

TREC: TRACEABILITY OF RADIOACTIVE EQUIPMENT AT CERN

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Abstract

Activated accelerator components are frequently removed from service due to changes in design, configuration or maintenance work. Safe and effective management of such components is a necessity [1]. Moreover, local authorities require the tracking of this equipment: any piece of equipment or waste which has been in a potentially radioactive area must be controlled by a radio protection responsible before leaving the accelerator premises. CERN must also be able to prove that the required measurements have been done and are properly stored in a computerised system. TREC is the official system used at CERN to trace potentially radioactive equipment. It replaces paper work by electronic data, manual phone calls by automatic email notifications and helps to enforce CERN safety rules. Some of the major benefits are the reduction of the delays related to equipment movements (from installation to workshops or waste storage areas) as well as increased personal safety. The system is fully integrated with the CMMS* tools used at CERN to ensure the complete equipment lifecycle's traceability.

MOTIVATION

The accelerator complex at CERN is the largest and most powerful in the world [2]. The amount of equipment which makes up the biggest machine is enormous. Maintenance of all this machinery requires the commitment and hard work of thousands of people. Without their involvement, performing most of the operations would not be possible. Their security is the priority for the Organization.

During accelerators shutdown periods many components have to be removed from service because of changes in the experimental setup or maintenance and then are stored on CERN premises. Material staying in the immediate vicinity of the accelerated particles can be irradiated. Its proper management is necessary to assure high safety of employees and the environment.

To eliminate, or if it is not possible, reduce the risk related to the ionising radiation, CERN is carrying out active radiation protection. It covers mainly the means of prevention: training of personnel, individual dosimetry, analysis of threat sources and the rules for handling, storage and transport of the radioactive material and waste. All the safety regulations, including radio protection are covered within the repository of regulations (Safety Code F - radiation) [3].

One of the fields which was under supervision and was reviewed carefully during the last few years is traceability of potentially radioactive equipment. Work on the

procedures and the Traceability of Radioactive Equipment at CERN (TREC) commenced early enough to be completely prepared for the longest, so far, technical stop of all the accelerators (the 1st long shutdown, LS1).

APPROACH

The product which is widely used at CERN for the maintenance of the technical infrastructure is Infor EAM (Enterprise Asset Management). It offers a large selection of functionalities which have been adopted and customised to fit CERN's requirements. Brief studies have shown that the system matches almost all the requirements and is a convenient place to store data of the radiation measurements.

Still such a complexity can also be the cause of problems, especially for the technicians who are only required to use a very small subset of the functionality. Further restrictions are time and money which are needed for the training of the future users involved in the process of equipment handling.

Basing on the success of the projects like EAM Mobile [4] it was decided that TREC will follow a similar path. It is integrated with Infor EAM using the already existing set of application programming interfaces called EDMS COMMON LAYER, which were developed at CERN within the project of EDMS (Engineering and Equipment Data Management System) [5]. The whole of TREC's business logic was written entirely in Oracle PL/SQL language. It allows effortless integration with the earlier mentioned APIs.

Oracle Application Express (Oracle APEX) was another major reason to use Oracle products. It is a declarative, rapid web application development tool which is fully integrated into the Oracle database. Thanks to built-in features such as user interface themes supporting mobile devices, form handlers, flexible reports possibilities, Oracle Application Express accelerated the TREC development process and allowed to focus on the business logic implementation. As the final outcome a highly customized, simplified, bilingual (English/French) user interface was created.

One of the major requirements, coming from the users, was that the TREC system should be accessible with mobile devices - tablets. Recently many technicians who are working in the accelerator complex use them to consult the equipment data. Again thanks to Oracle APEX it was possible to prepare customized application templates optimised for touch screen devices.

Of course due to the budget restrictions it is not possible to provide mobile devices to all the technicians working at CERN. It was taken into consideration and

* CMMS: Computerized Maintenance Management System

touch screen PCs were installed in the buffer zones, which are specially prepared places to temporarily store potentially radioactive material until a radiological check is done by the radiation protection officer. Standard touch screen desktop computers from HP (Touch Smart family) were used. Barcode scanners were additionally attached to facilitate the input of some of the data including equipment identifiers.

SYSTEM FUNCTIONALITIES

After the case study of the procedures, which are followed when dealing with potentially radioactive equipment, main functionalities were defined for the TREC system. These include the measurement request, the radiation control of the material and the further equipment handling.

Measurement Request

All the components which are taken from the CERN accelerator complex are considered as potentially radioactive. It means that they have to be controlled before leaving accelerator premises. In TREC measurement request was implemented as a wizard, which leads the user through a series of steps. He/she is asked to provide some basic information about the equipment, its previous location, physical characteristics, possible risk and planned future usage. Of course if equipment is properly identified in Infor EAM, a big part of this data will be already in the system and the user will simply be asked to validate it.

Still it may happen that some pieces of equipment were not identified yet. In this case the requestor has to utilise one of the generic labels which are provided in the buffer zones to identify the material. If the given generic identifier is not suitable it can be easily changed in the future.

Described functionality is accessible by all CERN personnel and also external contractors. People, who do not have a valid CERN computer account, can take advantage of a simple authentication procedure - guest login.

Radiation Control

The radiological check procedure aims at performing and storing the result of a radiological measurement. First of all an email notification about new pending jobs in the given location is sent. Only radio protection technicians (RP technicians) who are responsible for doing the measurements in a given area are notified. Depending on the place of the measurement RP technicians can use their mobile devices to access TREC system via wireless network or GPRS (General Packet Radio Service), or if the measurement was requested in the buffer zone, with dedicated computer attached to the CERN network. The system allows the storing of up to four measurements done using different devices and with different measure distances. Additionally information about the background radiation can be provided and saved.

