

PETROLEUM REFINERY ICR

DEFINITIONS AND ABBREVIATIONS

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Abbreviations for Petroleum Refinery ICR:

20 lb/ton coke burn-off	SO ₂ emissions limit in 40 CFR part 60, subpart J, of 9.8 kg/Mg (20 lb/ton) coke burn-off (40 CFR 60.104(b)(2))
50/25 ppmv SO ₂ limit	SO ₂ emissions limit in 40 CFR part 60, subpart Ja of 50 ppmv SO ₂ , dry basis corrected to 0 percent excess air, on a 7-day rolling average basis and 25 ppmv, dry basis corrected to 0 percent excess air, on a 365-day rolling average basis (40 CFR 60.102a(b)(3))
acfm	actual cubic feet per minute
APCD	air pollution control device
As	arsenic
ASTM	American Society of Testing and Materials
bbl	barrels
bbl/cd	barrels per calendar day
bbl/sd	barrels per stream day
bbl/yr	barrels per year
BOD	biological oxygen demand
BQ	benzene quantity
Btu/lb	British thermal units per pound
BWON	Benzene Waste Operations NESHAP (40 CFR part 61, subpart FF)
CAA	Clean Air Act
CAS	Chemical Abstracts Service
CBI	confidential business information
CCU	catalytic cracking unit
CEMS	continuous emission monitoring system

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
COD	chemical oxygen demand
COS	carbonyl sulfide
CRU	catalytic reforming unit
DCU	delayed coking unit
DIAL	Differential Absorption Light Detection and Ranging
E-cat	equilibrium catalyst
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitators
ETBE	ethyl tert-butyl ether
FCU	fluid coking unit
ft	feet
gal/day	gallons per day
gal/min	gallons per minute
H ₂ S	hydrogen sulfide
H ₂ SO ₄	sulfuric acid
HAP	hazardous air pollutants
HF	hydrogen fluoride
Hg	mercury
hr	hours
hr/yr	hours per year
ICR	information collection request
ID	identification number or code
Iso C5,C6	isopentane (aka 2-methylbutane), isohexane (aka 2-methylpentane)
Lat/Long	latitude and longitude
lb/ft ³	pounds per cubic foot
lb/hr	pounds per hour
lb/ton	pounds per ton
LDAR	leak detection and repair
LPG	liquefied petroleum gas
LT/cd	long tons per calendar day
MACT	Maximum Achievable Control Technology
MCRC	maximum Claus recovery/conversion

MDEA	methyl diethanolamine
Mg/yr	megagrams per year
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
MM lb	million pounds
MMBtu/hr	million British thermal units per hour
MMcf	million cubic feet
MMcf/cd	million cubic feet per calendar day
MMgal/day	million gallons per day
MTBE	methyl tert-butyl ether
MW	megawatts
MWh	megawatt-hours
NAD	North American Datum
NESHAP	national emissions standards for hazardous air pollutants
Ni	nickel
No.	number
NO _x	oxides of nitrogen
NSPS	new source performance standards
OVA	organic vapor analyzer
PM	particulate matter
ppmv	parts per million by volume
ppmw	parts per million by weight
PSA	pressure swing adsorption
PRD	pressure relief device
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
QA	quality assurance
QC	quality control
regen.	regeneration
SCC	Source Classification Code
scfm	standard cubic feet per minute
SCOT	Shell Claus Off-gas Treating
SCR	selective catalytic reduction
Se	selenium
SNCR	selective non-catalytic reduction

SO ₂	sulfur dioxide
SOF	Solar Occultation Flux
SRU	sulfur recovery unit
STERPP	storage tank emission reduction partnership program (72 FR 19891)
TAB	total annual benzene
TAME	tert-amyl methyl ether
THC	total hydrocarbons
TOC	total organic compounds
tons/cd	tons per calendar day
tons/yr	tons per year
TRS	total reduced sulfur
U.S. DOE/EIA	U.S. Department of Energy, Energy Information Administration
ULNB	ultra low NO _x burner (high fraction staged fuel)
UV	ultraviolet
VOC	volatile organic compounds
wt%	weight percent
WWTS	wastewater collection and treatment system
WWTU	wastewater collection or treatment unit
°F	degrees Fahrenheit
%	percent

Definitions for Petroleum Refinery ICR:

Activated sludge biological treatment unit: A basin, tank or surface impoundment where wastewater is aerobically treated using a biological floc composed of bacteria and protozoans (referred to as “activated sludge”) and air (oxygen) supplied by mechanical and/or diffused aerators followed by clarification and activated sludge return.

Additive or Promoter: Any component added to a catalyst to increase activity or selectivity. Examples are tin added to platinum reforming catalysts to improve selectivity to coke formation and chloride added to isomerization catalysts to increase activity.

Aerated surface impoundment: A surface impoundment where a transfer of oxygen from air into the solution of the basin occurs by mechanical action and/or diffused aerators. See also *Surface impoundment*.

Aerobic sludge digester: A mechanical wastewater treatment unit that provides secondary wastewater treatment by mixing air (oxygen) and aerobic and facultative microbes with the wastewater sludge.

Alkylate: The product of an alkylation reaction. It usually refers to the high-octane product from alkylation units. *Alkylate* is used in blending high octane gasoline.

Alkylation unit: A refining process for chemically combining isobutane with olefin hydrocarbons (*e.g.*, propylene, butylene) through the control of temperature and pressure in the presence of an acid catalyst, usually sulfuric acid or hydrofluoric acid. The product, alkylate, is an isoparaffin that has high-octane value and is blended with motor and aviation gasoline to improve the antiknock value of the fuel.

Alternative method: Any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated to the Administrator’s satisfaction to, in specific cases, produce results adequate for determination of compliance.

Amine treatment: A means to remove sulfur-containing and other undesirable compounds from acid gas by contacting the gas with amine. It is a common process in an oil refinery or in natural gas production. The amine absorbs H₂S and other compounds, and the “rich” amine is then regenerated by steam stripping to produce regenerated or “lean” amine, along with an acid gas with a higher H₂S concentration, which is then usually processed by the Claus process to convert it into sulfur.

Anaerobic sludge digester: A tank or vessel which excludes oxygen and in which a sludge is modified by the action of anaerobic bacteria.

Analyzer vent: A vent to the atmosphere associated with an extractive monitoring system, analyzer shed, or other equipment used to collect and transport samples to an analyzer. The analyzer vent does not include the exhaust from a flame ionization detector or associated chromatography column, if applicable.

API Gravity: American Petroleum Institute measure of specific gravity of crude oil or condensate in degrees. An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API; it is calculated as follows:

$$\text{Degrees API} = (141.5 / \text{sp.gr.60 deg.F/60 deg.F}) - 131.5$$

Aromatic extraction & UV stabilization: A lubricant manufacturing process by which vacuum tower residue or deasphalted oil (or both) is distilled for the separation of aromatics and cycloalkanes

(naphthenes) to produce lube oil base oils having high viscosity indices and other desirable lube oil qualities, such as color and stability. Main solvent used in this process is furfural, although phenol and liquid SO₂ can also be used.

Aromatics: Hydrocarbons characterized by their uniform unsaturated carbon ring structure and their often pleasant aroma. Commercial petroleum aromatics include benzene, toluene, ethyl benzene, xylenes, cumene, and naphthalene. The acronym BTX is commonly used to refer collectively to benzene, toluene, and xylenes; the acronym BTEX is commonly used to refer collectively to benzene, toluene, ethyl benzene, and xylenes. These chemicals are used as high octane components in gasoline.

Aromatics production: All equipment used to produce aromatics from various separation processes after catalytic reforming.

Asphalt: A dark brown-to-black cement-like material obtained by petroleum processing and containing bitumens as the predominant component. It includes crude asphalt as well as the following finished products: cements, fluxes, the asphalt content of emulsions (exclusive of water), and petroleum distillates blended with asphalt to make cutback asphalts. Note: The conversion factor for asphalt is 5.5 barrels per short ton.

Asphalt blowing still: A system in which air is blown through asphalt flux (the organic residual material from distillation of crude oil) to change the softening point and penetration rate of the asphalt flux, creating oxidized asphalt.

Atmospheric crude distillation or Atmospheric crude distillation unit: The primary distillation unit at a refinery used to separate crude oil components (including mixtures of other hydrocarbons) at approximately atmospheric pressure conditions by continuously vaporizing and condensing the components. For the purposes of this ICR, the *atmospheric crude distillation unit* includes the desalter or other crude oil feed pretreatment devices, the pipe still for vaporizing the crude oil, and the distillation column for separating the vaporized hydrocarbon components in the crude oil into fractions with different boiling ranges, the bottoms reboiler, and the overhead reflux condenser.

Aviation gasoline (finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in aviation reciprocating engines. Fuel specifications are provided in ASTM Specification D 910 and Military Specification MIL-G-5572.

Aviation gasoline blending components: Naphthas which will be used for blending or compounding into finished aviation gasoline (*e.g.*, straight-run gasoline, alkylate, reformate, benzene, toluene, and xylene). Excludes oxygenates (alcohols, ethers), butane, and pentanes plus.

Baghouse: An air pollution control device that filters dust particles by removing them from an air stream of exhaust gases before the stream is discharged to the atmosphere. Fabric filters, which use filtration to separate dust particles from dusty gases. They are one of the most efficient and cost effective types of dust collectors available and can achieve a collection efficiency of more than 99% for very fine particulates.

Barrel: A unit of volume equal to 42 U.S. gallons. Barrel is abbreviated as bbl.

Beavon process or BSR (Beavon sulfur removal): A process for removing residual sulfur compounds from the effluent gases from the "Claus" process. Usually used in conjunction of other processes. This process uses catalytic hydrogenation over a cobalt/ molybdenum catalyst converting carbonyl sulfide, carbon disulfide, and other organic sulfur compounds to hydrogen sulfide, which is then removed by the

“Stretford” process. A variation of this is BSR/MDEA, developed for small plants, which uses preliminary scrubbing with methyl diethanolamine.

Benzene (C₆H₆): An aromatic hydrocarbon present in small proportion in some crude oils and made commercially from petroleum by the catalytic reforming of naphthenes in petroleum naphtha. Also made from coal in the manufacture of coke. Used as a solvent in the manufacture of detergents, synthetic fibers, petrochemicals, and as a component of high-octane gasoline. See *Aromatics*.

Biofuels: Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.

Biomass or Biomass fuels: Non-fossilized and biodegradable organic material originating from plants, animals or microorganisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material.

Biosolids: Nutrient-rich organic materials resulting from the treatment of domestic sewage sludge in a treatment facility. *Biosolids* are carefully treated and monitored and must be used in accordance with regulatory requirements.

Bitumen: A naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulfur compounds and that, in its natural occurring viscous state, is not recoverable at a commercial rate through a well.

Blanketing: Applying a [gas](#) to the empty space in a storage tank.

Blendstocks: Petroleum products used for blending or compounding into finished motor gasoline. These include RBOB (reformulated blendstock for oxygenate blending) and CBOB (conventional blendstock for oxygenate blending), but exclude oxygenates, butane, and pentanes plus.

Blowdown: Act of emptying or depressuring a vessel. This may also refer to the discarded material such as blowdown water from a boiler or cooling tower.

Blowdown steam recovery system: Boiler water is blown down to control the amount of suspended and total dissolved solids (TDS) in the boiler. This water is pressurized, hot and dirty, creating large volumes of flash steam and possible disposal problems. A heat recovery system can reclaim large amounts of energy during this essential process. The continuous boiler blowdown is routed to a flash tank where the pressure is reduced and flash steam is produced. The heat recovery system uses the flash steam from the flash tank for deaeration. The blowdown from the flash tank is passed through an exchanger and used to preheat boiler makeup water. This low pressure steam can also be used for other applications.

Boiler: Enclosed device using controlled flame combustion and having the primary purpose of recovering and exporting thermal energy in the form of steam or hot water. Heat from an external combustion source is transmitted to a fluid contained within the tubes found in the boiler shell. This fluid is delivered to an end-use at a desired pressure, temperature, and quality.

