

QADEX--A RADWASTE DRUM STORAGE

FACILITY MANAGEMENT CODE PACKAGE

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ABSTRACT

QADEX is a computer code package used to manage the storage and transportation of solid radioactive waste drums. Users can easily conduct the package interactively to identify the configuration parameters in a repository, establish the basic drum information data base, manage the drums with query services, and simulate the radiation field around the shielded container. QADEX is written in FORTRAN-77 language and was completed in October 1985. This package is successfully operational on a PRIME-750 computer system at Taiwan Power Company. The extended work is in progress for QADEX application, storage facility optimization simulation and to complete the integral management of radwaste storage network in Taiwan.

There are currently three nuclear power stations (4 BWRs and 2 PWRs) in commercial operation in Taiwan, from which thousands of solidified low level waste (LLW) drums will be produced per year. These drums will be onsite stored in Temporary Storage Facility (TSF) for several decay years, until the drum surface dose rate meets the limitation issued by the Radwaste Administration of Atomic Energy Council, Republic of China (ROCAEC). A special shielded container will then be prepared to transport the radwaste (48 drums/container) to the offshore National Lan-Yu Storage Site for interim storage.

In the early days, lack of integral planning and a proper management program, the onsite stored radwaste drums in Chin-San Nuclear Power Station (NPS) of Taiwan Power Company (TPC) are stored in a queue in the TSF onsite. Facing the thousands of drums, it was quite difficult to handle and control the radwaste drums in TSF. What's more, the most important information on the drums were not kept, and it is very difficult to identify the content in each drum from the huge quantity of drums in the storage building. From 1982, as TPC started to ship radwaste drums for Lan-Yu, it is difficult to face the following critical problems:

1. Which drums are the most suitable ones for shipment?
2. Does any kind of radwaste drum arrangement in the containers meet the regulation (driver < 2 mrem/hr, surface < 200 mrem/hr, and 2 meters away < 10 mrem/hr)?
3. How to handle the vast paper work for registration and licensing applications?
4. How to efficiently manage the storage and transportation of radwaste drums to achieve the ALARA program?

A cooperative project to establish the radwaste drums management code package--QADEX, was initiated by TPC, Institute for Information Industry (III) and Institute of Nuclear Energy Research (INER) in May, 1985. The major purpose of this package is to establish the method and procedure to analyze the radwaste drums quickly and efficiently during

their storage and transportation. The general objectives of this project will be attributed to three items shown below:

1. To establish a basic data file for each drum in order to perform the management of radwaste drums.
2. To develop a computer code package to manage the drums during storage in TSF.
3. To establish and develop a dose rate conversion factor (DCF) data file and a code package to analyze the radiation field situation for various kinds of drum loading arrangements in the container before shipment.

Figure 1 shows the flow diagram of QADEX system, which describes the general design concept of QADEX package and the relationship between the seven subsystems and three data files. The basic function for each component will be briefly described as follows:

QADEX A Subsystem: This subsystem will execute the sampling and radiochemistic analysis of liquid radwaste in the storage tank before flushing to a solid radwaste system. It will provide the major isotopes and their relative fraction, which are needed in QADEX 1 data file.

QADEX B Subsystem: After adding cement and mixing it with radwaste in 55 gallon drums, an identification number will be marked on the lid of each drum. This subsystem would execute the measurement of the weight and surface dose rate of each drum to provide the basic drum data for QADEX 1 data file.

QADEX 2 Data File: QADEX 2 data file contains a set of dose rate/activity conversion factors for seventeen isotopes (usually found in the radwaste system) with five different drum densities, it is generated by the 3-D point kernel code QAD-DG. It could provide the DCFs for the dose rate and/or activity calculation in QADEX C, QADEX E, and QADEX G subsystems.

QADEX C Subsystem: This subsystem will perform the collection and establishment of the basic drum data

file. (ie. QADEX 1 data file will be shown in the following description).

QADEX 1 Data File: QADEX 1 data file contains drum identification numbers, weight, surface dose rates, major isotopes and their relative fraction, and storage location of each drum.

QADEX D Subsystem: This subsystem provides the user to identify the storage arrangement for a specific repository. Four functional commands (add, update, delete and list) to specify the repository managing parameters are included in QADEX D.

QADEX F Subsystem: This subsystem provides the calculation of curie contents in drums as a function of time due to the radioactive decay of each isotope.

QADEX E Subsystem: This subsystem provides the management of a radwaste drum storage facility. The major functions are shown as follows:

- a. move in the basic data of a new drum.
- b. move out the basic data of an old drum.
- c. update the basic data of an existing drum.
- d. query service, include querying of the information for radwaste drums, dose rate, isotopes and available locations in TSF.

QADEX 3 Data File: QADEX 3 data file contains a set of DCFs, by isotopes (17), detection point banks (13), drum positions (48) and drum densities (5) to calculate the dose rate outside the container due to each drum, which is also generated by code QAD-CG. It provides the DCF data library for QADEX G to perform the analysis before shipment.

