



# Refinery Equipment of Texas

The Smart Advantage



## MODULAR CRUDE OIL REFINING

### OVERVIEW

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## Crude Oil Refining



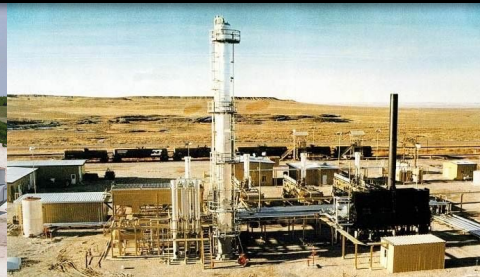
**A REOT Portable Diesel Fuel Plant** can be operated in the oil field to produce fuel for diesel engines. It is *simple-to-operate*, *easy-to-start*, and *easy-to-shut down*. Fill your diesel storage tanks and shut the plant down until it's needed again. This is one of the many configurations we can provide to meet your requirements.

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**Modular Refineries** - are skid mounted, modular crude oil Atmospheric distillation units (ADU) which process from 7,500 to 300,000 metric tons (150 - 6,000 BPD) of crude oil per year and are capable of producing a variety of finished products including naphtha (straight run gasoline), kerosene, arctic and summer diesel and fuel oil. A reformer may be added for producing high-octane gasoline. Two or more plants can be installed on a single site allowing the simultaneous processing of more than one type of crude oil; and one plant can still be in operation in the event one plant is down.

\*\* Metric Tons Per Day - To obtain the daily rate in metric tons, multiply the BPD rate by .15893 times the specific gravity of the crude. (BPD x .15893 x SG)

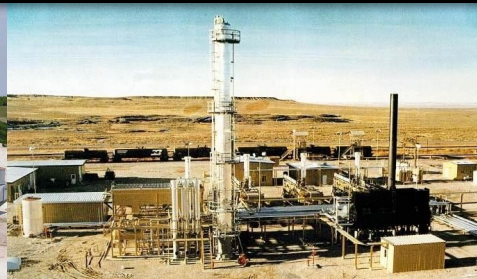
**Modular Refinery Turn Down Ratios** – Small modular refineries have practical turn down ratios of 2:1 (two to one) which simply means you can divide their bpd by two (bpd/2) to arrive at the minimum amount of crude oil that must be refined for the fractionation column to have proper hydraulics and work efficiently. For example, a 3,000 bpd unit must have a crude oil feed rate of at least 1,500 bpd to function properly. A 6,000 bpd unit must have a crude oil feed rate of at least 3,000 bpd to function properly. It is better to have two 6,000 bpd refineries than one 12,000 bpd single refinery. Operating two 6,000 bpd refineries gives you the crude oil feed rate flexibility to operate at 3,000 or 6,000 or 9,000 or 12,000 barrels per day without shutting down your refining operation.

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## **Modular Refinery Models – 150 / 1000 / 3000 / 6000 Barrels Per Day**

- Refineries can be set up and in operation within two days after arrival at a site where the foundation and storage tanks are in place.
- A single operator may restart the plant from a cold start and have the plant in full operation in less than two hours.
- Are completely automated and once an operator sets all the controlling points, all product temperatures and flows are controlled automatically. If a product specification drifts off or if a potentially hazardous condition develops, the plant automatically adjusts itself to a safe condition, without the help of an operator and a “first out” annunciator signals the reason for the shutdown by a flashing red light. The operator can then make the necessary adjustment or the plant will automatically shut down.
- Only level ground or concrete slab without anchor bolts is required for plant support
- Requires no water, steam, or instrument air to operate
- Fuel supply can be off-gas, natural gas, naphtha, diesel, fuel oil or a combination of these fuels.

### **REOT Can Supply the Following Additional Equipment:**

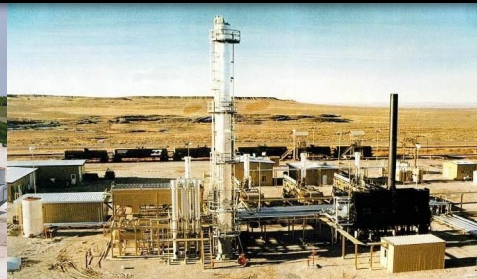
- Special alloy(s) which may be included in the plant design
- Desalter packages for removing salt from the crude
- Naphtha, jet fuel, and diesel hydrotreaters for removing sulphur from the products
- Reformers for producing high octane gasoline motor fuels
- Gasoline stabilizers for reducing the Reid vapor pressure of motor fuels
- Winterized skids for operation in Arctic weather
- Portable laboratory and control buildings with supplies.

