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The APS Intranet as a Man-Machine Interface*

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Abstract

The Advanced Photon Source at Argonne National Laboratory has implemented a number of methods for people to interact with the accelerator systems. The accelerator operators use Sun workstations running MEDM and Tk/TCL to interface interactively with the accelerator; however, many people need to view information rather than interact with the machine. One of the most common interfaces for viewing information at the Advanced Photon Source is the World Wide Web. Information such as operations logbook entries, machine status updates, and displays of archived and current data are easily available to APS personnel. This interface between people and the accelerator has proven to be quite useful. Because the Intranet is operating-system independent and inherently unidirectional, ensuring the prevention of unauthorized or accidental control of the accelerators is straightforward.

1 Introduction

The Advanced Photon Source consists of two linear accelerators, a positron accumulator ring, a booster synchrotron, and an 1104-m-circumference storage ring. The control system used for all of the machines is the Experimental Physics and Industrial Control System (EPICS). There are approximately 400 employees at APS, many of whom need to obtain information about the status of the various machines and systems. Due to the large number of people needing access to the facility's control system information, different interfaces to the machine were implemented. The two most common methods are the EPICS display tool MEDM (Motif Editor and Display Manger) and the APS Intranet.

2 MEDM

MEDM is the man-machine interface (MMI) used by operations personnel and others that need real-time interactive displays of machine parameters using a graphical user interface. While MEDM is a useful tool for the operators and system maintenance people, it is not the only interface to the machines. Due to the wide variety of computer systems, connection speeds, security needs, and connection overload needs, we have created the APS Intranet.

3 APS Intranet

The APS Intranet is a subset of the Internet located on a secure computer that is accessible only by APS personnel. By utilizing standard Internet protocols and software, APS has been able to create a World Wide Web-based environment that contains many different kinds of accelerator information. Some of this information requires interactive, real-time capabilities, but much does not. Examples of the latter are the APS on-line logbook, current and lifetime summary displays, and archived machine status graphs.

3.1 On-line Logbook

The APS Operations on-line logbook is the HTML (hypertext markup language) version of the paper logbook used in the control room. Making the logbook available on-line has increased its readership for two basic reasons. First, readers are able to access the logbooks more readily from their office computers than if they had to walk to the control room to read them. Secondly, the search capability of the Web browser enables readers to find information in the logbook quickly and efficiently. In fact, it has become as much of a man-machine interface tool as any other method of obtaining system information. The on-line logbook contains all of the shift entries from February 1995 to the present.

3.1.1 Internals

The Operations Group creates the logbook by entering information into a word processor document. The word processor used, FrameMaker, is configured to automatically save the document every 10 minutes so that a logbook update utility can convert the document to HTML and create new Web pages to point to the HTML version of the FrameMaker file. Any time a FrameMaker version of a logbook file is modified, the HTML version of the logbook is updated within 10 minutes. This is done using an APS-written, Perl [1]-based program called logcron in conjunction with the freely available fm2html [2] FrameMaker-to-HTML conversion utility.

The Perl logcron program looks at the FrameMaker files and determines if they are newer than the HTML versions of the logbook files. If the FrameMaker files are newer, the fm2html script is run. logcron takes care of

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items such as file locking for files currently being edited, Web page creation for the shift listings of the past seven days, archiving of HTML files, and Web page creation of the monthly archives of HTML logbook files.

The on-line logbook allows people to read the logbook in their office, from home, or while on business trips. Since it updates every ten minutes, the reader is always presented with the current logbook information. In addition, by using a standard word processor, the impact of this interface on operations is minimized. The operators type information into the word processor without needing any HTML knowledge. Even the AutoSave feature is performed without the operators having to do anything. All processing of the documents' updating of hyperlinks and archiving of files is done automatically. This allows the operators to devote more time to operating the facility rather than managing the logbook.

3.1.2 Logbook as an MMI

The logbook is arranged to quickly present readers with information. The current logbook entry is always hyperlinked to a static Web address; this allows people to bookmark the current logbook entry and always get the current logbook. The main logbook page consists of a listing of the last seven days of shift followed by the monthly archives. To read a logbook entry in a specific month, the reader clicks on the monthly archive hyperlink and then on the shift they wish to read. The most used hyperlink is the "Latest Logbook Entry" hyperlink near the top of Figure 1.

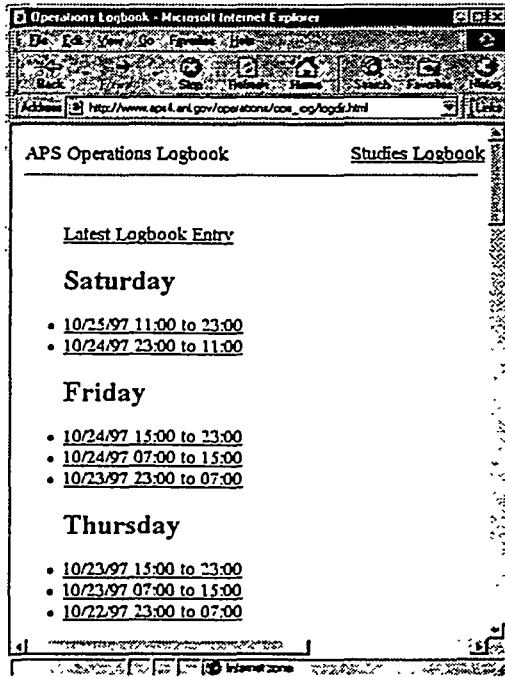


Figure 1. Main logbook page.

