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THE TRACKING OF HIGH LEVEL WASTE SHIPMENTS--TRANSCOM SYSTEM

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ABSTRACT

The TRANSCOM (transportation tracking and communication) system is the U.S. Department of Energy's (DOE's) real-time system for tracking shipments of spent fuel, high-level wastes, and other high-visibility shipments of radioactive material. The TRANSCOM system has been operational since 1988. The system was used during FY 1993 to track almost 100 shipments within the U.S. DOE complex, and it is accessed weekly by 10 to 20 users.

I. INTRODUCTION

The potential impacts associated with the transportation of spent fuel and other radioactive materials are important issue. The general public has frequently expressed concerns regarding the safety of transporting radioactive materials through their communities. In response to these concerns, DOE developed a system which allows communication with and near real-time tracking of high-visibility shipments of hazardous materials. This system, known as TRANSCOM (Transportation Tracking and Communications), is currently in operation, and its use for certain shipments is mandated by DOE Order 5632.11, *Physical Protection of Unclassified Irradiated Reactor Fuel in Transit*, September 15, 1992. Specifically, this order states that

"To achieve the objectives of this Order, a physical protection system shall be established and maintained to include:

- a. All shipments of DOE unclassified irradiated reactor fuel will utilize the DOE Transportation Communications System

(TRANSCOM) for communications between the transport vehicle, TRANSCOM Control Center, and the responsible field element/contractor Emergency Operations center.

- b. A Carrier's communications center at a designated location which will be staffed continuously by at least one individual who will monitor the progress of the irradiated reactor fuel shipment and will notify DOE and other appropriate agencies if an emergency should arise."

II. THE TRANSCOM SYSTEM

It is the mission of the TRANSCOM system to provide tracking and communications for shipments of spent fuel, high-level waste, and other high-visibility shipping campaigns as specified by DOE. The TRANSCOM system is comprised of satellite communications, data base management, computer networks, and a commercial telecommunications service which are used by carriers, shippers, and receivers and federal, state and tribal government agencies to monitor the movements of radioactive shipments and by carriers, shippers, receivers and DOE to communicate with vehicle operators.

This system is managed and operated at the TRANSCOM Control Center (TCC), which is located in Oak Ridge, Tennessee, for DOE's Transportation Management Division. Operations are conducted under a customized quality assurance program using a graded approach. The TCC, established in 1988, houses the UNIX-based computer network that stores information for each shipment in a central data base and controls all

TRANSCOM activities and communications. A number of different users regularly access the TRANSCOM system. Users include carriers, shippers, receivers, DOE Emergency Operations Centers, DOE Transportation and Traffic management staff, states, and Indian tribes. After a prospective user has completed an approved TRANSCOM training workshop, all that is needed to access the TRANSCOM system is a copy of the TRANSCOM Disk Operating System™ (DOS) software, a confidential user identification number and a password established during training, a standard telephone line, an IBM-compatible personal computer, and a 2400-baud Hayes-compatible modem.

Figure 1 shows the overall information flow of the TRANSCOM system. Vehicles carrying high-visibility materials (including spent nuclear fuel) requiring communication and tracking capability are equipped with Omni-TRACS™ mobile communication transponders which are made by QUALCOMM, Inc. These transponders are either owned and supplied by the carriers or are obtained from the TCC. During a tracking exercise, the UNIX computer periodically requests a positional update for specific transponders. A signal is sent from the satellite system to the appropriate transponder, and the return signal is used to calculate the geographical coordinates (latitude and longitude) of the vehicle. This information is returned to the TRANSCOM UNIX computer via commercial telephone lines. The time interval between positional updates can be varied from 1 to 9999 min. The lower time interval is a hardware limitation. It takes approximately 30 s to place a call to QUALCOMM and an additional 30 s to receive a positional update. The normal interval used for most shipments is a positional update every 15 min. The positional updates provide the capability of monitoring a shipment's location to within 1,000 ft.

Icons showing the position of the vehicle can be displayed on a series of computer-generated maps. Three levels of geographic detail are available to the user: the entire United States, an individual state, or an individual county. The user can select a map of any of these geographical areas and superimpose the highway and/or rail network upon the map. The icon is color-coded (green, yellow, magenta, or red) to show the status of the vehicle. A shipment that is proceeding normally is indicated by a green icon. A yellow icon indicates that there is a problem such as a mechanical breakdown, flat tire, etc. A more serious problem, yet not affecting safety, is displayed by a magenta icon. If the vehicle is involved in an accident or in other emergency situations, a red icon is displayed.

