

Formula 1

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Formula 2

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Formula 3

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Detailed Explanation

Alkaline electrolyzers rely on a concentrated aqueous KOH solution (typically 25–30 wt%) as the electrolyte to facilitate OH⁻ ion transport between nickel-based electrodes. The KOH circulation system maintains uniform concentration, removes ohmic heat from the stack, prevents gas bubble accumulation at electrodes, and mitigates carbonate precipitation (from CO₂ ingress). The P&ID standard codifies engineering best practices—including dual-pump redundancy, inline conductivity/temperature/level transmitters, corrosion-resistant materials (e.g., 316L SS, Hastelloy C-276, or fluoropolymer-lined components), and pressure-relief paths—to ensure continuous, safe operation under dynamic load-following conditions typical of renewable-powered hydrogen plants. Critically, the standard defines functional safety requirements: e.g., automatic shutdown triggers upon low electrolyte level (<70% tank capacity), high stack temperature (>90°C), or loss of circulation flow (<1.2 m/s velocity in main loop), all aligned with SIL-2 integrity targets per IEC 61511. Furthermore, it mandates traceability of instrumentation tags (e.g., FT-101 for flow transmitter, LIC-201 for level indicator controller), valve failure modes (FO/FC), and grounding/isolation protocols for electrochemical grounding loops to prevent stray current corrosion.

Key Components

#	Component
1	KOH storage and makeup tank
2	circulation pump(s) with NPSH-optimized suction
3	heat exchanger (plate or shell-and-tube, titanium or Ni-alloy)
4	electrolyte filter (5–10 µm sintered metal)
5	conductivity/temperature/level instrumentation suite
6	gas–liquid separator and recirculation manifold

Applications

#	Application
1	Design and review of electrolyzer balance-of-plant (BoP) systems
2	Regulatory certification submissions (e.g., TÜV, DNV, UL)
3	Digital twin development and control system (DCS/PLC) configuration

Related Concepts

#	Concept
1	Alkaline water electrolysis
2	P&ID symbology (ISA-5.1)
3	Corrosion management in caustic environments
4	Functional safety lifecycle (IEC 61511)
5	Green hydrogen system integration

Tags

green-hydrogen, alkaline-electrolyzer, P&ID-standard, KOH-circulation, electrochemical-engineering

Alkaline Electrolyzer KOH Circulation System P&ID Standard

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