Working Document of the NPC Study:
Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources
Made Available March 27, 2015

Paper #7-2

MULTI-MODE TRANSPORTATION LIMITATIONS

Prepared for the
Technology & Operations Subgroup

On March 27, 2015, the National Petroleum Council (NPC) in approving its report, *Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Technology & Operations Subgroup. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 46 such working documents used in the study analyses. Appendix D of the final NPC report provides a complete list of the 46 Topic Papers. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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# Topic Paper (Prepared for the National Petroleum Council Study on Research to Facilitate Prudent Arctic Development)		
7-2	**Multi-Mode Transportation Limitations**	
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Date: August 14, 2014		**Revision:** Final

SUMMARY
The Alaskan Arctic environment can be characterized as having severe environmental conditions coupled with vast distances and sparse population centers. Together, these combine to offer significant transportation constraints to logistical planners. This topic paper describes the operational environment and offers recommendations (technical, policy and regulatory) to optimize current multi-mode transportation operations.

PURPOSE

The purpose of this topic paper is to describe the operational limitations for multi-mode transportation within the Beaufort and Chukchi Seas.

BACKGROUND/ONGOING RESEARCH

Multimodal transportation, or combined transportation, used for the movement of passengers, cargo, and equipment is primarily driven by two main factors:

- Ice and metocean operational envelopes
- Regional accessibility to the operational area

Additional non-technical drivers and regulatory requirements such as the Jones Act, stakeholder management, environmental and social considerations and infrastructure availability will be discussed in other topic papers. The influence of the aforementioned factors on multimodal transportation provides both limitations and opportunities for enabling a seamless long-term multimodal transportation strategy for maximizing logistics resource availability while minimizing operational risks.

DISCUSSION

The most significant limitation to multimodal transportation is the aggregated environmental impacts associated with the Alaskan Arctic environment. Present aircraft, rail, maritime, and vehicular resources require modifications to extend their usefulness.

- Maritime Operations are impacted primarily by sea ice

- Ice formation starts in September, in northern regions of the Beaufort and Chukchi Seas, and by October landfast ice can be found along the coastline. By late October, ice can be found near Bering Strait by mid to late November. Its maximum extent is reached in March and ice decay starts in May at Bering Strait; by July, ice has disappeared in most regions of the Beafuort and Chukchi Seas with varying amounts of open water/low ice concentrations during the summer period.
- Pressure ridges and stamukhi impact effectiveness of currently available air cushioned vehicle technology in that ACV craft will have to go around them
- Extreme temperatures of the Alaskan Arctic during the winter, as highlighted in Table 1a, limits operational windows for outdoor activities
  - People
    - Must provide access to shelter and limit time outside work to short durations at -20 °F and curtailed entirely at -40 °F
  - Equipment
    - Must provide internal heating to ensure it continues to operate
    - Requires steel designed for severe, Arctic-cold temperatures for exposed facilities and equipment

Table 1a: January Air Temperature Data

January (°F)	Barrow	Nome	Fairbanks	Anchorage
Monthly Average	-13.6	4.7	-10.2	15.8
Minimum Monthly Average	-26.4	-15.2	-33.3	2.2
Minimum Daily Minimum	-56	-54	-66	-39

Source NCDC website

- Similarly temperatures during the summer, as highlighted in Table 1b, are likewise low in the northern parts of Alaska. Air temperatures over open water aer generally cooler

Table 1b: July Air Temperature Data

July (°F)	Barrow	Nome	Fairbanks	Anchorage
Monthly Average	39.8	52.6	62.6	58.4
Maximum Monthly Average	45.5	58.1	67.5	62.0
Maximum Daily Maximum	79	86	94	86

Source NCDC website

- Aviation is impacted by both temperature and visibility
  - The minimum operating temperatures vary by aircraft type, generally -32 °F to -40 °F; limits use during winter months
  - During winter months, the sun will drop below the horizon and "sets" for several months though twilight will provide additional "light" (Ref: Table 2).

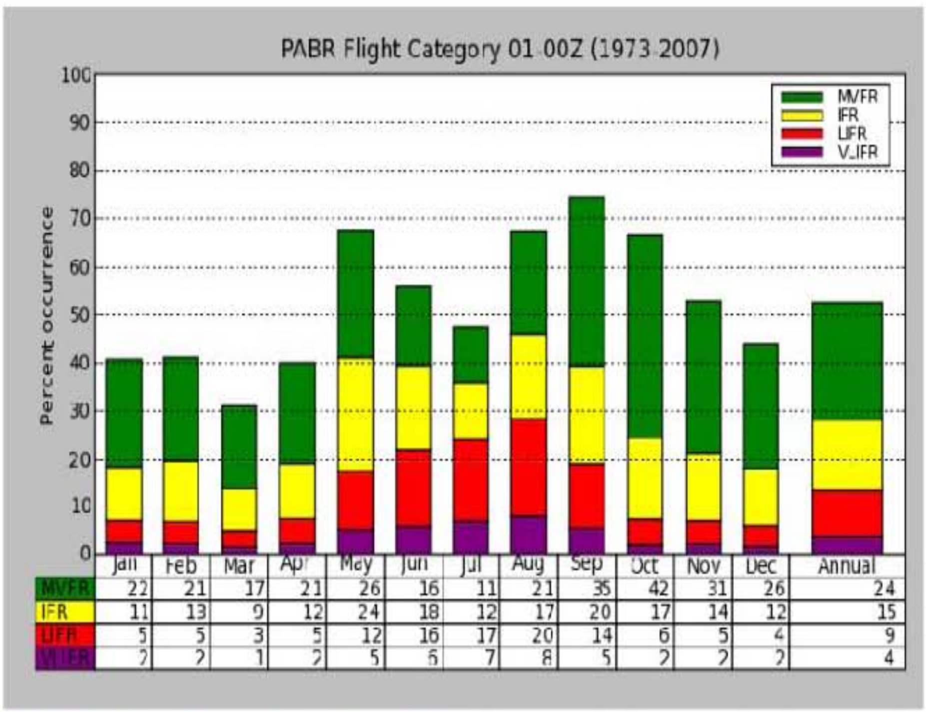
Table 2 Civil Twilight Calculation in the Chukchi Sea

