

WASTE ISOLATION PILOT PLANT WASTE INFORMATION SYSTEM

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) Waste Information System (WWIS) is the database that will contain data on all transuranic (TRU) waste shipped to WIPP. The database consists of several lookup tables that are used extensively in the edit and range checks performed on the data package transmitted by the shipper to the WWIS; and it includes the Audit Database that is a historical record of all additions, deletions, and modifications made to the Production Database. These databases were programmed in NOMAD2 that will allow WIPP to provide both routine and nonroutine reports in a timely manner and with great flexibility in the content and format.

INTRODUCTION

This is a time when massive amounts of data are accumulated and stored and when companies and government agencies expect quick, accurate responses to requests for data. Westinghouse Electric Corporation, as the management and operating contractor of the Waste Isolation Pilot Plant (WIPP), will meet this need by using the WIPP Waste Information System (WWIS). The WWIS contains data on all transuranic (TRU) waste shipped to WIPP, lookup tables that contain data required in the edit and range checks performed on data that the shipper transmits to the Temporary Database of the WWIS, and the Audit Database which is a historical record of all additions, deletions, and modifications made to the Production Database. The WWIS was programmed by the EG&G Idaho, Inc., National Database Development Unit and resides on an IBM 3083 computer operated by EG&G Idaho, Inc., which is a prime contractor at the Idaho National Engineering Laboratory. Access to the WWIS is controlled by the ACF2 security system and by EG&G Idaho procedures. Access is further controlled by the WIPP Data Administrator who assigns authorized users to one of five security categories.

The WWIS is a hierarchical database, consisting of the shared Temporary Database to which shippers transmit the data package for each shipment, and the Production Database that consists of the Shipment Database, the Package Database, several lookup table databases, and the Audit Database. The Temporary Database is the area to which the shippers transmit data packages prior to shipment in compliance with Department of Energy (DOE) Order 5820.2A (1) and the WIPP Waste Acceptance Criteria (WAC) (2). The file structure and data format are specified in WIPP-DOE-157 (3). The Temporary Database was designed to allow each shipper read/write access only to its own data and only until the shipper determines that all the errors have been corrected and the data package is ready to be transferred to the Production Database. To control and maintain a record of any changes that were made to the data package from the time it was shipped, the data package is transferred from the Temporary Database to the Production Database. Shippers do not have access to the Production Database. A very limited number of WIPP personnel may have read/write access, which allows them read access and the ability to produce certain reports and also the option to add, delete, or modify data. Several additional WIPP personnel

have read access and the ability to produce certain reports as menu options.

There are also modules for preparing a file for radioactive decay calculations and for receiving and using a file of data after decay calculations have been performed and preparing a file for transmittal to a personal-computer (PC)-based WIPP Waste Tracking System (WWTS) at WIPP and receiving a file of data from the WWTS.

Certain standard reports were anticipated, but the content and format of most reports that will be requested over the years cannot be anticipated. Because the WWIS was programmed in the fourth-generation language NOMAD2, WIPP will have extensive ad hoc reporting capabilities from the WWIS and will be able to respond quickly to complex data requests.

TEMPORARY DATABASE

The Temporary Database contains the Shipment Database, the Accepted (Package) Database, and the Rejected (Package) Database. Shippers are assigned a specific security category access which allows them read/write access to their data in the Temporary Database. Routinely, the shipper will transmit the data package in American Standard Code for Information Interchange (ASCII) format via RLINK (4) from an IBM or IBM-compatible PC at the shipping site to the Temporary Database on the mainframe, as illustrated in Fig. 1. (Visual verification that the data package passes all WWIS edit and range checks is available as a backup in the event the data package cannot be uploaded to the mainframe.) Because the Temporary Database is a shared database, multiple shippers have read/write access to their own data, and certain WIPP users have read-only access to all shippers' data. However, no shipper has access to another shipper's data.

