# A Data Base Operation and Maintenance to Support Powerful RAM Analysis

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## Abstract

In this paper a Data Base for Operation and Maintenance (BDOM stands for the initials in Spanish) of electric generation units is presented. It stores availability and maintainability data of coal power plants owned by the Empresa Nacional de Electricidad S.A. (ENDESA). The combination of both kinds of data makes BDOM a more powerful tool than conventional data bases for supporting comprehensive RAM analysis.

BDOM collects power plant operation data through the current activities of the Plant Control Center. Maintenance data in BDOM are collected through an interface with a computerized Data Base Maintenance Management System: The Integrated Management Maintenance System (SIGM stands for the initials in Spanish).

The reliability reports of BDOM can calculate the same indices than the conventional availability and maintainability data bases: failure rates, EFOR, MTTUOF, MTTR, MTBR, etc. Besides, BDOM allows one to perform advanced RAM studies requiring both availability and maintainability data.

BDOM is fully operational and ready to obtain specific reports for the power plants of ENDESA. An interface of BDOM with the UNIRAM program is being currently developed.

## Introduction

The need for good data to support RAM analysis of generating power plants is felt by every single utility that wants to approach reliability seriously. The obvious necessity for a large body of information has been the motivation of comprehensive efforts at national and even international levels such as those ones reported in Refs. 1-4. These global collection efforts have to be complemented with a parallel initiative at the individual utility level, which can therefore be tailored to the particular needs of each utility.

The most advanced concepts that have been proposed concerning the development of reliability data banks, see for instance Ref. 5, recognize the need for combining two sources of information: the first source draws on the occurrence of actual power plant failures(i.e., those causing loss of available power output of the plant) and sometimes also on failures of major components, even if they do not cause any loss of plant availability; the second major source of information is the complete set of records of maintenance actions, both corrective and preventive, including any relevant information such as duration, cost, manpower, priority level, etc. Obviously both sources of information partially overlap, which is actually very convenient, since this allows one to establish the correspondence between plant and component failures. An interesting application of this approach is described in Ref. 7. This paper presents the experience of building a reliability data bank based on the aforementioned principles. The BDOM (this stands for Data Base for Operation and Maintenance, in Spanish) stores availability and maintainability data of coal power plants owned by the Empresa Nacional de Electricidad, S.A. (ENDESA) in Spain. Maintenance data are taken from a Computerized Data Base Management System (SIGM stands for the initials in Spanish) already in operation for several years, while global plant reliability data are collected from information available at the Plant Control Center.

This paper describes the BDOM building process, the data manipulation procedures and the results that can be obtained from BDOM. The BDOM objectives and the project environment will be presented first. It follows the definition of the data requirements and a relation of the data contained in BDOM. The paper continues with a description of the mechanisms to collect the information for BDOM. The BDOM organization, logical structure and its characteristics are presented next, to continue with some brief ideas on BDOM implementation. Finally, the BDOM reliability reports are enumerated and discussed.

## Motivation, Objectives and Preliminary Studies in the BDOM Project

RAM techniques for generating plants are now well developed both under theoretical and implementation viewpoints. However, they cannot yield sound quantitative results without being supported by a reliability data base. For instance, equipment failure and repair rates, which are some of the most important reliability data, can only be obtained from the actual history of the equipment.Reliability data have their sources in the operation and maintenance history of each power plant.

There are two basic approaches to obtaining these reliability data. The first consists of using generic data from reliability data banks. The second method uses data obtained from the equipment itself. Obviously the latter approach must be always prefered when the required information exists since no generic data may describe the equipment better than its own historical data. The former method may be used as a last resort, or when relative comparisons among alternatives is all that is required. ENDESA has chosen the second approach, whereby each power plant collects operation and maintenance data, although the detailed procedures may change from a plant to another. The need to collect and process such a large amount of information is met by BDOM.

