

CONTROLS OJT

This OJT provides you with a checklist, guideline, and record of your Operator II Controls training, and introduces you to regular operational procedures as well as physical locations of equipment. **It is very important that you do not lose this document.** If you lose this document, the training you have completed will have to be redone.

This training list has been successfully completed.

Department Head (Signature/Date) _____

Contents

| | | | | | |
|---------|--|----|---------|---|----|
| Part 1: | MCR | 3 | 2. | Tevatron Clock (TCLK)..... | 17 |
| 1.1 | Consoles..... | 3 | 3. | Beam Sync Clocks (BSCLK) | 18 |
| 1. | MCR Console Usage..... | 3 | 1.7 | Links | 19 |
| 2. | Console Applications | 4 | 1. | MDAT Link | 19 |
| 3. | Sequencer | 4 | 2. | Vacuum Controls..... | 19 |
| 4. | Console Plotting Package..... | 5 | 1.8 | Status Monitoring | 20 |
| 5. | Remote Console Monitoring and Control | 6 | 1. | Status Indicator (Alarm) Screen | 20 |
| 1.2 | ACNET Parameters | 7 | 2. | Digital and Analog Alarms..... | 21 |
| 1. | Parameter Properties | 7 | 3. | FIRUS Monitoring | 21 |
| 2. | Data Paths for CAMAC Devices | 7 | 4. | Beam Budget Monitor (BBM) | 22 |
| 3. | Data Paths for Linac Devices | 8 | 5. | Beam Permits and Abort Monitoring | 22 |
| 4. | Data Paths for VME and VXI Devices | 8 | 1.9 | Miscellaneous Hardware..... | 23 |
| 1.3 | CAMAC..... | 9 | 1. | Controls Hardware | 23 |
| 1. | CAMAC Link Identification | 9 | 1.10 | Networks..... | 23 |
| 2. | CAMAC Front Ends | 9 | 1. | Local Area Networks (LANs) | 23 |
| 3. | CAMAC Troubleshooting..... | 9 | 2. | Cable TV (CATV) Network..... | 23 |
| 4. | CAMAC Cards..... | 10 | 1.11 | Troubleshooting | 24 |
| 5. | Ramp Card Pages | 10 | 1. | Controls Equipment Troubleshooting and Repair..... | 24 |
| 1.4 | ACNET..... | 11 | 2. | Oscilloscope Usage | 24 |
| 1. | ACNET | 11 | 3. | Computer Room Monitoring | 24 |
| 2. | Centra | 11 | Part 2: | Walkaround..... | 25 |
| 3. | Databases | 11 | 1. | Computer Room Equipment..... | 25 |
| 4. | Front Ends | 12 | 2. | Computer Room Utilities | 25 |
| 5. | Console | 12 | 3. | Pump Room..... | 25 |
| 6. | Console Program Development | 12 | 4. | Fire Protection Systems..... | 26 |
| 7. | ACL..... | 13 | 5. | MAC Room..... | 26 |
| 8. | Data Acquisition Engines (DAEs) | 14 | 6. | FIRUS Room..... | 26 |
| 9. | Java Client Applications | 15 | 7. | Booster Tower East | 26 |
| 1.5 | Archiving Data..... | 16 | 8. | MCR Console Hardware | 27 |
| 1. | Save, Compare, and Restore Programs .. | 16 | 9. | MCR Area Hardware | 27 |
| 2. | Lumberjack Datalogger..... | 16 | 10. | Patch Panel System | 27 |
| 1.6 | Timing | 17 | | | |
| 1. | Timeline Generator (TLG) Page | 17 | | | |

CONTROLS TRAINING

Part 1: MCR

1.1 Consoles

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|---------|------|
| Trainer | Date |
|---------|------|

1. MCR Console Usage

Know how to manipulate plots and pages on a console. Know what each plot or page is used for.