Boiler feed water: Water used to supply (“feed”) a boiler to generate steam or hot water. At most plants the feed water is usually conditioned or treated, stored, and pre-heated in a feed water tank and forwarded into the boiler by a boiler feed water pump.

Bottoms: The heaviest components of petroleum product left in the refining process after the light ends have been removed. These products include asphalt, coke and residuals.

Bottom loading: A type of organic liquid loading operation where the discharge opening is set at the bottom of the loaded vessel (below the liquid level), reducing velocity and pressure, which results in a much lower vapor generation.

British thermal unit: Quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit at about 39.2 degrees Fahrenheit; equal to 252 calories. British thermal unit is abbreviated as Btu.

Butane or n-butane or Normal butane (C₄H₁₀): Normally a gaseous paraffinic straight-chain or branch-chain hydrocarbon extracted from natural gas or refinery gas streams.

Butylene or n-butylene (C₄H₈): Olefinic straight-chain hydrocarbon extracted from refinery gas streams.

By-product: A chemical that is produced coincidentally during the production of another chemical.

Calcination: The process of thermally treating minerals without fusing to decompose carbonates from ore, so that hydrates, and the volatile material is expelled.

Calcium hypochlorite: A white crystalline solid, Ca(OCl)₂•4H₂O, used as a bactericide, fungicide, and bleaching agent.

CanSolv®: A regenerable process to remove sulfur dioxide from flue gas (flue-gas desulfurization) in tail gas cleanup processes. This patented technology uses an aqueous amine solution to achieve high efficiency selective absorption of sulfur dioxide from a variety of gas streams. The scrubbing byproduct is pure water-saturated SO₂ gas recovered by steam stripping, using low quality heat.

Carbon adsorber: A pollution control device that uses activated carbon to absorb volatile organic compounds from a gas stream (The VOC are later recovered from the carbon).

Carbonate: Compounds containing the radical CO₃⁻². Upon calcination, the carbonate radical decomposes to evolve carbon dioxide (CO₂). Common carbonates consumed in the mineral industry include calcium carbonate (CaCO₃) or calcite; magnesium carbonate (MgCO₃) or magnesite; and calcium-magnesium carbonate (CaMg(CO₃)₂) or dolomite.

Carbonyl sulfide (COS) hydrolysis: A thermal catalytic process through which COS is converted to H₂S and CO₂ in presence of water to facilitate removal of acid gases from feed gas streams such as synthesis gas produced by gasification of coal, coke, or heavy hydrocarbon oils. This process is mainly performed in combination with an acid gas removal process such as amine and solvent scrubbing systems (*e.g.*, MDEA, Rectisol®, Selexol®, Sulfinol®).

Catalyst coke: In many catalytic operations (*e.g.*, catalytic cracking and catalytic reforming), carbon is deposited on the catalyst, thus deactivating the catalyst. The catalyst is reactivated by burning off the carbon, which is used as a fuel in the refining process. This carbon or coke is not recoverable in a concentrated form. The conversion is 5 barrels (of 42 U.S. gallons each) per short ton. Coke from petroleum has a heating value of 6.024 million Btu per barrel. See *Petroleum coke*.

Catalytic cracking: The refining process in which petroleum derivatives are continuously charged and hydrocarbon molecules in the presence of a catalyst are fractured or react with a contact material into

smaller molecules to improve feedstock quality for additional processing and the catalyst or contact material is continuously regenerated by burning off coke and other deposits. For the purposes of this ICR, the *catalytic cracking* process unit includes the riser, reactor, primary (full-range) distillation column, regenerator, air blowers, spent catalyst or contact material stripper, catalyst or contact material recovery equipment, and regenerator equipment for controlling air pollutant emissions and for heat recovery (e.g., CO boiler). The *catalytic cracking* process unit does not include feed pretreatment (e.g., feed hydrotreater) or additional light-ends distillation columns after the primary (full-range) distillation column. Separate catalytic cracking reactor/regenerator pairs that exhaust to a common stack should be considered separate process units for the purposes of this ICR. *Catalytic cracking* process units typically employ a fluidized bed reactor (i.e., “fluid catalytic cracking units”), but they may employ a moving bed reactor (commonly referred to as “thermal catalytic cracking units”).

Catalytic hydrocracking unit: A refining process that uses hydrogen and catalysts with relatively low temperatures and high pressures for converting middle boiling or residual material to high-octane gasoline, reformer charge stock, jet fuel, and/or high grade fuel oil. The process uses one or more catalysts, depending upon product output, and can handle high sulfur feedstocks without prior desulfurization. For the purposes of this ICR, the *catalytic hydrocracking unit* includes the reactor, primary (full-range) distillation column, and hydrogen recovery equipment. The *catalytic hydrocracking unit* does not include feed pretreatment (e.g., feed hydrotreater) or additional light-ends distillation columns after the primary (full-range) distillation column and hydrogen recovery equipment.

Catalytic hydrotreating or Catalytic hydrotreating: A refining process for treating petroleum fractions from atmospheric or vacuum distillation units (e.g., naphthas, middle distillates, reformer feeds, residual fuel oil, and heavy gas oil) and other petroleum (e.g., cat cracked naphtha, coker naphtha, gas oil) in the presence of catalysts and substantial quantities of hydrogen. Hydrotreating includes desulfurization, removal of substances (e.g., nitrogen compounds) that deactivate catalysts, conversion of olefins to paraffins to reduce gum formation in gasoline, and other processes to upgrade the quality of the fractions.

Catalytic incinerator or Catalytic oxidizer: A control device that is mainly used for destroying organic compounds gas streams through an oxidation process employing a bed of active material (catalyst) that promotes the overall combustion reaction. Although no direct fire burning of feed gas stream occurs, it must be preheated to a sufficient high temperature (300 to 900 °F) to initiate the oxidation reactions.

Catalytic reforming: A refining process using controlled heat and pressure with catalysts to rearrange certain hydrocarbon molecules, thereby converting paraffinic and naphthenic type hydrocarbons (e.g., low-octane gasoline boiling range fractions) into petrochemical feedstocks and higher octane stocks suitable for blending into finished gasoline. For the purposes of this ICR, the *catalytic reforming* process unit includes the reactor or series of reactors, catalyst regeneration equipment, primary (full-range) distillation column, and hydrogen recovery equipment. The *catalytic reforming* process unit does not include feed pretreatment (e.g., feed hydrotreater) or additional light-ends distillation columns after the primary (full-range) distillation column and hydrogen recovery equipment. *Catalytic reforming* units (CRU) are reported in three categories. They are:

- *Continuous regeneration:* Regeneration process where small quantities of the catalyst are continuously removed from a moving bed reactor system, purged, and transported to a continuously operated regeneration system. The regenerated catalyst is then recycled to the moving bed reactor.
- *Cyclic regeneration:* Regeneration process where the unit has an extra reactor vessel, so that one reactor vessel can be isolated from the unit for regeneration. After the first vessel is

regenerated, it is brought back on-line and the second reactor vessel is then isolated and regenerated and so on until all vessels have been regenerated.

- *Semi-regenerative:* Regeneration process where the entire reforming unit is taken off-line to regenerate the catalyst in the reactor vessels. Catalyst regeneration in a semi-regenerative CRU typically occurs once every 12 to 24 months (18 months is typical) and lasts approximately 1 to 2 weeks.

Catch basin: An open basin which serves as a single collection point for stormwater runoff received directly from refinery surfaces and for refinery wastewater from process drains.

Chloramine: Any of several compounds containing nitrogen and chlorine, especially an unstable colorless liquid, NH_2Cl , used to make hydrazine. It is produced when ammonia and chlorine (as hypochlorous acid) react with each other. It is widely used as a disinfectant in water treatment plants rather than chlorine, as chloramine is much more stable.

ChlorsorbTM: The trade name of an air pollution control system for reducing chloride emissions from various process units, including catalytic reforming units. This system uses spent catalyst to recover chlorides from effluent gas streams and recycle the chlorides back to the process, decreasing the HCl content of the reduction zone effluent gas by as much as 99%.

Claus sulfur recovery plant: A series of process units which recover sulfur from hydrogen sulfide (H_2S) by a vapor-phase catalytic reaction of sulfur dioxide and H_2S . The *Claus sulfur recovery plant* includes the reactor furnace and waste heat boiler, catalytic reactors, sulfur pits, and, if present, oxidation or reduction control systems. One *Claus sulfur recovery plant* may consist of multiple trains. See also *Multi-stage Claus*.

Co-fired: The process of simultaneously using two substantially different fuels within a process heater or boiler via the main burners. A process heater or boiler can be *co-fired* by supplying each burner with the two substantially different fuels at the same time or by supplying a portion of the burners with one fuel type and the other burners with a second fuel type. Fuels are considered substantially different when the fuels are of different physical phases, *e.g.*, gaseous fuels are substantially different from liquid or solid fuels and liquid fuels are substantially different from gaseous or solid fuels. Process heaters that are fired with two different gaseous fuels, such as natural gas and still gas, are not *co-fired* process heaters. Process heaters that have gas burners with emergency oil back-up burners that are seldom if ever used are not considered *co-fired* process heaters.

Coal: All solid fuels classified as anthracite, bituminous, sub-bituminous, or lignite by the American Society for Testing and Materials Designation ASTM D388–05 Standard Classification of Coals by Rank.

Coke burn-off: Coke removed from the surface of a catalyst by combustion during catalyst regeneration. *Coke burn-off* also means the coke combusted in fluid coking unit burner.

Coking: Thermal refining processes used to produce fuel gas, gasoline blendstocks, distillates, and petroleum coke from the heavier products of atmospheric and vacuum distillation. The coke produced can be used either as a fuel or in other applications such as the manufacturing of steel or aluminum. There are three types of *coking* process units:

- *Delayed coking:* A semi-batch process where coke is produced in a series of coke drum reactor vessels. When a coke drum becomes filled with coke, it is taken off-line to remove the

coke. The process feed is then diverted to a second coke drum to maintain near continuous feed processing. This is the most prevalent type of coking process. See *Delayed coking unit*.

- *Fluid coking*: A continuous process unit in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is produced in a fluidized bed system. A portion of the coke produced is burned to provide energy for the coking reaction; the remainder of the coke produced is separated as a product. See *Fluid coking unit*.
- *Flexicoking*: Similar to fluid coking except that the produced coke is then gasified to produce a synthetic fuel gas. See *Flexicoking unit*.

Combined heat and power unit: A unit using a common energy source to produce both electricity and steam for other uses, resulting in increased fuel efficiency.

Combustion: Chemical oxidation accompanied by the generation of light and heat.

Combustion device: An individual unit of equipment such as a flare, incinerator, process heater, or boiler used for the combustion of organic vapors.

Compressor seal: Each compressor ring seal for reciprocating compressors. For centrifugal compressors the compressor seal refers to any opening in the liquid seal pot.

Condenser: Any device that removes condensable vapors by a reduction in the temperature of captured gases.

Condensate: Hydrocarbon liquid separated from natural gas which condenses due to changes in the temperature or pressure, or both, and remains liquid at standard conditions.

Connector: Any type of joined fittings other than a flange that is used to connect pipe line segments, tubing, pipe components (such as elbows, reducers, "T's" or valves) or a pipe line and a piece of equipment or an instrument to a pipe, tube or piece of equipment. A common connector is a screwed fitting. Joined fittings welded completely around the circumference of the interface are not considered connectors.

Controlled guidepole: A slotted guidepole with one of the following control measures specified in Appendix I to the storage tank emission reduction partnership program (STERPP) at 72 FR 19891: pole float system, pole sleeve system, internal sleeve system, or flexible enclosure system.

Cooling tower: A heat removal device used to remove by direct contact the heat absorbed in circulating cooling water systems by transferring the heat to the atmosphere using natural or mechanical draft.

