KEK-PS OPERATION RECORD AND ITS STATISTICAL CALCULATION BY COMPUTER

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Abstract

During the accelerator operation period of KEK-PS, it is very important to take the operation record, which includes the beam supply time for users, the shut-down time caused by various machine (Pre-injector, LINAC, 40MeV-BT, Booster ring, Main ring, etc.) troubles, and the beam intensity to different users. By analyzing of these data, we can determine the reliability of every machine and the contribution of PS to users. All of this work has been done by one person, which takes many hours. Therefore, we plan to manage the above work by computer: i.e. taking all data by beam switch PLC (programmable logic controller), communicating with PLC by the InTouch software, and calculating by EXCEL.

1 INTRODUCTION

KEK-PS is an accelerator complex composed of a 750keV Pre-Injector (Cockcroft-Walton type), a 40MeV LINAC, a 500MeV Booster ring and a 12GeV Main ring, which is operated in various machine modes for machine tuning, studies and users. The beam is accelerated by the Booster ring, and supplied to NML (neutron and meson science laboratory); also, one by the Main ring is supplied to the North Counter Hall and the East Counter Hall by slow extraction. We will supply the beam to the North Counter Hall by fast extraction for neutrino experiments from January, 1999. In order to evaluate the contribution of this machine complex to users, and to maintain operation with less maintenance troubles, it is very important to get the information of the averaged beam intensity supplied to the users and the integration time of every machine trouble. For this task, one person must collect data from the machine operation log, and calculate the time with the greatest care for many hours. Although this task is very complicated, it is mostly a fixed job. Therefore, we will introduce a computer for this task. These days, since the cost and calculating speed of a personal computer are being greatly improved, the trend to use computer in the factory automation trade is becoming stronger and stronger. We will use “EXCEL” as the calculation software and “InTouch” as the SCADA (Supervisory Control and Data Acquisition) software. “InTouch” is software of the PLC controller package, and has GP Editor (easily usable software), Net DDE (Dynamic Data Exchange: easy Network communication software), SQL data access and many PLC Device Drivers.

2 SYSTEM STRUCTURE

For the above purpose, a personal computer (“Operation Record Computer”) is inserted into the PS operation control system. As shown in Fig.1, the machine operator changes the operation mode and turns on/off the beam by a Beam Switch on the control panel. All of these operations are governed by PLC of the Beam Switch, which keeps watch over the various device statuses. This PLC also observes the beam intensities in various accelerator complex, and integrates them. It is connected to the computer through an I/O server. Therefore, the computer receives precise information about the operation mode, machine statuses of the accelerator complex, and beam intensities at various locations of the accelerator complex. We use the PC/AT machine (WindowsNT) for the Computer, Ethernet for the computer network, Omron (CV2000) for the PLC and Sysnet for the PLC local network.

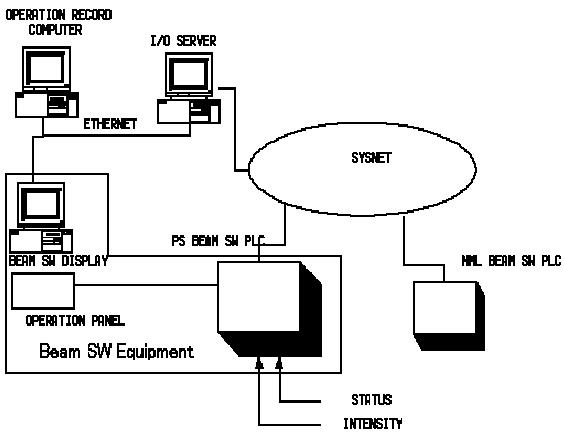

Figure1: System structure to input the operation mode and beam intensity

2.1 Integration of beam intensity

In order to achieve integration of the beam intensities (in the booster for NML user, in the booster to main ring and in the main ring for main ring user), sample hold signals of the beam-intensity monitors (at the booster and the main ring) are connected to the A/D input modules of the PLC. For their triggers, the beam-timing signals

synchronized with the accelerated beams (in the booster and the main ring) are connected to digital input modules. The integration of the main-ring intensity is done once per 3 or 4 seconds, and integration of the booster beam intensity is done once per 50ms, which is possible, because the scan time of the PLC is 2ms. The PLC also counts the acceleration numbers in the booster and the main ring.

