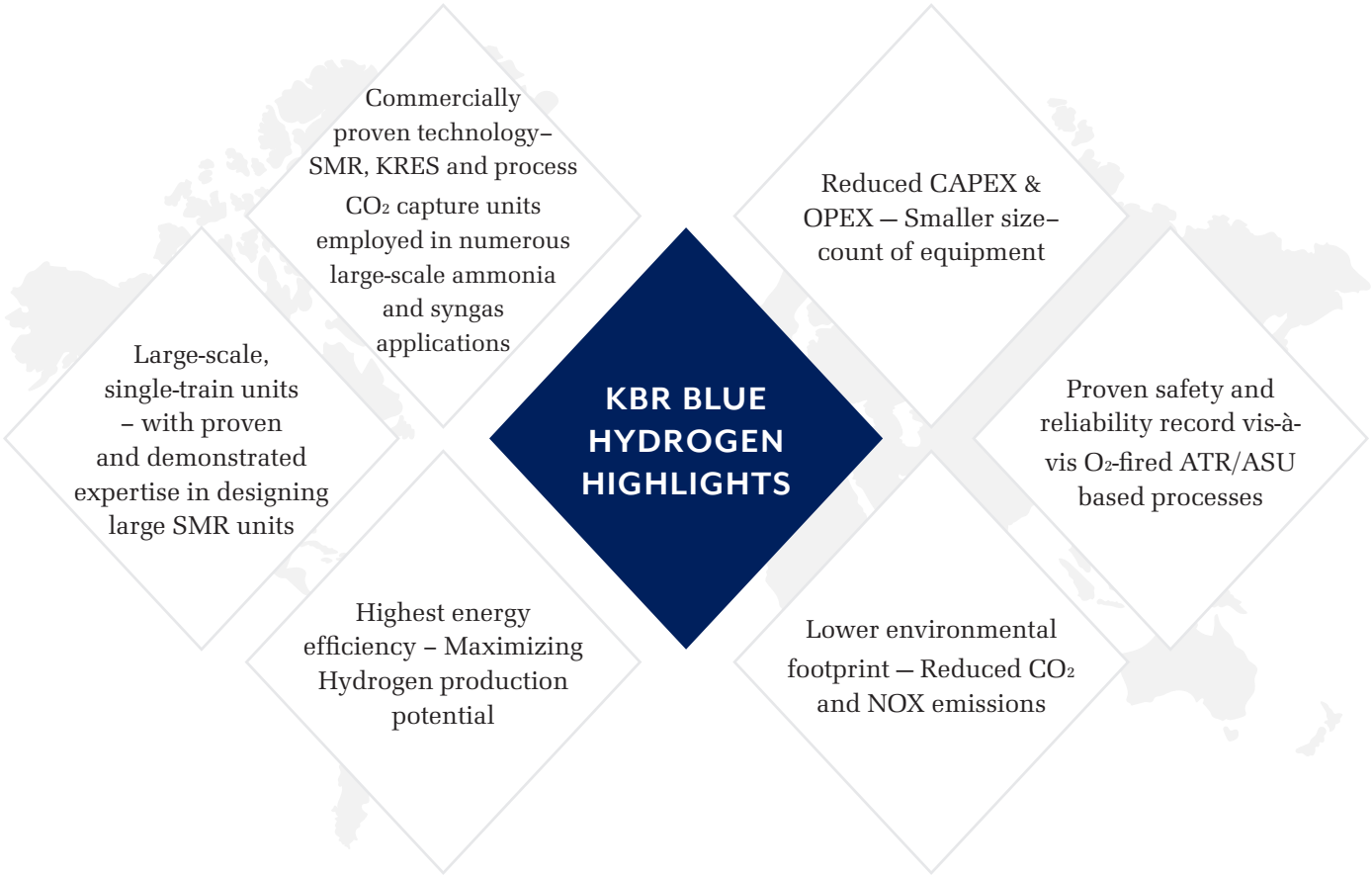
KBR Blue Hydrogen

Single-Stream large-scale blue hydrogen plant

SINGLE-STREAM BLUE HYDROGEN PLANT USING KBR'S WELL PROVEN SMR AND KRES™ BASED TECHNOLOGY

KBR offers its commercially well-proven and reliable Steam Methane Reforming (SMR) and KBR Reforming Exchanger System (KRES™) based single-stream blue technology to leverage economy of scale and expand single-train production capacity beyond the classic threshold, using industry standard equipment sizes and catalysts.