Each shift creates a logbook file; therefore the on-line logbook is arranged as shifts as shown in Figure 1. A view of a shift's on-line logbook is contained in Figure 2. Both the main logbook page and the current shift's logbook automatically refresh themselves every ten minutes. The refresh command is done by including the text <META HTTP-EQUIV="Refresh" CONTENT="600"> as the first line of the Web page. This command instructs the Web browser to automatically reload the Web page every 600 seconds (10 minutes). Thus, the reader has access to what appears to be a constantly updated logbook without the threat of overloading the Web server. In addition, the operators get a chance to work on a problem before people read about it in the on-line logbook.

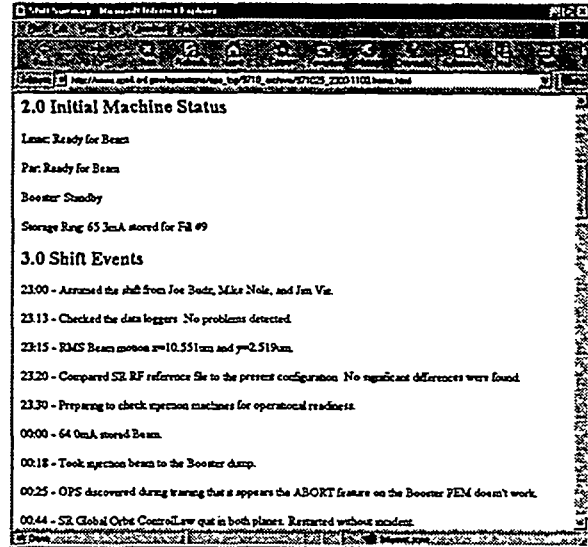


Figure 2. Sample on-line logbook.

The logbook search capability allows a reader to find matching words in the logbook. After searching through the HTML archive files and creating a list of hyperlinks to the various matches, a list of relevant logbook entries is displayed. This gives readers a method of looking up information if they do not know which shift or day an event occurred.

The on-line logbook has proven to be a popular method of checking the machine status at APS. It has increased the number of readers of the logbook and has decreased the number of phone calls to the control room requesting the status of the machine.

3.2 Status Displays

The logbook is one example of APS using an Intranet as a man-machine interface. APS also has datalogging systems that interface the EPICS control system to the Intranet. Several Web applications are completely software based, including the APS current and lifetime page and the technical systems status pages. Both

of these sets of Web pages present the user with Web-based, read-only machine interfaces, but they are created using two different methods.

3.2.1 APS Current and Lifetime Page

The APS current and lifetime Web page is used to display the beam current and lifetime along with a 24-hour beam current history graph and an area for Operations to display messages. This page (Figure 3) is created by a cron job that runs every two minutes. The cron job captures an MEDM screen using xwd and converts it to a GIF file. The Web page displayed by the browser includes the GIF image and is configured to refresh itself every two minutes. This allows a viewer to keep the page on their workstation or PC and view the current and lifetime at any time without having to reload the page for the latest version. In addition, the page is set to be non-cacheable to ensure the latest version is always displayed.

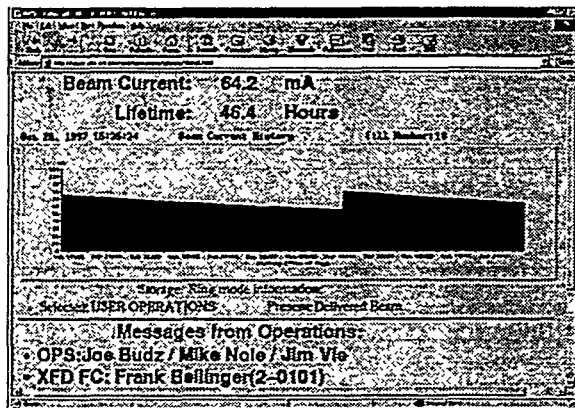


Figure 3. APS current and lifetime page.

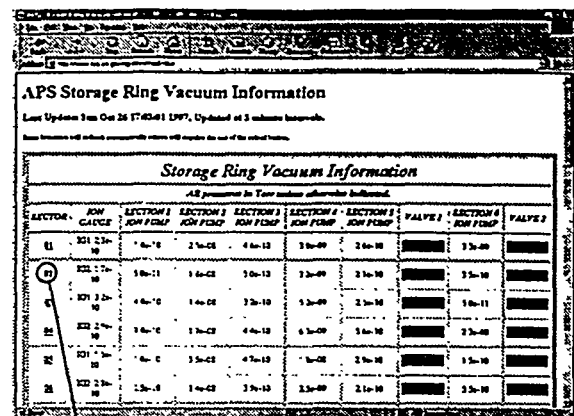
The current and lifetime Web page together with the operations on-line logbook provide the reader with the information necessary to understand readily what the last 24 hours of operations has been. These tools this can be used from work, home, or travel quickly and efficiently.