BDOM, as any data base, has capacity for storing a big amount of data in an organized way. The BDOM project aimed at providing the means for collecting, storing and processing the raw reliability-related information that is generated during the operation of the coal power plants of ENDESA. In this way BDOM can be used in reliability analyses and also for satisfying daily needs of the thecnical staff of the power plant.

BDOM cannot perform any reliability analysis by itself, but it is conceived as the means to support a large variety of these analysis.BDOM is intended to achieve the following objectives:

* To have available historical and statistical analyses of equipment and unit performance.
* To be able to evaluate the historical unavailability cost and to distribute it among systems, subsystem or components.
* To support multiple kinds of availability and maintainability analyses of the power plant and the equipment, at different levels of detail.

* To monitor and to study the influence of several operation parameters.

The following broad kinds of tasks can be supported by BDOM:

* Availability improvement planning.

BDOM can produce, through internal computer programs that process the raw data, the standard parameters that are typically used in component and/or plant reliability analysis (i.e.failure rates, failure rates on cause type ordered, etc.)It is possible to evaluate alternate scenarios by using real and/or theoretical unavailability and maintainability data, since BDOM can also store user-provided data for simulation of the behavior of prescribed components.

From these analyses one can identify critical areas for application of availability improvement strategies.

* Optimization of maintenance management.

With BDOM it is possible to allocate maintenance and unavailability costs among equipments and to evaluate different measures of the efficiency of the current maintenance program (MTBF, MTBR, MTTR, etc.)

* Global unit performance evaluation

BDOM also yields global indices that allow one to monitor unit performance. It is possible to evaluate total unavailability and maintainability costs, indices such as EFOR,fuel comsumption, etc. and to compare them with data from other units owned by the utility and also with generic data.

In summary, BDOM was conceived as a tool to support the entire decision-making process in the ENDESA power plants regarding availability and maintainability matters.

These ideas start the BDOM building project. Once the global BDOM objectives were defined, a number of studies were conducted in order to set the basic guidelines for the realization of the BDOM and, in particular, the decision about the data types that the BDOM should store.These studies included:

* A detailed survey of the philosophy and structure of existing reliability data bases .Many reliability data bases were reviewed, and their principal characteristics and data types were taken into consideration and classified. The result was a set of candidates or BDOM data types.

* The identification of the information needed to support all conceivable RAM analyses of interest. Different kinds of RAM analyses were reviewed to determine their data requirements. The result was another set of candidates for BDOM data types.

* A recollection of the needs expresed by the potential BDOM users. The BDOM project was introduced to the several potential users, both at the ENDESA's headquarters and in the power plants. They added new ideas. One of these ideas was the convenience of also collecting some operation data. These data were added to the set of candidates for BDOM data types.

* The study of the characteristics of other related data bases already operational in ENDESA and that could interface with BDOM. Among these,SIGM was of prominent importance. Data collection procedures already existing at power plant level were given the highest priority. Those included the ones implemented in SIGM concerning maintainability data.Specific new procedures had to be created.

* The evaluation of the existing and potential computational support available at ENDESA, and a preliminary assessment of the BDOM requirements. The data base facilities at ENDESA were studied in detail and a prototype configuration was defined which included the selected data types.

The main outcome of these preliminary studies was the complete definition of the data types to be collected and stored in the BDOM.This definition is presented in the next section.

## The BDOM Data Types

BDOM contains four basic types of data: component data, unavailability and maintainability data and also information concerning the global unit operation. The component data reflect the power plant structure, therefore they constitute the underlying framework for all the others, since the unavailability occurrences and the maintainability actions must be necessarily referred to components. The unavailability and maintainability data are all that is needed in most RAM analyses. What is not that common is to include both data types in a single data base, which is a BDOM especial feature. BDOM users need also to have available another data type: the unit monitoring generic data. These data allow the users to meet some specific daily needs at plant level and therefore they are also stored in BDOM. In this way, BDOM is used as a vehicle to link the entire operation information of the plant.

