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A USER FRIENDLY DATABASE FOR USE IN ALARA JOB DOSE ASSESSMENT[1]

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ABSTRACT

The pressurized water reactor (PWR) design chosen for adoption by Nuclear Electric plc was based on the Westinghouse Standard Nuclear Unit Power Plant (SNUPPS). This design was developed to meet the United Kingdom requirements and these improvements are embodied in the Sizewell B plant which will start commercial operation in 1994.

A user-friendly database was developed to assist the station in the dose and ALARP assessments of the work expected to be carried out during station operation and outage. The database stores the information in an easily accessible form and enables updating, editing, retrieval, and searches of the information.

The database contains job-related information such as job locations, number of workers required, job times, and the expected plant doserates. It also contains the means to flag job requirements such as requirements for temporary shielding, flushing, scaffolding, etc.

Typical uses of the database are envisaged to be in the prediction of occupational doses, the identification of high collective and individual dose jobs, use in ALARP assessments, setting of dose targets, monitoring of dose control performance, and others.

INTRODUCTION

The PWR design chosen for adoption by Nuclear Electric plc was based on the Westinghouse Standard Nuclear Unit Power Plant (SNUPPS). This design was developed to meet the United Kingdom requirements and these improvements are embodied in the Sizewell B plant which is expected to start commercial operation in 1994.

The Health Physics Department of the station is responsible for the radiological protection of all workers on the station. To assist the Health Physics Department in the dose and ALARP assessments of the work expected to be carried out during station operation and outage, a simple user-friendly database was developed. The database was called "The Task Dose Database."

Such a computer database is required to store the information in an easily accessible form in order to fulfill the following requirements:

- enable maintenance of the information; i.e, update/edit

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- retrieve information and carry out searches; i.e., on:
  - activities
  - collective/individual doses
  - parameters such as temporary shielding, scaffolding, etc.

- enable incorporation of operational data

The database contains job-related information such as job locations, number of workers required, job times, and the expected plant doserates. It also contains the means to flag job requirements such as requirements for temporary shielding, flashing, scaffolding, etc.

Typical uses of the database are envisaged to be:

- prediction of occupational doses,

- identification of high collective and individual dose jobs

- use in ALARP assessments

- setting of dose targets

- monitoring of dose control performance

- others

This paper describes the structure of the database, the sources of the initial data and the use of the database.

The Database Software and Hardware

The decision was taken from the beginning of the work to make the database easily transportable and to base its development on a commercially available database package.

The software used for the development of the database was chosen to be the DBASE III Plus software. The database is run on personal computers (IBM/IBM-compatible).

THE DATA SOURCE: THE ACTIVE-TASK DOSE ASSESSMENT DATA

A dose assessment of the tasks that are likely to be carried out within the station's Radiologically Controlled Area (RCA) during outage and normal power operation, the active-task dose assessment, was carried out in support of the station's Pre Operational Safety Case (POSR) and was included in the POSR.

This task dose assessment considers the locations, manpower requirements, times, and dose rates of the tasks in order to calculate the collective and individual doses associated with the tasks.

In presenting the information of the task dose assessment, various formats were found to be necessary. All formats are based on the same concept which gives the information on the details of the task, the location, the manpower, the dose rates, and the doses. The most typical example of presenting a task is shown in Table 1.

Table 1. Typical Dose Assessment of a Task/"Activity"

ISI of Flux Thimble Guide Tubes

Location: RB Flux Mapping Room - Seal Table
Test: VT (Visual Testing)

Frequency: 1/10 years

Step	Task Details	No. of Men	Time hr	Location	Dose Rate mSv/h	Indiv. Dose mSv	Collec. Dose mSv	Dose-Rate Point
1. Prepare Area	Set up inspection control area	1	0.5	Seal tab	0.08	0.04[2]	0.04	20
2. Equipment Preparation	a) Bring equipment in to RB	2	1.0	RB rooms	0.01	0.01	0.02	3456
	b) Set up equipment	1	1.0	Seal tab	0.08	0.08[1]	0.08	20
3. Inspection	Semi-remote inspection	1	16.0	Seal tab	0.08	1.28[1]	1.28	20
4. Equipment Removal	a) Equipment disassembly	1	1.0	Seal tab	0.08	0.08[1]	0.08	20
	b) Remove equipment	1	1.0	RB rooms	0.01	0.01	0.02	3456
5. Re-instate Area		1	0.5	Seal tab	0.08	0.04[2]	0.04	20

