ACRP Problem Statement 18-02-01 **Recommended Funding Amount: --**

Alternative Anti-Icing Airfield Runway Systems

ACRP Staff Comments

The proposed research should build on ACRP Report 123: A Guidebook for Winter Operations and other deicing-related reports.

TRB Aviation Committees Comments

ENVIRONMENTAL IMPACTS OF AVIATION COMMITTEE: Committee does not support this problem statement, but it could garner support if the scope were changed to compare the life cycle impacts of differing systems.

AIRCRAFT/AIRPORT COMPATIBILITY COMMITTEE: Alternative anti-icing systems have been tried at multiple locations around the world, on airfields and roadways, but the industry is still missing a good review of the state of the art and comparative analysis of the different technologies available. We are probably at the point where the need is for a reference book on different methods for controlling snow and ice on pavements using non-chemical methods since a growing body of research data into pavement design and performance is being collected. At 30 months, however, the duration seems a bit long.

Association Committee Comments

AAAE (MEMBER): Please accept this problem statement. It's of value and interest to airport operators.

NASAO (MEMBER): This is important research to Minnesota. Would like to see included in cost/benefit analysis the activity level that would justify the installation of these systems.

Review Panel Comments

Not recommended. Current options are limited and expensive; however, new approaches could be identified. If approved, the research should include a benefit-cost analysis. A lot of practice is exists. It is likely that the research will indicate any new practices will not be cost-effective.

AOC Disposition

There was no discussion. No funds were allocated.

ACRP *Problem Number* 18-02-01

AIRPORT COOPERATIVE RESEARCH PROGRAM PROBLEM STATEMENT

I. PROBLEM TITLE

Alternative Anti-Icing Airfield Runway Systems

II. BACKGROUND

Many US airfields are subjected to sub-freezing temperatures. Snow, ice, or slush runway conditions significantly impact aircraft landing and takeoff safety. To promote safety at US airfields, snow and ice removal are essential during wintry wet weather conditions. Typically snow and ice removal practices include blowers, brooms and chemicals. However, these practices are costly in terms of time, staff, and environmental resources. Alternative anti-icing runway systems or methods should be investigated to evaluate their cost effectiveness and environmental impact. Alternative techniques that are found to be efficient and effective will provide airports with cost savings, reduced down time during wintry wet weather conditions, and lower environmental impacts.

Between 1998 and 2004, runway water, ice or snow contributed to more than 50 airplane accidents (NASA 2004). Between January 1978 and January 2009, there were 100 accidents / incidents that occurred at US runways with slush, ice or snow involving jet or turboprop aircraft weighing more than 5600-lbs. and having a minimum of two engines (Ayres et al 2011).

Airport authorities use plows, snow blowers, and/or sweepers to remove snow to ensure safe aircraft ground movements during winter storm conditions. Runway de-icing fluids (RDF's) are used to break the bond between ice and pavement during icy conditions. Salt melts snow and ice; however, applying salt to a runway has the adverse effects of pavement and aircraft landing gear corrosion. Alternatively, more environmentally friendly freezing point depressant chemicals are used for anti-icing agents to reduce ice-pavement bond while complying with US EPA storm water regulations. Although, manually removing snow and applying de-icing solvents is one solution to ensure safe runways during winter conditions, alternative anti-icing/de-icing solutions are available and may be more advantageous.

Pavement heating systems provide a viable alternative to deicing chemicals for maintaining ice-free pavement surfaces. Heated pavement systems (HPS) maintain above freezing slab surface temperatures melting and preventing ice accumulation and other winter-like contaminants. Minimum performance requirements for use of heated pavement systems are included in FAA Advisory Circular 150/5370-17 (FAA 2011).

III. OBJECTIVE

Summarize existing anti-icing and de-icing practices, and develop new approaches for runway anti-icing to promote runway safety during wintry weather conditions.

IV. PROPOSED TASKS

- Review current airport runway anti-icing practices and categorize these practices as a function of ambient weather conditions. The survey should include domestic and foreign methods.

- Summarize currently used anti-icing practices as a function of their ambient condition suitability and economics.

- Develop an experimental plan to select and judge optimal alternative practices for their suitability.

- Conduct preliminary experimental work using these optimal practices.

V. ESTIMATED FUNDING

Estimated problem funding: $450,000

VI. ESTIMATED RESEARCH DURATION

Research period: 2.5 years

VII. RELATED RESEARCH

Alternative de-icing / anti-icing systems are currently being investigated. These approaches need to be summarized for their effectiveness and potential. Additionally, new systems need to be proposed and tested for their viability. Work was conducted by Tuan incorporating conductive concrete to develop a deicing concrete pavement slab (Tuan, 2008). The system was implemented at a bridge deck and tested. An Iowa State University research team led by Halil Ceylen is currently researching electrically conductive concrete heated pavements and using the approach in precast concrete panel units (Abdualla et al., 2016). The previous systems use grid electricity as their energy source. Conversely, Heymsfield et al (2013) incorporated conductive concrete with renewable energy as the system's energy source. Results in the Heymsfield study showed that the conductive concrete approach is energy inefficient and therefore not a cost effective option in a renewable energy system. An electrically conductive flexible pavement system was developed by Snowfree using a graphite powder mix and tried at the Chicago O'Hare Airport (Derwin et al., 2003).

Hydronic systems pump heated fluid through embedded conduits within the pavement slab to provide an above freezing temperature slab surface. Hydronic systems are already being used in Europe. Gardermoen International Airport in the Oslo, Norway area uses a hydronic system to heat the airport apron area. Plans for a hydronic system using geothermal energy at the Goleniow Airport in Poland are available in a reference by Zwarycz (2002). In the US, Binghamton University researched the feasibility of using an anti-icing apron system using geothermal energy (Ziegler 2009).

VIII. PROCESS USED TO DEVELOP THE PROBLEM STATEMENT

From research work that Ernie Heymsfield is currently involved in.

IX. PERSON DEVELOPING THE PROBLEM STATEMENT AND DATE

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