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Transportation Functions of the Civilian Radioactive Waste Management System

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TRANSPORTATION FUNCTIONS OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM

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TRANSPORTATION FUNCTIONS OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM

L. B. Shappert, Editor

ABSTRACT

Within the framework of Public Law 97.425 and provisions specified in the Code of Federal Regulations, Title 10 Part 961, the U.S. Department of Energy has the responsibility to accept and transport spent fuel and high-level waste from various organizations which have entered into a contract with the federal government in a manner that protects the health and safety of the public and workers. In implementing these requirements, the Office of Civilian Radioactive Waste Management (OCRWM) has, among other things, supported the identification of functions that must be performed by a transportation system (TS) that will accept the waste for transport to a federal facility for storage and/or disposal. This document, through the application of system engineering principles, identifies the functions that must be performed to transport waste under this law.

The Transport Waste functions were found to fall into three primary areas: accept waste for transport; transport waste; and support operations. This report assumes that the waste could be transported by truck, rail, barge, or a combination of modes (intermodal). In addition, by identifying the Transport Waste functions that must be performed, a top-level description of the TS, as well as the interfaces between the transport and other systems, is also identified.

0. INTRODUCTION

The transportation system (TS), being developed for the U.S. Department of Energy's Office of Civilian Radioactive Waste Management (DOE/OCRWM), will interface with over 100 utility-owned reactors, a waste repository, possibly a Monitored Retrievable Storage (MRS) facility, and other support facilities; it eventually will be responsible for the shipment of over 6000 metric tons of uranium (MTU) annually throughout the United States. This transportation activity will encompass a highly complex operation, far exceeding any domestic spent fuel shipping program implemented to date. To ensure that the system is adequately specified and all of its functions are identified, a systems engineering approach is being applied to develop the TS.

The TS will involve a large transportation fleet (perhaps 100 or more cask-vehicle units) and highly regulated facilities, equipment, and operations. The system will also involve large organizations of people concerned with administering or conducting a myriad of tasks. These tasks will be undertaken both within the envelope of the system's operations and at the boundary of the system in interactions with other systems (including regulators). In addition, the TS will involve detailed procedures and logistics tools that will make possible the orchestration of many simultaneous and sequential shipping campaigns and maintenance activities while accommodating operations needs and day-to-day disruptions in schedules. Although major new technologies will not be needed, the TS will use equipment, procedures, and software that take advantage of technical developments; the result will be improved operations efficiency and safety.

Nonetheless, the TS will be logistically and organizationally complex. It will have to operate in a manner that ensures that shipments can be made from multiple sites on a continuous basis for a 40-year period, even though the specific sites, equipment requirements, and payloads will vary significantly, both across sites and across time, as the system evolves. A summary description of the TS is presented in Appendix A. Current efforts to develop this system are being directed to ensure that its elements are appropriate, integrated, and proven; that the needs of the waste generators are accommodated; and that the receipt rate and fuel delivery requirements at the Civilian Radioactive Waste Management System (CRWMS) facilities are constantly matched with the transport capabilities.

This report is a successor to the ORNL report titled, Transportation Operations Functions of the Federal Waste Management System;[1] it is for use by DOE program managers and their staff to determine, in general, what the transport system must look like, the functions that the CRWMS's TS is responsible for, and some detail on the interfaces between the TS and other operating parts of the CRWMS. The report also addresses interfaces between the TS and generator facilities that it will serve. The interface relationships with generator facilities reflect concerns preserved by the Electric Power Research Institute.[2]

It will serve as a resource document for the DOE program managers to support technical guidance to managers responsible for projects to develop the TS. The report will also aid the project managers in making subsequent development assignments, identifying milestones, and developing budgets. Although the transport system is discussed in general terms in Appendix A, emphasis in this report has been placed on describing details of the main functions that the system must accomplish; these details are needed by both project managers and designers who will be responsible for the work to develop elements of the system. As such, this report provides the foundation for identifying transportation system requirements and supports the allocation of functional responsibilities. It also provides a basis for the understanding of lead times for system element development and it supports the identification of interface design criteria. The information can also be used to support management decisions on the funding and scheduling required to develop the TS into an operating system consistent with the development of other elements in the waste management system (e.g., the repository).

There are three related areas of activity that must be pursued in the TS: (1) development of operations capabilities of the system, (2) development of appropriate cask systems, and (3) development of the support systems to meet operational requirements. The development activities for casks and for the support transportation system must be responsive to the operational requirements, including those established by regulation. The transportation operational requirements must, in turn, be responsive to the requirements for the transportation services that are to be provided under the DOE-utility contract.

The TS development efforts are being guided by the logic of systems engineering through sequential development phases. For example, the cask system development effort has progressed through the earlier phases of system development in an accelerated fashion and is now approaching full-scale engineering development. In addition, a cask maintenance facility feasibility study is now complete.[3] In the meantime, the remaining efforts of the transportation system development are focused on the earlier phases. The material presented in this updated report reflects the current status of the

OCRWM transportation program as it relates to development of operations capabilities and support elements of the system.

As for other parts of the CRWMS, quality assurance (QA) will form one of the cornerstones of transportation operations and will affect all functions and activities. In this document, QA is discussed in Sect. 3.14. The thrust of this short section is that DOE/RW-0214, Quality Assurance Requirements for the Civilian Radioactive Waste Management Program, will be followed. This activity is very important, and the number of pages devoted to QA herein is not reflective of the level and scope of activity that is expected for this function.

The three primary transportation-related functions identified in the OCRWM Waste Management Systems Requirements and Descriptions (SRD)[4] are (1) accept the waste for transportation, (2) transport the waste, and (3) provide associated support functions (see Fig. 1). Each of these functions has been broken down into lower-level subfunctions. The identification of these subfunctions is the first step in a systems engineering process that is responsive to the 1985 OCRWM Mission Plan. The systems engineering process is being implemented to provide for the systematic development of a transportation system that is built, tested, and ready for operation. One of the next steps in the process will be to allocate the functions, a process that will ultimately determine where, what, how, and by whom they are to be performed. A summary discussion of the systems engineering process is presented in Appendix B.

This report consists of three major sections and three supporting Appendices. The major sections present descriptions of the activities that make up the system's functions, including the functional flow block diagrams (FFBDs) where appropriate. In order to completely identify the functions, it was necessary to identify the interfaces between functions, including those external to the transport system. Effort has been made to avoid overspecifying these external functions because fully defined interfaces with the MRS, geologic repository, waste generators, and other entities are yet to be developed.

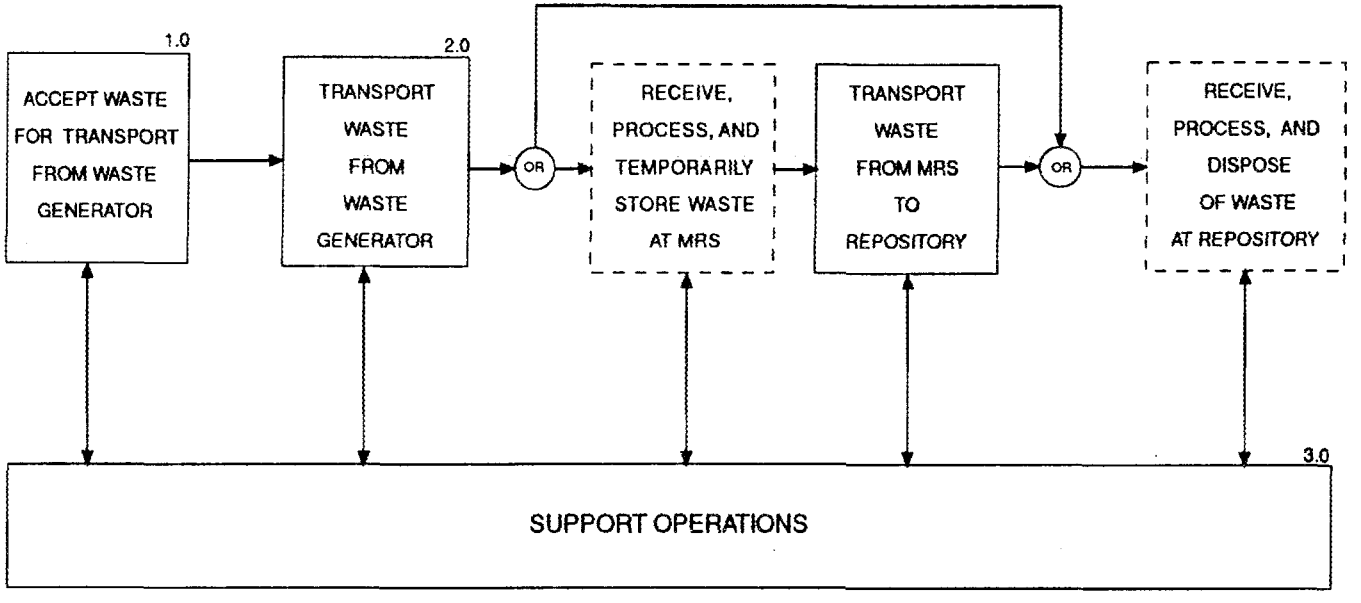

Fig. 1. Functional flow block diagram - transportation system.

1. ACCEPT WASTE FOR TRANSPORT FROM WASTE GENERATOR

The functions and related activities developed in this section are confined to those that directly support DOE in its acceptance of spent nuclear fuel and/or high-level radioactive wastes at a waste generator site for transport. They are largely drawn from, and are interpreted from, information in the generic utility contract.[5]

According to the generic utility contract, DOE will accept from a Purchaser of disposal services, waste in a cask, or properly packaged, ready for shipment. Therefore, for DOE, the Accept-for-Transport function includes taking custody of the spent fuel and waste and obtaining the appropriate backup documentation necessary for transport. Associated with this is the waste acceptance function, which includes title transfer and accountability functions, the scope of which is to be defined elsewhere.

Because the waste is received from the utility in a cask ready for shipment, activities within the Accept-for-Transport function consist of (1) observing certain operations at waste generator sites (some of which could precede final loading and shipping activities by many months), (2) verifying data in documentation provided and obtaining additional documentation if needed, and (3) determining overall readiness of a cask and payload for acceptance for transport and transportation. This implies a need for a continuing exchange of information between waste generators and DOE. "Observe and verify" activities within this function assist in ensuring that waste offered to DOE is consistent with the capabilities of the transportation system and established transportation planning and that the shipment is ready for transportation. Title to the material is assumed to pass to DOE upon completion of these custodial transfer activities and other activities associated with the Accept Waste function.

It should be noted that in actual operation, DOE may determine, after working with specific waste generators, that the observe and verify functions may be reduced to auditing if experience shows that information provided by waste generators is adequate to meet the intent of these functions. The generic

utility contract leaves this decision largely to DOE's discretion. Prior to the start of preparatory activities and cask loading at a waste generator's facility, DOE should review the generators' waste-loading procedures to ensure that all casks scheduled to be used at a specific site can, indeed, be properly and safely utilized by that site and its operating personnel. These procedures will form the cornerstone of the training of waste generator personnel in specific cask handling activities prior to the start of a shipping campaign.

There are two aspects to the Accept-for-Transport function that must be recognized. The first of these is the contract requirement in which the DOE takes title to the waste; the second is the physical acceptance of the waste after it has been determined that it meets the criteria as set forth in the DOE-utility contract. This section focuses on and discusses the activities involved with the physical acceptance function. Details of these activities include (1) observing certain operations at waste generator sites, (2) observing waste preparation for transport, (3) verifying (for transport preparation purposes) waste classification, (4) obtaining documentation that proves the package meets all federal requirements for shipping, (5) confirming that all documentation is correct, and, finally, (6) accepting the waste into the transport system for transport to DOE facilities. These activities are summarized graphically in FFBD 1.0 (see Fig. 2), and each flow block is described in more detail below.

1.1 OBSERVE WASTE PREPARATION

This function consists of observing advance waste preparation operations, which may be important to comply with transportation requirements, by a qualified individual at waste generator sites. The activity would be triggered by utility notification of impending preparation operations and DOE's decision to observe these operations. The observations could take place over several years or in as little as a few days prior to actual start of ashipping campaign. In any event, notification to DOE is required at least 60 days prior to performing such operations.[5] Exercise of the option to observe waste preparation could serve to assist the waste generator in ensuring

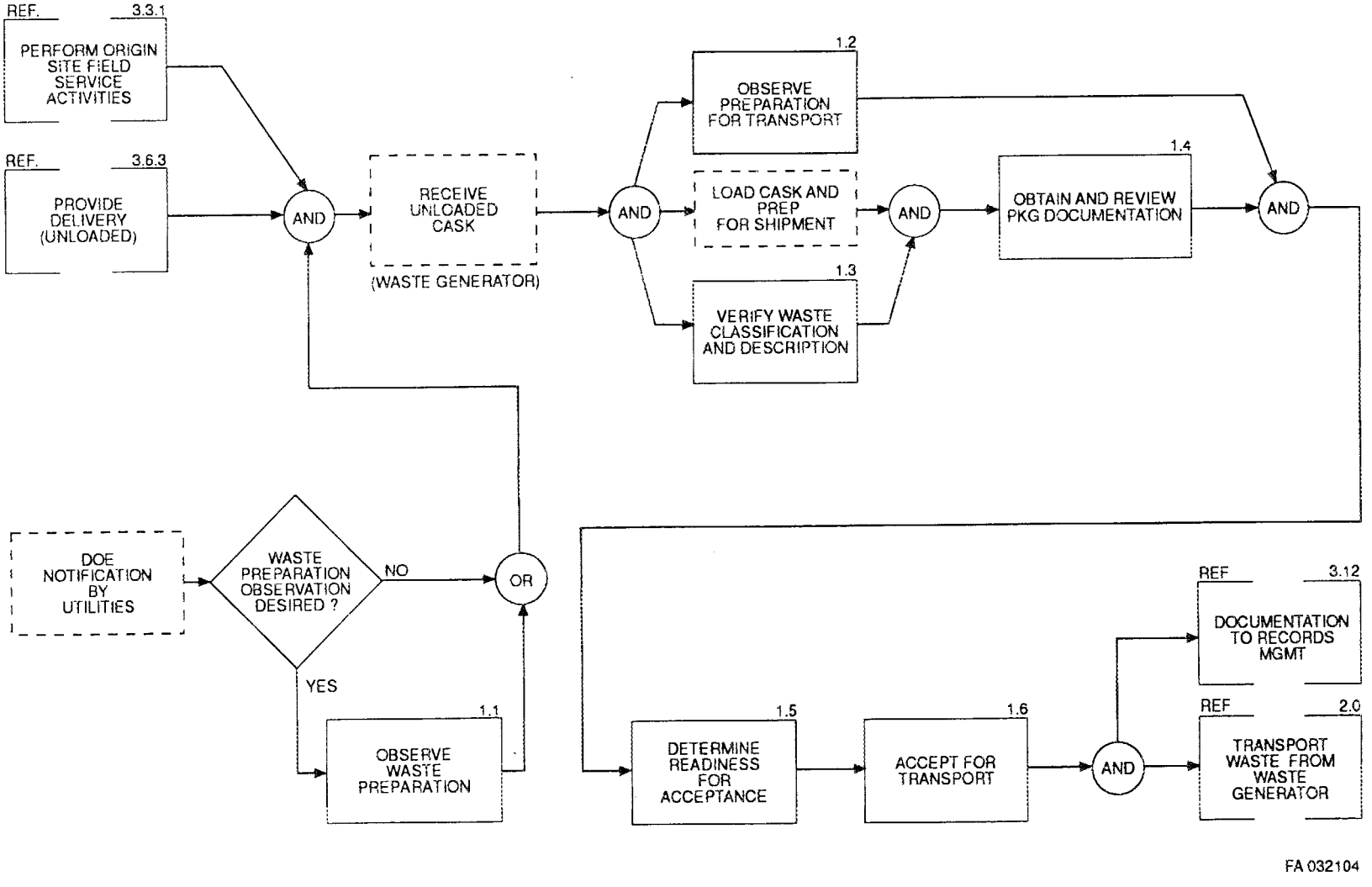

Fig. 2. Functional flow block diagram - accept waste for transport from waste generator.

compliance with the DOE-Utility Contract. It would also permit DOE to become familiar with methods, standard practices, operations, and limitations of such operations as these may be important to safe and efficient transport of the waste.

DOE may elect to observe loading of waste canisters that contain consolidated spent fuel and/or non-fuel-bearing components. This observation may help to ensure correct handling, classification (ref. 5, Appendix E), characterization, or description (ref. 5, Appendix F) of the waste or spent fuel and may assist in the identification of canister dimensions, handling, or sealing problems and would extend to verification of "soundness" of intact fuel assemblies.

Note that some waste generators are considering plans for fuel consolidation and canisterization; because these plans constitute one aspect of waste preparation, DOE should be notified 60 d prior to any physical activity that could modify normal, intact fuel assemblies as stored in the utility pools. These activities may have bearing on the procedures needed to transport the waste.

1.2 OBSERVE PREPARATION FOR TRANSPORT

This function may consist of (1) observing the selection and removal from storage racks of fuel assemblies that make up a prespecified shipping lot, (2) loading the cask, and (3) preparing the loaded cask for shipment. An on-site DOE representative may also verify adherence to procedures, completion of check-off lists, compliance with cask certificate requirements (including monitoring measurements taken during loadings), and verification of results of tests and inspections required by regulations.

1.3 VERIFY WASTE CLASSIFICATION AND DESCRIPTION

This function, which includes activities to verify the classification, characteristics, and condition of waste in the shipping lot, as reported to DOE in ref. 5, Appendices E and F, verifies that the fuel actually loaded in

the cask is the waste from the specified shipping lot and that this waste's characteristics are compatible with requirements specified in the Certificate of Compliance issued by the NRC for the transport cask. It is expected that these activities, if performed, will be conducted during cask loading and concurrent with the observation function in Sect. 1.2 above.

The physical characteristics and condition of the waste that could be verified include overall length, cross-section dimensions, active fuel length, enrichment, burnup, dates of permanent discharges, thermal output, deformation, and cladding condition.

Verification of the above characteristics, classification, and condition of the waste could be accomplished by (1) physical inspection, (2) review of analysis, (3) reliance on certifications made by the waste generator, or (4) audits of waste generator records. Receiving site physical inspections will also provide verification information. Development of specifications and procedures applicable to this verification function remain to be done.

1.4 OBTAIN AND REVIEW PACKAGE DOCUMENTATION

This function involves the collection and review of documentation on (1) cask contents, (2) loading operations, (3) tests and inspections required on the package to verify its proper assembly, and (4) compliance with cask certificate requirements and federal regulations. This activity could be accomplished concurrently with final preparations of the package for shipment, final survey of radiation levels, or other activities specified in Sects. 2.1.1 or 2.1.2. Documentation for each cask shipment is expected to include:

1. data on cask contents (taken from ref. 5, Appendices E and F);
2. radiation readings and smear survey results;
3. cask loading map;
4. signed procedure check-off lists;
5. results of tests and inspections required by the cask certificate;
6. results of impact limiter and tie-down inspections;

7. results of vehicle inspection;
8. results of other special measurements that may be required;
9. results of analyses (e.g., source-term or thermal analyses that demonstrate that the material shipped is in compliance with cask certificate limitations and/or receiving site limits); and
10. records of any servicing, maintenance, and/or repair activities related to the shipment.

1.5 DETERMINE READINESS FOR ACCEPTANCE

This task is designed to ensure that each shipment is supported by the correct documentation and that preparatory activities required by approved procedures and the contract have been completed and documented. A checklist is expected to be developed to ensure that required documentation is complete. Based on satisfactory completion of these documents and all prior observations, verifications, and documentation review, it is expected that an on-site DOE representative will make the determination that a cask is ready for transport.

1.6 ACCEPT SHIPMENT

Since DOE is responsible for shipment of waste from the waste generator site, the "transfer of custody" of the waste to DOE must occur. The DOE representative will take physical custody of the waste by signing the certification required by the contract. Signing the certification signifies completion of the responsibilities of the waste generator, which include proper preparations for shipment and delivery to the DOE f.o.b. carrier.

The nature of <u>legal</u> acceptance of the waste, including such aspects as "take custody," "take title," and "transfer of title" of the waste, is expected to require additional discussions between the DOE and the waste generator(s) for technical resolution so that physical acceptance for transport of the waste can be carried out in parallel.

As an example of the type of question that can arise in this area, it should first be noted that the functions in this document generally apply to single

cask shipments. However, it is possible that there may be multiple casks in one shipment (e.g., multiple rail cars, each having a cask, in a single train). Under these conditions, DOE may not wish to accept any single cask until all casks are loaded and ready for pickup.

2. TRANSPORT WASTE FROM WASTE GENERATOR

The functions and related activities described in this section are those that directly contribute to transport of spent nuclear fuel. They are principally derived from a knowledge of the activities that must occur to make a shipment, the applicable regulatory requirements, and the responsibilities of DOE as derived from the requirements of the Standard Disposal Contract.[5]

The functions described herein include cask system preparation for transport, the related traffic management operations, and the transport operation for both truck and rail shipments. Development of similar descriptions for barge transport will be completed as required (see Fig. 3).

2.1 PERFORM PRESHIPMENT PREPARATIONS (LOADED)

These steps include the preparations for shipment beginning after the cask is placed on the transporter and ending with carrier acceptance of the shipment as indicated by signing the bill of lading immediately prior to departure. The transporter could be a truck trailer, heavy-haul trailer, rail car, or barge (see Fig. 4).

2.1.1 Perform Preshipment Preparations for Highway Transport-Loaded Casks

Figure 5 encompasses activities that apply exclusively to shipments that leave the waste generator's site via highway.

2.1.1.1 Transfer drivers and tractor to site

The tractor and drivers are called to the waste generator facility by the TS representative, allowing sufficient time for clearing them onto the site and for a drivers' briefing prior to a scheduled departure. Typically, this tractor is used to remove the trailer from the cask receiving area to the point where final radiological surveys are taken prior to departure.

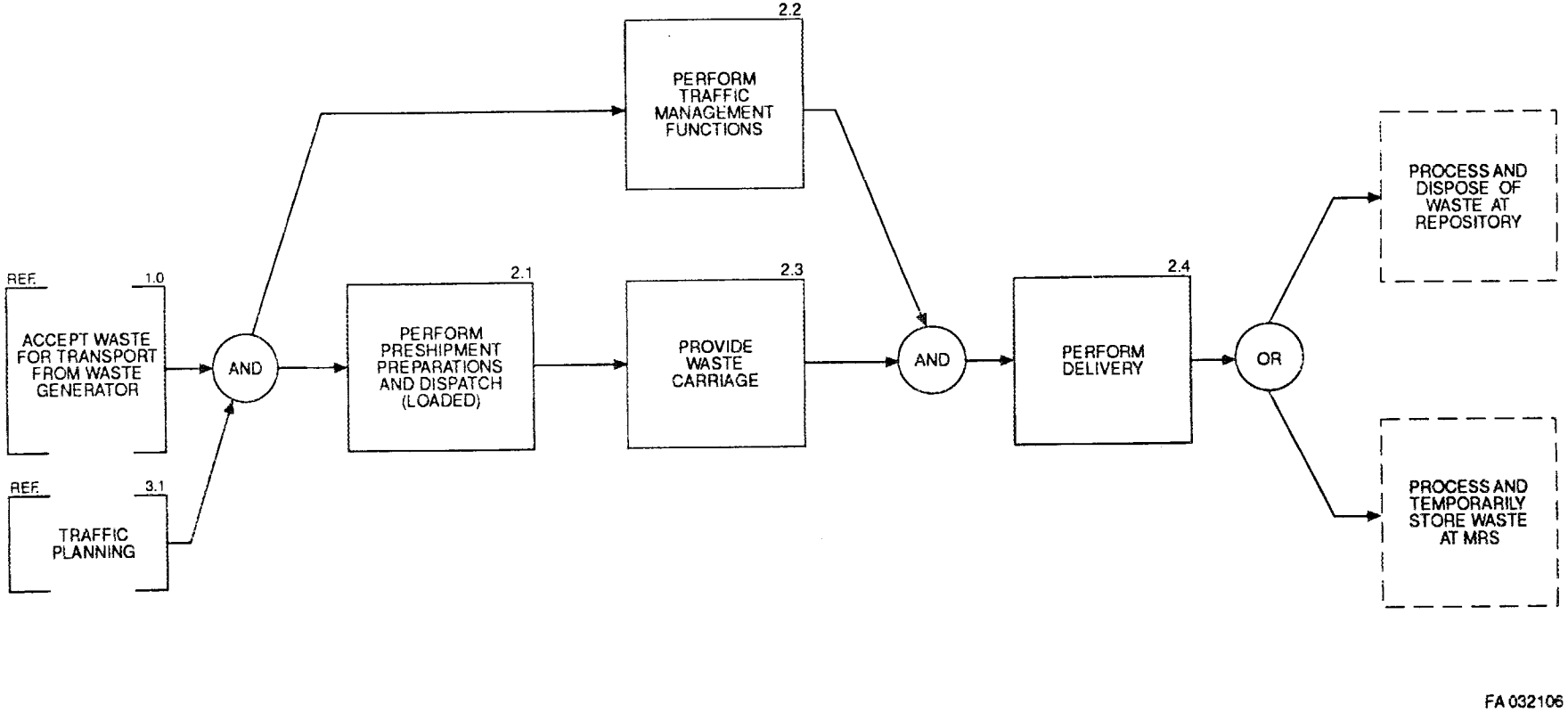

Fig. 3. Functional flow block diagram - transport waste from waste generator.

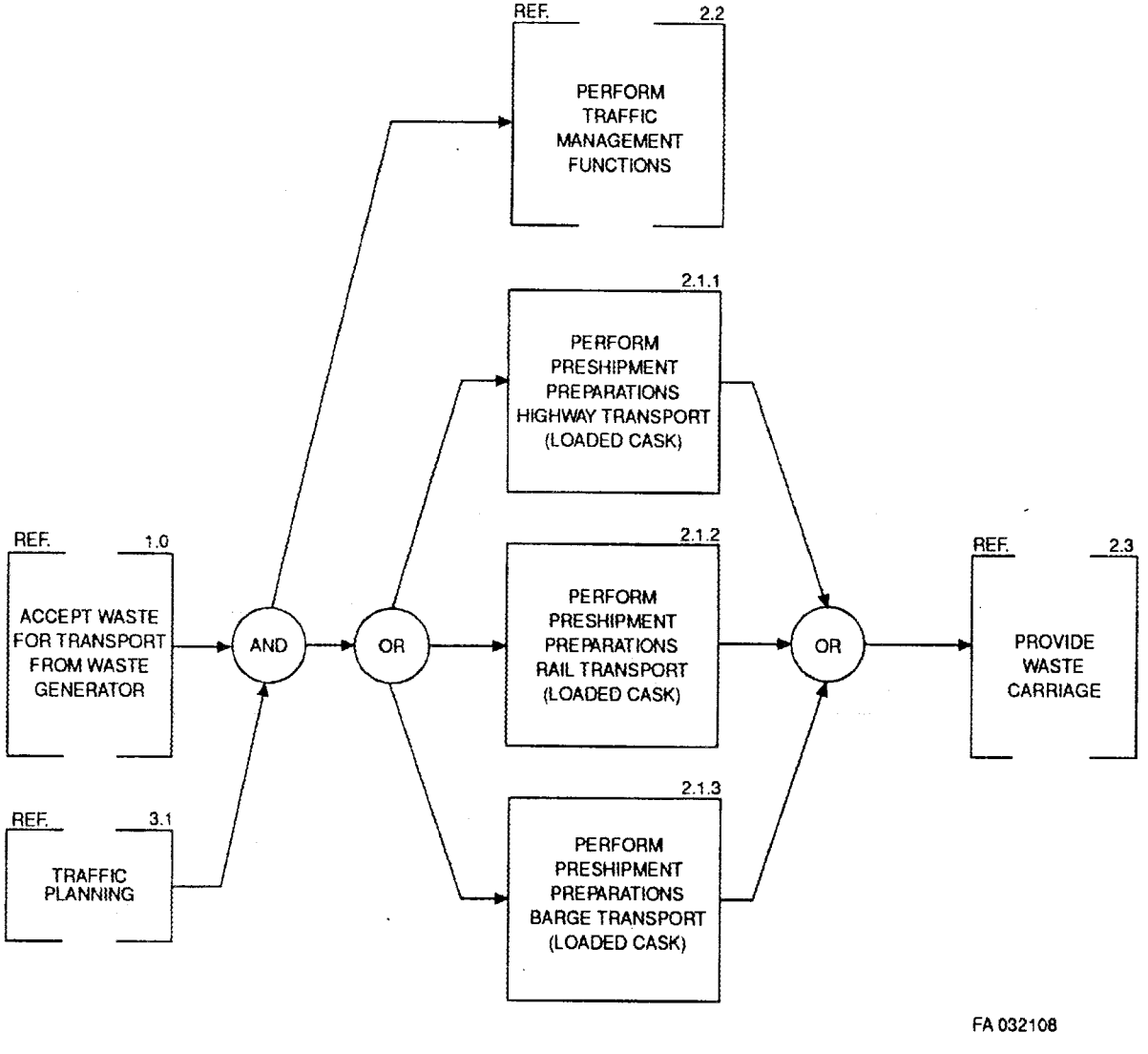

Fig. 4. Functional flow block diagram - perform preshipment preparations and dispatch (loaded).

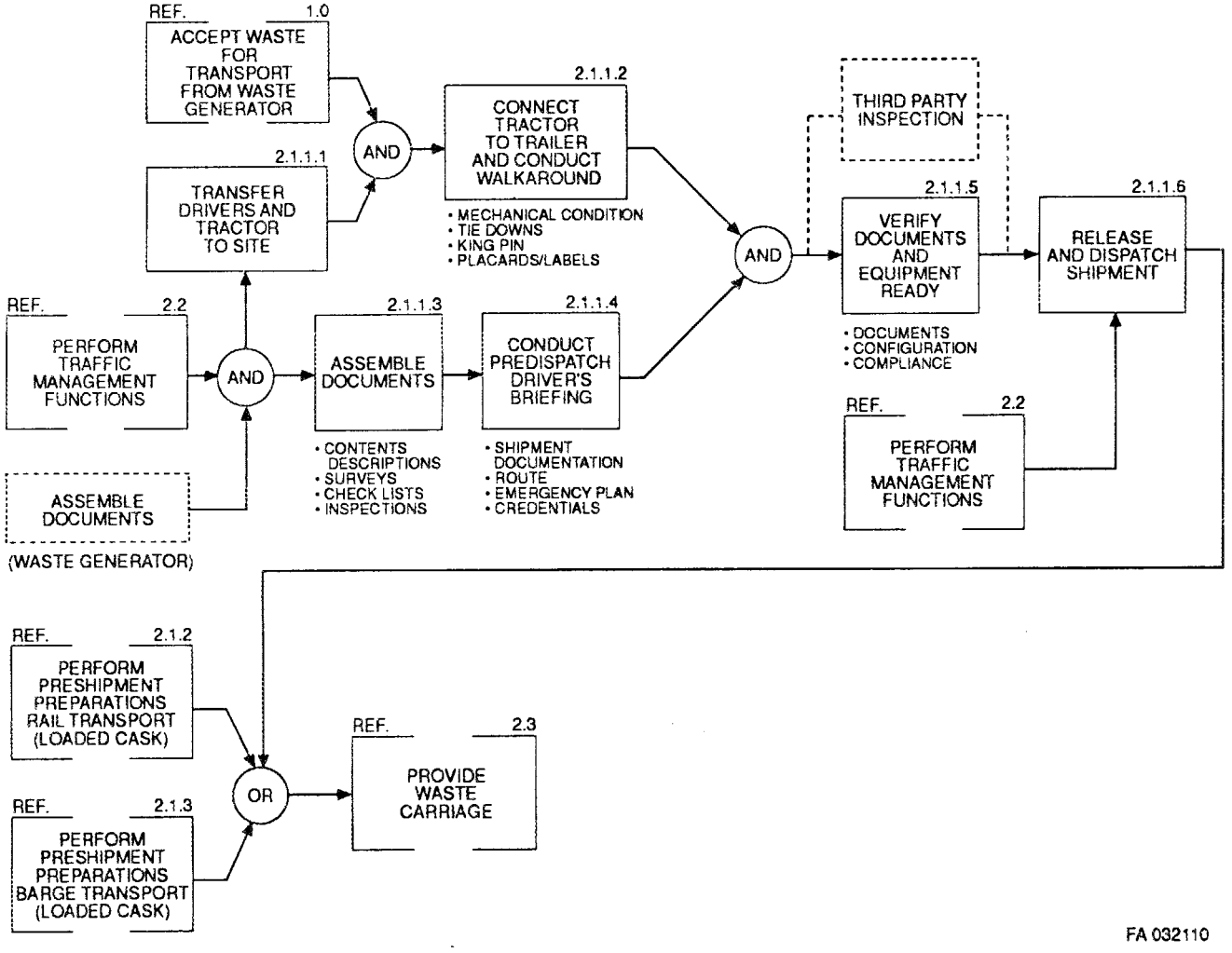

Fig. 5. Functional flow block diagram - perform preshipment preparations, highway transport (loaded cask).