In summary, BDOM contains the four mentioned data types: component, unavailability, maintainability and unit monitoring generic data. They are briefly described below.

* Component Data

BDOM envisions a power plant as organized in four hierarchical levels: power plant, units, systems and subsystems. BDOM stores data records for each component at each level. These data represent the physical characteristics of the components and establish the basic reference framework of BDOM.

The task of definition and codification of the BDOM components was fortunately easy, since these components and their codifications have been used in SIGM for a long time. Another significant advantage is that the utility personnel is already familiar with them.

Furthermore, SIGM contains two levels more than BDOM. The hierarchical breakdown of the unit in SIGM considers six integrated levels: power plant, units, systems, subsystems, machines and elements. Although BDOM includes data only up to the subsystem level, its structure is ready to encompass until the element level.

The component data records contain the name, the code and the principal characteristics of each power plant component. The system and subsystem records have the possibility of extending the number of considered physical characteristics by just using additional records associated to the original one.

* Unavailability Data

The concern now is to keep track of the different unavailability situations that occur in each generating unit. These situations are reflected on a data set in BDOM. This data set constitutes an unavailability record. An unavailability record has the following data:

- Unavailability record number.
- Unavailability starting date.
- Lost energy.
- Power plant, unit, system and subsystem codes of

components which are the cause of the unavailability.
- Date of the last updated lost energy.
- Unavailability ending date.
- Failure mode.
- Failure cause.
- Event description.
- Event type.
- Urgency type.
- Corresponding corrective maintenance work order numbers.
- Distribution of the energy lost among the corrective maintenance work orders.

* Maintainability Data

Now the attention focuses on the repair activities, whether they are associated or not to actual unavailabilities of the generating unit. BDOM should not store all this information because this is part of the mission of SIGM. However, since SIGM is a data base only for maintenance management, it is not directly suitable for reliability analysis. Then the idea is that BDOM may retrieve from SIGM all the information that might be needed for reliability purposes. This information can be obtained from the maintenance Work Orders (WOs). It must be noted that all WOs data in SIGM are not transferred to BDOM WOs, as only the relevant items from a relibilility viewpoint are stored in BDOM. So BDOM WOs have less information than SIGM WOs. These BDOM WOs are stored in maintainability records, or so-called WO records. The maintainability data stored in BDOM for each WO are:

- WO record number.
- WO starting date.
- Equipment code.
- WO ending date.
- Defect type.
- Priority type.
- Repair time.
- Active repair time
- Delay causes.
- Delay hours.
- Labor costs.
- Material costs.
- Other costs.
- Total cost of repair.

* Unit monitoring generic data

These data complement the unit performance data and satisfy some specific users' needs of BDOM at each power plant. They are not indispensable from a reliability viewpoint. However, some BDOM users also need another operation data in addition to just unavailability and maintainability data. BDOM differs in this aspect at every power plant, since it must comply with particular needs of the BDOM users.

These data are of two types: daily data and aggregated monthly data. The data of the first kind are daily collected in BDOM, the second type of data are aggregated every day in a monthly record.

The daily data are collected in different record types. There are, for instance, coal, fuel and gas comsumption (i.e. quantity and quality records, start-up records, physical data of water-steam cycle records, etc.).

There is a single monthly record at each month that contains average parameters of daily unavailability and maintainability records.

## Mechanisms to Collect Information

The BDOM data types are collected through well established mechanisms or procedures. They are carefully designed to avoid work overload of the power plant personnel, to make use if possible of the information paths already implemented and to satisfy the BDOM needs. These procedures consist of sets of rules and computer programs for collecting the BDOM data. Each type of data has its own mechanism for collection; therefore, BDOM has four of these mechanisms, which are explained next:

1) The mechanism to collect component data.