3 SOFTWARE STRUCTURE

The "Operation Record Computer" takes data concerning the ON/OFF time of operation, the operation status, the place of machine trouble and integration of the beam intensities. The software structure is shown in Fig.2. An explanation of how to obtain a data log is as follows:

- The ON/OFF signal from the PLC for beam SW is used for the ON/OFF time data.
- In the case of beam ON, the operation status is input by InTouch.
- In the case of beam OFF, the reason for the machine stop is input by InTouch.

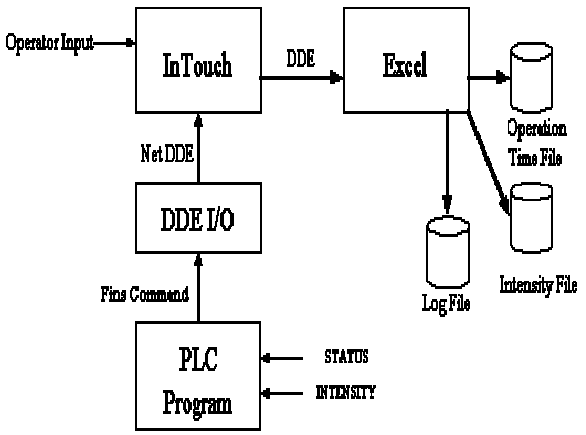

Figure2: Structure of software to obtain, calculate and record data

Fig.3 shows the console panel for the input data log. Concerning the operation status, there are two main branches, which are "for NML" and "for main ring". In every branch, there are more concrete statuses, such as "ACC (accelerator) Tuning", "ACC Study" and "Beam Utility". In the case of machine stop, there are statuses as "Scheduled Shut Down", "Set Up" and "Machine Trouble", including the machine part name. All input data are transferred to EXCEL sheets by a macro program. It can be re-entered within 20seconds; after that, the data are confirmed and recorded into comment columns of the data sheet in which the text form is written in CVS. The machine-trouble time is integrated in every machine part by EXCEL, in which the trouble is considered to be repaired at the next beam on. The intensity data are recorded every eight hours.

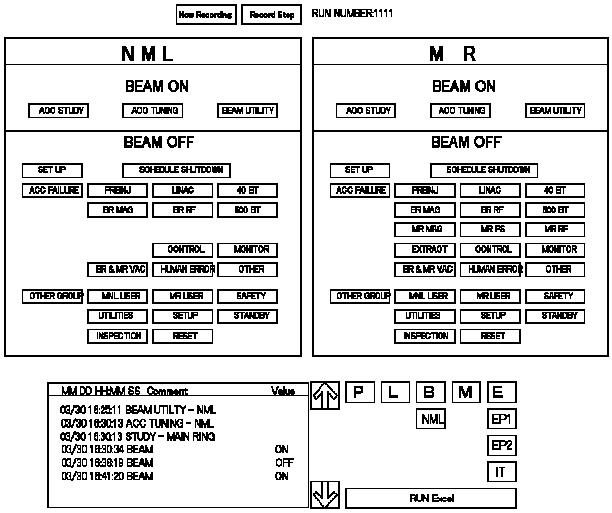

Figure3: Console panel for the input data log

4 OUTPUTS

By the above processes, we can obtain outputs of the operation record and statistical calculations. Figs. 4 show typical outputs. Fig.4a shows the item of the 12GeV PS machine time. From this graph, we can know the ratio of the PS machine time to various areas. Fig.4b shows the item of machine trouble in the accelerator complex, which tells us the reliability of every machine part. Also, Fig.4c shows the fiscal year dependence of the averaged main ring beam intensity. We can know the activity of our machine from the past to the present by this graph.