Conventional amine scrubber: An air pollution control device that employs a high-energy liquid amine spray such as monoethanolamine (MEA), diethanolamine (DEA), methyldiethanolamine (MDEA), or diisopropylamine (DIPA) to remove acidic substances (such as hydrogen sulfide and carbon dioxide) from industrial off-gases.

Crude distillation unit: See *Atmospheric crude distillation unit*.

Crude oil: A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Depending upon the characteristics of the crude stream, it may also include small amounts of non-hydrocarbons

produced from oil, such as sulfur and various metals, drip gases, and liquid hydrocarbons produced from tar sands, gilsonite, and oil shale. *Crude oil* is refined to produce a wide array of petroleum products, including heating oils; gasoline, diesel and jet fuels; lubricants; wax; asphalt; ethane, propane, and butane; and many other products used for their energy or chemical content. *Crude oil* is considered as either domestic or foreign, according to the following:

- *Domestic*: Crude oil produced in the United States or from its “outer continental shelf” as defined in 43 USC 1331.
- *Foreign*: Crude oil produced outside the United States. Imported Athabasca hydrocarbons (tar sands from Canada) are included.

Cryogenic separation process: A low temperature hydrogen separation process which uses the difference in boiling temperatures (relative volatilities) of the feed components to effect the separation. Hydrogen has a high relative volatility compared to hydrocarbons. The simplest and most common version of the cryogenic process is the partial condensation process. The partial condensation process condenses the required amount of feed impurities by cooling the feed stream against the warming product and tail gas streams in brazed aluminum multipass heat exchangers. The refrigeration required for the process is obtained by Joule-Thomson refrigeration derived from throttling the condensed liquid hydrocarbons. Additional refrigeration, if required, can be obtained by external refrigeration packages or by turboexpansion of the hydrogen product.

Cutting water: Water used in the delayed coking process to “cut” the coke from the coke drum. High pressure water jets are commonly used for coke cutting operations.

Delayed coking unit: A refinery process unit in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is produced in a series of closed, batch system reactors. A *delayed coking unit* includes all of the coke drums associated with a single fractionator; the fractionator, including the bottoms receiver and the overhead condenser; the coke drum cutting water and quench system, including the jet pump and coker quench water tank; process piping and associated equipment such as pumps, valves and connectors; and the coke drum blowdown recovery compressor system. See *Coking*.

DESOX catalyst (50/25 ppmv SO₂ Limit): A self-supporting hydrotalcite SO_x reducing catalyst used in catalytic cracking units that achieves a 50 ppmv 7-day rolling average and 25 ppmv annual average SO₂ concentration (dry basis, corrected to 0% excess air) in the regenerator exhaust.

Desulfurization: The removal of sulfur, as from molten metals, petroleum oil, or flue gases. Petroleum *desulfurization* is a process that removes sulfur and its compounds from various streams during the refining process. *Desulfurization* processes include catalytic hydrotreating and other chemical/physical processes such as adsorption. *Desulfurization* processes vary based on the type of stream treated (*e.g.*, naphtha, distillate, heavy gas oil) and the amount of sulfur removed (*e.g.*, sulfur reduction to 10 ppm).

Dissolved air flotation unit: A tank and the corresponding ancillary equipment where the separation of solids and oils from liquid effluents occurs by dissolving pressurized air into a liquid to form small bubbles that will float material to the surface.

Distillate fuel oil: A general classification for one of the petroleum fractions produced in conventional distillation operations and from crackers and hydrotreating process units. The generic term *distillate fuel oil* includes kerosene, kerosene-type jet fuel, diesel fuels (Diesel Fuels No. 1, No. 2, and No. 4), and fuel oils (Fuel Oils No. 1, No. 2, and No. 4). Products known as diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad

locomotives and agricultural machinery. Products known as fuel oils are used primarily for space heating and electric power generation.

Distillation or Fractionation: The process by which hydrocarbons are separated into distinct products or intermediates based on differences in boiling points of the different hydrocarbon compounds.

Distillation column or Fractionator: A device or vessel in which distillation operations occur, including all associated internals (such as trays or packing) and accessories (*e.g.*, the reboiler, condenser, vacuum pump, steam jet), plus any associated recovery system.

Drain: Pit, pipe or trench used to collect or intercept and divert stormwater, wastewater, groundwater or perched water away from the ground, soil or treatment area or other system component to an effective outlet.

Drain-dry: A storage vessel that is designed with a cone-down or sloped bottom and a sump. The storage vessel's withdrawal line is located in the sump so that the only liquid remaining after the vessel is emptied is that which clings to the vessel bottom and other wetted surfaces. No free-standing liquid remains in the sump after emptying.

Electricity-generating unit: A turbine (or similar device) and other ancillary equipment that is used to produce, store, and transmit electricity for sale to the grid or for use at other locations within the facility.

Electrostatic precipitator (ESP): A particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. *Electrostatic precipitators* are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream.

Empty or Emptying: The partial or complete removal of stored liquid from a storage vessel. Storage vessels that contain liquid only as wall or bottom clingage, or in pools due to bottom irregularities, are considered completely empty.

Energy efficiency: Refers to all changes or activities (including technological, behavioral and economic) that are aimed at reducing the energy used by substituting more advanced equipment, typically without affecting the services provided. Examples include high-efficiency appliances, efficient lighting programs, efficient maintenance programs, high-efficiency heating, ventilating, insulating and cooling systems or control modifications, efficient building/equipment design, advanced electric motor drives, and heat recovery systems.

Equalization basin: A holding tank or surface impoundment within which variations in sewage inflow rate and liquid nutrient concentrations are averaged.

Equipment: A pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, valve, or instrumentation system. Vents from wastewater collection and conveyance systems (including, but not limited to wastewater drains, sewer vents, and sump drains), tank mixers, and sample valves on storage vessels are not equipment.

Equipment or component malfunction: Any pump failure, pipe clogging, line breakage, or other similar event that can be directly identified and that substantially and unexpectedly alters the operation of a process unit or emission control device associated with a specific emissions point.

ETBE (Ethyl tertiary butyl ether) (CH₃)₃COC₂H₅: See *Oxygenates*.

Ethane (C₂H₆): A normally gaseous straight-chain hydrocarbon. It is a colorless paraffinic gas that boils at a temperature of -127.48 degrees Fahrenheit. It is extracted from natural gas and refinery gas streams.

Ethanol: A colorless liquid that burns to produce water and carbon dioxide. The vapor forms an explosive mixture with air and may be used as a fuel in internal combustion engines. An alcohol which is most often derived from corn. Ethanol is designed to be blended with gasoline to produce a cleaner burning fuel, and is an accepted oxygenate component for the oxygenated seasons mandated by the EPA.

Ether: A generic term applied to a group of organic chemical compounds composed of carbon, hydrogen, and oxygen, characterized by an oxygen atom attached to two carbon atoms (*e.g.*, methyl tertiary butyl ether).

Ethylene (C₂H₄): An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. Ethylene is used as a petrochemical feedstock for numerous chemical applications and the production of consumer goods.

Ethylene process unit: A chemical manufacturing process unit in which ethylene and/or propylene are produced by separation from petroleum refining process streams or by subjecting hydrocarbons to high temperatures in the presence of steam. The ethylene process unit includes the separation of ethylene and/or propylene from associated streams such as a C₄ product, pyrolysis gasoline, and pyrolysis fuel oil. The ethylene process does not include the manufacture of SOCOMI chemicals such as the production of butadiene from the C₄ stream and aromatics from pyrolysis gasoline.

EUROCLAUS®: This process has been developed to recover elemental sulfur from H₂S containing gases originating from gas treating plants such as alkanolamine units or physical solvent plants. The EUROCLAUS® process is an improvement of the SUPERCLAUS® process. Yields up to 99.7% overall sulfur recovery without any further tail gas clean up are possible.

External floating roof: A storage vessel cover in an open top tank consisting of a double deck or pontoon single deck which rests upon and is supported by the petroleum liquid being contained and is equipped with a closure seal or seals to close the space between the roof edge and tank shell.

Facility: Any physical property, plant, building, structure, source, or stationary equipment located on one or more contiguous or adjacent properties in actual physical contact or separated solely by a public roadway or other public right-of-way and under common ownership or common control.

Feedstock: Raw material inputs to a process that are transformed by reaction, oxidation, or other chemical or physical methods into products and by-products. Supplemental fuel burned to provide heat or thermal energy is not a feedstock. Crude oil, VGO, catfeed, naphtha, condensate and straight run residual fuel are commonly referred to as feedstocks.

Fixed roof tank: A tank with a mounted cover roof in a stationary position that does not move with fluctuations in the level of the liquid managed in the tank.

Flange: A type of joined fitting that has a projecting rim or edge, usually drilled with holes, to allow bolting to other flanged fittings. A *flange* can be used to connect pipe line segments, pipe components (such as elbows, reducers, "T's" or valves), or a pipe line and a piece of equipment or an instrument to a pipe or piece of equipment. A flanged fitting welded completely around the circumference of the interface is not considered a *flange*.

Flare: A combustion device, whether at ground level or elevated, that uses an open flame to burn combustible gases with combustion air provided by uncontrolled ambient air around the flame. The *flare* includes the foundation, flare tip, structural support, burner, igniter, flare controls including air injection or steam injection systems, flame arrestors, and the flare gas header system.

Flare gas: Gas disposed of by burning in flares usually at the production sites or at gas processing plants.

Flare gas header system: All piping and knockout pots used to collect and transport gas to a flare either from a process unit or a pressure relief device from the fuel gas system, regardless of whether or not a flare gas recovery system draws gas from the *flare gas header system*.

Flare gas recovery system: A system of one or more compressors, piping, and the associated water seal, rupture disk, or similar device used to divert gas from the flare and direct the gas to the fuel gas system or to directly to a process heater, boiler, turbine or similar combustion device.

Flare management plan: A plan describing the flare gas header system and measures identified to reduce refinery flare emissions by reducing the frequency and magnitude of flaring events (“prevention measures”). Prevention measures identified address flaring as a result of planned major maintenance, including startup and shutdown; flaring that may be reasonably expected to occur due to issues of gas quality or quantity; and flaring caused by recurrent failure of air pollution control equipment, process equipment, or processes.

Flexicoking unit: One or more coking units in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is continuously produced in a fluidized bed system and in which the produced coke is then gasified to generate a synthetic fuel gas (“syngas”) for use in other processes. A *flexicoking unit* includes the fluidized bed coking vessel, the distillation column receiving gas directly from the fluidized bed coking vessel, coke burners, and other equipment for producing and handling the syngas. See *Coking*.

Flexorb®: The registered trade name of a sterically hindered amine scrubbing technology that selectively removes H₂S from process gas streams (*i.e.*, Flexicoker Low Btu Gas (LBG) stream), even in presence of CO₂, reducing overall air emissions, and improving sulfur recovery.

Flue gas desulfurization (FGD): The current state-of-the art technology used for removing SO₂ from the exhaust flue gases in fuel combustion devices such as boilers, heaters and furnaces. Primary types of FGD processes are wet scrubbers, dry scrubbers, and sorbent injection. Sorbents include lime, limestone, sodium-based compounds, and high-calcium coal fly ash.

Fluid catalytic cracking unit: A catalytic cracking unit that utilizes a fluidized bed reactor system. See *Catalytic cracking*.

Fluid coking unit: One or more coking units in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is continuously produced in a fluidized bed system and in which the fluid coking burner exhaust gas is continuously released to the atmosphere. The *fluid coking unit* includes fluidized bed coking vessel, the distillation column receiving gas directly from the fluidized bed coking vessel, coke burner, and equipment for controlling air pollutant emissions and for heat recovery on the fluid coking burner exhaust vent. Flexicoking units that use gasifiers to generate a synthetic fuel gas for use in other processes and that do not exhaust to the atmosphere are not considered *fluid coking units*. See *Coking*.

Force draft cooling: A mechanical draft tower with a blower type fan at the intake. The fan forces air into the tower, creating high entering and low exiting air velocities. The low exiting velocity is much more susceptible to recirculation. Suitable to work with high static pressure. They can be installed in more confined spaces and even in some indoor situations.

