Abstract

We study the problem of finding the optimal routes and schedules for a fleet of vessels that are to perform maintenance tasks at an offshore wind farm. To solve the problem two alternative models are presented: an arc-flow and a path-flow formulation. Both models are tested on instances of varying numbers of vessels and maintenance tasks. The arc-flow model is solved with commercial software using branch-and-bound. The path-flow model is solved heuristically by generating a subset of the possible routes and schedules, but produces close to optimal solutions using a lot less computing time than the exact arc-flow model.

Problem description

The need for maintenance activities at an offshore wind farm change continuously over time, as new failures occur and old ones are fixed. We study the problem of deciding which maintenance tasks should be performed on a given day, and which vessels should be assigned to which task and in what order they should be executed. Figure 1 illustrates the problem faced on a given day. There are some turbines in need of repair, some that needs parts replaced, and some that are in need of an inspection. Each maintenance task is described by its duration, the number of technicians and the weight/volume of the spare parts needed, and finally a down-time cost that is incurred until the task is performed.

To perform the maintenance tasks we have a fleet of vessels available at an onshore base. The vessels are described by their fuel cost, personnel capacity, weight/volume capacity, the access and transfer time, and their wave criteria. We assume that the weather on the planning day is known, and this, together with the wave criteria of the vessel can be used to calculate a weather window for each vessel.

Results

The solution methodology has been tested on a set of randomly generated instances consisting of between 2 and 5 vessels, and 2 and 8 maintenance tasks. The computational results show that all instances can be solved to optimality in less than 1000 seconds, and most instances within 100 seconds. When compared with an arc-flow model implementation of the same problem, the results show that the path-flow model is much faster when the number of maintenance tasks and vessels increase.