2.1.1.2 Connect tractor to trailer and conduct walkaround

It is the responsibility of the driver to connect the tractor to the transport trailer, which includes locking the kingpin. Verification of the connection and locking should be done by a second person. This task also includes raising the trailer landing gear, removing chocks, and connecting the air (brake) and electric lines. The walkaround should verify that (1) the load is secure, (2) the system is functional (operational), and (3) the communications link and physical security features are operational. Load positioning and attachment, personnel barrier installation, labeling, and placarding are also checked. A survey for loose parts is also completed. This item is expected to be supported by a checklist.

2.1.1.3 Assemble documents

The tractor driver is required to have certain information in the cab of the vehicle regarding the material that he/she is transporting. Additional documentation is frequently included in order to ensure that the information provided is complete. The information that the driver must have includes (1) a bill of lading (completed as required by the regulations); (2) a route plan; (3) radiation field and smear results; (4) an "instructions to driver" list, which contains emergency response instructions; (5) any other important information or data; and (6) any required permits. Other information that may be needed would include a cask loading map, escort arrangement information, notifications to be made in the event of an accident, detailed emergency response data, copies of pertinent regulations and cask certifications, vehicle inspection reports, tamper indicating seals, etc. Verification of required contents of the packet is expected to be supported by a checklist.

2.1.1.4 Conduct predispatch drivers' conference

The purpose of the drivers' predispatch briefing is to ensure that each driver understands the nature of the cargo and is familiar with emergency response actions, the route plan, and physical security procedures. The drivers' credentials may also be reviewed at this time, if not done earlier.

Credentials may include his license and medical and training documents, as well as hours-of-service log.

As shipper, DOE (or other assigned agent) must conduct the predispatch drivers' briefing. It is expected to be documented.

2.1.1.5 Verify highway documents and equipment readiness

This function includes the verification that the shipment is ready for departure and involves checking documents, configurations, and compliance items. Documents are assumed complete in step 2.1.1.3. The configuration has been checked in 2.1.1.2. Compliance items include routing instructions, labeling, placarding, and other similar items discussed in 2.1.1.3 and 2.1.1.4. A final radiation survey, for the record, must also be completed. Any open items from previous steps must be completed. This verification is expected to be supported by a checklist.

The origin state may initiate a vehicle inspection. Arrangements for the inspection are expected to be the responsibility of DOE. Any record of the vehicle inspection would become a part of the shipping documentation.

2.1.1.6 Release and dispatch shipment

The shipment is considered ready for transport in interstate, or intrastate, commerce when the bill of lading is signed and accepted by the carrier.

This function includes the tasks associated with departure, radiological survey of the tires, collection of badges, and sign-out, etc. The driver is expected to advise the dispatcher of his departure time and to initiate physical security tracking.

2.1.2 Perform Preshipment Preparations for Rail Transport (Loaded Cask)

Figure 6 includes those activities that apply exclusively to shipments that leave a waste generator's site via rail.

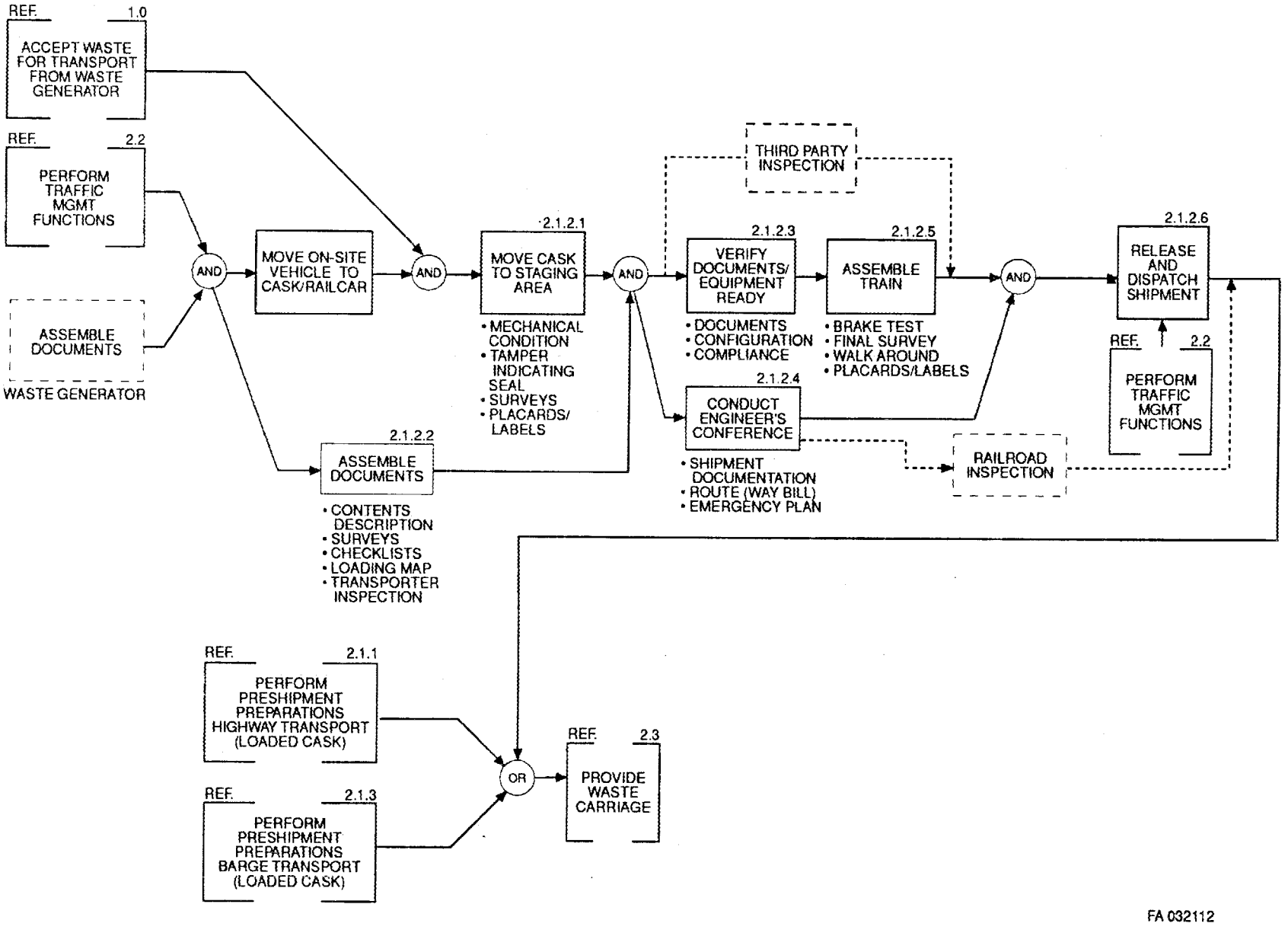

Fig. 6. Functional flow block diagram - perform preshipment preparations, rail transport (loaded cask).

2.1.2.1 Move cask to staging area

Once the cask is loaded onto the railcar and the railcar and cask are in a proper shipping configuration, the cask system may be moved to a staging area. (Rail shipments may consist of more than one loaded cask. As each cask is loaded, it would be moved from the cask receiving area to a shipment staging area.) The staging area would facilitate the assembly of loaded cask railcar(s) into a train.

Prior to movement, cask loading documentation and the surface contamination smear and radiation surveys would be completed. Verification of cask tiedown, tamper-indicating seal, and personnel barrier attachments would be completed during mechanical condition walk-around inspection. This activity is expected to be supported by a checklist.

2.1.2.2 Assemble documents

Rail carriers are required to possess certain information regarding hazardous materials accepted for transportation. This information includes (1) a Department of Transportation (DOT) shipping paper containing the required hazard communication information and signed by the shipper; and (2) emergency response information in a document such as the Emergency Response Guide. The rail operating crew handling hazardous materials shipments is required to have in its possession either the shipping paper or a waybill or other document containing the information shown on the DOT shipping paper, as well as detailed emergency response information.

For shipments deemed to require special handling, both the rail carrier and state or local jurisdictions may require additional documentation such as inspection reports and notification records. Extensive documentation of proper packaging and handling will often move with radioactive materials shipments as part of contractual agreements with the shipper.

Additional documentation is frequently included in order to ensure that the information provided is complete. This documentation could include copies of

pertinent regulations, detailed emergency response data, a copy of the cask certification, and a copy of the completed cask loading procedure checklist. A copy of the data package given to the train crew should be sent by mail to the consignee.

2.1.2.3 Verify rail documents and equipment readiness

This function verifies that the shipment is ready for departure. It includes the checking of documents, configuration, and compliance items. Documents are checked for completeness in step 2.1.2.2; the shipping configuration has been initially checked in 2.1.2.1. Compliance items include routing, labeling, placarding, consignee notifications, escort arrangements (if required), permits, and other similar items expected to be discussed in the predispatch carrier briefing. Final radiological surveys for individual railcar(s) must also be completed, if not already done. Any open items from previous steps must be completed. This verification of documentation and equipment is expected to be supported by a checklist.

2.1.2.4 Conduct predispatch carrier briefing

The purpose of the carrier predispatch briefing is to ensure that the carrier (train crew) understands the nature of the cargo and is familiar with the provided documentation, emergency response actions, shipping papers or way bill, and physical security procedures (if they are the responsibility of railroad personnel).

A copy of the shipping documentation is provided to the train crew picking up the railcar(s). A copy may also be provided to other representatives of the originating railroad. Documentation is typically transferred hand-to-hand during the course of dedicated-train rail shipments. (For general freight shipments, the documentation may transfer at yard boxes or coupling points.) The DOE representative, or an assigned agent, is expected to conduct the predispatch carrier briefing. It is expected to be documented.

2.1.2.5 Assemble train

If not previously completed in other steps, the cask system railcar(s) must be incorporated into the carrier's train.

This function is expected to include steps such as final walk-around inspection (for equipment tie-down, loose parts, placarding, and labeling), measurement of radiation dose rate in the closest occupied railcar or locomotive, brake test, verification of communication equipment operation, and completion of remaining documentation.

The assemblage of railcars could constitute a dedicated train or be incorporated into a regular train, depending on the then-current rail spent-fuel shipping arrangements.

2.1.2.6 Release and dispatch shipment

The shipment is considered released for interstate commerce when the bill of lading is signed by the shipper and accepted by the carrier. A DOE representative will sign the bill of lading.

This function also encompasses the tasks associated with departure, including collection of visitor badges and sign-out. The actual tasks are dependent upon the point of origin of the shipment.

The carrier, or the DOE representative, is expected to advise those responsible for traffic management functions of the time of departure. Physical security will be implemented in accordance with the current requirements.

2.2 PERFORM TRAFFIC MANAGEMENT FUNCTIONS

The principal activities of the Traffic Management functions involve administrative and operations efforts that result in the transport of loaded or unloaded shipments. The activities described must be considered as either

operational or oversight responsibilities. The split between operational and oversight depends on how responsibilities are assigned and how commercial services might be incorporated into the transportation system. Traffic Management administration supports the scheduling of carrier services and TS equipment and personnel in support of both loaded and unloaded shipments.

The Traffic Management operations provide the point of contact within the TS between the individuals that perform the carriage functions for in-vehicle communications, physical security tasks, and other routine and most unplanned activities.

Additional actions within this function could include obtaining required in-transit permits and making in-transit notifications to persons outside of OCRWM. Permits will be obtained in advance of shipments in so far as that is possible. The extent of notifications made outside of OCRWM for information purposes will be established by regulations, DOE Orders, and OCRWM policy.

2.2.1 Perform Traffic Management Administration

The Traffic Management administration provides support services that include obtaining and maintaining (1) status (availability) and location information on in-service and out-of-service equipment; (2) shipment (loaded and empty), route, and schedule information; (3) emergency procedures and call-out lists; (4) permit and other regulatory compliance information; and (5) equipment maintenance plans and schedules. Dispatch Administration also provides assistance in the identification of permitting requirements for given routes and package systems; it provides assistance to the shipment planning function. It maintains the capability for protecting schedule information and provides for the transport of yokes and other special equipment that is required at sites or for in-transit activities.

For contracted services, Traffic Management administration maintains an interface with rail and motor carrier dispatch operations to facilitate the resolution of schedule, equipment, training, qualification, and other related issues. Note that if transport personnel and equipment are supplied by TS,

then additional responsibilities may accrue to the dispatch function. These could include personnel scheduling, training, qualification and medical testing, equipment (heavy) maintenance, and similar tasks.

2.2.2 Perform Traffic Management Operations

The Traffic Management operations perform or have performed (through the carrier dispatch organization) logging and tracking functions (e.g., identification of times of arrival, departure, and intermediate contacts; shipment status; location; progress; and conditions) and provide support, via a communications link, to the in-transit vehicles and operators. The support may include supplying information such as where needed maintenance services might be obtained, assisting in replacing failed equipment, providing for replacement of truck drivers or escorts who cannot continue, issuing instructions for in-transit route changes, facilitating meeting ex-vehicle escorts (if required), obtaining in-transit permits, and providing support in emergencies.

Communications links are expected to include real-time data and voice channels between an operations center and in-transit vehicles. The links may satisfy both logistical and physical security (for loaded shipments) requirements. The communications links may be extended to ex-vehicle escort services, if such services are required.

Traffic Management operations will follow physical security procedures of a control center that complement those used by in-transit personnel, so that threats to the shipment can be addressed in an appropriate manner.

2.3 PROVIDE WASTE CARRIAGE

This function describes the in-transit tasks associated with transport of spent nuclear fuel (SNF) or high-level radioactive waste (HLW) (see Fig. 7) and, except for safeguards aspects, also generally describes the transport of unloaded casks (see Functioning, Sect. 3.6.2).

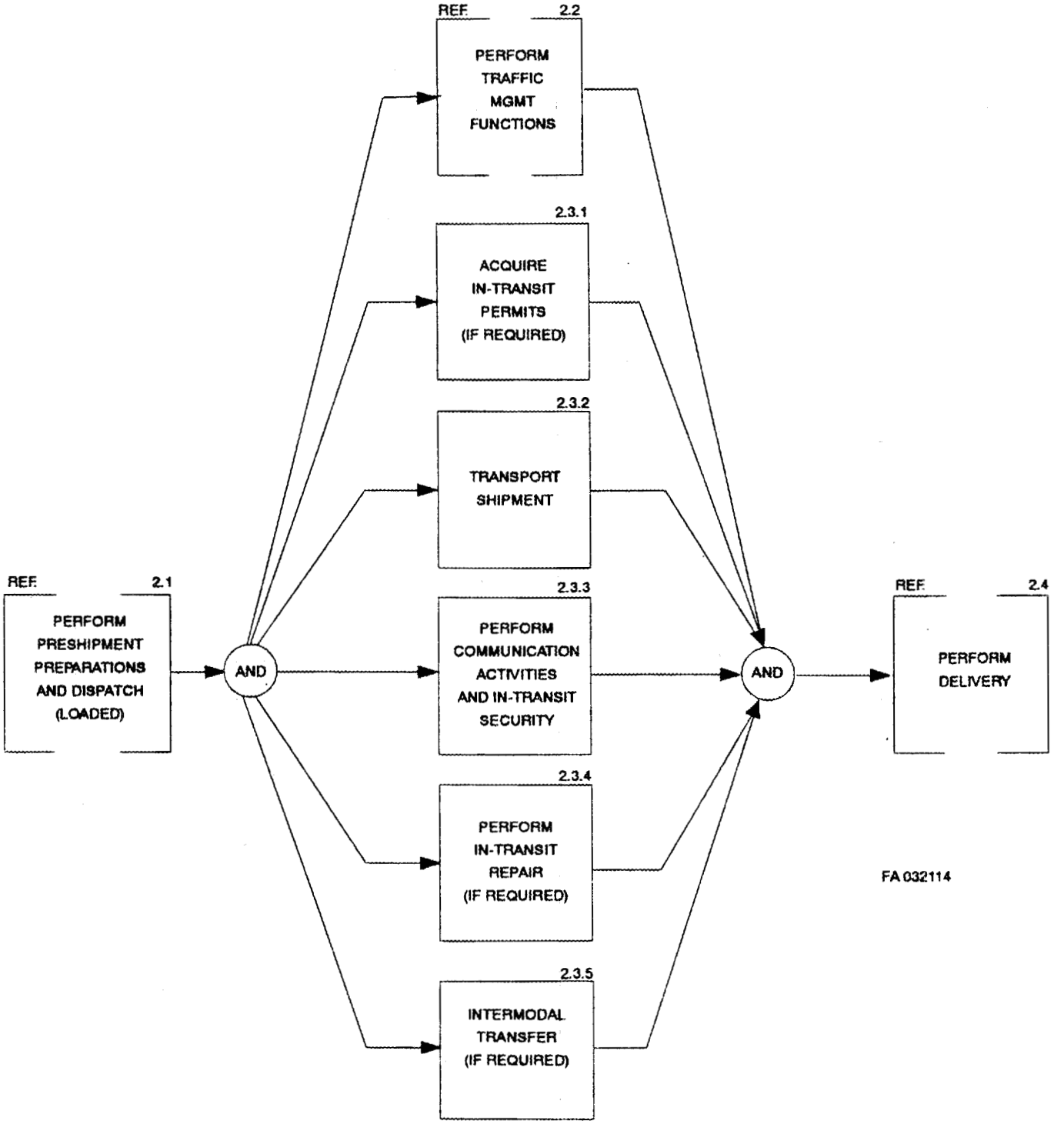

Fig. 7. Functional flow block diagram - provide waste carriage.

2.3.1 Acquire In-Transit Permits (If Required)

The need for permits should be determined, applied for, and provided in advance by the Traffic Management operations for shipments to which they apply. In general, permits should be obtained on a "campaign" basis, rather than on a "per shipment" basis. Carriers may apply for permits on a case-by-case basis, but dispatch should be so advised.

2.3.2 Transport Shipment

This function is the (more or less) continuous movement of a loaded shipment in accordance with the plan and procedures for the campaign of which it is a part and with the applicable regulations. It includes physical security activities and with state or tribal inspection and enforcement activities that may occur en route.

2.3.3 Perform Physical Security and Communication Activities

Status and location information for a loaded cask shipment must be communicated periodically to satisfy both physical security and system logistics requirements. It is expected that electronic tracking and status of the shipment information would be available over suitable data links using interrogator/transponder technology. The same system, or perhaps a separate one, would provide a voice channel for the communication of special needs and conditions. Such special needs might include assistance with equipment malfunction and breakdown, threat assessment and notification, emergency (accident and medical) notifications, and voice verification of data link information. Information transfer might also be required to describe equipment malfunctions, emergency (accident and medical) situations, and other similar needs. It is expected that either voice verification or a coded signal would be used for the (presently) required physical security check calls.

The utilization of motor and rail carriers is expected to influence how communications needs are met. Commercial carriers are expected to continue

(or want to continue) with the present practice of communication through their own carrier dispatcher. However, it is expected that electronic data and voice links could provide simultaneous information to more than one location.

In-transit physical security will be provided based on the regulations and DOE orders that are in effect at the time of shipment and on the extent of utilization of commercial services. For security that will be provided by an in-the-vehicle escort (e.g., in the case of rail transport, this includes escorts in a railcar that is located in the train such that the railcar carrying a loaded cask can be observed continuously), their activities would be described by procedures contained in the physical security plan. For security that may be provided by an ex-vehicle escort, their responsibilities may be provided by the state through which the shipment is passing, by a commercial organization or federal agency, or by a collection of such organizations, depending on requirements.

The Traffic Management function is expected to maintain essentially full-time contact with each loaded shipment, as well as assist in the coordination of escorts. Traffic Management may also be responsible for arranging in- and ex-vehicle escorts, including supplementary security as may be required to support unplanned stops, and would also assist in obtaining both law enforcement and emergency service assistance to the shipment if necessary.

2.3.4 Perform In-Transit Repair (If Required)

The driver (or conductor) is expected to be responsible for verifying the need for in-transit repair after confirming the need with Traffic Management operations for initiating the maintenance action. There are numerous factors involved in making the decisions to either wait for repair or simply replace a defective tractor or trailer should it be disabled. In any case, all in-transit repairs are expected to take place at typical commercial repair facilities and may require the implementation of additional physical security actions to ensure protection of the loaded cask. Coordination of the maintenance activity is expected to take place through the Traffic Management operations.

2.3.5 Perform Intermodal Transfer (If Required)

Transportation operations and the Dispatch function are expected to coordinate and carry out necessary intermodal transfers. The principal intermodal transfers are expected to take place between a heavy haul truck to train, but other intermodal transfers will be made as required. Transfers involving a heavy haul trailer will require special transport equipment, as well as lifting fixtures and cranes. The cask is expected to be positioned on a skid, which would be fitted with fixtures for lifting so that no direct handling of the cask would be required.

2.4 PERFORM DELIVERY

Delivery of the loaded cask will be made to the repository or the MRS (see Fig. 8).

2.4.1 Perform Delivery of Shipment

It is expected that cognizant site personnel will be aware of pending arrivals through the campaign planning process and through interactive participation with the TS Traffic Management function. The carrier may be expected to arrive at an access control point at a receiving site. Site security personnel would advise receiving personnel (typically health physics and maintenance organizations) that the cask and vehicle had arrived.

Carrier personnel are expected to go through a badging process and may be issued dosimeters. The vehicle (rail or highway) will be inspected for contraband and will be radiologically surveyed.

The shipping documents package is expected to be delivered to the consignee, along with any supplemental documentation provided by the shipper. Receipt of truck shipment is confirmed by signature of the consignee representative on the freight bill, with a copy of the bill retained by the carrier. No signature is required for a rail delivery at the time of delivery.

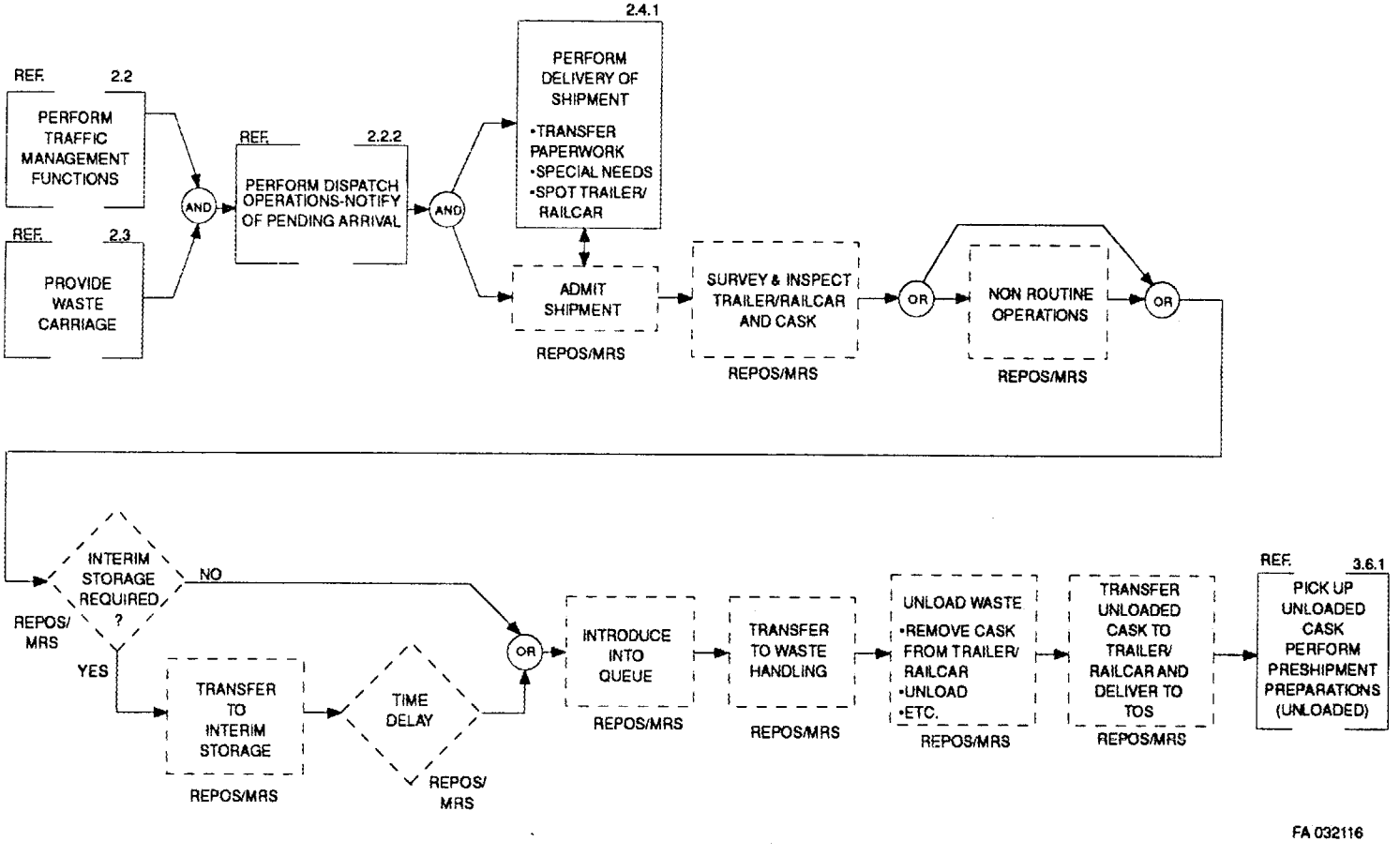

Fig. 8. Functional flow block diagram - perform delivery.

Designation of the consignee representative is expected to be determined by a site-specific procedure.

Should an incident or problem arise during transit, staff personnel at the receiving site (security, health physics, operations, or maintenance) would be advised prior to delivery, or as soon as practical after discovery. For shipments of unloaded casks going to reactor sites, it is appropriate that the receiving staff be aware of problems, but resolution of the problems should be coordinated through the Traffic Management function. The support available from receiving reactor sites is expected to be site specific (with some sites offering more assistance than others) and is likely to be dependent on the nature of assistance required.

Additional participation of the carrier in the delivery function may include initial spotting of the cask on its transporter at a designated location, disconnecting the tractor or locomotive, setting of the brake, and/or chocking of the wheels. Subsequent repositioning is expected to be the responsibility of the receiving site.

3. SUPPORT OPERATIONS

Numerous support activities must be provided by the transportation system to enable the Accept for Transport and Transport functions to be accomplished. These functions will be performed by trained personnel using combinations of approved procedures, computer hardware and software, casks, transport vehicles, special equipment, and facility resources. The functions identified here are independent of any organizational structure and are intended to guide the development of the support system and related operating plans. Seventeen support functions have been identified and are presented below. The first 6 are operational in nature, whereas the last 11 tend to be administrative.

3.1 TRAFFIC PLANNING

Traffic Planning functions include both campaign and route planning and are essential to ensure that waste transportation resources are applied effectively (see Fig. 9). Activities in this function will be to develop, assemble, and distribute campaign planning information to TS operating groups as well as to the operations management organizations at CRWMS receiving facilities and affected waste generator facilities. Planning information will be distributed to the TS organizations responsible for field service, traffic management, and maintenance and to others whose work schedules will be directly affected by the campaign planning activities. This information will cover the deployment status not only of casks and vehicles, but also of ancillary equipment, reconfiguration components (cask baskets), and maintenance and field service resources. An important part of this planning function involves coordinating transportation operations schedules with the waste generators and the repository or MRS receiving facilities.

3.1.1 Integrated Campaign Planning and Analysis

Activities in this function will be to develop, modify, assemble, and distribute campaign planning information to the TS organizations responsible for field service, traffic management, and maintenance and to others whose work schedules will be directly affected by the campaign planning activities

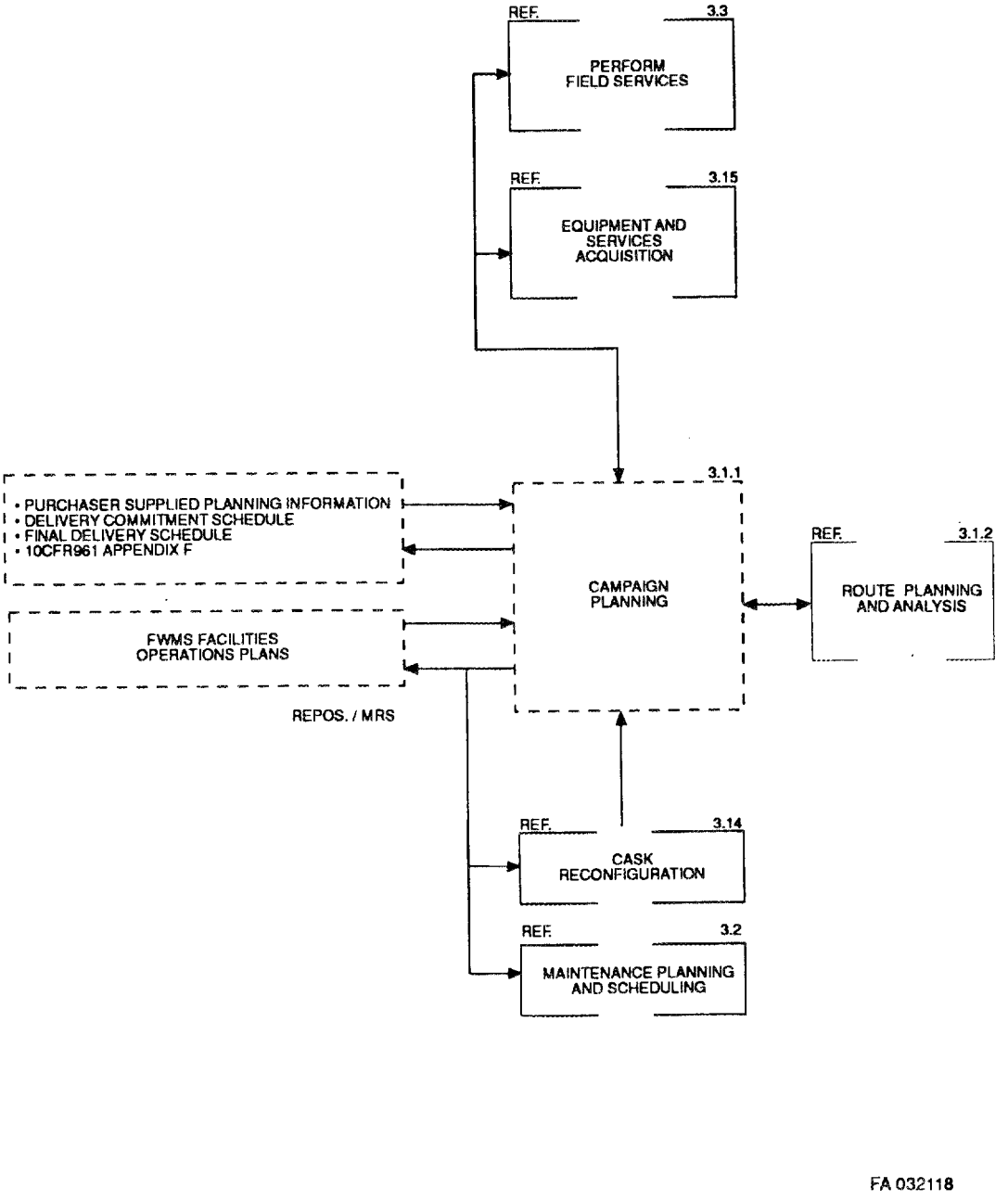

Fig. 9. Functional flow block diagram - campaign planning.