Fossil fuels: Natural gas, petroleum, coal, or any form of solid, liquid, or gaseous fuel derived from such material that resulted from the compression of ancient plant and animal life formed over millions of years, which is combusted with the purpose of creating useful heat or work.

Fresh feed: Any petroleum derivative feedstock stream charged directly into the riser or reactor of a FCCU except for petroleum derivatives recycled within the FCCU, fractionator, or gas recovery unit.

Fuel gas: Any gas which is generated at a petroleum refinery and which is combusted separately or in any combination with any type of gas. Fuel gas also includes natural gas when the natural gas is combined and combusted in any proportion with a gas generated at a refinery. Fuel gas does not include gases generated by catalytic cracking unit catalyst regenerators and fluid coking burners, but does include gases from flexicoking unit gasifiers. See *Still gas* and *Refinery fuel gas*.

Fuel gas system: A system of compressors, piping, knock-out pots, mix drums, and, if necessary, units used to remove sulfur contaminants from the fuel gas (e.g., amine scrubbers) that collects gaseous streams from one or more sources for treatment, as necessary, and transport to a stationary combustion unit. A fuel gas system may have an overpressure vent to a flare but the primary purpose for a fuel gas system is to provide fuel to the various combustion units at the refinery or petrochemical plant, such as heaters, furnaces, boilers, incinerators, gas turbines, and other combustion devices located within or outside of the facility. The fuel is piped directly to each individual combustion device, and the system typically operates at pressures over atmospheric. The gaseous streams can contain a mixture of methane, light hydrocarbons (e.g., ethane, butane, hydrogen) and other miscellaneous species.

Fuel gas treatment unit: A unit used to remove sulfur compounds from fuel gas.

Fuels solvent deasphalting: A refining process for removing asphalt compounds from petroleum fractions, such as reduced crude oil. The recovered stream from this process is used to produce fuel products.

Gallon: A measure of volume equal to 4 quarts (231 cubic inches). One barrel equals 42 gallons.

Gas oil: A liquid petroleum distillate having a viscosity intermediate between that of kerosene and lubricating oil. It derives its name from having originally been used in the manufacture of illuminating gas. It is now used to produce distillate fuel oils and gasoline.

Gas plant/light-ends distillation/LPG production unit: A series of equipment in which petroleum gas mixtures are separated from natural gas, or in which petroleum gas mixtures are fractionated or otherwise separated into liquefied petroleum gas (LPG) products or both. Examples of this equipment include: glycol dehydration; deethanizer, depropanizer, and/or debutanizer distillation columns.

Gas service: Unless defined otherwise in the regulation to which a process unit is subject, a piece of equipment that contains a gas or vapor at operating conditions, and the organic compound concentration in the process fluid is at least 5 percent by weight.

Gasification: A process where coal, petroleum coke, biomass, wastes, or other carbon-containing materials is subjected to high temperatures and mixed with steam and oxygen to produce a synthesis gas

or “syngas” and can be burned to generate power, steam, or process heat. The syngas typically contains hydrogen, carbon monoxide, and various impurities. For the production of hydrogen, the syngas is cleansed of impurities and mixed again with steam at lower temperatures to create pure H₂ and CO₂ gas. The hydrogen is separated for use and the CO₂ is either vented or captured.

Gasoline blending components: Naphthas which will be used for blending or compounding into finished aviation or motor gasoline (e.g., straight-run gasoline, alkylate, reformat, benzene, toluene, and xylene). Excludes oxygenates (alcohols, ethers), butane, and pentanes plus.

Geodesic dome roof: A domed or vaulted structure of a tank roof composed of straight elements that form interlocking polygons.

Heat exchanger: Any device that transfers heat from one fluid (liquid or gas) to another or to the environment.

Heat exchange system: A device or series of devices used to transfer heat from process fluids to water without intentional direct contact of the process fluid with the water (i.e., non-contact heat exchanger) and to transport and/or cool the water in a closed-loop recirculation system (cooling tower system) or a once-through system (e.g., river or pond water). For closed-loop recirculation systems, the *heat exchange system* consists of a cooling tower, all heat exchangers that are serviced by that cooling tower, and all water lines to and from the heat exchanger(s). For once-through systems, the *heat exchange system* consists of one or more heat exchangers servicing an individual process unit and all water lines to and from the heat exchanger(s). Intentional direct contact with process fluids results in the formation of a wastewater.

Heat input capacity: The maximum rated energy input, determined on a higher heating value basis, of a boiler or process heater when burning the primary fuel. Heat input from preheated air, pilot flames, or other sources should not be included.

Heavy liquid service: Unless defined otherwise in the regulation to which a process unit is subject, a piece of equipment not in gas service or light liquid service that contains a process fluid with an organic compound concentration of at least 5 percent by weight.

Heavy gas oil: Petroleum distillates with an approximate boiling range from 651 degrees Fahrenheit to 1000 degrees Fahrenheit. Commonly, this is a mixture of a distillate that contains residual fuel oil.

Heavy oil/asphalt refinery: A refinery that processes heavy crude slates to produce primarily road asphalt, roofing tars, and other asphalt products. These refineries are similar in complexity and equipment to topping refineries, except they typically also use vacuum distillation. See *Topping refinery*.

High-efficiency regenerator: A regenerator unit consisting of an energy-efficient version that operates in a fast-fluidized flow followed by plug flow reactor. The burning takes place in a fast-fluidized combustor. By conducting regeneration in this manner at high temperature, regeneration can be accomplished in a fraction of the time required and unit inventory is reduced, allowing complete CO combustion with little excess air or no promoter.

Higher heating value (HHV): The thermodynamic heat of combustion or enthalpy change for the oxidation reaction of a fuel assuming a common temperature of the compounds before and after combustion, in which case the water produced by combustion is liquid. The *higher heating value* takes into account the latent heat of vaporization of water in the combustion products.

Horizontal tank: A fixed roof tank constructed such that the length of the tank is not greater than six times the diameter to ensure structural integrity. Horizontal tanks are generally small storage tanks with capacities of less than 40,000 gallons.

Hydrogen (H₂): A colorless, odorless, highly flammable gaseous element. It is the lightest of all gases and the most abundant element in the universe, occurring chiefly in combination with oxygen in water and also in acids, bases, alcohols, petroleum, and other hydrocarbons.

Hydrogen plant: A collection of process equipment that are used collectively for the production and purification of hydrogen as a primary product. These processes include hydrogen conversion/production (e.g., steam reforming, coal gasification, partial oxidation, electrolysis, thermolysis) and hydrogen purification (e.g., pressure-swing adsorption). *Hydrogen plants* do not include catalytic reforming units where hydrogen is produced as a by-product during the production of reformat.

Hydroskimming refinery: A refinery equipped with atmospheric distillation, naphtha reforming, and necessary hydrotreating processes; *hydroskimming refineries* also typically include vacuum distillation as well as tankage, recovery facilities for gases and light hydrocarbons, and the necessary utility systems. A *hydroskimming refinery* is more complex than a topping refinery and it produces finished gasoline, but lacks conversion (coking or cracking) processes so they generally produce a surplus of fuel with unattractive price and demand. See *Topping refinery*.

Hydrotreating: see *Catalytic hydrotreating*.

Individual drain system: A stationary system used to convey regulated-material to a waste management unit or to discharge or disposal. The term includes hard-piping, all drains and junction boxes, together with their associated sewer lines and other junction boxes (e.g., manholes, sumps, and lift stations) conveying regulated-material. For the purpose of this subpart, an individual drain system is not a drain and collection system that is designed and operated for the sole purpose of collecting rainfall runoff (e.g., stormwater sewer system) and is segregated from all other individual drain systems.

Incinerator: An enclosed combustion device that is used for destroying organic compounds and does not extract energy in the form of steam or process heat. Auxiliary fuel may be used to heat waste gas to combustion temperatures. Any energy recovery section present is not physically formed into one manufactured or assembled unit with the combustion section; rather, the energy recovery section is a separate section following the combustion section and the two are joined by ducts or connections carrying flue gas.

Internal floating roof: A cover or roof in a fixed roof tank which rests upon or is floated upon the petroleum liquid being contained (but not necessarily in complete contact with it), and is equipped with a closure seal or seals to close the space between the roof edge and tank shell.

Isomerization: A refining process which alters the fundamental arrangement of atoms in the molecule without adding or removing anything from the original material. Used to convert normal butane into isobutane (C₄), an alkylation process feedstock, and normal pentane and hexane into isopentane (C₅) and isohexane (C₆), high-octane gasoline components.

Junction box: A manhole or access point to a wastewater sewer system line.

Kerosene: A light petroleum distillate with a maximum distillation temperature of 400 °F at the 10 percent recovery point, a final maximum boiling point of 572 °F, a minimum flash point of 100 °F, and a maximum freezing point of -22 °F. Included are No. 1-K and No. 2-K, distinguished by maximum sulfur

content (0.04 and 0.30 percent of total mass, respectively), as well as all other grades of kerosene called range or stove oil. Excluded is kerosene-type jet fuel (see *Kerosene-type jet fuel*).

Kerosene-type jet fuel: A kerosene-based product used in commercial and military turbojet and turboprop aircraft. The product has a maximum distillation temperature of 400 °F at the 10 percent recovery point and a final maximum boiling point of 572 °F. Included is Jet-A, Jet A-1 (JP-8), and JP-5.

Kilowatt: A unit of power, usually used for electric power or to energy consumption (use). A kilowatt equals 1000 watts.

Kilowatt hour (kWh): A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu or 3.6 million joules.

Knock-out pot or Vapor-liquid separator: A vertical vessel used in several industrial applications to separate a vapor-liquid mixture. Gravity causes the liquid to settle to the bottom of the vessel, where it is withdrawn. The vapor travels upward at a design velocity which minimizes the entrainment of any liquid droplets in the vapor as it exits the top of the vessel. The feed to a *vapor-liquid separator* may also be a liquid that is being partially or totally flashed into a vapor and liquid as it enters the separator.

Lift station: An structure containing relatively large pumps and associated piping, valves, and other mechanical and electrical equipment for pumping liquid.

Light liquid service: Unless defined otherwise in the regulation to which a process unit is subject, a piece of equipment not in gas service that contains a liquid that meets the following conditions: (1) The vapor pressure of one or more of the organic compounds is greater than 0.3 kilopascals at 20°C, (2) The total concentration of the pure organic constituents having a vapor pressure greater than 0.3 kilopascals at 20°C is equal to or greater than 20 percent by weight of the total process stream, and (3) The fluid is a liquid at operating conditions. Alternatively, a piece of equipment is in light liquid service if the percent evaporated is greater than 10 percent at 150°C as determined by ASTM Method D-86.

Liquid-mounted seal: A foam or liquid-filled primary seal mounted in contact with the liquid between the tank wall and the floating roof continuously around the circumference of the tank.

Liquefied petroleum gas (LPG): A group of hydrocarbon-based gases derived from crude oil refining or natural gas stream fractionation that are often liquefied, through pressurization, for ease of transport. They include: ethane, propane, normal butane, isobutane and isobutylene. Uses of these fuels include: home heating, industrial, automotive fuel, petrochemical feedstocks and for drying purposes in farming.

Loading operation: A fixed location for loading products into tank trucks, railcars, barges, tank ships, or other vessels. Loading equipment and operations that are physically separate (*i.e.*, do not share common piping, valves, and other equipment) are considered to be separate *loading operations*.

Loading rack: A single system used to fill tank trucks and railcars at a single geographic site. Loading equipment and operations that are physically separate (*i.e.*, do not share common piping, valves, and other equipment) are considered to be separate *loading racks*.

Lo-Cat®: A liquid phase oxidation process for tail gas stream desulfurization based on a dilute solution of a proprietary, organically chelated iron in water that convert the H₂S in water and elemental sulfur. The process is not reactive to CO₂. A small portion of the chelating agent degrades in some side reactions and is lost with the precipitate sulfur. Normally, sulfur is separated by gravity, centrifuging, or melting.

