

DEG Problem 1 Design Document

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Design



Documentation

Solution Overview (≤150 words)

FlexDER AI is an autonomous co-pilot for Distribution System Operators (DSOs). It detects feeder-level overloads using real-time telemetry and short-term forecasting, then quickly orchestrates subscribed DERs—home batteries, EV chargers, and smart heating—to reduce or shift load. FlexDER AI discovers available DERs using Beckn protocol flows, issues activation orders aligned to P415 VLP workflows, and verifies responses. All actions are logged with OBP IDs for P444 settlement. The system reduces peak stress, avoids costly grid reinforcement, and provides traceable activations for regulators and operators.

Technical Architecture (≤200 words)

FlexDER AI uses a multi-agent architecture deployed across edge and cloud layers. The Grid Monitoring Agent ingests SCADA/AMI telemetry (via Kafka/MQTT) and runs fast forecasting and anomaly detection at the edge to meet latency targets. It will also use the API from UK Power Networks Open Data and National Grid ESO to enrich grid status, constraints, and forecasting inputs. The Flex Orchestration Agent uses Beckn discovery and order workflows to select optimal DERs based on location, capacity, response time, and cost. The Dispatch Agent issues real-time commands to DERs over MQTT/WebSocket, ensuring sub-5-second detection-to-dispatch. The Audit & Settlement Agent creates immutable logs (including OBP IDs) and prepares P444-compatible reports. Supporting components include a time-series DB (InfluxDB/TimescaleDB), Kafka for events and auditing, and object storage (S3) for immutable log retention. The Operator Dashboard visualises feeders, events, DER availability, and auditable logs and allows manual overrides.

Agent Workflow (≤150 words):

FlexDER AI continuously monitors feeder data and forecasts short-term overloads. When a threshold is crossed or a forecasted spike appears, the Flex Orchestration Agent performs a Beckn /search to find enrolled DERs, optimises the combination to meet the required kW and latency constraints, and executes a Beckn /select → /initiate → /confirm order. The Dispatch Agent sends device-level commands (battery discharge, pause EV charging, shift thermostats) via MQTT. DERs acknowledge actions and report status; FlexDER AI verifies the load response and records every step (detection, rule used, chosen DERs, commands sent, ACKs) in an immutable audit trail for settlement and regulator review.

Business Model & Impact (≤150 words):

FlexDER AI is offered as a SaaS platform to DSOs and flexibility aggregators with subscription pricing per feeder and pay-per-activation options. Additional modules (advanced forecasting, regulatory reporting, and DER integration) are premium add-ons. Utilities reduce reinforcement costs and avoid outages, aggregators increase DER monetisation, and consumers earn incentives for participation. Regulators benefit from clear, auditable activation records. Expected impacts include measurable feeder peak reduction, faster activation times (minutes to seconds), deferred infrastructure upgrades, and better integration of renewables through automated flexible demand.

REFERENCES

1. <https://www.neso.energy/data-portal/api-guidance>
2. <https://ukpowernetworks.opendatasoft.com/api/explore/v2.1/console>