After the data package has been uploaded, the WWIS performs extensive edit and range checks, and it also performs certain WIPP-specific operations. Then, the WWIS automatically sends a report on the status of the upload to the user's PC printer at the shipping site. The report will state how many records were read, accepted, and inserted for the specified shipment. If errors were detected and the data package was not inserted, no specific error messages will be reported. But when a data package containing errors

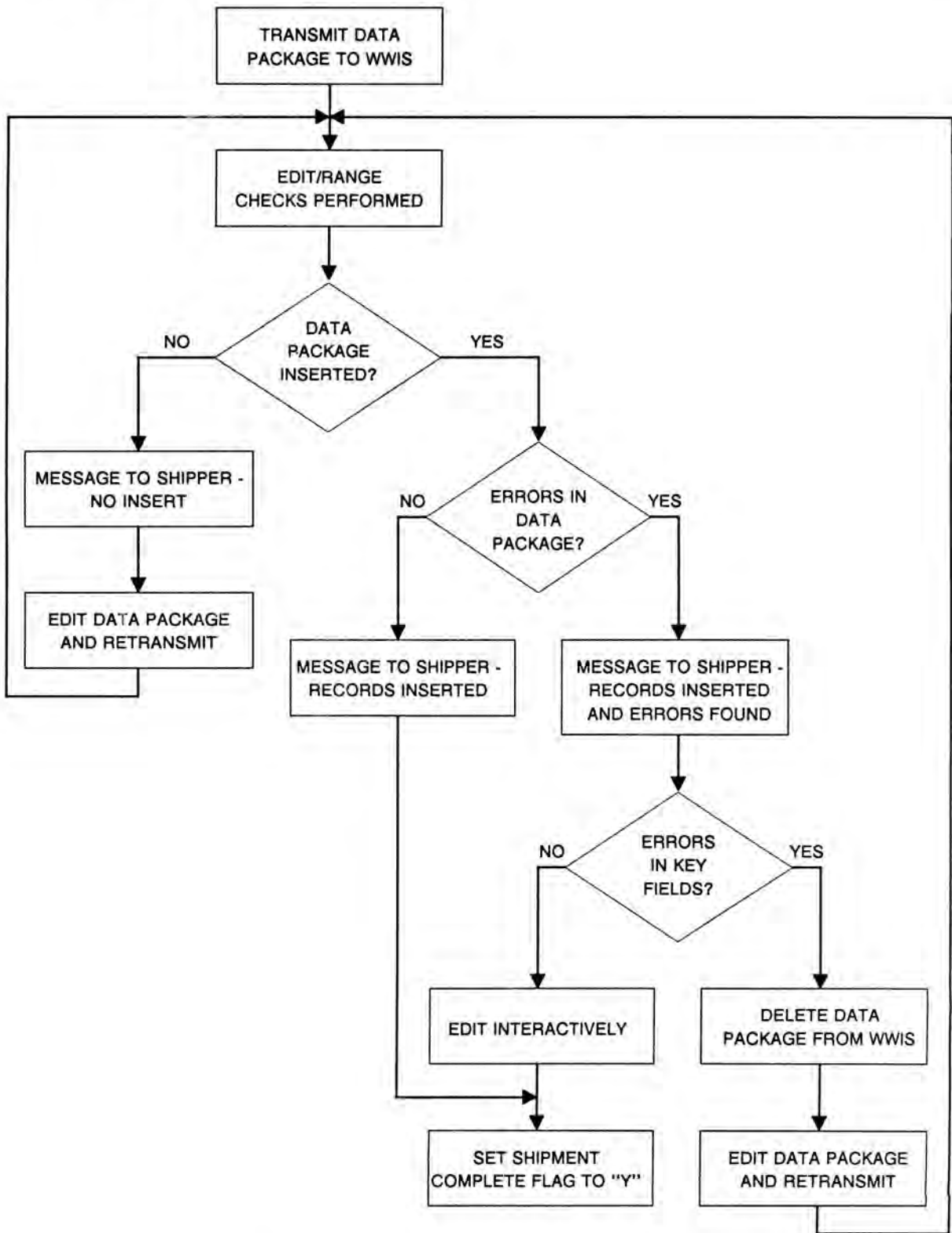


Fig. 1. Data Package Uploaded to WWIS.

is inserted, the report will provide a list of waste package identification (ID) numbers and the errors that were encountered either by the NOMAD system or by WWIS.