Before other data types are collected, BDOM must first store the component data. They are manually stored in BDOM by the power plant operators through a user friendly program. It is not necessary to complete the data component records, since BDOM just needs their names and codes in order to store the remaining data types. The component records are entered on the following hierarchical order: first, the power plant record; second, the power plant unit record; third, the system records of each unit; fourth and last, the subsystem records. Once the component data are stored, the BDOM is operative and other mechanisms to collect information can be used. When a fast set up of the BDOM is desired, only the names and codes of the component data need to be initially entered, since the remaining physical characteristics of the components may be stored at a later time.

2) The mechanism to collect unavailability data.

This mechanism is of utmost importance in the adopted scheme to create a comprehensive reliability data base. It is especially designed to be used by BDOM and requires a specific new implementation within the information collection processes currently established in power plants owned by ENDESA. It consists of a well defined sequence of activities, comprising two fundamental parts: The unavailability data collection and, once the unavailability event has ended, the unavailability data documentation. The first part is accomplished in the control room by an operator. The second part is done by a Reliability Engineer (RE) of the power plant, who is responsible for the BDOM information within the power plant as well as for the BDOM management. These two parts of the unavailability collection process are presented below.

Unavailability data collection.

The Control Room operator has a computer terminal to access BDOM. When a plant unavailability event occurs, the control room operator, whose first priority is to solve operational problems, must just record the event occurrence by accessing BDOM as soon as normality returns. Here a minimal data set is requested to avoid overloading the control room operator. As soon as possible after the beginning of a unavailability event, he must record its starting date, the code of the affected equipment (power plant, unit, system and subsystem), the failure mode, a short description of the occurrence and, optionally, he can also enter the failure cause. When these first data are stored in BDOM, it is formed a unavailability record and the record number is also automatically created. There are fifteen failure modes and sixty failure causes. The former ones only record the occurrence cause that apparently is the most likely, while the later state the real event cause after a detailed investigation. The rationale for this is that, at the beginning, the failure cause may not be apparent, so the control room operator may optionality enter it. Also since the amount of lost energy is not known at the beginning of the unavailability, it cannot be entered at that moment. When the unavailability occurrence finishes, the lost energy and the ending date are introduced in the corresponding record by the control room operator. If the unavailability remains for a long time, then every work shift of control room operators will have to update the lost energy and the date that corresponds to it. Furthermore, it is possible to add new descriptions as the unavailability evolves. However, the first description cannot be deleted.

While the unavailability record is opened (i.e., still without unavailabilit ending date), it is inacessible for documentation by the RE, although he can read it.

When the control room operator closes the record, then the RE can proceed to document the unavailability.

Unavailability data documentation

Once the RE has access to the unavailability records, which must be previously closed by the control room operator, he completes them, not only from a unavailability viewpoint, but also from a maintenance one. The RE cannot modify the information collected in the control room. This is a procedure designed to guarantee the integrity and prevent manipulations of the collected data. However, the RE can modify the failure cause, if it was previously introduced. He must record the event type, the urgency type and he also must establish a link between the unavailability records and the corresponding corrective maintenance WOs. This is the key point of BDOM, which establishes the main difference with similar data bases.

There is not a direct link between SIGM and BDOM. However, the RE has access to all WOs stored in SIGM. To link unavailability and maintainability data, he may see in SIGM all corrective maintenance WOs which have caused any unavailability. The starting and ending dates are a precious help for this task. If he finds one or several relevant WOs in SIGM, then he must write their record numbers on the unavailability record and he also must distribute the lost energy among these WOs, according to some prespecified criteria. Notice that SIGM contains two component levels more than BDOM: the machine and element levels. The lost energy distribution into several WOs permits one to assign responsibilities among machines and/or elements. Furthermore, the RE can add observations to the unavailability record.

3) The mechanism to collect maintainability data.

