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FALCAO – A RELATIONAL DATABASE TO STORAGING THE VARIABLES MONITORED IN THE RESEARCH REACTOR IEA-R1

José Gomes Neto[1] and Delvonei Alves de Andrade [1]

[1] Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-970 São Paulo, SP
gregogrego@ig.com.br, delvonei@ipen.br

ABSTRACT

The objective of this work is to introduce all initial steps for the creation of a relational database, named FALCAO, to support the storaging of the monitored variables in the IEA-R1 research reactor, located in the Instituto de Pesquisas Energéticas e Nucleares, IPEN – CNEN/SP.
As introduction, it is considered the modeling importance of the logic diagram and its direct influence in the integrity of the provided information.
It is presented the concepts and steps of normalization and denormalization including the entities and relations involved in the logical model. It is also presented the effects of the model rules in the acquisition, loading and availability of the final information, under the performance concept, since the acquisition process, loads and provides lots of information in small intervals of time.
The data logical model, considering the desired performance and the sharing information is also presented.

1. INTRODUCTION

The Data Acquisition System [1], named SAD, is responsible for registering seventy seven variables every day in the research reactor IEAR-1.
Due to the great volume and diversification of data, the current storage procedure has shown to be inefficient. It is often necessary a subsequent format and/or re-analysis by the user.
So that and due to the great current demand in integrating these information, the existence of a more practical, efficient and safer form of storaging and subsequent availability of these information is imminent.
One of the purposes of this work is to provide this demand through the creation of a system database manager taking into account the data integrity. Then make it available in a computational acceptable time through a Web system.

2. METHOD

To understand the proposed process, through which the information will be available, it will be divided into four phases:

- reactor data transmission and consistency;
- data modeling;
- data access, and
- WEB application.

2.1. Reactor data transmission and consistency

All variables, monitored in the IEAR-1 reactor, are copied to the SAD server in archives with .txt extension. It is transmitted through these archives and IPEN intranet to the database, which is installed in the FALCAO server, located in the Nuclear Engineering Center – CEN building, quite far from the reactor building.
These archives are divided in four groups, as follows:
- Nineteen (19) variables related to flow, grouped in a so-called archive vazao.txt;
- Thirty five (35) variables related to temperature, with a correspondent archive named temperatura.txt;
- Fifteen (15) variables related to radiation, grouped in a so-called archive radiacao.txt and
- Eight (8) variables related to the nuclear greatness which were grouped forming the archive nucleares.txt. Each archive contains an average of 1700 Kbytes.

At present these archives are defined in periods of seven days when they are manually produced and transmitted.
This work automates the generation as well as the transmission, making the process much more efficient.

In this implementation, the stage related to the transmission of the archives demanded a bigger automation since the schedule of archives generation and the sequence of generation cannot be previously programmed.

SAD server supplies the data to be loaded and is remotely located in relation to the server that loads the data, FALCAO server. This automation is done through a program called Transfere_Dados_IEAR-1, developed in the context of this work.

This process, after scheduled in any workstation connected to the IPEN intranet, periodically checks in the SAD server for the existence of such archives to be loaded. Then if it is the case, transmits it to FALCAO server.

As soon as the information are transmitted to FALCAO server, where it is loaded, the process called Consistencia_Dados is automatically started to validate the necessary queries which were previously established, loading or returning them to their place of origin for correction and subsequent retransmission and load.

Any process related to the transmission, consistency and data load is reported in details through log archives, in the data origin as well as in its destination. These archives contain date, hour, type of process, related file and the result of this process.

2.2. Data modeling

The data modeling is the process through which the integrity is guaranteed and consequently the information precision [2].

The response to a query in a proper time is understood as expected performance. However, precise values, as those considered in the four archives mentioned before, demand a hard-

working process of load and storage by the database, consequently demanding more precision of the whole process.

The processes used, so far, do not guarantee the integrity of the data and they are limited to small samples. Uncertainties associated to the results are not negligible and are quite undesirable in the analyses.

From the point of view of data modeling, to guarantee the information integrity means to store its values just once, avoiding redundancies, which in other words means the same information in distinct places, or inconsistencies corresponding to the same information with distinct values. So, considering the queries expected performance, however priorizing the precision associated to information, the data modeling was carefully studied.