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## The Company

Refinery Equipment of Texas, LLC and its associated engineering and manufacturing groups have designed and manufactured oil and gas equipment since 1978. They have completed numerous international projects, including oil and gas production flow stations, meter stations, compressor stations, custody transfer skids (lact units) refinery expansions, refinery de-bottlenecks, modular refinery equipment manufacturing and grass roots (120,000 bpd) refinery project execution and strategic project implementation.

### Why Refinery Equipment of Texas?

- Experienced Management
- Excellent and seasoned engineers
- Excellent fabricators – superior quality
- Excellent industry & supplier relationships
- Fast turn-around & delivery times
- Lean, flexible and responsive to client needs
- No bureaucracy – speak directly with owners

### Refinery Automation

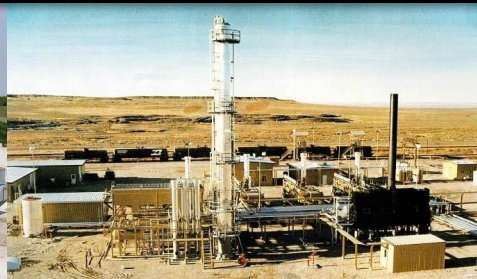
- Refinery is fully automated
- Push a button to start the plant
- Automatic shut-down if refinery parameters change from established set points
- Operator training is fast and easy
- System diagnostics is built into the software
- Refined products and diesel are excellent quality because of automated controls

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## **Refinery Security**

- Global safety - Cyber security is built into the plant controls
- 10 levels of security set by the owner
- Security levels can be increased or lowered as required
- Employee operator can be added or locked-out of the control system
- Audit trail built in to determine what changes have occurred
- Refinery telemetry – provides plant wide diagnostics and troubleshooting from anywhere in the world
- Many more features

## **Refinery Maintenance**

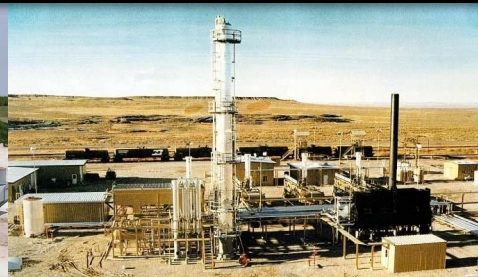
- REOT refineries use the latest and best technology with modern design and off the shelf parts – no exotic parts
- REOT uses only globally recognized manufacturers
- REOT parts are easily replaced with a minimum of down time and manpower
- REOT training helps the operators understand maintenance requirements and prevent failures before they occur or before they become a problem
- REOT provides the necessary support when you need it!

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## Modular Refinery Applications

Traditionally, the petroleum industry has constructed large-scale refineries at centralized locations, supplying them with crude oil and gas condensate via pipeline and transport truck. Refined grades of products are subsequently transported from the refinery to consumer markets, primarily by transport truck.

While large-scale refineries provide the bulk of refined products to the world marketplace, the majority of new hydrocarbon discoveries by industry majors and large independents occur in areas where there is limited or no available infrastructure for transportation and refining. Therefore, producers are forced to construct expensive infrastructures for transporting the hydrocarbons to an available refinery, or construct a new refinery at a location near the production site. Under the best of circumstances this process can take several years.

In populated areas near a pipeline or oil field and not near a refinery, a small REOT mini- refinery can be installed that will process crude oil directly from the pipeline.

This plant can “thief the diesel” or desired distillate for local consumption, and then injects the unused portion of the crude back into the pipeline.