- _____ Know which tasks are launched from the start menu
 - _____ ACNET console (CnsRun)
 - _____ Clx xterm
 - _____ Safety System
 - _____ RadMon
 - _____ Centra login
- _____ Know how to move, resize, minimize, and close screens
- _____ Know how to use the program application (PA) windows (PA, PB, PC, etc.) to display index pages and start console applications and parameter pages
- _____ Know how to use the graphics plot screens (GxSA, GxSB, ... GxPA1, GxPA2, etc.)
 - _____ Which ones are associated with a particular PA window and which ones are stand-alone plots
- _____ Know the function keys (F3-F12) and the most common uses for them
- _____ Know how to use the Utilities window
 - _____ Copy utility
 - _____ Print various screens to various printers
 - _____ Error help
 - _____ Change pixel size
 - _____ Stop Program and Abort Program
- _____ Know how to use the program tools dropdown menu
- _____ Obtain an ACNET console password with the “conpwd” Linux command
 - _____ Know that this password is used for authentication within D43, D80, and other PAs. Individual permissions are given on a case by case basis

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| Trainer | Date |
|---------|------|

2. Console Applications

Know how to use common console applications and parameter pages.

- ___ Know how to use and edit the console help (F7) pages
- ___ Know how to find information about any console application including keeper, PA number, etc.
- ___ Know how to get information on various error codes as they appear on console applications and parameter pages
- ___ Know how to search for console applications by program name or program keeper
- ___ Know how to find an ACNET device name if given only a partial name or description

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| Trainer | Date |
|---------|------|

3. Sequencer

- ___ Understand the common uses of sequencers and aggregates
- ___ Know how to switch between sequencers
- ___ Know how to select and execute aggregates
 - ___ From the aggregate command list
 - ___ From within the aggregate
- ___ Know how to run through an aggregate and respond to instructs
- ___ Be able to determine what individual sequencer commands will do
- ___ Know how to read sequencer logs and determine the last aggregate run
- ___ Know how to respond to errors that prematurely terminate an executed aggregate
- ___ Know who is responsible for making changes to aggregates

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| Trainer | Date |
|---------|------|

4. Console Plotting Package

Know how to use the console plotting packages.

- _____ Know how to start fast time plots (FTPs) and snapshot plots (SNPs)
 - _____ Know the difference between FTPs and SNPs
 - _____ Know when each should be used
- _____ Know that not all devices can be fast time or snapshot plotted
- _____ Know how to transfer plots
 - _____ Copy an FTP or SNP plot from one console to another
 - _____ Move a plot from one GxSA window to another
- _____ Know how to create different types of FTPs and SNPs
 - _____ Change between D/A and A/D plots
 - _____ Manipulate features like connecting points, characters, and blinking new data
 - _____ Trigger plots on different events
 - _____ Start a “One+” plot
 - _____ Change between engineering units, volts, and log
 - _____ Know how and when to change sample rates
 - _____ Save and restore saved plots
- _____ Know how to start knob plots
- _____ Know how to restart a plot without erasing the data already on the plot

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| Trainer | Date |
|---------|------|

5. Remote Console Monitoring and Control

Know how to interface with remote consoles.

- ___ Know how to use the console manager application, D9
 - ___ Recall saved plots
 - ___ Start remote plots
 - ___ Copy remote screens
- ___ Know how to use the console peek application, D15
 - ___ See and kill programs running on remote consoles
 - ___ Restart consoles
- ___ Know how to use the settings history application, D54
 - ___ Determine which consoles modified a device over a specific period of time
 - ___ Establish a live feed of current changes
- ___ Know how to enable or disable settings for a remote console

1.2 ACNET Parameters

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| Trainer | Date |
|---------|------|

1. Parameter Properties

Be familiar with how the Examine Database application, D80, can be used to view database information for any parameter. Know how to view and what is meant by the following device properties. Also know that many of these properties are also viewable from a parameter page.

