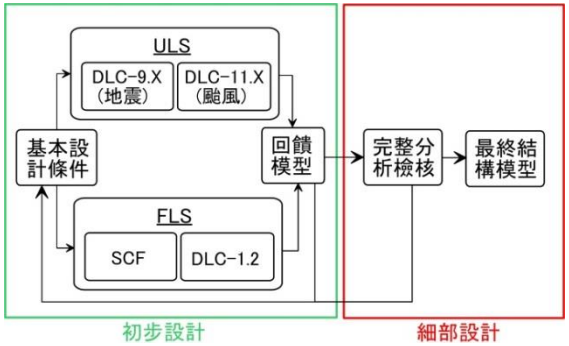
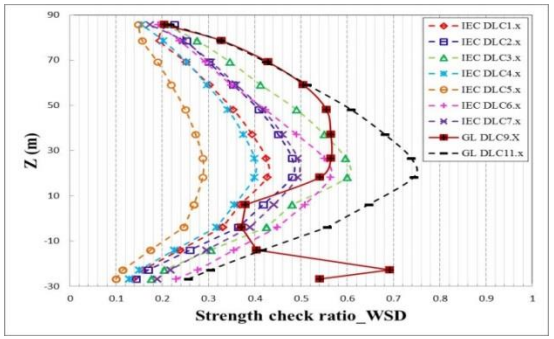
防颱抗震型離岸風機支撐結構整合設計驗證技術精進

執行單位	行政院原子能委員會核能研究所	計畫主持人	朱棟樑

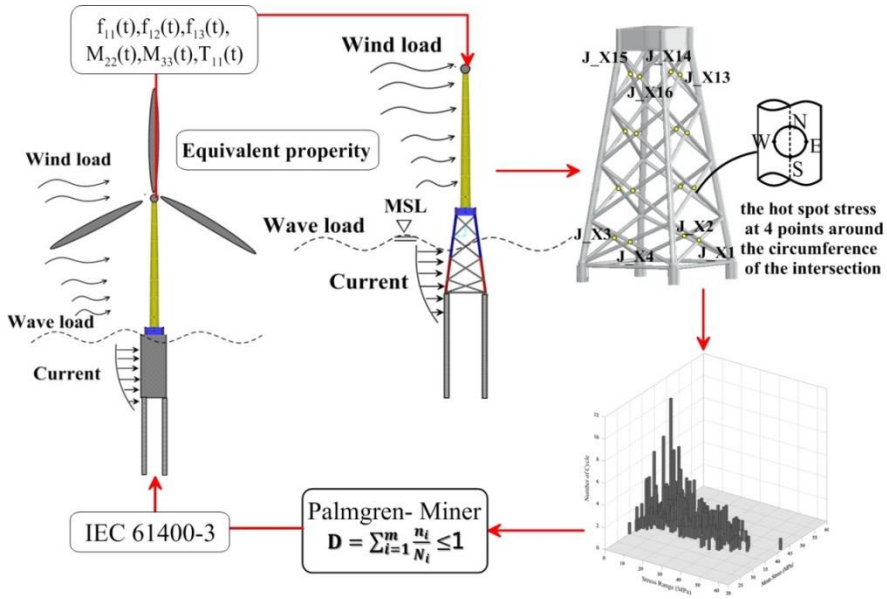
- 建立離岸風機在本土地質特性及颱風、地震之外部極端環境下，完成支撐結構之安全影響評估，應用於國內自主化離岸風機及支撐結構設計驗證技術。
- 有效縮短支撐結構初步載重計算流程(LCP，Load Calculation Procedure)設計時程。應用於初步設計階段，協助中鋼公司建立離岸風機支撐結構載重計算流程，以有效縮短設計時程達到快速估算支撐結構之尺寸。
- 塔架螺栓接合強度評估與設計，將成果應用於協助中鋼公司塔架螺栓接合強度評估與設計技術之建立。



初步設計階段之載重計算設計程序



極限強度安全評估結果



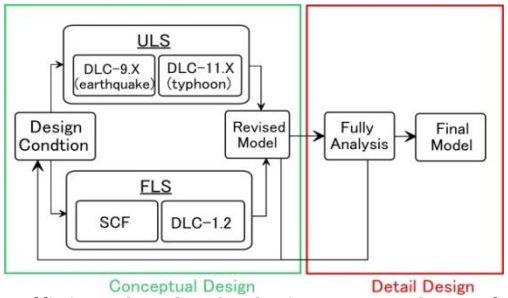
疲勞分析程序

- **計畫總目標：**
  - 考量國內風場環境與地質條件下，執行完整載重計算程序並確認影響整體結構安全評估之主控設計負載案例，藉以縮短概念設計階段之設計時程。
  - 塔架法蘭螺栓之接合強度評估與工程設計技術建立。
- **核心技術：**
  - 引進IEA Wind Task 30 OC3/OC4 國際合作計畫所建立之離岸風機整合動態載重計算與設計驗證技術。
  - 考量本土離岸風機場址特定環境條件與極端環境，建構完整離岸風機支撐結構之結構設計分析與疲勞損傷評估等工程技術。
  - 建構離岸風機支撐結構載重計算程序(LCP)，藉由產學合作提昇國內離岸風力技術能力。
  - 依據螺栓實際破壞案例，探討法蘭接頭斷裂破壞之發生肇因，並針對法蘭螺栓之受力行為做歸納分析。
- **重要國際活動：**
  - 以觀察員身份參加 IEA Wind Task30國際合作計畫OC5技術會議。
  - 邀請東京大學Takeshi Ishihara教授演講「離岸風機極端氣候設計工況及塔架結構設計導則」。
  - 參加國際離岸與極地工程學會(ISOPE, International Society of Offshore and Polar Engineering) 舉辦之海洋與極地工程研討會(ISOPE Ocean and Polar Engineering Conference)並發表論文。