LoTOX® scrubber: A NO_x emission control system based on the patented Low Temperature Oxidation (LTO) Process for removal of NO_x emissions. This system uses oxygen to produce ozone as the primary treatment chemical using an ozone generator. The oxidation of NO_x using ozone is a naturally occurring process in the atmosphere. This treatment method produces the treatment chemical, ozone, on demand from gaseous oxygen in the exact amount required for oxidation of the NO_x. The ozone is injected into flue gas stream where it reacts with relatively insoluble NO and NO₂ to form N₂O₃ and N₂O₅, which are highly water soluble, and are easily and efficiently removed and neutralized in a wet scrubbing system.

Low NO_x burners (LNB): Combustion modification NO_x controls that reduce NO_x formation by reducing peak flame temperatures. There are two basic types of LNB as described below:

- *Staged air LNB:* Air staging reduces both thermal NO_x and fuel NO_x, however it is most effective in controlling fuel NO_x and is, in fact, the best method for controlling the conversion of fuel bound nitrogen to fuel NO_x emissions. In this case the primary and secondary air are used to create the fuel rich combustion zone and the tertiary air stream on the periphery of the burner is the “staged air” used to complete combustion.
- *Staged fuel LNB:* Fuel staging is the reverse of air staging. Generally 30 to 50% of the fuel is injected into the combustion air to form a lean primary flame zone. Although excess oxygen is available, NO_x is minimized by the low flame temperatures that are generated due to the lean combustion conditions. The remainder of the fuel is then injected downstream forming a secondary flame zone where combustion is completed.

Low sulfur feed: Fresh feed that has a total sulfur content no greater than 0.30 percent by weight; limiting the fluid catalytic cracking unit or fluid coking unit to only low sulfur feed is one SO₂ compliance option for the Refinery NSPS (40 CFR §60.104(b)(3)).

Lubricants: Substances used to reduce friction between bearing surfaces or as process materials either incorporated into other materials used as processing aids in the manufacture of other products, or used as carriers of other materials. Petroleum lubricants may be produced either from distillates or residues. Lubricants include all grades of lubricating oils from spindle oil to cylinder oil and those used in greases.

Lubricant dewaxing: Lubricant manufacturing process by which the wax content of the raffinate oil from the aromatic extraction unit or the residual oil from the catalytic conversion unit is removed by either solvent extraction or catalytic treatment. These processes are described as follows:

- *Solvent dewaxing:* There are several solvent dewaxing processes in use today. They include the use of MEK, MIBK, liquid propane or liquid SO₂/benzol (Edeleanu) combination as the solvent that will be mixed with the feed entering the unit to promote the separation of the wax from oil. All of these processes with the exception of Edeleanu have similar process configuration, where the wax extracted by the solvent is removed through cold filtration.
- *Catalytic dewaxing:* Catalytic dewaxing is used to improve cold flow properties of diesel fuels and lube oils by selective hydroisomerization/ hydrocracking of normal and slightly branched paraffins with or without hydrogen presence. They are suited for use in the following applications:
 - i. conventional diesel fuels dewaxing to deep dewaxing (Arctic grade production) in 1st and 2nd stage applications,
 - ii. in combination with high pressure hydrocracking or mild hydrocracking catalyst package,

- iii. in mild hydrocracker bottoms pour point reduction for storage and transportation and
- iv. to produce lubes of exceptional quality.

Lubricants production: All processes associated to the lube oil manufacturing, including but not limiting to propane deasphalting, aromatic extraction and UV stabilization, catalytic hydrocracking/hydrotreating, solvent or catalytic dewaxing, and final lubricant polish (*i.e.*, lubricant grade separation).

Lubricating oil: See *Lubricants*.

Make-up water or Top-up water or Refill water: The water used to replace water lost to evaporation, splash-out, leaks and backwashing.

Manhole: An opening in a sewer component through which physical access is gained for service; incorporates a cover that can be secured.

Marine vessel or Marine tank vessel: Any tank ship or tank barge that transports liquid product such as gasoline, crude oil or petroleum products in bulk through the ocean, river, lake or any other surface water body.

Marketable coke: Those grades of coke produced in delayed or fluid cokers which may be recovered as relatively pure carbon. This “green” coke may be sold as is or further purified by calcining. The conversion is 5 barrels (of 42 U.S. gallons each) per short ton. Coke from petroleum has a heating value of 6.024 million Btu per barrel. See *Petroleum coke*.

Maximum true vapor pressure: The equilibrium partial pressure exerted by the stored liquid (1) at the temperature equal to the highest calendar-month average of the liquid storage temperature for liquids stored above or below the ambient temperature or (2) at the local maximum monthly average temperature as reported by the National Weather Service for liquids stored at the ambient temperature.

Mechanical-shoe seal: Includes but is not limited to a metal sheet held vertically against the tank wall by springs or weighted levers and is connected by braces to the floating roof. A flexible coated fabric (envelope) spans the annular space between the metal sheet and the floating roof.

Megawatt: A unit of electrical power equal to 1000 kilowatts or one million watts.

Membrane separation process: A hydrogen purification process consisting of two layers of membrane material; the first layer is nonporous, and the second layer is porous. A gas mixture under increased pressure is subjected to the surface, which allows a smaller molecule such as hydrogen to permeate faster than a larger molecule such as carbon dioxide. Typically, membrane separation involves hollow fiber membrane tubes that have extremely high surface areas.

MeroxTM: The trade name of a catalytic chemical process used in oil refineries and natural gas processing plants to remove mercaptans from LPG, propane, butanes, light naphtha, kerosene and jet fuel by converting them to liquid hydrocarbon disulfides.

Methane (CH₄): A colorless, flammable, odorless hydrocarbon gas which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas.

MTBE (Methyl tertiary butyl ether) (CH₃)₃COCH₃: See *Oxygenates*.

Motor gasoline (finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in spark-ignition engines. *Motor gasoline*, as defined in ASTM Specification D 4814 or Federal Specification VV-G-1690C, is characterized as having a boiling range of 122 to 158 degrees Fahrenheit at the 10 percent recovery point to 365 to 374 degrees Fahrenheit at the 90 percent recovery point. *Motor gasoline* includes conventional gasoline; all types of oxygenated gasoline, including gasohol; and reformulated gasoline, but excludes aviation gasoline. Note: Volumetric data on blending components, such as oxygenates, are not counted in data on finished *motor gasoline* until the blending components are blended into the gasoline.

- *Conventional gasoline:* Finished motor gasoline not included in the oxygenated or reformulated gasoline categories. Note: This category excludes reformulated gasoline blendstock for oxygenate blending (RBOB) as well as other blendstock.
- *Reformulated gasoline:* Finished gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under Section 211(k) of the Clean Air Act. It includes gasoline produced to meet or exceed emissions performance and benzene content standards of federal-program reformulated gasoline even though the gasoline may not meet all of the composition requirements (*e.g.*, oxygen content) of federal-program reformulated gasoline. Note: This category includes Oxygenated Fuels Program Reformulated Gasoline (OPRG). Reformulated gasoline excludes Reformulated Blendstock for Oxygenate Blending (RBOB) and Gasoline Treated as Blendstock (GTAB).

Multi-stage Claus unit: The Claus process usually consists of two steps, a thermal step and a catalytic step. Though substantial amounts of elemental sulfur are created in the thermal step, the catalytic step is used to increase conversion of H₂S to elemental sulfur. In order to maximize the overall recovery of elemental sulfur, Claus processes are typically multi-stage operations. With each stage comes additional conversion of H₂S and SO₂ to elemental sulfur, which is usually equilibrium-limited. While the first stage typically produces more elemental sulfur than any other single stage, adding stages can increase overall recovery. The amount of increase in sulfur recovery that will be realized in additional stages decreases as the number of stages is increased.

- *2-stage Claus unit:* A Claus process train utilizing two catalytic reactors in series.
- *3-stage Claus unit:* A Claus process train utilizing three catalytic reactors in series.
- *4-stage Claus unit:* A Claus process train utilizing four catalytic reactors in series.

Naphtha: A generic term applied to a petroleum fraction with an approximate boiling range between 122 °F and 400 °F. The naphtha fraction of crude oil is composed largely of paraffinic hydrocarbons that are subsequently upgraded to make up the major constituent of gasoline.

Natural draft cooling tower: A cooling tower that depends upon natural convection of air flowing upward and in contact with the water to be cooled. This tower utilizes buoyancy via a tall chimney. Warm, moist air naturally rises due to the density differential to the dry, cooler outside air. Warm moist air is less dense than drier air at the same pressure. This moist air buoyancy produces a current of air through the tower.

Natural gas: A naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in geologic formations beneath the earth's surface. The principal hydrocarbon constituent is methane that may be

field quality or pipeline quality. *Natural gas* is composed of at least 70 percent methane by volume or has a high heat value between 910 and 1150 Btu per standard cubic foot.

Natural gas system: A system of compressors, piping, and knock-out pots that transports natural gas to stationary combustion units such as heaters, furnaces, boilers, incinerators, gas turbines, and other combustion devices located within or outside of the facility. The fuel is piped directly to each individual combustion device, and the system typically operates at pressures over atmospheric.

Neutralization basin: A upstream wastewater treatment unit where high contaminant concentration such as ammonia, phenols, or high pH is diverted and treated to be neutralized or reduced avoiding a shock load that affect the activated biological sludge.

Next generation low NO_x burner: A burner that achieves extremely low NO_x emissions by merging technology advancements in ultra-low NO_x burners including combinations of lean premix combustion, internal furnace gas recirculation, multiple stages of fuel injection, and lifted flame technology. See *Ultra-low NO_x burner*.

Non-reclosing pressure relief device: A pressure relief device designed to remain open after operation. A manual resetting means may be provided. *Non-reclosing pressure relief devices* include rupture disks and pin devices that are installed either alone or in combination with a reclosing pressure relief valve.

Non-routine emissions: Emissions that occur during periods of start-up, shutdown, or equipment or component malfunction.

Normal operation: For the purposes of the emissions inventory reporting, *normal operation* is all operating periods for a specific emissions point other than periods associated with start-up, shutdown, or equipment malfunction. For cyclic processes, normal operation includes all periods of the cyclic process. For example, cycling coke drums on a delayed coking unit or regeneration cycles for catalytic reforming units are considered *normal operations*. Periods of low processing rates are considered *normal operations* unless they occur during a period of startup, shutdown, or equipment or component malfunction.

Offshore loading terminal: A location that has at least one loading berth that is 0.81 km (0.5 miles) or more from the shore that is used for mooring a marine tank vessel and loading liquids from shore.

Oil-water separator: Wastewater treatment equipment used to separate oil from water consisting of a separation tank, which also includes the forebay and other separator basins, skimmers, weirs, grit chambers, and sludge hoppers. Slop oil facilities, including tanks, are included in this term along with storage vessels and auxiliary equipment located between individual drain systems and the oil-water separator. This term does not include storage vessels or auxiliary equipment which do not come in contact with or store oily wastewater.

Oily wastewater: Wastewater generated during the refinery process which contains oil, emulsified oil, or other hydrocarbons. *Oily wastewater* originates from a variety of refinery processes including cooling water, condensed stripping steam, tank draw-off, and contact process water.

Once-through cooling water system: A system designed to withdraw water from a natural or other water source, use it at the facility to support contact and/or noncontact cooling uses, and then discharge it to a waterbody without recirculation. *Once-through cooling water systems* sometimes employ canals/channels, ponds, or non-recirculating cooling towers to dissipate waste heat from the water before it is discharged.

Open-ended valve or line: Any valve, except safety relief valves, having one side of the valve seat in contact with process fluid and one side open to the atmosphere, either directly or through open piping.