The TRANSCOM system provides TCC staff and shippers the ability to communicate with each other and to maintain a nationwide communication link with their vehicles, trains, and boats. This latter capability allows the TCC to transmit weather information to the carrier and the carrier to transmit information on the status of its movement: when it is stopping, why it is stopping, etc. Shipment information contained in the TRANSCOM system is available, depending on the access level of the user, in various forms, including

Shipment location. The location of each shipment is shown by an icon on a set of computer-generated maps. Over 3,100 maps are used by the TRANSCOM system.

Shipment status. The status of each shipment is indicated on the TRANSCOM maps by the color of the shipment icon. In addition, the icon also indicates the status of messages, if the shipment is transported by truck or rail, and whether the vehicle is loaded or empty.

Shipment characteristics. Shipment information includes material identification, hazard class, fissile class, activity level, and radionuclides. This information could be critical in the event of an emergency and would then help emergency response teams determine necessary actions.

Emergency response information. Information from the U.S. Department of Transportation's (DOT's) *Emergency Response Guidebook* is available for each shipment. This information is directly related to the material being transported and includes a list of response actions and emergency contacts.

Advance notification. Users who will be affected by a shipment are provided with shipment information before shipment departure to allow them to schedule routine inspections, coordinate logistics, and implement emergency preparedness measures.

Report. A condensed report listing shipments in transit is available to users directly involved in a shipment and to the users along the route. It allows users to prepare schedules, allocate resources, and prepare for any situation that may arise.

Two-way messaging. This function enables individuals involved with a shipment, including the vehicle operator, other users, and the TCC, to

communicate throughout the network. For example, the TCC staff can send the vehicle operator information on road and weather conditions. This helps implement safety measures, optimize equipment use, and improve customer service.

Four access levels are currently provided for TRANSCOM: (1) TCC has full functionality for all shipments; (2) carriers, shippers, and receivers have all functions for shipments in which they are involved; (3) DOE's Emergency Operations Centers have view-only functions for all shipments; and (4) states and Indian tribes have view-only functions for shipments travelling through their jurisdictions.

Normally, the TCC is manned 5 days a week, 8:00 a.m.—5:00 p.m. Eastern Standard Time. However, when shipments being tracked by TRANSCOM are on the road, the TCC is continuously manned 24 h/d.

While the TRANSCOM system was not designed as an emergency response system, the TCC is frequently the first office in the DOE chain to be aware of a nonroutine condition. When such a condition is noticed, the TRANSCOM operator will immediately notify the appropriate DOE Emergency Operations Center, which will in turn notify the first responders. During an emergency, it is envisioned that TRANSCOM would be a clearing house for information. For example, a responder in the field might contact the TCC for information noting the response procedure for a spill of hazardous material. The TCC can then generate a hard copy of the needed material from the emergency response information contained in the TRANSCOM system and telefax the information to the responder.

During FY 1993, the TRANSCOM system tracked almost 100 shipments; the system is accessed weekly by 10 to 20 users. During FY 1993, both the DOT and the U.S. Nuclear Regulatory Commission (NRC) were trained to use the system and became active users of it.

III. TRANSCOM-TRACKING ACTIVITIES

A. Mark 42 Shipping Campaign

The Mark 42 shipping campaign is a series of shipments of a spent-fuel-like assembly from the Savannah River Plant in Aiken, South Carolina, to the Hanford facility in Richland, Washington. This material is packaged in an approved truck cask and is normally transported by a common carrier.

Part of the TRANSCOM data requirements include a copy of the bill of lading and a projected route for the shipment. When the proposed route for a recent Mark 42 shipment was investigated, it was discovered that an improper route was proposed via I-80 and I-29 through the Council Bluff, Iowa, urbanized area. The State of Iowa designated an alternative route for this area. To conform to current routing regulations, the route must bypass Council Bluffs by following I-80 and I-680 around the east and north sides of the urbanized area. This bypass route has added approximately 37 miles to the total route distance. Subsequent discussions with the Oak Ridge National Laboratory Traffic Manager succeeded in having the route changed to one that meets all DOT and State of Iowa routing regulations.

