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Decision Support Tools for Selection of Pipelines Corrosion Coating

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ABSTRACT
A suitable coating is one with high performance and durability; low surveillance and maintenance needs; easy application with no health implications and finally is cost effective. It is not difficult to imagine that one type of coating would not be suitable for all situations. Thus, a decision support tool is needed to assist (not replace) the decision maker in choosing the most appropriate coating. This paper presents three methods for a pipeline corrosion coating selection process, where judgment of more than one expert can be aggregated to reach consensus. Based on a literature research, sixteen different criteria for the selection of coatings have been identified. Firstly the paper considers a few multi-criteria decision making methods, and then compares three different decision support tools namely: a simple addition of weights, Pugh's Matrix and Borda's algorithm, where the judgment of more than one expert can be elicited and combined. Criteria for selection of the coating are then identified, and a panel of experts are asked to rate a number of candidate coatings against these criteria. Their voting is combined using Borda's algorithm and Pugh's matrix. An example is presented to demonstrate the application of these methods and what a good compromise might look like; providing the decision-maker with the ability to weigh options and set priorities.

Keywords: pipeline corrosion coating; coating selection; multi-criteria decision making; decision support tool; comparative judgment.

1 INTRODUCTION

Application of corrosion coating on the external surface of transmission pipelines is an effective way of managing pipeline corrosion. As the cost of coating amounts to only about 5% of the total pipeline construction costs, external coating is also cost effective. Provided that coatings are produced, applied and maintained according to prevailing good practice as implemented in the current codes, they, alongside cathodic protection, should provide a trouble-free system, with minimal intervention requirements.

Codes require that pipeline owners perform and document a coating system evaluation and selection process. The process must consider parameters such as: installation and operating conditions, maximum operating temperature, soil conditions, stresses, backfill, minimum flexibility and repair-ability amongst other things. Codes define the minimum requirements for generic cases, which may not be fit for a specific case, however, the owner's minimum acceptance criteria should not be lower than codes' requirements. It is important that the applicators demonstrate that they are capable of applying the coating as per the specification. Qualification coatings must be performed prior to coating application. The testing parameters and pass/fail criteria of the coating must be decided by the owner, considering the site, operating conditions and long-term pipeline integrity (Andrenacci and Wong, 2007).

Standards specify the minimum requirements that each coating material must meet. Presumably commercially available material would meet, or exceed, the standards' requirements. Pipeline owners use standards to establish their minimum requirements. They often add more rigorous requirements in their own specification. The International Standards lay out the ground-work, but owners' specifications for a specific case, operational procedures, and quality/process controls are what ensure a successful outcome. Increasing coating thickness results in fewer problems but increases costs. The current standards require an average of around 350 microns and a minimum 250 microns to 300 microns for coating thickness.

The coating specification for offshore and onshore are similar, but not identical, as the conditions and installation are very different. For example, in deep water, the temperature is low, whereas on land, the ground and ground-water temperatures may be significantly higher. Also the sea water is a good conductor for cathodic protection current, but onshore, the soil resistivity can vary by location or by season. Finally, offshore pipeline installation requires greater flexibility. All coatings will benefit from good surface penetration, high impact strength, low moisture absorption, and so on. While the principles are the same for all coatings, the specifics are unique for each material and case; hence selection criteria are dependent on the pipeline working condition. Improved materials and new application technologies are added continually, and the problem of coating performance is addressed continuously (White and Dodds, 2002).

Any expert who is involved in a selection process brings her/his own vision, experience, metrics, and expectation. Owners and individuals use coatings which they have already had success with. Different stakeholders are looking at different problems and solutions. Safety and environmental professional are concerned about pollution, fire and blast; while, maintenance crews need to know where the problem is, how big it is, and if there is a requirement to shut-down the system. Integrity mangers are concerned about reliability; and cost is the project managers' main concern. For this reason it is useful to get experts from many fields involved. The vendors often think about performance through the contract specification and how they correlate with the performance tests. All these views must be expressed using a scale that allows numeral manipulation in order to obtain an optimal choice that best satisfies all

stakeholders' requirements - these decisions are happening against a background of uncertainties. This paper outlines three popular methods used in the selection process.

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