# AMMONIA

## N-ELEVA

Casale’s SMR-based Ammonia process
for world-scale traditional plants

CASALE

We are a global partner in the chemical industry, offering **integrated technologies, engineering, contracting and construction solutions** for over a century.

## Our mission

*Contribute to shape a new sustainable planet with our plants for the production of fertilizer, methanol, hydrogen, melamine and derivatives, and help our customers creating value respecting the environment.*

*We are a global company front leader in the energy transition: a key player in the sustainable transformation of the chemical and energy industry, from a social, economic and environmental point of view.*

## Our values

**INNOVATION** PEOPLE CARE **PROFESSIONAL EXCELLENCE**
QUALITY **SAFETY** ETHIC **SUSTAINABILITY**

AMMONIA

# N-ELEVA

N-ELEVA is Casale process for traditional ammonia plants, based on steam-methane reforming (SMR) of natural gas. One of the notable features of N-ELEVA Process is its adaptability to meet the specific needs of our clients, with the added benefit of an easy integration into downstream units.

## Capacity

- From **500** up to **3500+ MTD**

## Performances

- Energy consumption up to **6.5 Gcal/MT**

## Benefits

- Proven design
- Optimized plant cost
- Low energy consumption
- Casale proprietary items are adopted in the critical section of the plant

## Casale technical assets

- Design of the primary reformer
- High-efficiency design for the secondary reformer
- Axial-Radial® CO shift converters
- Ammonia Washing Unit (AWU) of the make-up gas
- Axial-Radial® ammonia converter
- Advanced waste heat boiler design in the synthesis loop
- Direct connection between converter and downstream exchanger

## Enviromental Impact

CASALE N-ELEVA process minimizes its environmental impact effectively. The only liquid waste effluents are the boiler blow-down and the condensate from compressor air interstage cooler, which are both reused in the cooling water circuit.

The primary reformer's flue gas contains 110 mg/Nm³ of NOx, well below the allowable limits, at 3% oxygen excess.

The ammonia content in other gaseous waste is maintained within allowable emission levels.

# PROCESS OUTLINE

**Feed Gas Desulphurization** – The conventional two-stage procedure in which the feed gas is preheated and hydrogenated over a Co/Mo catalyst followed by ab¬sorption of the resultant $H_2S$ on zinc oxide to reduce its sulfur content to less than 0.1 ppm.

**Primary Steam Reforming** – After mixing with steam and preheating, the desulfurized gas passes through manifold catalyst tubes in a gas-heated furnace, where they react to form hydrogen and carbon oxides. Fuel for the reforming furnace is mainly natural gas, the combustion air is preheated in the reformer flue gas heat recovery train (convection section).

**Secondary Reforming** – The reforming process is completed in a catalytic reactor using heat generated by partial combustion of the reformed gas from the primary reformer, using air introduced through a special patented Casale burner.
The air flow rate is adjusted to obtain a 3:1 $H_2/N_2$ ration in the final synthesis gas mixture.

**High-Temperature (HT) CO Shift** – After cooling in a waste heat boiler generating high-pressure steam, the bulk of the carbon monoxide (CO) content of the synthesis gas is converted to $CO_2$ and $H_2$ by reaction with steam.

**Low-Temperature (LT) CO Shift** – After further cooling, the CO shift reaction is completed in a LT shift stage. Casale Axial-Radial® flow internals are used in both the HT and LT shift reactors.

**$CO_2$ removal** – After cooling and condensing the surplus steam, the gas next passes into the absorption column of a high-efficiency regenerative $CO_2$ removal system, leaving with a $CO_2$content of <1’000 ppmv. The $CO_2$ is recovered in a concentrated form from the rich solution in the regenerator of the $CO_2$ removal section and made available for the urea plant or other uses or vented for special application. Casale can supply proprietary hardware.

**Methanation,** – The process gas is reheated and passed through a final purification stage – catalytic methanation – where any remaining carbon oxides are converted back to methane by reaction with hydrogen.

