HOW WE DO BUSINESS AT DESY

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Abstract

DESY is one of the larger accelerator laboratories in the world with three linacs, two synchrotrons and fife storage rings. All these machines are operated from one control room. The operators at DESY are recruited from the technical support groups and are doing shifts for roughly a third of their monthly work time.

Advantages and disadvantages of this unusual model will be described in this paper.

1 DESY

DESY (**D**eutsches **E**lektronen **Sy**nchrotron) in Hamburg, Germany, was founded in 1959. Today ten different accelerators are operated at DESY: Linac 2 (450MeV electrons or positrons) with the positron intensity accumulator PIA (29m circumference), Linac 3 (50MeV H^-), DESY 2 (8GeV e+/e- synchrotron, 239m circumference), DESY 3 (7GeV proton synchrotron, 317m circumference), DORIS 3 (4.5GeV synchrotron radiation source, 289m circumference), PETRA 2 (booster for 12GeV e+/e- or 40GeV protons, 2304m circumference), HERA (collider, 920GeV protons against 27.5GeV e+/e-, two separated rings of 6336m circumference each) and TTF-FEL, a free electron laser based on the TESLA test facility TTF, a superconducting 1GeV linac. Figure 1 shows how the different accelerators at DESY are connected.

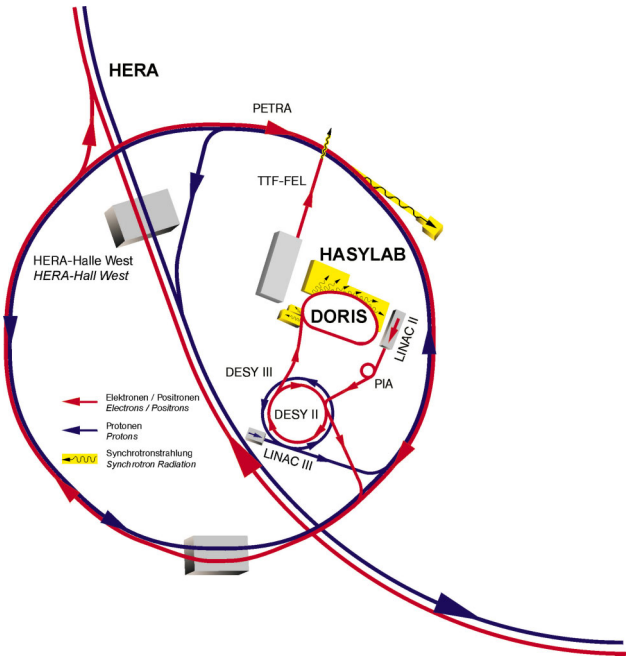

Figure 1: Accelerators at DESY.

2 HERA

HERA (Hadron Electron Ring Accelerator) is an electron proton collider for high energy physics. Two accelerator rings are built in one tunnel of 6.3km circumference: The proton ring with superconducting magnets reaches an energy of 920GeV with a beam current of 100mA, distributed in 180 bunches. The normalconducting electron ring reaches 27.5GeV with a beam current of up to 50mA in 189 bunches. Two of the four experiments at HERA (ZEUS and H1) use colliding beams to probe the structure of the proton, whereas the HERA-B detector uses a wire target in the halo of the proton beam for fixed target physics. The fourth experiment, HERMES, uses a polarized gas target and the polarized electron beam to investigate the spin structure of the proton.

3 ACCELERATOR OPERATIONS

The accelerators at DESY are operated 24 hours per day, 7 days per week, 8-11 month per year. All accelerators are operated from one central accelerator control room by the same shift crew. The crew consists of the shift leader (an experienced operator, responsible for operations and safety), three operators (engineers or technicians), two members of the power supply group and one accelerator physicist. In addition there are one operator and one or two physicists working on the TTF-FEL test accelerator. This crew operates ten very different accelerators with a total length of approximately 16km.

Apart from the accelerator control room there are the cryogenics control room, the technical emergency service (fire and first aid), the main gate and the control rooms of the four HERA experiments manned 24 hours per day.

