NEVADA DEPRTMENT OF TRANSPORTATION

FFY 2014 RESEARCH PROBLEM STATEMENTS

External Submission Form (Not to exceed 3 pages with font size 12)

I. PROBLEM TITLE

Comparing the Direct Costs and Infrastructure Implications of Anti-icing Strategies

II. PROBLEM DESCRIPTION

The proposed research addresses three critical research clusters for the Nevada transportation system: *Infrastructure and Materials*; *Data-Driven Decision Making;* and *Economics*. Specifically, it provides the data needed by the NDOT to select the anti-icing strategy best suitable for the Nevada highway system that balances the safety, infrastructure and environmental goals.

Currently, there is the lack of research to systematically examine anti-icing options for NDOT's various bridge decks and pavements. Relevant information based on field experience and reliable testing is much needed to assist NDOT in its process of developing anti-icing policies. Anti-icing has proven to be a pro-active approach to maintaining wintery roadways. Relative to deicing and sanding, anti-icing leads to improved level of service, reduced need for chemicals, and associated cost savings and safety/mobility benefits. However, the increased use of chemicals may pose a risk to the NDOT infrastructure such as decks and pavements and reduce their service life. Research is needed to compare various anti-icing strategies (mobile operations vs. fixed automated spray technology - FAST) and chemicals (granular salt, salt brines, magnesium chloride, potassium acetate, etc.) to determine their effects on infrastructure life-cycle.

Strategies such as high friction pavement surfaces may serve as a desirable alternative to FAST systems in terms of cost, reliability and versatility, and their cost-effectiveness is yet to be fully evaluated for NDOT. Preliminary studies have shown the benefits of such alternative anti-icing strategies in accident prevention; but there have been user concerns over their durability.

III. OBJECTIVE

The proposed research will synthesize information from existing research on anti-icing for comparison with NDOT practices and test the chemicals and products relevant to the NDOT current practices. The research will facilitate the understanding of how various anti-icing strategies and chemicals affect NDOT infrastructure and enable NDOT to make more informed decisions accordingly.

IV. CUREENT PRACTICE and RELATED RESEARCH

Over the last two decades, maintenance departments in North America have gradually made two transitions in their snow and ice control strategies. First is the transition from the use of abrasives to the use of more chemicals. This is partially owing to the negative impact of abrasives to water quality and aquatic species, air quality, vegetation, and soil and the hidden cost of sanding (e.g., cleanup cost). In more recent years, there is the

transition from mostly deicing to anti-icing wherever possible. Defined as "the snow and ice control practice of preventing the formation or development of bonded snow and ice by timely applications of a chemical freezing-point depressant", anti-icing has proven to be a successful method of proactively maintaining roadways during the winter season. Russ et al. concluded that "if there is forecast winter weather likely to affect driving conditions, it is desired to have some form of salt on the road, preferably in the form of dried brine. If there is no or very little salt residue on the road, pretreatment is recommended, except under the following conditions: (a) pretreatment would be rendered ineffective by weather conditions or (b) blowing snow may make pretreated roads dangerous". A recent Clear Roads study synthesized the current practices of during-storm direct liquid applications (DLA) and found DLA to be "a valuable asset for the winter maintenance toolbox". Depending on the road weather scenarios, resources available and local rules of practice, DOTs use a combination of tools for winter road maintenance and engage in activities ranging from anti-icing, deicing (including direct liquid or slurry applications), sanding (including pre-wetting), to mechanical removal (e.g., snowplowing), and snow fencing. Textured seal coats for pavements or bridge decks have the potential to prevent dangerous icy or slippery conditions and to significantly reduce the use of chemicals for snow and ice control.

V. RESEARCH METHODOLOGY

This section presents the WTI team's understanding of the needs and challenges associated with each research task, and the approach to solving them. The approach may be modified in consultation with NDOT in order to ensure the success and usability of this research.

Task 1: *Project management*

Task 2: *Literature review and survey of agencies*

Task 3: *Data collection from NDOT on anti-icing strategies, chemicals and affected infrastructure*

This task will entail the collection of qualitative and quantitative data or records relevant to the NDOT anti-icing strategies on bridge decks and pavements; rules of practice; chemicals used and typical application rates under various road weather scenarios; cost and performance of chemical applications, FAST or high friction pavement surfaces; NDOT infrastructure exposed to and at risk of anti-icing chemicals; typical mix design of NDOT bridge decks, overlays, and pavements; typical rebar and dowel bar used, etc.

Task 4: *Laboratory evaluation of NDOT anti-icer corrosion to infrastructure*

This task will evaluate the typical NDOT anti-icing chemicals (granular salt, salt brines with or without corrosion inhibitor, magnesium chloride, potassium acetate, blends, etc.) to the typical NDOT infrastructure (bridge decks, overlays, pavements, etc.).

Task 5: *Evaluating the cost-effectiveness of high friction pavement surfaces*

Task 6: Final Report and Presentation

VI. IMPLEMENTATION POTENTIAL

The proposed research falls under the Laboratory Prototype Stage. The *criteria for judging the progress of implementation* will be how the research findings modify the approach by the NDOT to select and implement their anti-icing program and enable them to make informed decisions on protecting their infrastructure from anti-icing chemicals.

The *end users* of this research will be mainly NDOT bridge/pavement engineers and managers and winter maintenance practitioners and administrators. The *implementation opportunities* may include: the improved understanding of how anti-icing chemicals affect infrastructure would enable NDOT to develop sound anti-icing policies and potentially and further modify the related NDOT policies and procedures. This research may provide information that the practitioners can immediately implement in their daily operations and in the snow and ice management program and bridge preservation program. The research findings may enable MDOT maintenance engineers to modify their approach to winter highway maintenance at key locations as well, e.g., deploying FAST systems or high friction surfaces.

VII. URGENCY AND PAYOFF POTENTIAL

This research is *urgently needed* in this fiscal year in light of the increased emphasis on the durability of transportation infrastructure and on sustainable winter operations. This research is expected to greatly contribute to the infrastructure preservation and anti-icing efforts by NDOT and other agencies. This research will enhance NDOT winter operations decisions and support sustainable, cost-effective, and infrastructure-friendly maintenance of wintery roads and bridge decks in Nevada and beyond. Anticipated benefits may include the identification of anti-icing strategies and chemicals for improved level of service (LOS) and infrastructure-friendly maintenance practices. The use of appropriate anti-icing chemicals and strategies will also help preserve the performance and service life of bridge decks and pavements, reduce the need for their costly and difficult repair and rehabilitation, and reduce the life-cycle cost of NDOT infrastructure. Furthermore, the implementation of best practices in anti-icing will have immediate positive impact on the NDOT highway system, including cost savings, enhanced traveler safety, reduced traveler delays, and minimized environmental impacts.

VIII. ESTIMATED BUDGET

$180,000/ 18 months

IX. DATE AND SUBMITTED BY

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X. NDOT CHAMPION, COORDINATION AND INVOLVEMENT

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Stakeholders: NDOT Bridge, Pavement, Maintenance & Asset Management divisions