B. Seawolf Barge Shipment

A barge shipment transporting two large containers from Oak Ridge, Tennessee, to Groton, Connecticut, was tracked by the TRANSCOM system between November 14 and December 2, 1993. The code name for this shipment was "Seawolf." As shown in Fig. 2, the route for this shipment proceeded down the Clinch and Tennessee rivers to the Tombigbee Waterway in northeast Mississippi. The shipment then proceeded along the Tombigbee through Mississippi and Alabama to Mobile, Alabama. After tug boats were changed at Mobile, the shipment crossed the Gulf of Mexico; passed south of Key West, Florida; and proceeded up the Atlantic coast to Groton, Connecticut.

Since there was no source of power on the barge to operate the TRANSCOM transponder, a solar power unit was assembled, before the journey began, to supply the necessary power. This unit consisted of 12 solar panels and 8 backup batteries. When fully charged, the batteries are capable of providing a 5-d supply of power without any solar input. The solar power system was constructed and tested at Oak Ridge.

Approximately 10 d before the shipment left the Oak Ridge area, the solar unit was installed on one of the large containers and transported to the dock. The time that the containers were stored at the dock waiting to be loaded onto the barge was during a period of extended cloudy weather in the Oak Ridge area. The TRANSCOM transponder was left running during this period of time. The net result was that the batteries were not fully charged when the shipment left on November 14.

The cloudy weather persisted during the first 5 d the shipment was underway. During the second night,

the battery charge fell to a point such that the transponder did not have adequate power for a 3-h period just before dawn. Around 9:00 a.m. on the third day, there was sufficient daylight to provide power to the transponder, and positional signals were received for the remainder of the daylight hours. However, there was not sufficient solar power available to recharge the batteries. On the third night, contact with the transponder was lost for a 15-h period (approximately 6:00 p.m. to 9:00 a.m.). These outages are shown by the blank areas on the route map (Fig. 2) in southern Tennessee and northern Alabama.

This situation continued until the fifth day when new, fully charged batteries were installed at Florence, Alabama. The new batteries and improving weather provided a continuous supply of power for the remaining 15 days of the trip.

The barge captain was impressed with the reliability of the TRANSCOM transponder and the solar power unit. When the barge was rounding the Florida peninsula, the shipment encountered waves 15 ft high. During that time, the system provided accurate and reliable positional updates.

In summary, the solar power unit provided a dependable source of power when daily solar input was sufficient to recharge the batteries during the day.

The main TRANSCOM processor experienced two disk failures during the Seawolf shipment. The first failure occurred during the afternoon of November 19. The system was reactivated after a 2-hour period. A second disk failure occurred around noon of November 22. At that time the TRANSCOM backup computer was installed and operated for the rest of the trip. The second outage also lasted for approximately 2 h.

After installing the backup computer, the system operated without any problems for the remaining 10 d of the trip. This tracking exercise proved once again that a solar power unit is able to provide a reliable source of power for shipments when an auxiliary power source is not available.

C. Rail Shipment of a Decommissioned Reactor Vessel

TRANSCOM's first test of a solar-powered unit occurred in August 1991 when a transponder was placed on a decommissioned reactor vessel being shipped by rail. The shipment travelled 1,624 miles through six states. Two tests of TRANSCOM's rail-tracking

capabilities were performed using two separate tracking units. One unit was installed on the rail passenger car and operated from the train's electrical current and battery-powered backup. A second unit was installed on the vessel rail car and operated using a solar-powered system designed by TRANSCOM personnel. Both tests were successful. Solar power was determined to be a viable alternative for a self-contained power source. Communications through TRANSCOM were maintained throughout this trip via the unit on the rail passenger car. At times, the train crew's primary sources of communications failed, and TRANSCOM was their only source of communication. TRANSCOM was also used by the shipper to inform the train crew of a potential problem with protestors.

D. Cesium-Shipping Campaign

Shipments by truck of 309 cesium capsules from the IOTTECH facility in Northglenn, Colorado, to DOE's Hanford facility in Richland, Washington, are scheduled to begin in February 1994. These will be transported in 21 monthly shipments.

IV. FUTURE PLANS

The future holds many opportunities for teaming arrangements between TRANSCOM and both national and international organizations. International groups have already expressed interest in using TRANSCOM to track shipments moving in and out of their countries. A Japanese delegation visiting the United States to learn about U.S. physical-protection systems and technologies displayed great interest in TRANSCOM and its capabilities. Interest has also been communicated from a group interested in tracking shipments within Russia.

In the United States, increasingly more organizations are becoming interested in using the TRANSCOM system. The U.S. Navy, which was responsible for the Seawolf shipment, is identifying additional tracking activities which TRANSCOM can support. The U.S. Postal Service has also expressed an interest in using TRANSCOM to track high-value postal shipments.

