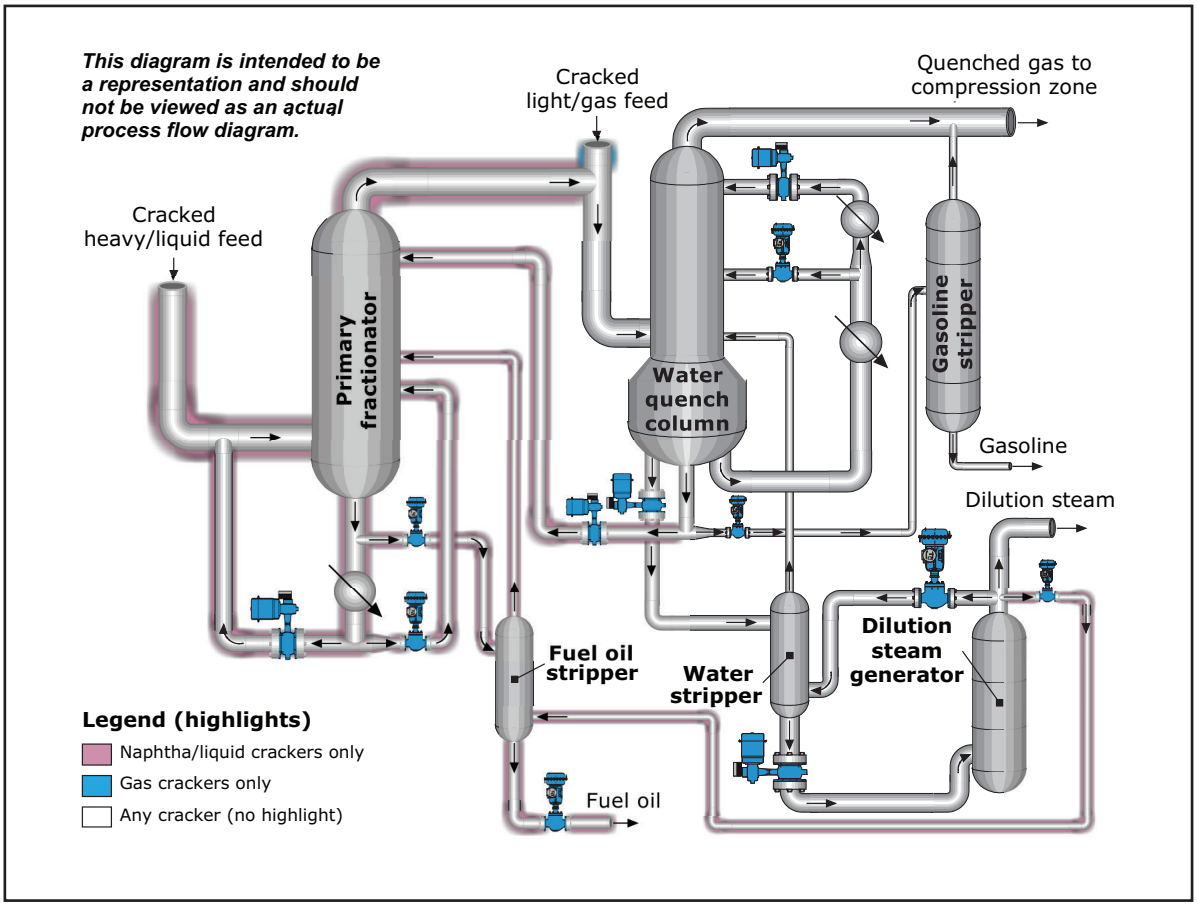
Steam cracking – Quench



Process overview

After the cracked gas leaves the transfer line exchanger, it needs to be cooled down further before it can be fed downstream to the separation columns.

If a heavier liquid feed such as naphtha is used, the cracked gas is cooled with quench oil before entering the primary fractionator. In the primary fractionator, fuel oil and quench oil are separated from the gas. The separated quench oil is cooled through a series of heat exchangers and used in quenching of further cracked gas. The fuel oil is stripped of dissolvable gasoline fractions before leaving the facility.

Further quenching is accomplished in the water quench tower. A water quench tower is used for both light gas feeds and heavy liquid (such as naphtha) feeds. In this tower, dilution steam and the heaviest gasoline fractions are condensed. The condensed dilution steam is stripped of impurities and revaporised to be reused in the cracking furnaces.

Gasoline separated at the bottom of the tower is used as reflux to the primary fractionator and the remaining part is fed to the gasoline stripper. Cracked gases are recovered in the gasoline stripper and mixed with the quenched gas heading to the compression zone.

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Quench valves

In the quench system, there are various valves present to control the cooling of the cracked gas.

If a liquid feed such as naphtha is used in the cracker, a quench oil section with respective valves is present.

Regardless of whether a liquid or gas feed is used in the cracker, there is a water quenching section with cooling on flow control. Valves for controlling dilution steam are also present.