After performing measurements RP technicians decide if equipment should be considered as radioactive and authorise special handling or transport if needed. When necessary TREC automatically generates transport request documents in the EDH (Electronic Document Handling) [6] system and notifies equipment responsible.

Every measurement request contains contact information including telephones numbers of both the measurement requestor and equipment responsible, who can be easily reached in case of ambiguity.

Equipment Handling

It is very important to trace all the movements of the material coming from the accelerator premises. As it was mentioned before TREC is taking care about the generation of transport request documents for radioactive equipment. After transportation TREC automatically changes location in Infor EAM.

Even waste, which is coming from the potentially radioactive area, has to be controlled and properly treated. For transportation purposes special metal containers are used. TREC reflects this process and allows equipment to be grouped and attached to the mentioned containers. Traceability of waste equipment is ensured up to its disposal.

For non-radioactive equipment the fetch functionality was introduced allowing a technician to easily change the location. Further equipment lifecycle can be managed by its responsible using the CMMS tools.

RESULTS

The TREC system has been successfully installed and adopted in all the LHC and SPS buffer zones. It was also introduced in the ALICE experiment buffer zone and in one of the main CERN facilities for the repair of radiated material. So far (April 26, 2013) there are 17 buffer zones equipped with the PC terminals (see Fig. 1). In addition the system was integrated with the Web System for Equipment Traceability and Radiation Monitoring for the ATLAS experiment (GLANCE) [7]. TREC is able to recognise all equipment declared in the GLANCE system, preventing necessity of double identification in both of them and avoiding future data synchronization problems.

The main goal of the whole project, which was preparation of the simplified interface to the Infor EAM, was achieved. TREC made the whole process of traceability of potentially radioactive equipment much smoother, for both technicians responsible for the equipment and radio protection technicians doing the measurements. People who need to use the system can follow a much simpler and what is more important a shorter training. Around 50% shortened time between equipment deposit and fetch from the buffer zone was observed. Furthermore, in the buffer zones where the system is installed, there is no longer a need to request measurements on the paper forms. Moreover, the number of phone calls to the radiation protection officers was reduced by approximately 80%. Unnecessary tours to the

buffer zones looking for the equipment are not needed any more as radiation protection teams receive automatic notifications about the new measurements which have to be performed.

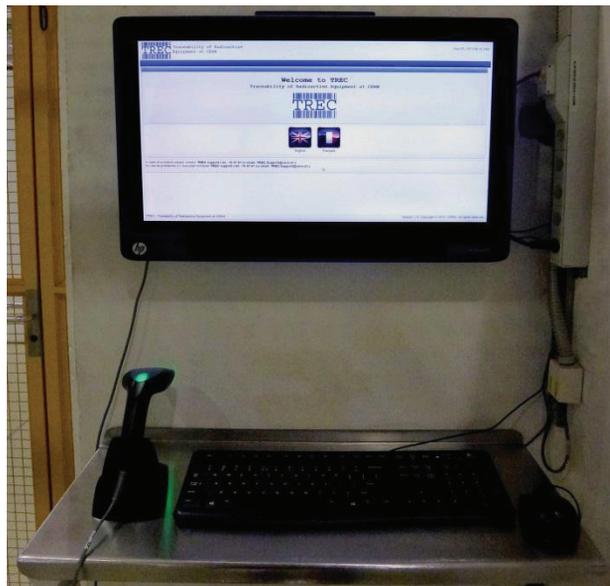


Figure 1: TREC installation in one of the buffer zones.

Required measurements are now stored in a computerised system. This is especially important from the safety point of view and was requested by the French and Swiss authorities. Of course the overall success still depends on the users, who shall follow the safety rules. Thanks to TREC, which sends alert messages to those responsible for the equipment, possibility of “loss” of material is greatly reduced. Automatic generation of the transport request documents in the Electronic Document Handling system for radioactive equipment is also a benefit.

As a summary some basic statistic are presented in the Table 1. These values illustrate clearly the amount of potentially radioactive material which also thanks to TREC has been treated properly.

Table 1: TREC Statistics during the Beginning of the LS1 (February 18 – April 26, 2013)

Factor	Result
Radiological checks requested in the buffer zones	1225
Radiological checks requested outside the buffer zones including the accelerator complex and all the CERN premises	1467
Total number of the transport requests generated via TREC and approved by the equipment responsible	430
Total mass of the material which was measured	80.5 t
Total mass of the material classified as radioactive	45.8 t

FUTURE PLANS

The crucial part of the system is fully functional and is a good base for the future development requested by users. The following steps are already scheduled:

- Integration with other experiments equipment databases, including CMS and LHCb.
- Further TREC terminals installations at CERN accelerator complex like PS and the North Area.
- Integration with ISRAM the radioactive waste management system at CERN.
- New functionality which allows taking and saving a photograph of the equipment. For this purpose integration with Engineering Data Management System is foreseen.

FINAL REMARK

The TREC system was presented and appreciated by the inspectors from the French Safety Authority (ASN) and Federal Office of Public Health of Switzerland (OSFP), visiting CERN in the framework of the tripartite agreement on the radiation protection and the radiation safety regulations. They were satisfied to hear that the TREC system would be extended consistently to the whole of CERN accelerator complex and cover not only all of the machines but also the experimental halls.

REFERENCES

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