Other atmospheric vent: Any continuous or intermittent process vent located at the facility and under common control with the potential to emit hydrocarbons, criteria pollutants, HAP, or greenhouse gases directly to the atmosphere during normal operation. *Other atmospheric vents* do not include those vents specifically covered in Sections 5 through 10 of Part II of this ICR, vents associated with process heater or boiler exhausts, and wastewater vents. *Other atmospheric vents* do include distillation tower vents; blowdown systems vents, knock-out pot vents, vacuum ejectors (hot well vents), analyzer vents as well as vents from Merox™ treatment systems, fuel gas treatment units (if any), catalytic hydrocracking units (if any), asphalt blowing stills, and coke calcining units. Vents recycled to process units, vents directed to a fuel gas system, or vents directed to a flare are not considered *other atmospheric vents*. *Other atmospheric vents* also do not include pressure relief vents where venting occurs only during upset, startup, or shutdown events or vents associated with storage tanks.

Other miscellaneous products: All refined petroleum products not defined elsewhere. These include, but are not limited to, naphtha-type jet fuel (Jet B and JP-4), petrolatum lube refining by-products (aromatic extracts and tars), absorption oils, ram-jet fuel, petroleum rocket fuels, synthetic natural gas feedstocks, waste feedstocks, and specialty oils. Organic waste sludges, tank bottoms, spent catalysts, and sulfuric acid are not *other miscellaneous products*.

Oxidation control system: An emission control system which reduces emissions from sulfur recovery plants by converting these emissions to SO₂ and recycling the SO₂ to the reactor furnace or the first-stage catalytic reactor of the Claus sulfur recovery plant.

Oxygenates: Substances which, when added to gasoline, increase the amount of oxygen in that gasoline blend. Fuel ethanol, methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), di-isopropyl ether (DIPE) and methanol are common oxygenates.

- *Fuel ethanol:* Blends of up to 10% by volume anhydrous ethanol (200 proof) (commonly referred to as the “gasohol waiver”).
- *Methanol:* Blends of methanol and gasoline-grade tertiary butyl alcohol (GTBA) such that the total oxygen content does not exceed 3.5% by weight and the ratio of methanol to GTBA is less than or equal to 1. It is also specified that this blended fuel must meet ASTM volatility specifications (commonly referred to as the “ARCO” waiver). Blends of up to 5.0% by volume methanol with a minimum of 2.5% by volume cosolvent alcohols having a carbon number of 4 or less (*i.e.*, ethanol, propanol, butanol, and/or GTBA). The total oxygen must not exceed 3.7% by weight, and the blend must meet ASTM volatility specifications as well as phase separation and alcohol purity specifications (commonly referred to as the “DuPont” waiver).
- *MTBE (Methyl tertiary butyl ether) (CH₃)₃COCH₃:* Ether used in the blending of reformulated gasolines, affecting vapor pressure and octane level. Blends up to 15.0% by volume MTBE which must meet the ASTM D4814 specifications. Blenders must take precautions that the blends are not used as base gasolines for other oxygenated blends (commonly referred to as the “Sun” waiver). Commonly made from the catalytic etherification of methanol (methyl alcohol) and isobutene.
- *ETBE (Ethyl tertiary butyl ether) (CH₃)₃COC₂H₅:* An oxygenate blend stock formed by the catalytic etherification of isobutylene with ethanol.

- *TAME (Tertiary amyl methyl ether) (CH₃)₂(C₂H₅)COCH₃*: An oxygenate blend stock formed by the catalytic etherification of isoamylene or isopentene with methanol in a catalytic cracking unit.
- *DIPE (Di-isopropyl ether) (CH₃)₂CHOCH(CH₃)₂*: An oxygenate blend stock formed by the etherification of propylene through a catalytic hydration.

Ozonation: The act of treating with ozone something with disinfection purposes, also, the act of converting into, or producing, ozone.

Packed-bed wet scrubber: An air pollution control device that removes soluble chemicals, fumes, particulates and odors through a specially designed packing media that is wetted with recirculated liquid spray. The liquid solvent absorbs the gas pollutant by physical or chemical means. A blowdown from the tank with makeup water addition removes contaminant products before they precipitate.

Perchloroethylene or Tetrachloroethylene (C₂Cl₄): A chloride solvent that is excellent in its use as a chloriding agent in the reforming catalyst regeneration process because of the amount of available chlorides. Also the primary solvent used in the industrial and commercial dry-cleaning of clothes. Its other major uses are as a metal cleaning and degreasing solvent, and as a chemical intermediate in the production of several fluorinated compounds.

Petrochemical feedstocks: Chemical feedstocks derived from petroleum principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics. The categories reported are “Naphtha Less Than 401°F” and “Other Oils Equal To or Greater Than 401°F.”

- *Naphtha Less Than 401°F*: A naphtha with a boiling range of less than 401 degrees Fahrenheit that is intended for use as a petrochemical feedstock.
- *Other Oils Equal To or Greater Than 401°F*: Oils with a boiling range equal to or greater than 401 degrees Fahrenheit that are intended for use as a petrochemical feedstock.

Petroleum: The crude oil removed from the earth and the oils derived from tar sands, shale, and coal. A broadly defined class of liquid hydrocarbon mixtures. Included are crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil, and natural gas plant liquids.

Petroleum coke or coke: A solid residue high in carbon content and low in hydrogen that is the final product of thermal decomposition in the condensation process in cracking. This product is reported as marketable coke or catalyst coke. The conversion is 5 barrels (of 42 U.S. gallons each) per short ton. Coke from petroleum has a heating value of 6.024 million Btu per barrel.

There are three main types of coke:

- *Needle coke*: Coke produced from feedstocks without asphaltene present, normally FCCU decant oils, and named for its needle-like structure. Needle coke is the premier coke, used in graphite electrode manufacturing (used in steel arc furnaces) and commands a high price, but needle coke requires special feedstocks, special coking, and special calcination to obtain the optimum properties that it requires.
- *Shot coke*: Coke produced by high concentrations of asphaltene in the feedstock, dynamics (velocity and/or turbulence) in the coke drum, and high coke drum temperatures. A

coker feedstock high in oxygen content can also produce shot coke. Shot coke is typically spherical.

- *Sponge coke*: Coke produced from vacuum reduced crude with a low to moderate asphaltene concentration and named for its sponge-like appearance. If sponge coke meets strict property specifications, it is considered anode grade sponge coke suitable for calcination for use in making carbon anodes for the aluminum industry. Otherwise, if sponge coke meets the more lenient fuel grade specifications, it can be used in its raw form for fuel.

There are two main grades of coke:

- *Anode grade coke*: Coke low in metals suitable for calcination and use in the aluminum industry.
- *Fuel grade coke*: Coke used in the production of cement and with fluidized bed boilers (using limestone for sulfur removal) for generation of steam and electricity.

Petroleum products: All refined and semi-refined products that are produced at a refinery by processing crude oil, natural gas, and other petroleum-based feedstocks, including petroleum products derived from co-processing biomass and petroleum feedstock together, but not including plastics or plastic products. *Petroleum products* include unfinished oils, liquefied petroleum gases, pentanes plus, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

Petroleum refinery: Any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, asphalt (bitumen) or other products through distillation of petroleum or through redistillation, cracking, or reforming of unfinished petroleum derivatives. A facility that produces only oil shale or tar sands-derived crude oil for further processing at a petroleum refinery using only solvent extraction and/or distillation to recover diluent is not a *petroleum refinery*.

Pressure relief device (PRD): A safety device used to prevent operating pressures from exceeding the maximum allowable working pressure of the process equipment. A common *pressure relief device* is a spring-loaded pressure relief valve. It is characterized by a rapid-opening 'pop' action or by opening in a manner generally proportional to the increase in pressure over the opening pressure. Devices that are actuated either by a pressure of less than or equal to 2.5 psig or by a vacuum are not *pressure relief devices*. For purposes of this ICR, liquid expansion pressure relief valves and pressure relief valves on mobile units and containers (*e.g.*, trucks, tank cars, totes, etc) are not considered *pressure relief devices*. For purposes of this ICR, a non-reclosing device in combination with a reclosing pressure relief valve is considered one *pressure relief device*.

Pressure swing adsorption (PSA): An adiabatic process that is applied for purification of gases by removing the accompanying impurities by adsorption through suitable adsorbents in fixed beds contained in pressure vessels under high pressure. Regeneration of adsorbents is accomplished by countercurrent depressurization and by purging at low pressure with previously recovered near product quality gas. Dependent on the types of impurity to be adsorbed and removed, adsorbents to be used comprise zeolitic molecular sieves, activated carbon, silica gel and activated alumina. Mostly, combinations of adsorbent beds are used on top of one another, so dividing the adsorber contents into a number of distinct zones. Monitoring and proper control of process parameters ensures a stable operation.

Pressurized/sphere tank: A closed container designed to hold gases or liquids (generally organic) at a [pressure](#) substantially different from the ambient [pressure](#). A *pressurized/sphere tank* is equipped with a pressure/vacuum vent that is set to prevent venting loss from boiling and breathing loss from daily temperature or barometric pressure changes.

Primary clarifier: A wastewater treatment plant component or tank that physically removes suspended solids particles from wastewater, typically by settling and flotation with or without the use of coagulant.

Primary fuel: The fuel that provides the principal heat input (*i.e.*, more than 50 percent) to the device. To be considered primary, the fuel must be able to sustain operation of the device without the addition of other fuels.

Process or recycled blowdown water: Water that has been used in any level of the manufacturing process or came from any recycled blowdown system. Recycled blowdown water is an industrial wastewater that is routinely released from a boiler or any other equipment that requires removal of water from the system to avoid the buildup of any impurity, sediment or contaminants such as dissolved/suspended minerals, heavy metals (iron, copper), corrosion inhibitors, oil, and/or algacides.

Process gas: See *Still gas*.

Process heater: An enclosed combustion device used to transfer heat indirectly to process stream materials (liquids, gases, or solids) or to a heat transfer material for use in a process unit, instead of generating steam. *Process heaters* do not include units used for comfort heat or space heat, food preparation for on-site consumption, or autoclaves. Process heaters can be classified by the type of draft used as follow:

- *Natural draft process heater:* A process heater in which the combustion air is supplied under ambient or negative pressure without the use of an inlet air (forced draft) fan or an exhaust outlet (induced draft) fan.
- *Induced draft process heater:* A process heater in which the combustion air is supplied under negative pressure produced by a fan at any location in the outlet exhaust gas line or stack. *Induced draft process heaters* do not use an inlet air (forced draft) fan.
- *Forced draft process heater:* A process heater in which the combustion air is supplied under positive pressure produced by a fan at any location in the inlet air line prior to the point where the combustion air enters the process heater. *Forced draft process heaters* do not use an outlet air (induced draft) fan.
- *Balanced draft process heater:* A process heater in which the combustion air is supplied with the use of both an inlet air (forced draft) fan and an exhaust outlet (induced draft) fan. *Balanced draft process heaters* are commonly used for process heaters using combustion air preheat.

Process tank: A tank or other vessel that is used within a process to collect material discharged from a feedstock storage vessel or a vessel in which crude oil or petroleum liquids are processed (*e.g.*, distillation column, condenser, coker) before the material is transferred to another processing vessel or a product storage vessel. Process tanks may be used only to provide temporary holding of a material, or unit operations (*e.g.*, blending) may be conducted in the tank. Examples of process tanks include surge control vessels and bottoms receivers.

Process unit: For the purposes of this ICR, a process unit is any segment of the petroleum refinery in which a specific processing operation is conducted. Examples of such units include, but are not limited to, alkylation units, catalytic hydrotreating (or catalytic hydrorefining or desulfurization), catalytic hydrocracking, catalytic reforming, catalytic cracking, crude distillation, lube oil processing, hydrogen production, isomerization, polymerization, thermal (coking) processes, sulfur recovery, and blending, sweetening, and treating processes.

Process vent: A gas stream that is continuously or periodically discharged during normal operation of a process unit, including gas streams that are discharged directly to the atmosphere, gas streams that are routed to a control device prior to discharge to the atmosphere, or gas streams that are diverted through a product recovery device line prior to control or discharge to the atmosphere. *Process vent* does not include safety device discharges, equipment leaks, gas streams routed to a fuel gas system or to a flare, or discharges from storage vessels.