**Compression** – The centrifugal synthesis gas compressor has two casings, each with two stages. All stages are provided with intercoolers. The compressor is driven by an extraction/condensing steam turbine.
The gas leaving the second compressor stage is dried by washing with liquid ammonia in a make-up gas ammonia scrubber, using a special Casale design. This removes the last few ppm of $CO_2$ as well. The expected combined water and $CO_2$ content after the ammonia wash is less than 0.1 ppmv.

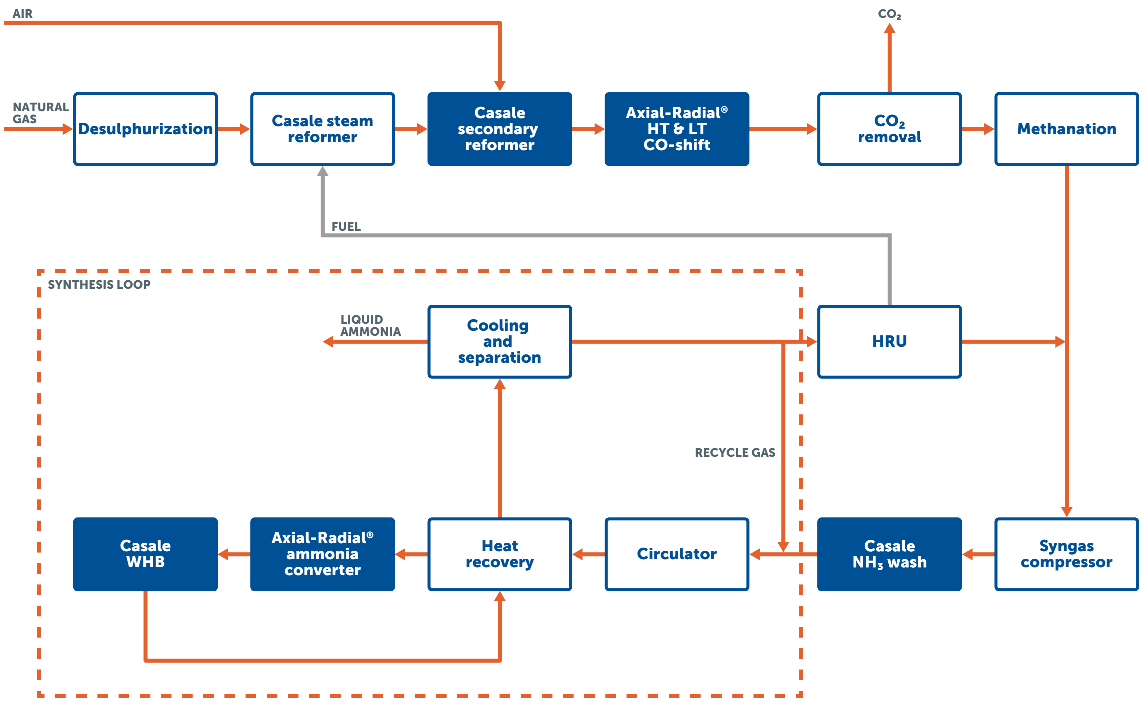
**Ammonia Synthesis** – Before it enters the ammonia converter, the combined make-up and recycle gas stream from the circulator is fed to the hot gas-gas heat exchangers, in which it is heated by hotter gas returning from the converter. The preheated gas then enters the ammonia converter, in which it reacts over an iron-based ammonia synthesis catalyst.
The ammonia converter is a well proven Casale design incorporating three adiabatic, Axial-Radial® beds, with intermediate cooling by two inter-bed heat exchangers.

**At the converter outlet** – The product gas is cooled, first in a waste heat boiler and BFW pre-heater and then in the hot gas-gas heat exchangers, before entering the condensation section, where ammonia is condensed, first in a water cooler and then in ammonia chillers.

**Ammonia Refrigeration** – The ammonia refrigeration section mainly consists in a multi-stage compressor. Gaseous ammonia leaving the last stage discharge is condensed by cooling and expansion and is collected in the refrigerant receiver.

**Ammonia Recovery** – To prevent Inerts concentration from building up, a portion of the loop recycle gas is continuously withdrawn as "purge gas". Along with inert gas from the refrigerant receiver, this gas is washed with water in two separate packed columns to absorb its residual ammonia content.