The Western Governors Association continues to rely on TRANSCOM to track shipment movements through its jurisdictions. Members of the National Conference of State Legislatures have also displayed an interest in using TRANSCOM to track shipments moving through states not already using the TRANSCOM system.

DOE is also working with the DOT and the NRC in their evaluations of the TRANSCOM system to determine how TRANSCOM can help meet their requirements.

V. CONCLUSION

The TRANSCOM system has demonstrated its capability to provide reliable tracking and communication with the vehicle and other users monitoring high-visibility DOE shipments. The nearly 100 shipments tracked within the U.S. DOE complex during FY 1993 and the number of users regularly accessing the system will continue to grow as interest in system use continues to expand in new areas with a variety of organizations. With this growing interest and increasing tracking requirements, the TRANSCOM system will also be upgraded.

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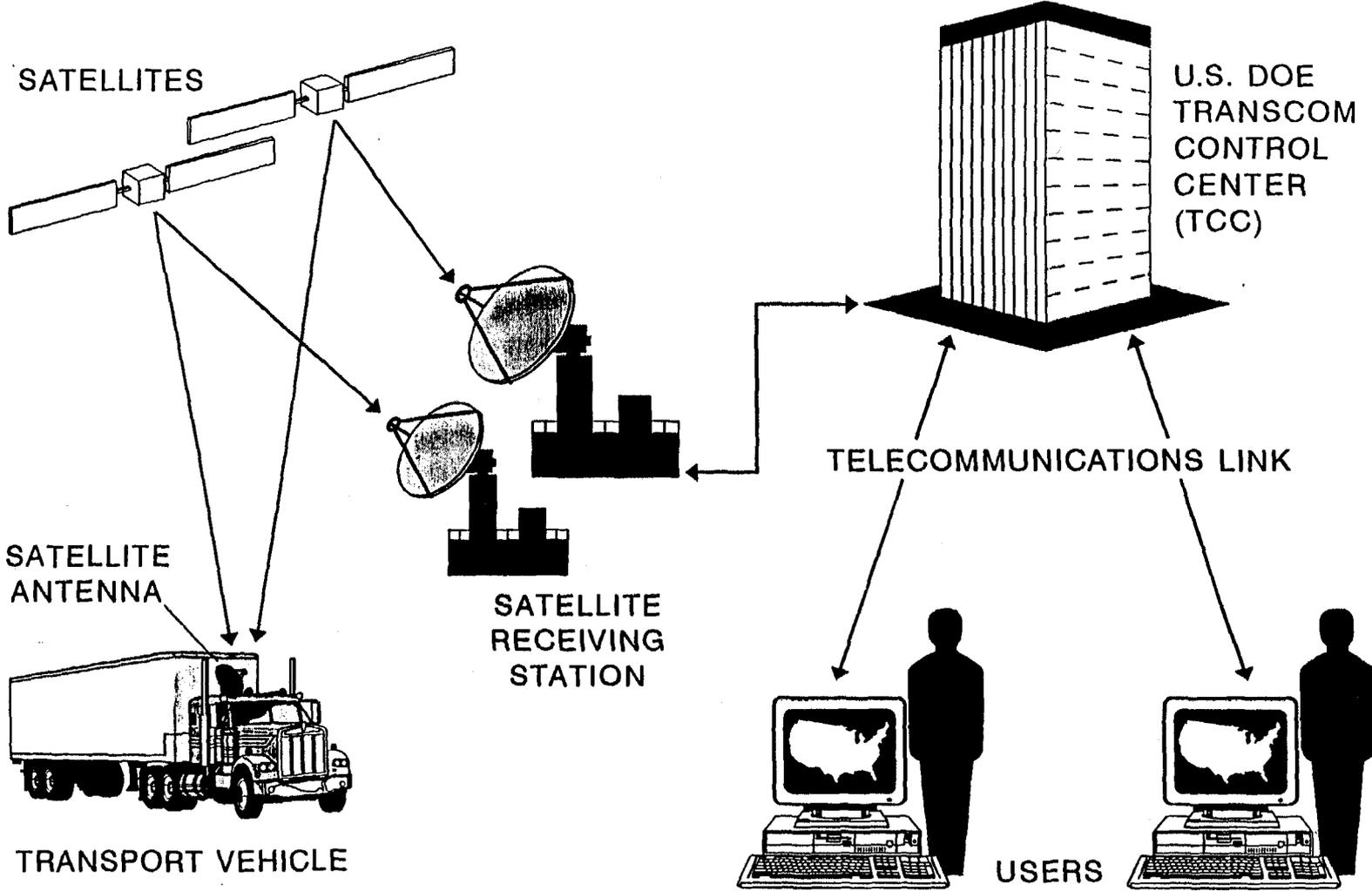


Fig. 1. Information flow in the TRANSCOM system.