(see Fig. 10). In addition, to assist in coordinating operations activities, planning information will be distributed to the operations management organizations at CRWMS receiving facilities and to the affected generator facilities.

3.1.1.1 Develop and coordinate transportation campaign plans with external systems

This function includes all the necessary activities to develop the coordinated operations schedules under which the TS will take delivery of SNF and HLW.

The function includes activities necessary to support annual issuance of the Acceptance Priority Ranking (APR) for taking deliveries of SNF under the standard contract. It also supports receiving and responding to submittals of Delivery Commitment Schedules (DCSs) by waste generators.

Details of the activities will be as follows:

1. Develop projections of the long-range (e.g., 5-year) operational requirements and capability of the TS.

2. Coordinate with MRS and repository operators to identify preferred long-range and near-term (e.g., 5-year and 1-year, respectively) SNF and HLW acceptance schedules. Support the development of the APR for deliveries of SNF and HLW to DOE.

3. Support the RW Logistics Branch and its approval or disapproval of these documents in its interactions with waste generators (identified in the contract as purchasers) relative to their submittal of DCSs and Exchange Requests.

4. Coordinate with MRS and repository operators, waste generators, and TS organizations to support preparation and acceptance of near-term Final Delivery Schedules (FDSs) consistent with operational needs of the waste generators' facilities and with efficient operations of the CRWMS.

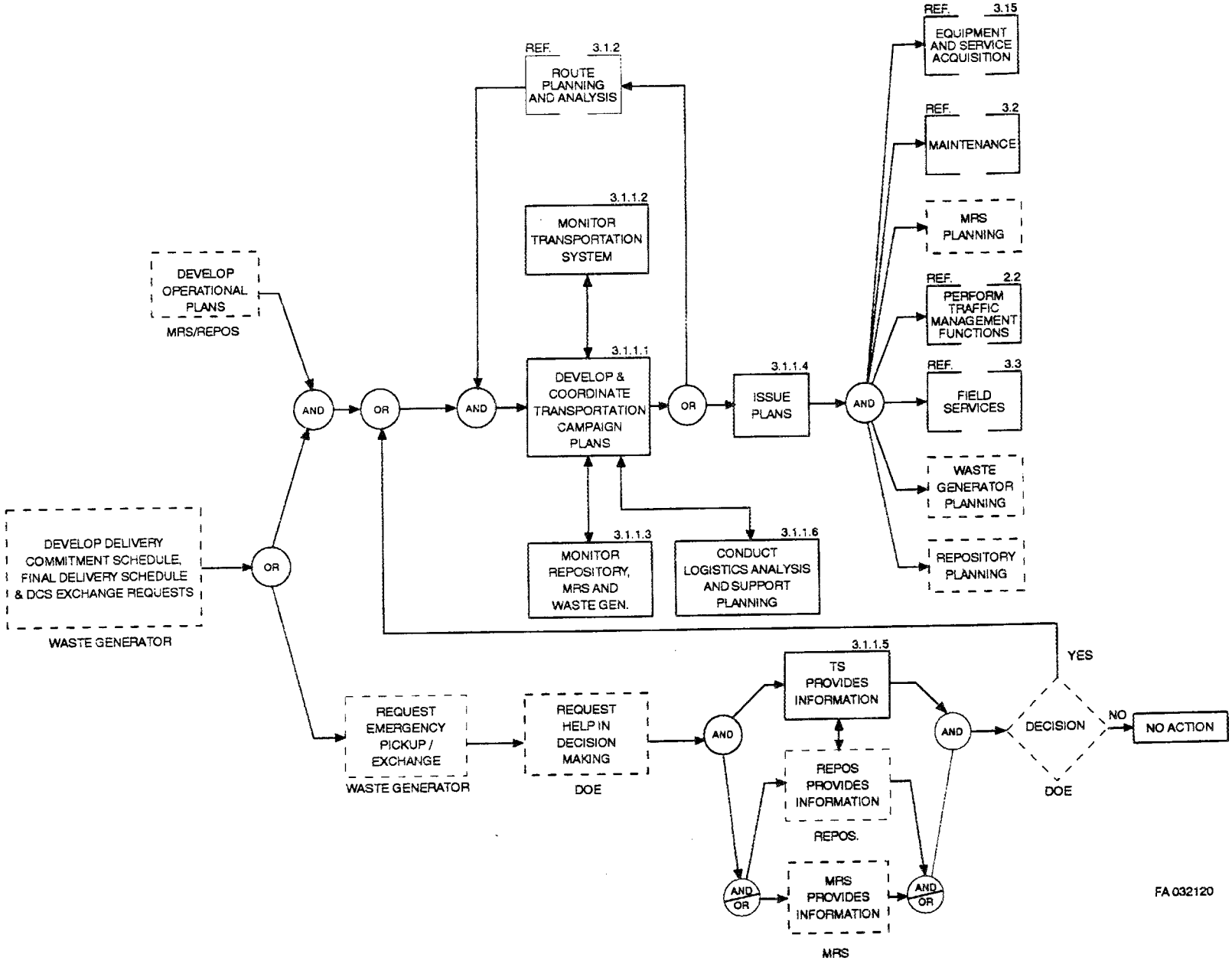

Fig. 10. Functional flow block diagram - integrated campaign planning and analysis.

5. On the basis of approved ERs and FDSs, develop and distribute campaign plans to affected parties. Campaign plans will identify shipping schedules, equipment requirements, technical support requirements, operations contingencies, transport mode requirements, and advanced preparations requirements.

6. Using campaign plans and equipment maintenance requirements, develop TS master plans.

Whenever external factors or variances change the existing campaign plans, planning is reinitiated. Revised plans, which reflect the external factor and coordinate with those affected, will be reissued.

3.1.1.2 Monitor transportation system deployment

This function includes all the activities that are conducted to maintain an awareness of the current status and projected near-term capabilities of the deployed resources of the TS. (It is noteworthy that this function will also concern itself with commercial cask resources that may be used to supplement TS resources.) Included are activities to monitor the status of each campaign that is under way, the next campaign deployment for each cask system, the current location and next campaign assignment for field service resources, and the schedule of TS maintenance and regulatory compliance activities. This function is essential to ensure that any necessary planning activities for ongoing transportation campaigns or any evaluations of purchaser requests for exchanges or emergency deliveries are provided with the current deployment status and capability of the TS.

3.1.1.3 Monitor repository, MRS, and waste generator operations status

This function includes all of the activities necessary to acquire and evaluate information concerning the availability (current and future) of repository and MRS receiving facilities to meet transportation campaign schedules. This function will utilize information from the SCSs and FDSs as well as on the receiving capabilities of the repository and the MRS and the shipping

capabilities of the waste generators. The function provides timely and current facility scheduling information that will be needed for replanning should transportation schedule disruptions occur. This information is also needed for longer-range transportation operations planning.

3.1.1.4 Issue plans

As a result of transportation campaign planning and the interaction with waste generators, repository, and MRS facilities, a formalized plan reflecting expected shipping campaigns will be issued. The information, which will be periodically revised, will constitute the official TS shipping plans for both loaded and unloaded casks for a specified time period.

3.1.1.5 TS provides information

This function covers all of the TS activities necessary to generate and supply appropriate transportation-related information that has been requested by DOE. This information will be used to support DOE's decision of whether to accept or reject specific requests by waste generators for emergency deliveries of SNF or HLW or for exchanges of delivery rights. These TS activities will be concerned with determining the impacts and feasibility of the redeployment of TS resources, which will be necessary in order to implement the requested changes.

This function will also provide direction to the activities described in Sect. 3.1.1.6 on logistics analysis. This direction will support efforts to identify and analyze alternate operating plans that could be implemented to accommodate the request for exchanges or emergency deliveries. Subsequently, this function will be responsible for reviewing the results of the logistics analyses and developing responses that will provide DOE with assessments of the impacts on TS operations that would result if the requests are accommodated.

3.1.1.6 Conduct logistics analysis to support planning

The activities in this function will determine the impact of proposed plans, as well as the changes requested by the utilities, on TS resources by identifying and analyzing alternative equipment deployments and TS operating schedules. In this function, analyses will be conducted to assess logistics factors concerned with TS operations. These analyses will be performed to evaluate operations scenarios of specific interest. The analyses will rely on operations status information provided by the monitoring functions, or previous campaign planning information, and on system capabilities and constraints information that will be resident in established system data bases. Ultimately, the logistics analyses will assist in identifying scenarios that are feasible and best satisfy the set of operating conditions that DOE chooses.

3.1.2 Route Planning and Analysis

Route planning is expected to be applied to all transport modes and utilizes, as input, information from governmental organizations as well as feedback from carriers transporting waste (see Fig. 11).

3.1.2.1 Monitor federal, state, tribal, and railroad route designation activities

This function includes all the activities to maintain current information on route designations, or constraints on uses of routes, as these are developed and imposed by authorities not within the CRWMS. The information will be collected for use in TS route planning. The purpose of this function is to ensure that the routes selected for use in transporting SNF and HLW will be ones that comply with the then-current routing requirements.

Specific activities in this function will include the following:

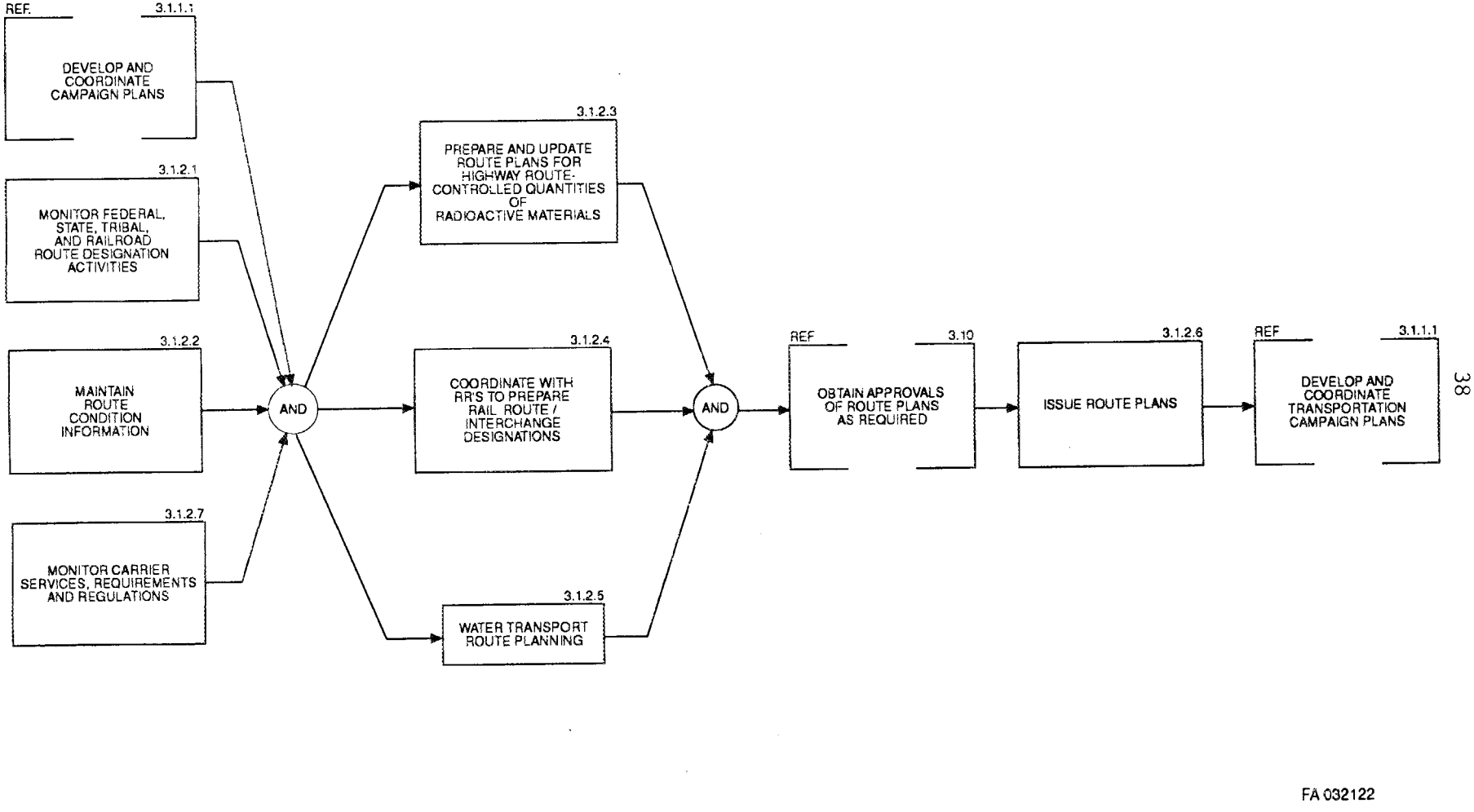

Fig. 11. Functional flow block diagram - route planning and analysis.

1. Monitoring, analyzing, and reporting on the outcomes of legislative initiatives in state legislatures, tribal councils, Congress, and in local government legislative bodies that do, will, or may influence the selection of routes or the procedures to be used in selecting routes.

2. Monitoring, analyzing, and reporting on the outcomes of regulatory actions by federal (rail abandonment proceedings), state (bridge, tunnel, and turnpike authorities), tribal, and local regulatory authorities as these actions have bearing on selections of routes or on route selection procedures.

3. Monitoring, analyzing, and reporting on changes in administrative practices (e.g., changes in inspection procedures or permitting practices that significantly alter the time en route) by regulatory authorities and transport carriers as these changes impact the selection of routes or the procedures used in route selection.

4. Monitoring, analyzing, and reporting on changes in operating policies, practices, and procedures of transport carriers (e.g., operating speed restrictions for selected sections of track in a rail carrier's system) as these changes impact the selection of routes or the procedures used in route selection.

Significant findings of the monitoring activities will be reported to several other TS functions including Route Planning and Analysis, Training, Operations Analysis and Planning, Regulatory Compliance, and External Relations. It is anticipated that information obtained from monitoring activities will be transferred into a TS information management system that will perform TS Information Management functions.

3.1.2.2 Develop and maintain route condition information

This function includes all the necessary activities to monitor route-related information, including present and projected route operating conditions and weight and size restrictions of rail, truck, and barge routes. The sources

for this information include state, tribal, and federal governmental agencies; rail carriers; and private companies.

The activities within this function will be as follows:

1. Determine, by mode, the routes that need to be monitored.

2. Collect and organize the information needed from state, tribal, and federal governmental agencies; and truck, barge, and rail carriers.

3. Coordinate and provide input on projected route conditions to the campaign planning activity and the route planning activities.

4. Monitor actual and projected changes in routing conditions as they occur.

3.1.2.3 Prepare and update route plans for highway route-controlled quantities of radioactive materials

The preparation of a route plan for a highway route-controlled-quantity SNF shipment in accordance with DOT regulations[6] includes the following:

1. Except for preferred routes designated by state or tribes, selection of the shortest practical route from the point of origin to the nearest interstate highway. This route must be acceptable for the weight and size of the planned shipment.

2. Selection of (preferred) interstate routes from this point of entry to a point of exit that provides the expected least-time-in-transit route to the destination. The interstate routes selected should use urban area bypasses where possible.

3. Except for preferred routes designated by states or tribes, selection of the shortest practical route from the interstate exit location to the

destination. This route must also be acceptable for the weight and size of the planned shipment.

4. Verification that the route includes preferred routes designated by state and tribal routing authorities, if any.

5. Regulations normally required carriers to notify the DOT of the route that was used within 90 d of the shipment; however, this requirement is waived for those shipments (e.g., of SNF) whose routes must be approved by the NRC (49 CFR 177.825f).

The above requirements have been summarized from the DOT Regulations (49 CFR 177.825f) that are frequently used to prepare and update route plans submitted to the NRC.

3.1.2.4 Coordinate with rail carriers the rail routing and interchange of spent fuel shipments

This function includes all the necessary activities to coordinate the development and acceptance of a rail routing and interchange plan to support transportation campaign plans prepared by the TS for scheduled SNF and HLW shipments.

Rail routing coordination will involve capturing and processing the informational input of all relevant parties to develop a routing and interchange plan. This plan must meet operational service requirements of the CRWMS and the operating constraints of rail carriers.

Activities include the following:

1. Obtain preferred and alternate routing recommendations for scheduled rail shipments that are contained in the campaign plans.

2. Coordinate with rail carriers to ensure that routing and interchange designations are compatible with their operations and support the operational security and safety requirements of the CRWMS.

3.1.2.5 Water transport route planning

The activities for planning routes for water transport of waste have not yet been identified, but they will be integrated with other transport mode routing requirements as they are developed.

3.1.2.6 Issue Route Plans

This function includes the activities necessary to issue route plans for use in campaign planning. Included in the activities will be work to coordinate with the Regulatory Compliance function in obtaining approvals, as may be required, for the route plans. Also included will be all efforts to ensure that the route plans are properly identified as controlled documents and that previous, superseded route plans are removed from use.

3.2 PERFORM MAINTENANCE

The Maintenance function is divided into three parts. The first part involves typical maintenance activities where equipment, including casks, is inspected, serviced, and tested in accordance with prescribed requirements; occasionally, unscheduled maintenance is also necessary. The second part involves rework or repair of casks and/or equipment due to damage. The distinction between these two is that the former maintains and verifies the original configuration and function, while the latter restores the original function and, to the degree required, the original configuration. Although somewhat different, the rework and repair activities are handled identically by the Maintenance function. The third and final part is modification. This is an activity that is assumed to apply to a particular class or model of cask or equipment if a generic type of need or cause for modification is found. That is, all units of one (or more) type will be modified to improve some characteristic or to comply with regulatory requirements (see Fig. 12).

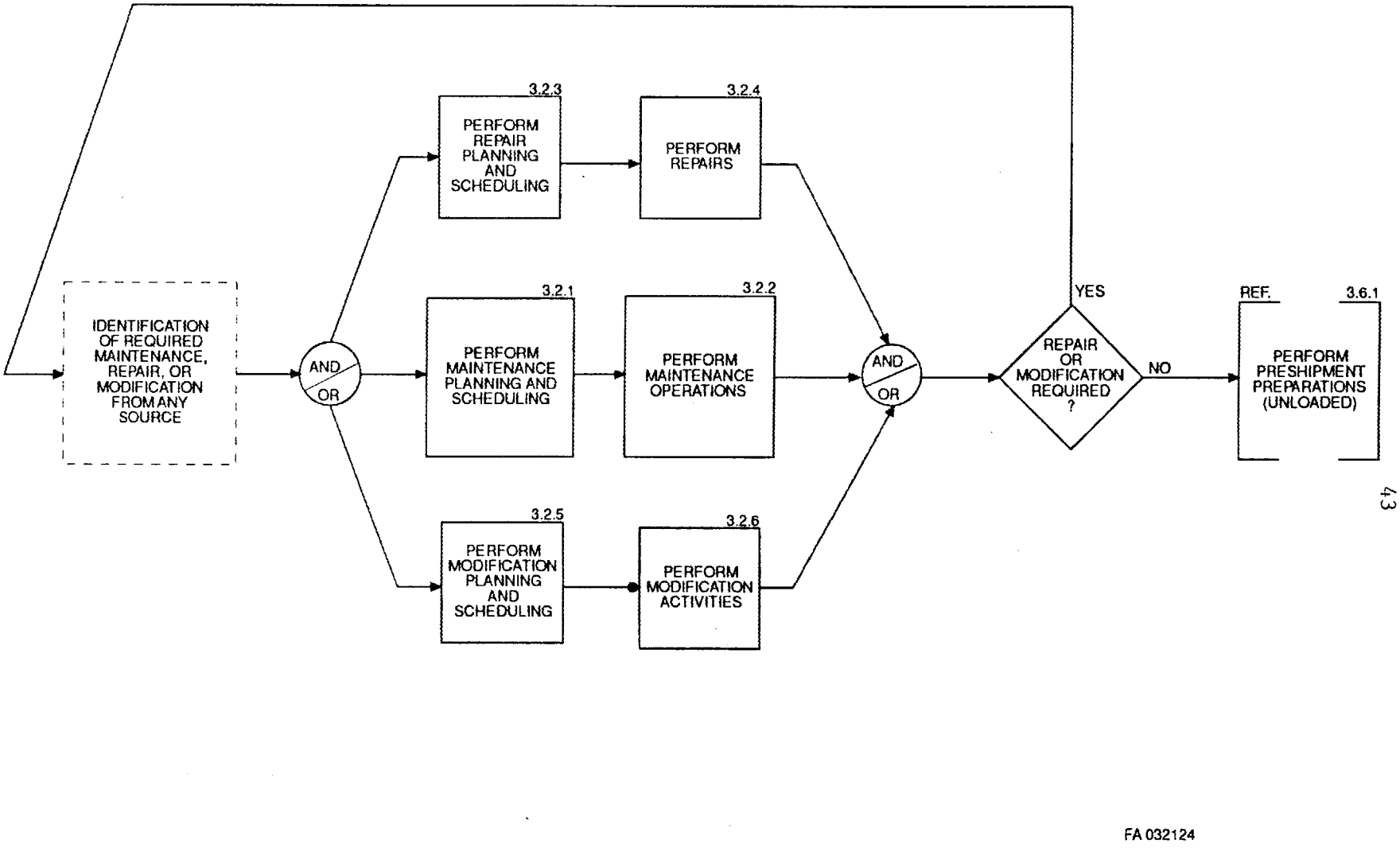

Fig. 12. Functional flow block diagram - perform maintenance activities.

Throughout the functions of this section, QA and QC play an important role. QA will be providing an independent assessment of periodic maintenance requirements and performing audits of the maintenance system for compliance with internal QA plans and procedures. QC personnel will be working directly with maintenance personnel to establish the quality attributes of the various maintenance activities and to perform certain validation tasks. Although QA/QC cannot be part of the maintenance organization (based on the requirement to separate organizational roles), it will, nevertheless, interact with it on a continuing basis and is therefore included in this discussion.

Maintenance involves a significant amount of recordkeeping. Information will be entered into and withdrawn from various archives in large quantities. It is thought that the time and personnel commitments may be equally divided between performing the Maintenance function and handling the documentation that accompanies the function. The FFBDs cannot show all document flows; thus, the reader must bear in mind that associated with virtually every activity is some form of traceable document.

Each of the three maintenance-related functions in this section is divided into two parts: (1) planning and scheduling and (2) implementation.

3.2.1 Perform Maintenance Planning and Scheduling

The Maintenance Planning and Scheduling function begins with gathering data on specific casks, vehicles, and ancillary equipment as they are initially received into the TS for use (see Fig. 13). All pertinent media, such as drawings, specifications, manuals, the Cask Safety Analysis Report for Packaging (SARP), and the Certificate of Compliance (CoC), provide these data, which form the basis for all maintenance. Some maintenance activities are intended to be preventive, while others are mandatory for regulatory compliance. As each piece of equipment is received into the system, its maintenance "clock" must start and then the maintenance history must be tracked throughout its service life. Coordination of maintenance activities with operations is essential for the uninterrupted supply of qualified equipment for service. The scheduling of equipment for maintenance is the

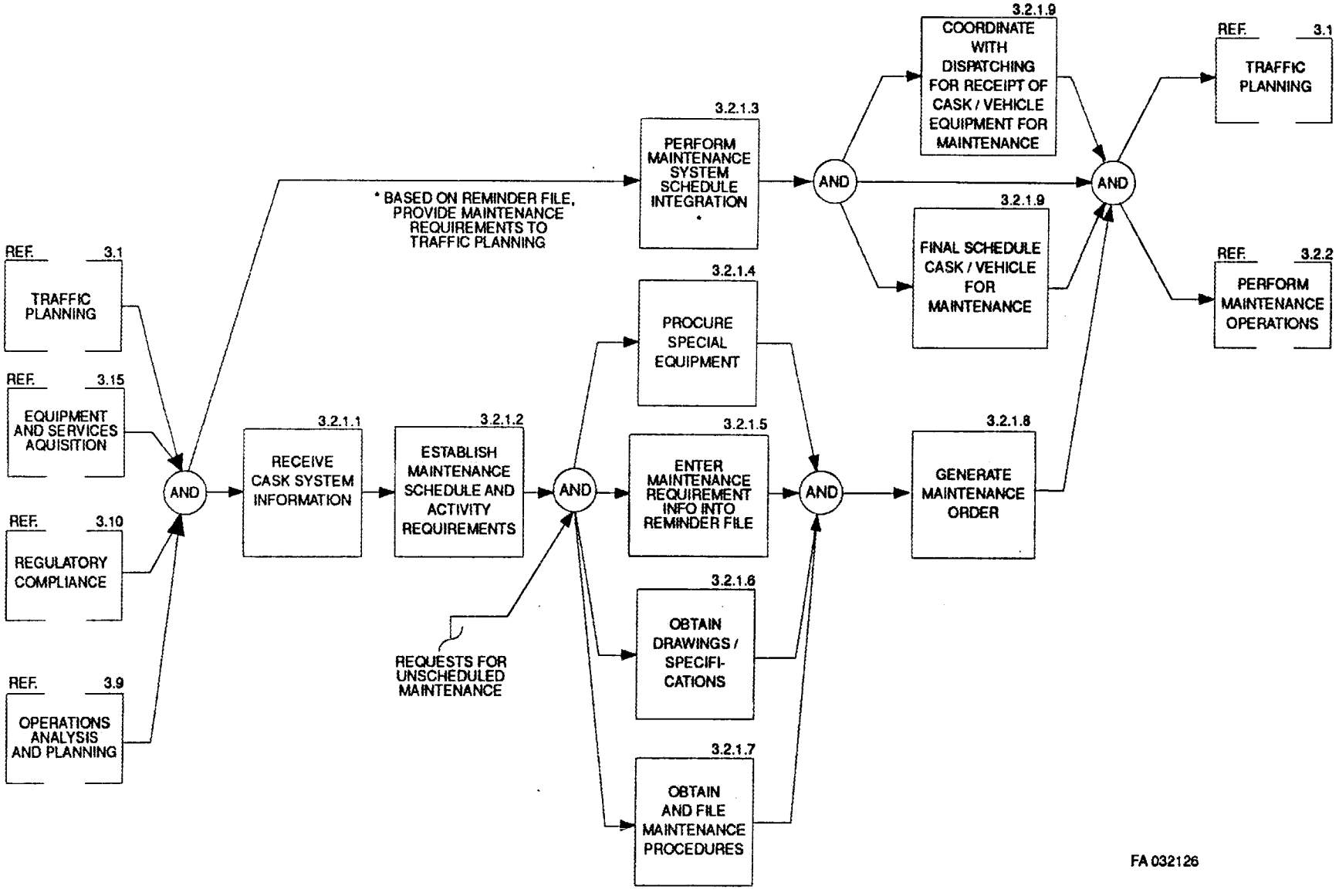

Fig. 13. Functional flow block diagram - perform maintenance planning and scheduling.

responsibility of the traffic planning activities, based on input from a maintenance organization. Maintenance, of course, has the responsibility for its internal planning and scheduling, as well as maintaining maintenance records.

Unscheduled maintenance, although nonroutine, is generally handled in a manner similar to the scheduled activities. Indeed, maintenance items cannot always be identified at the outset; thus, additions to the routine or scheduled list are frequently a result of having to conduct an off-normal or unscheduled maintenance activity.

Most maintenance will probably be performed at a specialized facility, but incidental maintenance may be performed elsewhere (such as at a waste generator's site, a rail or truck repair facility, or at the receiving facility).

3.2.1.1 Receive cask system information

This subfunction involves the gathering of all documents that are necessary for cask, transporter, and ancillary equipment maintenance and repair. This information includes, but is not limited to:

1. as-built (and shop) drawings of all casks and equipment;

2. fabrication specifications, including QA requirements, safety classifications, and material traceability,

3. fabrication procedures;

4. fabrication records (e.g., purchase requisitions, shop travelers, material certifications, and test records) on a unit-by-unit basis to the degree possible;

5. acceptance test plans, including the requirements for test equipment;

6. cask CoC, Safety Analysis Report for Packaging (SARP), and other documents and references (including drawings) that are cited in the CoC;

7. maintenance manuals and procedures for casks, equipment, and transporter;

8. recommended spare parts list; and

9. traffic planning schedule.

3.2.1.2 Establish maintenance schedule and activity requirements

In this subfunction, each major equipment item is uniquely identified. Then, the maintenance requirements and the maintenance frequency are established and assigned to each cask system or equipment item based on the documents identified, in part, in Sect. 3.2.1.1.

3.2.1.3 Perform maintenance system schedule integration

This function involves the internal scheduling of the Cask Maintenance Facility (CMF) activities. This includes the scheduling of activities that are the responsibility of the Maintenance function but that may not be performed within the CMF (e.g., incidental maintenance at the reactor site).

3.2.1.4 Procure parts and special equipment

This involves the processing of the appropriate paperwork to purchase any special equipment (including parts) needed to perform cask-specific maintenance activities. Any purchased parts will have to conform to the latest approved specifications, and the purchasing process will involve appropriate QA activities.

3.2.1.5 Enter maintenance requirement information into reminder file

The cask-specific requirements and scheduling data are entered into a computerized system that tracks each cask or equipment item by serial number. This tracking system, activated on demand or automatically, yields information on the schedule and details of maintenance for any given unit.

3.2.1.6 Enter drawings and specifications into the equipment file

The drawings and other fabrication-related documents are to be placed in a filing system where they can be stored and retrieved (with appropriate controls). This file is to be used as a resource bank for any subsequent work on the cask or equipment items.

3.2.1.7 Obtain and file maintenance procedures

The Maintenance function must request or create the proper procedures for performing maintenance activities. Further, these procedures must be filed in a controlled system where they can be retrieved for use.

3.2.1.8 Generate maintenance order

A work order is created that authorizes the performance of one or more maintenance activities. Such a work order is initiated by the maintenance reminder file, or when the need is recognized, and is always related to a major equipment item.

3.2.1.9 Coordinate with dispatching for receipt of cask or vehicle scheduled for maintenance

The Maintenance function must interface with the Traffic Management function to ensure the timely delivery of the cask, vehicle, or equipment item that is scheduled for maintenance.

3.2.1.10 Final schedule of cask or vehicle for maintenance

The final schedule for item maintenance is established and published.

3.2.2 Perform Maintenance Operations

Items for maintenance are received into the CMF or other designated site and taken out of service as indicated by some feature (e.g., a red tag). In preparation for maintenance, the item may be surveyed and decontaminated, inspected, and/or disassembled. The need for any unscheduled or nonroutine maintenance is assessed as part of the inspection. Maintenance procedures and any special equipment are obtained, and the maintenance activity proceeds. Upon completion of the maintenance activity, the item is reassembled and checked for functioning. QA approval is obtained, and the red tag is removed. The Traffic Management function is notified that the unit may be picked up and returned to service. All special equipment and procedures used for maintenance are returned to their respective locations. Any unexpected maintenance items or nonroutine activities are reported to Operational Analysis and Planning, Regulatory Compliance, or Engineering Support functions, as appropriate. These data will be used to assess any regulatory or maintenance-trend issues. The specific maintenance activity is entered into the permanent record of the item being maintained, and the reminder file clock is restarted for the next maintenance interval (see Fig. 14).

3.2.2.1 Receive item for maintenance

This function involves receipt activities for cask, vehicle, or equipment items that were dispatched for maintenance.

3.2.2.2 Prepare for maintenance

The item for maintenance is readied by performing such activities as inspection, radiation surveying, decontamination, and disassembly.