Propane (C₃H₈): A normally gaseous straight-chain hydrocarbon. It is a colorless paraffinic gas that boils at a temperature of -43.67 degrees Fahrenheit. It is extracted from natural gas or refinery gas streams. It includes all products designated in ASTM Specification D1835 and Gas Processors Association Specifications for commercial propane and HD-5 propane.

Propane deasphalting: A process by which the vacuum tower residue is distilled along with liquid propane to remove the asphaltene portion of the residue to prepare a suitable feedstock for catalytic conversion units (*i.e.*, lube hydrotreater) in the lubricants production.

Pyrolysis: The thermal decomposition of biomass at high temperatures (greater than 400 °F, or 200 °C) in the absence of air. The end product of pyrolysis is a mixture of solids (char), liquids (oxygenated oils), and gases (methane, carbon monoxide, and carbon dioxide) with proportions determined by operating temperature, pressure, oxygen content, and other conditions.

Reduction control system: An emission control system which reduces emissions from sulfur recovery plants by converting these emissions to H₂S and recycling the H₂S to the reactor furnace or the first-stage catalytic reactor of the Claus sulfur recovery plant.

Rectisol®: The trade name for an acid gas removal solvent (refrigerated methanol) that can separate, at relatively high pressures, acid gases such as hydrogen sulfide and carbon dioxide from feed gas streams such as synthesis gas produced by gasification of coal, coke, or heavy hydrocarbon oils.

Recycle feed: Feeds that are continuously fed back for additional processing.

Refinery fuel gas: A gaseous mixture of gases produced at the refinery (*i.e.*, still or process gas) and natural gas that is used as a fuel in boilers and process heaters throughout the refinery. Still gas is typically augmented with natural gas in a refinery's fuel gas system; the proportion of heating value contributed by still gas and natural gas is variable based on the quantity of still gas produced and the energy needs of the process units. For the purposes of this ICR, any mixture of still gas and natural gas is considered to be *refinery fuel gas*. See *Still gas*, *Natural gas*, and *Fuel gas system*.

Reformate: The liquid product stream of catalytic reforming units. *Reformate* is characterized by a high concentration of aromatics and high octane level, and it is used as a gasoline blending component or as feedstock for aromatics production.

Residual fuel oil: A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. It

conforms to ASTM Specifications D 396 and D 975 and Federal Specification VV-F-815C. No. 5, a residual fuel oil of medium viscosity, is also known as Navy Special. It is used in steam-powered vessels in government service and inshore power plants. No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.

Residuum: Residue from crude oil after distilling off all but the heaviest components, with a boiling range greater than 1000 degrees Fahrenheit.

Road oil: Any heavy petroleum oil, including residual asphaltic oil used as a dust palliative and surface treatment on roads and highways. It is generally produced in six grades from 0, the most liquid, to 5, the most viscous.

Rotating biological contactor: An aerobic treatment system that rotates plastic media with fixed microbial film alternately through liquid effluent and air to reduce the BOD value.

SCOT unit or SCOT process: A Shell air pollution control process for treating the tail gas or off-gas from a Claus unit to increase the overall sulfur recovery to as high as 99.9% and thus minimize emissions of sulfur compounds.

Secondary clarifier: A wastewater treatment plant component or tank that uses biological and chemical treatment processes designed to remove organic matter.

Secondary fuel: A fuel fired to a process heater or boiler that provides supplementary heat in addition to the heat provided by the primary fuel, but provides less than 50% of the heat input to the process heater or boiler. The *secondary fuel* may be fed through the primary burner or a burner other than the primary fuel burner. Pilot gas is not considered to be *secondary fuel*. See *Primary fuel*.

Selective catalytic reduction (SCR): A non-combustion control technology that destroys NO_x by injecting a reducing agent (e.g., ammonia) into the flue gas that, in the presence of a catalyst (e.g., vanadium, titanium, or zeolite), converts NO_x into molecular nitrogen and water.

Selective non-catalytic reduction (SNCR): A non-combustion control technology that destroys NO_x by injecting a reducing agent (e.g., ammonia, urea, or cyanuric acid) into the flue gas, downstream of the combustion zone that converts NO_x to molecular nitrogen, water, and when urea or cyanuric acid are used, to CO₂.

Selexol®: The trade name for an acid gas removal solvent (a mixture of the dimethyl ethers of polyethylene glycol) that can separate at high pressures acid gases such as hydrogen sulfide and carbon dioxide from feed gas streams such as synthesis gas produced by gasification of coal, coke, or heavy hydrocarbon oils.

Semi-refined petroleum product: All oils requiring further processing. Included in this category are unfinished oils which are produced by the partial refining of crude oil and include the following: naphthas and lighter oils; kerosene and light gas oils; heavy gas oils; and residuum, and all products that require further processing or the addition of blendstocks.

Sewer line: A lateral, trunk line, branch line, ditch, channel, or other conduit used to convey refinery wastewater to downstream components of a refinery wastewater treatment system. This term does not include buried, below-grade sewer lines.

Shutdown: The process by which the complete cessation of operation of a processing unit is achieved. For the purposes of this ICR, cycling coke drums on a delayed coking unit or regeneration cycles for catalytic reforming units are not considered a complete cessation of operation of these processing units. *Shutdown* of a delayed coking unit entails the eliminating feed to the delayed coking unit fractionator reboiler and all coke drums associated with the fractionators; *shutdown* of a catalytic reforming unit entails the eliminating feed to all reforming reactors for reasons other than catalyst regeneration (*e.g.*, to completely replace the catalyst or to perform maintenance on equipment).

Slotted guidepole: Any gauge pole, gauge pipe or stilling well that has slots or holes through the wall of the pole. The slots or holes allow the stored liquid to flow into the pole at liquid levels above the lowest operating level.

Sodium hypochlorite: An unstable salt, NaOCl, usually stored in solution and used as a fungicide and an oxidizing bleach. A solution of sodium hypochlorite is frequently used as a disinfectant.

Solid guidepoles: Any gauge pole, gauge pipe or stilling well that does not have slots or holes through the wall of the pole. Controls include a guidepole cover at the top of the guidepole and a well cover positioned at the top of the guidepole well that seals any openings between the well cover and the guidepole (*e.g.*, pole wiper), any openings between the well cover and any other objects that pass through the well cover, and any other openings in the top of the guidepole well.

Sour water: Process or waste water that contains sulfur compounds, most commonly hydrogen sulfide.

Sour water stripper: A stream stripper used to treat sour water to remove hydrogen sulfide from the water prior to other wastewater treatment units or prior to reuse in a process unit. For the purposes of this ICR, the *sour water stripper* is considered a wastewater treatment unit regardless of the disposition or use of the treated water stream.

Special naphthas: All finished products within the naphtha boiling range that are used as paint thinners, cleaners, or solvents. These products are refined to a specified flash point. *Special naphthas* include all commercial hexane and cleaning solvents conforming to ASTM Specification D1836 and D484, respectively. Naphthas to be blended or marketed as motor gasoline or aviation gasoline and naphthas that are to be used as petrochemical and synthetic natural gas (SNG) feedstocks are excluded.

Spray dryer absorber (SDA): A pollution control system developed to remove acidic pollutants, SO₂, heavy metals and dust through absorption into a finely atomized aqueous mist of hydrated lime from flue gases of various origins, primarily fossil fuelled power stations, waste incinerators and steel industries.

Stabilized crude oil: Crude oil that does not meet the definition of unstabilized crude oil.

Staged air low NO_x burner: See *Low NO_x burner*.

Staged fuel low NO_x burner: See *Low NO_x burner*.

Startup: The process by which a new process unit first begins operation and an existing process unit initiates operation after a shutdown.

Steam: Water in vapor form; used as the working fluid in steam turbines and heating systems.

Steam generating unit: A unit in which steam is generated for sale or for use at other processing locations within the facility. *Steam generating units* do not include process heaters, hot water heaters, or space heaters.

Steam methane reforming: A catalytic process that involves a reaction between natural gas or methane and steam. The result is a mixture of hydrogen, carbon monoxide, carbon dioxide, and water.

Steam stripper: A process that uses steam for the removal of volatile component from a liquid by vaporization. The stripping operation is an important step in many industrial processes which employ absorption to purify gases and to recover valuable components from the vapor phase.

Sterically-hindered amines: Chemical compounds containing an amine functional group surrounded by a crowded steric environment. They have uses such as gas scrubbing, as stabilizers against light-induced degradation of polymers, and as reagents for organic synthesis. Sterically-hindered amines are found to be superior to diethanolamine (DEA) as promoters for alkaline salts in the “hot pot” acid gas scrubbing process.

Sterically-hindered amine scrubber: An air pollution control device that employs liquid hindered amines spray to remove acidic substances (such as sulfur dioxide or hydrogen sulfide) from industrial off-gases.

Still gas or *Process gas:* Any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylenes, propane, propylene, etc. *Still gas* is used as a refinery fuel and a petrochemical feedstock. For the purpose of this ICR, *still gas* is also any gaseous fraction containing hydrogen gas and any combination of the above other gases. The conversion factor is 6 million BTU per fuel oil equivalent barrel. *Still gas* mixed with natural gas is considered refinery fuel gas. See also *Refinery fuel gas*.

Stretford process®: A process developed to remove hydrogen sulfide (H₂S) from town gas. It was the first liquid phase, oxidation process for converting H₂S into sulfur to gain widespread commercial acceptance. Developed by Tom Nicklin of the North-Western Gas Board (NWGB) in 1940. The process uses reduction-oxidation (redox) chemistry to oxidize the H₂S into elemental sulfur, in an alkaline solution containing vanadium as an oxygen carrier.

Storage vessel or *Storage tank:* A tank or other vessel (excluding sumps) that is designed to contain an accumulation of liquids that contain hydrocarbons and is constructed entirely of non-earthen materials (e.g., wood, concrete, steel, plastic) that provide structural support. Process tanks and vessels permanently attached to motor vehicles are not considered storage vessels.

Stormwater sewer system: A drain and collection system designed and operated for the sole purpose of collecting stormwater and which is segregated from the process wastewater collection system.

SubDewPoint MCRC™-SUPERCLAUS®: Process consists of two well-known processes in series: The sub-dewpoint MCRC process followed by the selective oxidation stage of SUPERCLAUS®, with the patented main combustion air control of SUPERCLAUS®. The sub-dewpoint part consists of a thermal stage followed by two or more catalytic reaction stages with sulfur removed between stages by condensers. The first reactor is always operated at normal Claus conditions, the second reactor (MCRC) is a sub-dewpoint reactor being regenerated on-line by increased inlet temperature, and the third sub-dewpoint reactor operates below the dewpoint of sulfur. These reactors are filled with standard Claus catalyst while the last reactor (the SUPERCLAUS® stage) is filled with proprietary selective oxidation catalyst. In the thermal stage, the acid gas is burned with a substoichiometric amount of controlled combustion air such that the tail gas leaving the last sub-dewpoint reactor contains an increased H₂S

concentration of typically 0.2 to 0.3 vol.%. Under these conditions, hardly any SO₂ leaves the sub-dewpoint part. Because the proprietary catalyst neither oxidizes H₂S to SO₂ and H₂O nor reverses the reaction of sulfur and water to H₂S and SO₂, a total sulfur recovery efficiency of 99.7% can be obtained.

Submerged fill loading: A type of organic liquid loading operation where the fill pipe discharge opening is completely submerged when the liquid level above the bottom of the vessel is eight centimeters (3.2 inches) or higher.

Sulfinol®: Trade name for an acid gas removal solvent (a mixture of Sulfolane, DIPA or MDEA and water) that can separate acid gases such as H₂S, CO₂, COS and mercaptans from feed gas streams such as synthesis gas produced by gasification of coal, coke, heavy hydrocarbon oils or natural gas production.

