Please provide me todo list of goal in order to write Doctor's paper.

Here is a structured to-do plan you can use to write your Doctor of Philosophy paper on DCS in thermal power plants with the latest edge AI technologies, focusing on boiler, control systems, and electrical balance of plant.

1. Define scope, objectives, and thesis

- Clarify plant type and boundaries: subcritical, supercritical, ultrasupercritical, coal, gas, or combined cycle; include boiler-turn turbine interactions and power export.
- State the central thesis: e.g., “Edge-enabled AI-augmented DCS architectures improve heat rate, transient response, and emissions compliance in thermal power plants while maintaining safety and cybersecurity under variable fuel quality and load.”
- Formulate testable hypotheses and success metrics (see below).

2. Literature synthesis and gap analysis

- Map current DCS architectures (centralized vs distributed, edge-enabled), AI applications in power plants, and state-of-the-art in boiler control, combustion optimization, and emissions control.
- Identify gaps: latency impacts, edge-security frameworks, validation with real plant data, integration with legacy DCS, and ROI benchmarks.
- Build a literature map/table that categorizes sources by technology strand (edge computing, AI in control, digital twin, cybersecurity, data fusion, plant reliability) and by plant scope (boiler, turbine, EMS/SCADA, emissions).

3. Reference architecture and data model

- Develop a vendor-agnostic reference architecture that splits functions across edge devices (sensor-level analytics, fast loops), local controllers, central DCS PCUs, HMIs, historians, and cloud/enterprise analytics.
- Define data models and interfaces: data catalogs, time synchronization schemes, data quality checks, and standard communication protocols (OPC UA, Ethernet/IP, Modbus, etc.).
- Specify data flows: real-time signals, edge inferences, setpoint updates, alarm/event propagation, and long-term historical data for KPI analytics.

4. Edge AI design and control strategy

- Identify latency-critical loops suitable for edge processing (e.g., combustor air/fuel ratio, drum level, steam temperature control, turbine inlet pressure).
- Propose edge-enabled control schemes:

  - Lightweight inference for fast setpoint adjustments.
  - Model-based or adaptive control blocks at the edge paired with central optimization.
  - Multisensor data fusion for diagnostics and fault detection.
- Outline methods for safe deployment: fail-safe paths, deterministic timing, supervisor validation, and operator overrides.

5. Emission and fuel variability handling

- Plan how edge AI can adapt to variable coal quality, gas composition, and ambient conditions while complying with NOx/SOx and CO_2 emissions targets.
- Include strategies for combustion optimization, air staging, and post-combustion controls in edge-enabled routines.

6. Security, reliability, and governance

- Define a cybersecurity framework for edge-enabled DCS, including:
  - Zero-trust assumptions, secure boot, mutual authentication, and encrypted telemetry.
  - Segmented networks with clear access controls and monitoring.
  - Change management and firmware governance for edge devices.
- Develop a resilience plan: redundancy schemes, failover pathways, and cyber-attack tabletop scenarios.

7. Methodology and validation plan

- Choose a validation approach:
  - High-fidelity simulations of boiler-turbine models with both centralized and edge-augmented control.
  - Hardware-in-the-loop or pilot-scale testbed if available.
  - Retrospective data-driven benchmarking using historical plant data to compare baselines with edge-assisted scenarios.
- Define performance metrics:
  - Heat rate improvement (% or kJ/kWh), ramp rate (MW/min), turbine stability margins, boiler drum level stability, emissions indices (NOx, SO_2, CO_2), availability, and reliability.
  - Cybersecurity metrics: incident detection rate, mean time to containment, and false positive rates.
- Statistical plan: design of experiments, confidence intervals, sensitivity analyses for fuel quality, sensor noise, and network latency.

8. Data collection and ethics

- Plan data acquisition from plant partners or public datasets, including data cleaning, labeling, and privacy/safety considerations.
- Ensure compliance with industrial data governance, confidentiality agreements, and regulatory reporting requirements.

9. Case studies and benchmarking framework

- Develop several deployment scenarios (e.g., retrofitting an existing plant vs greenfield edge-enabled DCS).
- Create benchmarks: baseline centralized control vs edge-augmented control on identical scenarios.
- Provide ROI and lifecycle cost analysis, including hardware, software, maintenance, and training.

10. Paper structure and writing plan

- Introduction: motivation, problem statement, and research questions.
- Background and technical foundations: DCS architectures, boiler-turbine dynamics, AI/edge concepts, and cybersecurity basics.
- Reference architecture and data model: diagrams, interfaces, data dictionary, and integration approach.
- Methodology: simulation setup, validation plan, and metrics.
- Results: comparative analyses, robustness tests, and sensitivity results.
- Security and governance: risk assessment framework and compliance considerations.
- Case studies: deployment scenarios and expected benefits.
- Discussion: interpretation, limitations, and industrial impact.
- Conclusions and future work: summary and concrete next steps.

11. Research gaps and contribution plan

- Explicitly articulate the novel contributions: e.g., a modular edge deployment blueprint for boiler-turbine DCS, a data governance framework for edge AI in critical power systems, a validated methodology for assessing heat-rate benefits under fuel variability, and a cybersecurity-first edge architecture for industrial control networks.
- Align contributions with journal expectations and conference themes in thermal engineering, control systems, and AI in energy.

12. Timeline and milestones

- Set a realistic timeline with milestones such as literature review completion, architecture design, simulation model development, validation experiments, data analysis, thesis writing, and defense preparations.
- Include buffer periods for collaboration with industry partners and for addressing reviewer feedback.

13. Potential chapter outlines (example)

- Chapter 1: Introduction and motivation
- Chapter 2: DCS in thermal power plants – state of the art
- Chapter 3: Edge AI in control systems – concepts and requirements
- Chapter 4: Reference architecture and data model
- Chapter 5: Methodology and simulation framework
- Chapter 6: Edge-enabled control strategies for boiler and turbine

- Chapter 7: Security, reliability, and governance
- Chapter 8: Case studies and benchmarking
- Chapter 9: Economic assessment and ROI
- Chapter 10: Conclusions and future work

14. Practical tips

- Engage with industry partners early to access data, testbeds, or pilot opportunities.
- Use a mix of theoretical analysis, simulation studies, and, if possible, experimental validation to strengthen the paper.
- Present concrete metrics and, where possible, quantify improvements with clear figures and tables.
- Ensure the narrative clearly connects edge AI capabilities to tangible improvements in boiler performance, control reliability, and emissions.

If you want, this plan can be tailored to a specific university format, target journal or conference, or a particular vendor ecosystem. I can also help draft a detailed literature map, a data dictionary tailored to your plant type, or a chapter-by-chapter outline with suggested figures and tables.

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1. https://www.benthamopenarchives.com/abstract.php?ArticleCode=TOEEJ-8-700
2. https://www.irjweb.com/IMPLEMENTATION OF DCS IN THERMAL POWER PLANTS.pdf
3. https://www.diva-portal.org/smash/get/diva2:1503393/FULLTEXT01.pdf
4. https://www.sciencedirect.com/science/article/abs/pii/S0016236121002283
5. https://flyingv.ucsd.edu/papers/PDF/256.pdf
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7. https://www.sciencedirect.com/science/article/abs/pii/S0306454924005449