Trip Report – Visit to St. Lawrence Seaway in Massena, New York
Including St. Lawrence Seaway Development Center (SLSDC) and their Traffic Management System (TMS).

Participants:
Mr. Keith Hofseth, Army Corps of Engineers
Dr. James Campbell, University of Missouri St. Louis
Ms. Denise Franke, University of Missouri St. Louis
Ms. Carol A. Fenton SLSDC, Deputy Associate Administrator
Ms. Lori Curran, Director of Lock Operations
Mr. Christopher Ehrman, Operation Specialist
Mr. Terry Jordan, Marine Specialist

Wednesday, 25 May 2005:
Ms. Franke and Dr. Campbell flew into Syracuse Airport.
They met with Mr. Hofseth and then all drove to Massena.

Thursday, 26 May 2005:
Drove to SLSDC Offices in Massena and met with Ms. Carol Fenton, Deputy Associate Administrator.
Drove together to the Dwight D. Eisenhower (IKE) Lock where we viewed the Vessel Traffic Center's Traffic Management System.
Met with Ms. Fenton, Ms. Lori Curran, Mr. Chris Ehrman, and Mr. Terry Jordan.
Viewed lockage of the Atlantic Erie traveling downstream.
Returned to Syracuse Airport.

Notes:
Overview and History of the Seaway

Originally planned by the Canadian government, the Wiley-Dondero Act (a.k.a. the Seaway Act) authorized U.S. participation in the navigation project and established the Saint Lawrence Seaway Development Corporation (SLSDC) as the U.S. agency to work with the Canadian Seaway Authority in the construction, maintenance and development of the waterway. The seaway opened to commercial traffic on April 25, 1959.

There are fifteen locks along the 2,342 mile Great Lakes - St. Lawrence Seaway system that raise vessels from sea level to 183.49 meters above sea-level (at Lake Superior). Eight of the locks are along the Welland Canal (connecting lake Erie and Lake Ontario) and the other locks are along the St. Lawrence Seaway between the Atlantic Ocean and Lake Ontario. Two locks on the Seaway are managed by the SLSDC while the remaining 13 are managed by the Saint Lawrence Seaway Management Corporation (SLSMC) of Canada. The IKE lock uses twenty two million gallons of water to raise and lower ships more than 40 feet in less than 10 minutes. There are approximately 2000 lock transits annually and operations of the locks along the St. Lawrence Seaway (between the Atlantic Ocean and Lake Ontario) are limited to only about nine months a year.

Traffic in the Seaway differs from the Upper Mississippi in that the vessels on the Seaway are nearly all individual ships, and thus travel through the lock in a single cut. Primarily, ocean and lake vessels transit the Seaway locks, with dimensions up to 740 feet in length and 78 feet wide. An additional difference between locking on the Seaway and on the Upper Mississippi River is that a pilot is required on all seaway vessels. Domestic vessels may provide their own certified pilots; however, international vessels are required to engage a certified seaway pilot.

The Great Lakes and Seaway navigation system is unique. The primary commodity movements consist of low cost, dry bulk products such as iron ore, grain, stone, coal and cement. Markets for these products have seen much upheaval in the last 5 years. Iron ore and lime stone shipments have declined. An iron ore mine in Minnesota closed and a steel company declared bankruptcy and shut down five blast furnaces in Ohio and Indiana.

Before 1984, both Canada and the United States charged the shipper management companies tolls. The 1986 Harbor Maintenance Trust Fund was established to carry out section 210 of the Water Resources Development Act of 1986, for payments of rebates of tolls or charges pursuant to section 13(b) of the Act of May 13, 1954, and for the payment of all expenses of administration incurred by the Department of the Treasury, the Army Corps of Engineers, and the Department of Commerce related to the administration of subchapter A of chapter 36 (relating to harbor maintenance tax).

Performance Measures/Service Level Objectives

Per a spreadsheet provided by Ms. Fenton, the operation of the Seaway is evaluated on standard performance measures and service level objectives. The service level objectives include: Reliability; Efficiency; Safety and Quality. Each is further broken into measurable objectives to address: minimizing delays, managing delays, and improving customer satisfaction. The performance measures include: System availability; Lock Equipment Maintenance (measured in season days vs. downtime); Management accountability (satisfaction survey of agents every 2 years; Emergency response training, Enhanced Seaway Inspections (ESIs) (inspect all ocean transit inbound); and ISO Measurement (non-conformities measured via external audits).

