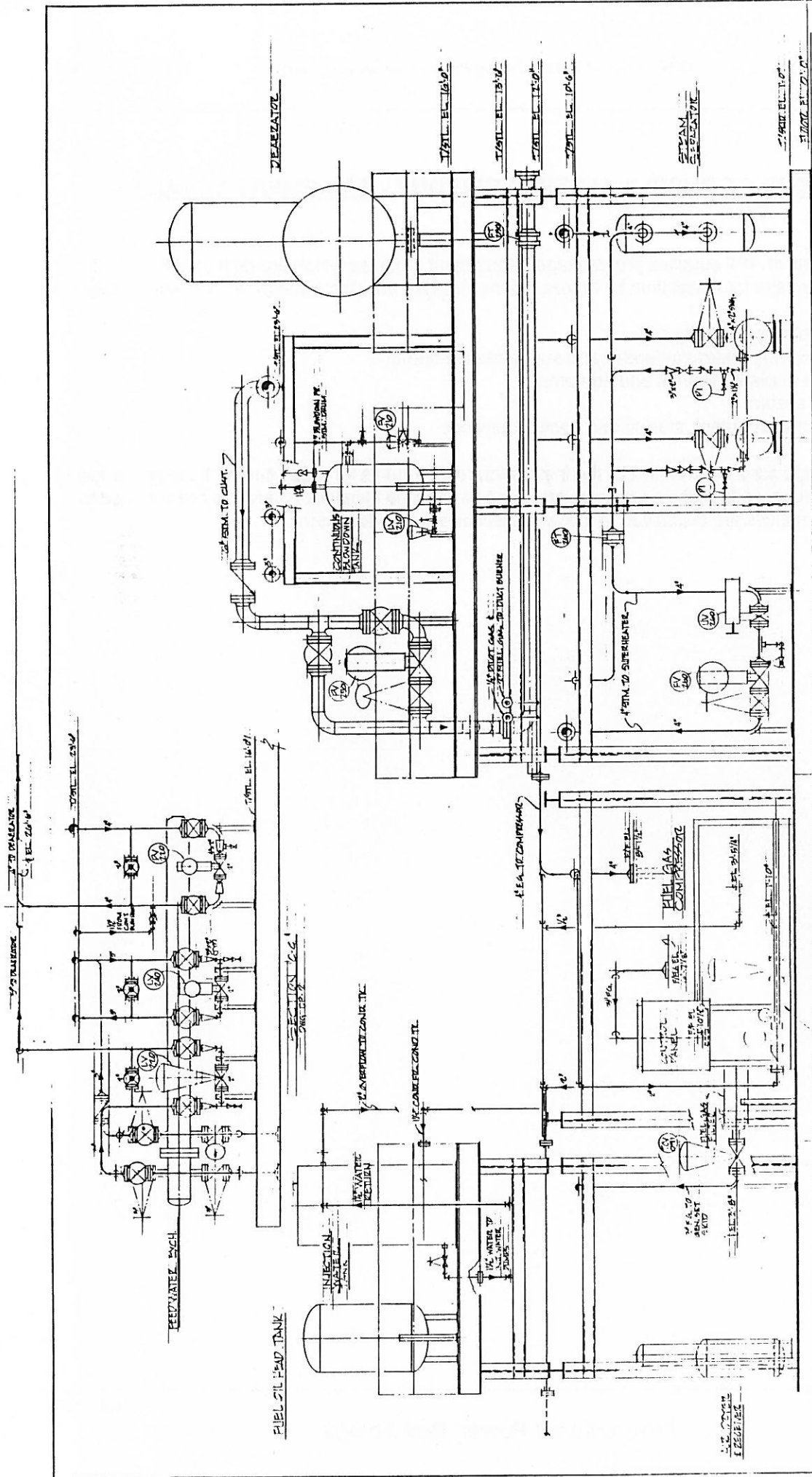
CONTRACT NO.		INTERNATIONAL POWER TECHNOLOGY	
MOD 4		2800 V BAYSHORE, PALO ALTO, CA.94303, USA	
DRAWN	FRANK LU	CHENG CYCLE SERIES 7 COGEN. UNIT	
CHECKED	H. NYGARD	GENERAL ARRANGEMENT,-ELEVATION	
ISSUED	F. SPAKOSKI	REV. B	
3/10/87			

SPL-GA-M004-IPT-1-1



CONTRACT NO.		MOD #4	
DRAWN	FRANK LU	INTERNATIONAL POWER TECHNOLOGY 2800 V BAYSHORE PALO ALTO CA 94303, USA	
CHECKED	H. NYGARD	OUTLINE TURBINE GENERATOR SET	
ISSUED	F. SPAKOSKI	EQUIPMENT ARRANGEMENT, -ELEVATION	
2-19/87		REV. A	