Sulfur: A yellowish nonmetallic element, sometimes known as “brimstone.” It is present at various levels of concentration in many fossil fuels whose combustion releases sulfur compounds that are considered harmful to the environment. Some of the most commonly used fossil fuels are categorized according to their sulfur content, with lower sulfur fuels usually selling at a higher price.

Sulfur recovery plant: All process units which recover sulfur or produce sulfuric acid from hydrogen sulfide (H₂S) and/or sulfur dioxide (SO₂) from a common source of sour gas at a petroleum refinery. The *sulfur recovery plant* also includes sulfur pits used to store the recovered sulfur product, but it does not include secondary sulfur storage vessels or loading facilities downstream of the sulfur pits. For example, a Claus sulfur recovery plant includes: reactor furnace and waste heat boiler, catalytic reactors, sulfur pits, and, if present, oxidation or reduction control systems, or incinerator, thermal oxidizer, or similar combustion device. Multiple sulfur recovery units are a single *sulfur recovery plant* only when the units share the same source of sour gas. Sulfur recovery units that receive source gas from completely segregated sour gas treatment systems are separate *sulfur recovery plants*. See also *Claus sulfur recovery plant* and *Sulfur recovery unit*.

Sulfur recovery unit: A single train of process equipment used to recover sulfur or produce sulfuric acid from hydrogen sulfide (H₂S) and/or sulfur dioxide (SO₂). For example, a Claus *sulfur recovery unit* includes a single reactor furnace, the series of catalytic reactors associated with the reactor furnace, sulfur pits associated with the series of catalytic reactors, and oxidation or reduction control systems, or incinerator, thermal oxidizer, or similar combustion device used to treat the tail gas from the series of catalytic reactors (associated with the single reactor furnace). See also *Sulfur recovery plant*.

Sump: Any lined pit or reservoir that serves to collect liquids drained from a leachate collection and removal system or leak detection system for subsequent removal from the system.

Surface impoundment: A waste management unit which is a natural topographic depression, manmade excavation, or diked area formed primarily of earthen materials (although it may be lined with manmade materials), which is designed to hold an accumulation of liquid wastes or waste containing free liquids. A surface impoundment is used for the purpose of treating, storing, or disposing of wastewater or residuals, and is not an injection well. Examples of surface impoundments are equalization, settling, and aeration pits, ponds, and lagoons.

SUPERCLAUS®: A sulfur recovery unit developed to further improve the removal of sulfur-containing compounds from gas streams over a normal Claus unit. This process consists of a thermal stage followed by three or four catalytic reaction stages. The first two or three reactors are filled with Claus catalyst while the last reactor is filled with the selective oxidation catalyst. In the thermal stage, the acid gas is burnt with a sub-stoichiometric amount of controlled combustion air so that the tail gas leaving the second reactor contains 0.8% to 1.5% by volume of H₂S. In practice, the *SUPERCLAUS®* process in

which the selective oxidation stage is implemented with gas which has passed three Claus reactors yields sulfur recovery percentages of about 99.3%.

TAME (Tertiary amyl methyl ether) (CH₃)₂(C₂H₅)COCH₃: See *Oxygenates*.

Tap water: For the purposes of this ICR, any non-used clean water coming from municipal water systems, groundwater, surface water (*e.g.*, river, lake, lagoon), or storm water pond.

Thermal catalytic cracking unit: See *Catalytic cracking*.

Thermal cracking: A refining process in which heat and pressure are used to break down, rearrange or combine hydrocarbon molecules. Thermal cracking includes visbreaking, fluid coking, delayed coking and other thermal (non-catalytic) cracking processes. See *Coking*.

Thermal incinerator or Thermal oxidizer: Any enclosed device that is mainly used for destroying organic compounds by heating the feed stream with a nozzle-stabilized flame to its ignition temperature during certain residence time. It is the temperature at which the combustion reaction rate (and consequently the energy production rate) exceeds the rate of heat losses, thereby raising the temperature of the gases to some higher value.

Turndown: Processing at less than 50% of equipment capacity. For example, a process heater is considered to operate in *turndown* when the actual heat input to the process heater is less than 50% of the rated heat input capacity of the process heater.

Toluene (C₆H₅CH₃): Colorless liquid of the aromatic group of petroleum hydrocarbons, made by the catalytic reforming of petroleum naphthas containing methyl cyclohexane. A high-octane gasoline-blending agent, solvent, and chemical intermediate, base for TNT. See *Aromatics*.

Topping refinery: The simplest refinery configuration designed to prepare feedstocks for petrochemical manufacture or for production of industrial fuels in remote oil-production areas. It consists of tankage, a crude distillation unit, recovery facilities for gases and light hydrocarbons, and the necessary utility systems (steam, power, and water-treatment plants). *Topping refineries* produce large quantities of unfinished oils and lack hydrotreating and reforming units needed to produce finished gasoline. See *Hydroskimming refinery* and also *Heavy oil/asphalt refinery*.

Tray tower wet scrubber: An air pollution control device that removes soluble chemicals, fumes, particulates and odors through a specially designed perforated plates in different configurations (*e.g.*, impingement, valve, tubular slot, and sieve trays) upon which a layer of liquid is kept at a certain level by a weir using liquid recirculation. The liquid solvent absorbs the gas pollutant passing the perforated trays by physical or chemical means.

Trench: A narrow excavation in the soil either lined (*e.g.*, concrete, plastic) or unlined for drainage diversion.

Trichloroethene or Trichloroethylene (C₂HCl₃): A solvent usually used for degreasing operations and in the production of pure 100% ethanol.

Trickling filter: A bed of gravel or pebble media through which clarified effluent percolates and microbial activity removes BOD, suspended solids and ammoniacal nitrogen.

True vapor pressure (TVP): The equilibrium partial pressure exerted by a petroleum liquid as a function of temperature as determined in accordance with methods described in Section 7.1 of AP-42 or by any other method approved by the Administrator. See also *maximum true vapor pressure*.

Ultra-low NO_x burner (ULNB): A burner that achieves very low NO_x emissions by advances in burner technology that allows a higher percentage of fuel gas to be staged than in low NO_x burners.

Unfinished oils: All oils requiring further processing, except those requiring only mechanical blending. Unfinished oils are produced by partial refining of crude oil and include naphthas and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum.

Unstabilized crude oil: For the purposes of this ICR, crude oil that is pumped from the well to a pipeline or pressurized storage vessel for transport to the refinery without intermediate storage in a storage vessel at atmospheric pressures. Unstabilized crude oil is characterized by having a true vapor pressure of 5 pounds per square inch absolute (psia) or greater.

Upgrading refinery: A refinery equipped with cracking and/or coking processes, such as catalytic cracking units, catalytic hydrocracking units, and/or fluid or delayed coking units, to convert heavy fuel oil into light and middle distillates. Upgrading refineries are more complex than hydroskimming refineries and have more flexibility in the mix of products produced. See *Hydroskimming refinery*.

UV disinfection: The process of killing (inactivating) harmful and objectionable bacteria and other microorganisms (pathogenic) by using ultraviolet light. UV radiation penetrates the outer cell-wall of the microorganism, passes through the cell-body, reaches the deoxyribonucleic acid (DNA) and alters the genetic material, thereby destroying the microorganism in a non-chemical manner.

Vacuum distillation: Distillation under reduced pressure (less the atmospheric) which lowers the boiling temperature of the liquid being distilled. This technique with its relatively low temperatures prevents cracking or decomposition of the charge stock.

Valve: Any device for halting or regulating the flow of a liquid or gas through a passage, pipeline, inlet, outlet, or orifice; including, but not limited to, gate, globe, plug, ball, butterfly and needle valves.

Vapor balancing system: A vapor collection system or piping system that is designed to collect organic vapors displaced from marine tank vessels during marine tank vessel loading operations and that is designed to route the collected organic vapors to the storage vessel from which the liquid being loaded originated or to compress collected organic vapors and commingle with the raw feed of a process unit.

Vapor collection system: Any equipment located at the source, *i.e.*, at the terminal, that is not open to the atmosphere, that is composed of piping, connections, and flow inducing devices, and that is used for containing and transporting vapors displaced during the loading of marine tank vessels to a control device or for vapor balancing. This does not include the vapor collection system that is part of any marine vessel vapor collection manifold system.

Vapor-mounted seal: A foam-filled primary seal mounted continuously around the circumference of the tank so there is an annular vapor space underneath the seal. The annular vapor space is bounded by the bottom of the primary seal, the tank wall, the liquid surface, and the floating roof.

Venturi wet scrubber: A scrubber that is designed to effectively use the energy from the inlet gas stream to atomize the liquid being used to scrub the gas stream. This type of technology is a part of the group of air pollution controls collectively referred to as wet scrubbers.

Visbreaking: A thermal cracking process in which heavy atmospheric or vacuum-still bottoms are cracked at moderate temperatures to increase production of distillate products and reduce viscosity of the distillation residues.

Volatile organic compounds (VOC): A combination of chemical pollutants that form ozone or smog. The Clean Air Act was designed in part to reduce VOC in gasoline in order to reduce ozone pollution from gasoline exhaust and emissions.

Wastewater or Process wastewater: Water or wastewater that, during manufacturing production or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product and is discharged into any individual drain system. Examples are feed tank drawdown; water formed during a chemical reaction or used as a reactant; water used to wash impurities from organic products or reactants; water used to cool or quench organic vapor streams through direct contact; and condensed steam from jet ejector systems pulling vacuum on vessels containing organics.

Wastewater collection and treatment system: Any grouping of components or pieces of equipment such as catch basins, drains, junction box, sewer line, pipeline, etc. used for the collection and routing of waste waters from petroleum refinery process units to a plant to be processed, treated, or purified and the components or pieces of equipment that process, treat, or purify the oily wastewater.

Wastewater treatment process: Any grouping of component, pieces of equipment, or installations that processes, treats, or purifies wastewater.

Wastewater vents: Atmospheric vents associated with wastewater drain systems and gases purged from covered wastewater collection and treatment systems.

Water seal controls: A seal pot, p-leg trap, or other type of trap filled with water that has a design capability to create a water barrier between the sewer and the atmosphere.

Watt: The unit of electrical power equal to one ampere under a pressure of one volt. A *watt* is equal to 1/746 horse power.

Wax: A solid or semi-solid material at 77 °F consisting of a mixture of hydrocarbons obtained or derived from petroleum fractions, or through a Fischer-Tropsch type process, in which the straight-chained paraffin series predominates. This includes all marketable wax, whether crude or refined, with a congealing point between 80 (or 85) and 240 °F and a maximum oil content of 50 weight percent.

Weir: A device designed to measure or control flow; consists of a wall or obstruction of known geometric shape placed perpendicular to the direction of flow.

Wellman-Lord process: A regenerative process to remove sulfur dioxide from flue gas (Flue-gas desulfurization) in tail gas cleanup processes without creating a throwaway sludge product. The process employs an aqueous alkali sulfite solution (usually sodium sulfite) which chemically combines with the sulfur dioxide gas in an absorption tower by forming sodium bisulfite. The process includes a separate regeneration facility to convert the bisulfite back to sulfite and recover SO₂ gas which is compressed and bottled or converted sulfuric acid or to elemental sulfur. In the case of flue gases from coal fired plants, a separate unit for removal of fly ash and chlorides is included.

Wet electrostatic precipitator (Wet ESP or WESP): A control device that operates with saturated air streams (100% relative humidity). A wet ESP is commonly used to remove liquid droplets such as

sulfuric acid mist from industrial process gas streams. A wet ESP is also commonly used where the gases are high in moisture content, contain combustible particulate, have particles that are sticky in nature. See *ESP*.

Xylene ($C_6H_4(CH_3)_2$): Colorless liquid of the aromatic group of hydrocarbons made the catalytic reforming of certain naphthenic petroleum fractions. Used as high-octane motor and aviation gasoline blending agents, solvents, chemical intermediates. Isomers are metaxylene, orthoxylene, paraxylene. See *Aromatics*.