QADEX G Subsystem: This subsystem is used to analyze the radiation situation around the container to check if the radiation level will be within the limitation of regulatory requirements.

Besides the functions provided by these subsystems, HELP is written in QADEX system to help users to handle the whole package.

QADEX which was written in FORTRAN 77 language, was completed in October 1985. At the present, it is loaded on PRIME computer system in TPC, and users can easily handle this system interactively with a graphical color terminal - CHROMATICS 4300.

The extended task right now in progress is to increase QADEX's query function, and reload it on a personal computer. We look forward to a series of its applications on the TSFs in Taiwan beginning soon after the package is revised specifically for each TSF. At the same time, a system analysis technique to simulate the storing situation in TSF will be carried on. It will be helpful to optimize the arrangement and

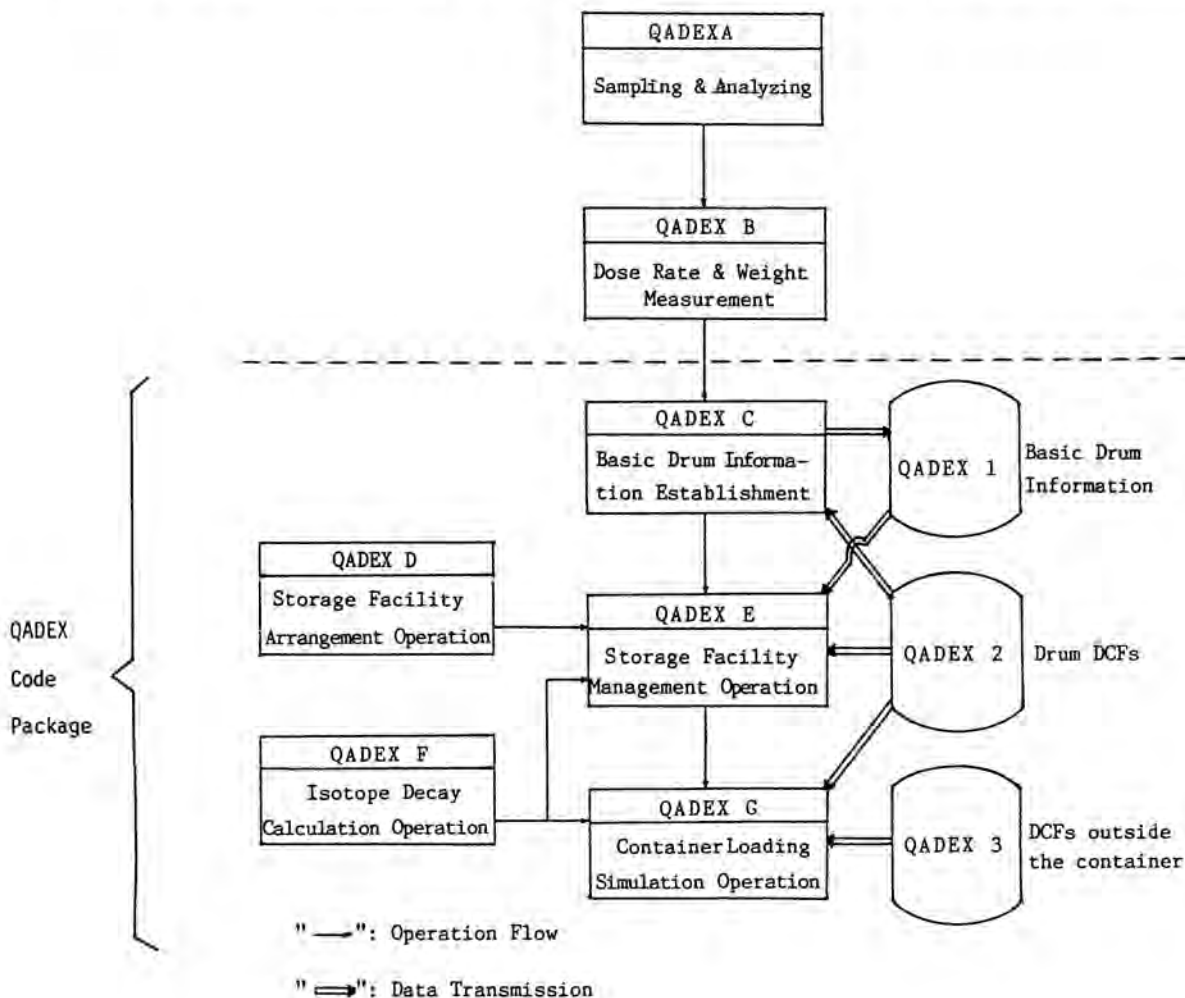


Fig. 1 QADEX System Operation Flow Diagram

configuration of a TSF before storage. The final target of the whole project is to achieve a linkage of radwaste management systems in each NPS with that of National Lan-Yu Storage Site to complete the integral management of radwaste storage facility network in Taiwan.

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