The crew for the accelerator control room is recruited from many different groups of DESY's machine department. 61 people from 20 different groups do part time shift work. Their working contract contains the obligation to do 77 shifts per year, equally distributed over day and night, weekdays and weekends. These shifts are done in 11 blocks of 7 shifts per block with two working days off after the end of each shift block. For the individual operator this means that he will work in his office for about three weeks, go on shift for one week, back in the office for about three weeks, back on shift for another week and so on. As the operators do not work in fixed teams during their shifts, the time between two shift blocks can be individually adjusted to the work schedule and vacation plans of each operator. On average every operator does shift work for about 30% of his monthly work time.

During each shift block there is a forward rotation from early shift (7am to 3pm) to late shift (3pm to 11pm)

to night shift (11pm to 7am). This rotation assures that every operator begins a shift block after a longer break of office work or vacation on an early shift with a crowded control room and plenty of people around to explain recent changes in machine operation.

4 OPERATOR TRAINING

The only regular operator training is a one hour weekly meeting, where background information about accelerator physics issues are given, recent hardware and software changes are announced and news and current problems are discussed. Due to their shift cycle only about 2/3 of the operators can attend that meeting.

Once per year, usually during the shutdown, there is a one week seminar held outside DESY where the progress of the last year and the plans for the coming year are discussed. The meeting is attended by the accelerator physicists, the shift leaders and some operators, if time and budget allows.

The most important part of the operator training is the training on the job. New operators do several shift blocks as trainees before they become regular members of the shift crew. As there are no fixed shift crews, the trainees work with many different shift leaders and operators during their trainee time. Depending on their curiosity, this gives them the ability to learn from experts on many different subjects.

5 MAINTENANCE

Once per month HERA operation is interrupted for a service day. During 8 hours access to the tunnel there is time for preventive maintenance and for a lot of smaller repairs, which have piled up during the previous month. The experiments get 16 hours access to their detectors, while the tunnel is closed after 8 hours to allow for component tests in the remaining time.

If an accelerator component breaks unexpectedly during operation, the shift crew is able to respond quickly. All power supply failures are handled by the shift crew and the mixture of people from different groups on shift helps to solve almost all other problems without external help. However, several groups have people on call (quench protection, vacuum, RF, superconducting cavities, cooling water, power distribution), who can give advice on the phone, check their systems from their computers at home or come to DESY and help to solve the problem. Although most shift crews take pride in solving problems themselves, the shift leaders do not hesitate to call even people who are not ‘on call’ to solve severe problems and get the machines running again.

6 INFORMATION FLOW

The main source of information about the operation of HERA is the electronic logbook [1]. The logbook is a DESY product and was originally designed for an international collaboration (TESLA, TTF). It uses JAVA, is web based and can be read from every computer inside DESY. The logbook contains both texts and pictures, and every window of a console application in the control room can easily be printed into the logbook through an additional printer queue. The logbook contains a search engine.

In addition to this electronic logbook, there is a hand written logbook for radiation safety issues (temporary access,…).

The information flow from shift to shift is organized through a 15 minute meeting at every shift change, where the shift leader reports about the last 24 hours and especially about the progress during his shift. This meeting takes place at a big table in the accelerator control room and (during daytime) is attended by many people.

Every workday at 8:30am there is an additional meeting in which the shift leader reports about all technical failures in the last 24 hours. This meeting is attended by representatives of all technical support groups.

7 THE CONTROL ROOM

All accelerators at DESY are operated from the same accelerator control room by the same shift crew. Nevertheless there are different consoles for the different accelerators. This is necessary due to specific hardware for specific machines and it helps to minimize the disturbance during machine studies. The use of one big room makes the communication between the machines easier, which is important as different machines are using the same preaccelerators.

Due to the separation of the control room into different areas for the different machines, the control room has to be rather big (11m x 38m = 418m²) and has to have a great number of console screens (152 screens in total).

Figure 2 shows the layout of the accelerator control room and the areas used for the different machines.