Civil Twilight Calculation 163 30W, 71N Month	**Min**	**Max**	**Avg**
January	3:44	7:22	5:25
February	7:30	11:33	9:30

March	11:41	16:30	14:01
April	16:41	24:00	20:21
May	24:00	24:00	24:00
June	24:00	24:00	24:00
July	24:00	24:00	24:00
August	18:25	24:00	22:13
September	13:13	18:11	15:34
October	08:42	13:03	10:51
November	04:42	08:34	06:35
December	03:17	04:35	03:43
Source: U. S. Naval Observatory Model			

- Table 3 below shows the percentage of time per month that given visibilities for aircraft operations occurred at Barrow Airport from 1973 to 2007. Depending upon latitude, a location can have zero daylight. For example, Barrow has only 2 hours of civil twilight in December

Table 3: Percentage of time per month that given visibilities for aircraft operations occurred at Barrow Airport



Source: Alaska Weather Aviation Unit

The visibility categories are again:

- MVFR – marginal visual flying rules defined as a cloud ceiling between 1000 and 3000 feet and visibility between 3 and 5 statue miles
- IFR – instrument flight rules defined as a cloud ceiling < 1000 feet and visibility < 3 statue miles
- LIFR – low instrument flight rules defined as a cloud ceiling < 500 feet and visibility < 1 statue miles
- VLIFR – very low instrument flight rules defined as a cloud ceiling < 200 feet and visibility < 0.5 statue miles

- Both road and rail transportation are impacted by weather to an extent but the primary limiting factor is availability of a network across northern Alaska.

Remoteness from major cities and ports is another key element defining the arctic environment.

- Re-supply operations in Alaska involve long distances from a major marine port or airfield.
- Re-supplying an offshore facility becomes more of an issue when ice is involved. Icebreaking vessels can be used, but at certain times of the year, there may be restrictions on their use due to wildlife and subsistence hunting.
- The Port of Dutch Harbor, 1650 nautical miles from Seattle, WA and 1076 nautical miles from the Chukchi Sea, is the only deep draft, ice-free port from Unimak Pass west to Adak and north to the Bering Strait.
- The flight time from Prudhoe Bay (Deadhorse), or Barrow to Anchorage is over 2 hours requiring lead times to support any aviation movement of materiel or personnel; there is limited access outbound of Prudhoe Bay (Deadhorse): no roads or public dockage.
- Many airfields in the North Slope do not have hard surface runways; limiting the aircraft types that can operate
    - Limited, or no local Emergency Response (Fire Crash Rescue)
    - Most village airfields do not provide a full range of services, such as fuel.
    - The FAA has not established air traffic routing for offshore helicopter operations.
- There is only one main road from Fairbanks to Prudhoe Bay (Deadhorse), the James W. Dalton Highway, supporting the land-based transportation requirements
- Fairbanks is the northern-most point for the Alaska Railroad Company
- The isolation of most population centers results in high costs for transportation services, infrastructure development and maintenance support services
    - Further aggravating the development of services is the impact on land use interests ranging from impacts to subsistence hunting to wildlife protection

RECOMMENDATIONS/POTENTIAL AREAS FOR FURTHER RESEARCH

The following opportunities warrant further work or research to reduce the limitations on multimodal transportation:

- Ice-classed vessels to include ACV (hovercraft)
- Further development and support for Alaska's Roads to Resources Program
- Development of a true deep water or man-made port option to support the Chukchi prospects
- FAA support to develop controlled airspace and the means to provide IFR control to aircraft in the Chukchi and Beaufort prospect areas. Specifically, the ability to provide close control for rotary-wing assets supporting these prospects

The complexities of multimodal transportation within the Arctic environment are complicated by its environmental and geographical isolation. Moreover, Arctic-capable transportation assets are in short supply due to high cost and uncertainty of future demand. These impacts combine to limit the numbers of available vendors to support energy exploration operations. The solutions for optimizing and increasing logistics resource availability requires a holistic approach spanning public, private, and international cooperation.

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