Infrastructure improvement projects are continually being undertaken on the Seaway to better meet the objectives. Customer satisfaction is impacted by winter closure, service fees and the absence of a single price, door-to-door transportation option. The main selling point of Seaway transit are the dedicated fleet of vessels for Great Lakes traffic, the environmental advantages of lower emissions over alternative methods of transportation, and lower accident rates than other modes (rail or truck).

Navigation improvements have included an increase in allowable ship size, the deepening of channels and the extension of the navigation season. The Seaway locks underwent a major rehabilitation program competed in 1992 and an electrical upgrading

in 1994. The locks are now due for some mechanical improvements in the form of new gate mechanisms and lock wall rehabilitations. The degradation of lock walls from the alkali aggregate reaction (AAR) process that occurs when reactive aggregate combine with high alkali cement and sufficient moisture to cause a reaction resulting in lock wall swelling, damage to the walls and misalignment of mechanical parts. The SLSMC plans to spend $170 million over the next five years to support this project. This maintenance will aid the locks in reaching their 100 year design (through 2059) life.

AIS

Automatic Identification System (AIS) is a shipboard broadcast transponder system operating in the Very High Frequency (VHF) maritime band that is capable of sending and receiving ship information such as identification, position, heading, speed, ship length, beam, type, draft and hazardous cargo information to other ships and to shore. Ship-to-ship communications via AIS are especially useful to aid in collision avoidance. Ship-to-shore communications via AIS provide automated ship identification, position, heading/speed, and other ship information. Shore-to-ship communications via AIS provide lock availability, water levels and flows, wind data, ice conditions, and other safety related messages.

In 2002, the St. Lawrence Seaway implemented AIS and integrated it with the Seaway's TMS. (All vessels entering the Seaway system are inspected, entered into the TMS and are often in the system for days prior to arrival at a U.S. port.) Implementation and integration of AIS was a joint venture of the SLSDC, the SLSMC, and the U.S. Volpe Transportation Systems Center. Nine base stations broadcast water levels, weather data and lockage order-of-turn information for each lock within the Seaway. AIS transponders are required on all commercial vessels transiting through the Seaway's traffic sectors.

Through agreements with the Canadian Shipowners Association and the Shipping Federation of Canada, the cost of implementing AIS was shared equally by commercial carriers, the SLSDC, and the SLSMC. The overall cost of the AIS development and implementation was approximately $2 million, primarily over three years. The Volpe Center provided technical assistance in all aspects of software development, hardware evaluation, and procurement, the installation of AIS shore base stations and the integration of AIS with the Seaway TMS.

According to the SLSDC, AIS benefits users of the Seaway by reducing transit time through better scheduling of vessel lockages and vessel meets, timely pilot dispatching minimizing delays, shore-to-ship communication regarding water and environmental conditions as well as real-time ship-to-ship communication enhancing safety. AIS benefits the management of the Seaway by providing accurate vessel position information resulting in more efficient traffic management and timely pilot dispatch and scheduled inspections, improved monitoring capability, and potentially to the rationalization of Traffic Management Centers.

AIS Testing

Prior to installation of the AIS infrastructure, the Volpe Center conducted AIS signal coverage tests on the Saint Lawrence Seaway in the region between the St. Lambert lock and the Iroquois Lock (Carol Fenton provided details in a follow-up email: *Draft Saint Lawrence Seaway AIS Signal Coverage Test Report*, August 3, 2001). Four transponders were used to perform the tests. Two Saab R30 base-stations were used as shore side base-stations. Two Saab R3 mobile transponders were temporarily placed on vessels. It was demonstrated that the Saab equipment closely met the AIS on-air Time Division Multiple Access (TDMA) protocols as defined in the ITU-1371 standards.