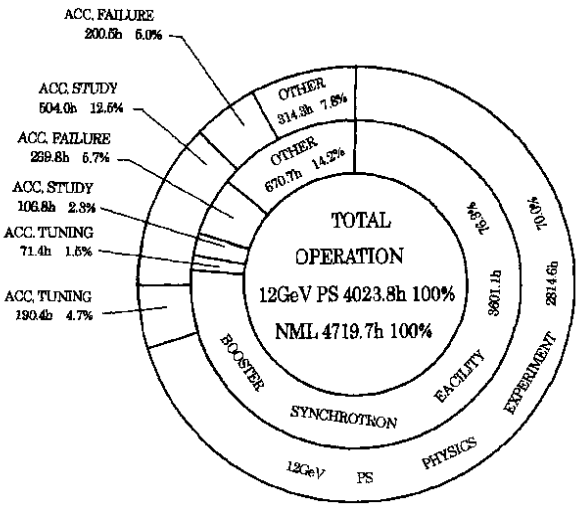

Figure4a: Item of 12GeV PS machine time

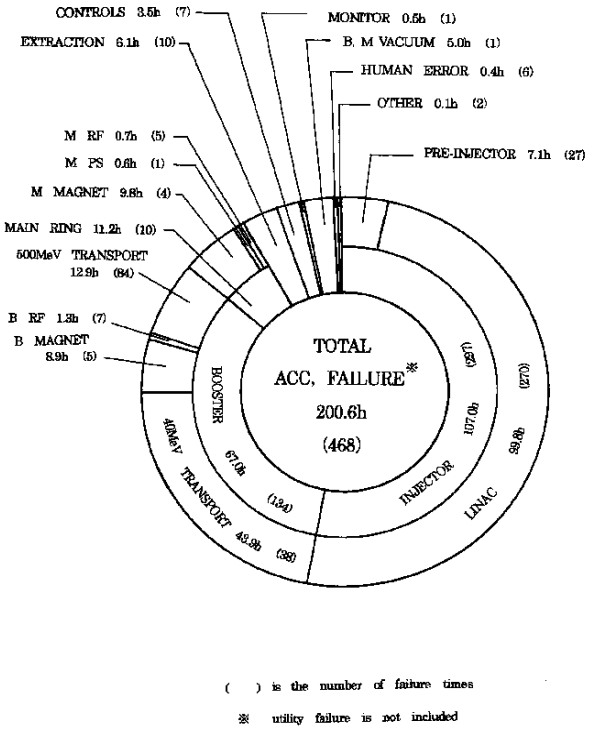

Figure4b: Item of machine trouble in the accelerator complex

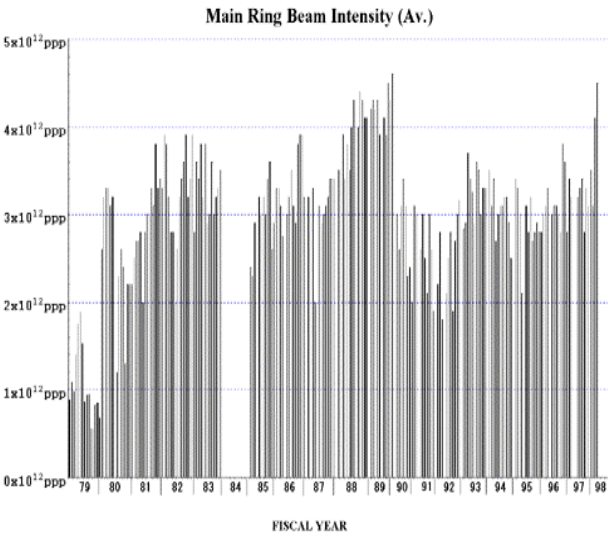

Figure4c: Fiscal year dependence of averaged main ring beam intensity

5 FUTURE IMPROVEMENTS

The operator's load to input the data should be as small as possible by improving the software. Also, the outputs can be obtained by general users through the Web.

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