It is important to emphasize that, even with the WEB application in progress, the use of the data stored in FALCAO database has demonstrated a great potential of use in the researchers daily routine.

A substantial improvement is observed concerning the data acquisition time if compared with the time previously spent for the same task.

2.3. Data access

An automated system for collecting information, named SACI, is used for accessing data in FALCAO server. SACI is started via browser installed in remote stations spread out in IPEN domain. Native interfaces, in case of database administrators may also be used. Administrators must obey the predefined policies for allowing access to the database. Access is controlled by password with corresponding permissions according to the necessities of the respective user.
Nonetheless, the access was studied and implemented as to have acceptable time and to allow simultaneous queries to FALCAO from different access points at IPEN. On the other hand, it can not interfere on the information originating from other processes using the same computer intranet.

It is important to emphasize that the flow of information on FALCAO server takes place exclusively at IPEN domain, but the access to the database is controlled due to nature of the information.

Although SACI application is the most efficient way to access the recorded data in FALCAO server, it is not the only way of access since one needs only a permission through a database user to make other forms possible. However, it is impracticable if compared to SACI. The native interface of the Oracle Database Management System – DBMS [3], named SQL-PLUS is an example. It permits access to the data although with some limitations. It is oriented to character and for this motive a lot less interactive and versatile than SACI.

A third form of access is through a commercial tool called TOAD. Though it has its own characteristics, different from the native interface, its main goal is to access the database.

2.4. WEB Application

Every computer system is created guided by some rules. A specific system, as SACI, counts on two possibilities concerning these rules, since it manipulates data.

Specific systems have as a main characteristic the possibility to store the rules in its source-code or impose it to the database through constrains or limitations.
The first case is adopted when the processes are less critical from the performance point of view; when the information is open and especially, when the purpose of the system is constantly changing.

The second case is commonly applied when the performance is the focus; when changes in the application are not frequent and especially, when the data access does not take place through a unique application.

Basically, the following reasons justify the choice of second case in this paper.
- proper computational access time;
- database is at spot and frequent changes in the application are not necessary;
- possibility to access the database through other applications.

SACI was projected based on these concepts. All the data monitored in the reactor and stored in FALCAO are accessed by the users through this application.
Although in progress, SACI will allow the user to instantly produce reports, graphics and files.

Portability is fundamental since IPEN presents great variety of machines, some with good performance, others with low capacity of processing but with different operating systems such as Windows, Linux, and Unix. JAVA [4] is the language used for the application development.

3. RESULTS

As mentioned, this work is intended to the storaging and comparison of big volume of data. Manual processes were substituted by automated processes of transmission, storage and data availability. So, immediate conclusions are now possible and are impracticable with obsolete information or outdated information presented in graphs or imprecise files.
Certain cases show that with a graphic efficient comparison, determined phenomenon or tendency that would be treated correctively can now be preventively or even predictively treated.

Fig. 1, generated by the manual process, presents the input and output temperatures of the reactor primary circuit, the difference between them and the ambient temperature.