- ___ Device index
- ___ Node
- ___ Analog alarm and digital alarm
 - ___ Beam abort
 - ___ Nom/Tol vs. Min/Max
 - ___ Tries needed
- ___ Analog reading and analog setting
 - ___ Raw reading, primary units, and engineering units
 - ___ Primary and Common transforms
 - ___ Expression for calculated or composite devices
- ___ Basic status and basic control
- ___ Know that Dabbel is the program used to make changes to these properties in the device database

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| Trainer | Date |
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2. Data Paths for CAMAC Devices

Diagram the path that an analog readback takes from its origin to a console. Diagram similar paths for analog settings, digital control, and digital status signals.

- ___ Device interfacing to controls system (i.e. power supply, etc.)
- ___ MADC fan-in and MADC
- ___ CAMAC cards for analog readback, analog settings, digital control, or digital status
- ___ CAMAC Tevatron serial crate controller (TSCC)
- ___ CAMAC link repeater
- ___ CAMAC links
 - ___ Program input/output transmit (PIOX)
 - ___ Program input/output receive (PIOR)
 - ___ Block transfer (BTR) – snapshot plotting
- ___ CAMAC VME front end and built in serial link driver (SLD)
- ___ MCR console

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| Trainer | Date |
|---------|------|

3. Data Paths for Linac Devices

Have a basic understanding of the path an analog readback takes from its origin to the console for Linac devices.

- Linac VME nodes
- Smart Rack Monitors (SRMs)
- A/D and D/A chassis

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| Trainer | Date |
|---------|------|

4. Data Paths for VME and VXI Devices

Have a basic understanding of the path an analog readback takes from its origin to the console for VME and VXI devices.

- Know that VXIs are a type of VME specialized for RF signals
- Know that VMEs have an Ethernet interface
- Know that VMEs make up the majority of ACNET front ends
- Know that some VMEs talk directly to hardware
 - LLRF (VXI)
 - MECAR (VME)
 - BLM (VME)
 - BPM (VME/VXI)
 - IRM (VME)
- Know that some VMEs interface with other hardware
 - PLCs
 - Vacuum
 - HRMs
 - CAMAC

1.3 CAMAC

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| Trainer | Date |
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1. CAMAC Link Identification

Know that the following CAMAC links exist. Know how to obtain a map of each link and how to determine which link a parameter is coming from.

- | | | | |
|-----|--|-----|------------|
| ___ | Booster (BST1, BST2) | ___ | Tevatron |
| ___ | NuMI | ___ | Switchyard |
| ___ | TCLK | ___ | Muon |
| ___ | Main Injector (MI1, MI2, MI3, MI4) | ___ | Neutrino |
| | | ___ | Meson |

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| Trainer | Date |
|---------|------|

2. CAMAC Front Ends

Know the purpose of the CAMAC VME front ends.

- ___ Know that PIOX, PIOR and BTR links connect to front end via a SLD
- ___ Know that front ends pass requests for data on to the CAMAC link and relay the replies back to ACNET
- ___ Know that there is a front end for each CAMAC link

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| Trainer | Date |
|---------|------|

3. CAMAC Troubleshooting

Know how to troubleshoot common CAMAC issues, including:

- ___ Determine the health of a CAMAC link or crate with the CAMAC link status application. Know how to identify:
 - ___ A faulty repeater
 - ___ A faulty crate
 - ___ A faulty card
- ___ Know how to change out various CAMAC cards
- ___ Know how to change out a modular CAMAC crate and power supply
- ___ Know where spare CAMAC cards and power supplies are located
- ___ Know how to reset a CAMAC 290 from the C290 test application, H32
- ___ Know how to check the health of a front end SLD card using the SLD statistics applications, D12 or H5

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| Trainer | Date |
|---------|------|

4. CAMAC Cards

Know the function(s) of major CAMAC cards, including those listed below. Know how cards in each category are similar. Refer to the Accelerator Controls Department's CAMAC Module webpage for more information.

