A NEW CONTROL ROOM FOR SLAC ACCELERATORS*

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Abstract

We are planning to construct a new control room at SLAC to unify and improve the operation of the LCLS, SPEAR3, and FACET accelerator facilities, and to provide the space and flexibility needed to support the LCLS-II and proposed new test beam facilities. The existing control rooms for the linac and SPEAR3 have been upgraded in various ways over the last decade, but their basic features have remained unchanged. We propose to build a larger modern Accelerator Control Room (ACR) in the new Research Support Building (RSB) which is currently under construction at SLAC. Shifting the center of control for the accelerator facilities entails both technical and administrative challenges. In this paper, we describe the history, concept, and status of this project.

INTRODUCTION

The Main Control Center (MCC), housed in Building 005, has been the primary control location for operation of the SLAC 2-mile linear accelerator and associated systems for nearly half a century. In the earlier years of SLAC, this was the central control point for accelerating electron beams and directing them to various fixed-target high energy particle physics experiments in End Station A and other facilities in the Research Yard. From the late 1980's until 1998, the primary high-energy physics program was the SLAC Linear Collider (SLC), which was followed by the PEP-II "B-Factory" until 2008. Throughout this period, fixed-target and test beam programs, including a variety of experiments in End Station A and the Final Focus Test Beam (FFTB) facilities, were carried out on an intermittent basis until 2006, all controlled from MCC. In recent years, the last third of the linac has been reborn as the Linac Coherent Light Source (LCLS) and has provided intense beams of x-rays for a rich program of scientific investigations. More recently, the first two-thirds of the linac have been used to provide beams of electrons to the Facility for Advanced Accelerator Experimental Tests (FACET).

The SPEAR storage ring, which was originally built as a high-energy electron-positron collider, has been extensively upgraded twice, first as SPEAR2 and later as SPEAR3, optimizing it for use as a synchrotron radiation source. From the beginning, this facility has been controlled from a separate dedicated control room located inside the ring, close to the power supplies and other technical components.

Last year, a project was initiated to construct a new building to house most of the staff of the Accelerator Directorate. As plans for this building came into focus, the potential advantages of relocating the main accelerator control room to this new building became obvious; a control room large enough to handle all the major accelerators, including LCLS-II, would lead to significant economies of scale and consistency in the conduct of

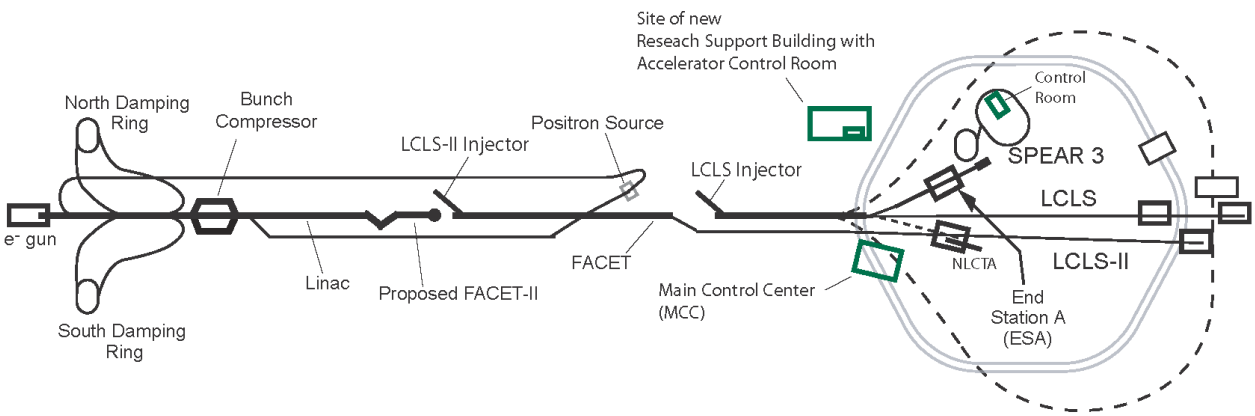

Figure 1: Schematic representation of the major accelerators at the SLAC National Accelerator Laboratory. The location of the new Research Support Building, which will house the new Accelerator Control Room, is shown, along with the existing Main Control Center and the SPEAR3 Control Room (not to scale).