8 THE CONTROL SYSTEM [2]

The HERA control system has three system layers: The console layer (Windows NT), the middle layer and the device sever layer. For communication the data exchange protocol TINE (Threefold-Integrated Network Environment) is used. It provides threefold integration: Multi platform (UNIX systems (Solaris, Linux, HP-UX, SGI, OSF), DOS, Win16, Win32, ALPHA-VMS, VAX-VMS, VxWorks), multi protocol (IP, IPX) and multi architecture (client - server, publisher - subscriber, producer - consumer model). For the console layer the Graphical Application Programmers Interface ACOP (Accelerator Component Oriented Programming) is used.

9 SPECIAL CHALLANGES

The challenge for operators at DESY is the operation of ten very different machines like an electron linac, a H^- linac, an electron synchrotron, a proton synchrotron, a synchrotron radiation source and an electron proton collider at the same time. The most difficult machine is

HERA as a collider with very much different energies, a superconducting proton machine with an energy gain of 23 and an electron machine with several kilowatts of synchrotron radiation that have to be guided through the interaction region without hitting the very sensitive detectors.

10 REFERENCES

[1] http://ttfinfo.desy.de/doocs/elogbook/logbook.html

[2] R. Bacher, "Status of the DESY Accelerator Control Systems," PCaPAC2000, Hamburg, October 2000.

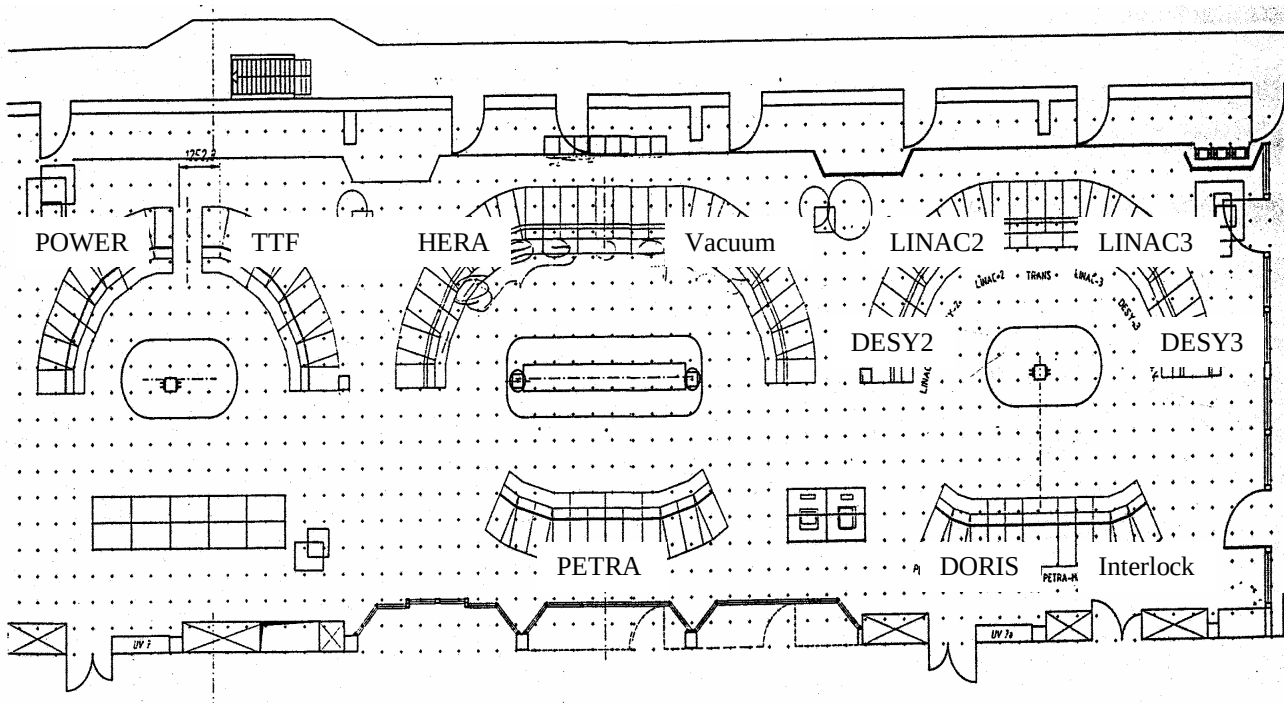

Figure 2: Layout of the DESY accelerator control room.