- | | |
|----------------------------|---------------------|
| _____ MADC controller | _____ Abort link |
| _____ 190/ 290 | _____ 201 |
| _____ Power supply control | _____ 200 |
| _____ 119 | _____ 204 |
| _____ Ramp cards | _____ MDAT |
| _____ 165 | _____ 166 |
| _____ 453 | _____ 169 |
| _____ 46x | _____ TCLK |
| _____ 473 | _____ 175 |
| | _____ 176 |
| | _____ 178 |
| | _____ Timing cards |
| | _____ 177/ 377 |
| | _____ 279/ 379/ 479 |

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|---------|------|
| Trainer | Date |
|---------|------|

5. Ramp Card Pages

Know how to monitor and control CAMAC ramp waveforms for the various ramp cards (e.g., I14 for C4xx and S11 for C165).

- _____ Be familiar with common CAMAC ramp cards and their corresponding ramp control program
- _____ Know how to determine which ramp corresponds to a given event
- _____ Know how to enable or disable a ramp
- _____ Know how each column affects the ramp calculation of the ramp
- _____ Know how scale factors affect the ramp
- _____ Know how MDAT data can be used in the ramp and how to determine which MDAT channels a ramp card uses
- _____ Know that some ramp tables are calculated in other programs and should not be edited directly

1.4 ACNET

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| Trainer | Date |
|---------|------|

1. ACNET

Have a basic understanding of ACNET.

_____ Know that ACNET is a communication protocol carried over Ethernet that ACNET nodes use to communicate accelerator data with each other

_____ Know that ACNET can also refer to:

_____ The entire control system

_____ The console program environment

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| Trainer | Date |
|---------|------|

2. Centra

Have a basic understanding of Centra and how to troubleshoot common issues.

_____ Know that Centra runs the central services that support running the control system

_____ Alarms (AEOLUS)

_____ CPLD (delegation of program loading, i.e. which binary executable to run)

_____ Know how to check the health of an ACNET process with the Heartbeat Users application, D130

_____ Know how to log into Centra and restart dead tasks

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|---------|------|
| Trainer | Date |
|---------|------|

3. Databases

Know the basic function of the ACNET databases.

_____ The device database stores definitions for all ACNET parameters

_____ This includes which front end the devices come from, scaling, alarms, etc.

_____ The application database stores internal information for some applications

_____ This includes which parameters are on a parameter page, layout of vacuum pages, etc.

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| Trainer | Date |
|---------|------|

4. Front Ends

Have an understanding of front ends, where they are used and how to troubleshoot common issues.

- ___ Know that they interface with hardware and links
- ___ Know that they respond to console requests for data
- ___ Know that they are the source of all ACNET parameter data
- ___ Know that they generate alarms
- ___ Know how to check the health of a front end and reboot it with the ACNET node poll application
- ___ Know how to determine who's responsible for any given front end

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| Trainer | Date |
|---------|------|

5. Console

Know the basic function of an ACNET console, how it interfaces with the rest of the controls system and know how to troubleshoot common issues.

- ___ Know that consoles run on a Linux machine in the computer room, forwarding their displays to a different machine
- ___ Know that consoles communicate with Centra, databases and front ends to display ACNET parameters and programs
- ___ Know how to check ACNET and console processes from the MCR using the "cnsshow" command
- ___ Know how to restart console processes

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| Trainer | Date |
|---------|------|

6. Console Program Development

Understand the basic development lifetime of console programs.

- ___ Know what the Z index page is used for
- ___ Know what the W index page is used for
- ___ Know how MECCA is used in console program development
- ___ Know that a revision control system tracks changes made to console programs. Examples include MECCA, CVS, and Git

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| Trainer | Date |
|---------|------|

7. ACL

Know that Accelerator Command Language (ACL) is an ACNET scripting language used in automation of the controls system.

_____ Know how to view the ACL code for:

_____ Sequencer ACL scripts

_____ Parameter page ACL scripts

_____ Know how to view the list of ACL scripts currently running in the background with the ACL Utilities application, D132

_____ Determine where a spawned ACL script is running

_____ Kill a spawned ACL script

_____ Know how to restart or kill persistent ACL scripts using the ACL Launch Service application, D129

_____ Be aware of the various places ACL scripts may be edited

_____ ACL Edit/Run in Program Tools

_____ ACL File Editor, D136, for database stored ACL files

_____ MECCA sequencer_acl and utilities_acl projects on the Controls Linux CVS Repository

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| Trainer | Date |
|---------|------|

8. Data Acquisition Engines (DAEs)

Have a basic understanding of DAEs and how to troubleshoot common issues.

