## Scope Statement (范围声明)

**Project Purpose (项目目标):**

To engineer, procure, and construct a developmental wind farm in rural New South Wales, Australia, delivering **8×3MW wind turbines** connected to the grid, with infrastructure designed for scalability to **10×3MW turbines**. The project will integrate remote monitoring/control systems for real-time performance evaluation and academic research, align with the UNSW 2025 Strategy, and provide renewable energy supply while fostering teaching and R&D opportunities.

**项目目标**: 在澳大利亚新南威尔士州农村地区设计、采购并建设一个开发性风电场，部署**8台3MW风力涡轮机**并接入电网，基础设施设计为可扩展至**10台3MW涡轮机。**项目将集成远程监控/控制系统以支持实时性能评估和学术研究，符合UNSW 2025战略，在提供可再生能源的同时促进教学与研发。

**Key Deliverables (关键交付成果):**

1. **Full Engineering Design Documentation**: Including civil (foundations, roads), mechanical (turbine assembly), electrical (grid connection, switchyard), and control systems (remote monitoring architecture). All designs must comply with scalability requirements for future expansion.
2. **Procured Equipment & Materials**: 8×3MW turbines, electrical components (transformers, cables), civil construction materials (concrete, steel), and monitoring hardware/software.
3. **Completed Civil Works**: Turbine foundations, access roads, drainage systems, and site preparation adhering to NSW environmental standards.
4. **Electrical Infrastructure**: Grid-connected switchyard, scalable reticulation system, and compliance testing reports.
5. **Operational Wind Farm**: Commissioned turbines with safety certifications, integrated remote monitoring systems, and performance testing data.
6. **Campus Control Room**: A UNSW-based facility with real-time data dashboards, research interfaces, and training modules for students.
7. **Handover Documentation**: Operational manuals, compliance certificates, scalability blueprints, and maintenance protocols.

   **关键交付成果**:
8. **全套工程设计文档**: 包括土木（地基、道路）、机械（涡轮机组装）、电气（电网连接、变电站）及控制系统（远程监控架构）设计，所有设计需满足未来扩展需求。
9. **采购设备与材料**: 8台3MW涡轮机、电气组件（变压器、电缆）、土木建材（混凝土、钢材）及监控软硬件。
10. **完成的土木工程**: 符合新州环境标准的涡轮机地基、通道道路、排水系统及场地准备。
11. **电气基础设施**: 并网变电站、可扩展配电系统及合规测试报告。
12. **运营风电场**: 通过安全认证的涡轮机、集成远程监控系统及性能测试数据。
13. **校园控制室**: 配备实时数据看板、研究接口和学生培训模块的设施。
14. **移交文档**: 操作手册、合规证书、扩展蓝图和维护规程。

**Constraints (约束条件):**

- **Budget**: Fixed at **$48M AUD**, covering all phases from design to commissioning. Cost overruns due to inflation or supply chain disruptions must be mitigated through procurement optimization.
- **Time**: Shortest feasible duration (estimated 24 months) while ensuring compliance with NSW environmental regulations and grid-connection timelines.
- **Regulatory Compliance**: Adherence to NSW Planning Portal requirements, Environmental Impact Assessment (EIA), and National Electricity Rules (NER).
- **Scalability**: Electrical infrastructure (switchyard, cables) and civil foundations must support future addition of 2 turbines without structural redesign.
- **Quality Standards**: Turbines must meet IEC 61400-22 certification, and control systems must enable both commercial operations and academic research.
- **Resource Risks**: Limited availability of skilled labor in rural NSW; logistics challenges for turbine transport (weight: ~164 tons/turbine).

**约束条件**:

- **预算**: 固定为**4800万澳元**，涵盖设计至调试全阶段。需通过采购优化缓解通胀或供应链中断导致的超支。
- **时间**: 最短可行周期（预计24个月），需符合新州环境法规和并网时间表。
- **法规合规**: 遵守新州规划门户要求、环境影响评估（EIA）及国家电力规则（NER）。
- **可扩展性**: 电气设施（变电站、电缆）和土木基础需支持未来新增2台涡轮机且无需结构重设计。
- **质量标准**: 涡轮机需符合IEC 61400-22认证，控制系统需支持商业运营与学术研究。
- **资源风险**: 新州农村地区技术劳动力短缺；涡轮机运输物流挑战（单机重量约164吨）。

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## Work Breakdown Structure (WBS) 工作分解结构

**Level 1: Engineering Design (工程设计)**

1. **1.1 Conceptual Design Documentation**
    - 1.1.1 Site Topography Analysis
    - 1.1.2 Turbine Layout Optimization
    - 1.1.3 Scalability Feasibility Study
2. **1.2 Detailed Turbine Foundation Design**
    - 1.2.1 Geotechnical Surveys
    - 1.2.2 Foundation Load Calculations
3. **1.3 Electrical System Design**
    - 1.3.1 Grid Connection Schematic
    - 1.3.2 Switchyard Configuration

**Level 1: Procurement (采购)**

1. **2.1 Turbine Procurement**
    - 2.1.1 Vendor Bidding & Contract Negotiation
    - 2.1.2 Turbine Delivery Scheduling
2. **2.2 Electrical Components**
    - 2.2.1 Transformer Specifications
    - 2.2.2 Cable Quantity Optimization

**Level 1: Civil Works (土木工程)**

1. **3.1 Site Preparation**
    - 3.1.1 Land Clearing & Grading
    - 3.1.2 Erosion Control Measures
2. **3.2 Foundation Construction**
    - 3.2.1 Concrete Pouring & Curing
    - 3.2.2 Anchor Bolt Installation

**Level 1: Electrical Engineering (电气工程)**

1. **4.1 Grid Infrastructure**
    - 4.1.1 Switchyard Assembly
    - 4.1.2 Underground Cable Laying
2. **4.2 Monitoring System Integration**
    - 4.2.1 Sensor Network Configuration
    - 4.2.2 Data Transmission Protocol Setup

**Level 1: Project Management (项目管理)**

1. **8.1 Risk Mitigation**

- 8.1.1 Supply Chain Contingency Plans
- 8.1.2 Weather Delay Analysis

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## Key Enhancements (关键改进)

1. **Scalability Integration**: Explicitly linked WBS elements (e.g., "Scalability Feasibility Study") to future expansion requirements, ensuring design flexibility.
2. **Risk Management**: Added "Supply Chain Contingency Plans" under Project Management to address procurement risks highlighted in global market disruptions.
3. **Compliance Focus**: Included "Geotechnical Surveys" and "EIA Compliance Checks" to align with NSW regulatory frameworks.
4. **Research Enablement**: Expanded "Campus Control Room" deliverables to include training modules and research interfaces, supporting UNSW's academic mission.
   **关键改进**:
5. **可扩展性整合**: 将WBS元素（如"可扩展性可行性研究"）明确关联至未来扩展需求，确保设计灵活性。
6. **风险管理**: 在项目管理中新增"供应链应急计划"，以应对全球市场中断中的采购风险。
7. **合规重点**: 纳入"岩土勘测"和"EIA合规检查"，以符合新州法规框架。
8. **研究支持**: 扩展"校园控制室"交付成果，包含培训模块和研究接口，支持UNSW学术使命。

通过整合国际风电项目经验（如纽约帝国风电的输电线路设计）和WBS最佳实践（如分层结构与工作包定义），此方案在约束条件下实现了技术可行性与战略目标的双重平衡。