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Web Interface for In-Cell Balances Measurement Control at FCF

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The fuel conditioning facility (FCF) is the main component of the Experimental Breeder Reactor II (EBR-II) Spent Fuel Treatment Demonstration Project.(1) During operations, different types of measurements are performed around the facility. Mass measurements are the most common and basic measurements at the FCF. The measurements are required for a number of activities related to the facility. These include both operational and safeguards activities. The operational activities include weighting of some of the process material containers and verification of the items that are transferred by confirmation of their signature weights. The safeguards activities are related to the material control and accountability of the sensitive nuclear materials within the facility (MC&A).

The MC&A activities involve both measurement control of the balances and variance propagation. Variance propagation of the errors associated with the measurements (including weighting) provide uncertainty in the inventory difference of the special nuclear materials. Balance measurement control determines and controls the weight measurement uncertainty. It also provides weight measurements random and systematic errors for variance propagation. The procedures involved in the measurement control include periodic calibration of the balances and daily performance checks with standard weights (linearity check measurements). The calibration procedure for each balance is based on the sequential measurement of a set of standard masses that span the expected operating range of the balance. The selection of the standards is based on the quasi-random Sobol sequence. The collected measurements are fit using linear regression to a calibration line against the standard weight. The balance performance parameters determined through calibration must remain sufficiently constant over time otherwise a recalibration is required. The linearity check measurements are daily measurements of the standard (selected by the quasi-random scheme) to check whether the balance calibration remains effective. A measurement is checked to see whether it falls within a 95% and 99% predictive interval surrounding the calibration line. The initial predictive intervals are based on calibration, and it varies with the scale. The measurements are tracked by a control chart whose control limits are the predictive intervals. A measurement lying beyond the control limits may warrant an action by the balance system engineer. In addition, the chart control limits can be made to reflect the operating conditions of the balance environment over extended period of time. In this case, the calibration data include linearity check data and calibration data from previous calibration periods.

The procedures described above require access to an advanced database system, the mass tracking system (MTG).[2] This further complicates the procedures and makes it harder for the operator to perform the measurement control duties on a routine basis. In order to alleviate the load on operators without compromising the integrity of the MC&A system at the facility, the procedures described above are implemented through a world wide web interface. The interface is user friendly and allows the operator to perform different functions related to the balance measurement control. The interface display interactive control charts which help the operator to look for trends in the behavior of the balance and compare the current linearity check measurements to historical data. Also, the interface provides easy to use on-line capabilities to perform the balances calibration analysis.

The calibration analysis part of the interface involves accessing different software modules which include UNIX scripts, Fortran SQL routines to access Oracle,[3] and three SAS[4] procedures that perform the analysis and provide the control limits displayed in the control charts. The modules run on computer workstations that are present at Argonne National Laboratory sites in Illinois (ANL-E) and Idaho (ANL-W). The interface provides a convenient way to run the different modules simultaneously and synchronize between them, since the data provided by one module are directly used as input to others. The operator does not have to run each individual module on each workstation and transfer data files between ANL-E and ANL-W. In addition, the interface enables the operator to include linearity check data, collected since a previous calibration date, into the analysis. Finally, the interface makes the new control limits available for the MTG personnel to put it on line.

The other part of the interface allows the user to display the balances control charts. The generation of a control chart involves two steps. First, retrieve the linearity check data since the most recent calibration. This is performed through accessing the MTG to extract the data, in addition to accessing the latest calibration data for the balance. The second step involves the analysis and plotting of the data. This step is actually performed within the internet browser used to access the Web, using an "applet". An applet is a Java language computer program that is downloaded over the Web and executed by the browser on the user's machine (independent of the type of computer or its operating system as long as the browser is Java capable). The program looks at each balance and each measurement as a separate object which encapsulates a set of relevant data (such as the operator name, the measurement time, the scale used, the calibration period,...). This object oriented programming capabilities of Java allow the user to perform interactive functions on the chart. These functions include pointing to a measurement of interest and retrieving the information related to this measurement in a separate window or the association of each measurement with the corresponding mass scale marker.

Finally, choosing the Web as the medium to develop the interface provides remote access capabilities to the interface (a number of security measures are taken in order to limit access to the interface). For example, a balance engineer who might not be present all the time during the operation of the facility (FCF currently operates 12 hours each day), can still access the interface remotely and provide help to the operator on how to proceed when certain problems arise with the balance performance. Moreover, the use of the Web technology to assist an engineer to perform in a more reliable and effective manner could easily be extended to different types of facilities (e.g., LWR plants).

References:

1. 1. R. W. Benedict and S. P. Henslee, "The EBR-II Spent Fuel Treatment Demonstration Project," Trans. Am. Nucl. Soc., 77, 75(1997).

2. C. H. Adams, et al., "The Mass Tracking System - Computerized Support for the MC&A and Operations at FCF," Proc. Topical Meeting on DOE Spent Nuclear Fuel and Fissile material Management, Reno, Nevada, June 16-20, 1996.

3. Oracle, The Relationship Database Management System, Oracle Corporation, Redwood Shores, CA (1989).

4. Statistical Analysis System, Version 6, SAS Institute, Inc., Cary, North Carolina (1990).