- _____ Know that DAEs are the primary way for Java client applications to interface with ACNET
- _____ Know the different tasks that run on some DAEs
 - _____ Open access front-end client (OAC): Examples include MACALC, SETS (used by D54) and SRSAVE (used by D1 and D2)
 - _____ Dataloggers
 - _____ Java client data
 - _____ Front end consolidation
- _____ Know that servlets run on the DAE Tomcat server
 - _____ Servlets are Java http applications: Examples include the Boss-O-Schedule web application and the Autotune servlet
- _____ Know the different types of DAE machines and their primary duties
 - _____ DUE and DCE (OACs, dataloggers, servlets and front end consolidation)
 - _____ DPE (development, not operational)
 - _____ DSE (client data)
 - _____ Know that some DAEs may stray from these conventions
- _____ Know how to interface with a DAE machine and perform common fixes
 - _____ Determine which DAE an OAC, datalogger, or servlet is running on through use of the [DAE Machine Information webpage](#)
 - _____ Start a DAE. This will start or restart any datalogger or OAC assigned to the DAE
 - _____ Restart Tomcat (servlets). Restarts servlets
 - _____ Reboot OS. Only as a last resort; this will disconnect all other users from the DAE and may need to restart clients that were connected to the DAE

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| Trainer | Date |
|---------|------|

9. Java Client Applications

Have a basic understanding of how to launch, navigate and troubleshoot Java client programs.

_____ Know how to launch a Java application

_____ Via a console index page (yellow titles). This launches the program on a CLX machine

_____ Via the [Application Index](#) (APPIX). This launches the program on a local machine

_____ Be familiar with the data acquisition methods Java applications use

_____ Remote Method Invocation (RMI): Direct connection to a DAE for client data. Examples include the Real Time Plotter program and the Java Fast Time Plot program

_____ Data Messaging Queue (DMQ): Uses data brokers and a fixed cluster of DAEs to provide client data. Examples include the Linac 400 MeV Steer program and the Synoptic viewer

_____ Be able to use features common to Java applications

_____ Discover the keeper and version number

_____ Email a program image

_____ Post an e-log entry

_____ Enable settings

_____ Determine user

_____ Determine DAE or DMQ connection status

1.5 Archiving Data

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| Trainer | Date |
|---------|------|

1. Save, Compare, and Restore Programs

Know how to use the save and restore applications and understand the differences between them.

- ___ Know how to perform a D1 machine save
- ___ Know how to perform a D1 and D2 single crate save/restore
- ___ Know how to use D1 or D2 to compare values between saved files
- ___ Know when it is appropriate to use D1 or D2
- ___ Know how to use the DAQ redirection feature in the Utility window
 - ___ Be aware that DAQ redirect is single-user
 - ___ Be aware of archive and circular saves

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| Trainer | Date |
|---------|------|

2. Lumberjack Datalogger

Have a general understanding of how datalogger data is saved.

- ___ Know how to use the Lumberjack Config application, D43, to add devices to be saved
 - ___ Find which dataloggers and intervals a device is logged by
 - ___ Each datalogger writes data to a circular buffer; understand why this is important
 - ___ Any changes to datalogger lists need to be coordinated with that Lumberjack's group
- ___ Know how to use the Lumberjack application to plot saved data
- ___ Know how to determine which DAE a datalogger is running on
 - ___ Via D44
 - ___ Via a DAE machine information webpage

1.6 Timing

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| Trainer | Date |
|---------|------|

1. Timeline Generator (TLG) Page

Know how to use the TLG application.