Highly directional Yagi antenna systems were used at the shore sites. A Yagi antenna concentrates the transmitted energy along the axis of the radiating elements resulting in a considerable increase in signal gain, or effective radiated power, over an omni-directional antenna. The proposed maximum power for the Saab transponders was limited to 10 Watts; therefore, the 12.5 Watts antenna restrictions were appropriate. Stations along the shore of the Saint Lawrence River were best served by using a highly directional antenna system. An eight dB gain omni-directional antenna with offset pattern was used at the Orleans, NY site (the highest of all shore sites along the river and one which also provided the greatest coverage range). Three-element antennas were chosen for locations where a wider beam width was needed to accommodate larger changes in the course of the river. For long straight sections, a six-element antenna provided the best coverage range.

The tests were designed to determine the signal coverage areas of four shore side base-stations. The coverage tests also provided an opportunity to evaluate both the vessel tracking aspects of AIS and shore-to-ship messaging capabilities. Based on a 95% or better message completion rate between the mobile transponders and the base-stations, results showed that there was continuous signal coverage and approximately 53% of the route presented overlapping coverage. In all cases where two base-stations were in operation simultaneously, messages broadcasted from either base were consistently received by the other station. Coverage ranged from 13 to 46 nautical miles from the base-stations, depending on terrain and height of the base-station transponder. The Orleans, NY transponder was installed on a Verizon cellular tower (ground elevation of 360 feet compared to the others ranging from 79 to 282 feet in elevation) and it had the greatest coverage area.

The final configuration post-testing consists of nine base stations from Montreal through the Welland canal. Three stations are located on the U.S. side of the Seaway and six on the Canadian side. Currently, the port of Montreal has not completed deployment of AIS.

TMS

The Traffic Management System (TMS) provides a structured method of managing transits along the St. Lawrence Seaway. Users can create single vessel,

multiple vessel, or pleasure craft transits. Existing transits may be modified, and vessels may be added or removed from the transit. Vessel information is entered and stored in the database, and is used to populate the transit records. Vessel information consists of the vessel number, IMO number, full name, fleet, length, depth, beam, units, origin, ultimate destination, other destination beyond the Seaway. Other information maintained includes: pre-clearance status, inspection report date, fleet, vessel group and type, country of registry, agent, cellular number, and last transit date.

One point worth noting is that the U.S. based Seaway and locks are located between Canadian locks. The TMS lists all vessels in the Seaway with active transits. Most information regarding vessels is entered into the TMS by the SLSMC prior to reaching the U.S. locks. Specifically around the Niagara Lock area, pleasure craft information must be entered. This information includes: full name, name tag, short name, direction, number of people, overall length, cursing speed, radio channel, craft type, and transit ticket.

Plans are maintained for each transit. Information about what is visible on the TMS graphics is added in the plan. Fields such as lake course, whether or not name and model information should be visible on the TMS graphics, load conditions (i.e., ballast), hazardous cargo, flight lock side information, last location, calculated actual time of arrival, and ultimate destination. Information regarding origin, call in location, turning location, fuel stop, and destination are maintained in the plan. Delays regarding vessel movements can be added, modified and deleted. These include but are not limited to: vessel loading, vessel discharging, marginal weather conditions, slow fill/dump, avoid meeting, personnel to board/depart, awaiting orders, or violation of seaway regulations.

The Vessel's Enhanced Seaway Inspection (ESI) Reports and Vessel Cargo Information (identifying cargo, country, quantities, remarks and load plans) can be stored in the TMS. Cargo information is entered for toll purposes at the Canadian Locks.

The TMS user can verify the AIS signal through the TMS. The AIS tab of the TMS displays all of the information being broadcast by the vessel's AIS transponder. Notable information includes length, beam, name, antenna distance from port and starboard, precision (DGPS or GPS), and heading. If TMS is receiving a valid vessel position from the AIS, the vessel's nametag on the graphic display will include a magenta icon with the letter 'A'. Vessel's speeds are monitored with the AIS. Every minute, the ten minute speed average is compared to the speed zones. The traffic controller receives a message if a violation is noted. The controller reads the violation message to the vessel. Fines may be levied for multiple infractions.

Many of the details and descriptions in this report are taken from various documents provided by the Seaway authorities.