This mechanism is in charge of transferring certain WOs from SIGM to BDOM. An IBM 4341 computer currently hosts the SIGM. However, BDOM is implemented in a VAX-8600 computer. Therefore an automatic procedure is needed to move the relevant information contained in the WOs of interest from SIGM to BDOM. The direct communication between both computers is not feasible at this moment. However, an indirect linkage is possible via magnetic tape. This is the adopted means of interfacing BDOM with SIGM. The supervision of this mechanism is also the responsability of the RE. He has full access to SIGM and BDOM and he may always link the corrective maintenance WOs with the corresponding unavailabilities. Furthermore, he can also choose other WOs which are important from a reliability viewpoint, even though they have not unavailability consecuences.

The RE has a especial computer program in SIGM to accomplish this task. This program stores in magnetic tape the WOs chosen by the RE. There are four WOs selection criteria in this program:

- WOs selection by record number. This criterion allows one to link WOs to unavailabilities.

- WOs selection by total cost threshold. This criterion allows the RE to include WOs in BDOM that are not cause of plant unavailability, although their associated cost certainly makes them candidates for a maintenance planning program.

- WOs direct selection of specific systems or subsystems. This criterion allows the RE to analyze any system or subsystem in detail.

- WOs selection by annual or monthly failure rate thresholds. This criterion permits the RE to find equipments with low WO cost that cause frecuently problems even if they do not cause any plant unavailability.

The IBM computer produces a magnetic tape with all this information. This tape is read in the VAX computer, where the format is changed from EBCDIC to ASCII code. It is now when the RE runs a program that automatically connects some of the WOs to their corresponding unavailability records, and that simply stores the remaining WOs (without connecting them to unavailability records) that were chosen because of any of the last three criteria.

4) The mechanism to collect unit monitoring generic data.

This mechanism consists of programs prepared to process daily information. These programs run on-line. An operator collects the information and feeds with it the programs. The daily input data automatically updates the monthly record information.

## The BDOM Organization and Logical Structure

BDOM is ready for collecting data of four coal power plants: Puentes de García Rodríguez (4 units, 1400 Mw), Compostilla II (5 units, 1312 Mw), Teruel (3 units, 1050 Mw) and Costera (1 unit, 550 Mw).

The data are entered in BDOM on every power plant through the aforementioned mechanisms. The RE is the BDOM manager at power plant level. He is responsible for the power plant data contained in BDOM and also of performing any RAM analysis concerning the plant. He cannot change data belonging to another power plant which he is not responsible for.The RE can only read data from another plants in reports of a prespecified format.

BDOM also has been conceived so that it must have a data base central manager in the ENDESA's Headquarters at Madrid. This central manager has access to any data from each power plant. Its principal mission is to coordinate the BDOM management procedures and support the new users' needs.

In figure 1 the geographical situation of coal power plants and BDOM are shown.

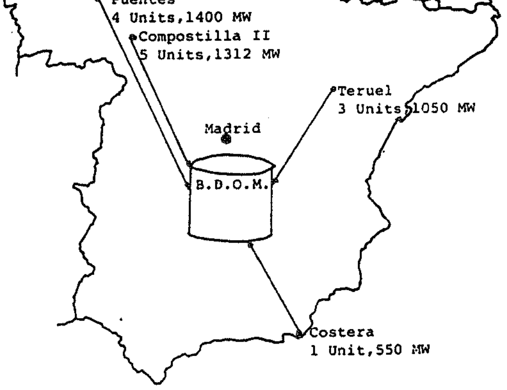


FIGURE 1

BDOM has a unique structure for every plant of the ENDESA system. This structure resides in a computer at Madrid. Each power plant can access BDOM by opening a window from which only the data corresponding to that plant can be seen.

The BDOM logical structure is named BDOM schema and the windows for every power plant are named BDOM subschemas.

There are four BDOM data types, then each one is stored in a data storage area. Therefore, there are four areas to store data for each power plant and BDOM has sixteen of them. It is possible and easy to add new power plants to BDOM.

The areas where data from each power plant can be stored are: component data area, unavailability data area, maintainability data area and unit monitoring generic data area. The number of power plants is conceptually unlimited.