**Below - Two 1,000 BPD units, one crated for overseas shipping**

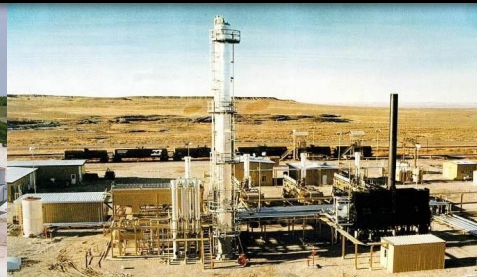


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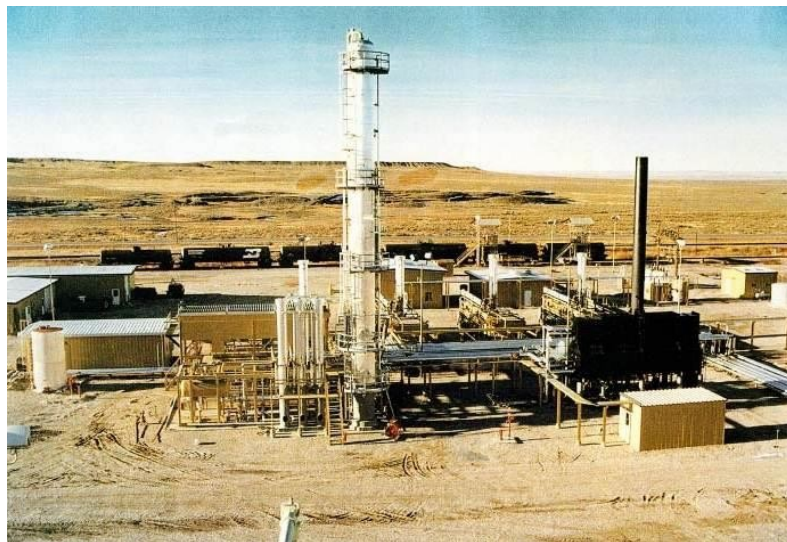




## Modular Refining Equipment

Refinery Equipment of Texas and its associated engineering and manufacturing groups designs, manufactures and markets equipment capable of processing from 150 to 6,000 barrels of crude per day (BPD). Multiple product streams can be drawn from the distillation process yielding light naphtha, heavy naphtha, kerosene /jet fuel, diesel and residual fuel oil. Each process plant is skid mounted, modular in design and transportable to the source of crude production or a pipeline location. System commissioning at the site, on the small units, can be complete within 48 hours after arrival at the completed site. These units are easily relocated with a minimum amount of field construction. Refined products produced from a mini-refinery processing plant can be sold to local markets or supplied as a feedstock for further processing and the residual oil returned to the crude pipelines. Additionally, the residual oil product can be used to fuel diesel-electric cogeneration plants for the production of electricity or any heavy oil fired process equipment such as boilers, heaters and etc. Mini-refineries are particularly effective in areas where there is a ready supply of crude but limited product distribution or refining capacity, where transportation costs or capability present a problem, such as remote areas or offshore platforms.

**Below - An installation incorporating one 6,000 and four 1,000 BPD systems and related supporting equipment.**

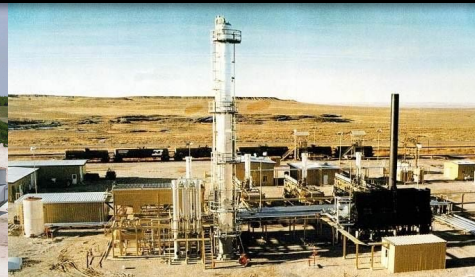


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## Small Refinery History

The first mini-refinery was installed thirty-five years ago. This plant was a 1,000 BPD plant on a single skid containing an electric generator, a horizontally mounted tower for hand cranking to a vertical position, and permanently mounted hand jacks for jacking the skid off a truck. The intent was that the plant could be in operation in one day after arrival at the new location, without the need for a crane, concrete foundation or a power supply. We thought the plant would be moved monthly.

### As time went by, it has been learned:

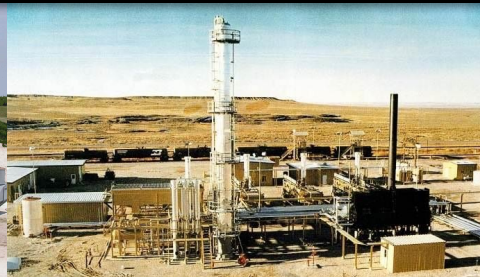
1. The plants stayed in each location for years.
2. Most sites had to be substantially larger to support other facilities.
3. Cranes were available at most sites, so hand jacks are not required. And since cranes were available to set the skids, it was acceptable to use multiple skids to allow more room for operating the equipment. These skids could be assembled and tested in the shop and reassembled by crane at the site without the need for welders or special technicians.

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## Small Refinery History (Continued)

With all of the above information in mind, a small modular refinery was designed with the following special features:

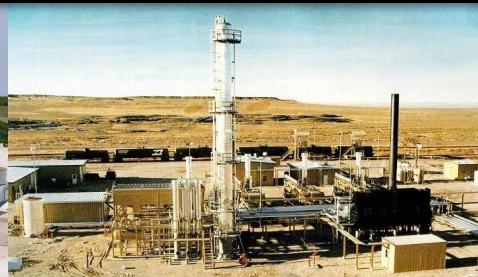
1. A recent development in the process design allows the elimination of level control valves, level controllers, gauge glasses, some pumps, and all of the associated piping, electrical, instrumentation and spare parts. The elimination of such equipment substantially reduces the plant requirements for operation and maintenance.
2. Completely automated for self-operation and self-monitoring so that if a potentially hazardous situation develops, the plant automatically shuts down and the “first-out” annunciator, signals the operator the reason for the shut down.
3. An enclosed control room and lab space.
4. A supply of hand tools and lab equipment.
5. Two years supply of spare parts.
6. The unit can be operated in arctic or tropical locations.