When a data package is inserted into the WWIS, the shipment portion is inserted into the Shipment Database. The records for individual waste packages (package, radionuclide, and hazardous constituent data) are inserted into the Accepted Database if the data for that waste package ID passed all edit and range checks. Records that did not pass all edit and range checks are inserted into the Rejected Database. The term "accepted" as used here only means that the data passed the series of edit and range checks, without implying that WIPP accepted or approved the data or shipment.

The method of resolution of errors depends on the nature of the errors and the fields involved. Major errors in the shipment number or package ID number that would prevent its being saved and accessed later result in the data package not being inserted. The shipper must resolve such errors and retransmit the data package to the WWIS. A data package that was inserted but contained errors in a key field must be deleted by the shipper using the Shipment Database screen because key fields cannot be edited interactively in the WWIS. The shipper must resolve the errors and retransmit the data package. The most probable case is where the data package was inserted and errors were found in non-key fields. In this case, the shipper may resolve the errors and interactively edit the shipment and/or package records in the Temporary Database. When all errors are corrected and the record is saved, it is transferred automatically from the Rejected Database to the Accepted Database. In each of these cases, when all package records are correct, they will be in the Accepted Database.

When the data package has been accepted and all error conditions have been corrected, the shipper accesses the shipment screen for that shipment, sets the shipment complete flag to "Y", and saves the change. If the WWIS confirms that all errors have been corrected, the change is accepted, and the shipper no longer has access to that data package. Neither the shipper nor WIPP personnel can access the data package at this point. WIPP personnel then transfer the data package from the Temporary Database into the Production Database. Any changes made to the data package from this point will be made interactively in the Production Database by the WIPP Data Administrator or the alternate and will be documented in the Audit Database.

Since it is the shipper's responsibility under the WAC to provide an accurate data package, only the shippers have read/write access to the Temporary Database. WIPP personnel with Security Category 1 access (the Data Administrator, Database Administrator, and their alternates) will have read access to the Temporary Database. Those Category 1 users will be permitted read/write access to the Temporary Database only for brief periods of time for testing or demonstration purposes but not to modify a shipper's data. Otherwise, Category 1 users have full read/write access to the entire WWIS and time-of-day access that will be used for ad hoc reporting. If in the future,

certain WIPP Operations personnel need to enter data packages for WIPP's site-generated waste, they would be assigned Security Category 4 access and have the same options as a shipper.

There are currently two WIPP-specific operations that are performed at the time of the edit and range checks to prepare for storing and using data. These are the expansion and storage of radionuclide data and the identification of any waste package for which a WAC exception has been granted.

The first WIPP-specific operation is handling of radionuclide data, which includes storage of the data as originally reported, calculation of mass in grams or activity in curies (whichever was not reported), and storage of both mass and activity. As many as 25 radionuclides may be reported for each waste package ID. The radionuclide symbol may be reported one of three ways: grams or curies of an individual radionuclide (e.g., Pu-239), grams of standard mixture with known weight percents of radionuclides (e.g., Pu-52, weapons-grade plutonium mixture), or curies of a mixture of undetermined composition [e.g., mixed activation products (MAP) or mixed fission products (MFP)]. The WWIS stores the radionuclide data as originally reported to permit modification of data if required in the future.

The WWIS then expands the data. The WWIS uses the reported quantity and units of measure for each radionuclide in the waste package and calculates the mass in grams or the activity in curies (whichever was not reported). When one or more mixtures are reported, the WWIS calculates the masses and activities of the individual constituents of the mixtures and then sums all like radionuclides to calculate the total mass and activity of each radionuclide in the waste package. Similarly, like radionuclides are summed when an individual reported radionuclide is also a constituent of a reported mixture.