Individual Dose
1. Operator 1 = 1.44 mSv
2. Operator 2 = 0.08 mSv

task collective dose = 1.56 mSv
including 10% Health Physics dose = 1.72 mSv

x frequency 1/10

annual average coll. dose = 0.172 mSv

The station work was grouped according to its nature in nine groups called 'Work Functions' consistent with the USNRC grouping. These are:

1. In service Inspection (ISI)
2. Refuelling
3. Scheduled Maintenance - mechanical
4. Scheduled Maintenance - electrical
5. Scheduled Maintenance - In Service Testing (IST)
6. Waste Processing
7. Unscheduled Maintenance
8. Operations and Surveillance (Ops. & Surv.)
9. Health Physics (HP)

The tasks in the Work Functions are further classified into "Classes" and "'Categories." For example, the ISI work has the following Classes: ISI of Reactor Pressure Vessel (RPV), ISI of Class 1 components, ISI of Class 2/3 components; the tasks in the Class 1 components ISI are further subdivided in Categories such as the Steam Generator ISI, the Pressuriser ISI, etc.

In the POSR, detailed task dose assessment was carried out for the first six work functions. The dose assessment of the last three was based on operational experience. In particular:

- Unscheduled Maintenance: this was set equal to the scheduled maintenance dose,
- Operations & Surveillance: this was expressed as a percentage of the total collective dose (12%),
- Health Physics: this was added as a dose allowance on the other work (10%).

Out of these three, the Health Physics dose is added as a dose allowance on each work activity and the dose from the other two is added to the total collective dose.

The database incorporates the data from the detailed dose assessment of the six work functions. No work activities have been included in the database for Unscheduled Maintenance and Operations & Surveillance. These can be added by the user (the station) at a later time as the work requirements become better defined.

THE STRUCTURE OF THE DATABASE

The Task Dose Database was set up initially to contain the POSR information and to enable the updating of this information as station operating experience develops. It was recognised that the data should be stored in a manner which minimizes the possibility of data inconsistencies during its updating and enables the inclusion of features to search and retrieve the data.

The "database" as such is a set of interrelated databases which are manipulated by a central program which also provides the interface with the user. In order to define the structure of the databases to be used, the following three steps were followed: (a) definition of the data to be included, (b) normalisation of the data-fields, and (c) definition of the databases.

The form to be used as the basis of the database is shown in Table 1. This is called an "ACTIVITY."

The information included in an Activity is (see Fig.1):

(a) Activity Identifier: an activity is identified by a Unique Number and its title.