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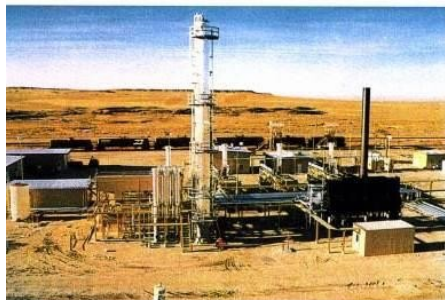
## Small Refinery History (Continued)

**The following standard sizes are offered:**

Barrels Per Day	No. of Skids	Hours Required for Commissioning
150	2	24
1000	3	48
3000	5	96
6000	8	168



Various models being tested and prepared for shipment



Four 1000 BPD plants and one 6000 BPD plant



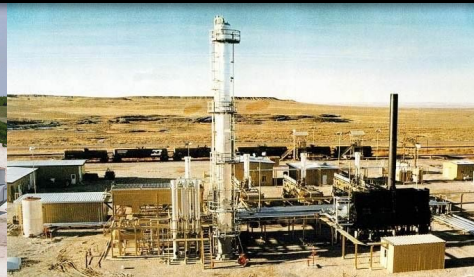
One model 1500T being tested prior to shipment

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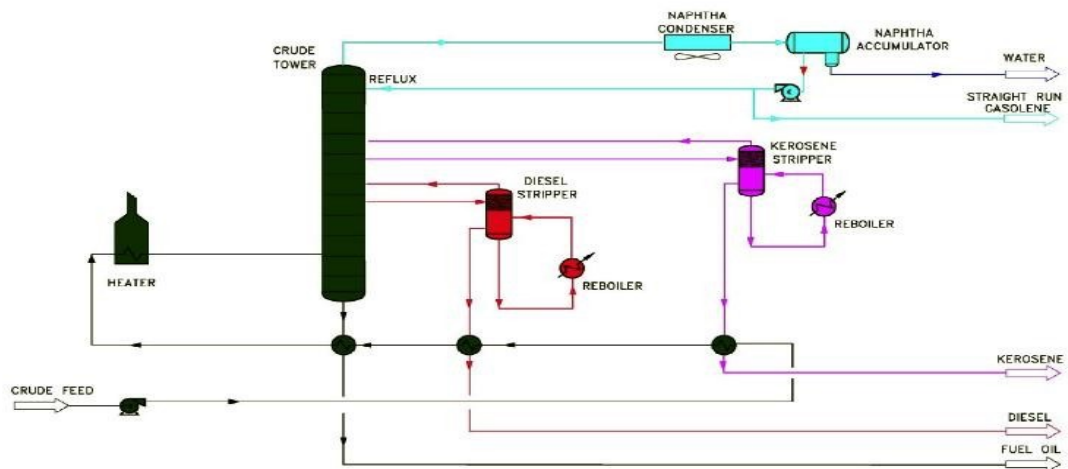
## Small Refinery History (Continued)

The above times are based on offsite facilities being complete and having a crane available when the plant arrives at the site.

In addition to the above Modular refinery models, REOT has a standard 3,000 BPD and 6,000 BPD design with the following extras available:

- Additional Side Draws
- Desalter Skid
- Caustic Water Wash Skid
- Catalytic Reformer complete with Splitter, Hydrotreater, Reformer, and Stabilizer
- Jet and / or Diesel Hydrotreater(s)

### Refinery Equipment of Texas – Typical 1000 / 3000 / 6000 bpd Process Flow Diagram

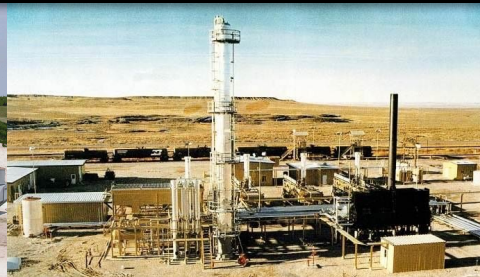


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## Technical Operation

Typically, cold crude oil from off-site storage is received at the topping plant battery limits and pumped by the crude charge pump on flow control. The crude oil exchanges heat with the atmospheric tower product streams.

The crude then flows to the crude heater where it is further heated and partially vaporized. The crude heater is a direct-fired radiant-convection heater, designed to burn off gas, natural gas and/or liquid fuel, or a combination of these fuels. Constant heater outlet temperature is maintained automatically by controlling the fuel to the heater.