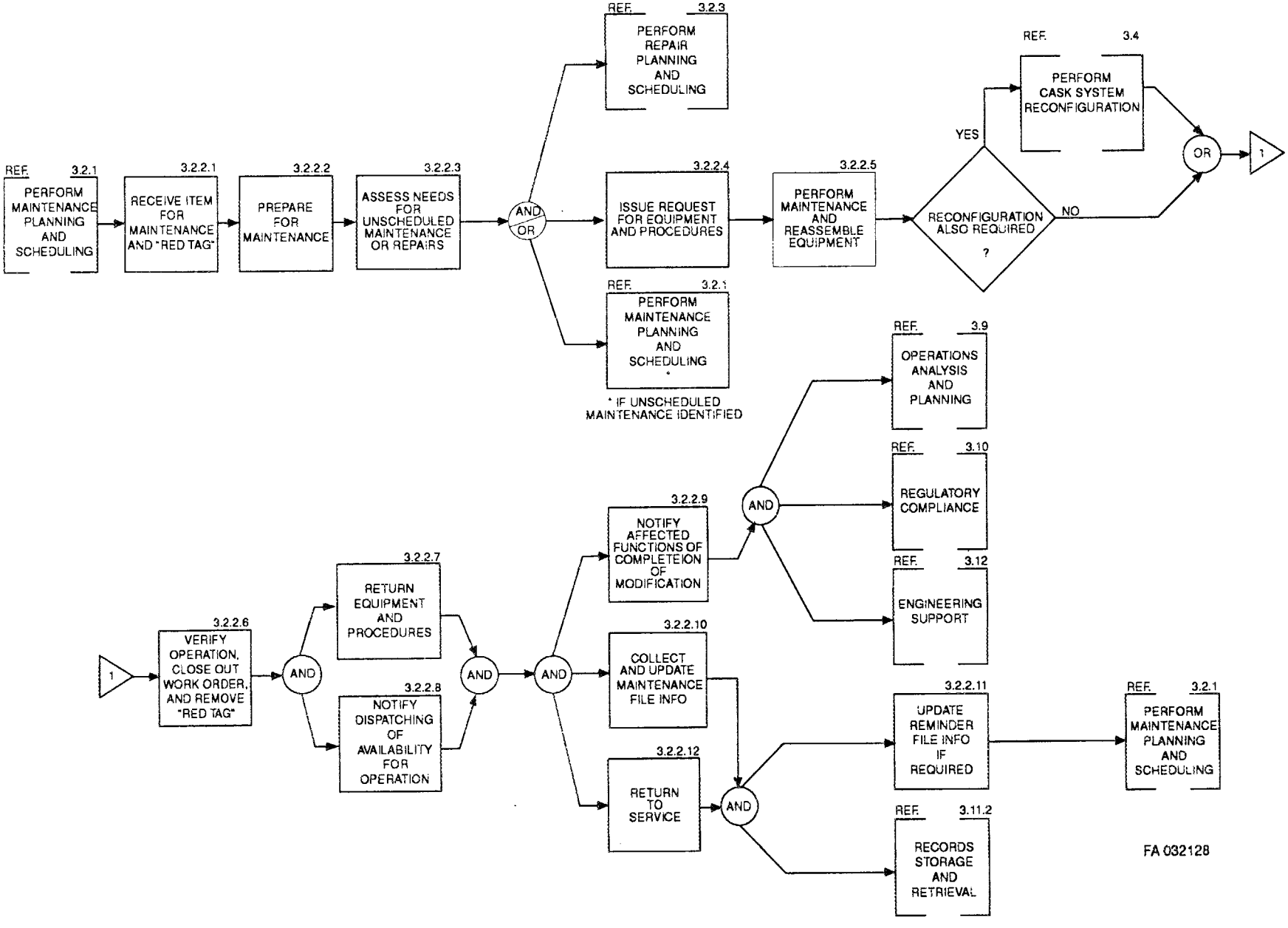

Fig. 14. Functional flow block diagram - perform maintenance operations.

3.2.2.3 Assess needs for unscheduled maintenance, repairs, or modifications

The Maintenance function, as a result of the preparation for maintenance activities and other inputs, determines if activities (e.g., repairs or modifications) other than the scheduled maintenance are required.

3.2.2.4 Issue request for maintenance equipment and procedures

The Maintenance function orders the procedures and equipment from the document control system and the tool room that will be needed to perform the scheduled activities.

3.2.2.5 Perform maintenance activities and reassemble equipment

In this function, scheduled maintenance activities, including prescribed inspections, tests, disassembly and reassembly, and component replacements will be performed according to established procedures and specifications. QA will ensure that all signatures, data, etc., have been recorded on appropriate procedural check sheets.

3.2.2.6 Verify operation, close out work order, and remove red tag

Upon completion of the maintenance activity, the Traffic Management function will be notified that the cask system or equipment item can be reintegrated into the operating fleet. The Maintenance function will remove the inoperative indicator (e.g., the red tag) from the cask or equipment, signifying its suitability for service.

3.2.2.7 Return equipment and procedures

The equipment required for the maintenance activity is returned to the tool room, and the maintenance procedures are returned to the document control system.

3.2.2.8 Notify Traffic Management of availability for operation

The Maintenance function notifies the Traffic Management function that the cask system or equipment item is ready for pickup.

3.2.2.9 Notify affected functions of completion of maintenance

Field Services, Operations Analysis and Planning, Engineering Support, and/or Regulatory Compliance functions may be notified and provided appropriate information following maintenance activities. Other appropriate functions should also be notified of the completion of the work.

3.2.2.10 Collect and update equipment maintenance file information

The results of the maintenance activity are entered into the historical record of the cask or equipment item being maintained. This record should include documentation of any new maintenance items that might have been identified during inspection or usage.

3.2.2.11 Update equipment maintenance reminder file information

The reminder file clock for the particular cask or equipment item is restarted for that specific maintenance activity. Also, any new maintenance activities are added, as appropriate, to the reminder file.

3.2.2.12 Return to service

The Return to Service function ensures that the cask and/or equipment is returned to service in accordance with the instructions from the dispatcher.

3.2.3 Perform Repair Planning and Scheduling

Repairs to casks, transporters, and ancillary equipment are under the control of the Maintenance function. Such repairs may be performed by Maintenance, or they may be done by others, with Maintenance oversight. Repairs are not part

of the routine operation of the TS; nevertheless, once identified, they must be planned and scheduled. Repairs may range from trivial to significant. The determination of the scope of the repairs and the way in which the repairs are made lie with the Regulatory Compliance and Engineering Support functions, although the discovery of the need may come from any number of sources (e.g., Field Services or Maintenance). The in-service schedule requirements for the item under repair must come from the Traffic Management function. All of this information is received and processed by the Maintenance function in its internal planning and scheduling activities (see Fig. 15). Of course, other functions are likely to monitor the repair activities, especially if the repairs involve or affect a safety-related component.

3.2.3.1 Receive repair information

Repair data from Regulatory Compliance and Engineering Support functions are received by the Maintenance function. This information describes the damage and suggests repair activities. These data will form the basis for a cooperative planning effort that includes all affected parties. The relevance of specific repair activities to other casks of the same type will be evaluated and, as necessary, cask users will be notified. If required, cask operations, and possibly features, will be revised.

3.2.3.2 Establish repair schedule and activity requirements

This is the actual planning where the Maintenance, Regulatory Compliance, Engineering Support, and Traffic Planning functions determine specifically what must be done and when it must be completed. The implementation of these requirements is the responsibility of the Maintenance function.

3.2.3.3 Perform maintenance system schedule integration for repair

This subfunction is the internal scheduling of the CMF activities for rework and repair. This includes the scheduling of activities that are the responsibility of the Maintenance function but that may not be performed

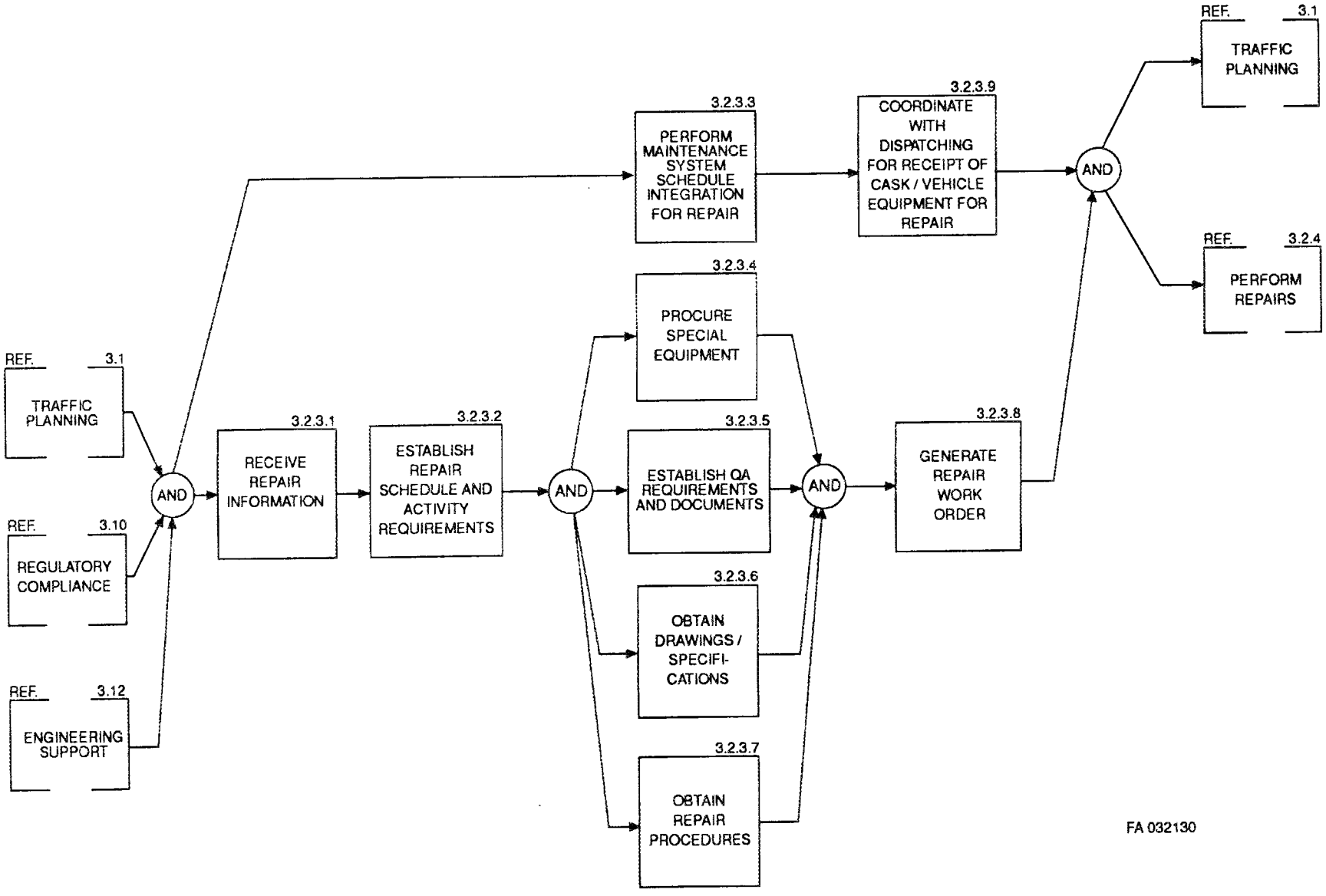

Fig. 15. Functional flow block diagram - perform repair planning and scheduling.

within the CMF (e.g., railcar repair that might be undertaken at an outside shop).

3.2.3.4 Procure parts and special equipment

Any special tools, equipment, or parts that are required for the repair will be ordered. These parts would have to conform to the latest approved specifications, and the purchasing process will involve appropriate QA activities.

3.2.3.5 Establish QA requirements and documents

The Repair, Planning, and Scheduling function, with assistance from the Engineering function, will assess the damage or defect needing repair, review appropriate design and certificate information, identify an appropriate repair method and procedures, and specify test and inspections required. It is expected that the QA function will need to review and concur with recommendations from the Engineering function.

3.2.3.6 Obtain drawings and specifications

If required, the Maintenance function will obtain from their files, or request from the Engineering function or other sources, the necessary drawings and/or specifications applicable to the repair.

3.2.3.7 Obtain repair procedures

If required, the Maintenance function will request from the Engineering or Information Management functions, or another source, the necessary procedures for performing the repairs.

3.2.3.8 Generate repair work order

All repair information will be assembled into a data package. That package will include a work order that authorizes the performance of the repair activity.

3.2.3.9 Coordinate with dispatching for receipt of casks, vehicles, or equipment for repair

The item for repair must be received into the maintenance system. This could mean moving it to the CMF or to an appropriate alternative repair facility. In any event, the item must be transferred to the control of the Maintenance function, before the repairs can be performed.

3.2.4 Perform Repairs

First, the item for repair is received into the control of the Maintenance function. For minor repairs following handling mishaps, this may occur at a waste generator's facility, if appropriate. For more significant repairs, and based on the work order, the repair is performed, inspected, and tested. The operability of the item is checked and, after satisfying QA and regulatory requirements, is returned to service (see Fig. 16).

3.2.4.1 Receive item for repair and "red tag"

The item for repair is received into the Maintenance function, either at the CMF or another appropriate location (e.g., a work generator facility). The red tag signifies that the item is not available and/or not approved for service. The red tag should be placed on the item at the time that the damage or defect is discovered.

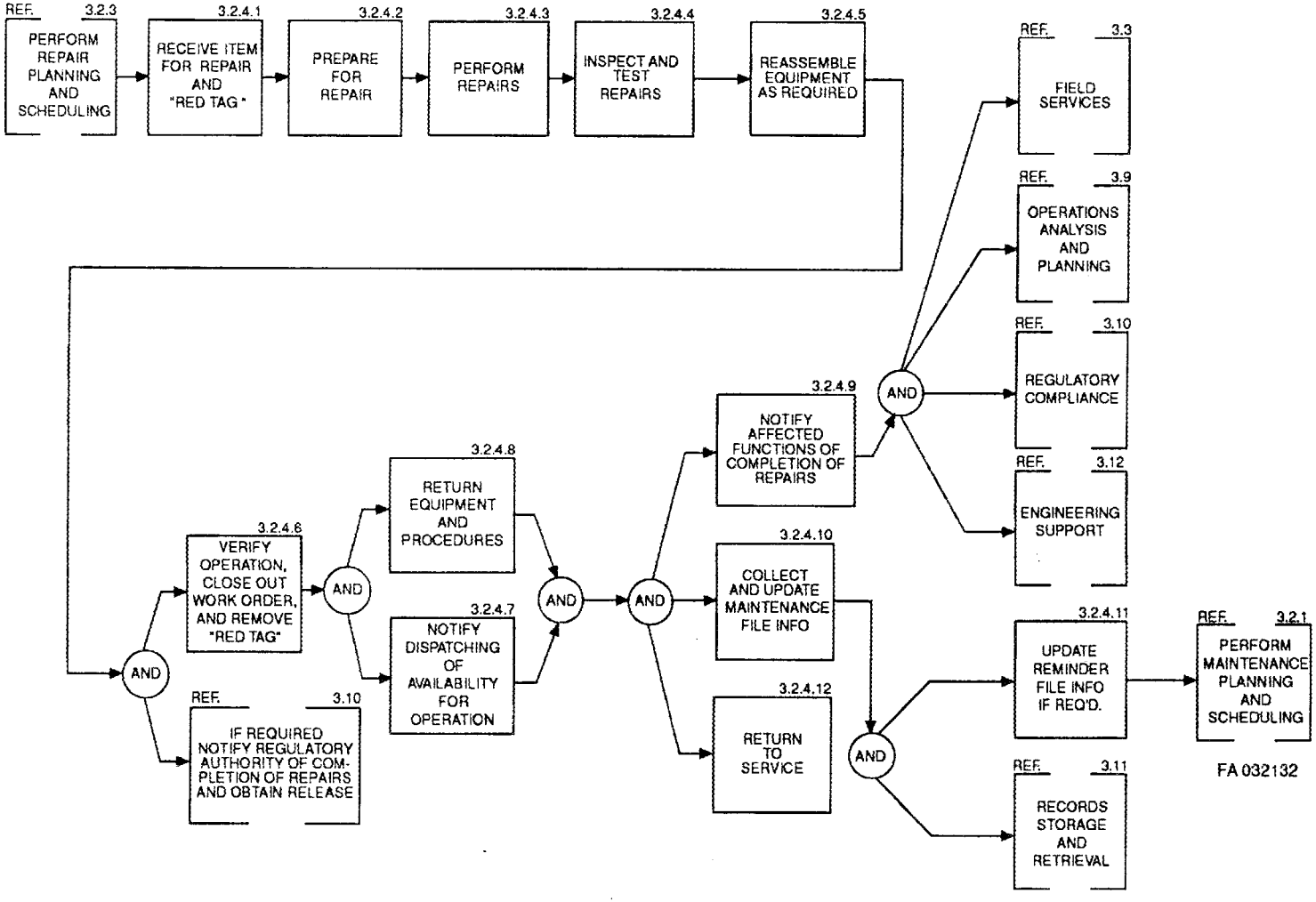

Fig. 16. Functional flow block diagram - perform repairs.

3.2.4.2 Prepare for repair

The Prepare for Repair function involves visual inspection, radiation surveying, decontamination, or cleaning, depending on the nature of the activity and the component being repaired.

3.2.4.3 Perform repairs

Using the drawings, specifications, procedures, QA requirements, and special equipment contained (or referenced) in the repair work order, the maintenance organization performs the repair or causes the repair to be performed by others. If repaired by others, there is an administrative activity within this function that ensures that the work order information is properly transmitted.

3.2.4.4 Inspect and test repairs

This activity ensures that the repair properly corrects the damage or defect and that it has been performed in accordance with drawings, specifications, and procedures that have been approved for the repair.

3.2.4.5 Reassemble equipment, as required

This function ensures that equipment removed for repair is properly reassembled.

3.2.4.6 Verify operation, close out work order, and remove "red tag"

This function ensures that the completed item performs as intended following reassembly. The closing out of the work order involves acceptance of the repair by all performing and affected parties, including QA. The removal of the red tag indicates that the unit is ready to be returned to service. In some instances, it may be necessary to obtain regulatory review and approval of the completed repair prior to returning the unit to service.

3.2.4.7 Notify dispatching of availability for operation

The Traffic Management function is responsible for integrating the repaired unit into the operating system. They are notified by the Maintenance organization of the completion of the repair work.

3.2.4.8 Return equipment and procedures

Any special equipment used in the repair operation must be returned to storage (i.e., tool room), and any controlled documents (including procedure sign-off sheets) must be returned to the Information Management function.

3.2.4.9 Notify affected functions of completion of repairs

Field Services, Operations Analysis and Planning, Engineering Support, and/or Regulatory Compliance functions may be notified following the repair activity. Other appropriate function(s) should also be notified of the completion of the work.

3.2.4.10 Collect and update maintenance file information

The maintenance file is generated on an item-by-item basis. Repair information must be logged for the particular unit serviced. The repair information must be entered into the information management system for retention.

3.2.4.11 Update reminder file information

If the repair affected the reminder file for the specific modified item, that file must be updated accordingly.

3.2.4.12 Return to service

The cask, transporter, or equipment item is released by the Maintenance function from the repair location as directed by the Traffic Management function.

3.2.5 Perform Modification Planning and Scheduling

Modifications to casks, transporters, and ancillary equipment will be under the control of the Maintenance function. Such modifications may be performed by Maintenance, or they may be done by other facilities with Maintenance oversight. Modifications are not part of the routine operation of the TS; nevertheless, once identified, they must be planned and scheduled. The scope of modifications may range from minor, such as replacing a valve or fitting, to major. The determination of the extent of the modifications and the way in which the modifications are made lies with Regulatory Compliance and Engineering Support functions, although the discovery of the need may come from any number of sources (e.g., Field Services or Maintenance). The operations schedule requirements for the item to be modified comes from the Traffic Planning function. All of this information is received and processed by the Maintenance function in its internal planning and scheduling activities (see Fig. 17). Of course, other functions are likely to monitor the modification activities, especially if they affect a safety-related component.

3.2.5.1 Receive modification information

Modification data from Regulatory Compliance and Engineering Support functions are received and reviewed by the Maintenance function. This information describes the item and suggests modification activities. These data will form the basis for a cooperative planning effort that includes all affected parties.

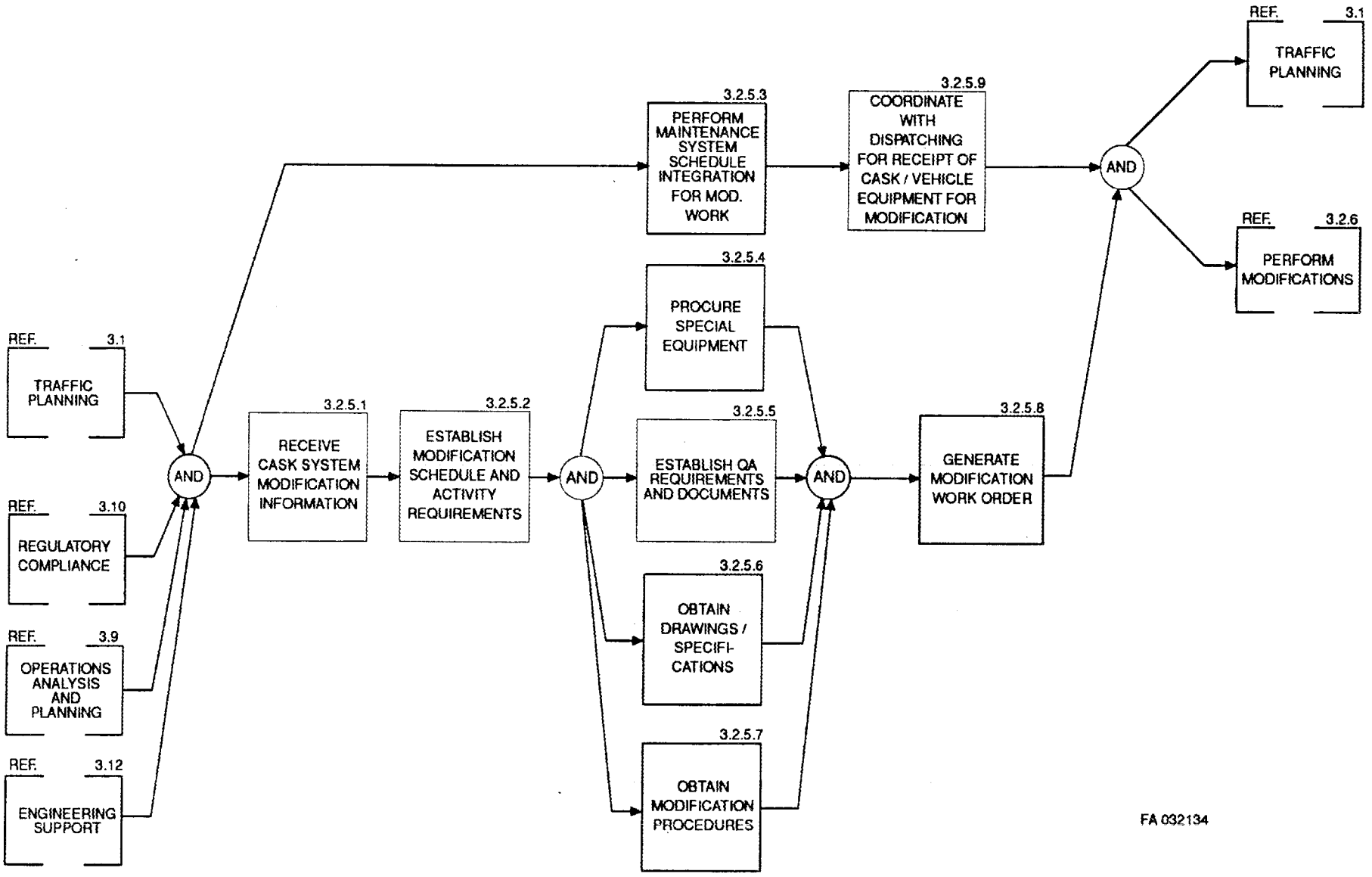

Fig. 17. Functional flow block diagram - perform modification planning and scheduling.

3.2.5.2 Establish modification schedule and activity requirements

This is the actual planning in which Maintenance, Regulatory Compliance, Engineering, and Traffic Planning functions decide specifically what must be done and within what time frame. The implementation of these requirements is the responsibility of the Maintenance function.

3.2.5.3 Perform maintenance system schedule integration for modification work

This subfunction involves the internal scheduling of the CMF activities for modification work. This includes the scheduling of activities that are the responsibility of the Maintenance function but that may not be performed at the CMF (e.g., modification of a lifting device that might be undertaken at a vendor's shop).

3.2.5.4 Procure parts and special equipment

Any special tools, equipment, or parts that are required for the modification are ordered. These parts would have to conform to the latest approved specifications, and the ordering and purchasing process would involve appropriate QA activities.

3.2.5.5 Establish QA requirements and documents

The Repair, Planning, and Scheduling function, with assistance from the Engineering function, will assess the modification needing repair, review appropriate design and certificate information, identify an appropriate modification method and procedures, and specify test and inspections required. It is expected that the QA function will need to review and concur with Engineering recommendations.

3.2.5.6 Obtain drawings and specifications

If required, Maintenance will request from its own files, Engineering, or other sources the necessary drawings and/or specifications applicable to the modification.

3.2.5.7 Obtain modification procedures

If required, Maintenance will request from Engineering, Document Control, or another source the necessary procedures for performing the modifications.

3.2.5.8 Generate modification work order

All modification information will be assembled into a data package. That package will include a work order that authorizes the performance of the modification activity.

3.2.5.9 Coordinate with Traffic Management for receipt of casks, vehicles, or equipment for modification

The item for modification must be received into the Maintenance system. This could mean moving it to the CMF or to a convenient alternative location. In any event, the item must be transferred to the control of the Maintenance function, before the modifications can be performed.

3.2.6 Perform Modifications

The item for modification is received into the control of the Maintenance function. Then, based on the work order, the modification is performed, inspected, and tested. The operability of the item is checked and, after satisfying QA and regulatory requirements, is returned to service (see Fig. 18). It is likely that approved modifications to a cask will be applied to all models of the same cask type.

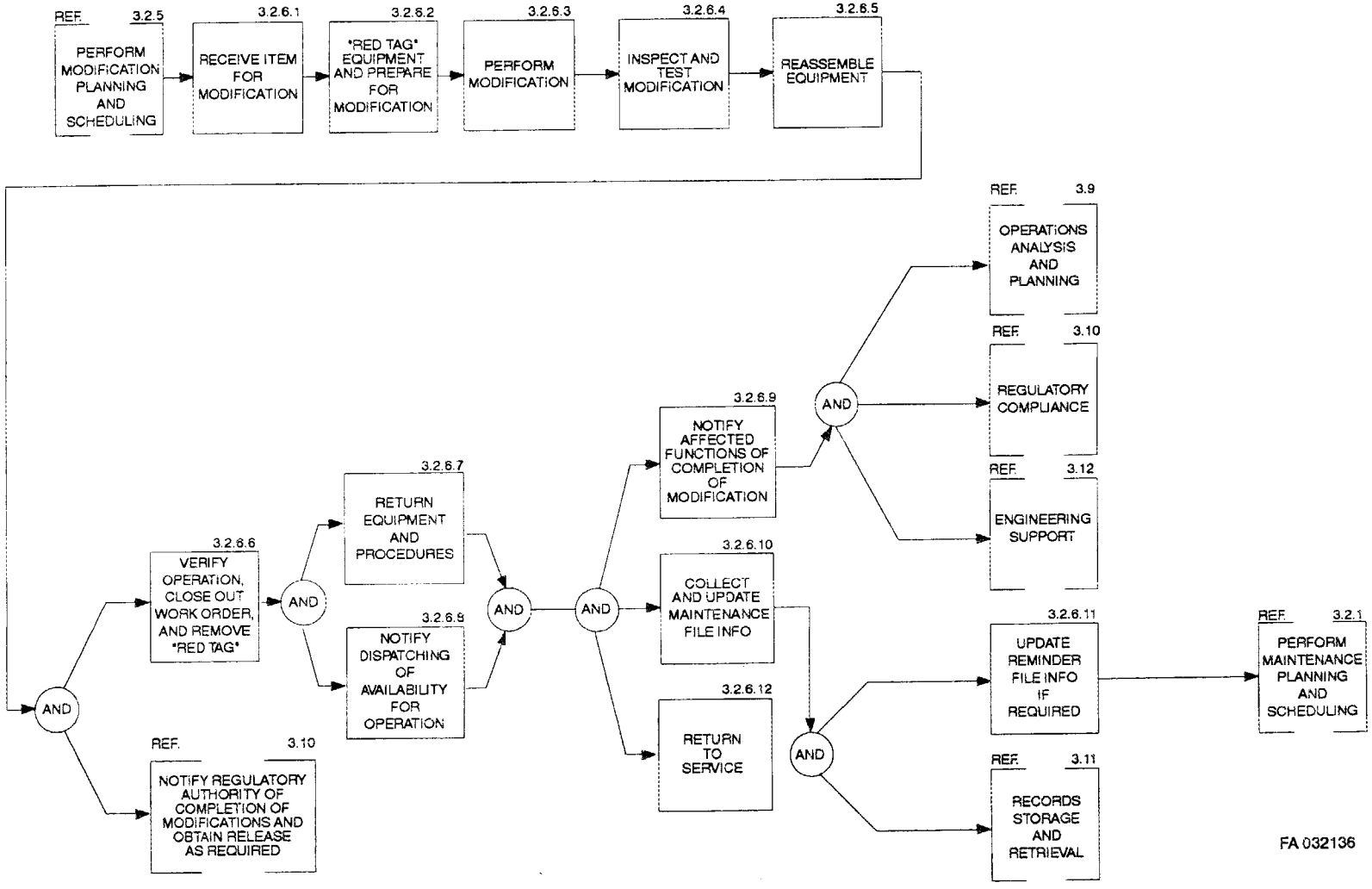

Fig. 18. Functional flow block diagram - perform modification operations.

3.2.6.1 Receive item for modification

The item for modification is received into the Maintenance function, either at the CMF or another appropriate location.

3.2.6.2 "Red tag" and prepare for modification

The red tag function signifies that the item is not available and/or not approved for service. Preparation for modification involves visual inspection, radiation surveying, decontamination, or cleaning, depending on the nature of the activity and the component being modified.

3.2.6.3 Perform modifications

Using the drawings, specifications, procedures, QA requirements, and special equipment contained in (or referenced in) the modification work order, the Maintenance function performs the modification or causes the modification to be performed by others. If modified by others, there is an administrative function within this activity that ensures that the work order information is properly transmitted.

3.2.6.4 Inspect and test modification

This activity ensures that the modification performed in accordance with the drawings, specifications, and procedures that have been approved for the modification.

3.2.6.5 Reassemble equipment, as required

This function ensures that equipment removed for modification is properly reassembled.

3.2.6.6 Verify operation, close out work order, and remove "red tag"

This activity ensures that the completed item is functioning as intended following reassembly. The closing out of the work order involves acceptance of the modification by all performing and affected parties, including QA. The removal of the red tag is the indication that the unit is ready to be returned to service. In some instances, it may be necessary to obtain regulatory review and approval of the completed modification prior to returning the unit to service.

3.2.6.7 Return equipment and procedures

Any special equipment used in the modification operation must be returned to storage (i.e., tool room), and any controlled documents (including procedure sign-off sheets) must be returned to Document Control.

3.2.6.8 Notify Traffic Management of availability for operation

Traffic Management is responsible for integrating the modified unit into the operating system. They are notified by Maintenance of the completion of the modification work.

3.2.6.9 Notify affected functions of completion of modifications

Operations Analysis, Field Services, Engineering, and/or Regulatory Compliance functions may be notified following the modification activity. Other appropriate function(s) should also be notified of the completion of the work. It is likely that all casks undergoing a specifically approved change will not be modified at the same time. Care must be exercised to ensure that there is no mix-up if all casks are not withdrawn from service before the modification is completed.

3.2.6.10 Collect and update maintenance file information

The maintenance file is on an item-by-item basis. Modification information must be logged for the particular unit serviced. The modification information must be entered into the information management system for retention.

3.2.6.11 Update reminder file information

If the modification affected the reminder file for the specific modified item, that file must be updated accordingly.