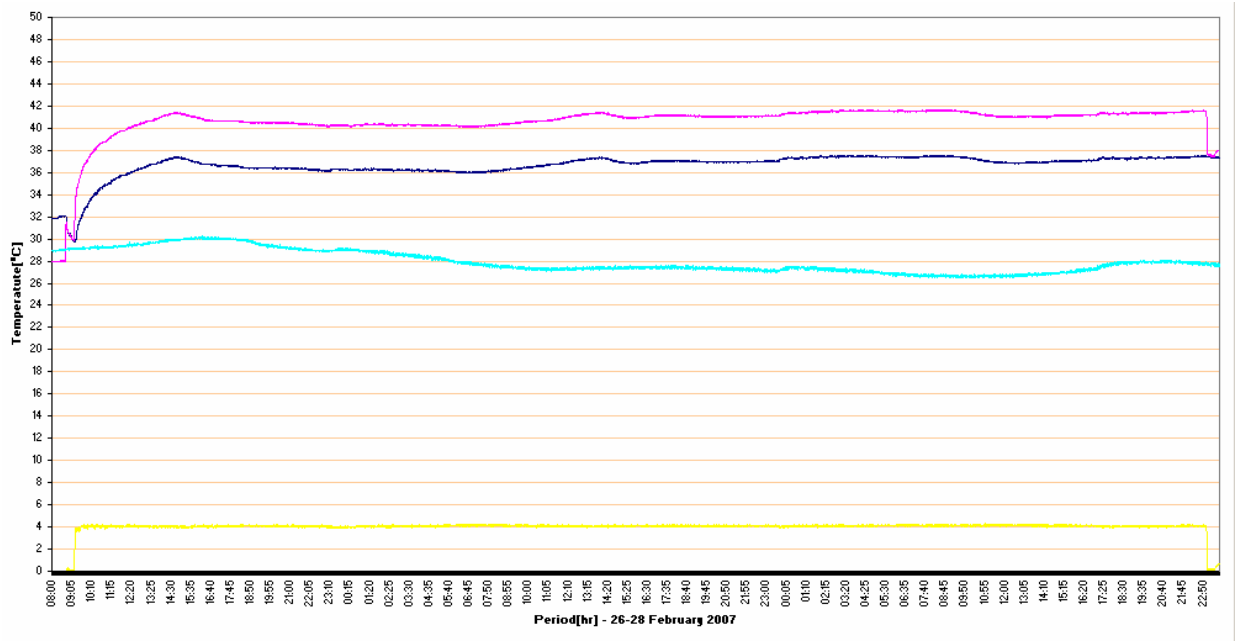

Figure 1 – Reactor primary circuit temperature x period (hr) – Manual Process

Fig. 2 was generated by SACI and presents the same variables as those showed in Fig. 1. It is instantly created compared with the manual process.

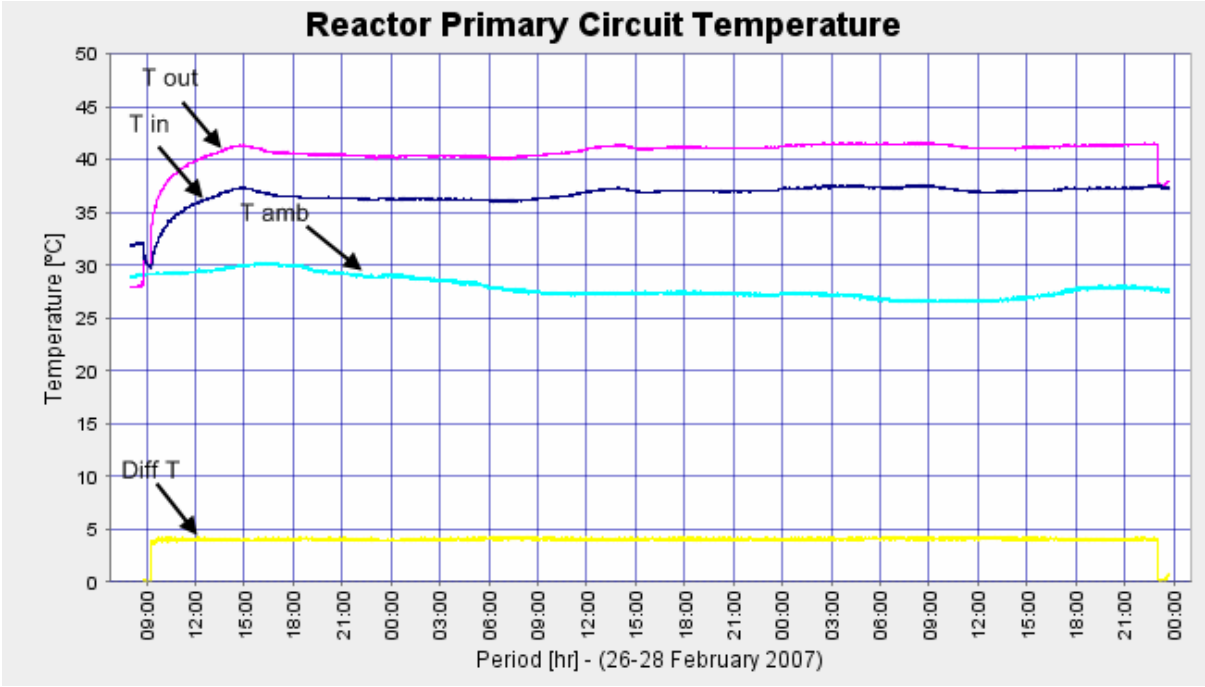

Figure 2 – Reactor primary circuit temperature x period (hr) – SACI system

Fig. 3 presents the reactor primary circuit power. It is calculated instantly through the temperatures shown in Fig. 2.