Partially vaporized crude oil from the crude heater flows to the flash zone of the atmospheric tower where the vapor and liquid separate. The vapor flows up the tower where it is cooled and partially condensed by reflux to form the side stream products. The liquid joins with the over flash liquid from the first tray above the flash zone and flows to the reduced crude stripping section in the bottom of the atmospheric tower.

The overhead vapor from the atmospheric tower is cooled and partially condensed in the overhead condenser and flows to the overhead accumulator where liquid unstabilized naphtha, water and uncondensed gas separate. The water is automatically withdrawn from a boot on the overhead accumulator and flows off-site.

A portion of the liquid naphtha from the accumulator is returned to the top of the atmospheric tower as reflux to maintain the overhead vapor at a constant temperature and the remainder flows to off-site storage. Uncondensed gas from the accumulator flows on backpressure control to be used as supplemental fuel for the crude heater.

Un-stripped side draw product flows on tower temperature control from its draw tray on the atmospheric tower to its stripper. The side draw product is stripped with re-boiled vapor to control the flash point. Product flows from the bottom of the stripper on level control, is cooled by exchanging heat with crude, and then flows to battery limits.

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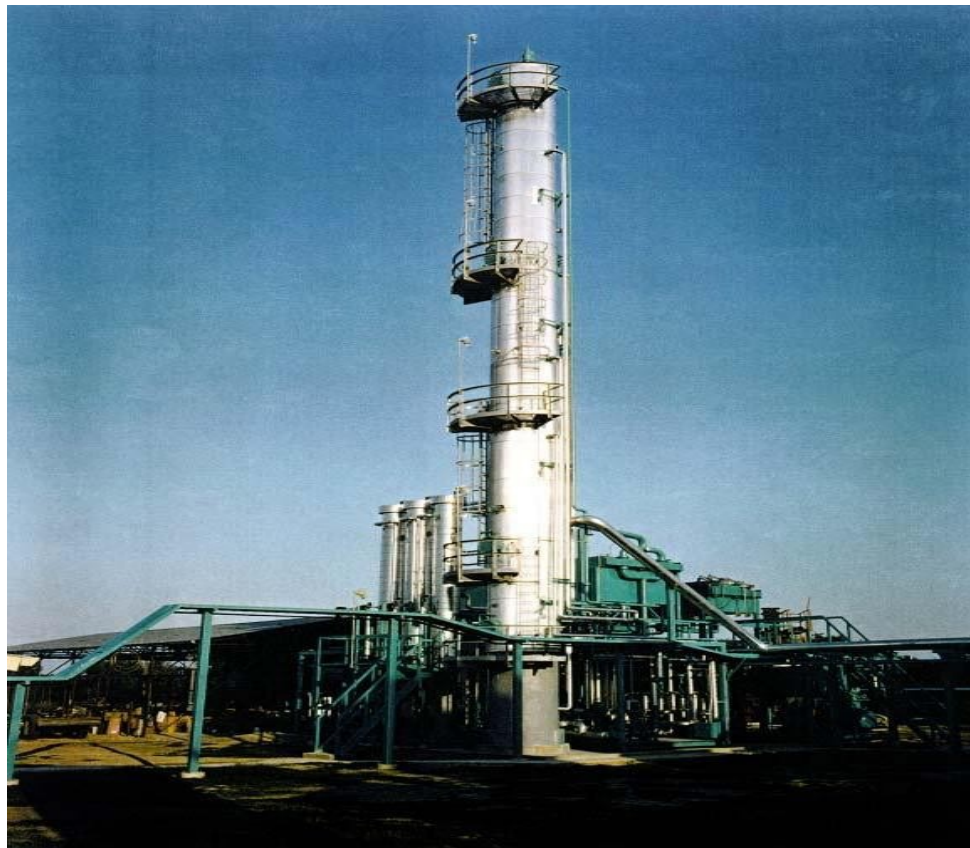


## Technical Operation (Continued)

Reduced crude product is pumped from the bottom of the atmospheric tower on level control through the re-boiler, and is then further cooled by the reduced crude/crude exchangers before flowing outbound to battery limits.

Since the side stream stripper is re-boiled with hot tower bottoms, the plant does not require steam. However, nozzles are provided on the tower and stripper for steam stripping, if required. The only requirement for water is for a desalter if one is included.

**Below: 6,000 BPD Modular refinery designed manufactured and installed. Over \$1 million in CR-9 and special alloys are used in this processing plant to combat corrosion.**



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