3.2.6.12 Return to service

The cask, transporter, or equipment item is released by the Maintenance function from the modification location as directed by the Dispatch function.

3.3 PERFORM FIELD SERVICES

The Field Services function consists of those technical support activities required (1) at shipment origin facilities, (2) during transit in the public domain, and (3) at receiving or destination facilities to sustain transportation system operations (see Fig. 19). This includes providing technical advice and assistance in order to support normal routine operations as well as to support recoveries following abnormal events. It is expected that activities carried out by the Field Services function will be minimal at CRWMS facilities.

3.3.1 Perform Origin-Site Field Services Activities

Origin-site Field Services may include some, or all, of the following site-specific activities:

1. Conduct site visits, review and concur with cask operating procedures, and verify readiness to initiate a campaign. Identify any facility modifications and/or special equipment that may be required.

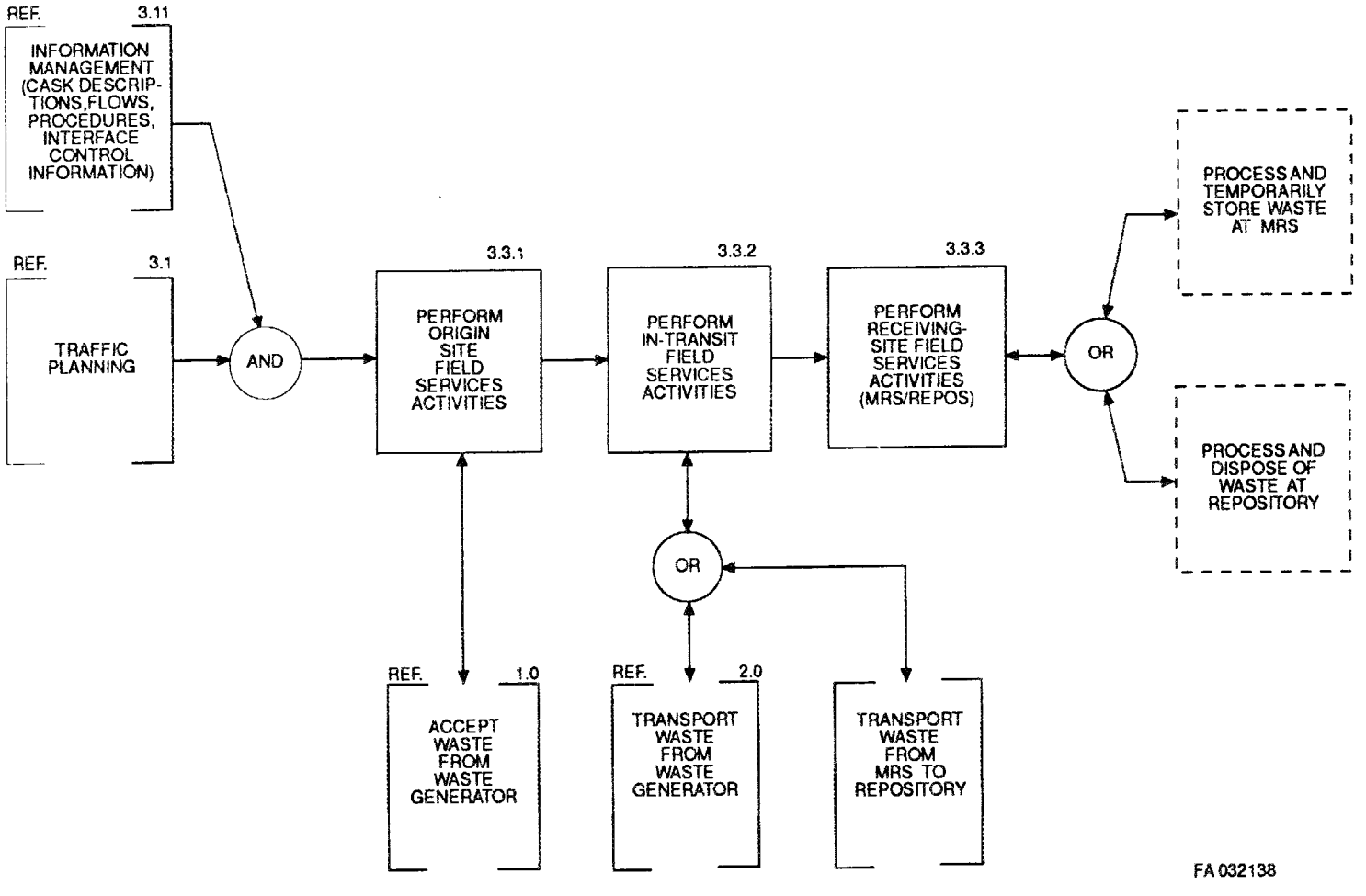

Fig. 19. Functional flow block diagram - perform field services.

2. Provide advice and assistance to utility crews in cask handling, loading, and preparation for shipment.

3. Identify all site-specific equipment and supplies that will be needed in the shipping campaign.

4. Identify any needs for subcontractor services for DOE-supplied equipment that may be required at certain sites and provide specific requirements and requisition data to procurement. Monitor subcontractor activities at the site in performance of the requirements.

5. Assemble and maintain handling procedures and technical data on cask systems.

6. Provide technical support to the Accept for Transport function.

A major function of Field Services is to ensure that personnel involved in waste transportation operations at origin sites are properly trained and qualified to carry out required tasks. This includes (1) maintenance in training waste generator personnel as requested and required, (2) verifying qualifications of any contractor personnel who may be employed in the shipping campaign, and (3) verifying qualifications of other Field Services personnel. Field Services functions will consult with waste generators to determine training aids, documentation, manuals, videotapes, and procedures needed and will support, as requested, classroom and hands-on training of waste generator and contractor personnel.

Origin-site field service activities should be initiated early, before the first shipping campaign, to support facility modifications that may be needed and training. It may be desirable to carry out a "dry run" at each waste generator site using the appropriate cask type prior to initiating a shipping campaign. These activities are likely to take several weeks and are expected to uncover any operational shortcomings, enhance overall safety, and promote a more rapid turnaround of cask systems at these facilities.

The Field Services function will, when requested, provide technical advice and assistance to waste generators during cask handling, loading, and preparation for shipment and intermodal transfer. Occasionally, circumstances may be encountered that require modification of procedures, incidental maintenance, or minor repair to the shipping systems.

Field Services functions at the waste generator site will also ensure that all documentation (e.g., check-off lists, certifications, inspection records, and off-site shipment records) is collected and forwarded to appropriate recipients.

3.3.2 Perform In-Transit Field Services Activities

During the course of transportation operations in the public domain, abnormal incidents or accidents involving the cask-vehicle system may be encountered (e.g., tractor, trailer, or railcar breakdowns) that require technical assistance and support before the equipment can be returned to service. The Field Services function will provide this technical support whenever conventional in-transit repair or service is unavailable. Such support could include identification of facilities for in-transit maintenance; in-place temporary repair of tractors, trailers, or railcars; or, in some cases, assistance during replacement of a transporter. In the case of severe accidents, the Field Services function will provide technical advice and assistance as requested and will assist in recovery operations of the equipment and restoration of normal transport operations.

3.3.3 Perform Receiving-Site Field Services Activities (MRS/Repository)

The need for field services at MRS and repository facilities is expected to be minimal during normal operations because operating personnel at the receiving facility will be trained and qualified to handle incoming and outgoing transportation equipment. In the event of abnormal events involving transportation system equipment or transportation equipment failures or malfunctions at the MRS or repository, the Field Services function will

provide support and technical assistance so that appropriate actions are taken before the equipment is returned to service.

3.4 PERFORM CASK SYSTEM RECONFIGURATION

From time to time, some casks may require reconfiguring (i.e., changing the cask internals) such that they will physically accommodate a waste type scheduled for delivery. This function can vary in scope from changing inserts in spent fuel baskets (to accommodate shipment of different longer or shorter fuel) to a complete basket changeout to permit the movement of a different type of waste (e.g., canistered fuel). The reconfiguration function may occur at a waste generator's facility or at a repository, MRS, or CMF, depending on the scope of the reconfiguration requirements and logistical considerations (see Fig. 20).

3.4.1 Receive Reconfiguration Request

Typical for this activity, the Maintenance function receives from Traffic Planning a request to change the internals of a cask that is currently undergoing maintenance. The request must be specific with respect to the particular cask to be reconfigured, the exact configuration required, and the timing of the reconfiguration activity. This activity may be performed by personnel other than those employed by TS but under TS supervision.

3.4.2 Perform Facility Schedule Integration

This function is the internal scheduling of CMF activities for reconfiguration work. From the Maintenance function perspective, reconfiguration should always be performed in conjunction with another maintenance activity, such as routine maintenance, rework and repair, or modification.

3.4.3 Prepare and Issue Reconfiguration Work Order

Once the new cask configuration is established, the Maintenance function will issue a work order describing the complete reconfiguration activity.

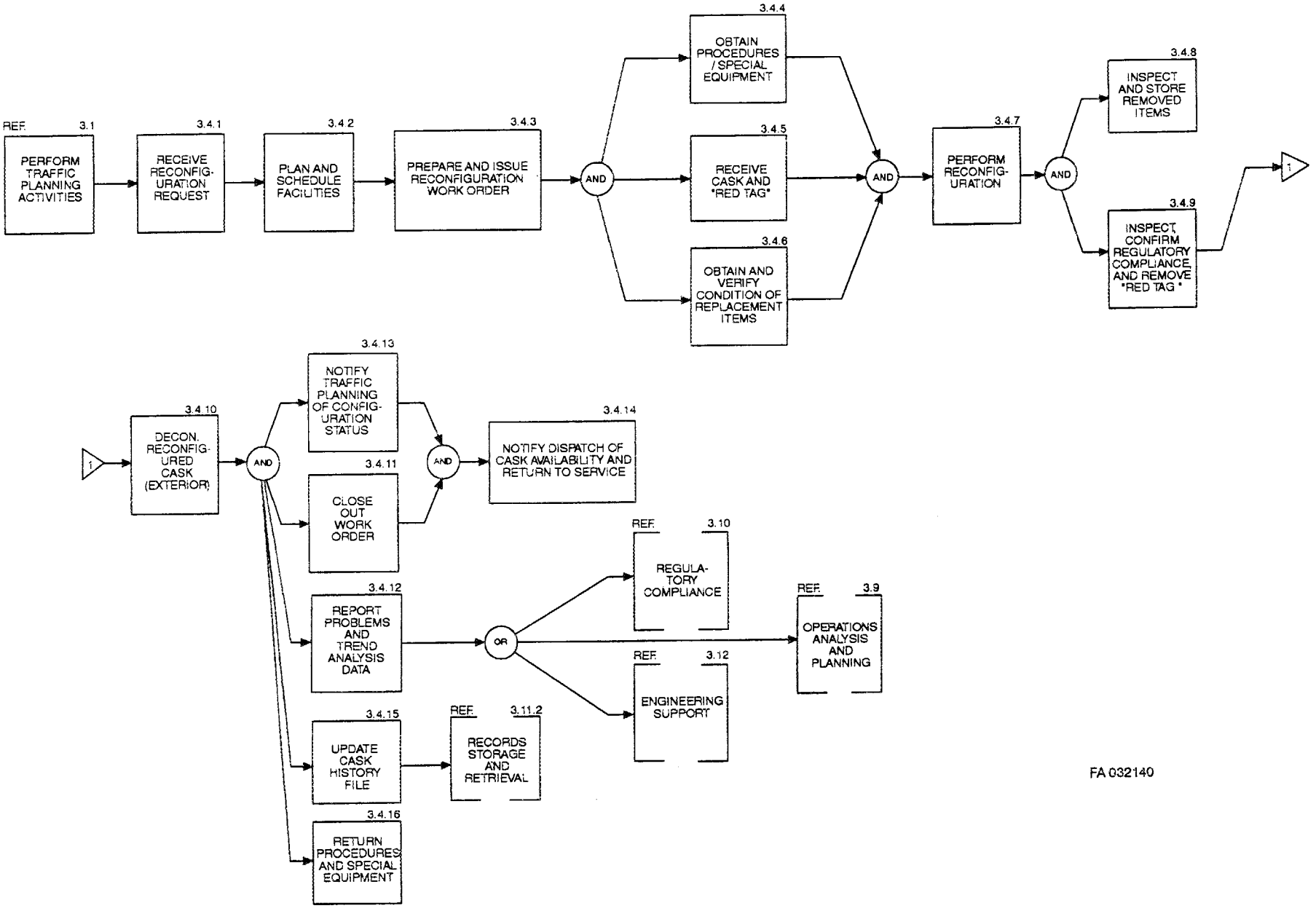

Fig. 20. Functional flow block diagram - perform cask system reconfiguration.

3.4.4 Obtain Procedures and Special Equipment

Reconfiguration must be performed using approved procedures that are listed in controlled documents. Additionally, reconfiguration activities may require the use of special tools or equipment which would be available from the tool room.

3.4.5 Receive Cask and "Red Tag"

For this function, the cask will already be under Maintenance control; but it may have to be delivered to those responsible for the reconfiguration work. Each cask will be physically marked ("red tagged"), indicating that the specific cask is in the process of being reconfigured and cannot be returned to service until compliance with certain regulatory requirements has been reconfirmed.

3.4.6 Obtain and Verify Condition of Replacement Items

This means the removal from storage and inspection of the reconfiguration components (e.g., basket and/or spacers) that are to be placed into the cask. Work includes inspection for mechanical damage and verification of serial numbers, as appropriate.

3.4.7 Perform Reconfiguration

This activity is the physical removal of the previous components and the installation of the replacement ones to produce the desired reconfiguration. Prior to the removal of the existing internals, some form of decontamination may be required. Note that reconfiguration also will occur at locations other than the maintenance facility.

3.4.8 Inspect and Store Removed Items

The removed items will be stored until needed again. Prior to storage, they may need to undergo decontamination to preestablished activity levels.

Following this operation, the components will be inspected for indications of damage or deterioration. Needs for repair will be identified and repairs planned accordingly.

3.4.9 Inspect, Confirm Regulatory Compliance, and Remove "Red Tag"

This activity is the QA step wherein the completed reconfiguration activity is reviewed to be sure that it was properly performed. If satisfactory, the red tag is removed.

3.4.10 Decontaminate Reconfigured Cask Exterior

The reconfiguration work may be performed with the cask in a contaminated environment (i.e., pool or hot cell). Consequently, the cask exterior may need to be cleaned to preestablished activity levels before being returned to service.

3.4.11 Close Out Work Order

The removal of the red tag signifies the completion of the reconfiguration work and permits the closing out of the work order that authorized the task.

3.4.12 Report Problems and Trend Analysis Data

This activity will provide information to Regulatory Compliance, Engineering, and Traffic Planning functions on observations made during the reconfiguration work. This information provides an indication of damage or deterioration of equipment that will, in turn, permit the assessment of equipment behavior under operational conditions.

3.4.13 Notify Traffic Planning of Configuration Status

This notice is to indicate to the Traffic Planning function that the cask has been reconfigured as requested.

3.4.14 Notify Traffic Management of Cask Availability and Return Cask to Service

The Traffic Management function is notified of the cask's readiness for service. Traffic Management makes the necessary arrangements to move it out of the location where the reconfiguration was performed.

3.4.15 Update Cask System Item History File

The location and configuration status of all casks and components must be identified and kept current. The history file must be updated to indicate that a particular set of internals was returned to storage and that another set was placed in the reconfigured cask.

In addition, the work order authorizing the reconfiguration must be placed in the history file for the specific cask.

3.4.16 Return Procedures and Special Equipment

The controlled nature of the procedures requires them to be returned to the Information Management function. Any special tools or equipment must be returned to the appropriate custodian of the items.

3.5 EMERGENCY RESPONSE AND RECOVERY (ERR)

Emergency Response and Recovery (ERR) functions consist of those accomplished during routine operations (incident free) and those required in event of an actual incident or accident (see Fig. 21). These two areas of activity are described in DOE Order 5500.1A, along with DOE's approach to integrating generic response capabilities with CRWMS resources. The DOE Order also describes the overall DOE Emergency Management System (EMS), of which policies and procedures for management and procedures for management of transportation emergencies are a subset. The description of the ERR functions to be performed by the TS are given below.

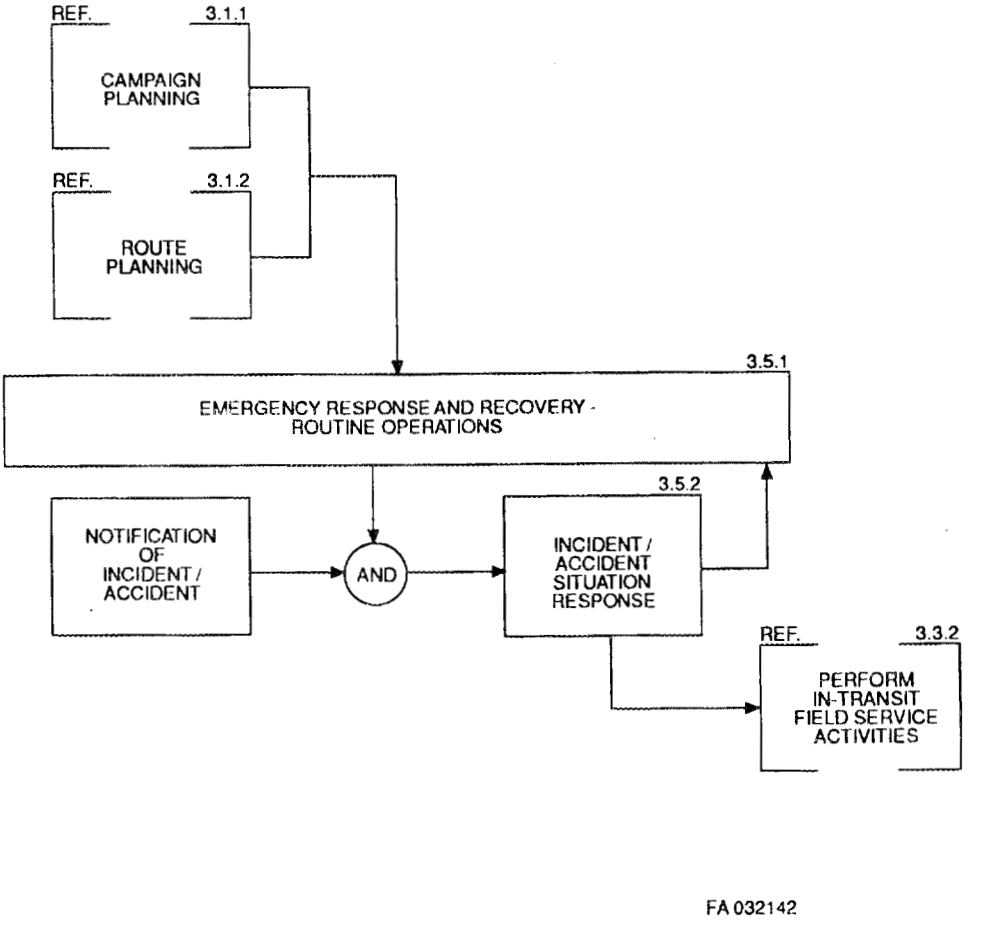

Fig. 21. Functional flow block diagram - emergency response and recovery.

3.5.1 Routine Operations (Incident Free)

The function of the TS during routine operations consists of (1) integrating TS resources with the DOE-EMS structure and (2) maintaining the TS in a state of readiness to support EMS responses in the event of CRWMS transportation incidents/accidents. The interrelationship of these functions is shown in Fig. 22. The functions include (1) designating and training appropriate staff in specified EMS activities, (2) ensuring that appropriate documents and technical data are up-to-date and present in the DOE's HQ and Field Office Emergency Operations Centers (EOCs), (3) and ensuring that appropriate TS personnel are designated and are on call at all times to support the EOC staff and emergency response personnel at an accident scene in event of actual transportation emergencies. To accomplish these routine functions, comprehensive and continuous liaison will be required between the TS, the DOE's EMS, and the higher-level management of the CRWMS. This will include maintaining and updating a library of information containing: (1) ERR plans/procedures developed during the system development phase, (2) cask system technical data, (3) generic accident scenario analyses, (4) site-specific transportation campaign plans, and (5) data on local ERR capabilities. Figure 22, 3.5.1.1 through 3.5.1.4, shows these relationships. This information will need to be kept current at the EOCs. TS personnel must know and understand this documentation in the event of EOC emergency mobilization. Training for personnel should ensure that they can readily retrieve and apply data from the documentation. In addition, training and designation of TS emergency response personnel must ensure that the TS will be able to provide knowledgeable assistance to ERR authorities and will be prepared to recover TS equipment safely and efficiently.

3.5.2 Incident/Accident Emergency Response/Recovery

In the event of an actual incident or accident, emergency response actions will most likely be initiated upon notification by persons at or near the scene. These persons may be from a carrier, local police, fire or civil defense organizations, or state officials. Initial notifications may be directed to a number of places, including a TS traffic manager, DOE/HQ, a DOE

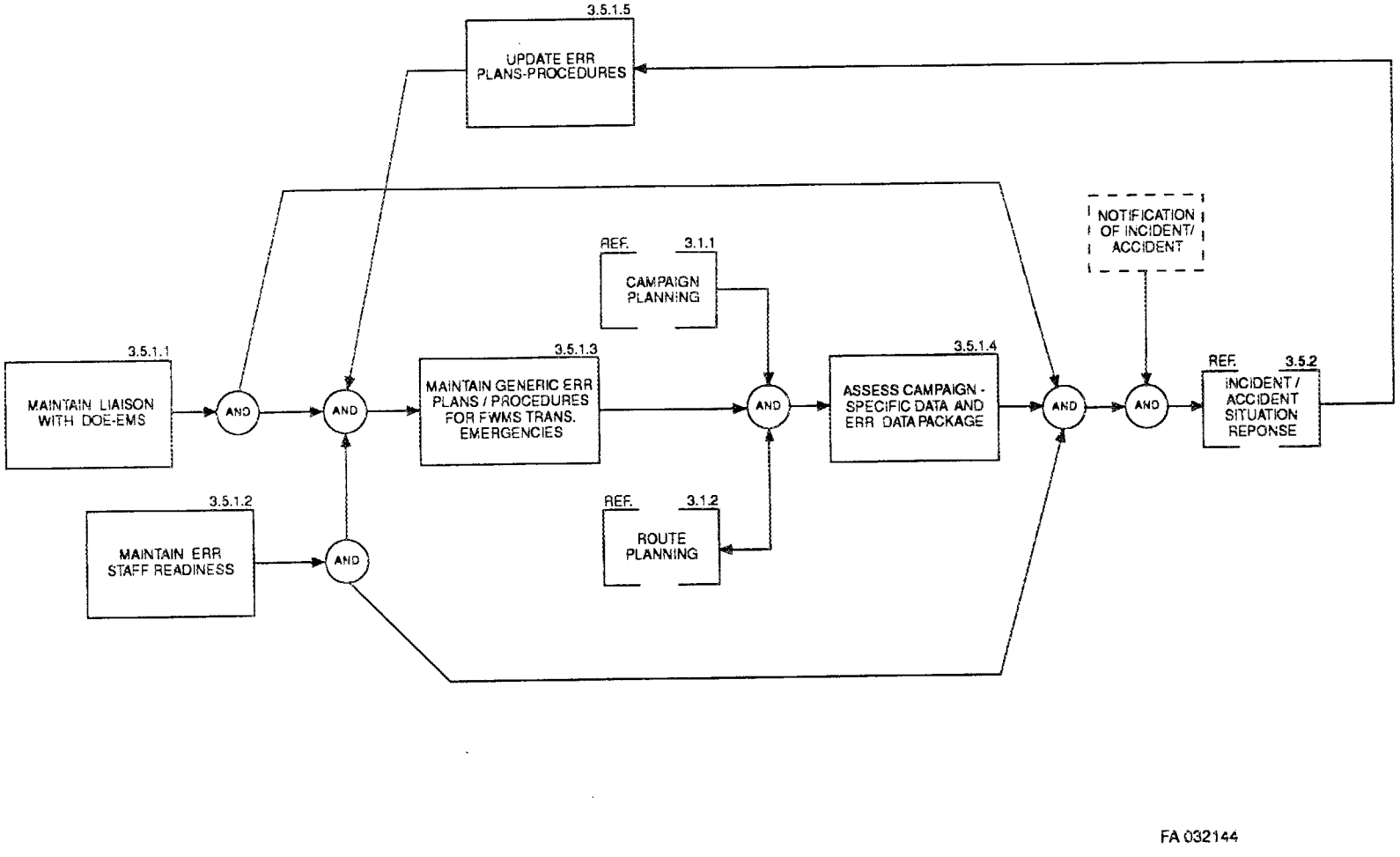

Fig. 22. Functional flow block diagram - emergency response and recovery-routine operation.

field office, or possibly CHEM/TREC. The functions identified here apply to any notification received by any TS element of an CRWMS transportation emergency. The initial response of the TS will be to establish reliable communications with people in the field. Further actions will be based on written TS procedures and information received from the field. Figure 23 shows detailed actions that will be included in these procedures and the interrelationships among these actions.

Following an in-transit incident or accident, the initial determination of a "radiological emergency," if one exists, may be made by those on the scene (e.g., state or local police). Followup actions will rely on good communications between responsible parties. If it is determined that no radiological emergency exists, the response will become a recovery activity carried out by TS. Otherwise, the response functions will proceed as indicated in Fig. 23. It is important to recognize, in conformance with the DOE Order, that actions by TS personnel must be coordinated with EMS personnel and the appropriate DOE field office. TS recovery functions may vary widely but will focus on removal of TS equipment from the accident scene and restoration of normal transport operations.

If the initial notification of an incident/accident comes to TS, the first function will be to establish appropriate response communications. Figure 23 shows these response actions in 3.5.2.1. Initial contacts will be made with the HQ-EOC and the field office EOC in the region of the incident. If the initial notification comes to HQ or the field office EOC, they would first establish communications with the TS and each other. Communications with pre-established state and local contacts, as specified in approved procedures, would also be established. Subject to established procedures or HQ-EOC direction (HQ-EOC would be mobilized immediately including designated HQ transportation program staff), TS predesignated technical staff would be dispatched to the scene (see Fig. 23, 3.5.2.2) unless it could be quickly determined by qualified state or local officials at the scene that no radiological hazard exists and that no technical advice or assistance from TS was required. If appropriate, TS would also alert nearby recovery resources of the actual or potential need for recovery assistance.

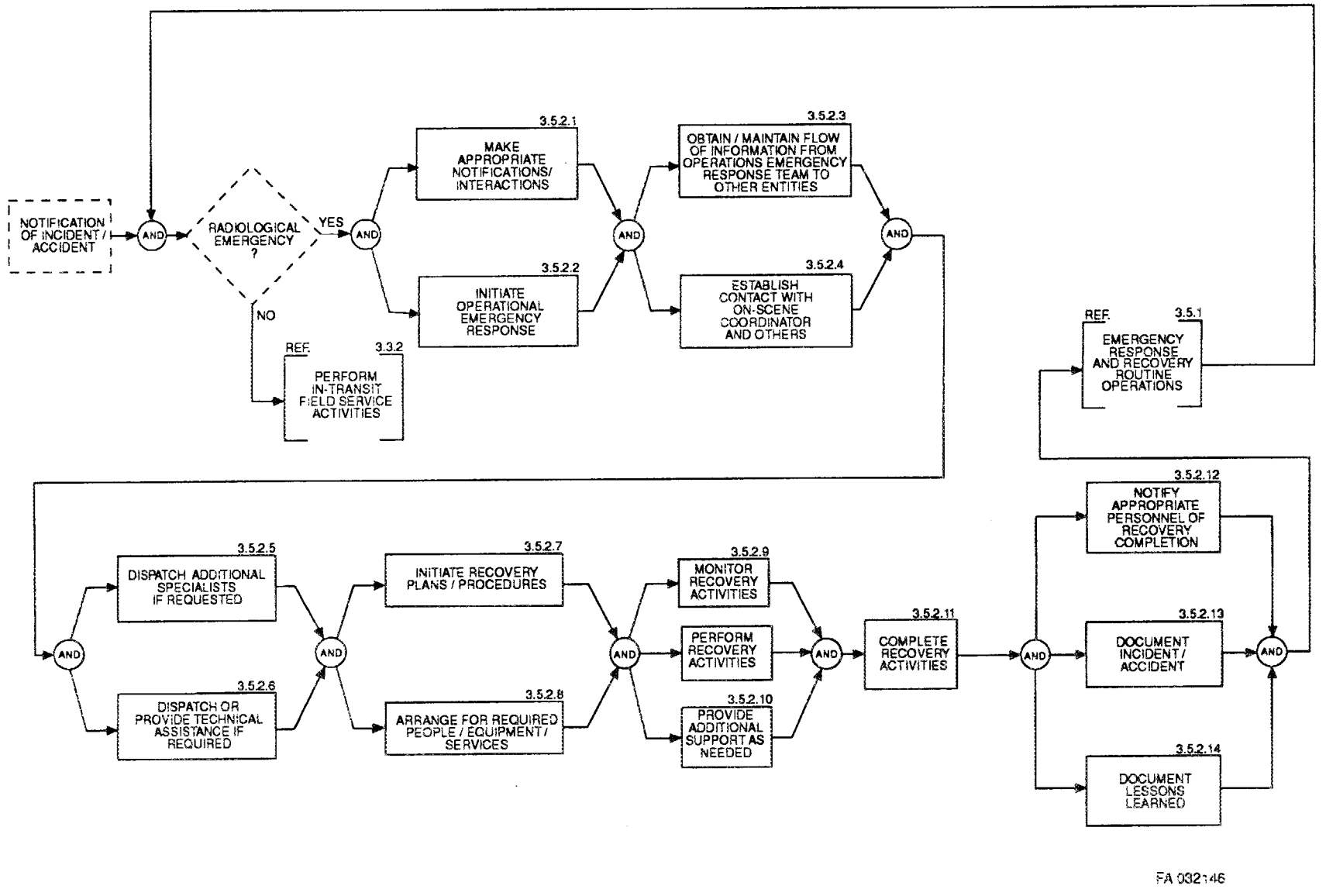

Fig. 23. Functional flow block diagram - incident/accident situation response.

If, based on communications from the scene, there is an actual or suspected radiological hazard, the primary TS function will be to provide available expertise plus information about the shipment to those in charge at the scene. TS advisers may be dispatched to the scene and to HQ and field office EOCs to assist and advise in response and recovery actions. TS staff at the scene may also monitor response and recovery actions being taken by state and local agencies and contractors and provide a steady flow of information to TS managers. This relationship is shown in Fig. 23, 3.5.2.3 and 3.5.2.4.

Once a determination has been made by authorities at the scene that no radiological hazard exists, or that a radiological hazard condition no longer exists, ERR functions will largely become equipment recovery activities. Also included in these activities will be dispatching cask system specialists and equipment to the accident scene to thoroughly inspect and evaluate cask integrity and to determine suitable recovery actions. These activities are detailed in Fig. 23, 3.5.2.7 and 3.5.2.8. Following these activities, the ERR function is to prepare extensive documentation of all aspects of the incident, possibly including recommendations to prevent recurrence, as shown in Fig. 23, 3.5.2.13 and 3.5.2.14.

3.6 TRANSPORT UNLOADED CASKS

The movement of unloaded casks through the system has been addressed in this report as a separate support activity. The casks are referred to as unloaded rather than empty because, following DOT regulations, an unloaded spent fuel cask having normal contents of residual contamination may not be transported on a vehicle with an empty placard. In addition to originating at an MRS or waste repository, unloaded casks could come from the CMF, be newly purchased casks, or originate from other facilities such as those upon which repair or maintenance operations have been carried out. Other subfunctions that must be carried out in order to transport unloaded casks are discussed below (see Fig. 24).