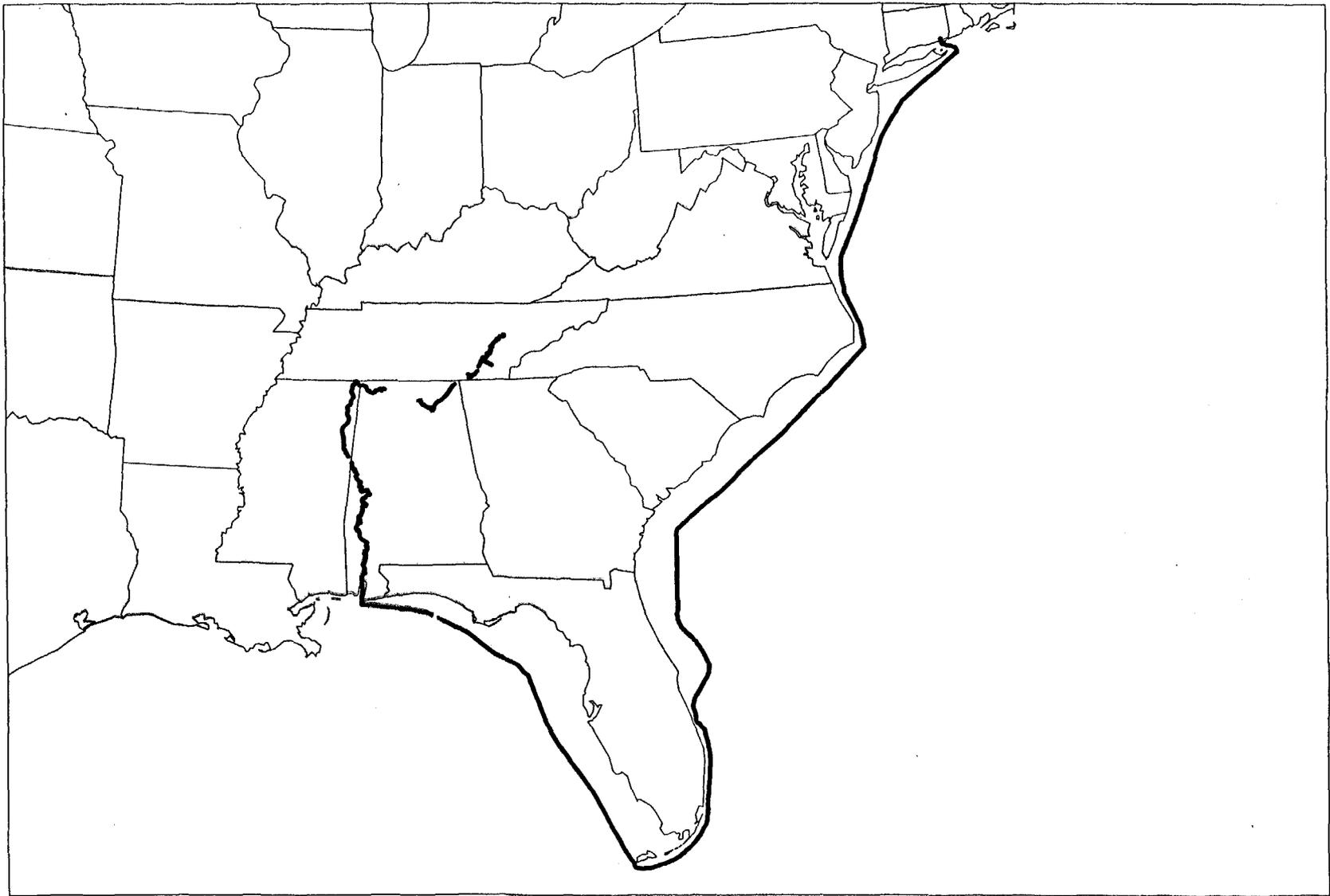


Fig. 2. Route map for the Seawolf shipment.