- ___ Know how to change from one saved timeline to another
- ___ Know how to create and modify timelines
- ___ Know how timeline changes affect beam with regard to the safety envelope
- ___ Know how to adjust the BNB rep rate
- ___ Know how to manage timelines with multiple modules while avoiding conflicting events and holes in the timeline
- ___ Know the purpose of energy saving timelines
- ___ Understand that the Crew Chief should be notified whenever a timeline is changed

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| Trainer | Date |
|---------|------|

2. Tevatron Clock (TCLK)

Know how TCLK is generated and used.

- ___ Know which devices are typically triggered by TCLK events and why
- ___ Know common CAMAC cards that respond to TCLK events
 - ___ Timer cards
 - ___ Ramp cards
- ___ Know how to find TCLK events using [TCLK Event Definitions](#) webpage or the Tevatron Clock application, T61
 - ___ Caution is needed when using T61, as it can issue events regardless of the timeline
- ___ Know how to use the Clockscope application
 - ___ Monitor TCLK events in the present supercycle
 - ___ Use the logger function to view events in previous supercycles
- ___ Know how TCLK events are generated
 - ___ TLG
 - ___ TCLK transmitter CAMAC cards
- ___ Know how to determine which machine a given clock event is for
- ___ Know the common TCLK beam events

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| Trainer | Date |
|---------|------|

3. Beam Sync Clocks (BSCLK)

Understand beam sync clocks, where they are used and why.

- ___ Have a basic understanding of BSCLK operation
- ___ Know which machines use BSCLK
 - ___ MIBS
 - ___ RRBS
- ___ Know which devices are typically triggered by BSCLK events and why
- ___ Know the common CAMAC cards that respond to BSCLK events
- ___ Know how to find BSCLK events using the [BSCLK Event Definitions](#) webpage or the Beam Sync Clocks application, T63
- ___ Know how BSCLK events may be generated
 - ___ TCLK trigger event
 - ___ 377 card delay
 - ___ BSCLK event and reflected TCLK event(s)

1.7 Links

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| Trainer | Date |
|---------|------|

1. MDAT Link

Have a basic understanding of the MDAT link.

- ___ Know which information is carried over the MDAT link
- ___ Know how to determine which modules generate each MDAT frame
- ___ Know how ramp cards use the information carried over the MDAT link
- ___ Know which CAMAC cards encode and decode MDAT data

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|---------|------|
| Trainer | Date |
|---------|------|

2. Vacuum Controls

Know the basic data path vacuum readbacks take from their origin to a console.

- ___ CIA crates
 - ___ Ion pump card
 - ___ Sector valve card
 - ___ Crate controller (PiVac)
- ___ Vacuum front ends
 - ___ BOOVAC
 - ___ Erlang vacuum front end
- ___ Networked ion pumps

1.8 Status Monitoring

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| Trainer | Date |
|---------|------|

1. Status Indicator (Alarm) Screen

Know how to monitor alarms and setup your alarm screen.

- ___ Know what the different colors mean on the alarm screen
 - ___ Red signifies a beam inhibit alarm
 - ___ Yellow signifies an acknowledgeable alarm
 - ___ Cyan signifies a non-beam inhibiting alarm
- ___ Know what the different symbols mean on the alarm screen
 - ___ “:” signifies an analog alarm
 - ___ “◆” signifies a digital alarm
 - ___ “Δ” signifies a microprocessor alarm
 - ___ “>” signifies a family alarm
- ___ Know how to reset various types of alarms
- ___ Know which MCR console drives the alarm sounds
- ___ Know which MCR console drives the permit annunciation
- ___ Know how to access the alarm list control application or the digital status application from the alarm screen
- ___ Know how to use the alarm screen setup application, D6, to restart or modify the alarms screen

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|---------|------|
| Trainer | Date |
|---------|------|

2. Digital and Analog Alarms

Know the difference between digital and analog alarms. Know how to manipulate each type of alarm.