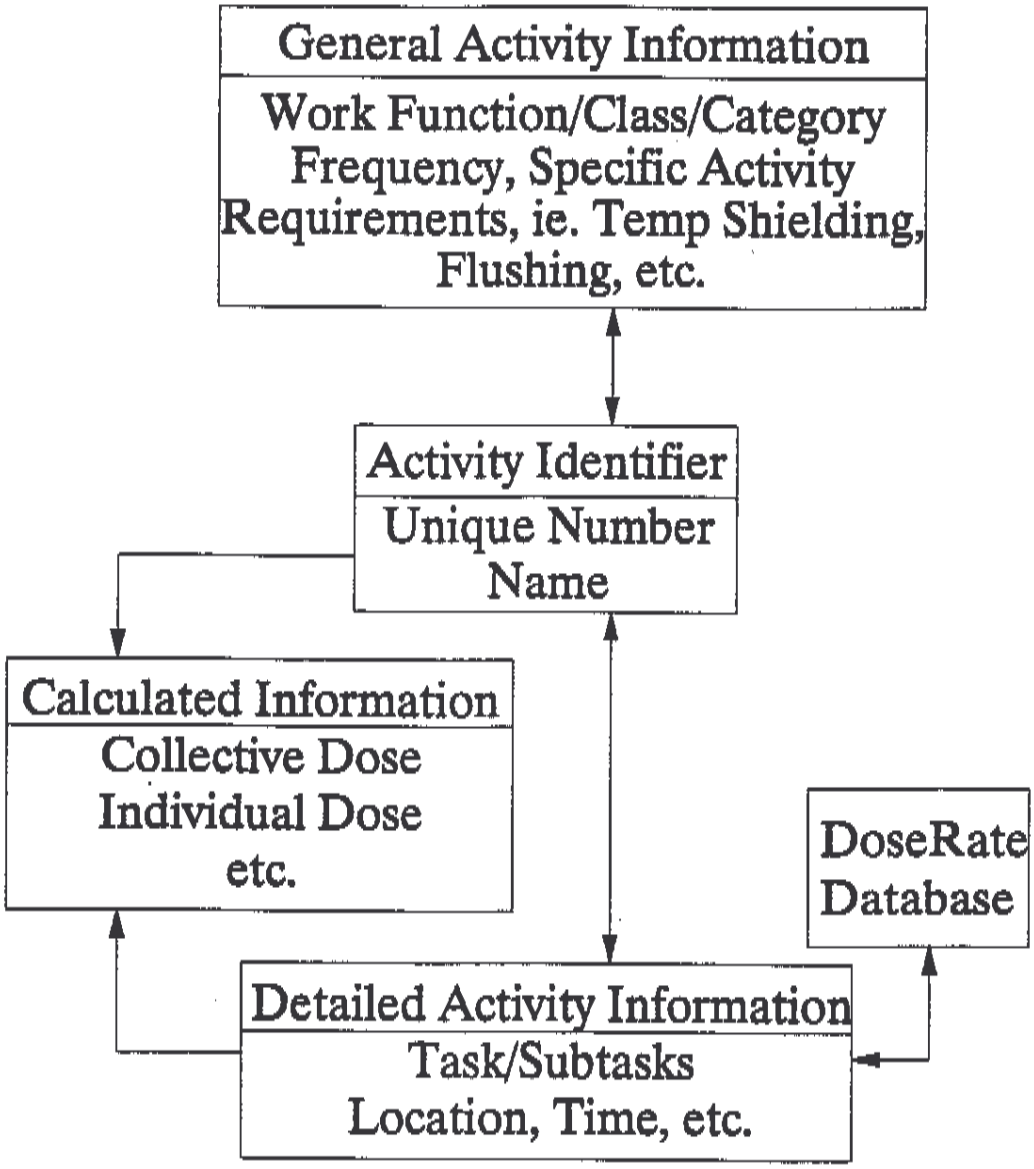

Fig 1: Information to be included in the Database

(b) General Information: this gives general information about the activity such as the Work-Function to which the Activity is grouped under, the frequency of operation, etc.

(c) Detailed Information: this details the work being carried out, the number of men, times, locations, etc.

(d) Dose rate Information: this is information about the doserates being used in the calculation of the doses.

(e) Calculated Information: this is information which is calculated from other defined data such as the individual and collective doses, etc.

In order to decide on the structure for the database, a procedure called Normalisation was used. This procedure groups attributes (or fields) into well structured relations and results in a database (or set of databases) which contains the minimum amount of data redundancy. The user is, therefore, allowed to insert, delete, and modify the data without errors or inconsistencies resulting from these operations.

The resulting database structure includes six separate databases as follows:

ACTIVITIES	(Unique_No, Activity, WorkF_Code, Class_Code, Categ_Code, Frequency, Scaff_Reqd, TShld_Reqd, Flush_Reqd, Other_1, Other_2, Comments)
TASKS	(Unique_No, Task_No, Task_Name, Subtask_ID, Subtask, Manpower, Time, Location, Worker_ID, Drt_Ref, Rel_Activ)
WORKFUNCTIONS	(WorkF_Code, Full_WorkF)
CLASSES	(Class_Code, Parent_WFn, Full_Class)
CATEGORIES	(Categ_Code, Parent_Class, Full_Categ)
DOSERATES	(Drt_Ref, Drt_Code, Drt_Location, Dose_Rate, Dep1, Dep2, Dep3, Dep4)

The Underlined fields represent the key field (primary search field) of the database that it is contained in. The Dotted Underlined fields are the fields which are the Key field in another of the databases.