The second WIPP-specific operation is the identification of any waste package that has been granted an exception to the WIPP WAC. If a shipper had an uncertifiable waste package, an exception to the WAC could be requested for that waste package. The WAC Lookup Table will be used as a log of the requests, items of exception, and disposition of the request. When a WAC exception number is reported in the data package, the edit and range checks determine whether the WAC Exception Lookup Table shows that it was approved and that the reported value for the field in exception does not exceed the approved value. If the exception number for that waste package ID was not in the lookup table, if it had not been approved, or if any values exceeded the standard and exception values, then an error message would be sent to the shipper, and that package record would be inserted into the Rejected Database. But if the WAC exception allowed a maximum weight of 456 kg when the standard limit is 454 kg, the shipper would not receive an error message for the weight field unless it exceeded the approved 456-kg limit. WIPP Operations personnel may choose from their menu a standard report of data on a specified shipment, which includes the identification of any package ID for which a WAC exception has been approved.

Foreknowledge of such a package will allow time for any special arrangements that might be needed for its handling.

TRANSFER FROM TEMPORARY TO PRODUCTION DATABASE AND TRACKING SYSTEM FILE

The Data Administrator is responsible for ensuring the integrity of the data in the WWIS. After the shipper has set the shipment complete flag to "Y", the Data Administrator must transfer the data package from the Temporary Database to the Production Database before it can be read or used.

PRODUCTION DATABASE

The Production Database contains the Shipment Database, the Package Database, several lookup tables, and the Audit Database. The Shipment Database is identical to its counterpart in the Temporary Database. The Package Database contains all data from the Temporary Database plus fields for entering the hazardous waste manifest number and the receipt, emplacement, and overpack data. The lookup tables contain data that can be edited easily and that are used extensively in the edit and range checks. The Audit Database provides a historical record of all changes made to the Production Database.

Since the Production Database is not a shared database, at any given time, NOMAD will only assign write access to the first user to logon as Security Category 1 or 2. Read-only access is assigned to all users who subsequently logon. For another user to obtain write access, the first user must logoff, and the user who needs write access must also logoff and then logon again. At times this will require coordination between WIPP personnel, but it should not pose a problem since the primary users will be the Data Administrator and the alternate. Only the Data Administrator, the Database Administrator, and their alternates will have full read/write access and the time-of-day access required for ad hoc reporting. However, the Database Administrator would rarely, if ever, change data.

The WWIS provides interface points with the WIPP internal waste tracking system, the WWTS. When the verified data package is transferred to the Production Database, certain data are appended to a file for subsequent transfer to the WWTS. The key field is the waste package ID number, and the other data are the shipment number, the TRUPACT/cask number, the package assembly number, and the surface dose rate. During waste handling operations, additional data are entered into the WWTS by package ID number. These are the shipment receipt date; emplacement date; emplacement panel and room; emplacement location that is comprised of panel, room, and a location in a grid; and the overpack ID number (if overpacking was required).

Security Category 2 access is assigned to those WIPP Operations personnel who need write access for short periods of time to transfer data between the WWIS and the WWTS via a batch process and who then need read access to verify that the data transferred. At least once a day, as required, data will be transferred between the WWIS and WWTS. At the time of upload, the WWIS performs edit and

range checks on those data. It will only accept data that both pass all edit and range checks and fill empty fields in the WWIS. Once data have been uploaded to the WWIS, the Data Administrator will have to be notified and make any changes. Changing a value in the WWTS and repeating the upload will not change the value in the WWIS. In the event the data transfer cannot be accomplished, the Data Administrator can download data to his PC and relay the information to Operations. The Data Administrator can interactively enter data provided by Operations if it cannot be uploaded from the WWTS. Separate from the WWTS, Waste Handling will provide the Data Administrator with the hazardous waste manifest number or notify him that there is none for each shipment.

LOOKUP TABLES

Lookup tables are data tables that are used extensively in the edit and range checks. Lookup tables are easy to maintain and edit when a value changes or records need to be added or deleted. This allows the Data Administrator to change values as required without reprogramming. Unlike the Shipment and Package Databases, lookup tables are not subject to automatic edit and range checks. But, like the Shipment and Package Databases, all additions, deletions, and modifications to the lookup tables are recorded in the Audit Database.