Quench oil valves

Quench oil valves are used to control the flow of quench oil from the primary fractionator to heat exchangers for cooling. Quench oil flow back into the primary fractionator and the flow that is mixed with cracked gas is also controlled. Part of the quench oil is also diverted into the fuel oil stripper.

This is a demanding application due to the potential for coke accumulation, causing erosion. In addition, the temperature of the quench oil is around 200 °C (400 °F). Rangeability is also required as the accumulation of coke hinders cooling through heat transfer, which can be combated by increasing flow.

Dilution steam valves

Dilution steam is generated in the process by using heat recovered from quench oil if using a heavier feed, or an external heat source in case a lighter feed has been used. The generated steam is in part used for by-product stripping and the rest is sent to the furnace valves for cracking.

The generated steam can be very hot, 200-300 °C (400-600 °F). Furthermore it also has a high pressure.

Quench water valves

Quench water valves are used for controlling the temperature at the bottom and the top of the water quench tower. The valve used to control the flow of condensed dilution steam to the water stripper is also a very similar application.

As accumulation of coke occurs at the furnaces and transfer line exchangers, cooling efficiency is decreased. This also leads to a higher temperature gas arriving at the water quench tower, requiring a valve with good rangeability to control the quench water in order to cope with the rising temperature.

Metso solution

Metso offers two types of valves which are well-suited for all of the applications presented above. The selection of valves for these applications depends on the type of feed and fouling conditions, piping layout and size at the plant.

Metso's **Neles GB/GU-series metal-seated globe valves** with VD spring diaphragm or VC cylinder actuators meet all the demands of the application.

They are especially well suited for high pressure and high noise applications such as dilution steam valves due to the variety of trims available.

- **Best possible control accuracy,** ensuring that the flow can be set at the required amount
- **Fugitive emission certified,** according to ISO 15848
- **Wide rangeability,** allowing adjustment of process parameters to combat heat transfer efficiency loss caused by fouling
- **A variety of trim designs available,** including the Tendril design, making the valve suitable for high pressure drop, high noise and cavitation applications
- **Rugged one piece body structure** to minimise the leak paths and make the valve insensitive to pipe stress
- **Easy maintenance** – Top entry construction for easy access, valve assembly is simple and self-guiding
- **Wide temperature range,** by utilizing an extension bonnet enabling operation at over 260 °C (500 °F)

Neles globe valve

Metso's **Neles RE-series metal-seated V-port segment valves** are economical and accurate high performance valves with a quarter-turn design.

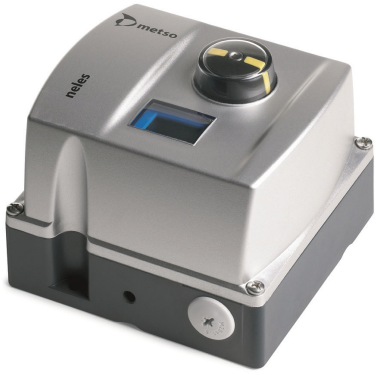
The valves are especially suitable for dirty/fouling applications such as quench oil if there is a potential for coke accumulation. They also excel in applications where very wide rangeability is required, allowing small and large flows to be controlled with a single valve.

- **Accurate control** – Steady and gentle contact between the seat and the V-ported segment minimises friction, lowers torque requirements and results in clearance-free movement
- **Low fugitive emissions,** due to rotary operation which eliminates packing leakage (ISO 15848 certified)
- **Best possible rangeability,** allowing one to use the same valve and piping during start-up and actual process conditions
- **Self-cleaning low noise/cavitation Q-Trim** available, allowing the valve to handle impurities such as coke without plugging
- **Uniquely durable design,** as the seat is not located directly in the flow stream extending service life
- **Economical** – Low torque requirements reduce wear and reduces actuator size, resulting in better reliability and a lower cost unit
- **High temperature version** available, making the valve operable in temperatures as high as 425 °C (797 °F)

Neles segment valve

For optimal performance, control valves equipped with the top-class intelligent **ND9000 valve controller** ensure high quality products and process control in all operating conditions with unique diagnostics and incomparable performance features.

- **Top class control accuracy,** enabling better control loop performance saving raw materials and energy and improving end product quality
- **Fast response time,** allowing quick flow adjustments with control signals
- **Linear flow characteristics,** ensuring a steady non-fluctuating flow
- **Diagnostic features,** reducing plant downtime and cutting maintenance costs
- Simplified installation by installing different mechanical or inductive proximity switches inside the ND9000 housing
- **Install to any common control system,** due to its low power consumption
- **Cold environment** compatible version available, operating at temperatures as low as -53 °C (–64 °F)



ND9000 valve controller

Benefits

- Save costs in piping design by using valves with wide rangeability during changing flow loads, such as start-up and full capacity
- Improved process performance through better control
- Meet the noise level requirements at the plant
- Meet the emission requirements according to standards set by local authorities for the plant
- Eliminate clogging of valves
- Predictive maintenance planning and reaching plant uptime targets with on-line diagnostic capabilities
- Reliable and lasting valve operation

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