Two databases (ACTIVITIES, TASKS) contain the information relevant to the Activities and are linked through the Activity identifier (an Activity unique number).

Three databases (WORKFUNCTION, CLASSES, CATEGORIES) contain the information on the grouping of the Activities into Work Functions and classifications within the Work Functions. These three databases are linked with the general activity database through abbreviated codes.

The sixth database (DOSERATES) contains the information on the doserates and is linked to the database containing the detailed activity data through the doserate reference.

A seventh database (a Configuration database) is also used to hold other general data that is required for various purposes such as the percentage contribution of the Health Physics work.

FACILITIES PROVIDED TO THE USER BY THE DATABASE

The purpose of setting up the task dose database is to enable the user to manipulate the data and extract information with ease.

The software package used to set up the database provides some basic facilities for updating the database and extracting information. It also provides a programming language which enables the development of further facilities for more complex data operations.

As part of the development of the database, a set of user options have been specified and developed as user tools. The approach adopted in the development of the options is to use a hierarchy of menus to guide the user to the required facility/option. The principle of the use of menus is illustrated in Figure 2. The user options are discussed below.

Data Operations

This group of options provides the user with the means to add, delete and modify the following data in the database files:

- Activities
- Tasks / Subtasks
- Work Functions / Classes / Categories.

View Information

This group of options provides the user with the means of extracting and presenting the raw data contained in the database files as follows:

- General information on: Work Functions / Classes / Categories
  Primary data of a group or range of activities
- Detailed task/subtask information of a group or range of activities

Searches

This group of options provides the user with the means of retrieving specific information from the database based on criteria specified by the user as follows:

- Miscellaneous searches for activities requiring scaffolding, temporary shielding, etc.
- Individual Dose: search activities or subtasks for specified individual doses.
- Collective Dose: search activities or subtasks for specified collective doses.

Collective Dose Calculations

This group of options provides the user with the means of calculating the collective dose of groups or ranges of activities specified by the user. The database provides the means for storing two task frequencies. One frequency is used to store the overall frequency of the task and the second frequency is used to store the frequency of the task for the period of interest.