The lookup tables in the WWIS are the Generator/Shipper/Certifier Code, Container Code, Content Code, Radionuclide, Mixture, Hazardous Material Code, and WAC Exception Lookup Tables.

The Generator/Shipper/Certifier Lookup Table consists of the site code and name of each site that generates, certifies, and/or ships TRU waste to WIPP. It is necessary to be able to determine which site performed which function for each waste package. This becomes more complicated because some TRU waste has been transshipped from generators to interim storage sites and because some transshipped waste was certified by the generator and some by the interim storage site (i.e., the shipper). This lookup table is the reference used when verifying valid generator, shipper, or certifying site codes as individual fields or within a larger field, such as the shipment number where the shipping site's code is the first two characters.

The Container Code Lookup Table contains the WIPP-assigned container code for the Department of Transportation (DOT) Type A packagings that have been authorized for shipment to WIPP, the dimensions and volume of the container, various limits as for weight, fissile material loading, surface dose rate, neutron dose rate, etc. This lookup table is extensively used in verifying that those fields in the data package that have limits do not exceed the limits for that container. It will also be used in calculating the total volume of waste packages that have been emplaced at WIPP.

The Content Code Lookup Table, unlike the other lookup tables, has a triple concatenated key field that is comprised of the certifying site ID code, the content code, and the waste type. When a site is authorized by the WIPP Waste Acceptance Criteria Certification Committee (WACCC) to certify a content code, it will be entered into

this lookup table. However, more than one site may be authorized to certify a particular content code, and depending on surface dose rate, a given content code could appear as contact-handled (CH) and remote-handled (RH) waste. Hence, the triple concatenation is required to ensure uniqueness. This lookup table will be used to determine whether the site listed as the certifying site was authorized to certify that content code and waste type (CH or RH) as of the certification date listed in the data package.

The Radionuclide Lookup Table contains more than 1300 radionuclide symbols, most of which were taken from the three libraries used by ORIGEN, which will be used to perform decay calculations. In addition to those, the radionuclide symbols that will be entered for mixtures of unspecified constituents (e.g., MAP and MFP) and for standard mixtures are in this table. Other fields in this lookup table are specific activity, specific power, the ORIGEN library in which it is found, the ORIGEN identification number, major decay mechanism, and whether or not the radionuclide is TRU (atomic number greater than 92, alpha decay, and half-life greater than 20 years).

The Mixture Lookup Table contains the weight percents of the radionuclide constituents of each standard mixture (e.g., Pu-52). It is used in the calculations for expanding radionuclide data when the data package is transmitted from the shipper.

The Hazardous Material Code Lookup Table contains the Environmental Protection Agency (EPA) hazardous waste codes (e.g., F001) and a brief description of each. It is used to verify the validity of EPA hazardous waste codes reported in the data package.

The WAC Exception Lookup Table functions as a lookup table but also as a log of the status of requests for exceptions to the WIPP WAC. The Data Administrator enters data into this table when a request for exception is received. Those data include the unique WAC exception request number, waste package ID number, date of the request, the value for the field that exceeds a limit, other conditions if the exception is not based on a numeric limit, the name of a contact at the site, etc. As disposition of the request is made, its approval or disapproval and the date of that disposition are entered. The shipment number will be added when the data package containing that waste package ID number is received.

AUDIT DATABASE

The Audit Database is an especially important aspect of the WWIS because it is a historical record of all additions, deletions, and modifications to the entire Production Database. Before changes can be saved, the WWIS requires the user to enter the reason for the change. The user may enter a new reason or enter the reason appearing on the screen. The second option is intended as a convenience to the user in the event numerous changes are being made for the same reason. Although the NOMAD system itself would permit the user with time-of-day access to interactively change data records, WIPP chose not to permit any WWIS user to do this as it would circumvent the Audit Database and permit untraceable changes. Traceability of changes

was deemed important historically as well as for quality assurance.

The Audit Database is unique in that its records cannot be edited by the users. It is a sequential database to which records are appended automatically as the Production Database is modified. The database is archived on a quarterly and annual basis and will be stored permanently.