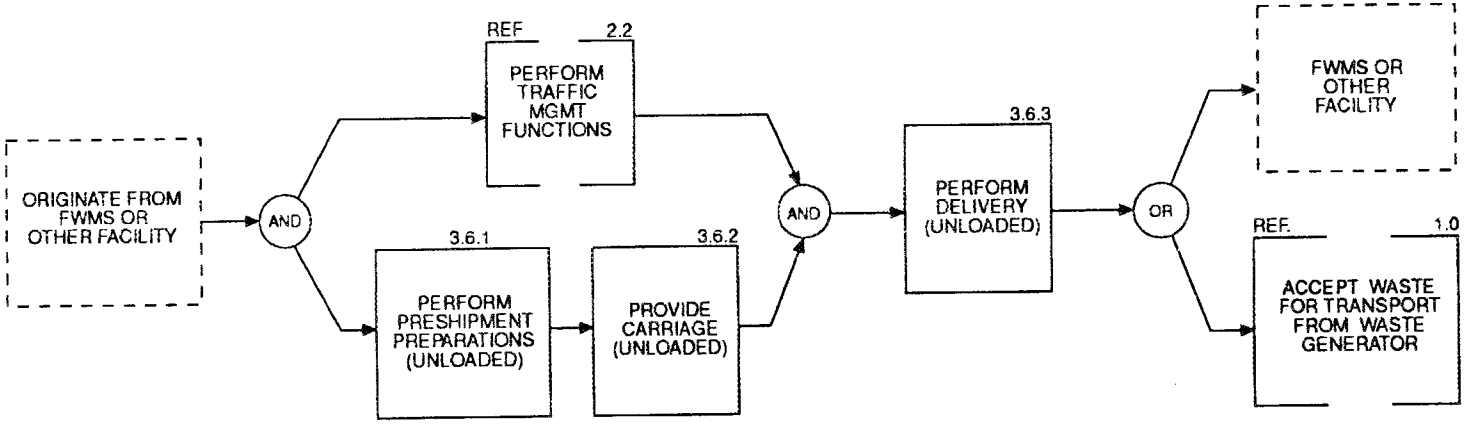

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Fig. 24. Functional flow block diagram - transport unloaded casks.

3.6.1 Perform Preshipment Activities (Unloaded Cask)

These activities include the preparations for shipment beginning with the cask being placed on the transporter and ending with carrier acceptance of the shipment; completion of the preshipment activities is indicated by a TS representative signing the bill of lading immediately prior to departure. The activities are intended to apply to all modes of transport (see Fig. 25). For these activities, DOE prepares the cask for shipment and is the "shipper of record."

3.6.1.1 Inspect trailer and railcar

The readiness check of the transporter, as defined by federal regulations, is made to ensure that the transporter is satisfactory for its intended use. The check should include (as appropriate) an inspection of the accessible portions of air lines, electrical wiring, structural and nonstructural welds, mechanical linkages, tires, hoses, glad hand seals, lights, brakes, brake adjustor travel, hand brake, wheels, landing gear, reflectors, placard holders, alarm devices, communication equipment, road safety equipment, and other safety features. Completion of this readiness check is expected to be supported by a checklist.

3.6.1.2 Move carrier equipment to site

Carrier equipment is moved to the shipping facility following receipt of a dispatch order. Traffic Planning is expected to schedule carrier equipment and personnel to support required shipments.

3.6.1.3 Perform prime mover inspection (without transporter)

TS inspection of the prime mover (primarily for highway tractors) supplied by the carrier is made to ensure that it is satisfactory for its intended use.

The check of the tractor should include an inspection of the tires, hoses, glad hand seals, lights, brakes, brake adjuster travel, wheels, placard

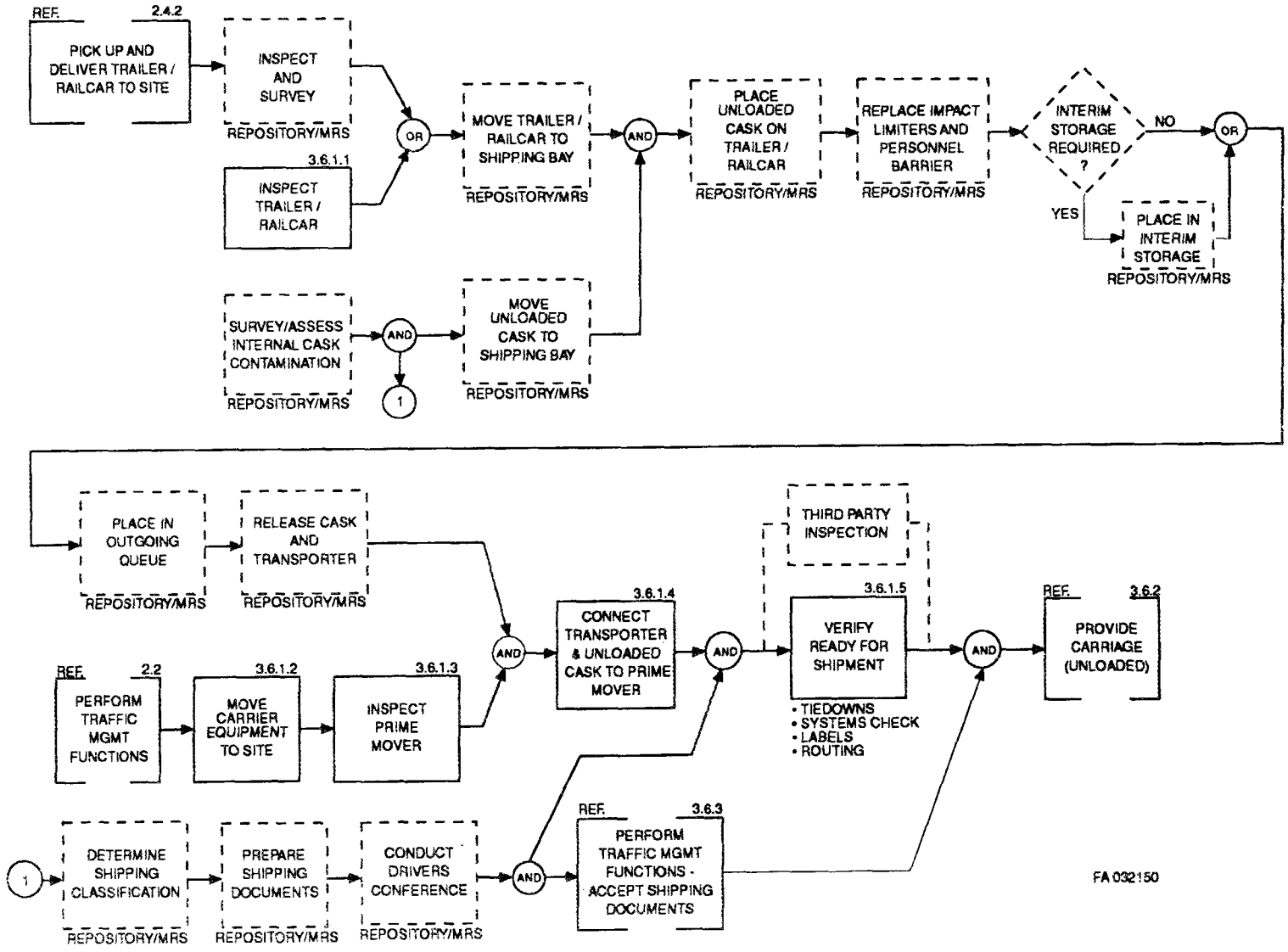

Fig. 25. Functional flow block diagram - perform preshipment preparations (unloaded).

holder, panel indicators and alarms, physical security and communication equipment, road safety equipment, and other physical equipment. Completion of the tractor inspection is expected to be supported by a checklist. At present, the railroad equipment, barges, and heavy haul equipment are maintained and inspected by the carriers' own personnel.

3.6.1.4 Connect transporter to prime mover

As appropriate to either truck or rail shipment, this function verifies that the tractor-trailer or locomotive-railcar systems are properly assembled and operational. The function includes making air and electrical connections and verifying operation, including brake tests. Following testing, all of the operational tests are expected to be documented on a checklist.

This function also includes the completion of the radiological survey required for shipping documentation.

3.6.1.5 Verify readiness for shipment

This function verifies that the shipment is ready for departure. It includes the checking of documentation, configuration, and compliance items. Documentation requirements include the bill of lading, radiological surveys and contents information sheets, route plan (way bill), and emergency instructions.

Configuration verification includes cask tie-down and personnel barrier attachment, loose parts check, and systems operational check.

Compliance items include labeling, permits, and other similar items that are required by regulation or by DOE Orders that are in effect at the time of shipment. During this time period, DOE may contact the state where the shipment originates to determine if the state wishes to carry out an inspection. If so, the inspection is expected to take place just prior to departure.

This readiness verification should be supported by a checklist.

3.6.2 Provide Carriage (Unloaded)

This function is the in-transit tasks associated with the transport of unloaded casks (see Fig. 26).

3.6.2.1 Acquire in-transit permits (if required)

For routine shipments, permits should be obtained in advance as often as possible. The need for permits should be determined, applied for, and provided in advance by the Traffic Management function.

Carriers may apply for permits on a case-by-case basis, but the Dispatch Operations function should be advised when the permits are obtained.

3.6.2.2 Transport shipment

This function is responsible for the continuous movement of the unloaded shipment. These shipments will be made in accordance with campaign or other plans, will use approved procedures, and will comply with the applicable regulations. It includes the integration of inspection activities that may occur en route.

3.6.2.3 Communication activities (unloaded)

Status and location information concerning the shipment will be communicated as needed to satisfy system logistics requirements. It is expected tracking and status of the unloaded shipment information would be available using suitable communication methods.

The utilization of motor and rail carriers is expected to influence how communications needs are met. Commercial carriers are expected to utilize the present practice of communication through the carrier dispatcher.

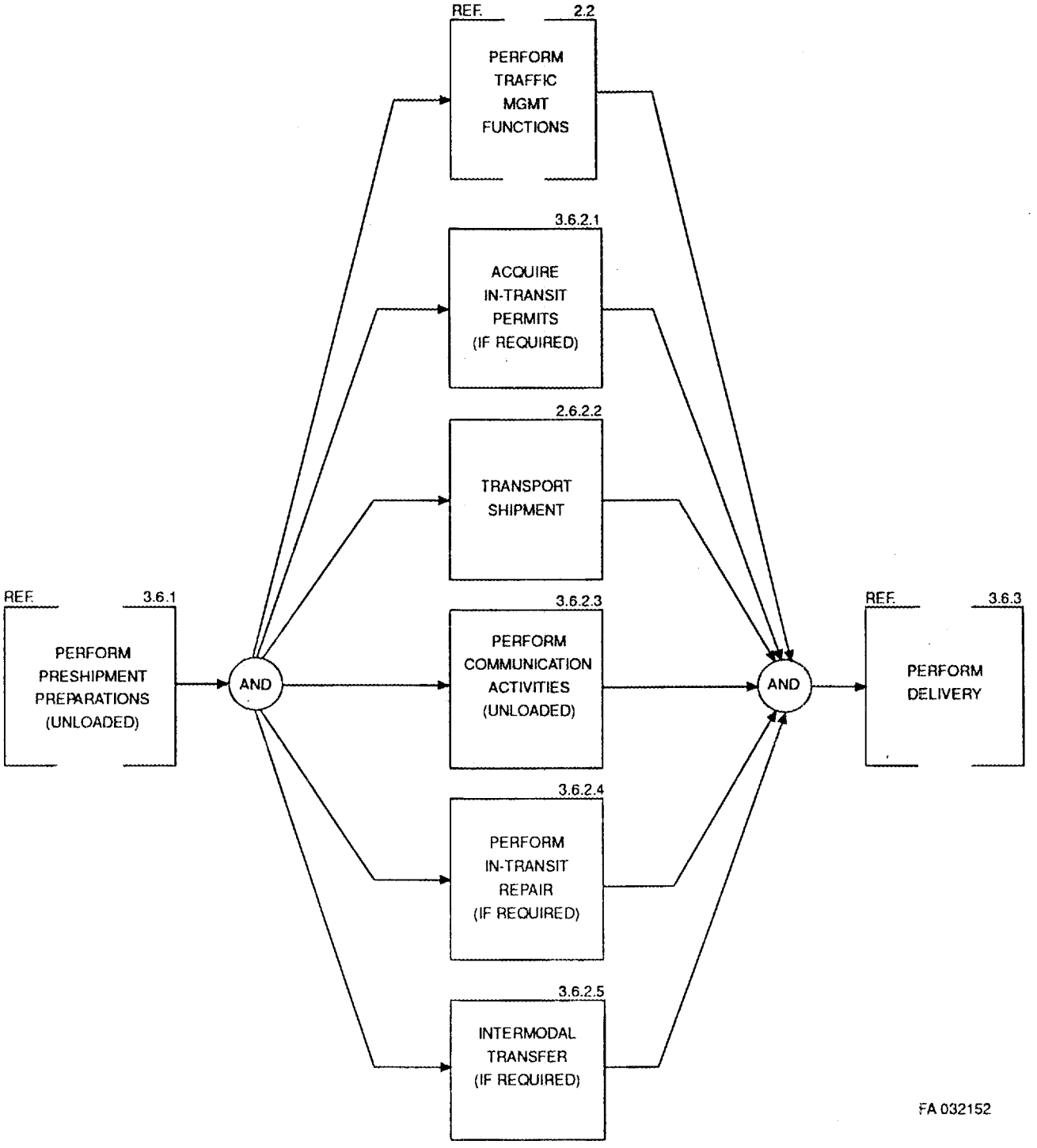

Fig. 26. Functional flow block diagram - provide carriage (unloaded).

3.6.2.4 Perform in-transit repair (if required)

The driver, water craft crew, or train crew is expected to be responsible for verifying the need for in-transit repair and, after confirming the need with the Traffic Management, for initiating the appropriate maintenance action. There are numerous factors involved in making the decisions to either wait for repair or simply replace defective equipment. In any case, all repairs are expected to take place at typical repair facilities and may require the implementation of physical security actions to ensure protection of the unloaded cask. Coordination of the maintenance action may be expected to take place through the Traffic Management function.

3.6.2.5 Perform intermodal transfer (if required)

The Intermodal Transfer function will involve the transfer of a transportation cask from a transport vehicle used for one mode of transport (e.g., heavy-haul truck) to a transport vehicle for a second mode (e.g., rail). Such transfer operations may take place at rail sidings or at barge loading facilities and may be conducted within areas controlled by transportation facilities or at locations accessible to the public. The transfer operations will make use of special transfer equipment and/or facilities. Most intermodal transfers are expected to take place from a heavy haul truck to train or from train to truck. Transfers involving a heavy haul trailer will require special transport equipment, as well as lifting fixtures and cranes. The cask is expected to be positioned on a skid, which would be fitted with fixtures for lifting so that no direct handling of the cask would be required.

3.7 MANAGEMENT OF TS-GENERATED WASTES

The majority of the waste generated by the transportation system will be associated with cask operations. Each waste stream that the TS is responsible for will be monitored for activity and characterized by placing it into one of the following categories:

1. hazardous, radioactive wastes;

2. nonradioactive, nonhazardous wastes;
3. hazardous, nonradioactive wastes;
4. low-level radioactive, nonhazardous wastes (LLW); or
5. high-level radioactive, nonhazardous wastes (HLW).

It should be noted that hazardous wastes are those that are defined as hazardous by the Toxic Substance Control Act (TSCA) and/or the Resources Conservation and Recovery Act (RCRA). These acts specifically exclude radioactive emissions from their list of hazardous wastes; instead, they place wastes having such characteristics in a separate radioactive category. Thus, high-level radioactive wastes do not necessarily fall into the "hazardous" category, but rather the "radioactive" category, even though they are hazardous and are frequently referred to as "mixed wastes."

The waste in the above categories can be in a liquid or solid form. All liquid wastes that are potentially contaminated will be processed and converted to a solid form prior to disposal. It is assumed that no radioactive waste will be disposed of at any TS-operated site.

The TS will provide centralized control and monitoring of all cask system decontamination activities and is expected to provide for control, monitoring, collection, and treatment of all other TS radioactive wastes. The majority of the TS wastes are expected to be LLW. These wastes will be stored, treated, packaged appropriately, and ultimately sent off-site for disposal by an approved method.

3.7.1 Cask Decommissioning and Disposal

In the act of decommissioning, if the cask can be decontaminated to a level permitted for release as normal scrap salvage, no special disposal methods will be required. However, it may be necessary to disassemble certain components for disposal as LLW in order to dispose of the remainder of the cask as commercial nonradioactive waste. Decommissioning procedures will evolve based on the regulatory requirements that are in effect at the time.

3.8 TRAINING

Training requirements are embodied in federal regulations and DOE Orders covering NWPA activities. The training function will include the activities required to impart staff orientation and enhanced skill levels concerning some aspect of the TS. Training will be required for all personnel performing functions within the TS. The level of training implemented and the content of training programs will be tailored to the task assignments of trainees.

Training will be required for TS personnel who engage in any activity which, if improperly performed, would have a potentially negative impact on the health or safety of any individual or on the performance of any Transportation System element.

3.8.1 Monitor and Implement Training Requirements

This function will include activities that monitor regulations, standards, and other documents that affect training requirements. Training will be required for all TS activities, including such functions as cask handling and operations, highway vehicle operation, cask maintenance, health and safety-related activities, and incident response activities.

3.8.2 Support Training

Training and training programs and materials will be made available to other organizations interfacing with the TS. Subcontractors will provide services to the TS in accordance with negotiated contracts. Training requirements will be defined as a portion of those contracts either by specific requirement or by inference.

Waste generators are required to perform multiple cask-handling operations. The TS will train cask-handling personnel (see Field Services, Sect. 3.3). Other waste generator site-specific personnel will be trained if requested.

Individuals who may act as first responders (e.g., state or local agencies) to unplanned incidents and some escorts (e.g., state police) are not a part of the TS. However, the TS will have the capability of providing training to these personnel if a request is made to the appropriate authorities.

3.9 OPERATIONS ANALYSIS AND PLANNING

Operations Analysis and Planning functions will include long-range planning for future operations and analysis and evaluations of current transportation operations. The evaluation of current operations will include monitoring, analyzing, and providing feedback to managers of the transportation system with regard to performance, costs, and schedule parameters. Examples of items expected to be tracked include the measures of quality that will be applied to transportation operations--these are expected to include incident/accident rates; radiation exposure histories for TS workers; recurring problems and delays; and compliance with training, inspection, and shipment schedules. Other items to be tracked will include cask system equipment availability and utilization factors; compatibility with utility- handling facilities; transporter servicing, maintenance, and repair costs; and transportation and operation costs. Analysis of trends in collected data will be used to maintain or improve system safety and efficiency by providing findings, information, and action recommendations to the QA, Operations, and Maintenance functions.

Operations analysis activities will also identify system enhancement needs and alternatives for satisfying these needs. It is anticipated that long-range transportation plans will be developed by using waste generators' delivery commitment schedules and 10-year discharge projections. These plans will provide input to DOE for the preparation of the CRWMS Waste Acceptance Priority Ranking and Annual Capacity reports. The plans will also permit the TS to assess ongoing and future fleet size and modal mix requirements and to identify cask system and support equipment acquisition and replacement needs.

3.10 REGULATORY COMPLIANCE

Compliance functions encompass all activities involving interactions with permitting, licensing, and certifying authorities. These activities will apply to the maintenance of TS licenses, permits, and C of Cs issued by appropriate agencies.

Compliance functions also include activities to maintain conformance with industry and other standards of practice. These various activities necessitate the monitoring of new developments and changes in regulations, laws, standards, and industry practices. This monitoring is also part of the compliance function.

Activities within this function will also involve monitoring compliance with the transportation-related part of the DOE Standard Contract for Disposal of Spent Fuel and HLW.

3.11 INFORMATION MANAGEMENT

The operation of the transportation system will necessitate the development, collection, and maintenance of an extensive body of data, drawings, and descriptions pertaining to all aspects of the TS. This information will be used to support (1) traffic planning, (2) cask fleet management, (3) cask maintenance activities, (4) cask certification and maintenance facility licensing activities, and (5) maintenance of radiation records and other activities. The information will need to be stored in many different, easily retrievable formats, depending on the nature and quantity of the data and on the needs of users.

The information to be stored includes, in part, C of C data; licensing data; as-built cask and facility drawings; waste generator facilities interface description information; state and tribal interface and requirements data; federal, state, and tribal legislative data; shipping records; maintenance and repair records; accountability records (as required); health physics records; operations status data; operations plans data; and QA records. These data

bases will also include status records for each cask in the fleet. The files will contain information on the current configuration of a cask, its current basket and spacers, what types of fuel it can accept, etc.

3.12 ENGINEERING SUPPORT

It is assumed that complete specifications for approved cask systems are available prior to startup of the waste management transportation system and that the cask prototypes and major required facilities have been approved, designed, sited, licensed, and constructed. Nevertheless, Engineering Support functions for the TS will be required and will involve design, analysis, and other engineering operations to support ongoing certification licensing, regulatory, and equipment acquisition activities for casks as well as for TS facilities. These functions will also provide engineering support to the Field Service or Maintenance organizations as requested. Since the work will support the maintenance of casks, equipment, and facilities that will already exist, this is not expected to be a large effort.

3.12.1 Acquisition Support

Acquisition Support refers to that engineering advice, approval, and direction provided to individuals who are responsible for purchasing an item and/or to the individuals who have contracted to supply an item to the acquisition office. It includes acceptance test requirements so that a purchased item is shown to be fit for its intended use.

3.12.2 Regulatory Support

Regulatory Support involves providing engineering capabilities in support of cask certification or facility licensing activities. These activities will address engineering aspects of operations and items in the transportation system when the use, configuration, location, or status of the items and/or operations are regulated.

3.12.3 Technical Support to Field Services

Technical support to the Field Services function is the act of providing engineering services, information, and analyses when needed. This support will generally involve resolving problems concerning the interface between a cask and a waste generator facility.

3.12.4 Technical Support to Maintenance

Technical support to the Maintenance function encompasses a number of engineering services supplied to the Maintenance function when requested. Typically, such services would be requested when the Maintenance functions were involved with equipment repair or modification.

3.12.5 System Enhancements

System Enhancements involve those engineering activities associated with improving the transportation system, subsystem, or equipment.

These activities include:

1. recognition of needs,
2. definition of technical requirements,
3. design,
4. system acquisition support,
5. testing and evaluation,
6. installation and initial operation, and
7. documentation of the "as-built" system or equipment.

3.12.6 Special Equipment Design

Special equipment design is the entire process required to develop sufficient information so that a specific item of equipment can be procured and, at the same time, ensure that the item will properly fulfill its designated function.

Typically, design consists of translating design criteria, which are derived from functional requirements, into a set of drawings and specifications.

3.13 ENVIRONMENT, SAFETY, AND HEALTH (ES&H)

Environment, Safety, and Health (ES&H) functions encompass those activities concerned with controlling air, water, and soil pollution; limiting the health and safety risks of both operating personnel and the general public to acceptably low levels; and adequately protecting property against accidental loss and damage. Typical subfunctions include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facilities safety, nuclear safety, emergency preparedness, and radioactive and hazardous waste management. Applicable state regulations must be evaluated as facilities are sited and as related operations at those sites are defined. It is expected there will be a close coordination between ES&H and most operational functions of the TS.

3.14 QUALITY ASSURANCE

The function of QA is to establish, implement, and maintain an effective management system that ensures that the TS complies with DOE and regulatory requirements. TS organizations will apply procedures developed by the QA group to ensure that operations are conducted according to approved methods and plans, using approved materials, equipment, and components, and properly qualified personnel, and in a manner that ensures results that meet or exceed documented requirements.

QA functions are specified in DOE/RW-0214, Quality Assurance Requirements for the Civilian Radioactive Work Management Program (QAR).

The management controls imposed will be structured to meet programmatic needs; that is, the controls will be graded to meet the requirements depending on the importance of the item or task activity to safety, transportation, or other program objectives.

Activities will be, in part, as follows:

1. Preparation and maintenance of Quality Assurance Planning Documents (QAPDs) that identify (1) the organizations involved in TS activities; (2) applicable requirements of the QAR; and (3) procedures for the performance of quality-affecting activities, including a schedule for those procedures that must be developed.

2. Preparation and maintenance of task descriptions and QA specifications that define subtier activities and the required level of management controls to be imposed.

3. Preparation and maintenance of technical and administrative implementing procedures that define how the TS tasks will be performed and evaluated.

4. Provide staff orientation and training in the use of the implementing procedures and identification of their importance to the accomplishment of mission objectives.

5. Perform regular assessments of the QA program to determine if it is being effectively implemented. These overview activities shall ensure that nonconformances, deficiencies, and other conditions that could affect programmatic quality adversely are corrected in a timely manner.

3.15 EQUIPMENT AND SERVICES ACQUISITION

In addition to acquiring cask system components for the cask and vehicle fleet, it is expected that there will be a wide variety of specialized equipment, tools, spare or repair parts, and services that will have to be procured during the time the TS is in operation. This will give rise to an Equipment and Services Acquisition function that will involve both purchasing and contracting activities. The effort will be responsive to Traffic Management, Maintenance, Field Services, and Engineering Support functions.

3.15.1 Fleet Procurement

This term refers to the purchase, lease, or other method of acquiring the casks, as well as the necessary components that make up, and become integrated with, the transportation system fleet. These components include the trailers, railcars, and ancillary equipment used to accomplishment the overall transport waste functions.

3.15.2 Ancillary Equipment Design and Procurement

Ancillary equipment design and procurement involves the purchase of the engineering design for a piece of specialized equipment or a system. The purchase contract could specify that just the design (i.e., drawings and specifications) be provided, or the purchase contract could include the design, fabrication, and qualification for the item or system.

3.15.3 Spare Parts and Consumables

The Equipment and Services Acquisition function includes the acquisition of spare parts and supplies to replace those that are consumed during the normal operation of the transportation system.

3.15.4 Major Equipment Repair

The transportation system does not, in general, expect to have to perform major repairs on any items or pieces of equipment. It is anticipated that major repairs will be of such an infrequent nature that the cost for procuring such activities from outside vendors will be far less than providing the heavy-duty capital equipment that would be required to perform these repairs. This is especially true if the necessary repair equipment and facilities would be idle a great percentage of the time.

3.15.5 Carrier Services

Carrier services include those normally provided by a commercial carrier who provides transportation services as a primary business. These services are expected to be provided by private industry carries and procured to fulfill the Carriage function for the transportation system.

3.16 TRANSPORTATION SYSTEM MANAGEMENT

Transportation System Management functions include, but are not limited to, the following:

- Planning,
- Directing,
- Controlling,
- Reviewing,
- Reporting,
- Coordinating, and
- Budgeting.

There are certain other management-related functions that must be closely monitored to ensure smooth, continued operation of the system, such as

- Finance & Accounting,
- Personnel,
- Medical,
- Benefits Administration, and
- QA (addressed separately in this document, see Sect. 3.14).

Each of the above functions will be applied to all TS activities. The full implementation and further detailed breakdown of these activities will depend on the organizational structure selected for the entire waste management system as well as that of the TS. For example, the Finance & Accounting and the Reporting activities could vary tremendously among different management structures. The way they function will depend on the contract (if any)

between DOE and/or its agents and contractors who will be performing the work for OCRWM.

3.17 EXTERNAL RELATIONS

This function is concerned primarily with supporting the CRWMS interactions with all public and private organizations external to the DOE systems that are interested in matters which would impact the operating TS. The areas of support covered by this function include external relations, TS policy development, and information services. The subfunctions that must be carried out include:

1. supporting CRWMS interactions with outside organizations,

2. developing transport operations-related information as requested,

3. maintaining TS policies and plans for external distribution as requested,

4. monitoring external activities that may result in interactions with the TS, and

5. implementing informational plans and developing materials.

The External Relations function will also include policy development activities to help ensure that the TS works in concert with other DOE organizations and within the guidelines and requirements of the NWPA and its amendments. By maintaining the necessary awareness of the DOE system and external forces that may help shape that system, the TS will also be capable of providing information to the public and federal organizations as requested by the CRWMS.

4. REFERENCES

1. Transportation Operations Functions of the Federal Waste Management System, ORNL/TM-10811, June 1988.

2. Waste Acceptance Criteria Study, Issues and Results, Vol. 1 & 2, EPRI NP-6001, September 1988.

3. Feasibility Study for a Transportation Operations System Cask Maintenance Facility, M. J. Rennich, L. G. Medley, and C. R. Attaway, ORO/TOPO-5404.0 (ORNL/TM-11019), January 1991.

4. Waste Management Systems Requirements and Descriptions (SRD), Office of Civilian Radioactive Waste Management, DOE/RW-0063, January 1986.

5. 10 CFR 961 - Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Radioactive Waste.

6. 49 CFR 177.825 - Routing and Training Requirements for Radioactive Materials (HM - 164).

APPENDIX A

DESCRIPTION OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT TRANSPORTATION SYSTEM

(A "White Paper" submitted to J. H. Carlson, U. S. Department of Energy)

Appendix A was written as a stand-alone white paper describing the transportation system of the CRWMS. It was submitted to OCRWM in fulfillment of a milestone. Because it is reproduced verbatim, the figure numbers are the same as in the original white paper (i.e., they start at Fig. 1 and run through Fig. 6) and this full report is cited as a reference.

DESCRIPTION OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT TRANSPORTATION SYSTEM

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DESCRIPTION OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT TRANSPORTATION SYSTEM

1. Introduction

Within the framework of Public Law 97-425 and provisions specified in the Code of Federal Regulations, Title 10 Part 961, the U.S. Department of Energy has the responsibility to accept and transport spent fuel and high-level waste from nuclear utilities and other organizations, generically identified as Purchasers, which have entered into a contract with the Federal Government to purchase these services. In implementing these requirements of the contract, the Civilian Radioactive Waste Management System (CRWMS) is, among other things, developing the concept of a Transportation System (TS) that will accept the waste for transport to a federal facility for storage and/or disposal. Recently, a document[1] was completed in which the various functions of the transport system were identified by applying a Systems Engineering Process. A next step in this process is to allocate the responsibilities for the various functions to functional elements (subsystems or subsystem components). This document identifies those subfunctions of the TS and further breaks them down into elements and components. The result is a description of the transportation system which encompasses all functions that it must accomplish.

The TS for waste will have five major parts (subsystems), working together to efficiently and safely transport spent nuclear fuel and high-level radioactive wastes. The five subsystems are:

1. **Planning and Control,**
2. **Transportation Cask,**
3. **Carriage,**
4. **Field Operations,** and
5. **Servicing and Maintenance.**

This component structure of the TS is depicted graphically in Fig. 1. This method of depicting the TS's composition illustrated in the figure is also

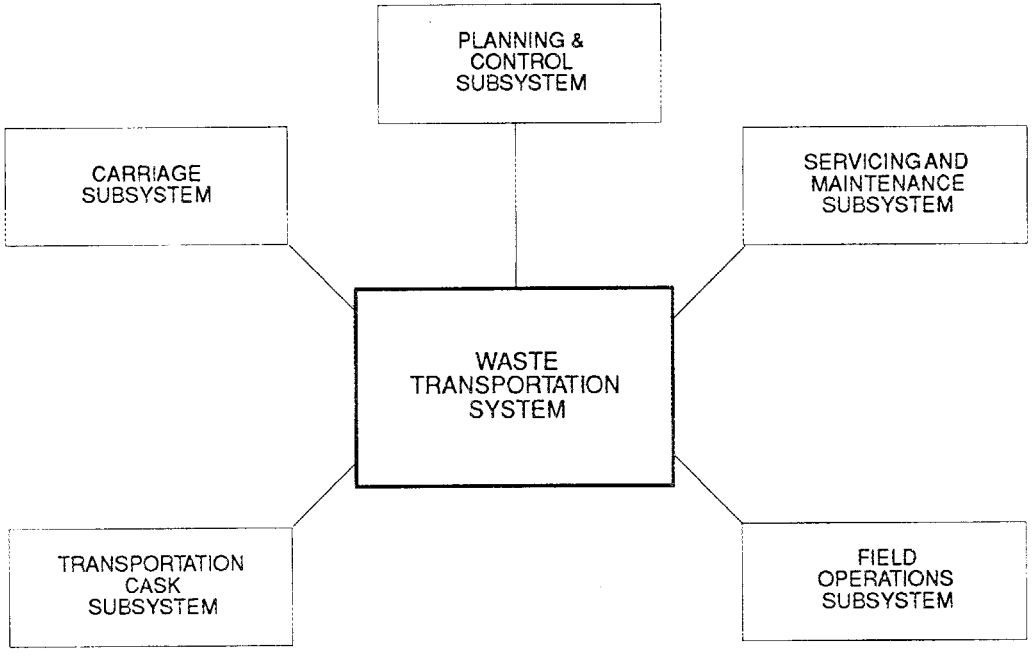

Fig. 1. Subsystems of the Waste Transportation System (TS).

used in the following five sections to illustrate the composition of each of the subsystems.