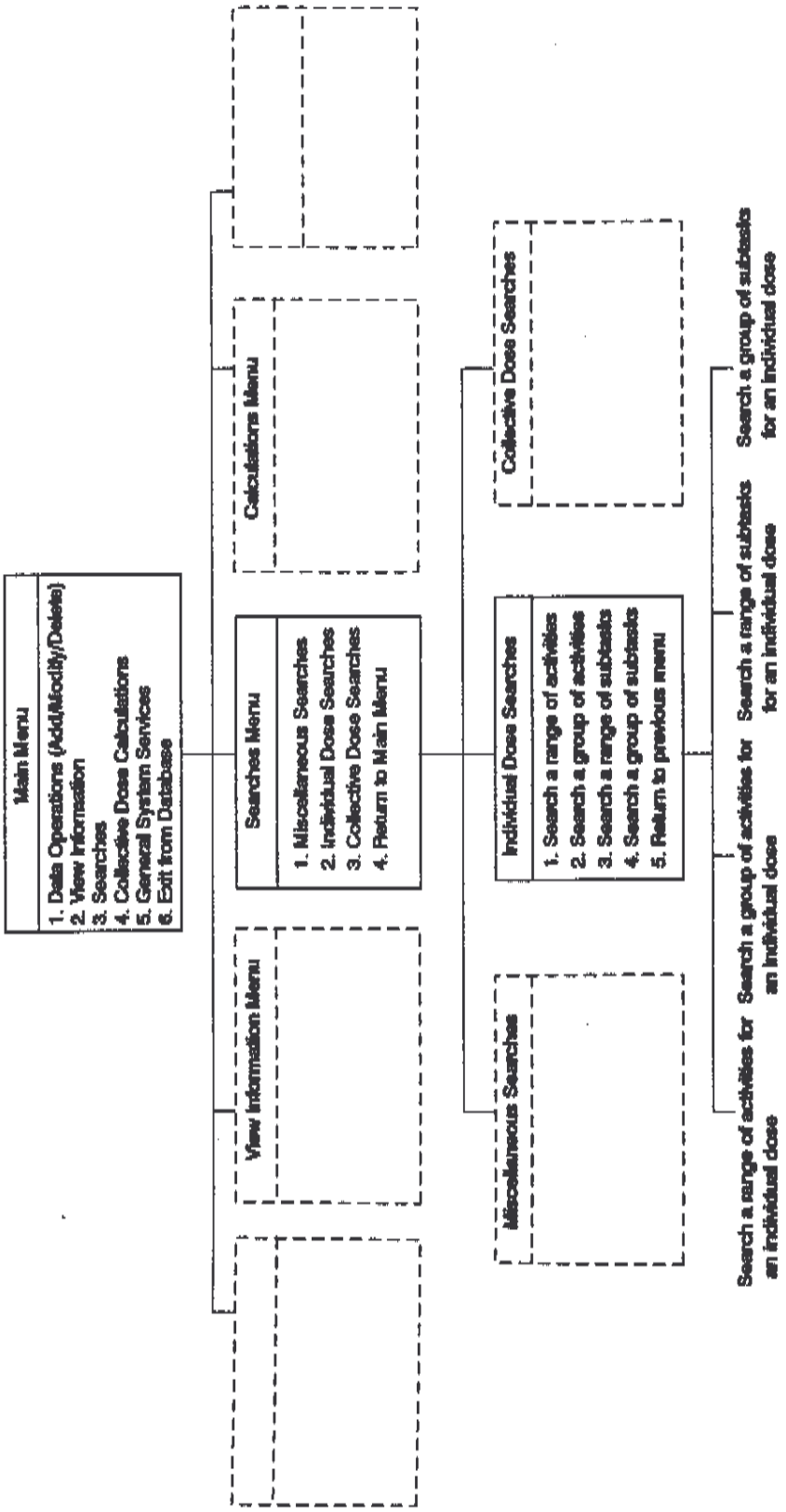

Fig 2: Illustration of Database Menu Structure

General System Services

This group of options provides the user with the means of changing the output device (print or screen), the Health Physics dose factor, to back-up and restore the database to and from a floppy disk, and to provide database diagnostic information (number of records and data/time of last changes).

DATABASE QUALITY ASSURANCE

The quality assurance of the database addressed the data input to the database and the software developed for the database.

The data input to the database originated from the Active Task Dose Assessment report. The contents of the data files were checked against the data presented in the report.

A test program was developed for the testing of the database software and the software was tested by extensive trial runs on a test database.

CONCLUSIONS

The requirement for the means to store, update, and retrieve information to assist in the performance of the station Health Physics duties was identified. The task dose database described in this paper was developed to fulfil this function and will be used at the Sizewell B Station.

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Author Biography

Anastasios M Zodiates is a Radiological Protection (Operator) Engineer with the PWR Project Group, Nuclear Electic plc., England. Dr. Zodiates is involved with the development of the radiological protection aspects of the design and licensing of the Sizewell B PWR. Before joining the Sizewell B team, he worked as a Reactor Physicist at the company's Heysham 2 Advanced Gas Cooled Reactor. He was born in the island of Aprodite, Cyprus, and attended university in England. He has a B.Sc. in Electrical Engineering from Southampton University, an M.Sc. in Nuclear Reactor Physics and Technology, and a Ph.D. in Physics from Birmingham University. He is a UK registered Charterd Physicist and Engineer.

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DISCUSSION

Lau: Will the QA manual fit on a diskette?

Zodiates: Yes, but you will not have the signature for the test.