The Audit Database stores the date of the change, identification of the user who made the change, the database changed, and the contents of the record before and after it was modified. When a record is added, there is no prior version unless the record had been deleted and reentered. The converse is true of a record that has been deleted. Querying a record is not recorded. Currently two standard reports with some options are available as menu options. The short report provides all but the actual before and after records, and the long report includes them. With ad hoc reporting capability, the user will be able to tailor reports as desired (e.g., if the history of all changes to the record for a particular waste package were desired).

PROCESSING BEFORE AND AFTER ORIGEN DECAY CALCULATIONS

Because it will be necessary to report the inventory at WIPP after radioactive decay to some point in the future, options were programmed into the WWIS that will process data before and after decay calculations are performed. A menu allows the user to select various parameters for data selection and processing prior to decay calculations. Selection criteria include the package certification year, waste type (CH, RH, or both) emplacement panel/room (panel, panel/room, or all), shipper (one or all), content code (0-5 codes if one certifying site is selected), whether or not to include MAP and MFP, and a range of emplacement dates (specify from and to dates). The beginning date for all decay calculations is the certification date, since that is the date nearest the assay date from which the radionuclide content was determined. This means that for waste packages meeting the selection criteria, like radionuclide masses are summed for a given certification year. That data set then is downloaded from the Production Database to an IBM or IBM-compatible PC. The user edits the PC ORIGEN input shell to specify the number of years to decay the data, the report title, and the time/date stamp. PC ORIGEN2, from Oak Ridge National Laboratory, is used to perform the decay calculations.

After decay calculations, the file created as ORIGEN2 output is uploaded to the WWIS. If the user needs to sum data from two or more decay runs, he does not change the time/date stamp in the shell. The data uploaded to the WWIS are retained for 60 days as a file from which reports can be generated. After 60 days, the file is purged.

REPORTING CAPABILITIES

One of the great advantages to using NOMAD is its ad hoc reporting capabilities. The Data Administrator and other Category 1 users will have time-of-day access that will permit them to write the short programs to create ad hoc reports. This will allow them to quickly respond to data

requests and to tailor the reports with a minimum of effort. At this point in the history of WIPP, only a few definite reporting requirements have been identified. The majority of the reports generated from the WWIS will be ad hoc reports generated in response to a specific request for data. Some of those will become routine reports, but many will be required only once. One routine requirement is to provide an annual report containing data on waste emplaced at WIPP to the Integrated Data Base (IDB) at Oak Ridge National Laboratory.

DOE orders require that WIPP maintain a permanent record of the emplacement location of the waste. Emplacement locations can be reported for a waste package ID, for a shipment number, for a package assembly, or for a hazardous waste manifest number, the last being a requirement under the Resource Conservation and Recovery Act (RCRA). The emplacement location code consists of the panel number, room number, and a grid location where the package assembly, box, or canister is emplaced. This could make available data for a cut-away view of the room by identifying all boxes or package assemblies on the waste face at a specified length from the starting point in the room or from a specified position by width or layer (height) in the five-wide by three-high stacking array of package assemblies (i.e., seven packs or boxes). Actual mapping of the waste locations is not planned at this time but could be

supported by emplacement location data in the WWIS if this were necessary.

CONCLUSION

The WWIS will meet all the current requirements for maintaining and reporting on data for all TRU waste shipped to WIPP. It will facilitate the transfer of data from the shipper to WIPP prior to shipment, the maintenance of those data, and the addition of receipt and emplacement data. It will permit quick responses to both routine or nonroutine data requests while permitting great flexibility in the content and format of those reports.

REFERENCES

1. DOE Order 5820.2A, Radioactive Waste Management, September 26, 1988.
2. DOE/WIPP-069, TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant, current revision.
3. DOE/WIPP-157, Data Package Format for Certified Transuranic Waste for the Waste Isolation Pilot Plant, current revision.
4. RLINK is a RAM-resident micro/mainframe communications program copyrighted by the Renex Corporation.