- ___ Know how to use the alarm list control application
 - ___ Examine and change analog alarm properties from the Analog subpage
 - ___ Examine and change digital alarm properties from the Digital subpage
 - ___ Bypass, activate, and validate alarm groups from the List Index subpage
 - ___ Modify alarm lists from the List Edit subpage
- ___ Know how to use the digital status application
 - ___ Know what the different color texts mean in either the global or individual subpages
 - ___ Globally control lists of devices
 - ___ Examine the digital status of an individual device
 - ___ Edit both the global and individual device subpages
- ___ Know how to manipulate alarms from a parameter page
 - ___ Change minimum, maximum, nominal and tolerance values
 - ___ Bypass and activate analog alarms
 - ___ Know what the digital bits on the far right of some parameters mean
 - ___ Call up the digital status page for a device from the parameter page
- ___ Know how to use the Alarms Log Display webpage to view alarm history

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| Trainer | Date |
|---------|------|

3. FIRUS Monitoring

Know what systems the MCR Fire Utility System (FIRUS) console monitors and know how to manipulate the FIRUS console.

- ___ Know how to change console preferences
- ___ Know how to switch to monitoring another FIRUS terminal
- ___ Know how to view the FIRUS alarm log
- ___ Know the difference between fire, emergency, trouble, and utility alarms
- ___ Know what to do if FIRUS goes down

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| Trainer | Date |
|---------|------|

4. **Beam Budget Monitor (BBM)**

Know how to monitor accelerator compliance with the safety envelope beam permits.

- _____ Know how to use the BBM application, D105, to generate both graphical and numerical integrated beam intensities
- _____ Know how to use D105 to find out what devices are used for gathering intensity data
- _____ Know where to find the various beam budget limits on both the D105 PA and the graphical display
- _____ Know how to respond to both a real and false BBM violation
- _____ Know how to manually calculate integrated accelerator intensities based on current running conditions and compare them to the beam envelopes

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| Trainer | Date |
|---------|------|

5. **Beam Permits and Abort Monitoring**

Know how to use the ACNET applications to diagnose the causes of C200 related beam permit drops. Know that beam permit drops are commonly referred to as aborts.

- _____ Know how to locate the ACNET C200 related beam abort applications for the appropriate accelerators and beamlines
- _____ Know how and when to mask an abort bit via both hardware and software
 - _____ Know how the abort link is generated, maintained, and what happens to the abort link when an input is pulled
- _____ Understand how the beam switch sum box (BSSB) uses abort status, TCLK events and beam switches to decide if requests for beam should be permitted or inhibited for a given beam scenario
- _____ Know what happens to the beam currently in each machine when a beam permit is pulled
 - _____ Some aborts send the beam to a dump immediately while others inhibit the next injection into that machine
 - _____ Beam permits dropped downstream of MI/RR can cause beam sync events to be inhibited, preventing beam from being extracted from MI/RR
- _____ Know the role of the following CAMAC cards in an abort link:
 - _____ C201 abort link generator
 - _____ C200 abort concentrator module
 - _____ C204 beam permit module

1.9 Miscellaneous Hardware

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| Trainer | Date |
|---------|------|

1. Controls Hardware

Know the function of the following controls hardware and where they are most commonly used.

- | | |
|------------------------|---------------------|
| _____ MUX | _____ A/D converter |
| _____ Fiber-optic link | _____ D/A converter |

1.10 Networks

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| Trainer | Date |
|---------|------|

1. Local Area Networks (LANs)

Have a general knowledge of the various network components used in our control system listed below.

- _____ Ethernet

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| Trainer | Date |
|---------|------|

2. Cable TV (CATV) Network

Know how the CATV system is used to broadcast Channel 13 and miscellaneous equipment for both the accelerators and the beamlines.

- _____ Know how to select channels from one of the eight available networks and what types of devices exist on each network.
- _____ Know how to use the Cable TV Guide, D100

1.11 Troubleshooting

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| Trainer | Date |
|---------|------|

1. Controls Equipment Troubleshooting and Repair

Know how to troubleshoot and repair various controls equipment failures. Know when these steps are appropriate for a given system.