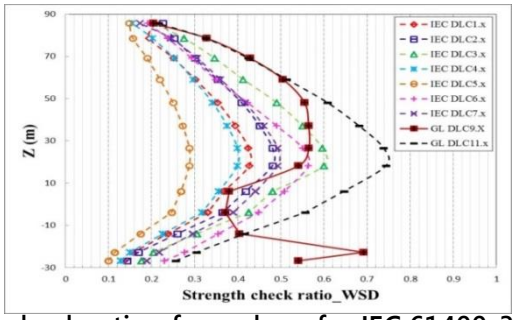
Technology Improvement of Design Verification for Typhoon and Earthquake Resistant Offshore Wind Turbine and Support Structure Integration

Execution Unit	Institute of Nuclear Energy Research Atomic Energy Council, Executive Yuan
Project Director	Huang, Chin-Cheng

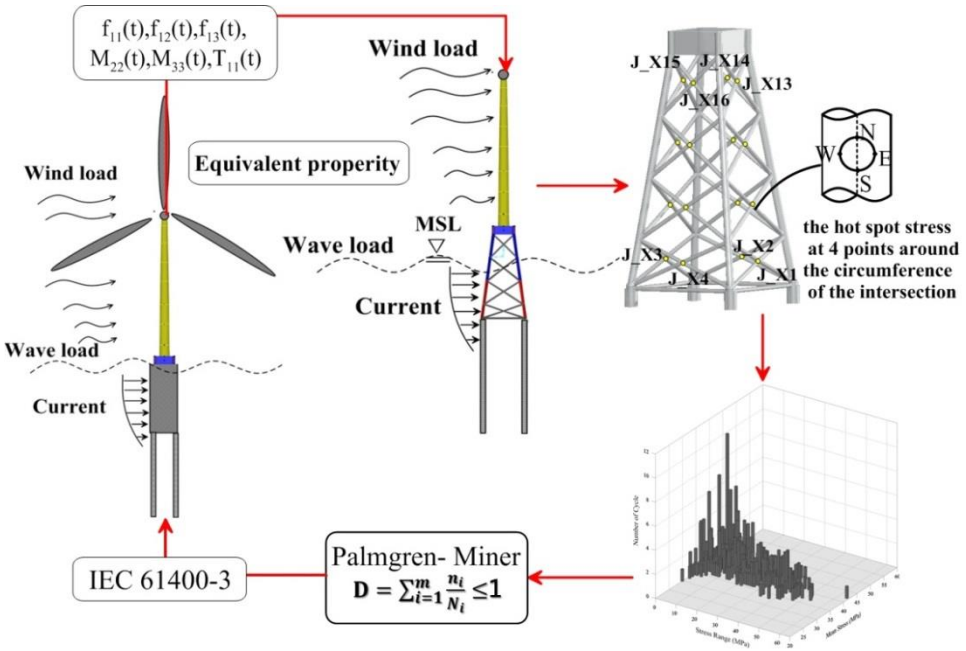
- Establishment of load calculation procedures (LCPs) on offshore wind turbine systems under Taiwan's local environmental conditions, such as typhoon, wave/current and earthquake.
- Development of more efficiency LCPs for the conceptual design to be helpful for cost assessment and selection of adequate types of substructures to be utilized in future offshore wind farms by China Steel Corporation (CSC)
- Establishment bolt connection strength analysis to be used for tower bolt-flange design.



More efficient load calculation procedures for the conceptual design



Strength check ratio of members for IEC 61400-3 and GL



The load calculation procedures for fatigue analysis

Overall objectives:

- Execution a fully series analysis for offshore wind turbine (OWT) of support structure to confirm dominant design load cases(DLCs) under Taiwan's local environmental conditions.
- Evaluating the bolt-flange connection strength for OWT of tower structure.

Important techniques:

- This project is primarily to conduct a series of analyses for the offshore wind turbine of support structure to confirm the domestic dominant DLCs by IEC standard and GL guideline.
- The effects of domestic typhoon and earthquake for offshore wind turbine and support structure have been successfully evaluated and engineering technology of structural design analysis and fatigue damage assessment have been developed.
- More efficiency LCPs for conceptual design have been successfully established to enhance domestic engineering technology .
- Cases of bolt-flange connection strength for actual wind turbine failures have been evaluated that will be helpful for assessment of structural safety.

Important international activities:

- Dr. Chin-Cheng Huang, project leader, was invited to participate in the IEA Wind Task 30 international cooperation program OC5 technical conference as an observer.
- This project team invited Professor Takeshi Ishihara from the University of Tokyo to deliver a lecture entitled “Development of Guidelines for Design of Wind Turbine Support Structures and Foundations“ at the INER.
- Participated in the International Ocean and Polar Engineering Conference and published a important paper entitled “Fatigue Analysis for Jacket-Type Support Structure of Offshore Wind Turbine Under Local Environmental Conditions in Taiwan”.