**Hydrogen recovery** – The hydrogen contained in the purge gas is recovered in an Hydrogen Recovery Unit (HRU) and sent to the synthesis loop.




A notable feature of an N-ELEVA-based plant is that it can be easily converted to produce blue ammonia switching to Casale 's N-ELEVA BLUE configuration by adding a pre-combustion unit downstream the $CO_2$ removal section and a Carbon Dioxide Removal (CDR) unit unit on the flue gas of the primary reformer.

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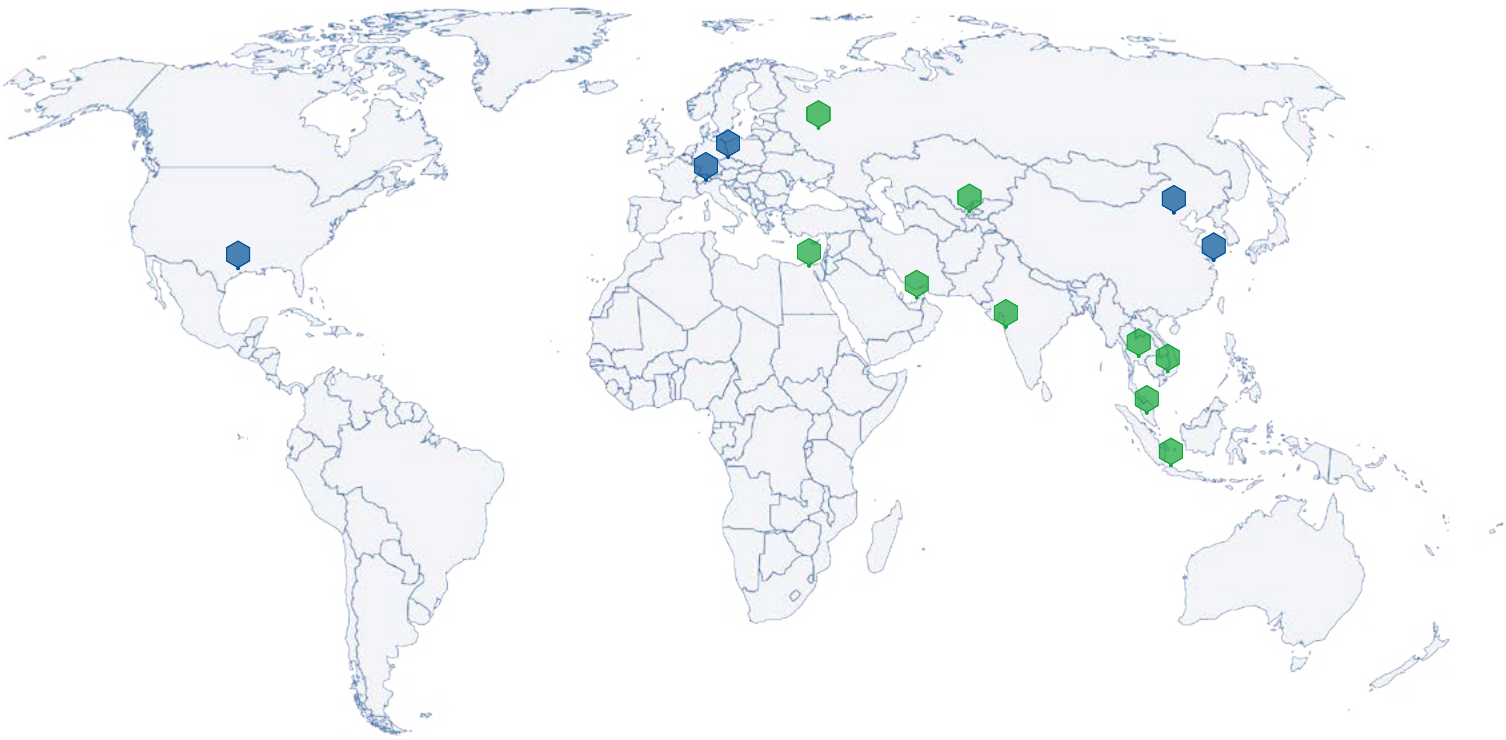
**PLANTS FOR**
**A NEW PLANET.**
**SINCE 1921.**

# Casale in the world



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