- _____ Know how to check a power supply for proper voltage and acceptable ripple levels with a multimeter and oscilloscope
- _____ Know how to determine if a fuse has blown and replace it if necessary
- _____ Know which LEDs typically indicate a good or bad status
- _____ Know how to determine if upstream and downstream modules are functioning correctly by tracing cables
- _____ Know how to determine how a module is behaving by comparing its status LEDs to neighboring modules
- _____ Know how to ensure that connections are secure by checking electrical contact between cables and modules, cards, and crates
- _____ Know how to determine if the problem follows the module or stays with the chassis by swapping modules between chassis
- _____ Know the common indicators of failures

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2. Oscilloscope Usage

Know how to use an oscilloscope to view and troubleshoot electrical signals and voltages.

- _____ Know how to adjust the display voltage and time ranges for multiple channels
- _____ Know how to change the way the oscilloscope triggers via either input signal level or an external trigger signal
- _____ Know how to use horizontal and vertical cursors to measure specific points on the trace
- _____ Know how to use the measurement menu to measure properties of the trace
- _____ Know how to use the save/restore menu to make and recall oscilloscope setups
- _____ Know how to save a screen shot of the oscilloscope trace

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| Trainer | Date |
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3. Computer Room Monitoring

- _____ Know how to monitor the computer room environment

Part 2: Walkaround

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| Trainer | Date |
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1. Computer Room Equipment

- ___ Universal clock decoder (UCD) A and B
- ___ MCR01/02/03 (GPIB front end for the MCR)
- ___ CAMAC VME front ends
 - ___ Recognize typical LED activity during normal operation
- ___ CLX console nodes
- ___ Centra
- ___ Databases
- ___ CHABLIS (www-bd.fnal.gov server)
- ___ ELOG1 and ELOG2
- ___ BEAMS-TS (remote desktop)

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2. Computer Room Utilities

- ___ Red emergency off (crash) buttons
 - ___ Know that the crash buttons remove all power from equipment in the computer room and turn off the air conditioning (AC) units
- ___ Uninterruptable power supplies (UPSs)
- ___ Power outage notebook
 - ___ Know what information is relevant to the computer room

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| Trainer | Date |
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3. Pump Room

- ___ Pump room AC unit
 - ___ Controller
- ___ Chilled water pumps for AC units
 - ___ How to reset the pumps
- ___ Ops backroom AC unit
 - ___ Controller

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4. Fire Protection Systems

- ___ Halon bottles
 - ___ Computer room
 - ___ MAC room
 - ___ MCR
- ___ Know what happens to the AC units when the Halon dumps
- ___ Know how, in the event of a false alarm, to inhibit the Halon from dumping in the MCR

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| Trainer | Date |
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5. MAC Room

- ___ TLG VME crates
- ___ BSCLK and TCLK crates
- ___ Fiber optic repeater for MI link
- ___ Main Injector CAMAC front ends
- ___ TCLK front end
- ___ Emergency off (crash) buttons
 - ___ Know how to reset these

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6. FIRUS Room

- ___ FIRUS system
- ___ Know how FIRUS gets power if the Cross Gallery power is out
- ___ Know how FIRUS gets power if the entire site loses power

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7. Booster Tower East

- ___ CAMAC card spare cabinets
 - ___ Keys to these cabinets
- ___ CAMAC power supply spares

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8. MCR Console Hardware

- ___ Console screens and comfort display
 - ___ Know that these are different console instances
- ___ Beam switch boxes
- ___ Key switches
- ___ Oscilloscopes
- ___ Patch panels
- ___ CATV monitors and controls

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9. MCR Area Hardware

- ___ Back racks
 - ___ CAMAC crates
 - ___ Repeater links
 - ___ TV demodulators
- ___ BSSB
- ___ BBM
- ___ Know that some MCR consoles are on UPS power
- ___ Know what MCR equipment is on the Wilson Hall emergency generator

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10. Patch Panel System

- ___ Patch panels in front of the console racks
- ___ Miniframes in the back of the console racks
- ___ Main frames and analog fan outs in the back racks (MCRR #36-#40 or MCRR #61-#62)
- ___ Know the purpose of the patch panel system
- ___ Know how to trace a signal through the MCR patch panel system