UNB | Off-site Construction Research Centre

EST. 1785
UNIVERSITY OF NEW BRUNSWICK

PROJECT PROFILE

MALTA INC. (PHASE 2)

PROJECT BACKGROUND

The Off-site Construction Research Centre (OCRC) at the University of New Brunswick (UNB) recently concluded a collaborative project with Malta Inc. to study and optimize their Pumped Heat Energy Store (PHES) system designs. The project highlighted the need for a digitized planning platform for construction sequencing and site layout planning. The next phase aims to refine construction processes for compact heat exchanger trains integrated into the PHES system and develop the Plant Configurator platform.

METHODOLOGY

The OCRC's role in the project encompassed a comprehensive analysis to determine the most cost-effective design for the heat exchanger train, enabling efficient off-site assembly. The methodology involved the following key steps:

Comprehensive Analysis: The OCRC conducted an extensive analysis to optimize the design of the heat exchanger train. This analysis included examining design optimization, modular shipping, and logistics, on-site installation methods, and conducting a comprehensive cost-benefit analysis.
Supply Chain Analysis: To ensure successful implementation, the OCRC evaluated the capacity and capability of the local and regional supply chain. This analysis considered transportation and logistics constraints, with a focus on ensuring design repeatability and constructability both locally and across North America.
Simulation Development: A site simulation methodology was developed by the OCRC to facilitate the implementation of a modularization plan for Malta Inc.'s M100 plant system. This simulation provided valuable insights into the feasibility and effectiveness of the proposed off-site construction approach.
Optimization and Monetization: The OCRC's work aimed to optimize the design and constructability of Malta Inc.'s PHES system for commercialization. By enhancing the efficiency and marketability of the system, this optimization enabled Malta Inc. to further monetize their technology.

RESULTS

The research conducted simulations and constructability analysis using project drawings, 3D models, pipe dimensions, and assumed crane productivity to compare three scenarios: one crane with conventional methods, two cranes with conventional methods, and two cranes with modular methods. The modular approach significantly reduced project duration by 49.4%, total cost by 17.4%, and number of lifts by 6%. This analysis considered crane rates, lift types, and the sequence of construction.

Industry input highlighted the productivity benefits of modularization, emphasizing pre-planning, priority sequences, and factors affecting installation rates. Steel production and pre-cast concrete recommendations were also provided. Design tolerance management focused on surveying techniques, pipe spool installation tolerances, and minimizing field welds. The design tolerance simulation employed Monte Carlo techniques to assess risk areas.

Shipping and logistics considerations included width, height, and weight constraints, along with escort requirements and subcontractor responsibilities. Local capabilities were evaluated, showcasing expertise in pipe spool fabrication, modular steel construction, pre-cast concrete, and general contracting.

Finally, an evaluation criteria table compared local and overseas manufacturing based on cost, quality, lead time, flexibility, IP protection, environmental impact, and economic impact.

CONCLUSIONS

This report concludes that modularization offers significant benefits including reduced project duration, cost savings, and improved constructability, with the use of two cranes and modular methods being the most efficient approach for the M100 plant system. Proper design tolerance management and collaboration with local experts like Sunny Corner, OSCO Construction Group, and FCC Construction are crucial for successful implementation. Recommendations focus on leveraging modular construction advantages, optimizing design, and addressing shipping constraints for a successful project outcome and future planning.

If you are interested in getting involved in this initiative or other research and development projects, please contact the Off-site Construction Research Centre at: **offsiteconstruction@unb.ca**

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