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operations among the various facilities and would encourage closer interaction among the accelerator physics and operations staff members.

Figure 1 is a schematic representation of the SLAC accelerators, including the LCLS, FACET, and SPEAR 3 facilities, along with the proposed LCLS-II facility. Also shown is a possible location for FACET-II, which is being discussed as a follow-on to FACET-I.

EXISTING CONTROL ROOMS

Figure 2 shows the floor layout of the existing control room in the Main Control Center. In 2007-2008, this control room was upgraded with new heating and air conditioning systems, a raised ceiling, improved lighting, and work-surface counter tops that are deeper and ergonomically improved over the originals. The overall size and general arrangement of control consoles have not changed over the years, although more than 100 CRT computer monitors were removed as part of the last remodelling project and most have been replaced by larger LCD flat-panel display monitors.

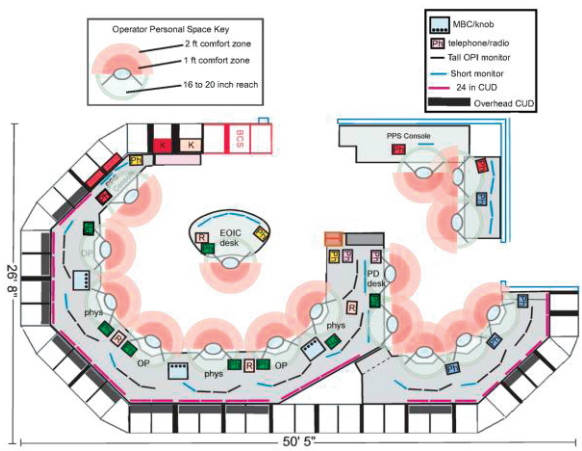

Figure 2: Layout of the existing control room in the Main Control Center (MCC).

The MCC control room has proven to be adequate for running two accelerator programs simultaneously when both programs are running smoothly, but the room becomes crowded, noisy, and sometimes uncomfortably hot during machine studies and maintenance days when there may be 20 or more persons actively working in the room. The dark pink and lighter pink areas around each of the elliptical operators in Fig. 2 indicate the minimum "elbow room" and "personal comfort" zones preferred by most staff members.

Figure 3 shows the floor layout of the SPEAR3 control room. This room is considerably smaller than the MCC control room, but has been adequate for normal operations when everything is running smoothly. As with the MCC control room, this room also becomes crowded at times and offers very little space for expansion.

Figure 3: Layout of the existing SPEAR3 control room.

In the early days of SLAC, most of the accelerator controls were hard-wired, with operators continuously adjusting knobs while observing oscilloscope signals, video monitors, and large arrays of indicator lights. As a result, the existing control rooms are the termination points for seemingly uncountable numbers of cables that enter through the walls, above the ceilings, and under the floors, filling standard relay racks around the perimeter of each room.

Over the last four decades, controls technology and accelerator requirements have evolved to support much more complex control systems. Now most of the controls operate through graphical computer interfaces and most critical control functions are automated with feedback systems and monitored with computer status displays. With the advent of high speed digital communications through optical fibers, moving the accelerator controls to a new location is a relatively straight-forward project.

THE ACCELERATOR CONTROL ROOM

The Research Support Building (RSB), now under construction at SLAC, is illustrated in Fig. 4.

Figure 4: Artist's drawing of the RSB currently under construction at SLAC looking north. The ACR will be on the first floor beyond the parked cars.

A rectangular area with a sunken floor approximately 78 feet by 42 feet has been allocated for the ACR and an adjoining Accelerator Network Room (ANR) in the southeast quadrant of the first floor. A raised computer floor, level with the RSB's first floor, will be installed in this area. The space below this computer floor will accommodate cables and air ducts between the two rooms and cable conduits leading outside the building.