2. The Planning and Control Subsystem

The **Planning and Control subsystem** performs the planning, implementing, directing, and controlling functions necessary to the operation of the total TS. This subsystem provides the top-level management and integration of the operations of the other subsystems as well as manages the TS side of interfaces with other systems internal and external to the CRWMS. Included in TS management are activities to (1) schedule the use of TS resources and administer budgets for the overall operation of the TS; (2) provide administrative support for the TS operations and staff; and (3) prevent duplication of resources and capabilities in the other subsystems of the TS. The composition of the **Planning and Control subsystem** is illustrated in Fig. 2. As shown, this subsystem consists of nine major elements: Waste Transportation System Manager, Operations Management, Information Management, Engineering Support, Administration, Long-Range Planning and Analysis, Training, Quality Assurance, and Regulatory Compliance.

2.1 Waste Transportation System Manager. This subsystem element consists of the personnel, equipment, software, and facility resources that will be needed to plan, direct, and control the transportation system as a whole. Typically, this element would include a top-level manager who has overall responsibility for, and associated authority to direct and control, the current and long-range operational performance of all components of the system. This manager would be assisted and supported by administrative and professional staff. The manager's office (the title for the collection of staff and other resources that make up this transportation system element) would operate in compliance with approved policies and procedures, would use office equipment and software, and would reside in office space located in a fixed-base facility.

2.2 Operations Management. This element consists of the personnel, equipment, computer software, facilities, and information/data required to

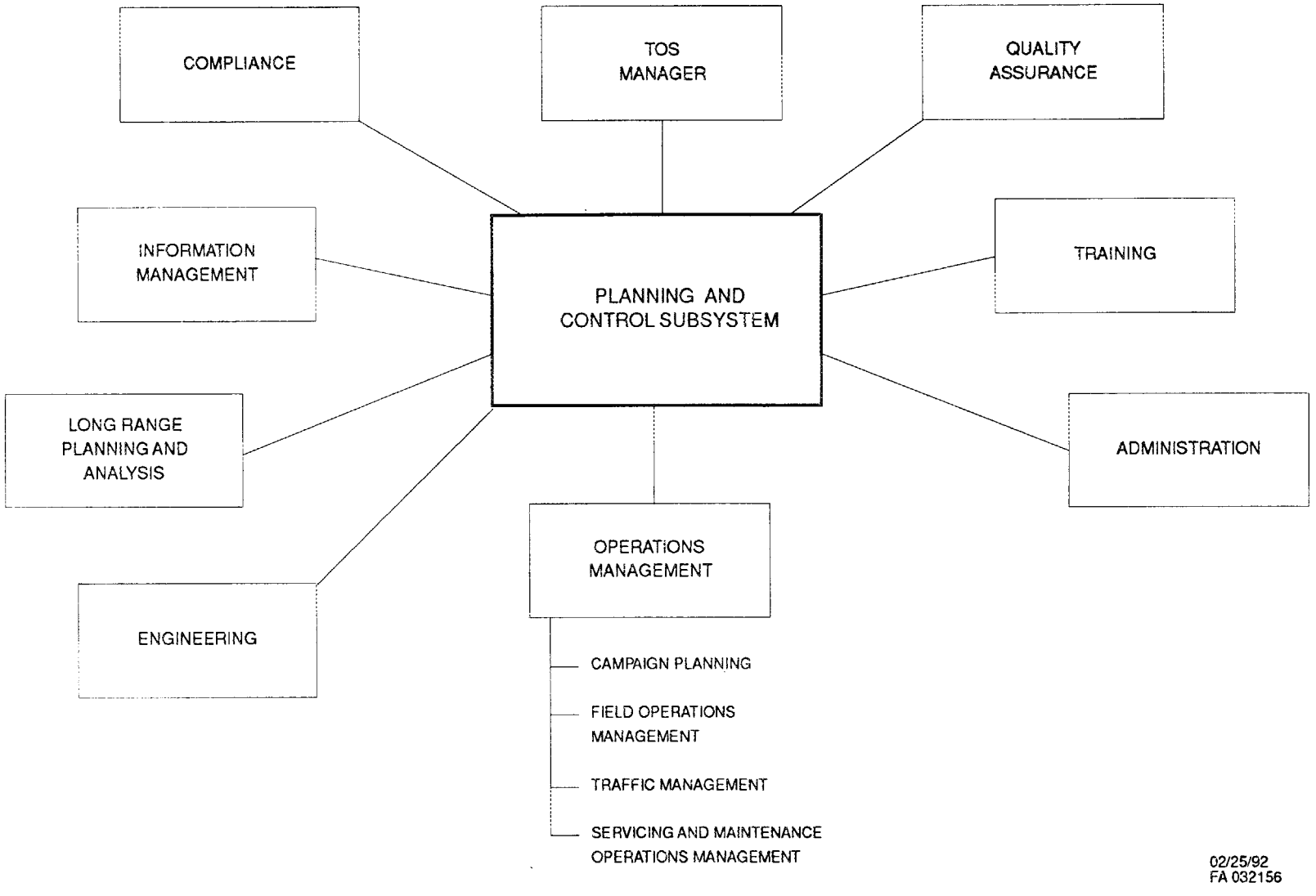

Fig. 2. Elements of the Planning and Control Subsystem.

effectively manage day-to-day transportation operations, including managing the operating interfaces between the TS and systems internal and external to the CRWMS. As shown in Fig. 2, this element is envisioned to consist of four components: **campaign planning**, **field operations management**, **traffic management**, and **servicing and maintenance operations management**. Each of these components will require various facilities, equipment, personnel, and software (including computer software, written procedures, and other written documentation).

- **Campaign planning** encompasses those activities required to develop, modify, assemble, and distribute information pertaining to a consecutive set of shipments from a given shipping (originating) site over a fixed period of time. It is also concerned with ensuring that the personnel, equipment, and facility resources of the TS are used effectively in the conduct of all planned campaigns. For each campaign, information will be distributed to the operations management organization at CRWMS receiving facilities and at the affected waste generator facility. In addition, planning information will be distributed to the TS organizations responsible for field services, traffic management, and maintenance, and to others whose work schedules will be directly affected by the campaign planning activities. This activity oversees and coordinates the planning between the **Carriage** (Sect. 4), **Field Operations** (Sect. 5), and **Service and Maintenance subsystems** (Sect. 6).

- **Field operations management** is concerned with ensuring that the equipment, personnel, information/data, procedures, etc., required for the management of field operations functions are available at the right place and at the proper time and that the performance of the **Field Operations subsystem** satisfies requirements and meets goals. The specific field operations activities are described in more detail in Sect. 5.

- **Traffic management** involves administrative and operations functions that manage the transport of loaded and unloaded cask shipments as well as

shipments of ancillary equipment needed to support campaign operations at shipping facilities. It will include administrative and operations activities associated with dispatching shipments. It manages the operation of the **Carriage subsystem** to satisfy performance requirements, meet established goals, and ensure proper interfacing with the **Field Operations** and **Servicing and Maintenance subsystems**.

- **Servicing and maintenance operations management** is primarily concerned with the coordination and scheduling of **Servicing and Maintenance subsystem** resources, including facilities, and with the management of the subsystem's performance to meet requirements and goals. The coordination of the **Servicing and Maintenance subsystem** with the **Carriage and Field Operations subsystem** is accomplished here.

2.3 Information Management. This element encompasses the collection, maintenance, and distribution of data, drawings, and descriptions pertaining to all aspects of the TS. Examples of specific information that will be managed are:

- records of cask maintenance,
- NRC Certificates of Compliance,
- Safety Analysis Reports for Packaging (SARPS),
- as-built manufacturing and construction drawings for casks and other equipment and for TS facilities and associated equipment,
- training records,
- shipment records,
- route plans,
- emergency response plans,
- organizational responsibility assignments,
- operating procedures,
- Quality Assurance records.

This body of historical and current information will be required to properly manage the TS and will ensure that the "corporate memory" of the

planning, development, and operation of the TS is retained; this is critical due to the long duration of these activities (expected to be a number of decades). The information management element will interface with all other elements of the TS.

2.4 Engineering Support. This element provides engineering-related support to the TS. The Engineering Support element's activities will include design, analysis, and other engineering operations to support ongoing licensing, regulatory, and equipment acquisition activities for casks, ancillary equipment, and TS facilities. It will have primary interfaces with the **Field Operations** and **Servicing and Maintenance subsystems**.

2.5 Administration. As in any system, certain administrative functions must be performed. These functions, which will be accomplished by the Administration element, will include finance and accounting, human relations, medical, and benefits administration.

2.6 Long-Range Planning and Analysis. This element encompasses those activities designed to anticipate TS operations in the time period 5 years or more into the future and to plan for needed system improvements/enhancements and growth. In addition, the Long-Range Planning and Analysis element will develop and provide management information on the performance of current operations. The evaluation of current operations will include monitoring, analyzing, and providing feedback with regard to TS performance, costs, and schedule parameters.

2.7 Training. This element encompasses the necessary training of TS staff, as well as provides support to the **Field Operations subsystem** in conducting training of utility and CRWMS facility personnel for the proper and safe handling of transportation cask systems. Training will be required, at some level, for all personnel performing functions within the TS.

2.8 Quality Assurance. This element maintains a TS Quality Assurance (QA) program that complies with DOE and regulatory requirements. Personnel will be

assigned to perform QA functions in accordance with the requirements of DOE/RW-0214, Quality Assurance Requirements for the Civilian Reduction Waste Management Program, or its successor.

2.9 Regulatory Compliance. This element will interact with authorized permitting, licensing, and certifying authorities. Compliance functions also include activities to maintain conformance with industry and other standards of practice. TS personnel will be responsible for ensuring compliance with regulatory requirements.

3. The Transportation Cask Subsystem

The **Transportation Cask subsystem** includes casks, trailers/railcars, ancillary equipment, and documentation required to transport spent nuclear fuel and high-level radioactive waste within the CRWMS. It provides certified transportation casks and associated transporters necessary to safely transport spent nuclear fuel and high-level waste in the public domain.

The elements of the **Transportation Cask subsystem** are identified in Fig. 3. As shown, this subsystem consists of three major elements: From-Reactor Cask Systems, Commercial and Defense High-Level Waste (HLW) Cask Systems, and MRS-to-Repository Cask Systems.

3.1 From-Reactor Cask Systems include those cask systems used to transport spent nuclear fuel from waste generators or from temporary storage sites to a Monitored Retrievable Storage (MRS) facility or repository. This element may be further subdivided into six components:

- **CRWMS legal weight truck cask systems** will be used to transport spent nuclear fuel from spent fuel facilities (principally reactors); each component consists of a cask and transporter (tractor and trailer) with a maximum gross loaded-vehicle weight of 80,000 lb and supporting tools, spare parts, and ancillary equipment;

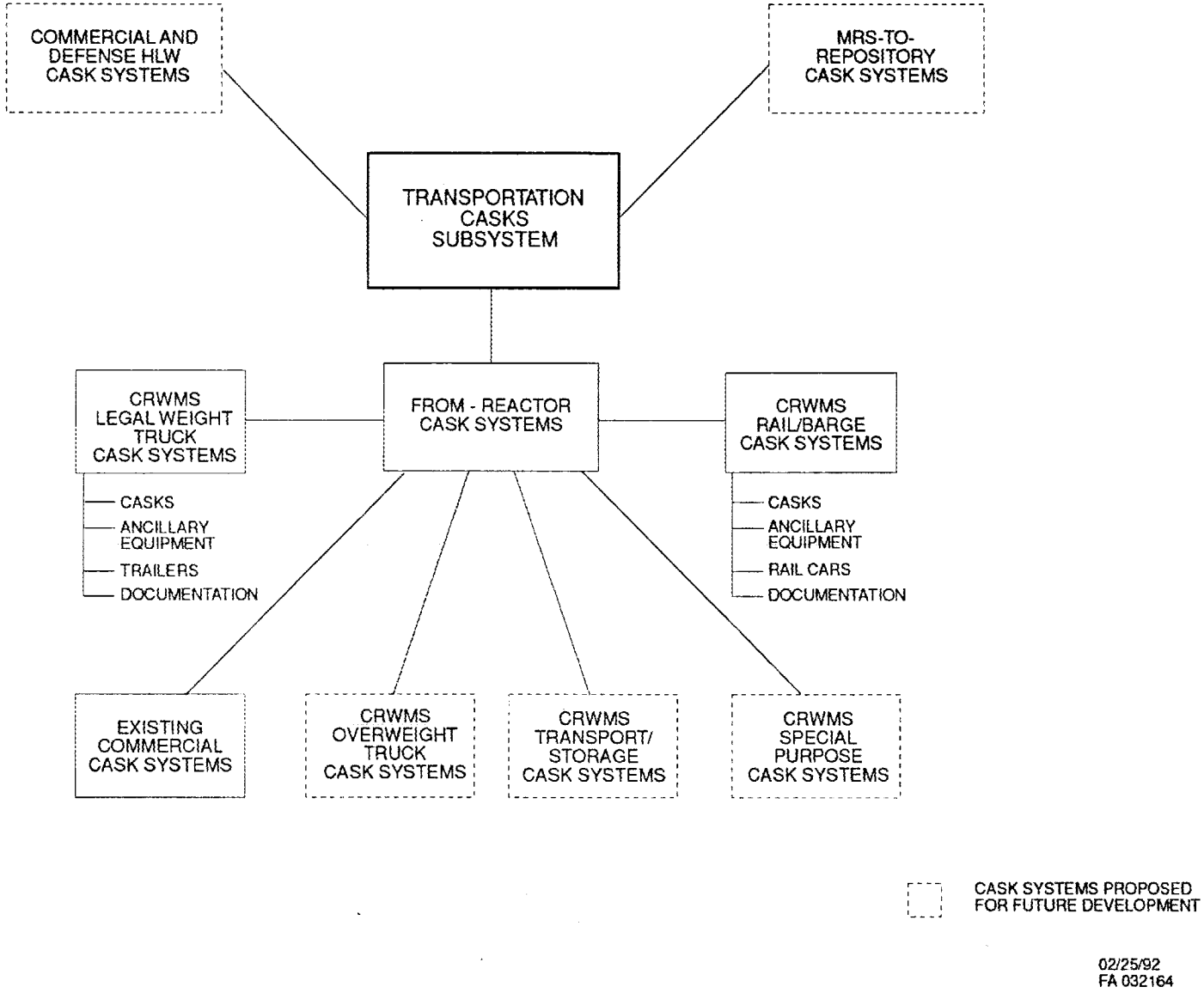

Fig. 3. Elements of the Transportation Cask Subsystem.

- **CRWMS rail/barge cask systems** will be used to transport spent nuclear fuel from spent fuel facilities over rail lines and/or waterways; the system utilizes a cask with a weight limit of 100 tons, a railcar, and supporting tools, spare parts, and ancillary equipment;

- **CRWMS special purpose cask systems** will also be used for transport of spent nuclear fuel from spent fuel facilities where **legal weight truck or rail/barge cask systems** either can not be accommodated at the reactor facility, or the fuel can not be accommodated in these "standard" casks; these casks may be either legal weight truck, overweight truck, or rail/barge casks (It is anticipated that these systems would be similar to other **from-reactor cask systems** and would be used for the carriage of such items as failed fuel, nonstandard fuel, and/or canistered fuel and would probably utilize specially designed spacers, baskets, or other unique cask features);

- **CRWMS transport/storage cask systems** may also be used to transport spent nuclear fuel from spent fuel facilities to CRWMS facilities where they would be placed into long-term storage with the contained fuel. Long-term storage could also occur prior to shipment. These casks are expected to be rail/barge types with a maximum cask weight of approximately 125 tons;

- **CRWMS overweight truck cask systems** may also be used to transport spent nuclear fuel from reactors: A system will consist of a cask and transporter (tractor and trailer) with a maximum gross weight exceeding the legal limit of 80,000 lb; it will also include associated ancillary equipment, tools, and spare parts; and

- **Existing** (at the time when casks are needed for CRWMS transportation operations) **commercial cask systems** may also be used to transport spent nuclear fuel from spent fuel facilities; these cask systems consist of casks and transporters (legal weight truck, overweight truck, or

rail/barge type) that are currently (CY 1992) available, or which may become available in the future from commercial cask suppliers.

In all cases, the ancillary equipment includes such items as personnel barriers that surround the cask during transport and protect personnel from thermal exposure and prevent unauthorized access to the cask surface; tie-down hardware to secure the cask to the transporter; and maintenance and test equipment associated with the cask system.

Also, for all cask types, documentation will be required. The documentation includes, among other things, the SARP, as-built manufacturing drawings, NRC Certificate of Compliance, and operations and maintenance procedures manual.

3.2 Commercial and Defense HLW Cask Systems. The Standard Contract (10 CFR 961) requires that the CRWMS accept high-level waste as provided in Section 302 of the Nuclear Waste Policy Act of 1982. Both defense high-level waste and commercial high-level waste will be solidified and canistered at the point of origin and are planned to be transported directly to the repository. The cask expected for use with truck transport is estimated to weigh about 25 tons, with a capacity for 1 high-level waste canister. For rail transport, the cask is expected to have a weight limit of 100 tons. Because development of high-level waste cask systems has not progressed beyond the study phase, definitive design descriptions are not available.

3.3 MRS-to-Repository Cask Systems. Spent nuclear fuel is expected to ultimately be transported from an MRS facility to a repository by dedicated trains or, under unusual conditions, possibly part way by heavy-haul trucks. The dedicated trains are envisioned to move 5 large (150 tons), high-payload capacity, rail casks using 8-axle railcars, although 6-axle railcars are a possibility. Since development of MRS-to-Repository Cask Systems has not progressed beyond an initial conceptual study phase, definitive design descriptions are not available.

4. The Carriage Subsystem

The Carriage subsystem transports, and provides any required in-transit security for, casks loaded with spent nuclear fuel or high-level radioactive waste. It also performs these functions for unloaded casks and for other materials associated with the CRWMS, such as ancillary equipment, replaceables, and spares shipped to a cask-loading facility prior to the start of a shipping campaign. The subsystem consists of transportation carriers and in-transit security providers. The carriers may be private (if DOE acts as its own carrier for some activities), contract, or common (depending on circumstances) and will encompass highway, rail, barge, and intermodal transportation. The in-transit security providers may be private sector companies; a Government organization; or a Government Owned, Commercially Operated (GOCO) enterprise. Carriers may elect to provide both carriage and in-transit security services. Day-to-day operations of the **Carriage subsystem** will be controlled by the Traffic Management element of the **operations management** component of the **Planning and Control subsystem**.

The major elements of the **Carriage subsystem** are identified in Fig. 4. As shown, this subsystem consists of two elements: Carrier Operations and Physical In-Transit Security.

4.1 Carrier Operations. When performing carriage services for the **Carriage subsystem**, carriers will be responsible for providing motive power (highway tractors, locomotives, tugboats) and other conveyance equipment (buffer cars, heavy haul equipment) not provided as components of the **Transportation Cask subsystem**; personnel to operate this equipment; and all procedures, documentation, and computer software required to conduct transport functions. It is expected that carriers will be responsible for their equipment used in the **Carriage subsystem**. This responsibility is expected to extend to:

- maintenance (including in-transit maintenance of vehicles and other conveyance equipment),
- repair,

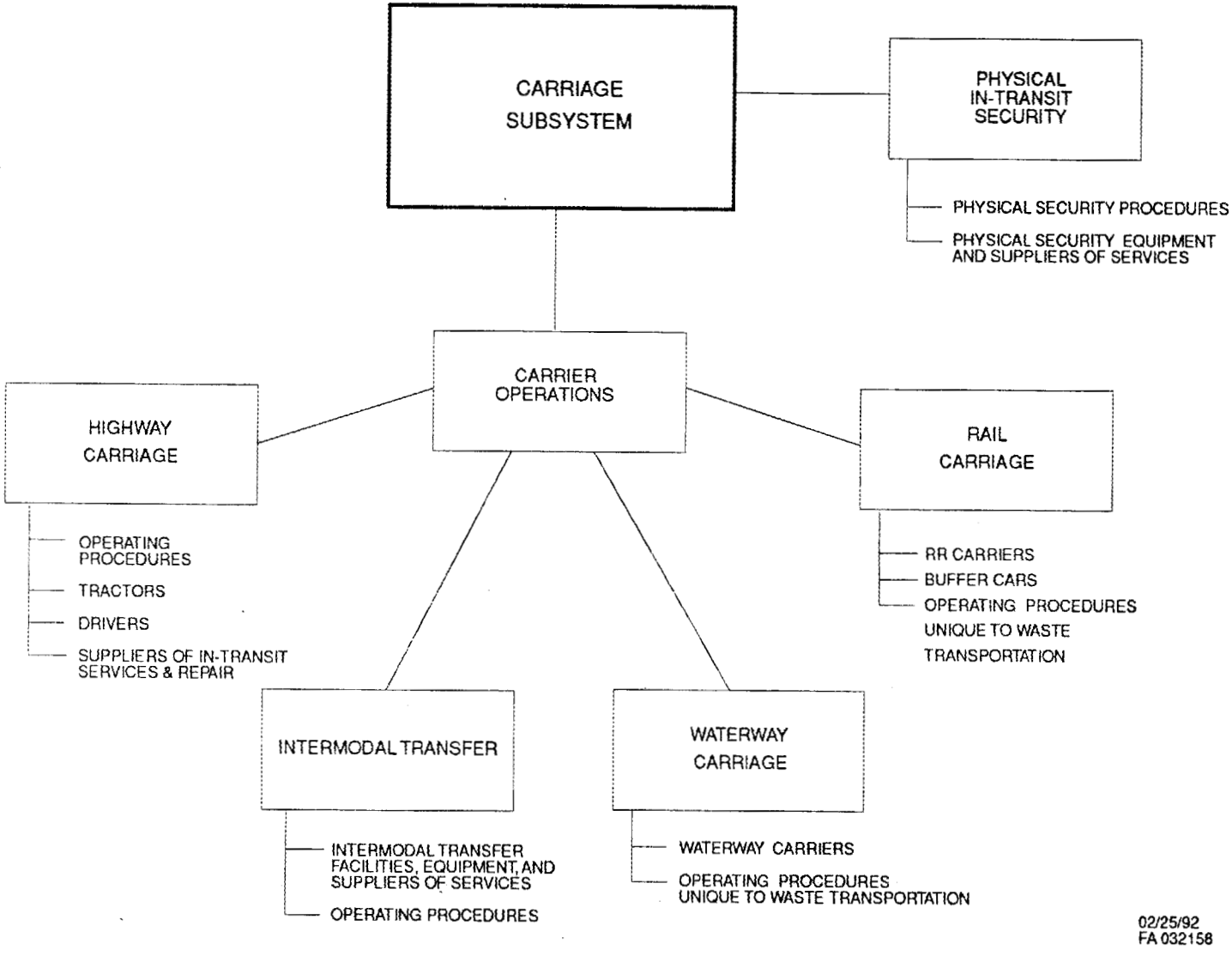

Fig. 4. Elements of the Carriage Subsystem.

- replacement,
- safety,
- reliability,
- availability,
- maintainability,
- and other features or capabilities that may be required by DOE.

It is expected that the carriers will also be responsible for ensuring and verifying the availability, qualifications, and fitness (per DOT regulations and including DOE-required qualifications and measures of fitness, if any) of personnel provided to operate and maintain the motive power and other conveyance equipment used in the transport function. Carriers will also be responsible for providing all documentation normal to carriage (e.g., vehicle registrations, operating licenses, driver logs). Other transportation documents, such as Bills of Lading, emergency action plans, security plans, and route plans, will be supplied to carriers by other subsystems of the TS.

4.2 Physical In-Transit Security. The in-transit security providers will be responsible for supplying, or arranging for, all in-transit equipment (e.g., communications equipment and escort vehicles) necessary to satisfy regulatory and DOE requirements for in-transit security of loaded cask shipments. Organizations that perform in-transit security services for the TS will also be responsible for providing, and ensuring and verifying the qualifications and fitness (per NRC regulations and DOE Orders) of, personnel to perform in-transit security functions. Security providers will be responsible for providing any necessary documentation that would normally be associated with transportation security activities (e.g., firearms permits for security specialists).

The personnel of the Physical In-Transit Security element will include security specialists, communications specialists, and escorts. Special equipment required for Physical In-Transit Security is expected to include a satellite tracking system capable of providing two-way communication and real-time shipment location, computers and special satellite tracking software, customized computer data base software, portable radio telephones, and

dedicated emergency telephone lines at the CRWMS facilities. The Physical In-Transit Security element will also be responsible for maintaining and implementing a documented Security Plan which will delineate the security provisions and requirements that will apply to spent nuclear fuel shipments.

The following is a generalization of security requirements as published in 10 CFR 73.37. These requirements apply to all modes unless specifically indicated otherwise. It is assumed that TS in-transit security operations will follow these requirements. Included are requirements that

- tractors used in highway transport of spent nuclear fuel will be equipped with immobilization devices capable of immobilizing the transport vehicle for a minimum of 30 min;

- drivers and escorts will be trained in accordance with the provisions of 49 CFR 177.825 (for drivers), 10 CFR 73.37, and any applicable requirements of the TS (for both drivers and escorts);

- a central communication center which is staffed at all times will be used when spent nuclear fuel is being transported. This center will be for the purpose of receiving check calls and initiating emergency response actions if necessary;

- all check calls will be recorded by communications personnel and shipment escorts;

- shipments travel over preplanned and approved routes;

- emergency assistance arrangements have been made with local law enforcement agencies along the route of movement;

- transport vehicles are occupied at all times; and

- the shipments are kept under constant surveillance during transport.

In the case of highway shipments, team drivers are considered escorts if they have received the security training required by 49 CFR 177.825, 10 CFR 73.37, and applicable DOE Orders.

5. The Field Operations Subsystem

The Field Operations subsystem consists primarily of TS personnel who carry out field service functions and provide support to facilities where SNF or HLW are accepted for transport to CRWMS facilities. Field Operations personnel also provide both training and advice to CRWMS operators as necessary and to emergency response authorities if requested.

This subsystem consists of five elements (see Fig. 5), each of which is discussed below. They are:

- Waste Generator Facility Interface Information,
- Facility Interface Equipment,
- Accept-for-Transport Operations,
- Waste Generator Technical Support, and
- Emergency Response Operations Support.

5.1 Waste Generator Facility Interface Information. Initially, a Site and Facility Waste Transportation Services Planning Document (SPD) is to be developed for each storage pool that will be served by the TS. Each SPD will be followed by (or will evolve into) a Site-Specific Servicing Plan (SSSP). The information to be contained in these documents is not necessarily available now but is needed to:

(1) ensure that the TS knows what the interface requirements are for each facility so that appropriate equipment, documentation, and support can be selected and provided;

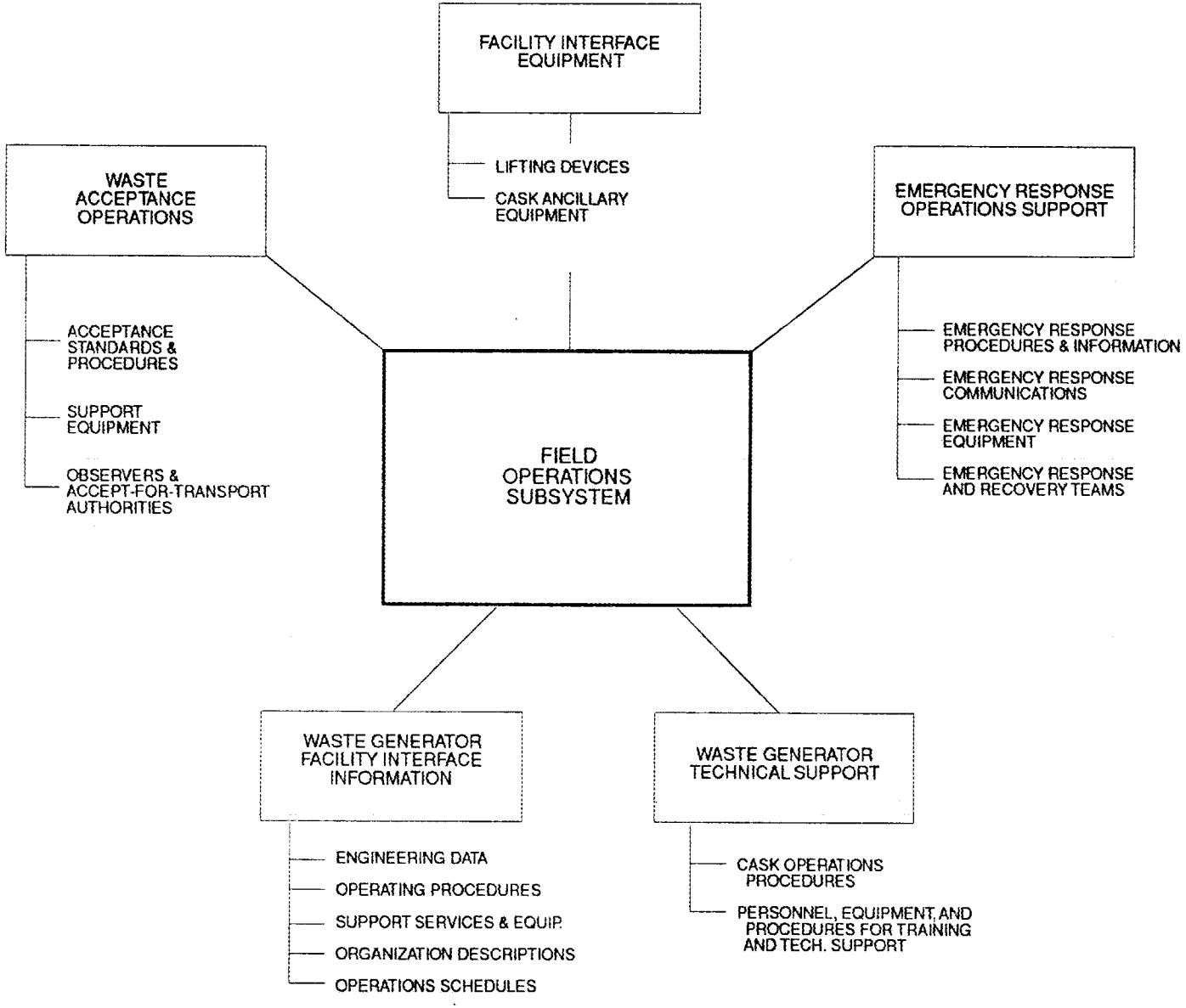

Fig. 5. Elements of the Field Operations Subsystem.

(2) ensure that any restrictive limitations of the site or facility are known and addressed or mitigated before shipping campaigns are initiated; and

(3) allow opportunity for removing any restrictive limitations of the site or facility as may be appropriate and if determined to be beneficial by the Purchaser.

Much of the Waste Generator Facility Interface Information consists of the data, procedures, and other documentation available to field operations personnel and will be required to ensure that the operational interface between the TS equipment and each reactor facility (or other Purchaser designated facility) is defined, documented, and understood by both parties.

The Facility Interface Information can be divided into five components: (1) **engineering data**, (2) **operating procedures**, (3) **support services and equipment**, (4) **organization descriptions**, and (5) **operating schedules**, which are discussed below:

- **Engineering data** - These data consist of technical information (primarily drawings and specifications) related to the TS equipment and which can be used to define unique aspects of the functional and physical interfaces between the CRWMS transportation equipment and the Purchaser's equipment and facilities. The transportation equipment (casks and supporting equipment) is to be supplied by the DOE. The related engineering data will be maintained by the TS; it will be used by field operations personnel to ensure proper preparations for, and informed assistance during, shipping campaigns.