3PL-GA-MOD4-IPT-2



SECTION 10-B
 SUPPLEMENTAL BURNER FUEL SHUTOFF

Howe-Baker Engineers, Inc. TEXAS	
DEAERATOR & GAS COMP. PIPING STUDY DETAILS	
INTL. POWER TECHNOLOGY No. 1212-OP-2A	3PL-OP-MOODA-8.0-(A)-1

PROJECT NO. 1212-OP-2A SHEET NO. 10-B DATE 11-1-66 DRAWN BY J. G. B.	CHECKED BY J. G. B. APPROVED BY J. G. B.
---	---

3. SCOPE OF SUPPLY ALTERNATIVE ONE - EQUIPMENT MODULES

Under this alternative, IPT supplies pre-packaged equipment modules which are delivered FOB to the cogeneration plant site for installation by others. Items included are discussed in the following categories:

- Gas turbine generating set
- Heat recovery steam generator and supplemental burner
- Balance of plant systems and equipment
- Control system
- Project management, startup and training services

The last section provides an overview of the installation requirements for these items. If the power island or turnkey plant supply alternatives are selected, some or all of the installation services are provided by IPT. These alternatives are discussed in following sections of this document.

Items Included:**Gas Turbine Generating Set (Genset):**

Electrical power is produced using a steam injected Allison 501KH gas turbine engine driving a generator through a speed reduction gearbox. The standard package is natural gas fueled and generates at 4.16 kV. Other fuel and generating voltage configurations are available as optional equipment. The turbine and generator are packaged as a complete unit within a skid-mounted, acoustic enclosure. The fuel control system, speed reduction gear, and lubrication system are also included in this enclosure. Attached to the rear of the enclosure is an air-conditioned compartment housing a control module, a control panel, and a motor control center for genset skid and off-skid auxiliary equipment motors.

The following components are included as standard:

Mounted on the genset skid:

- Allison 501KH gas turbine engine equipped for operation on natural gas
- Gas turbine engine governor system
- Speed reduction gear between the turbine and generator
- AC generator, 4.16 kV, 60 hertz with termination cabinet
- Brushless excitation system
- Motor control center with starters, transformer and distribution panel for turbine/generator system power, lighting and control needs
- Control system components and synchronizer
- Fuel gas combustion control system
- Lube oil system for turbine, speed reduction gear and generator
- Electro-hydraulic engine starter system
- Acoustic enclosure for turbine/generator equipped with frame and hoist for turbine installation and removal
- Compressor wash system (mixing cart is supplied loose with quick disconnect couplings)
- Fire and gas detection system, with automatic halon fire suppression system
- Gas turbine injection steam piping
- Air-conditioned control compartment
- Structural steel base for complete genset skid
- Expansion joint between turbine exhaust and HRSG transition duct
- Forced air cooling systems for the generator/gearbox, and gas turbine compartments

Associated equipment located off-skid:

- Compressor wash system
- Turbine combustion air filtration and inlet silencing

HRSG and Supplemental Burner System:

Steam for process and gas turbine injection is produced using a natural circulation, supplementally fired HRSG. The unit is shop fitted, then shipped to the site in sections. The major sections are: evaporator, economizer, superheater, supplemental burner, firing duct, platforms and stack. Interconnecting piping is shop fabricated into flanged spools for easy field assembly. Trim is shipped loose.

The supplemental burner is used to augment steam production. The unit is located between the

superheater and the evaporator, and includes an augmenting air system and all necessary control and safety devices. The standard unit is equipped for operation on natural gas, with different fuel configurations available as optional equipment.

The following components are included as standard:

- Two drum natural circulation evaporator with insulation and metal casing
- Economizer unit with insulation and metal casing
- Drainable stainless steel superheater
- Gas fuel duct burner
- Burner augmenting air blower with automatic damper
- Duct burner scanner air blower
- Duct burner firing duct, internally insulated and lined
- Interconnecting piping between HRSG components and the HRSG accessory skid
- Interconnecting piping between the superheater and the genset for gas turbine injection steam
- Transition duct between gas turbine exhaust expansion joint and superheater, with internal insulation and lining
- Circular exhaust gas stack, 50 feet above ground level
- Emission monitoring ports downstream of the economizer. (no instrumentation included)
- Platforms and ladders for access to boiler steam drum and emissions monitoring ports
- Boiler trim piping, local gages, relief valves, etc. (shipped loose)

Balance of Plant Systems and Equipment:

The balance of plant is provided as a set of prefabricated modules. The equipment on these modules is grouped to minimize fabrication and installation costs, and to enhance operability and maintainability.

Standard equipment includes:

Water treatment module - depending on site specific raw water quality, this module will be configured to have some or all of the following elements:

- Multi-media filters
- Sodium zeolite softeners
- Reverse osmosis system

Plant air module:

- Air compressor
- Air receiver
- Automatic regeneration air dryer
- Air-cooled genset lube oil cooler

Fuel module:

- Fuel gas compressor
- Gas filter-separator
- Filter-separator blowoff standpipe
- Supplemental burner fuel piping