The ANR will accommodate conventional electronics racks for network interface electronics, personnel protection and radiation safety systems, and other specialized instrumentation that must be collocated near the control room. Most of the computer servers and related equipment will remain in the segregated computer room in MCC.

The proposed new control room is shown in Fig. 5. Notice the scale of this drawing is significantly different than the scales of Figs. 2 and 3. This control room is substantially larger, which is evident when noting the number of individual workstation consoles in each figure.

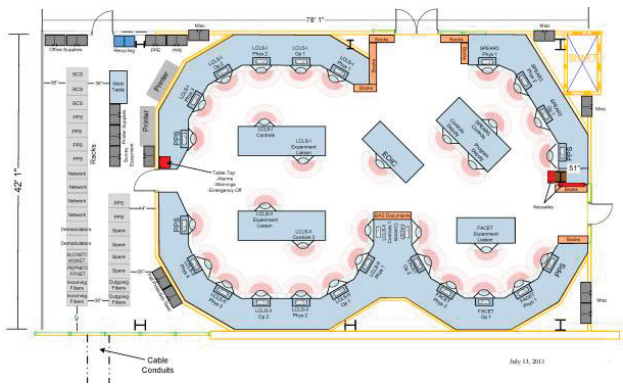

Figure 5: Proposed layout of the Accelerator Control Room.

This control room will normally be occupied 24 hours per day, seven days per week, for approximately ten months per year while the accelerators are running, but only weekday day-shifts during the two months when they are not. In order to ensure a comfortable work environment at all times, the ACR will have a heating and air conditioning system separate from the rest of the building. The air ducts for this system will pass upward to dedicated HVAC equipment on the roof through a rectangular shaft visible in the upper right of Fig. 5.

Approximately 24 control consoles will be arranged around the perimeter of the room to accommodate all normal operations and machine studies activities. In addition, a special desk and work station will be provided near the center of the room for the Engineer-Operator-in-Charge of each shift, and table space will be provided for a designated Program Deputy, experimenter liaison persons, or others as needed.

The ANR area is shown in the left-most quarter of the rectangular area in Fig. 5. As part of the RSB construction project, sixteen 4-inch conduits have been installed below the parking area, extending from the space below the ANR floor to a large manhole south of the RSB. From here, new conduits will be installed to provide a protected path for optical fibers and other signal cables back to MCC and to SPEAR3.

When this control room is completed in 2014, it will become the center of operations for the entire linac and SPEAR3. Operation of the LCLS, FACET, and SPEAR3 programs can then be carried out by a unified operations group from a single control room. This will lead to improved efficiency by allowing a single operator crew to monitor and control linac and SPEAR3 programs simultaneously. The control consoles are being designed with enough flexibility to allow most accelerator programs to be operated from any location in the control room, enabling crew members to monitor multiple programs from closely grouped consoles during smooth running periods, or to spread out during intense commissioning or machine studies periods.

The ACR will be physically located in the same building with most of the accelerator physicists' and engineers' offices. This proximity will make it easier for these people to participate in ongoing accelerator activities and to stay informed of progress and challenges as new systems are commissioned and brought into full operation. Combining linac and SPEAR3 operations into the same control room will also encourage greater interaction and mutual support among the systems experts from these previously separate facilities.

As LCLS-II systems come into operation in the next few years, the ACR will be the center of commissioning activities. Future visions for SLAC include FACET-II, an Injector Test Facility using the first third of the linac, and PEP-X, a high performance synchrotron light facility that could be built in the existing PEP-II tunnel. The ACR will be well positioned to provide a central operations point for all these facilities.

SUMMARY

The Research Support Building, now under construction at SLAC and destined to become the new home of the Accelerator Directorate staff, includes a large rectangular space on the first floor to be used for a new accelerator control room. The new control room, now in its early design stage, will be larger than the combined sizes of the MCC and SPEAR3 control rooms, and will be equipped to support simultaneous operation of the LCLS, FACET, ESA test beams, and SPEAR3. It will be flexible enough to accommodate LCLS-II when it is ready for operation, and the Injector Test Facility, FACET-II, and the PEP-X synchrotron light source, when they become realities.

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