  In addition, field operations will have access to, and use, engineering data that describe the operations features of the transportation equipment (casks, etc.); this information will also be made available to operators of the Purchasers' facilities. Included will be descriptions of operations features important to cask handling, loading, and

preparations for shipment. Cask and ancillary equipment drawings and specifications (including operating specifications) are examples of such engineering data.

For a specific facility, additional data will be needed, including:

- drawings and specifications for special equipment unique to the facility, such as lifting extensions, and hook adapters (if required) and slings to be used with the cask handling crane;

- drawings and specifications for a failed fuel canister for failed spent fuel selected for delivery and for which DOE has agreed to a schedule for delivery;

- drawings and specifications for special tools and equipment unique to the facility and required for cask assembly/disassembly, personnel barrier installation/removal, cask loading, and cask tiedown.

- **Operating procedures** - Procedures that relate to cask operations and which have been prepared and approved by the facility's operations staff will be required and will then need to be followed for all work performed at a facility where spent nuclear fuel is stored. This will also cover any operations work (e.g., inspections, equipment receipt activities) at the facility that may be performed by the TS's field operations personnel. These operating procedures will set forth any and all limitations for handling of spent fuel in the facility; preparation of spent fuel or high-level waste for delivery to DOE; and preparation for cask handling, loading, and shipment at the facility.

  Each Purchaser's site has a requirement for qualifying personnel as "fit for duty" who are to be on-site, unescorted. Fitness-for-duty requirements will be applied to nonfacility personnel, including TS

personnel, when they are to be on-site, unescorted, in order to perform necessary tasks. This is discussed in more detail in Sect. 5.3.

The facility procedures for cask operations are derived, in part, from cask operating procedures. There will be an operating procedures manual provided to Purchasers by the TS for each cask type used at the site. This manual will have detailed operating procedures for handling, loading, shipment preparation, and maintenance activities for the type of cask to be provided, but it will address facility interfaces generically; the cask operating procedures manual will be used and maintained by field operations personnel responsible for providing support to a Purchaser's facility in advance of, and during, shipping campaigns.

In advance of a shipping campaign, TS personnel will provide support to a Purchaser's facility operators to assist in generating the facility-specific operating procedures. Support will be provided for developing any or all procedures needed to accomplish tasks related to the preparation for, and delivery of, spent fuel or high-level waste to DOE for transportation.

- **Operating procedures** will cover at least the following:

  - in-plant cask handling, loading, and preparations for shipment, including incidental maintenance, for each specific reactor site;

  - activities that prepare the spent fuel or high-level waste in advance of shipping campaigns as well as handling and loading of failed fuel canisters;

  - loading a cask onto, and unloading it from, a transport vehicle; cask impact limiter removal/installation and tiedown; personnel barrier installation/removal; and final preparations for shipment, considering the mode of transport to be used; and

- acceptance-for-transport support equipment utilization (see accept-for-transport operations in Sect. 5.3).

- **Support services and equipment** - Each reactor facility having a storage pool will provide support services and equipment for cask-related operations. These services and their equipment will also be identified and described in TS documents used for reference by the field operations personnel. Information in the TS documents will be maintained by TS personnel with the help of the shipping facility's operators. The information will include:

  - identification of qualified experts who can provide plant-specific technical advice and assistance if it becomes needed during advanced preparations for (or during) cask handling, loading, and shipment preparations;

  - identification of available spare parts and consumables on-site or nearby;

  - identification of qualified maintenance and repair capabilities available on-site or nearby; and

  - identification and listings of qualified test equipment and testing services available on-site or nearby.

- **Organization descriptions** - A complete, updated, description of the TS will be provided to the operating organizations of the Purchasers' shipping facilities. This information will provide both the TS (principally the field operations personnel) and the storage facility operations personnel with names of individuals who will act as points of contact to coordinate interactions between the two organizations. This information will include:

- organization charts for DOE/subcontractor and Purchasers' facility organizations with names of individuals to be contacted for various functions;

- descriptions of responsibilities and areas of expertise for the personnel shown; and

- location and phone numbers (both day and nighttime) of personnel shown;

- **Operating schedules** - Both the planning for shipping campaigns and the planning for TS operations in general are the responsibility of the **Planning and Control subsystem** (specifically, the campaign planning and long-range planning and analysis elements). However, field operations personnel will have access to information concerning the operating schedules of the facilities where the TS accepts deliveries of spent fuel and high-level waste for transportation. The TS's **Field Operations subsystem** will provide day-to-day coordination with a facility operator regarding scheduling of operations associated with deliveries of spent fuel or high-level waste casks to the facility. In addition, the **Field Operations subsystem** will be responsible for monitoring the schedule status of all operating facilities where deliveries will be accepted in order to provide information to the TS's **Planning and Control subsystem** for use in developing and revising TS operations plans. The **Field Operations subsystem** will also have access to the current status of schedules for TS cask, equipment, and personnel resources; this information will also be useful to advise spent fuel storage facility operators in the event that pickup and delivery schedules change.

5.2 Facility Interface Equipment. Facility Interface Equipment provided by the **Field Operations subsystem** consists of all special handling, testing, maintenance, and inspection equipment required to interface a cask and its unique handling and operating features with the Purchasers' spent fuel storage facilities. These interfaces occur between the cask yoke and the crane hook;

between the cask plumbing and the facility's water, air, gas, and vacuum supplies, etc. Other equipment associated with preparations of the spent fuel or high-level waste in advance of a shipping campaign might also be included. An example of this latter type of equipment might be a device for gauging the burnup of spent fuel prior to being loaded into a cask.

Most interface equipment will be (1) owned by CRWMS, (2) stored when not in use at a CMF, and, (3) for each new campaign, assembled into campaign kits at a CMF. The campaign kits will be tailored to the specific facility where a campaign will be conducted. The equipment will generally arrive at a facility just prior to the start of a shipping campaign.

The equipment used at each spent fuel storage facility historically has been grouped into two categories (lifting devices and ancillary equipment) as noted below:

- **Lifting devices** include the following:
  - lifting yokes and accessory fittings;
  - lifting extensions;
  - slings (lid positioning, personnel barrier removal/emplacement, etc.); and
  - hook adapters (if required).
- **Cask ancillary equipment** includes:
  - interface connectors to access a facility's demineralized water supply for filling and flushing the cask's cavity;
  - interface connectors to access a facility's compressed air supply in order to dry a cask's cavity and for pressure testing;

- interface connectors to access a facility's inert gas supply to purge and backfill a cask's cavity;

- any special cask decontamination equipment;

- interface connector to access a facility-supplied vacuum pump for evacuating the cask cavity;

- leak testing equipment; and

- any special equipment used for disassembling, assembling, purging, pressure testing, or other activity associated with preparing a cask for loading, loading a cask, or preparing it for shipment.

5.3 Accept-for-Transport Operations. These operations encompass the equipment, procedures and personnel required to accept for transport loaded casks at waste generators' facilities. Accept-for-transport operations can be divided into three components: (1) **acceptance standards and procedures**; (2) **support equipment**; and (3) **observers and accept-for-transport authorities**; these are discussed below.

- **Acceptance standards and procedures** - 10 CFR 961 requires that a detailed description of each distinct fuel type within a shipping lot be delivered to DOE not later than 60 d prior to the scheduled transportation date. The information will include:

  - fuel assembly and upper and lower fittings drawings;

  - number and type (BWR, PWR, other) of assemblies described;

  - descriptions of distortions, cladding damage, or other damage to spent fuel or non-fuel components that require special handling procedures;

- calculated heat output per assembly.

- procedures for ensuring that the SNF or HLW is properly loaded, packaged, marked, labeled and readied for transportation;

- procedures for ensuring that all paperwork for acceptance is properly executed and disseminated.

- procedures for verifying that a cask has been properly prepared for transport.

Article VI of 10 CFR 961 specifies standards and procedures for accepting SNF at a waste generator's facility. These procedures will cover field operations activities that support verifying characteristics of the spent nuclear fuel or high-level waste loaded into a cask for transport to ensure consistency with the cask's Certificate of Compliance. These procedures and standards will rely to some degree on information provided by the Purchaser, including data specified in Appendix F of 10 CFR 961.

- **Support equipment** - Special support equipment may be needed to implement the procedures for accepting SNF or HLW for transport, which may include:

  - equipment to perform visual dimensional inspection and inspection for structural deformity (for example, closed circuit TV system with a submergible camera);

  - equipment to verify heat output; and

  - equipment to verify the neutron multiplication factor (K_{eff}) of a loaded cask;

- **Observers and accept-for-transport authorities** - DOE may designate field operations personnel to observe the activities of the Purchasers' spent fuel and high-level waste facilities whenever these activities concern preparations of waste for delivery to DOE, cask loading, or preparations for shipment. Field operations observers will perform functions to collect information needed to ensure the current and ongoing safe and effective operation of the TS.

  In order to support DOE's action to take custody of a shipment, accept-for-transport authorities will be field operations personnel who will verify that transportation casks
  have been properly loaded and prepared for transport by a Purchaser's spent fuel or high- level waste facility in conformance with:

  - the applicable NRC Certificate of Compliance,
  - DOE Orders,
  - the requirements of the Standard Disposal Contract,
  - the regulations of the Department of Transportation, and
  - other regulations and requirements that may apply.

  Both **observers and accept-for-transport authorities** will generally require access to the shipping facility. In turn, this will require that they qualify as being "fit for duty" at each site. Currently, reactor sites have "fitness for duty" requirements which must be satisfied to allow any individual unescorted access to a site. Often, the fitness for duty qualification at one site is not acceptable at another site. Furthermore, being fit for duty at one reactor of a multiunit site does not necessarily guarantee that the individual is fit for duty at the other reactors at that site. Satisfying the

requirements can often require a significant period of time and may include testing of personnel, including drug testing.

5.4 Waste Generator Technical Support. DOE will provide, if requested, personnel, equipment, training, and procedures to support the operating staff of a Purchaser's facility during activities to prepare spent fuel or high-level waste for shipment and activities associated with cask handling, loading, and shipment.

- **Cask operating procedures** - Standard cask operating procedures will be provided to a facility's operators in advance of shipping campaigns. In addition, if requested by the Purchaser, field operations personnel will assist facility operators in preparing facility procedures and, from time to time, making modifications or generating additional procedures that may be required for unanticipated activities.

- **Personnel, equipment and procedures for training, and technical support** - One of DOE's responsibilities under the Standard Disposal Contract is to provide training for waste generator personnel in cask loading and handling operations. In performing this task, field operations personnel will first consult with the spent fuel facility operator personnel to determine what training is needed and how training will be conducted. The training provided by the TS to facility operators will use training aids, documentation, manuals, videotapes, etc. Both classroom and hands-on training of reactor operator personnel will be offered.

5.5 Nonroutine and Emergency Response Support. **Field Operations systems** will provide personnel, procedures, and equipment to support the DOE Emergency Management System (EMS) and others, as requested, in responding to transportation emergencies involving TS shipments of loaded and unloaded spent nuclear fuel and high-level waste casks. DOE Order 5500.1B describes the overall approach to responding to operational emergencies and provides the general framework for the development, coordination, exercise, testing, and

validation of emergency plans. The Transportation Operational Emergency Plan for NWPA shipments describes how the DOE-EMS will be supported with CRWMS resources in developing and maintaining readiness and in providing for effective response to actual transportation emergencies.

Support for the emergency response activities is divided into five components: (1) **emergency response (ER) procedures and information**; (2) **ER communications**; (3) **ER equipment**; (4) **ER advice teams**; and (5) **equipment recovery teams**.

- **Emergency response procedures and information** - A library of information generated by the TS will be maintained at DOE field offices and other locations offering emergency response support applicable to any transportation emergency involving casks in use within the Transportation System. This information will include:

  - emergency response and recovery plans/procedures;
  - cask system technical data;
  - generic accident scenario analyses;
  - current and near-term transportation campaign plans; and
  - data on local emergency response and recovery capabilities.

- **Emergency response communications** - The **Field Operations subsystem** of the TS, coordinated with the Traffic Management component of the **Planning and Control subsystem** and in-transit security element of the **Carriage subsystem** will maintain a communications system that will include equipment, personnel, and procedures that will be available for use in the event needs arise from transportation emergencies. The capability for effective communication from the site of an accident/incident to Emergency Operations Centers (EOCs), state and local officials, DOE offices, etc., must be established quickly and

maintained. Communications equipment, such as cellular phones or radios, need to be readily available and communications established in accordance with predetermined plans and procedures.

- **Emergency response equipment** - Various items of equipment may be required in order to assess damage and recover a cask and transport vehicle in the event of an accident. These items may be available, in part, locally or may have to come from DOE/contractor resources. The current locations, serviceable status, and availability of such equipment will be identified and documented for reference in the event of need. Some equipment may be provided and/or maintained by the TS. ER equipment includes:

  - portable light sources;
  - equipment for measuring levels of ionizing radiation (health physics);
  - area rope-off and emergency marker equipment;
  - cranes, slings, hook adapters, and cask lifting parts (trunnions);
  - wreckers;
  - cask tie-down and release tools; and
  - standard hand tools.

- **Emergency response advice teams - The Field Operations subsystem** will maintain, on-call, teams of specialists that are trained in all aspects of emergency response and recovery to assist and advise DOE and other federal and/or local officials, as requested, in accident response and recovery actions. If and when requested, these teams will be dispatched to an accident scene and/or to a designated DOE Emergency Operations

Center. A team at an accident scene will monitor emergency response and recovery actions and will provide a steady flow of information to appropriate transportation operations personnel.

- **Equipment recovery teams** - Predesignated, trained, and on-call equipment recovery teams will be available at all times during cask operations. Cask systems specialists and equipment will be dispatched once a request for support is received. These teams will thoroughly inspect and evaluate cask integrity and containment capability at an accident site and determine and monitor suitable recovery actions.

6. The Servicing and Maintenance Subsystem

The Servicing and Maintenance subsystem will service and maintain cask systems (casks, ancillary equipment, transport vehicles) used by the TS. It will also maintain the facilities and other equipment dedicated for use by the TS. In addition, it will maintain a supply of qualified replacement parts and consumables (e.g., valves, seals, etc.) used in the operation of, or which are component parts of, the casks. To perform this work, **the Servicing and Maintenance subsystem** will employ personnel, equipment, software (documents), and facilities that may be owned by DOE and operated by DOE contractors (GOCO), owned and operated by private sector companies under service contracts to DOE or some combination of the two.

The schematic diagram presented in Fig. 6 identifies the major elements of **the Servicing and Maintenance subsystem**. As shown, this subsystem consists of three elements: (1) Cask and Ancillary Equipment Servicing and Maintenance; (2) Transport Vehicle Servicing and Maintenance; and (3) Support System Facilities Maintenance.

The Servicing and Maintenance subsystem will perform servicing and maintenance and associated quality-affecting (e.g., equipment calibration) functions using qualified maintenance personnel following qualified and approved plans and procedures using qualified and approved equipment and facilities. The plans

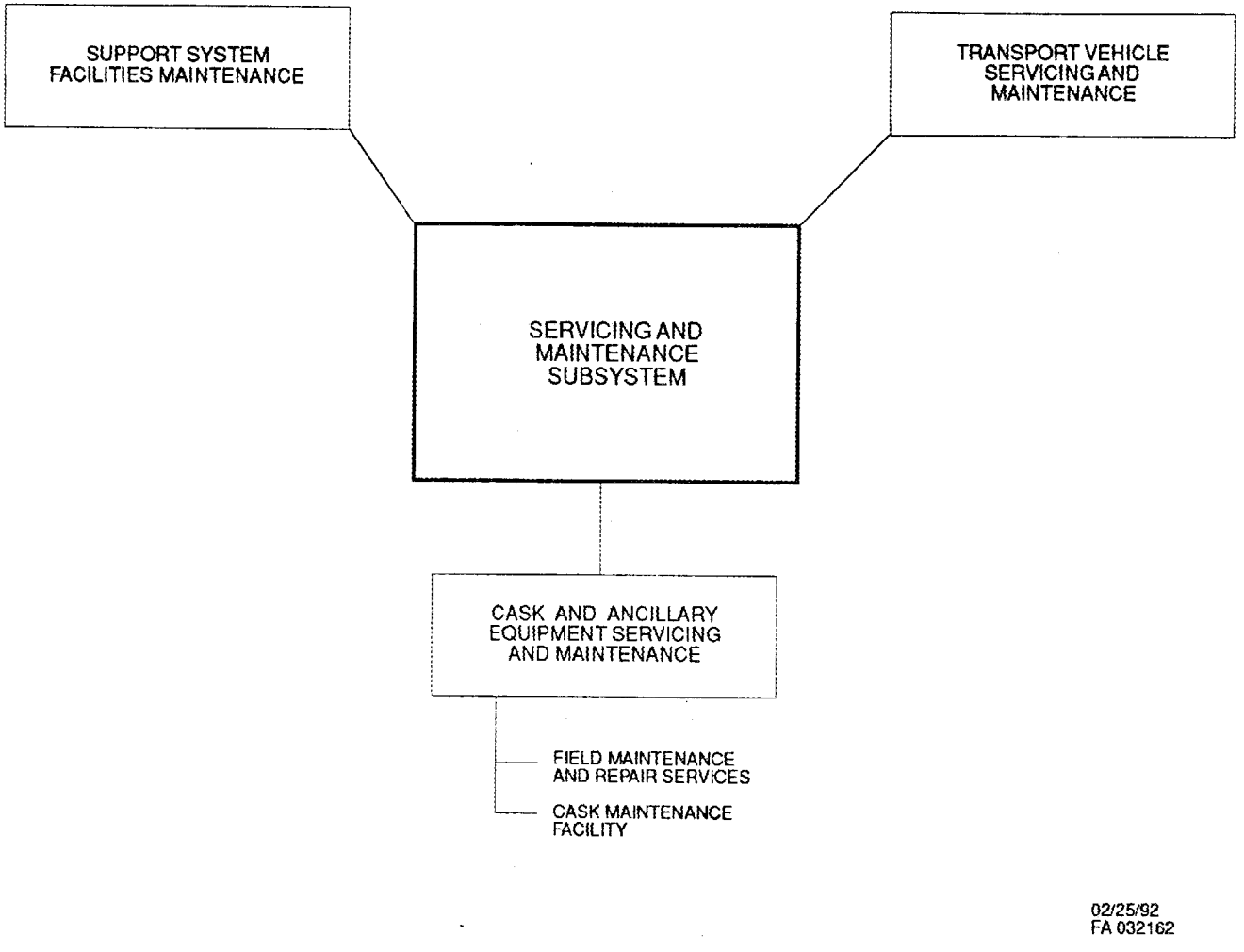

Fig. 6. Elements of the Servicing and Maintenance Subsystem.

and procedures (which will be approved, and subject to periodic review, by appropriate elements of **the Planning and Control subsystem**) will specify measures for controlling the quality of servicing and maintenance work. The Quality Assurance element of **the Planning and Control subsystem** will monitor and verify the performance of the servicing and maintenance and related functions through activities such as independent verification and auditing. **The Servicing and Maintenance subsystem** will be responsible for providing complete records to the information management element of **the Planning and Control subsystem** for all servicing and maintenance work. In turn, the Information Management element will be responsible for providing timely and complete access to servicing and maintenance records and data needed by, and used by, **the Servicing and Maintenance subsystem**.

Most cask servicing and/or maintenance will be performed at a Cask Maintenance Facility (CMF) operated by, or on behalf of, the TS. The work will be done on casks that will weigh from 25 to 150 tons, will be as large as 10 ft in diameter and 20 ft in length when laid down, and will have significant amounts of radioactive material contamination. This work will require equipment and facilities commensurate to the physical, environmental, and personnel safety demands of handling and working on such items. In addition, incidental servicing and/or maintenance are expected to be performed at the Purchasers' spent fuel storage facilities and at other DOE facilities.

6.1 Cask and Ancillary Equipment Servicing and Maintenance is made up of two components: (1) **cask maintenance facility (CMF)** and (2) **field maintenance and repair services**.

- The **CMF** is envisioned to have two operational buildings and two vehicle storage areas on an approximately 20-acre fence-secured site. One operational building, the Process Building, is dedicated to the maintenance of casks, the other for servicing vehicles. The facility is expected to be located close to, or adjacent to, one terminus of the transportation cycle (i.e., either the MRS facility or the repository). The **CMF** will have prime movers for both rail cars and tractor trailers.

It will have the capability to maintain, repair, test, and exchange internal baskets and/or spacers and decontaminate and decommission a significant number of casks each year. It will also serve as a storage point for spare parts and equipment that will make up the "campaign kits," consisting of equipment and parts tailored to specific reactor sites that will be initiating shipping campaigns.

A second operational building, the Vehicle Maintenance and Inspection Building, will primarily be used to decontaminate vehicles, as necessary, for off-site maintenance. It will also have the capability to bead blast contaminated parts, remove paint and repaint vehicle surfaces, and perform limited maintenance on prime movers dedicated to operation on the **CMF** site.

Personnel that operate the **CMF** will use procedures developed for all maintenance and repair activities expected to be carried out on casks. They will interface with personnel of the regulatory compliance element of **the Planning and Control subsystem** to ensure that cask rework or repairs restore a cask to an in-compliance state.

All records that identify anything that has been done to every cask, item of ancillary equipment, and vehicle, including shipments, repairs, modifications, etc., will have to be stored and maintained by the TS. Records input will be from **CMF** personnel or field operations personnel if the cask is serviced in the field or at a reactor site.

The **CMF** will provide support procedures, advice as requested, and material as requested to Emergency Response personnel.

- The **field maintenance and repair services** component relates to those maintenance and repair activities that are not performed at the **CMF**. These activities will require portable, calibrated equipment; written procedures; and knowledgeable personnel. TS personnel will have the capability of performing, or supervising the performance of, many small

maintenance functions in the field. Procedures will be written and maintained by TS personnel specifically for maintenance, repair, or other operations in the field.

For each shipping campaign, the **Servicing and Maintenance subsystem** (e.g., through facilities and services provided by the **CMF**) will need to include the capability to provide a "campaign kit" made up of equipment, spare parts, and procedures to each site for the safe and effective operation of casks to be used. The campaign kit will consist of certain consumable or easily damaged parts (seals, studs, hoses, etc.), certain cask-specific components (lifting yokes, basket spacers for the specific fuel length to be shipped, special-purpose tools, etc.), and certain pieces of equipment (e.g., vacuum pumps, general-purpose tools) that might not be available at the reactor site. Documents, which will also be included in the campaign kit, will consist of a full set of procedures for cask handling under normal operations and special case procedures already developed. Equipment in the kits may be mildly contaminated from prior use.

6.2 Transport Vehicle Servicing and Maintenance. Most routine servicing and maintenance of rail, truck, and barge transporters are expected to be performed at facilities away from a CMF. It is expected that maintenance of these equipment items will be performed under contract to the DOE by carrier, or by companies in private industry that provide similar service to others.

During the transport of the cask from one location to another, there will be occasions when some maintenance will be required for the transport vehicles. These maintenance activities will be handled on a case-by-case basis, probably by private businesses close to where the maintenance is needed.

6.3 Support System Facilities Maintenance. The TS will not have a large number of facilities to maintain. The two facilities envisioned are the CMF and an Operational Control Center. These facilities, which generally include

only the physical plant but may include some of the equipment, will be maintained within this element.

7. Reference

1. Transportation Functions of the Civilian Radioactive Waste Management System, L. B. Shappert, ORNL/TM-11232, Oak Ridge National Laboratory, Oak Ridge, TN, March 1992.

APPENDIX B

SYSTEMS ENGINEERING PROCESS

SYSTEMS ENGINEERING PROCESS

This report is a product of one part of a Systems Engineering (SE) Process being applied in the development of the Transportation System (TS). The SE Process is a structured, iterative technique for ensuring the effective use of technical resources in progressing from a definition of mission need, identified in the OCRWM Mission Plan in this case, to realization of an effective system that is built, tested, demonstrated, and ready for operation. A typical flow diagram that illustrates the major steps in the SE Process is given in DOE Order 4700.1 and is shown in Fig. B-1. As shown in the diagram, once the mission need, project objective, and overall constraints have been delineated, the next step is to perform functional analysis.

The first step in functional analysis for the TS, identifying system functions and subfunctions and the sequence in which they will be performed, was completed in FY 1988. The results of this work were reported in Ref. 1. This report presents the results of continuing work in which details of the functions and subfunctions have been described. In addition, because of the iterative nature of this process, some of the TS functions identified in the FY 1988 work have been modified, reflecting a better understanding of what the system must do. The functions described in this document contribute basic information required to proceed iteratively and systematically to conceptual and final designs of the TS.

This effort to identify, describe, and sequence functions and subfunctions is critical to the systematic approach to TS development. The described functions provide a clear understanding of what the system must do and when it must do it. This understanding is needed to ensure that the TS design will satisfy the mission need and project objectives. Also, the documentation of TS functions, subfunctions, and descriptions provides the basis for traceability of designed capabilities to the TS mission requirements.

Another important step in functional analysis is to examine each function and subfunction to establish a required level of performance. In this step, the questions to be asked for each function and subfunction are "What are the

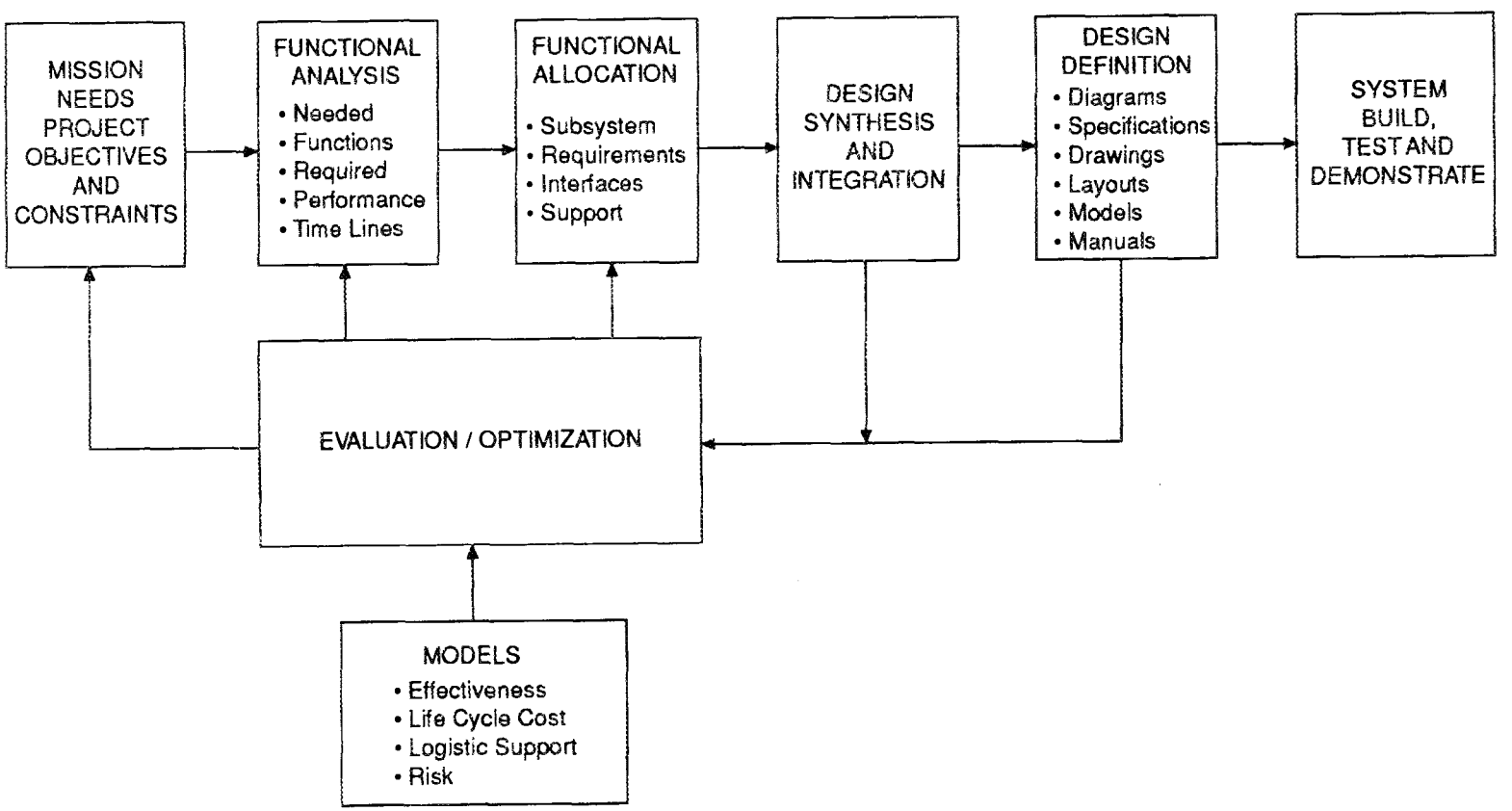

Fig. B-1. Systems engineering process.

relevant measures of performance?" and "How well does this function need to be performed?" Not all functions will have quantitative and objective performance requirements associated with them. However, performance requirements should be stated in measurable terms (time, radioactivity, etc.). The functions, subfunctions, and descriptions contained in this report provide the basis for subsequent iterative determination of the required level of performance.

Another important use of the derived functions/subfunctions, their descriptions, and their sequence of occurrence will be in the development of timelines. The information in this document provides the basic information needed to develop timelines for operations sequences. Note that the "and" and "or" logic of the Functional Flow Block Diagrams (FFBDs) is ideally suited for timeline analysis. The "and" logic indicates parallel activities, and the "or" logic indicates alternative paths.

Functional Allocation (see Fig. B-1) can take at least two different forms. First, in the iterative process of system development, functional allocation is the step in which the responsibilities for the functions are assigned to the functional elements (subsystems, subsystem components) of the TS (see Appendix A). Second, for identified functions which interface with systems outside the TS (repository, waste generator, MRS), functional allocation provides a methodology for defining interfaces. This effort provides the basis for interface discussions, agreements, assignments of responsibilities, and subsequent detailed definition and documentation of the characteristics of interfaces with other systems.

Design Synthesis and Integration is the process of developing the system's conceptual design (i.e., the TS). A general system concept is first postulated during mission analysis, the process which defines mission needs, project objectives, and constraints. The system concept is then iterated (or refined) through the evaluation/optimization process until it is mature enough to proceed to final design definition.

The evaluation/optimization process analyzes design and performance characteristics of alternative designs of the system or system elements and then develops conclusions about them. In this process, many factors may be considered, including life cycle cost; reliability; maintainability; development risk, cost, and schedule; quality assurance requirements; and margins of safety. One of the primary purposes of this process will be to address and assist in resolving issues that are identified at any stage of system development.

Issues that have been identified in developing the functions descriptions will be reported in the near future. These issues will form the basis for some of the trade-off studies, which are part of the evaluation/optimization activities implied in Fig. B-1.

APPENDIX C

TECHNICAL REVIEW GROUP

TECHNICAL REVIEW GROUP

This report has undergone a technical review. The invitation to be a member of the peer review group was extended to the individuals listed below and was based on their known credentials and experience in facets of transporting radioactive materials. This group also brought with them current knowledge and experience from their transportation-related interactions with DOE-HQ, several operations offices, and the repository project. Committee membership is as follows:

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P. L. Hofmann, Battelle/OTSP
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W. G. Bevan, SSS/DOE-HQ
M. Ruska, EG&G/Idaho
K. H. Henry, EG&G/Idaho
W. Lake, DOE-HQ

A draft copy of this report was sent to each member of the Technical Review Group one week in advance of the review meeting, which was held on May 3-4, 1989. At the meeting, the report was considered page by page. Each member's comments were recorded by a rapporteur. These comments were organized by the rapporteur, typed, and formally transmitted to all authors. The document was then modified to reflect resolution of the comments. Details of the comments and their resolution are available from ORNL.

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