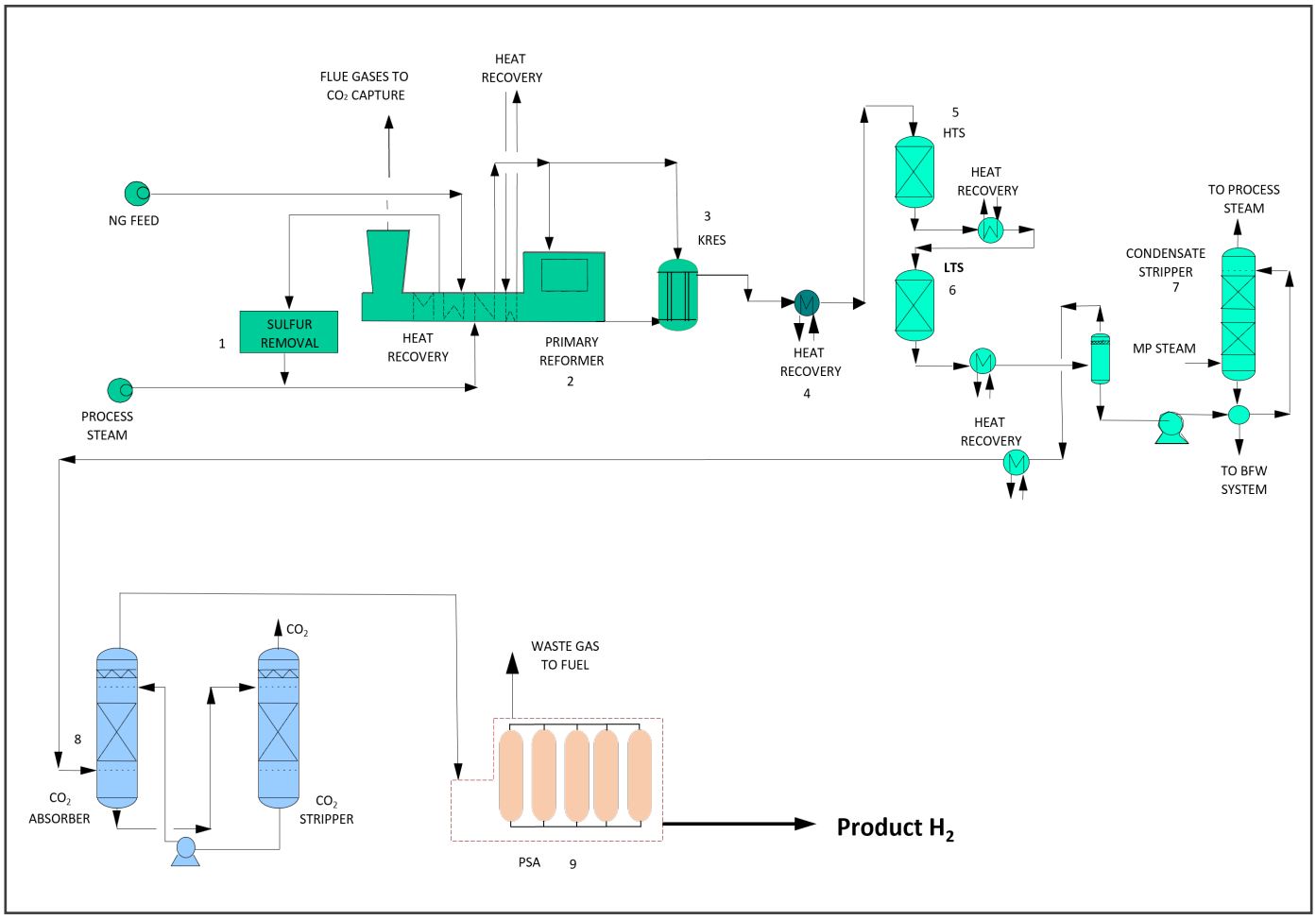
PROVEN DESIGN, LOW CAPEX AND OPEX

KBR's large-scale blue hydrogen process uses its proprietary KRES and well-proven SMR-based technology for expanding single-stream hydrogen capacity. Bulk of the CO_2 generated in the process is captured as pure CO_2, readily available for CO_2 capture applications. KBR large-scale blue hydrogen process uses a single top-fired Primary Reformer that is not limited by size, unlike competing technologies that employ an Auto Thermal Reformer (ATR) to overcome this limitation. The design uses an optimized equipment/piping count and sizes, and the factors that make it low on capital and operating expenditures are:

- No oxygen-fired ATR and Air Separation Unit (ASU) — Enhanced process safety, higher reliability, lower operational complexity and lower OPEX & CAPEX
- All equipment except standby pumps in single unit i.e.:
  - One Steam Methane Reformer
  - One KRES
  - One Waste Heat Boiler
  - One vessel each for HT and LT Shift
  - One CO_2 Absorber, HP/LP Flash Column and Stripper for primary hydrogen purification
  - One small PSA unit for final hydrogen purification
  - All exchangers in single unit
  - Optimized Plot size

BENEFITS

- Single-train steam methane reformer – proven demonstrated capability
- KBR Proprietary KRES for lowering steam export and stack flue gas emissions – proven references
- KBR Proprietary Reformed Gas water tube thermosyphon boiler well proven for over four decades
- Flue gas generation is about 50% lower than conventional processes
- Steam export is about 60 -70% lower than conventional processes
- PSA unit is four times smaller than the conventional processes, reducing plant footprint and lowering SMR size
- KBR's two-stage Hydrogen purification is CAPEX-neutral as compared to conventional processes but results in lower energy consumption due to better heat integration
- About 72% of the total CO_2 generated is recovered directly as process CO_2 with purity >99% maintaining high energy efficiency of the process
- CO_2 recovery >95% of the total CO_2 generated as process CO_2 is feasible with minor energy penalty. This can eliminate requirement of post combustion CO_2 capture plant – High CAPEX and OPEX savings
- Overall, low CAPEX/low OPEX SMR-based operator-friendly process with flexibility to capture process CO_2 in the range of 72% - >95%



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ABOUT KBR, INC.

We deliver science, technology and engineering solutions to governments and companies around the world. KBR employs approximately 28,000 people performing diverse, complex and mission critical roles in 34 countries.

KBR is proud to work with its customers across the globe to provide technology, value-added services, and long- term operations and maintenance services to ensure consistent delivery with predictable results.

At KBR, We Deliver.

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