

Formula 1

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Formula 2

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Formula 3

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Detailed Explanation

Annex B of IEC TS 62872-2:2023 addresses the unique challenges of protection coordination in multi-terminal HVDC grids—especially in offshore wind applications where conventional AC protection principles do not directly apply due to absence of natural current zero-crossings, rapid fault propagation, and complex interaction between power electronics-based converters and passive DC network elements. The flowchart prescribes a hierarchical, time- and logic-gated decision process that integrates measurement inputs (e.g., DC current/voltage derivatives, rate-of-rise, residual energy), protection function activation conditions (e.g., pole-to-pole, pole-to-ground fault detection), and interlocking signals (e.g., block, trip, lockout, reclose enable) across multiple protection layers—including converter internal protection, DC line protection, station-level backup protection, and grid-code-mandated fault ride-through logic. Crucially, it enforces strict selectivity by defining maximum permissible operating times for each protection stage (e.g., <100 μ s for ultra-fast converter blocking, <5 ms for solid-state DC breaker triggering, <100 ms for AC-side backup) and mandates coordination margins (typically 20–30 ms) between adjacent protection zones. The flowchart also incorporates system state awareness (e.g., topology configuration, control mode, communication health) to support adaptive coordination—enabling dynamic reconfiguration of protection settings during maintenance, islanded operation, or post-fault recovery scenarios.

Key Components

#	Component
1	Fault Detection Logic Tree
2	Time-Graded Protection Zones
3	Inter-Device Communication Triggers (e.g., CB-TRIP, CONVERTER-BLOCK)
4	Adaptive Coordination Logic Based on System Topology
5	Backup Protection Activation Sequence

Applications

#	Application
1	Offshore wind farm HVDC collector and export substation protection design
2	Multi-terminal HVDC grid protection validation and SIL (Safety Integrity Level) assessment
3	Digital twin-based protection scheme testing and commissioning

Related Concepts

#	Concept
1	DC Circuit Breaker Operation Principles
2	Converter Blocking and De-blocking Sequences
3	IEC 61850-10 Compliance for Protection Testing
4	Fault Ride-Through (FRT) Requirements for HVDC Grids
5	Protection Zone Partitioning in HVDC Networks

Tags

HVDC protection, offshore wind, IEC standard, protection coordination, DC substation

IEC TS 62872-2:2023 Annex B – HVDC Substation Protection Coordination Flowchart

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