The component data are stored in power plant, unit, system and subsystem records. The unavailability data area stores unavailability records. The maintainability data area stores WO records. The unit monitoring generic data area stores fuel comsumption records, start-up records and other aggregated monthly data records.

BDOM has mechanisms to guarantee the data integrity and security and it also has error checks.

BDOM is currently implemented in a VAX-8600 using the D.E.C. Data Base Management System (DBMS). DBMS allows one to easily build the BDOM logical structure such as it has been conceived. Since DBMS is a commercial product whose description can be found anywhere, only a broad outline of its logical structure will be briefly discussed here.

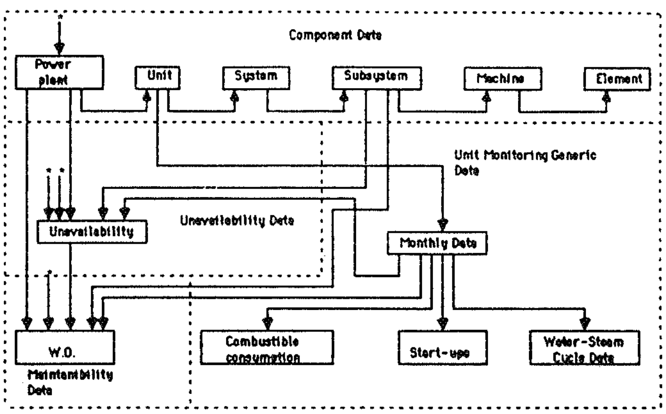


Figure 2

Figure 2 shows the general BDOM structure.The BDOM storage areas appear within dotted lines, and they are named the DBMS realms. The different record types are contained in the boxes and they are linked through relations named sets. Every set has an owner record and one or several member records. Once the owner records are entered in BDOM, the member records are added to the set. This addition is ordered either in a sequential or indexed mode according to the set insertion definition. The sequential insertion allows one to add records according to the order of arrival. The indexed insertion adds new records according to one or several keys. These keys are record items. Notice that a unique piece of information can be accessed in several different ways.

## BDOM Implementation Data

BDOM currently stores component data of four power plants (13 units) with approximately 2600 records. It also stores unavailability history since November 86 and maintainability history since January 85 of the Puentes de García Rodríguez plant. BDOM is still a new software product, and its management procedures are in a trial phase; however, the present experience indicates a good performance. The BDOM structure and its management programs are completely finished, except for the unit monitoring generic data area, which is still under development, since the users are suggesting new applications and requesting more data.

Some relevant software characteristics of BDOM follow:

- BDOM has been implemented in a VAX-8600 computer.
- DBMS supports the BDOM structure.
- BDOM has 18 main programs, 20 secondary programs, 3 libraries and 60 screen applications.
- BDOM uses auxiliary tools, such as TDMS, SMG$ and LIB$ routines.
- The programming language is FDML (Fortran Data Manipulation Language). It is a Fortran language compatible with DBMS.

The main programs are used only by the BDOM central manager. Each RE has similar versions of these programs, but they have been made plant-specific, so they can only see the data of its power plant.

For accessing to BDOM there is available a set of terminals (VT set of printers (LA-120 and LN03), only for outputs.

## BDOM Reliability Reports

Besides collecting data, BDOM also provides important processed RAM information. Notice that BDOM is primarily meant to be a tool to help in applying reliability techniques. Once it has been explained how BDOM collects reliability data, in this section it will be described how this information is processed to prepare reliability and maintainability reports.

BDOM has programs for the automatic preparation of the reliability reports, which can be either standard (i.e., the same format for any plants) or specific (for individual plants). All reports are intended to help the RE in the application of reliability techniques. The programs are very user friendly, allow a flexible data input and offer several options regarding the contents of the information output. The output reports can be obtained via the screen and/or the printer, and their execution can be either in an on-line or a batch mode. It is also possible to obtain paper copies of the screen contents. Only the standard reports will be discussed here. There are three types of standard reports:

* Unavailability and maintainability chronological event reports.