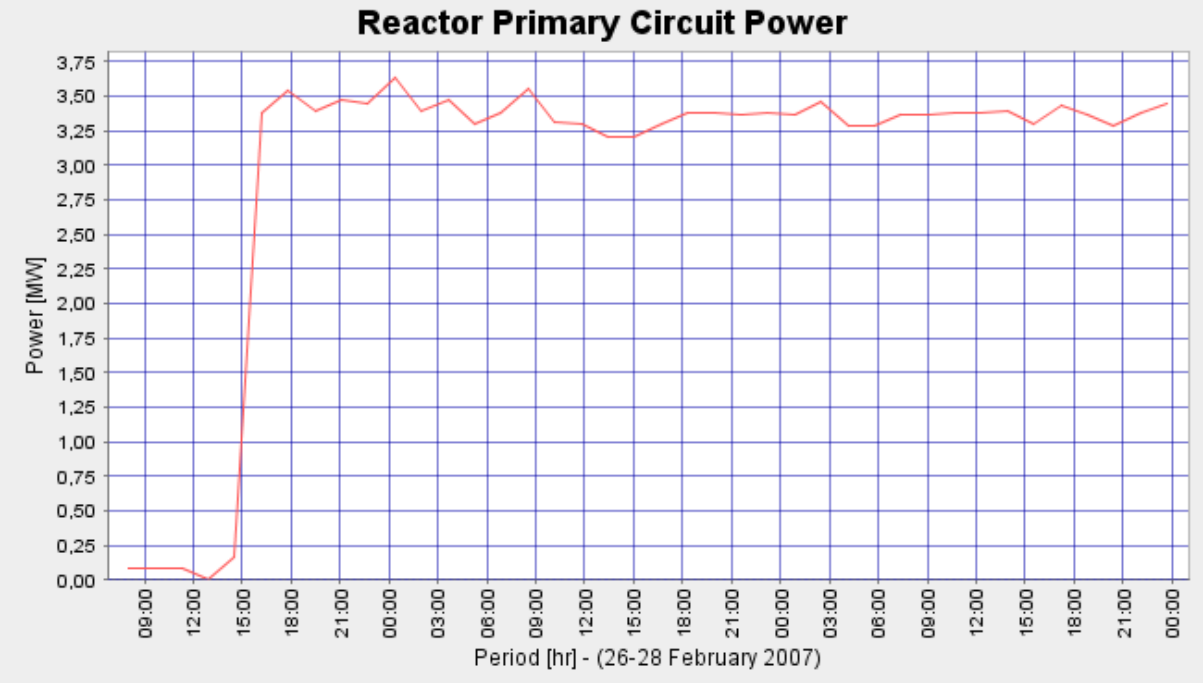

Figure 3 – Reactor primary circuit power

4. COMMENTS AND CONCLUSIONS

The implementation of FALCAO database reached the expected results. It has shown considerably favorable scenario after exhaustive tests in its data load process.

Even with the whole work not finished, it is observed a substantial improvement of the current processes when compared to the ones that were not using FALCAO database.

The most significant factor of improvement is the smaller time spent with the information retrieval, associated to versatility and clearness given by SACI system.

At present, the database server is located at CEN building. After an exhaustive test routine by the process of data load, it is now available and operational.

FALCAO provides data for the last four years, 2004-2007. However it is prepared and dimensioned to receive data for the next four years, up to 2011.

Certainly there is a lot do to collaborate with the automation of complex processes, especially nuclear processes as this one which justifies this study.

A natural task to continue this work is the development of a system that, besides storaging and providing information, is also capable to interact with the reactor daily routine in order to take automatic decisions. A conjugation of heuristical and analytical techniques could be used for this purpose.

The viability of this work is substantiated by the efficiency it attends the needs and current demand in a proper time.

It is also useful and necessary to allow that new inquiries are possible with reduced time and also to keep the database users updated regarding the data tendencies.

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