The importance of the Operator on the Availability / Reliability of the machine

G. Garnodon
ESRF – Grenoble – France

ARW2015 – Knoxville– Tennessee

With a machine that runs 24/7, two-thirds of the time the Operator is the only person on the site who mans the machine and can operate it in case of failure.
It is necessary to have experts on call who are able to repair the machine.
It can often take more than half an hour to arrive on site.
Therefore, including the time it takes to repair the machine, the total time the machine is down is at least an hour.
So if the Operator is able to repair it by himself, the AVAILABILITY of the machine is improved.
The best thing is to avoid the breakdown, so the RELIABILITY of the machine is increased.
It is important that the Operator is skilled, as they have an important role in maintaining the machine, so it does not break down, and repairing it case of failure.

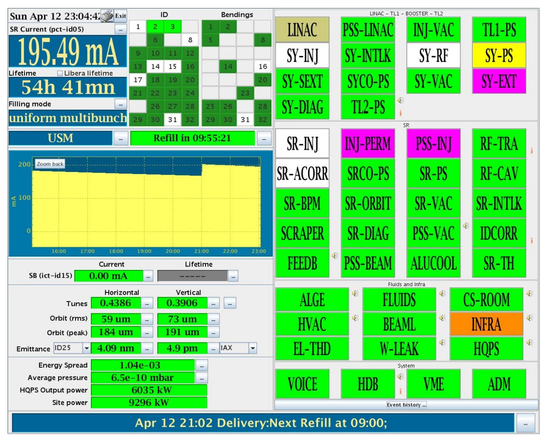
At the ESRF , the definition of "availability" is the percentage of time that the beam is actually delivered to the Users divided by the time it is initially scheduled to be delivered.

$$Availability = \frac{Real\ delivery\ time}{Scheduled\ time} = \frac{Real\ delivery\ time}{Real\ delivery\ time + Failure\ time} = \frac{MTTF}{MTTF + MTTR}$$

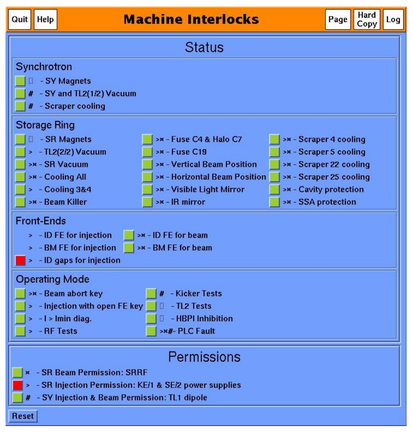
A good analysis of the failure reduces the time of the intervention.
If the Operator doesn't call the right expert, a lot of time is wasted.
If the Operator is able to diagnose the problem and repair it alone, a lot of time is saved and therefore the availability is improved.
Some tools are available to help the Operator to diagnose the failure, but these are insufficient without a good knowledge of the machine.

TOOLS

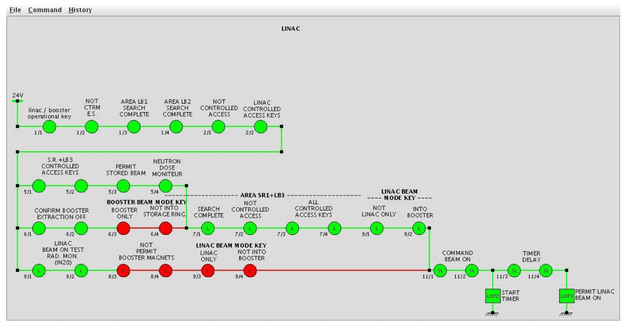
Synopsis



Machine Interlock



Interlock Bubble System



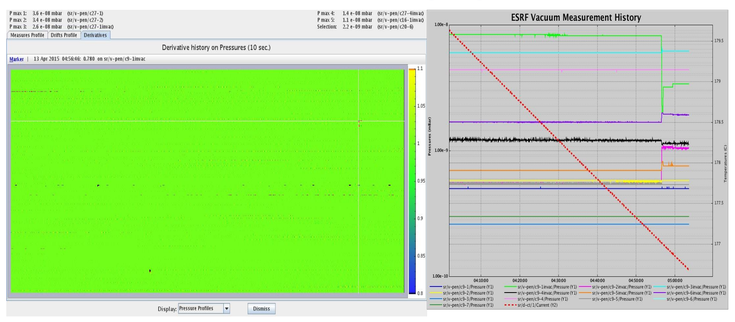
The **reliability** is the probability that an item will perform a required function without failure under given conditions for a given period of time.

Some breakdowns can be avoided by an attentive survey of the machine settings.
On a complex machine there is a lot of equipment that can interlock the machine and as many settings to monitor.
A lot of alarms can be set on the machine, but it's not easy to define their thresholds and for a multi-configuration machine it's practically impossible to get close to the operating value.

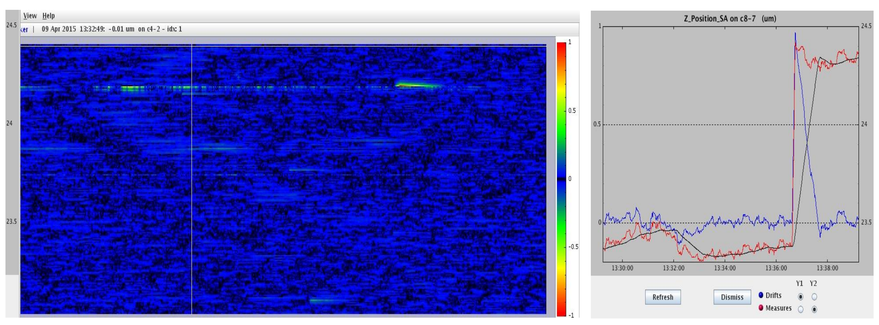
At the ESRF, we use a rolling display system that shows the moving average of the settings, it is very useful.
You can survey a lot of settings at a glance.
Thanks to the monitoring of the derivative of the value, you can see an immediate change in one setting among hundreds.
With this system you can't quantify the amplitude of the movement but you see that something abnormal has occurred.
Then you can use further dedicated monitoring with history or stored buffer to determine and analyse what has happened.
To analyse these parameters the Operator has to have a good knowledge of each part of the machine (RF, Vacuum, Magnets, Theory, Diagnostics tools, etc.).

ROLLING DISPLAYS

250 Vacuum gauges



224 BPMs



How to improve the skills of the Operator

Training:

Accelerator school, Internal training… A good way to know your machine is to spend time with the experts during their works in the Control Room.

Part Time Shifter:

The PTS is a member of the Staff who works in the Control Room to assist the Operator a few days per year.
It's a good way to know the people who work and what they do.
It is a perfect time for an exchange between the Operator and the PTS.
During these shifts, the PTS can teach the Operator a lot of things in his specialty and can learn how another part of the machine works from the Operator.

Machine Dedicated Time and Restart Time:

This time allows for machine maintenance, to tune the machine (procedure) and for the expert to test new equipments and ideas.
During these tests the experts spend some time to explain to the Operators what they do.
The Operator improves their knowledge. A useful knowledge exchange is created.

Shutdowns:

When the machine runs, the Operators are in the Control Room and the only contact with the machine is from the control system.
Therefore, it is very useful for the Operators to spend some time close to the equipment by performing some maintenance.

Thanks to Laurent Hardy, Isabelle Leconte and Anya Joly for their help.

garnodon@esrf.fr - Accelerator & Source Division – Operation Group

ESRF, 71 avenue de Martyrs, 38000 Grenoble