These reports present an ordered list of unavailabilty and/or maintainability records information. They do not involve almost any data processing.Reports included in this category are:

- Unavailability chronological report.
- Maintainability chronological report.
- Unplanned and planned unavailability reports.
- Unavailability and associated corrective maintenance WOs chronological report.

* Conventional reliability index reports.

These reports present conventional reliability indices for the units and/or components. These indices are calculated using unavailability or maintainability data. Notice that as BDOM only stores a selection of the total WO in SIGM,the maintainability indices calculated by BDOM will be only approximations in some instances, their precision depending on the WO selection criteria chosen by the RE. Reports of this kind include:

- Failure rate reports.
- Mean time to unplanned outage failure (MTTUOF) reports.
- Mean time to repair (MTTR) reports.
- Equivalent forced outage rate (EFOR) reports.

* Advanced reliability reports.

These reports present information not usually considered in standard RAM studies.They reflect the kind of RAM analysis that is intended to be performed by ENDESA's RAM engineers. It follows a brief description of some representative reports of this kind:

- FCIL (Failed Critical Item List) [Ref.5]

This report presents an equipment list in a descending order of cost, with this cost being the addition of the cost associated to the energy lost and the corrective maintenance costs. FCIL is used to determine critical problem areas. When possible, revisions of maintenance strategies should address these areas.

There exist options in the FCIL report that result in an equipment list regarding only the unavailability or the maintainability cost.

- KCIL (Key Critical Item List) [Ref.5]

This report presents a potentially problematical equipment list. Therefore KCIL is used to determine potentially critical problem areas. When it is possible, the maintenance should address these areas, once FCIL areas are attended. KCIL is calculated from WOs that are not linked to unavailability records. Notice that these WOs are selected by the RE from SIGM.

BDOM allows one also to collect theoretical unavailability data and/or theoretical WO data as well as real unavailability data and/or real WO data. These theoretical records have a first character 'T' in the record number. They are a very special feature of BDOM which can be very useful in certain RAM studies and/or maintenance planning approaches, since with them it is possible to represent potential situations of interest. The RE can store theoretical operation and maintenance data in BDOM and prepare reports with these data. Later, he can compare wit real data andforecast possible new states of planning maintenance management. KCIL has options allowing one to take into account real WOs with no link to real unavailability records, or theoretical data (unavailability and/or maintainability) or any other combination of these.

- FCIL in relation to a reference unit(s).

This report is similar to FCIL. It compares a system of a given unit to a similar system of a reference unit(s).

- EFOR in relation to all units owned by ENDESA

This report is similar to EFOR. It compares an EFOR index set which belongs to a system set of a unit, with an EFOR index set which belongs to a similar set of all the units owned by ENDESA.

## Summary and Conclusions

In this paper a data base for storing unavailability and maintainability data (BDOM) is presented. Customary availability data bases can calculate availability parameters as BDOM, but usually they cannot evaluate, for instance, the associated maintenance costs, as BDOM does. Going from maintenance work orders to their impact in plant operation is also possible with BDOM. This especial feature makes BDOM a valuable tool for supporting advanced RAM analyses. Other operation data also collected by BDOM can be used in specific RAM studies that are requested by each individual plant.

BDOM is currently operational, therefore illustrating the possibility of building a data base combining unavailability and maintainability data. Its data types and its structure have been presented in this paper. Some of the reliability reports that can be obtained from BDOM have been also described.

A successful implementation of a data base such as BDOM is not possible without the Reliability Engineer (RE). He is responsible for the correctness and completion of BDOM information at his power plant and also of the development of RAM. His important role is stressed throughout the paper.

Although BDOM, as it has been described in this paper, is fully operational, these are new ideas for extensions and for improvements in the current implementation. For instance, it is necessary to extend the number of standard reports and to improve the reports with graphic outputs. There is also a plan for including hydraulic power plant data in BDOM. Finally, there is an on-going project to design an interface of BDOM to the UNIRAM program.

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