3.2.2 Technical Status Displays

The technical status displays are used to view more specific types of information such as water temperatures, vacuum readings, and rf power readings. Most systems have overview displays and 24-hour stripchart plots. For example, Figure 4(a) is an overview of the main vacuum information Web page. Figure 4(b), Sector 2's information, is reached by clicking on the Sector 2 hyperlink in Figure 4(a).

Each of these system Web pages has data and charts that are created by cron jobs that run on the various control room workstations. Both the EPICS' channel access and SDDS [3] programs are used to generate the Web pages every 15 minutes.

(a)



(b)

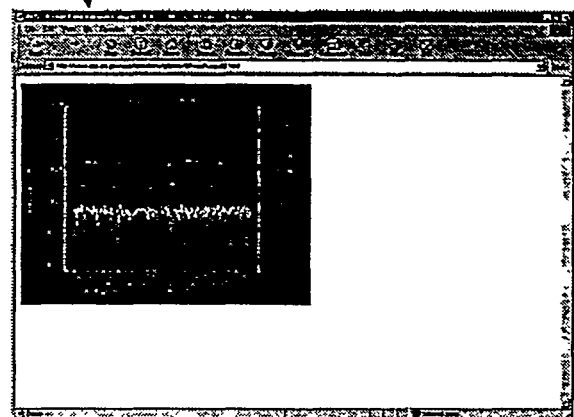


Figure 4. (a) Storage ring vacuum status page, and (b) Sector 2 vacuum data plot. Clicking a link on page (a) brings up data plot on page (b).

4 Other Intranet Uses

While the above examples show how APS uses the Intranet as a man-machine interface for accelerator operation, other uses have been created. Three of these are the work request system; Repair, Maintenance, and Development (RM&D) system; and downtime system. Each of these is an interactive system used by the operators and technical systems personnel.

4.1 Work Request System

The work request system is used to coordinate the work done on the various technical systems at APS. People responsible for performing or supervising work to be done fill out a work request. The work request system then sends the people who can approve the work request an e-mail message that contains a hyperlink to the approval section of that work request. The Operations Group reviews the work requests submitted and approves, reschedules, or denies them. Work requests can be sorted

and viewed by various fields or chronologically. When the work starts, the people performing the work go to the control room with a copy of the work request and give it to the Operations Group. When the work is completed, the control room is notified so that the work request can be closed.

4.2 RM&D

The APS RM&D system is used to convey to technical groups any information about problems or items that need to be investigated or worked on. The Operations Group or others fill out RM&Ds and personnel from the affected systems receive an e-mail containing a brief description along with a hyperlink to the response section of the RM&D system. Multiple people can respond to an RM&D. When an RM&D has been sufficiently addressed, it is removed from the active system.

4.3 Downtime System

Another Intranet application at APS is the downtime system. This system tracks the various downtimes that occur during operation. The operators enter the downtime information into a Web-based form that creates a downtime incident for each type of failure. A processing program takes the downtime data and creates reports from the data.

In these three examples, the Intranet provides people with the ability to interact with the databases in order to enter work or RM&Ds and respond to problems and downtimes. While these systems do not control the accelerators or technical systems, they do control and report on the work that people perform on those systems.

5 Machine Security

Using the APS Intranet as a man-machine interface rather than using EPICS-based or other tools has created a more secure system for machine operations. The Web-based approach is currently a one-way method of interfacing with the control system. Even though APS does use channel access security features in EPICS, it is preferable that users access machine information via the Web to ensure there is no chance of accidentally altering any data.

6 Intranet Security

While making all of the Intranet Web pages available to APS personnel is desirable, we do not want to make it available to everyone. Therefore, the Web pages that are only for APS use have been secured. To do this, APS has put all of the logbook and machine status web pages on a single web server that is configured to serve only APS machines.

7 Conclusion

The APS Intranet has allowed everyone at APS to monitor the machine status without having to run the typical EPICS-based tools. This allows people with PCs, Unix workstations, Macintosh computers, and any other device with a Web browser to access the system information in a manner that is easy, quick, and efficient.

8 References

- [1] Larry Wall, Programming Perl, O'Reilly & Associates, 1997.
- [2] Jon Stephenson von Tetzchner, "Frame to Html Filter," <http://www.w3.org/Tools/fm2html.html>.
- [3] Louis Emery, "User's Guide for SDDS-compliant EPICS Toolkit Version 1.5," August 1997, <http://www.aps.anl.gov/asd/oag/manuals/EPICStoolkit/EPICStoolkit.html>.